

SETTING THE STANDARDS

15
YEARS

New IBM RISCs: Blazing Speed, a new Unix, runs DOS

PAGE 124

BYTE

APRIL 1990

A MCGRAW-HILL PUBLICATION

THE NEW
OS/2

Good-bye, DOS-in-a-Box
Hello, True 32-bit Power!

PAGE 119

Apple redefines
top of the line
with the 40-MHz

Mac IIx

Lotus 1-2-3/G

Toshiba T1200XE

Mylex EISA Triple Play

Emerging Architectures:
IBM's SAA, DEC's NAS,
Others

REVIEWS

23 386-Clone Motherboards

NEC Prospeed CSX

Low-Cost Color Scanner

HP NewWave

Ami Pro vs. Windows Word
vs. Legend

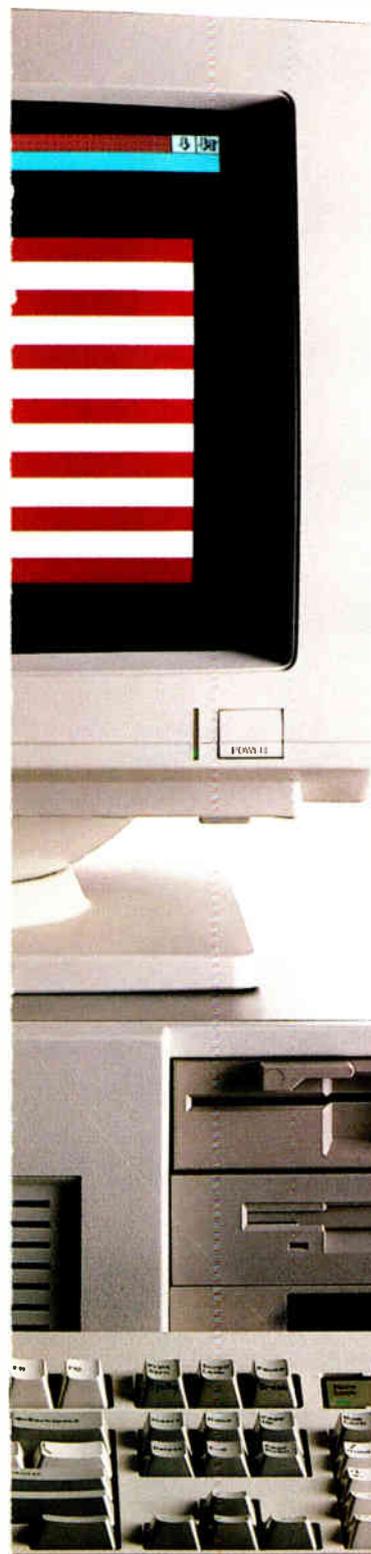
FoxPro

MPW C++ vs. Think C 4.0



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

S OF DER.



PC MAGAZINE
BEST BUY
1993

THE DELL SYSTEM® 310
20 MHz 386.

The best combination of performance and value in its class.

- STANDARD FEATURES:**
- Intel 80386 microprocessor running at 20 MHz.
 - Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
 - Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
 - Page mode interleaved memory architecture.
 - VGA systems include a high performance 16-bit video adapter.
 - Socket for 20 MHz Intel 80387 or 20 MHz WEITEK 3167 math coprocessor.
 - 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
 - Dual diskette and hard drive controller.
 - Enhanced 101-key keyboard.
 - 1 parallel and 2 serial ports.
 - 200-watt power supply.
 - 8 industry standard expansion slots (6 available).
 - 12-month On-Site Service Contract provided by Xerox.
- **Commercial Lease Plan. Lease for as low as \$123/month.**
Xerox Extended Service Plan pricing starts at \$251.
- | | |
|---|---------|
| 40 MB TTL Monochrome System | \$3,299 |
| 40 MB VGA Color Plus System | \$3,799 |
| 100 MB VGA Color Plus System | \$4,399 |
| 100 MB Super VGA Color System (800x600) | \$4,499 |
- Prices listed reflect 1 MB of RAM. 80, 150 and 322 MB hard drive configurations also available.



THE DELL SYSTEM® 316SX
16 MHz 386SX.

The perfect low profile mainstream computer, combining 386SX power and compatibility with unprecedented value and support.

- STANDARD FEATURES:**
- Intel 80386SX microprocessor running at 16 MHz.
 - Standard 512 KB of RAM, optional 640 KB, 1 MB or 2 MB of RAM* expandable to 16 MB (8 MB on system board).
 - Page mode interleaved memory architecture.
 - LIM 4.0 support for memory over 640 KB.
 - Integrated diskette and high performance 16-bit VGA video controller on system board.
 - Socket for Intel 80387SX math coprocessor.
 - 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
 - Integrated high performance hard disk interface on system board.
 - Enhanced 101-key keyboard.
 - 1 parallel and 2 serial ports.
 - 3 full-sized 16-bit AT expansion slots available.
 - 12-month On-Site Service Contract provided by Xerox.
- **Commercial Lease Plan. Lease for as low as \$72/month.**
Xerox Extended Service Plan pricing starts at \$187.
- | | |
|-----------------------------------|---------|
| 20 MB VGA Monochrome System | \$1,899 |
| 40 MB VGA Color Plus System | \$2,399 |
| 40 MB Super VGA System (800x600) | \$2,499 |
| 100 MB Super VGA System (800x600) | \$3,099 |
- Prices reflect 512 KB of RAM. 640 KB versions of the above systems are available for an additional \$50. 1 MB versions for an additional \$150, and 2 MB versions for an additional \$300. 80 and 170 MB configurations also available.



THE NEW DELL SYSTEM® 316LT
16 MHz 386SX.

This new full-featured, battery powered 386SX laptop costs less than most 286 laptops.

- STANDARD FEATURES:**
- Intel 80386SX microprocessor running at 16 MHz.
 - Standard 1 MB of RAM, optional 2 MB of RAM* expandable to 8 MB (on the system board using 1 MB SIMM).
 - LIM 4.0 support for memory over 1 MB.
 - Adjustable and detachable 640 x 480 VGA Liquid Crystal Display.
 - One industry standard half-size 8-bit expansion slot.
 - Socket for 16 MHz Intel 80387SX math coprocessor.
 - 3.5" 1.44 MB diskette drive.
 - 83-key keyboard with embedded numeric keypad and separate cursor control keys.
 - 1 parallel, 1 serial, and external VGA monitor port.
 - Connector for 101-key keyboard or numeric keypad.
 - Two Removable and rechargeable NiCad batteries, packs utilizing DMLC™ Continuous-Flow Battery System™ (patent pending).
 - AC Adapter.
 - 12-month On-Site Service Contract provided by Xerox.
- **Commercial Lease Plan. Lease for as low as \$127/month.**
Xerox Extended Service Plan pricing starts at \$300.
- | | |
|-----------------|---------|
| 20 MB, 1 MB RAM | \$3,499 |
| 20 MB, 2 MB RAM | \$3,699 |
| 40 MB, 1 MB RAM | \$3,799 |
| 40 MB, 2 MB RAM | \$3,999 |



THE DELL SYSTEM® 210
12.5 MHz 286.

The price says this is an entry-level system. The performance says it's a lot more.

- STANDARD FEATURES:**
- 80286 microprocessor 12.5 MHz.
 - Standard 512 KB of RAM, optional 640 KB, 1 MB or 2 MB of RAM* expandable to 16 MB (6 MB on the system board).
 - Page mode interleaved memory architecture.
 - LIM 4.0 support for memory over 640 KB.
 - Integrated diskette and high performance 16-bit VGA video controller on system board.
 - Socket for Intel 80287 math coprocessor.
 - 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
 - Integrated high performance hard disk interface on system board.
 - Enhanced 101-key keyboard.
 - 1 parallel and 2 serial ports.
 - 3 full-sized 16-bit AT expansion slots available.
 - 12-month On-Site Service Contract provided by Xerox.
- **Commercial Lease Plan. Lease for as low as \$61/month.**
Xerox Extended Service Plan pricing starts at \$158.
- | | |
|-----------------------------|---------|
| 20 MB VGA Monochrome System | \$1,599 |
| 20 MB VGA Color Plus System | \$1,899 |
| 40 MB VGA Monochrome System | \$1,799 |
| 40 MB VGA Color Plus System | \$2,099 |
- Prices listed reflect 512 KB of RAM. 640 KB versions of the above systems are available for an additional \$50. 1 MB versions for an additional \$150, and 2 MB versions for an additional \$300. 80 and 100 MB hard drive configurations also available.

THE DELL SYSTEM® 325 25 MHz 386.

An even better value at these low prices.

- STANDARD FEATURES:**
- Intel 80386 microprocessor running at 25 MHz.
 - Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
 - Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
 - Page mode interleaved memory architecture.
 - VGA systems include a high performance 16-bit video adapter.
 - Socket for 25 MHz Intel 80387 or 25 MHz WEITEK 3167 math coprocessor.
 - 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
 - Dual diskette and hard drive controller.
 - Enhanced 101-key keyboard.
 - 1 parallel and 2 serial ports.
 - 200-watt power supply.
 - 8 industry standard expansion slots (6 available).
 - 12-month On-Site Service Contract provided by Xerox.
- **Commercial Lease Plan. Lease for as low as \$153/month.**
Xerox Extended Service Plan pricing starts at \$370.
- | | |
|---|---------|
| 40 MB VGA Monochrome System | \$4,199 |
| 100 MB VGA Color Plus System | \$5,099 |
| 100 MB Super VGA Color System (800x600) | \$5,199 |
| 150 MB Super VGA Color System (800x600) | \$5,699 |
- Prices listed reflect 1 MB of RAM. 80, 150 and 322 MB hard drive configurations also available.
- Ask about our high resolution graphics.

*Performance Enhancements: Within the first megabyte of memory, 128 KB (316SX, 316LT and 210), 384 KB (325 and 310) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 316SX and 210. 4 MB configurations available on all systems. Call for pricing. All systems are shipped with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typographic or photographic reproduction based on 30-day return open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark of Dell Computer Corporation. Intel is a registered trademark and 386 is a trademark of Intel Corporation. Other trademarks and trade names are used to identify the entities claiming the marks and names or their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. On-site service may not be available in certain locations. © 1993 Dell Computer Corporation. All rights reserved.

ADCODE 11 E13

THESE COUNTRIES JUST GOT TOGETHER AND ELECTED A NEW LEADER.



When computer publications from nine countries got together and voted for the best 386™ computer, it marked a major shift in power.

They chose the Dell System® 325 head and shoulders over every other system in the world.

Turn the page and find out why.

800-283-1170



FOR NETWORK OR UNIX INFORMATION, CALL 800-678-UNIX.
For Dell in Canada, call 800-387-5752.

THE CREDENTIAL A WORLD LEAD

Before the Dell System 325 was named the top 386 personal computer by the rest of the world, it had quite a following at home.

Winning both the *PC Magazine* Editor's Choice and *PC World's* Best Buy awards.

And most recently, it was rated number one for overall customer satisfaction, in a *PC Week* poll of corporate volume buyers.



One reason for this unprecedented popularity is that Dell deals directly with every Dell customer in the world.

Custom configuring each computer. Responding to the needs of each user.

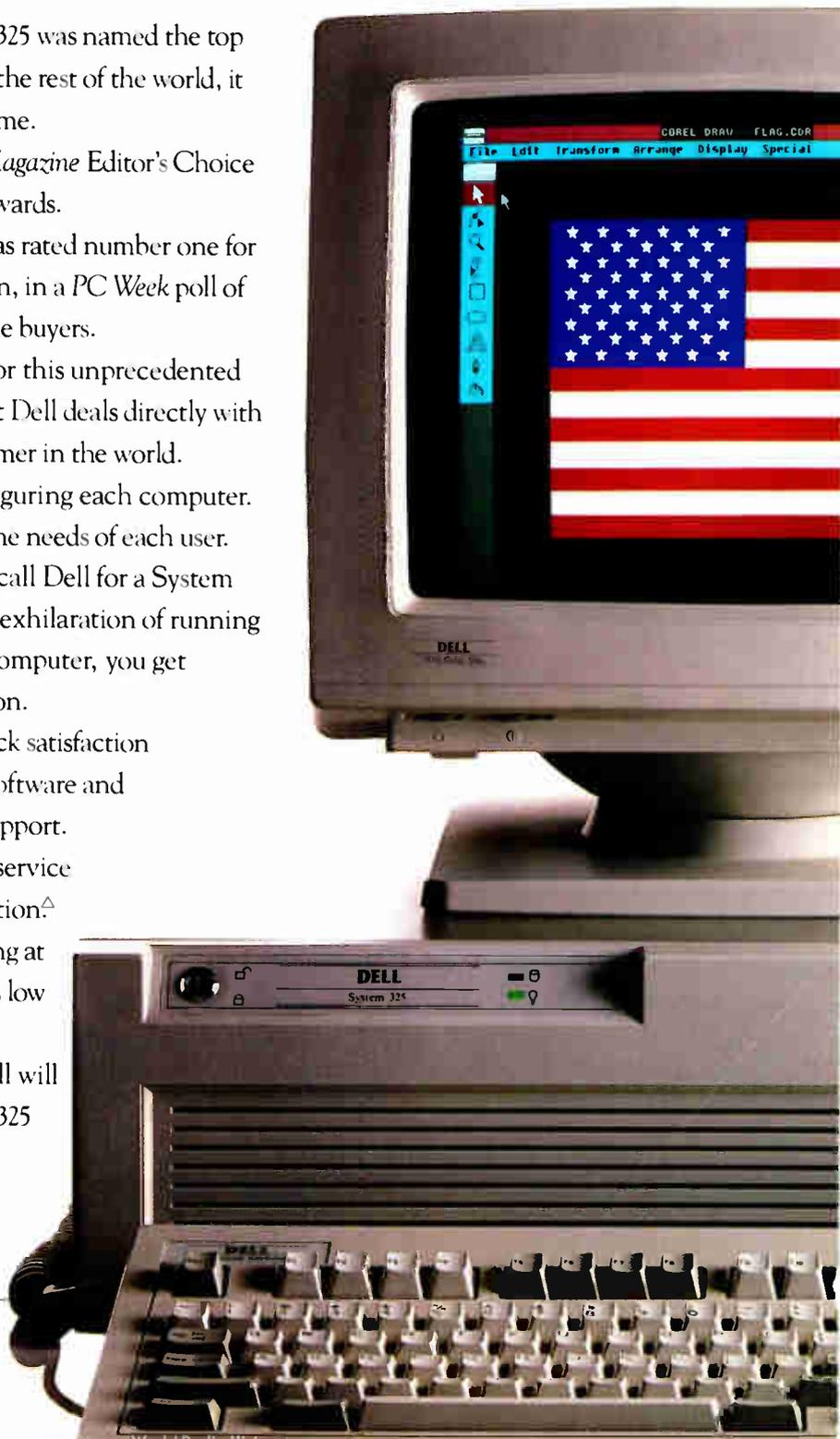
So when you call Dell for a System 325, you get more than the exhilaration of running the world's top rated 386 computer, you get something called satisfaction.

With a 30-day money-back satisfaction guarantee, self-diagnostic software and toll-free expert technical support. As well as next day on-site service provided by Xerox Corporation[△]

And you can get it starting at \$4,199. With leasing plans as low as \$153 a month.**

Call us toll-free. And Dell will custom configure a System 325 for you.

After all, that's what the world is coming to.





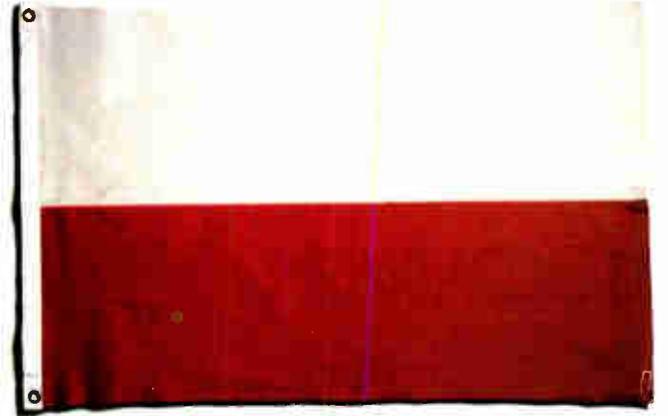
Germany



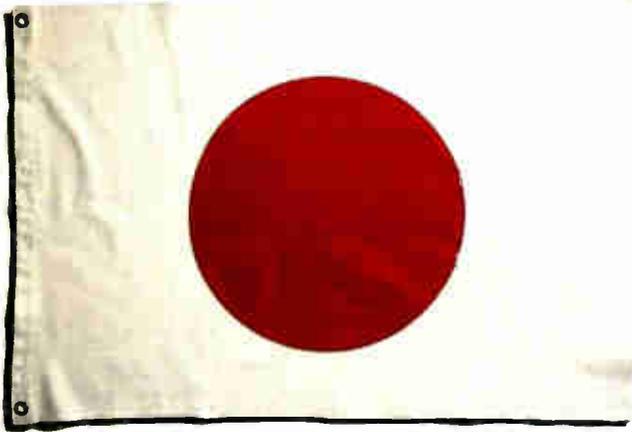
Hungary



Yugoslavia



Poland



Japan



United Kingdom



Spain



Italy

Circle 86 on Reader Service Card



powerCache 4... The most advanced What else would you expect



PC MAGAZINE, January 1989,
"In a field of powerhouse machines there can only be one winner, and ALR's FlexCache is it."

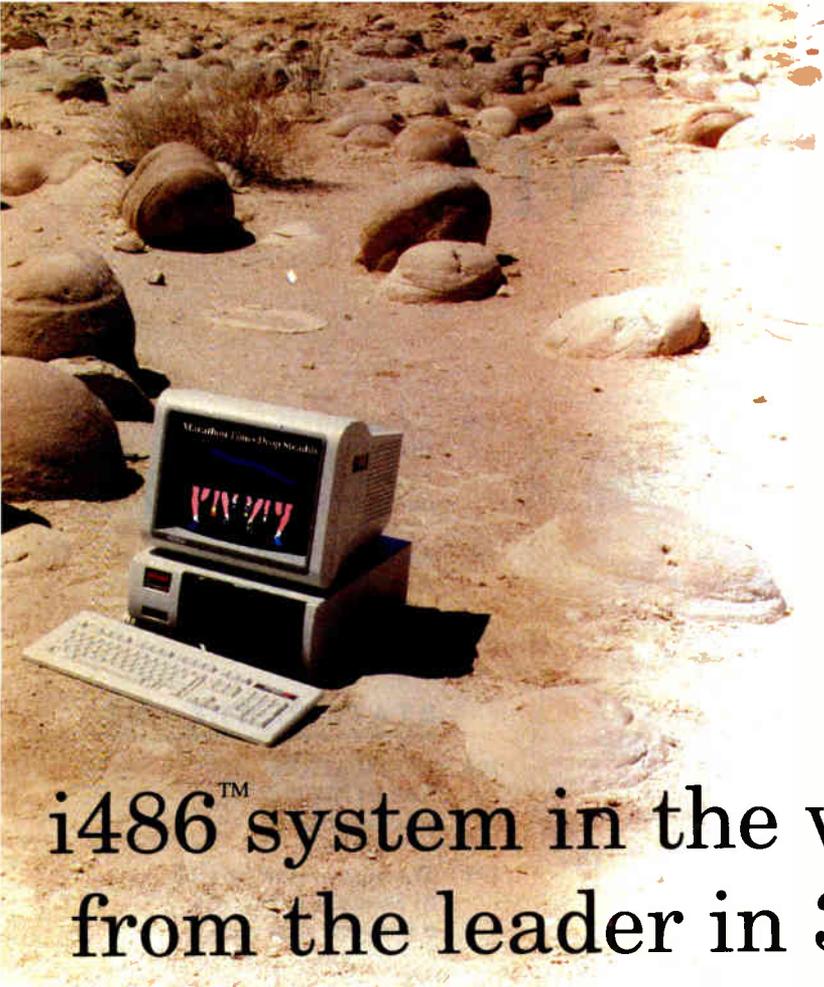
INFO WORLD, July 1989,
"ALR Systems Unleash 486 Power. The PowerCache 4 shines in the CPU-specific portion of the InfoWorld Automated Benchmark Test, gaining a score of 16.3."

PC WEEK, July 1989,
"Based on a series of benchmarks run last week on Advanced Logic Research, Inc.'s prototype 486 desktop system, ALR will enter the 486 market with a bang."

At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we've designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR's custom ASIC chips which deliver the fastest processing speed ever.

More important, PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing a better than zero wait state performance as compared to the i386. Furthermore, the ALR PowerCache 4 is 100% IBM® PS/2™ Micro Channel™-compatible supporting bus mastering devices and giving

	ALR M130 Desktop	ALR M150, M350 M650 Floor-Standing	IBM M70-A21 Power Platform™
CPU	25 MHz i486	25 MHz i486	25 MHz i486
Bus	MCA	MCA	MCA
External Cache	128 KB cache Read and Write-Back	128 KB cache Read and Write-Back	None
Video Opt. on board	640x480 1024x768	640x480 1024x768	640x480 None
I/O Slots	6 expansion slots	6 expansion slots	3 expansion slots
Storage Expansion	4-3 1/2"	1-full height 2-1/2"-height 2-3 1/2" drives	3-3 1/2" drives
Disk Capacity	130 MB-260 MB	150 MB-650 MB	110 MB
Price	\$9,990	Starting at \$11,490	\$12,990



**California Anza-Borrego
Desert State Park**

(Cannonball-shaped sandstone. These concretions are formed of onion-skin layers of minerals resistant to erosion.)

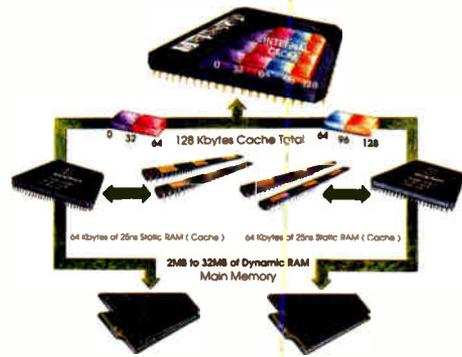
i486™ system in the world. from the leader in 386™ technology.

you a more efficient system for a variety of multi-user and fileserver applications. Like most ALR computers, the PowerCache 4 is a truly balanced system. The fastest power is achieved by enhancing our PowerCache 4 design with the industry's fastest disk drives and interface. The PowerCache 4 systems come standard with a high-speed 15MHz ESDI and 32 KB hard disk cache on the disk controller. What more could you possibly need.

It's no wonder ALR remains ahead of the pack with our innovative design expertise. As far back as 1986, we've been recognized in the industry as a leader in performance. Recently, the highly acclaimed 386/220 won us "Best of 1987" from *PC Magazine*. 1988 brought us the honor of receiving the *PC Magazine* Award for Technical Excellence for designing the industry's most advanced cache architecture. As for 1989 we've already begun to excite the industry with the PowerCache 4.

Now, what else would you expect from a company who is so committed to innovation and high-performance technology that we take you a step beyond. At ALR, we are concerned with your processing needs. Our technical support staff is available to assist you by one simple phone call. All our systems are backed by a one year warranty. Call today for more information on the new PowerCache 4 and the name of an authorized reseller nearest you.

1-800-444-4ALR



PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing better than zero wait state performance as compared to the i386.



Advanced Logic Research, Inc.
9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9240
For our Canadian office:
1-800-443-4CAN
For our UK office:
0 635-521 922 FAX: 0 635-521 844
For our Singapore:
(65) 258-1286 FAX: (65) 258-1285

ALR and Advanced Logic Research, Inc. are registered trademarks. PowerCache 4 is a registered trademark of Advanced Logic Research, Inc. IBM and PC, PS/2, Micro Channel are registered trademarks of International Business Machines Corporation, Intel, 386 and i486 are registered trademarks of Intel Corporation.

Circle 16 on Reader Service Card (DEALERS: 17)

BYTE

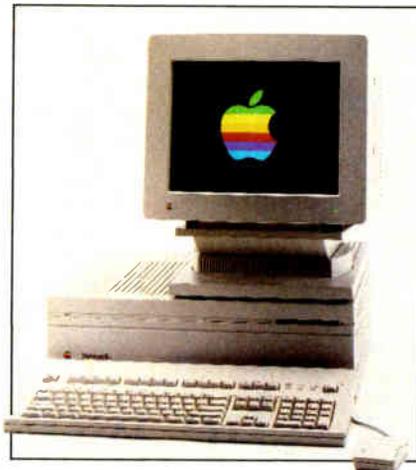
CONTENTS

April 1990
Volume 15, Number 4

COVER STORY

Apple's Special fx page 111

Apple redefines
top-of-the-line
with the
speedy IIfx.



NEWS

- 19 MICROBYTES
- 36 WHAT'S NEW

FIRST IMPRESSIONS

- 102 **SHORT TAKES**
LaserJet III,
HP's trailblazing printer
- Photoshop,**
Adobe eases image manipulation
- Toshiba T1200XE,**
impressive notebook computing
- R:base 3.0,**
many new features from Microrim
- Lotus 1-2-3/G,**
three dimensions for PM
- 119 **FIRST IMPRESSIONS**
OS/2 2.0: It's a Family Affair
Microsoft's long-awaited
32-bit OS/2 forges ahead, with
DOS and windows in tow.
- 124 **FIRST IMPRESSIONS**
Sizzling RISC Systems from IBM
IBM's RISC System/6000 family
sets a new standard
of performance.

REVIEWS

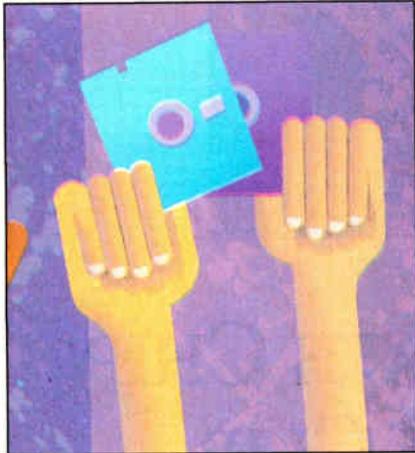
- 130 **PRODUCT FOCUS:**
The Heart and Soul
of a PC Compatible
The BYTE Lab examines 23
25-MHz 80386 motherboards.
- 145 **Color Hits the Streets**
NEC brings color to a laptop,
but is it worth it?
- 151 **Svelte Scanner Is No**
Fistful of Dollars
Sharp's low-cost scanner delivers
high-quality color images
to those who can afford to wait.
- 157 **Word Processing in Windows**
Ami Professional, Legend,
and Word for Windows are the first
WYSIWYG word processors
for Microsoft Windows, but
are they fast enough?
- 163 **A Better dBASE**
FoxPro may have outdone
all other dBASE systems,
including dBASE IV.
- 171 **Windows Rides a New Wave**
With NewWave, Hewlett-Packard
expands Windows, but it's
not easy.

- 179 **C Compilers Have**
Different Strengths
Apple and Symantec bring object-
oriented C compilers to the Mac.
- 193 **Reviewer's Notebook**
A compilation of brief reviews
and updates to previously
published evaluations.

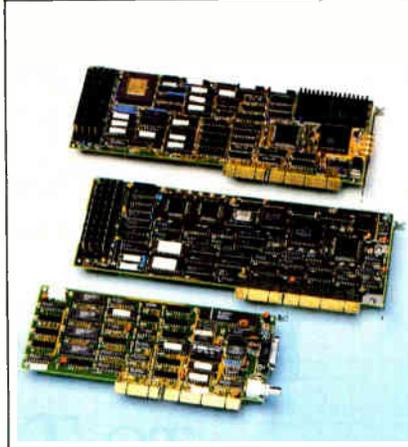
STATE OF THE ART

- 196 **APPLICATIONS**
ARCHITECTURES
Introduction
- 199 **Transparent and Portable**
By providing a consistent
framework, applications
architectures let software
run on different machines
and operating systems.
- 205 **From TTY to VUI**
Frank Hayes discusses the past,
present, and future of user-
interface design.
- 215 **Behind the Scenes**
Understanding your programming
interface can help you decide
which user interface to support
in a heterogeneous environment.
- 225 **Bridging Troubled Waters**
Thriving in a diverse computing
environment is a lot easier if
you have the right tools.
- 237 **Blueprints for the 1990s**
IBM's SAA versus DEC's NAS—
how do they compare?
- 246 **An Open Approach**
With its new Distributed
Applications Architecture,
Data General challenges
IBM and DEC.
- 248 **Building Blocks**
A sampling of products and
organizations involved in
applications architectures.

Time and Money/252



Editorial/10



FEATURES

- 252 Time and Money**
A program called Spawn uses auctions to fairly allocate precious computer time.
- 261 New Objects for Old Structures**
Using object-oriented techniques to convert existing applications has its advantages.
- 269 Who Owns the Copyrights?**
Who owns the copyrights on independently developed programs? An attorney discusses recent developments.
- 275 Managing the Well-Tempered LAN**
ISO standards signal that network management help is on the way.

HANDS ON

- 287 UNDER THE HOOD**
Gateways to Protected Mode
DOS extenders deliver 16-bit compatibility and 32-bit performance.
- 297 SOME ASSEMBLY REQUIRED**
Flirting with Assembly
Armed with a few general concepts, you can make assembly language improvements without knowing assembly.

DEPARTMENTS

- 6 Spotlight**
- 10 Editorial: Mylex Struts EISA's Stuff**
- 32 Letters, Ask BYTE, and Fixes**
A 286/386SX/386 debate goes on.

PERSPECTIVES

- 349 CHAOS MANOR MAIL**
- 350 1.5 Decades of April Fools**
This is a serious business, but it has had its funny side.
- 352 PRINT QUEUE**
Advise and Compute
The tortuous evolution of copyright law in the computer world.
- 356 STOP BIT**
To Boldly Benchmark
New meaning for the term "high-level benchmarks."

READER SERVICE

- 343** Editorial Index by Company
344 Alphabetical Index to Advertisers
346 Index to Advertisers by Product Category
Inquiry Reply Cards: after **348**

PROGRAM LISTINGS

- From BIX: See **284**
From BYTEnet: call (617) 861-9764
On disk: See card after **336**

EXPERT ADVICE

53
COMPUTING AT CHAOS MANOR
Chaos Manor Awards
by Jerry Pournelle
Find out if your favorite product has been honored.

71
THE UNIX /bin
Getting UUCP Running, and Other Stories
by David Fiedler
Our columnist details how to set up UUCP communications.

77
DOWN TO BUSINESS
CD-ROM to the Rescue
by Wayne Rash Jr.
CD-ROM databases can provide your business with valuable information in a hurry.

81
MACINATIONS
Two Sides of the Same Coin
by Don Crabb
A bright side with education, a darker side with software development.

85
OS/2 NOTEBOOK
Living with OS/2 1.2
by Mark J. Minasi
Life with OS/2 1.2 is a lot like life with version 1.1, with some welcome changes.

97
NETWORKS
Faraway LANs
by Mark L. Van Name and Bill Catchings
You don't have to be in the office to take advantage of the office LAN.

BYTE (ISSN 0360-5280/90) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate \$29.95 per year. In Canada and Mexico, \$31.95 per year. Single copies \$3.50 in the U.S., \$3.95 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. Printed in the United States of America. Postmaster: Send address changes: USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520.

PAINT POWERFUL DATA-ENTRY SCREENS WITH POWER SCREEN™



Design screens and menus with PAINT™, placing input fields and messages precisely where you want them to appear in your final application. PAINT stores screen definitions in a single file — which can be modified without recompiling or relinking your application. Your program manages screen display and I/O through the POWER SCREEN Runtime Library. All essential features are supported, including:

- ◆ Block multi-field or single-field I/O
- ◆ Automatic range checking
- ◆ Configurable editing/menu key definitions
- ◆ Application context-sensitive, cross-referenced help
- ◆ Virtual/automatic scrolling screens within viewports
- ◆ Multiple, overlapping viewport display
- ◆ Plus much, much more!

The Runtime Library can be linked directly with Turbo Pascal applications, or installed as memory resident.

All this for just \$149.00

Includes complete sample programs, a comprehensive reference manual, and the Norton Instant Access program and guides to assist you during program development. And, we offer a 30-day money back guarantee. Supports Microsoft C/QuickC, Turbo C, Turbo Pascal, QuickPascal and QuickBASIC.

Other powerful products from Blaise Computing:	
C ASYNCH MANAGER™	\$189
ASYNCH PLUS™	\$189
View 232™	\$189
C TOOLS PLUS™	\$149
Turbo C TOOLS™	\$149
POWER TOOLS PLUS™	\$149
POWER SEARCH™	\$149

Call today for more information

(800) 333-8087 Fax (415) 540-1938

BLAISE COMPUTING INC.

2560 Ninth Street, Suite 316 Berkeley, CA 94710 (415) 540-5441

Trademarks are property of their respective holders.



S P O T L I G H T



Rob Mitchell

Stan Wszola

Steve Apiki

FROM MATH CHIP TO TIE CLIP

The trials and tribulations of testing 25-MHz 386-based motherboards

At first, it seemed simple: Set up a standard system configuration that would let us plug in and benchmark 25-MHz 386-based motherboards. We would run both MS-DOS and Unix tests, compare features and price, and assess expandability. In the end, we accomplished our goal: to tell you which motherboards make the best PC clones (see "The Heart and Soul of a PC Compatible" on page 130). Our mistake was thinking that it would be easy.

Technical editor Rob Mitchell and testing editors Steve Apiki and Stan Wszola wrestled with one problem after another. The PC market is changing as fast as the technology. Consequently, several vendors revised their motherboards in the midst of the review, forcing us to duplicate work already done.

Not every vendor supplied a math coprocessor, so the BYTE Lab had to install one 25-MHz 80387 chip into a number of machines. While we placed the math chip in a special carrier to minimize wear and tear, and used special

chip-pulling tools, by the end of testing we had somehow cracked the math chip, making it into the most expensive tie clip BYTE has ever purchased.

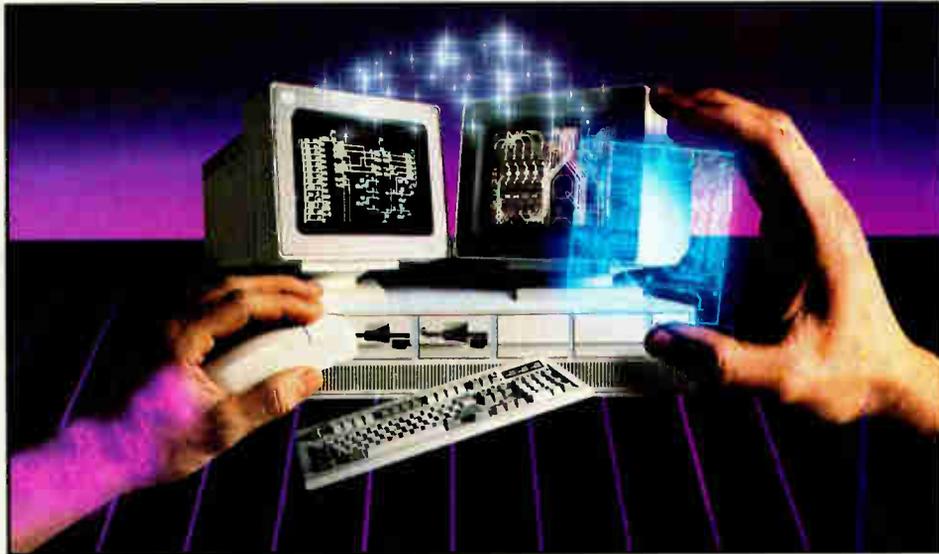
Assembling and disassembling systems from the ground up was more time-consuming than we had expected and brought more than a few surprises. Several boards failed, some spectacularly, when powered up in the BYTE Lab. One failure trashed the hard disk drive containing our Unix benchmark code.

We wanted to look at motherboards available through dealers and distributors for those of you who want to build or upgrade a machine yourselves. We also wanted products that you can't buy directly, but that you are likely to find in popular PC clones. Sorting out how each company markets its motherboards required a great deal of phone work.

But if you find any part of our effort useful when you shop for your next PC clone, we'll consider it work well done.

—Michael Nadeau

Integrated Software for Schematics & PCB Artwork



Introducing HiWIRE®-Plus

Wintek's smARTWORK® pioneered low-cost printed-circuit-board CAD. Then HiWIRE set the standard for productivity and ease-of-use in schematic capture. Now Wintek introduces HiWIRE-Plus, integrating HiWIRE's schematic features with a powerful printed-circuit-design facility.

Creating Schematics

With HiWIRE-Plus, simply connect library symbols with wires and buses. Creating and changing symbols is fast and painless. Produce your drawing using a dot-matrix printer, laser printer, or pen plotter.

Circuit-Board Design

HiWIRE-Plus gives you all the design freedom you want: you choose the grid size, trace widths, and pad shapes. The board size and number of layers are virtually unlimited. HiWIRE-Plus is perfect for surface-mount, micro-strip, and ECL applications.

Current Versions

HiWIRE-Plus V 1.3r0
smARTWORK V 1.4r0

HiWIRE-Plus Advantages

- One tool for schematics and printed-circuit artwork
- Easy-to-learn menu-driven operation; complete documentation and tutorial
- Schematic libraries with TTL, CMOS, ECL, ladder, micro-processor, and discrete components
- Netlist and bill-of-materials utilities included
- Circuit boards up to 60x60 inches and 256 layers
- Variable grid size, trace width, and pad size (.001" resolution)
- PCB library with DIPs, SIPs, SMDs, PGAs, TOs, and edge and D connectors
- Schematic-to-layout cross-checking
- Design-rule checker
- 800 number for free support



"HiWIRE", "smARTWORK", "Wintek", and the Wintek logo are registered trademarks of Wintek Corporation.

System Requirements

- IBM PC, XT, AT, or PS/2 with 512K RAM, printer port, color monitor, and CGA, EGA, or VGA graphics card
- Microsoft Mouse
- IBM ProPrinter or Epson dot-matrix printer, and/or
- Houston Instrument or Hewlett-Packard pen plotter

Higher Performance Better Value

Still only \$895, HiWIRE-Plus delivers quality schematics and PCB artwork. You don't need to guess if HiWIRE-Plus is right for you—we guarantee it! Try it for 30 days at absolutely no risk. Call toll free today and put HiWIRE-Plus to work for you.

Wintek Corporation

1801 South Street
Lafayette, Indiana 47904-2993
(800) 742-6809 or
(317) 742-8428
FAX: (317) 448-4823
Telex: 15-624-6480

Europe: RIVA Ltd., England,
Phone: 0420 22666, FAX: 0420 23700
Australia: Wintek Software
Phone: (08) 2720028, FAX: (08) 3733145

Circle 400 on Reader Service Card

Introducing the best the office memo since

They're here...

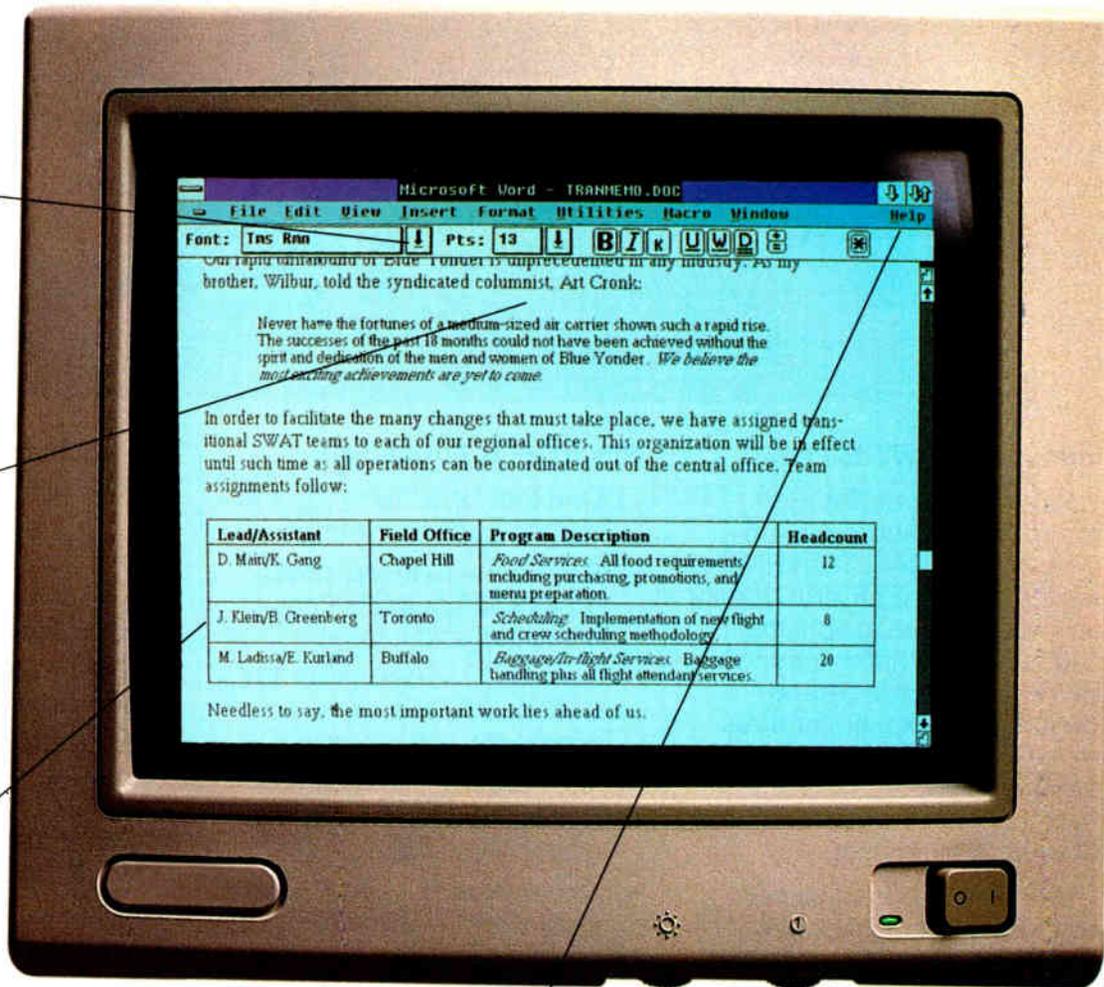
Intuitive icons on the Ribbon make those everyday tasks, like formatting, as easy as ABC. Or, more precisely, see, point, do.

Save a tree.

WYSIWYG editing shows what each page will look like, before it's printed, a feature that's easy on paper. Not to mention your patience.

We offer outstanding table service.

Now, creating a table is easier than dining out. The Word for Windows table feature allows you to organize numbers, text, and graphics in a spreadsheet-like array of cells. And there's no tab.



Help wanted.

Word for Windows context-sensitive, on-line help gets you up and running quickly. And keeps you there.

Chances are, those simple, everyday memos you've been creating aren't so simple to create anymore. What with the time-consuming process of messing with formatted paragraphs, typefaces, and tables.

And even if your documents aren't formatted, there's probably someone in your

office who wishes they were. You, perhaps.

Enter Microsoft® Word for Windows™. The word processor that compares to predecessors like the correction key compares to white-out.

Word for Windows' intuitive graphical user interface makes the most annoying and mundane parts of everyday memos as easy as ABC.

Or, more precisely, see, point, do.

Its computer-based training program and



Customers inside the 50 United States, call (800) 541-1261, Dept. K42. In Canada, call (416) 673-7638. Outside the U.S. and Canada, call (206) 882-8661. © Copyright 1990 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered acquisition of product, for a limited time. Offer good only in the 50 United States.

the thing to happen to the correction key.

BLUE YONDER AIRWAYS



INTEROFFICE MEMO

To: All personnel
From: Orville Bannister
Re: Transition to passenger service
Date: November 1, 1989

Congratulations to all of you who have worked so hard over the last two years to make Blue Yonder a full-service passenger airline. The final licensing procedures were completed at 18:53 hours on October 27, authorizing us to commence passenger service immediately.

Our rapid turnaround of Blue Yonder is unprecedented in any industry. As my brother, Wilbur, told the syndicated columnist, Art Cronk:

Never have the fortunes of a medium-sized air carrier shown such a rapid rise. The successes of the past 18 months could not have been achieved without the spirit and dedication of the men and women of Blue Yonder. We believe the most exciting achievements are yet to come.

In order to facilitate the many changes that must take place, we have assigned transitional SWAT teams to each of our regional offices. This organization will be in effect until such time as all operations can be coordinated out of the central office. Team assignments follow:

Lead/Assistant	Field Office	Program Description	Headcount
D. Main/K. Gang	Chapel Hill	<i>Food Services.</i> All food requirements, including purchasing, promotions, and menu preparation.	12
J. Klein/B. Grecaberg	Toronto	<i>Scheduling.</i> Implementation of new flight and crew scheduling methodology.	8
M. Ladissa/E. Kurland	Buffalo	<i>Baggage/In-flight Services.</i> Baggage handling plus all flight attendant services.	20

Needless to say, the most important work lies ahead of us.

Off we go!

Blue Yonder Airways, Inc. 1000 First Flight Boulevard Kitty Hawk, North Carolina 27949

Our guide will lead the way.

Document Templates give you transparent access to sophisticated features like macros, glossaries and Styles, guiding you through the creation of a document.

Achieve the right consistency.

Style sheets allow you to name character and paragraph formats. Then apply them quickly, easily, and, most important of all, consistently. So it's simple to maintain corporate standards or establish your own.

Choose your weapon.

Word for Windows was designed with the mouse in mind, but it can be used equally well with keyboard commands.

context-sensitive, on-line help make getting started every bit as natural as using it.

In addition, Word for Windows allows you to make the quantum leap into graphical word processing without losing the equity you have in your current program. It reads and writes files from virtually all word processing applications.

In twenty years of office automation, you've never experienced anything like Word for Windows.

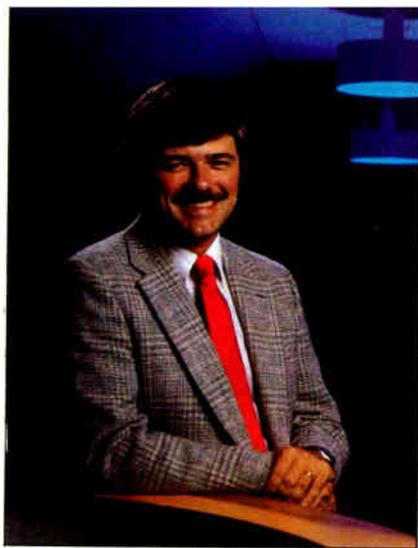
But you can.

Just call (800) 541-1261, and ask the people in Dept. K42 to send you a \$9.95* Working Model.

You'll discover that switching to Word for Windows means you won't be making any mistakes.

Microsoft
Making it all make sense

trademarks and Making it all make sense and Windows are trademarks of Microsoft Corporation. *The Working Model saves and prints documents up to two pages in length; the charge of \$9.95 covers shipping/handling, excluding sales tax, and is refundable upon



MYLEX STRUTS EISA'S STUFF

The most complete EISA offering to date clearly shows EISA's performance edge

As we were going to press, Mike Nadeau, associate managing editor for reviews, and the BYTE Lab got to test the most complete Extended Industry Standard Architecture (EISA)-based product line to date—an i486-based motherboard, a caching SCSI disk drive controller, an Ethernet adapter, and a prototype Texas Instruments Graphics Architecture (TIGA) graphics coprocessor, all from Mylex.

Mike reports that these EISA products are *fast* and that they suggest that we've just scratched the surface of EISA's power. For example, the disk drive controller is by far the fastest SCSI device that we have seen, approaching the performance of the best ESDI caching controllers. The GXE020A TIGA board—incidentally, it is the first 34020-based board that we have tested—scored as much as 45 percent higher on our low-level benchmark tests than any other TIGA board evaluated: This board could well be the year's TIGA performance leader. The other components in the demonstration system are equally impressive.

Motherboard

The prototype MAE 486-25 motherboard looked like a finished product, except for the firmware (an early Phoenix EISA BIOS), which needed some help from device drivers to configure the EISA boards.

It has six 32-bit EISA slots and two 8-bit slots, a 128K-byte write-back external cache, and a socket for a Weitek 4167 math coprocessor. It will accept up to 32

megabytes of RAM in two single-in-line-memory-module memory banks.

The Mylex scored well on the BYTE CPU and FPU benchmarks, with indexes of 6.21 and 27.44, respectively. Mylex has designed this board for use in file servers, Unix/Xenix systems, and engineering and scientific workstations. This explains why the designers added an external RAM cache and the FPU socket when the i486 already has a small cache and an FPU integrated on the chip.

Graphics

The GXE020A TIGA bus-mastering board was in an earlier stage of development. It had preliminary AutoCAD and TIGA drivers, with X Window System, Presentation Manager, and Windows/386 drivers in the works. The company expects to ship the board sometime during the second quarter, which is noteworthy since no one at this time has yet produced even an Industry Standard Architecture (ISA) 34020 board, much less an EISA version.

With 1280- by 1024-pixel resolution (a 1600- by 1280-pixel version is planned), the GXE020A runs at 32 MHz (up to 40 MHz is planned) and supports 256 colors on-screen from a palette of 16 million. Our test unit came with 4 MB of RAM.

Disk Drive Controller

The DCE376 caching SCSI disk drive controller, based on the Intel 80376 processor, was designed for service in networking or multiuser environments. It comes with drivers for MS-DOS 3.3 and 4.0, OS/2 1.1, Novell NetWare 3.0, and 386/ix V.3.2. Our unit came with 1 MB of cache RAM, expandable to 8 MB. The bus-mastering DCE376 supports up to seven SCSI devices, and you can program it for use with optical disks, scanners, tape drives, or CD-ROM drives.

Ethernet

The Mylex LNE390A Ethernet adapter is not a bus-mastering device. Neverthe-

less, Mylex claims an impressive host-to-adapter data transfer rate of 32 megabytes per second. The adapter is built around a National Semiconductor DP8390 Network Interface Controller, which takes over data buffer and communications management from the system's CPU. It supports both thick and thin Ethernet interfaces, and Mylex provides software support for Novell NetWare 2.15 and 3.0.

Pricing

The downside to all this is the price: The motherboard lists for a steep \$7600, including a 128K-byte RAM cache and 4 MB of memory. The TIGA controller goes for \$5100—expensive, but only about \$500 more than the most expensive 34010-based TIGA boards. The SCSI controller and Ethernet adapters are more reasonable at \$1700 (with 1 MB of RAM) and \$500, respectively, and the DCE376 is comparably priced with ISA ESDI controllers.

Mylex is perhaps best known for its high-performance motherboards. The company does not sell complete systems to end users, but you can buy the EISA boards for your own system, and at least one vendor, Samsung Electronics, will sell systems using the Mylex motherboard and other EISA products. All the products except the TIGA board should be available by the time you read this.

EISA proponents have bet that bus's future on early availability of EISA-capable products and compatibility with the ISA standard. Mylex has addressed three key areas where bottlenecks occur: disk I/O, graphics, and network communications. The company will be among the first to actually sell EISA boards to end users. So far, EISA is well ahead of Micro Channel at its early stages, and all indications say that this trend will continue. Stay tuned.

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

Be Objective.

Turbo Pascal,* the world-standard Pascal compiler, adds Object-Oriented Programming with our new version 5.5. We combined the simplicity of Apple's Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

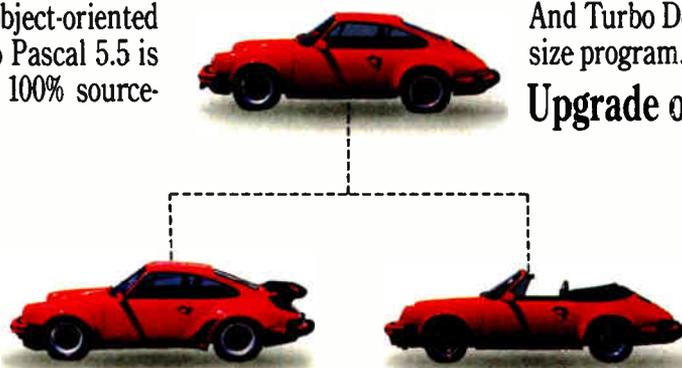
It's easy to extend yourself

If you're already programming with Turbo Pascal, it's easy to extend yourself from structured programming to object-oriented programming. And, Turbo Pascal 5.5 is the *only* compiler that is 100% source-code compatible with your existing Turbo Pascal 4.0 and 5.0 programs.

A fast object lesson

Object-oriented application programs more closely model the way you think. Objects contain both data and code.

As in a spreadsheet cell, the value and the formula are together. Objects can *inherit* properties from other objects. For example, a Porsche Carrera inherits most



Inheritance provides powerful modeling capabilities by allowing objects to inherit attributes from other objects.

attributes from the base model 911, but it also sports a whale tail.

Turbo Pascal 5.5's object-oriented extensions give you code that's easier to change, extend, and support.

Turbo Pascal 5.5 Professional with Turbo Debugger® and Turbo Assembler®

The award-winning Turbo Debugger now includes an object inspector and hierarchy browser. And Turbo Debugger can debug any size program.

Upgrade objectively

Pascal owners: Upgrading from Turbo Pascal 5.0 to 5.5 is only \$34.95 plus \$5 shipping and handling (\$75 plus shipping and handling for owners of Turbo Pascal 4.0 or earlier). And upgrading from Turbo Pascal 5.0 and

earlier to Turbo Pascal 5.5 Professional is only \$99.95 plus \$10 shipping and handling. To order, CALL (800) 331-0877.

Turbo Pascal 5.5 Features

- Inheritance
- Static & dynamic objects
- Constructors & Destructors
- Object constants
- Compiles @ > 34,000 lines/minute
- New integrated environment tutorial
- Hypertext Help with copy and paste
- Enhanced smart linker & overlay manager
- Support for 8087/80287/80387
- Integrated source-level debugging



B O R L A N D

Code: MA54

Mail upgrade orders to: Borland, P.O. Box 660001, Scotts Valley, CA 95066-0001. For orders outside the U.S., call (408) 438-5300. Turbo Pascal, Turbo Debugger, and Turbo Assembler are registered trademarks of Borland International. Copyright ©1989, Borland International, Inc. All rights reserved. BI 1324

Circle 49 on Reader Service Card (DEALERS: 50)

We make a super VGA monitor



NEC presents the MultiSync® 2A, the best VGA monitor you can buy.

It's the first monitor from the leader in the color monitor industry that's been customized to

the needs of the VGA user.

The MultiSync 2A is affordable and uncompromised. And compatible with all VGA modes. In short, it performs brilliantly. But what's equally important, it allows you to move effortlessly to the next major graphics standard: SuperVGA. That's something fixed-frequency monitors like IBM and Compaq can't do.

All this in a monitor that gives you a 14" non-glare screen on a tilt-swivel base, for nearly 30% more viewing area than standard 12" screens, as well as a new, ergonomically designed cabinet.

VGA mode shown at 320 x 200.

MultiSync is a registered trademark of NEC Technologies, Inc.

MultiSync 2A. One super VGA monitor.

IBM is a registered trademark of International Business Machines Corporation.

that's also a SuperVGA monitor.



But that's only part of the story. NEC also presents the best SuperVGA monitor you can buy. MultiSync® 2A.

The monitor that senses the software you're using and makes the switch from a VGA monitor to SuperVGA, the new standard developed by NEC and recognized by VESA. SuperVGA delivers a maximum resolution of 800 x 600, which is 56% higher than VGA.

After all, since you're most likely buying a board that goes beyond VGA, your monitor should too.

The MultiSync 2A is also available in a gray-scale version called the MultiSync GS2A monitor, with a 14" paper-white flat surface screen.

Compaq is a registered trademark of Compaq Computers Corporation.

Either way, it's one super SuperVGA monitor. For literature call

NEC is a registered trademark of NEC Corporation.

1-800-826-2255. For information call NEC at 1-800-FONE-NEC.

VESA is the Video Electronics Standards Association.

MultiSync 2A. One SuperVGA monitor.

©1989 NEC Technologies, Inc.

NEC

BYTE

EDITOR IN CHIEF
Frederic S. Langa

MANAGING EDITORS

Operations: Glenn Hartwig
News: Rich Malloy
Reviews: Michael Nadeau

NEWS

New York: Managing Editor: Rich Malloy
Associate News Editor: Andrew Reinhardt
Peterborough: Senior Editor, Microbytes:
D. Barker
Senior Editor, What's News, Short Takes:
Anne Fischer Lent
Associate News Editors: Roger Adams,
David Andrews, Martha Hicks
San Francisco: Bureau Chief: Nicholas Baran
News Editor: Owen Linderholm
Associate News Editor: Jeffrey Bertolucci
London: Senior Editor: Colin Barker

REVIEWS

Managing Editor: Michael Nadeau
Senior Editor: Dennis Allen
Technical Editors: Alan Joch, Robert
Mitchell, Tom Yager

BYTE LAB

Director: Rick Grehan
Testing Editors: Stephen Apiki, Stanford
Diehl, Howard Eglowstein, Stanley Wszola

STATE OF THE ART

Senior Editor: Jane Tazelaar
Technical Editor: Robert M. Ryan

FEATURES

Senior Editor: Kenneth M. Sheldon
Technical Editors: Janet J. Barron,
Ben Smith

SENIOR EDITORS, AT LARGE

Tom Thompson, Jon Udell

SPECIAL PROJECTS

Senior Editor: Gene Smarte

SENIOR CONTRIBUTING EDITOR

Jerry Pournelle

CONTRIBUTING EDITORS

Bill Catchings, Don Crabb, David Fiedler,
Hugh Kenner, Mark J. Minasi, Wayne Rash
Jr., Mark L. Van Name

CONSULTING EDITORS

Jonathan Amsterdam, Laurence H. Loeb,
Trevor Marshall, Stan Miastkowski, Dick
Pountain, Phillip Robinson, Peter Wayner

COPYEDITING

Chief Copy Editor: Lauren Stickler
Copy Administrator: Cathy Kingery
Copy Editors: Susan Colwell, Jeff
Edmonds, Judy Grehan, Nancy Hayes,
Margaret A. Richard, Warren Williamson

EDITORIAL ASSISTANTS

Office Manager: Peggy Dunham
Assistants: Linda C. Ryan, June Sheldon,
Lynn Susan Valley

ART

Director: Nancy Rice
Assistant Director: Joseph A. Gallagher
Art Assistants: Jan Muller, Lisa Nardecchia
Technical Artist: Alan Easton

PRODUCTION

Director: David R. Anderson
Senior Editorial Production Coordinator:
Virginia Reardon
Editorial Production Coordinators: Barbara
Busenbark, Denise Chartrand, Michael J.
Lonsky

TYPOGRAPHY

Systems Manager: Sherry Fiske
Applications Manager: Donna Sweeney
Typesetter: Christa Patterson

ADVERTISING/PRODUCTION (603) 924-6448

Director of Advertising: Lisa Wozmak
Assistant: Christine W. Tourgee
Customer Service Supervisor: Linda Fluhr
Senior Account Coordinator: Lyda Clark
Account Coordinator: Dale Christensen
Materials Coordinator: Karen Cilley
Advertising Assistant: Roxanne Hollenbeck
Production Coordinator: Rod Holden
Creative Services Manager:
Susan Kingsbury
Production Artist: Lillian J. Doucet
Quality Control Manager: Wai Chiu Li

ADMINISTRATION

Publisher's Assistant: Donna Nordlund

MARKETING AND PLANNING

Director: L. Bradley Browne
Marketing Communications Manager:
Pamela Petrakos-Wilson
Public Relations Manager: Dawn Matthews
Assistant Promotion Manager: Lisa
Jo Steiner
Marketing Art Director: Stephanie
Warnesky
Associate Art Director: Sharon Price
Senior Market Research Analyst: Julie
Perron
Copyrights Coordinator: Faith Kluntz
Reader Service Coordinator: Cynthia
Damato Sands
Marketing Assistant: Carol Pitman

FINANCIAL SERVICES

Director of Finance and Services:
Philip L. Penny
Business Manager: Kenneth A. King
Assistants: Marilyn Parker, Diane Henry,
JoAnn Walter, Jaime Huber, Agnes Perry

CIRCULATION

Director: Dan McLaughlin
Assistant Manager: Vicki Weston
Distribution Coordinator: Karen Desroches
Back Issues: Louise Menegus
Direct Accounts Coordinator: Ellen Dunbar
*Direct Accounts Telephone Sales
Representative:* Karen Carpenter

BUILDING SERVICES

Manager: Tony Bennett
Assistants: Cliff Monkton, Gary Graham

PERSONNEL

Human Resources Administrator:
Patricia Burke
Receptionist: Beverly Goss

EXCHANGE EDITORS

Macintosh Exchange: Laurence H. Loeb,
IBM Exchange: Barry Nance, *User Group
Exchange:* David Reed, *Interactive Game
Exchange:* Myrrh Mist, *Amiga Exchange:*
Joanne Dow, *Writers Exchange:* Wayne
Rash Jr.

BUSINESS AND MARKETING

Secretary: Patricia Bausum, *Customer
Service:* Denise A. Greene, *Trammy Warnock,
Customer Credit and Billing:* Brian
Burgess

TECHNOLOGY

Programmer/Analyst: John Spadafora,
Programmer: Peter Mancini

PUBLISHER/GROUP VICE PRESIDENT

J. Burt Totaro

ADVERTISING SALES

*Associate Publisher, Vice President
of Marketing:* Steven M. Vito
Administrative Assistant: Carol Cochran

Eastern Regional Sales Manager:

Arthur H. Kossack (312) 751-3700
Sales Assistant: Julie Barker
Western Regional Sales Manager:
Jennifer L. Bartel (214) 701-8496
Sales Assistant: Susan Vernon

NEW ENGLAND

ME, NH, VT, MA, RI, ONTARIO, CANADA,
& EASTERN CANADA
Daniel D. Savage (617) 262-1180

ATLANTIC

NY, NYC, CT, NJ (NORTH)
Kim Norris (212) 812-2645

EAST

PA, KY, NJ (SOUTH), MD, W. VA,
DE, DC
Thomas J. Brun (215) 496-3833

SOUTHEAST

NC, SC, GA, FL, AL, TN, VA, MS, AR, LA
John Schilin (404) 252-0626

MIDWEST

IL, MO, KS, IA, ND, SD, MN, WI, NE,
IN, MI, OH
Kurt Kelley (312) 751-3740

SOUTHWEST, ROCKY MOUNTAIN

CO, OK, TX
Alison Keenan (214) 701-8496

SOUTH PACIFIC

SOUTHERN CA, AZ, NM,
LAS VEGAS, UT
Ron Cordek (714) 557-8292
Andrew B. Uphoff (213) 480-5243

NORTH PACIFIC

HI, WA, OR, ID, MT, NORTHERN CA, WY,
NORTHERN NV, WESTERN CANADA
Bill McAfee (408) 878-0371
Roy J. Kops (415) 362-4600
Leslie Hupp (415) 362-4600

OUTSERTS

Scott Gagnon (603) 924-4380

INSIDE SALES

Director: Liz Coyman
Administrative Assistant: Susan Boyd

NATIONAL SALES

Mary Ann Goulding (603) 924-9281
Patricia Payne (603) 924-2654
Jon Sawyer (603) 924-2665

BYTE BITS (2x3)

Mark Stone (603) 924-6830

THE BUYER'S MART (1x2)

Brian Higgins (603) 924-3754

REGIONAL ADVERTISING SECTIONS

James Bail (603) 924-2533
Barry Echavarría (603) 924-2574
Larry Levine (603) 924-4379

BYTE POSTCARD DECK MAILINGS

BYTE DECK
Ed Ware (603) 924-6166

COMPUTING FOR DESIGN & CONSTRUCTION

COMPUTING FOR ENGINEERS
Ellen Perham (603) 924-2596

INTERNATIONAL ADVERTISING SALES STAFF

See listing on page 345.

EDITORIAL AND BUSINESS OFFICE:

One Phoenix Mill Lane, Peterborough, NH
03458, (603) 924-9281.

West Coast Branch Office: 425 Battery St.,
San Francisco, CA 94111, (415) 954-9718;
3001 Red Hill Ave., Building #1, Suite 222,
Costa Mesa, CA 92626, (714) 557-6292.

New York Branch Editorial Office: 1221 Avenue
of the Americas, New York, NY 10020, (212)
512-3175.

BYTEnet: (617) 861-9764 (set modem at 8-1-
N or 7-1-E; 300 or 1200 baud).

Editorial Fax: (603) 924-2550. *Advertising Fax:*
(603) 924-7507.

SUBSCRIPTION CUSTOMER SERVICE:

Outside U.S. (609) 426-7070; inside U.S. (800) 232-
BYTE. 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, \$31.95 for one year,
\$59.95 for two years, \$79.95 for three years.

\$50 for one-year air delivery to Europe.
Y28,800 for one-year air delivery to Japan,
Y14,400 for one-year surface delivery to
Japan, \$30 surface delivery elsewhere. Air
delivery to selected areas at additional rates
upon request. Single copy price is \$3.50 in
the U.S. and its possessions, \$3.95 in
Canada, \$4.50 in Europe, and \$5 else-
where. 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.

Subscription rates for institutions, libraries,
clubs, groups, and bulk rates are available
upon request. Contact: (603) 924-2550.

Advertising rates for 1990 are available
upon request. Contact: (603) 924-2550.

Reprints: (603) 924-2550.

Back issues: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

Advertising: (603) 924-2550.

Subscription: (603) 924-2550.

Customer Service: (603) 924-2550.

General: (603) 924-2550.

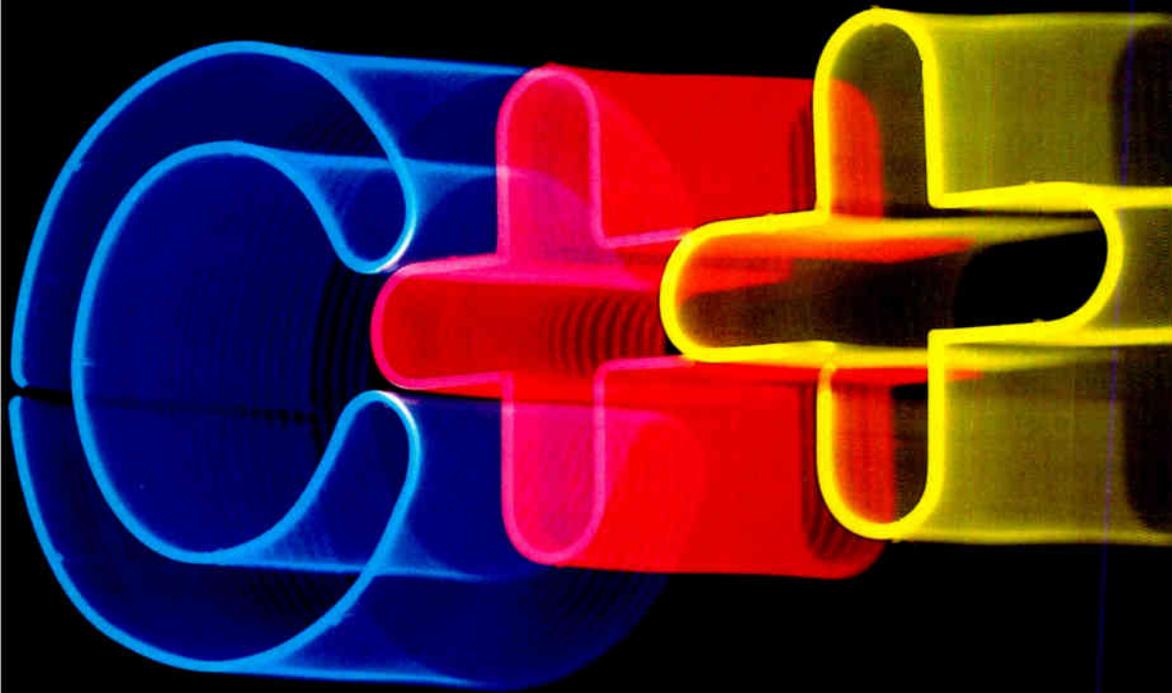
BIX BYTE INFORMATION EXCHANGE

DIRECTOR
Stephen M. Laliberte

MANAGING EDITOR
Tony Lockwood

MICROBYTES DAILEY

Coordinator: D. Barker *Peterborough,*
Rich Malloy *New York,* Nicholas Baran
San Francisco, Jeffrey Bertolucci
San Francisco, Laurence H. Loeb
Wallingford, CT, Stan Miastkowski
Peterborough, Wayne Rash Jr. *Washington,*
DC, David Reed *Lexington, KY,* Andrew
Reinhardt *New York,* Jan Ziff *Washington,*
DC



ZORTECH

“Zortech C++ is one of the best MS-DOS products I’ve had the luck to use. I can highly recommend Zortech V2.0”

Scott Robert Ladd – Dr. Dobbs Journal – January 1990

NEW! AT&T C++ V2.0 SPECIFICATION

Zortech is first again with the release of its new C++ V2.0 Developer’s Edition featuring the AT&T C++ V2.0 specification.

NEW! MS WINDOWS COMPATIBILITY

New V2.0 features like Multiple Inheritance and Type Safe Linkage make this the most advanced compiler available today.

NEW! C++ SOURCE LEVEL DEBUGGER

You get 1500 pages of clear, high quality, professional documentation.

NEW! EXPANDED C++ TOOLS

Zortech C++ V2.0 makes it really easy for you to move code over from most other leading C compilers.

Zortech C++ V2.0 Developer’s Edition comes with a great new environment that lets you edit, compile and debug with ease.

Zortech present another “World’s First” with its new C++ Source Level Debugger for MS-DOS. Once you’ve used our

debugger you will never want to go back to any other.

The Developer’s Edition also includes a 99% ANSI compatible C compiler, seamless LIM/EMS support, C++ Graphics Shell, TSR functions, C++ Tools, Optimizer, SAA/CUA style user interface, and full standard library source code.

Please call for our color brochure.

PRICES

- C++ Compiler \$199.95
 - C++ Debugger \$149.95
 - C++ Tools \$149.95
 - Library Source \$149.95
- Save \$200—Get the Developer’s Edition for only \$450 (includes all the above items).
OS/2 Compiler \$CALL
C++ Video \$499.95

USA: Zortech Inc.
1165 Massachusetts Ave.
ARLINGTON MA 02174
Voice: 617-646-6703
Fax: 617-643-7969

EUROPE: Zortech Ltd.
106-108 Powis Street
LONDON SE18 6LU
Voice: 44-1-316-7777
Fax: 44-1-316-4138

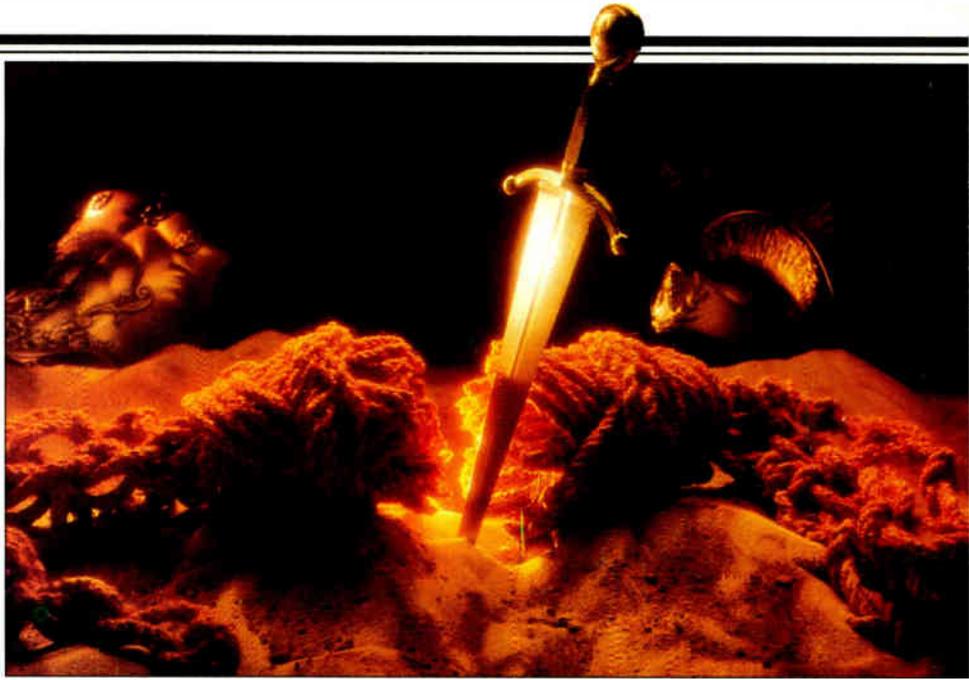
HOTLINE 1-800-848-8408

Circle 302 on Reader Service Card



Smalltalk/V[®] PM.
 Think of it as a bold,
 “seat-of-the-pants” solution
 that cuts to the heart of the
 OS/2 Presentation Manager
 complexity challenge. Thus
 unlocking the potential of this
 powerful operating system.

With the introduction
 of Smalltalk/V PM, object-
 oriented programming



Introducing Smalltalk/V PM. The to fulfill the promise of OS/2.

moves out of the realm of mystery
 and into a new era of breakthrough
 applications that promises to be of
 legendary proportions.

OS/2 PM is designed to push

“user friendly” to a whole new level
 of sophistication. If you compare it
 to an orchestra, OS/2 has capabili-
 ties no ordinary assemblage of in-
 struments has ever dreamed of

possessing. Yet to tap
 its potential, OS/2
 PM demands a con-
 ductor capable of true
 genius. That conduc-
 tor is Smalltalk/V
 PM.

You’ll find Small-
 talk/V PM a perfect
 language for repre-
 senting and manipu-
 lating high-level
 information. Because

you go from designing to prototyp-
 ing to delivering a completed appli-
 cation in one seamless step, you
 cleanly avoid the old costly “crash
 and burn” delays so common with
 languages born in the age of main-
 frames.

UNLEASHING THE AWESOME POWER OF OS/2 PM

Smalltalk/V PM. It helps stop
 the natural drift toward vaporware
 so common in software develop-
 ment today. It lets you dive right in
 and get to the creative parts with-
 out the usual grunt work. For ex-
 ample, if you want to ignore the
 complexities of understanding
 OS/2 PM details you can immedi-

Is The Most Important Part Of Your Developer’s Kit Missing?

OS/2 PM offers you a powerful, rich environment
 loaded with advantages like a Graphics Program-
 ming Interface (GPI), a LAN manager, multitask-
 ing, SQL, just for starters. And all of these
 components are accessible in a standard way using
 Smalltalk/V PM through Dynamic Link Libraries
 (DLLs). Combined with DDE (Dynamic Data
 Exchange), you can call and exchange data with
 other PM services or applications. Seamlessly.
 Now developers can write truly reusable compo-
 nents, which greatly increases their value. And
 you’ll find Smalltalk/V PM the perfect “glue”
 between applications written in other languages.





The Gordian Knot. A legendary case of complexity. It had baffled and stymied the best minds of the ancient world until Alexander the Great cut through the convoluted challenge with one bold, swift stroke of his sword. This "seat-of-the-pants" solution set in motion the prophecy that whoever unraveled the knot would one day rule Asia.

"THIS IS THE RIGHT WAY TO DEVELOP APPLICATIONS FOR OS/2 PM.

OS/2 PM is a tremendously rich environment, which makes it inherently complex. Smalltalk/V PM removes that complexity, and lets you concentrate on writing great programs. Smalltalk/V PM is the kind of powerful tool that will make OS/2 the successor to MS/DOS."

*Bill Gates, Chairman
Microsoft Corp.*

grammer struggling with the complexities of Presentation Manager should take a close look at this product."

*Charles Petzold, Contributing Editor,
PC Magazine*

"Digitalk's Smalltalk/V PM is dazzling! This product makes Presentation Manager pay off."

*Jeff Duntemann, Contributing Editor,
Dr. Dobbs Journal*

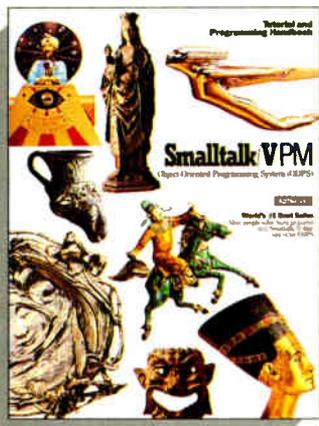
"Smalltalk/V PM is an excellent tool for rapid delivery of prototypes which have all the functionality and user interface of a complete PM application."

*Richard A. Landsman,
System Architect, Lotus Development*

"Smalltalk/V PM from Digitalk is the greatest! This is an incredible product."

*J.D. Hildebrand
Editor-in-Chief, Computer Language*

fast, seat-of-the-pants way



THE FIRST FULLY-COMPILED SMALLTALK.

Because Smalltalk/V PM is fully compiled it provides you with a more responsive environment than ever before. Now you'll be able to generate stand-alone applications (.EXE).

debugger simplifies application development and gives you instant response when you implement an idea. Our extensive user manuals and tutorials have earned us high praise.

SMALLTALK/V PM. THE TALKING HAS ALREADY STARTED.

"Digitalk's Smalltalk/V PM is a masterful implementation of a classical object-oriented programming language and a state of the art graphical user interface. Any pro-

ately start creating without any limitations on your efficiency.

However, if you're the curious type, we have tools called browsers to help you fathom the masterpiece called OS/2 PM. You'll also find our incremental program development capability and push-button

THE BEST PM INVESTMENT YOU'LL EVER MAKE.

Smalltalk/V PM \$499.95

Prices and information on these and other Digitalk products are available on request:

Smalltalk/V, Smalltalk/V 286, Smalltalk/V Mac

Smalltalk/V. A product of Digitalk Inc., 9841 Airport Blvd., Los Angeles, CA 90045. For information or to find a dealer near you call:

1-800-922-8255

1-213-645-1082

CompuServe 71361,1636

FAX 1-213-645-1306

Smalltalk/V is a registered trademark of Digitalk Inc. Prices subject to change without notice. Other product names are trademarks or registered trademarks of their respective holders.

Smalltalk/V



Circle 91 on Reader Service Card

NANOBYTES

Open Look, AT&T and Sun's answer to the OSF/Motif graphical user environment, has been upgraded. An AT&T representative said that Open Look 2.0 includes bug fixes and performance enhancements, as well as utilities that used to be options.

Intel (Santa Clara, CA) has formed a joint venture with the Japanese company **NMB Semiconductor** to manufacture and market high-speed DRAM chips. The new Intel/NMBS DRAM Fabrication Co. plans to make 1- and 4-megabit chips at NMB's site in Tateyama City, Japan, and eventually in the U.S. NMBS will handle the manufacturing, and Intel, the marketing.

Prometa USA (Gainesville, FL) showed at UniForum a Motorola **88000-based coprocessor card** that plugs into **Micro Channel-based computers**. Using bus-mastering techniques, the board handles its own I/O, freeing the host processor to run DOS or OS/2 applications without additional overhead. The board runs Unix System V release 3.2. Prometa has built extensions to Microsoft Windows and Presentation Manager to allow execution of Unix programs from within DOS and OS/2. Prometa subscribes to the 88open Binary Compatibility Standard, so applications built for other 88000 platforms should run unmodified on Prometa's card.

Graphic Software Systems (Beaverton, OR) now has a version of its XVT (Extensible Virtual Toolkit) graphical interface library that runs under **OSF/Motif**. Previously, XVT allowed programmers to create interface modules in C that can be compiled with minimal changes across Microsoft Windows, Presentation Manager, Macintosh, and nongraphic character displays. GSS has enhanced XVT with color support, dynamic menu modification, text editing, and child windows. A Universal Resource Language specification and compiler allow interface elements to be textually described and transported across various platforms, GSS says.

computer can ever be built. Some computer scientists maintain that optics will be restricted to system I/O and connections between electronic components. And some say that optical gates will never be a practical alternative to transistors.

A fully optical computer is more than five years away, according to the Bell Labs group. The most viable use now for optical technology is in hybrid systems that combine optics and electronics. The researchers are now focusing their work on optical interconnects between chips, which could be practical in as little as three years. Optical interconnections could vastly increase the amount of data moving in and out of chips.

A big problem with electronic chips is their data I/O bottleneck: Signal lines need a critical mass to carry data and must be kept far enough

apart to prevent cross talk. By contrast, light is very resistant to interference and has a huge bandwidth. Streams of photons can even cross one another without causing any distortion.

Optics and computers will likely converge gradually. The Bell Labs processor is a significant step toward an optical computer, but there are other hurdles, including developing techniques for programming an optical machine. By 1995, AT&T says, supercomputers and telecommunications computers could contain 20 percent to 30 percent optical components; by the year 2000, as many as half the components could be optical. But it will be quite a while before you'll be running your favorite application program on your desktop optical computer.

—Andy Reinhardt

Have They Been Doing It Wrong? Discovery Could Help Chip Makers, Researcher Says

In the process of designing a device for monitoring peak voltages on silicon surfaces, a Stanford University researcher says that he accidentally made a discovery that could greatly improve manufacturing yields and the reliability of ICs. Contrary to a basic assumption governing silicon chip design and production, Dr. Wieslaw Lukaszek says that he discovered that the process of depositing electrical charge on silicon surfaces (called *doping*, it's used to introduce voltage differentials into a semiconductor) tends to distribute the charge evenly over the surface, rather than concentrating the charge in proportion to the area of the surface.

Until this discovery, Lukaszek says, chip manufacturers have assumed that ion implanters and other charging devices act as a current source and deposit their charge on the silicon wafer in proportion to the size of its area. On the basis of this assumption, manufacturers have believed that they could prevent excessive electrical charge simply by limiting the size of the polysilicon wafer.

With this same assumption in mind, Lukaszek set out to design a peak voltage monitor that could measure and store in memory the voltage levels of a wide range of silicon structures subjected to electri-

cal charge. Lukaszek says he found that "no matter what the size of the polysilicon structure, it sees the same voltage [given the same electrical charge]." In other words, explains Lukaszek, "the ion implanter behaves more like a voltage source than a current source." Or, in still other words, a basic assumption of making semiconductors is wrong, he claims. Until now, there has been no way of verifying the assumption, Lukaszek says. "It was based on looking at the residual damage in chips, sort of like doing an autopsy."

Lukaszek hopes to work with semiconductor companies to refine his voltage monitor so that the manufacturers can gain a better understanding of what's going on. Lukaszek told *Microbytes Daily* that he thinks this new insight could lead to better control of manufacturing conditions and less electrical "stress" on silicon wafers, thus resulting in higher yields. His finding could possibly enable manufacturers to understand better how silicon wafers behave in response to doping and then to redesign their equipment without worrying about wafer area, but focusing instead on other factors. "Manufacturers have been getting clobbered, and they didn't know about it," he says.

—Nick Baran

continued

Until now there was only one way to integrate C and Assembler.



While C and Assembler give you power to burn, switching back and forth between them can leave your brain feeling a little fried.

All that stopping. And starting. And constantly retracing your steps.

Well, relax. Now there's Microsoft® QuickAssembler. Available with our clever QuickC® Compiler in one location: the first integrated environment for C and Assembler.

For the first time, you can save time with an integrated editor, compiler, assembler and debugger that let you create C programs, mixed C and Assembler programs, or Assembler programs that stand alone.

To make sure you feel at home in your new environment, we've designed Microsoft Quick Advisor, a hypertext electronic manual that coaches, coaxes and guides you on screen.

Quick Advisor gives you access to information on all ROM BIOS and MS-DOS® calls. And it even lets you cut and paste sample programs, so you can make both C and Assembler subroutines part of your routine in no time.

For more details on the incredible integrated power of QuickAssembler and QuickC Compiler, call (800) 426-9400. If you own QuickC Compiler version 2.0 already, we'll tell you how to add on QuickAssembler quick.

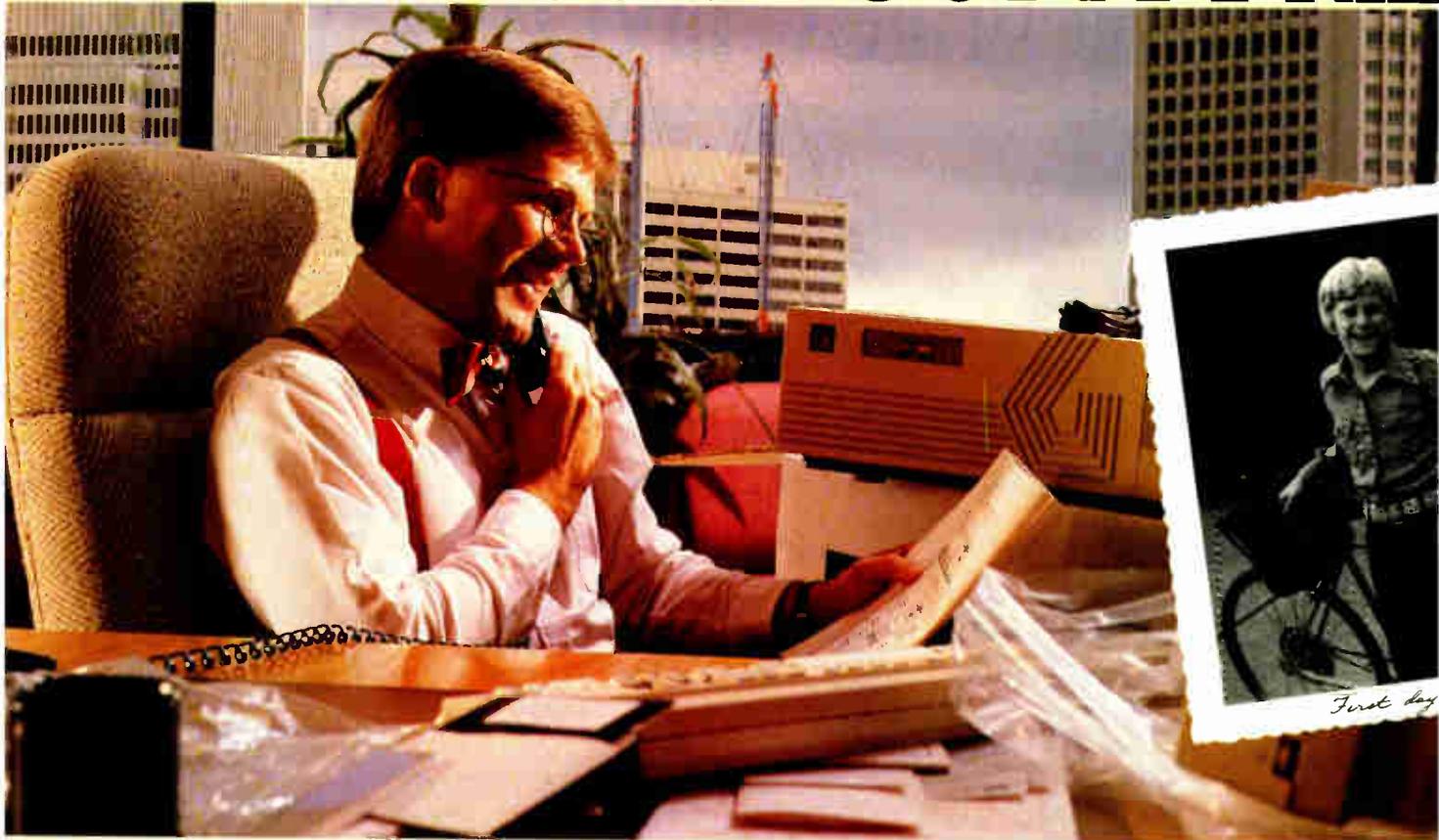
And take a load off your mind.



Microsoft
Making it all make sense.

Customers inside the 50 United States, call (800) 426-9400. In Canada, call (416) 673-7638. Outside the U.S. and Canada call (206) 882-8661. © Copyright 1989 Microsoft Corporation. All rights reserved. Microsoft, the Microsoft logo, MS-DOS and QuickC are registered trademarks and *Making it all make sense* is a trademark of Microsoft Corporation.

YOU'VE GOT A FRIE



Whether you're considering one computer or 1000, you've got a friend in the business at Gateway 2000. You're assured of getting fully loaded machines for the same price as the competition's stripped down models. The standards in your new system will be second to none. From painstaking assembly by Gateway technicians to rigorous quality controls, the system you receive will be the **best value** in the industry.

Here's what the experts have to say about Gateway 2000:

"With Gateway's low price, you get plenty of power for your money."

PC Magazine

"Let me save you a lot of legwork: one of the strongest candidates around is the Gateway 2000..."

Computer Shopper



"...the Gateway 2000 386/33 is an amazing value...for top price and performance, there's no beating ...Gateway..."

PC World



"The leader in support policies is Gateway..."

Infoworld

"...Gateway 2000 isn't sacrificing quality to deliver a low-priced 386."

PC Resource

Every Gateway computer purchase includes:

- 30 Day Money Back Guarantee
- 1 Year Warranty
- Lifetime Toll-Free Technical Support
- Free Federal Express Shipment of Replacement Parts
- Bulletin Board Technical Support Service
- Free On-Site Service (to most locations if support by phone, BBS or Federal Express shipments doesn't correct a problem.)

Of course a good source of information about any company is its customers. Here's a small sampling of what Gateway 2000 customers have to tell you:

"I have purchased about 20 computers by mail order and your company has been the most courteous I have dealt with. Thanks for fine products, very good service, and fair pricing..."

J. Keith Sharp

"I have performed an exhaustive search and study as to the price and performance of comparative systems on the market. Gateway 2000 has emerged to the top of my evaluation by a wide margin."

Kenneth P. Battista

"Rarely do you find a company who will REALLY stick by the customer AFTER the purchase. I can honestly say, Gateway 2000 is one of these rare breeds."

Charles Paul Hosey

"I am most impressed thus far with my new Gateway 2000 20 Mhz, 80386 computer. I am also impressed with your company. Your people are knowledgeable and friendly. Your prices are the best I have seen for a quality product line."

Hobart K. McDowell III

"We've standardized on Gateway 2000 systems in our department. Your prompt service and technical support has kept our sales operation running better than ever. Based on the quality and performance of your systems, I would strongly recommend them to other corporations."

Elizabeth Coyman, McGraw-Hill



GATEWAY2000

"You've got a friend in the business."

Call Toll Free 800-523-2000

610 Gateway Drive • North Sioux City, South Dakota 57049 • Telephone 605-232-2000 • Fax 605-232-2023

ND IN THE BUSINESS.



12 MHZ ■ 286 VGA

- 80286-12 Processor
 - 2 Megs RAM
 - 1.2 Meg 5¼" Drive
 - 1.44 Meg 3.5" Drive
 - 65 Meg 28ms RLL Drive
 - 16 Bit VGA with 512K
 - 14" 1024 x 768 Color Monitor
 - 1 Parallel & 2 Serial Ports
 - 101 Key Keyboard
 - MS DOS 3.3 or 4.01
- \$1995.00**

GATEWAY ■ 386SX

- 2 Megs RAM
 - 1.2 Meg 5¼" Drive
 - 1.44 Meg 3.5" Drive
 - 65 Meg 28ms RLL Drive
 - 16 Bit VGA with 512K
 - 14" 1024 x 768 Color Monitor
 - 1 Parallel & 2 Serial Ports
 - 101 Key Keyboard
 - MS DOS 3.3 or 4.01
- \$2195.00**

20 MHZ ■ 386 VGA

- 4 Megs RAM
 - 1.2 Meg 5¼" Drive
 - 1.44 Meg 3.5" Drive
 - 65 Meg 28ms RLL Drive
 - 16 Bit VGA with 512K
 - 14" 1024 x 768 Color Monitor
 - 1 Parallel & 2 Serial Ports
 - 101 Key Keyboard
 - MS DOS 3.3 or 4.01
- \$2695.00**
64K Cache Add \$500

25 MHZ ■ 386 VGA

- 4 Megs RAM
 - 1.2 Meg 5¼" Drive
 - 1.44 Meg 3.5" Drive
 - 160 Meg ESDI Drive
 - 32K Cache Controller
 - 16 Bit VGA with 512K
 - 14" 1024 x 768 Color Monitor
 - 1 Parallel & 2 Serial Ports
 - 101 Key Keyboard
 - MS DOS 3.3 or 4.01
- \$3395.00**
64K Cache Add \$500

33 MHZ ■ 386 VGA

- 64K Cache RAM
 - 4 Megs RAM
 - 1.2 Meg 5¼" Drive
 - 1.44 Meg 3.5" Drive
 - 160 Meg ESDI Drive
 - 32K Cache Controller
 - 16 Bit VGA with 512K
 - 14" 1024 x 768 Color Monitor
 - 1 Parallel & 2 Serial Ports
 - 101 Key Keyboard
 - MS DOS 3.3 or 4.01
- \$4395.00**

25 MHZ ■ 486 VGA

- 4 Megs RAM
 - 1.2 Meg 5¼" Drive
 - 1.44 Meg 3.5" Drive
 - 160 Meg ESDI Drive
 - 32K Cache Controller
 - 16 Bit VGA with 512K
 - 14" 1024 x 768 Color Monitor
 - 1 Parallel & 2 Serial Ports
 - 101 Key Keyboard
 - MS DOS 3.3 or 4.01
- Call For Price**

This device has not been approved by the Federal Communications Commission. This device is not and may not be offered for sale or lease, or sold or leased until the approval of the FCC has been obtained.

Due to the volatility of the DRAM market all prices are subject to change.

NANOBYTES

Omron Advanced Systems (Cupertino, CA) is looking for remarketers in the U.S. to sell its Luna workstations. Manufactured in Japan, the Luna systems incorporate advanced performance and features in a small package. The original Luna, based on a 68030/68882 CPU/math coprocessor combination, includes 8 megabytes of RAM, a 150-MB hard disk drive, a 155-MB tape backup system, and a 19-inch monochrome display. The Luna runs Mach 2.5 (the operating system on which OSF/1 is based). Retail pricing is not set, but the product is less than \$7000 in OEM quantities. The Luna/88K, a multiprocessing workstation, will incorporate up to four coupled Motorola 88000 chip sets running at 33 MHz.

Frame Technology Corp. (San Jose, CA) has signed with The Santa Cruz Operation (Santa Cruz, CA) to port **FrameMaker** desktop publishing software to SCO's **Open Desktop** graphical environment.

In a move prompted by **Compaq's** debut last November of its SystemPro, **Zenith** plans to offer an enhanced version of its **Z-1000 multiprocessing Unix system** in May. The Z-1000 currently uses two to six 386 processors; they're linked using a special bus configuration that includes standard AT-bus-style connectors and "C-Bus" connectors developed by Corollary. The new version of the Z-1000 will have EISA connectors in place of the AT connectors and will be able to use i486 processors as well as 386s. Zenith says that with six i486s in place, the new system will be capable of over 100 MIPS. Since the Z-1000 uses a passive backplane type of bus, current owners should be able to upgrade to the EISA version easily. As for software, the current Z-1000 can run only a special multiprocessing version of Unix. Zenith said that in the future, it will offer a multiprocessing version of Microsoft's LAN Manager and Novell's NetWare. Compaq has promised a multiprocessing version of LAN Manager (with two processors) for its SystemPro.

IBM Will Offer NeXT Environment to Unix Users

It came as no surprise, but it's good news for NeXT. IBM announced officially that it will offer NeXT's NextStep user interface and development environment on its workstations and PS/2 personal computers running AIX, IBM's version of Unix. IBM licensed NextStep from NeXT in 1988 but then made no public commitment to using it. While it's not yet clear that users of IBM's new RT will want to run NextStep on top of AIX 3, the fact that it's an option gives NeXT's environment the official seal of approval from the world's biggest computer company.

NextStep is a graphical user interface layer for Unix. NeXT uses a version of Unix called Mach, developed primarily at Carnegie Mellon University. IBM's AIX version of Unix is not compatible at the binary level with Mach; therefore, programs developed on NeXT Computers will have to be recompiled to run under AIX, and IBM programs developed with NextStep will have to be recompiled to run on NeXT Computers. While it is likely that little, if any, code modification will be necessary because NextStep uses a consistent graphics model on either NeXT or

IBM systems, neither company has publicly demonstrated the portability of NextStep applications.

IBM will also support the Open Software Foundation's Motif interface, which can be considered a competitor of NextStep. NextStep has advantages over OSF in that it offers an excellent development environment for programmers with its Interface Builder and Application Kits, which facilitate software design. NextStep's possible disadvantage is its use of a proprietary windowing system, while most of the Unix market has settled on the X Window System. While the Window Server doesn't have the acceptance that the X Window System has gained, some NeXT users have said that they think it's superior.

Some major software companies have already said that they're developing applications to run under NextStep, including Lotus, Informix, WordPerfect, and Adobe.

IBM's decision to offer NextStep is good news for developers working on NextStep applications. It gives them the opportunity to market their programs on IBM PS/2s and workstations that run AIX.

—Nick Baran

Group Proposes Decorum for OSF

In an effort to set an industry standard for distributed computer networks that contain software and hardware from different vendors, the Open Software Foundation (Cambridge, MA) has been evaluating responses to its "request for technology." Although the OSF has received 50 proposals for a standard distributed computing environment, observers say that one of the front-runners is Decorum, backed by a group that includes IBM, Microsoft, DEC, Apollo, Locus Computing, and Transarc.

Decorum defines tools that developers can use to more easily create applications for distributed environments. Although obviously aimed primarily at Unix-based environments, the proposal also defines ways of connecting with other operating systems, including DOS and OS/2. Other main components include remote procedure calls using Apollo's Network Computing System proto-

cols; process transparency, provided by the Transparent Computing Facility, jointly developed by IBM and Locus; and a distributed file system, based on Transarc's AFS (formerly the Andrew File System of Carnegie Mellon). These provide support for uniform file systems across networks, as well as for integrating DOS and Unix file systems.

Rounding out the complex proposal are threading facilities based on POSIX, time services using the Network Time Protocol (NTP), distributed access to remote devices, administrative services for managing and monitoring networks, and capabilities for diskless systems.

A spokesperson for the Decorum group says that each of the major components of the proposal are designed as independent layers that can be combined into a complete distributed computing environment.

continued

New FoxPro

**Classic Beauty. Legendary Power.
A Higher Standard in Relational Databases.**

Introducing FoxPro. The *only* relational database management system that combines astonishing performance with a sleek interface of amazing power and beauty.

- FoxPro offers all the elegance and accessibility of a graphic-style interface, yet operates at the stunning speeds possible only with character interfaces.
- FoxPro is so easy to learn and use, even beginners can become productive immediately; yet it's powerful and sophisticated enough to satisfy the needs of the most demanding developers and power-users.
- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it's able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don't even need a graphics card or special windowing software.

Nothing is Faster

Fox Software products are famous for their unmatched execution speed. FoxPro extends that tradition.



FoxPro is up to eight times faster than dBASE IV—more than 15 times faster than dBASE III PLUS!

And that blazing speed translates into unprecedented power. Now you can efficiently process gigantic databases with hundreds of thousands—even millions—of records.

Protecting Your Investment

With FoxPro, your existing FoxBASE+ or dBASE III PLUS programs will run perfectly—first time, every time, no excuses. And FoxPro is language-compatible with dBASE IV.

But FoxPro doesn't stop there. It has over 140 language enhancements not found in any version of dBASE. We've outdone ourselves by adding more than 200 language extensions you won't find in FoxBASE+.

Best of all, FoxPro opens up whole new worlds for your applications by letting you move them onto a variety of different platforms.

The Tradition Continues

Fox Software is committed to excellence—our products prove it.

We've been producing superb database management software since 1983. And our products for both the PC and the Macintosh continue to win awards worldwide.

We've taken everything we know about software engineering, databases and interface design, and focused it into one remarkable product—FoxPro.

FREE Demo Disk

But don't just take our word for it. Try FoxPro for yourself, and see what the higher standard of database management can do for you.

Call (419) 874-0162 now to get your free demo disk. Or ask for the FoxPro dealer nearest you. One look, and we think you'll agree: *Nothing Runs Like The Fox.*

FoxBASE+ Users: Call About Our Liberal Upgrade Offer!

System Requirements: FoxPro operates in 512K RAM (640K recommended) with MS/PC-DOS 2.0 or greater and an 8086/8088, 80286 or 80386 microprocessor. For optimum performance, FoxPro takes complete advantage of any available EMS (expanded memory) or a math coprocessor.

Trademark/Owner: FoxPro, FoxBASE+ / Fox Software; dBASE III PLUS, dBASE IV/Ashton-Tate.

Fox Software

Nothing Runs Like The Fox.

Fox Software, Inc. (419) 874-0162
134 W. South Boundary FAX: (419) 874-8678
Perrysburg, Ohio 43551 Telex: 6503040827 FOX

Circle 121 on Reader Service Card

Most VGA monitors this colorful,

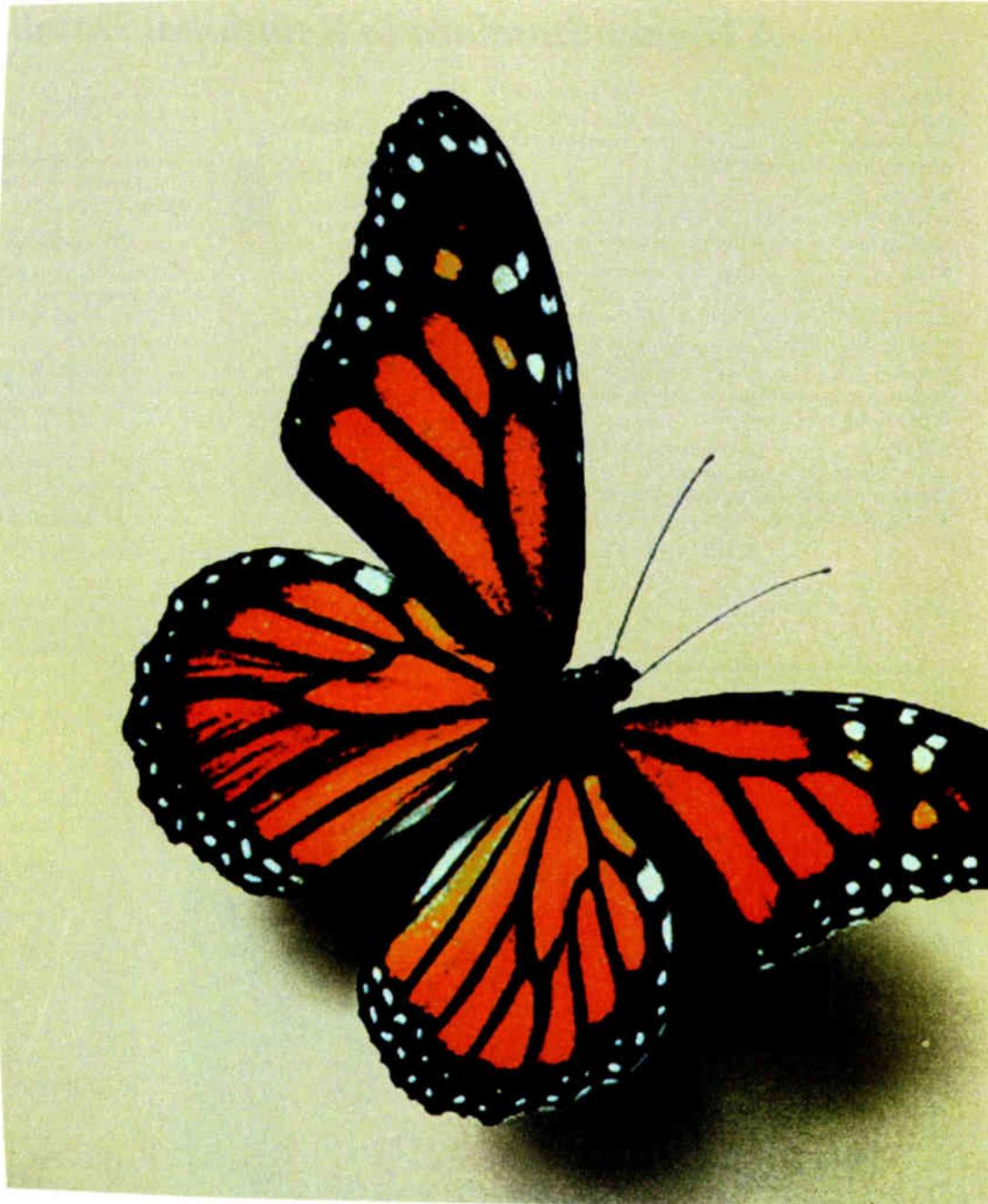
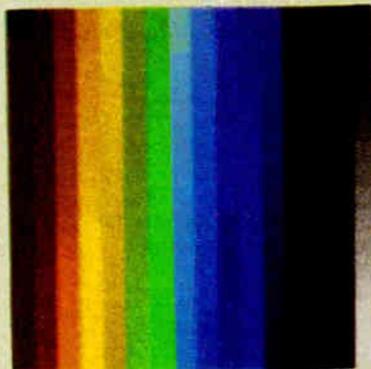


Image created on the Samsung VGA-GraphicMaster™ color monitor using RIX Softworks, Inc. Software.
Unretouched photograph. © 1989, Samsung Information Systems America, Inc.

cost 20% more.



The Monarch butterfly is one of Mother Nature's most splendid creations.

And as you can see, Samsung's new high resolution VGA color monitor vividly brings to life its rich colors and striking contrasts.

Capable of displaying an unlimited palette of colors, the VGA-Graphic Master's™ 14-inch screen with 640 x 480 resolution creates images of superb quality. The tight .31mm dot pitch keeps everything from graphics to type super-clear and razor sharp.

Add to that convenient, up-front controls, a non-glare screen and tilt-swivel base for comfortable viewing, and you've got an array of features that add up to a monitor costing hundreds more.

But this, of course, should come as no surprise. Because along with outstanding performance, Samsung has for years enjoyed a reputation for unmatched value and reliability. All of which have gone a long way toward making Samsung the world's largest monitor maker, with over 8 million units sold.

So if you're looking for high performance, for a lot less, take a good look at Samsung.

For literature or the name of your nearest Samsung distributor, call 1-800-446-0262.



 **SAMSUNG**

Circle 250 on Reader Service Card
(DEALERS: 251)

NANOBYTES

The Soviet software industry isn't much of an industry just yet, according to Alexey Pajitnov, developer of the popular Tetris computer game and probably the USSR's most famous programmer. "We have practically no software products, only programs. We have a very small number of computers, and usually we use them only for scientific or research applications," he said during a recent tour of the U.S. to promote his new game, Welltris (distributed by Spectrum Holobyte). Soviet programmers work "in the same style" as Western ones, Pajitnov said. As for computers in the Soviet Union, Pajitnov doesn't expect to see a PC on every desktop in the near future. He said that his country has "a lot of serious problems" like food shortages and civil unrest that need greater attention.

Meanwhile, ComputerLand is opening the first computer store in the Soviet Union. The new Moscow franchise will sell systems from IBM, Compaq, AST, Epson, and Hewlett-Packard. The store will not sell Macintoshes yet because Apple is currently developing a Cyrillic keyboard for the Russian market, according to ComputerLand spokesperson Brian Okun. The Moscow store will be owned by Michael Tseytin, a Russian immigrant who owns ComputerLand franchises in Secaucus, New Jersey, and Dresher, Pennsylvania.

Are you lonesome tonight? UUNET Communications (Falls Church, VA), an independent company directly connecting 130 Unix sites around the world, has started a telephone-based service through a 900 number. At a rate of 40 cents per minute (telephone toll charges included), users of the 900 number can send E-mail to any machine in the worldwide network of some 100,000 computers and can also pull public files off the UUNET machine, which is the repository for most free Unix software, including the source code for the X Window System from MIT and GNU compilers and editors.

Each layer is designed to operate with the others, yet remain independent.

Another prominent proposal comes from Sun Microsystems and involves Sun's Network File System, which is a standard of sorts in the Unix world and is more mature than most of the components in the Decorum model.

Even though Sun is an industry rival of the OSF, the group has shown a remarkable ability to cut through politics and meld technologies from competing companies. A decision on the distributed computing environment could come this month.

—Stan Miastkowski

Ethernet-on-a-Chip Will Save PCs a Slot

Turning an IBM PC or compatible into an "Ethernet-ready" system usually involves plugging a network card into a valuable expansion slot. But now U.S. Sage (Longwood, FL) has developed a chip that incorporates most Ethernet hardware functions. The company hopes that PC makers will use the Ethernet Needing Zero Overhead (ENZO) chip on their motherboards.

ENZO combines most of the Ethernet hardware functions on a single chip, according to U.S. Sage president Alex DuBrow. The LAN controller and Manchester encoding/decoding functions, which often require two chips on Ethernet boards, are included in the chip. ENZO is compatible with the IEEE 802.3

Ethernet network standard and supports both Novell's NetWare and U.S. Sage's MiniLan operating systems, the company says.

Building an Ethernet-ready motherboard really isn't a new concept (witness the NeXT Computer). But it's an idea that hasn't been exploited by manufacturers of IBM compatibles. DuBrow thinks that PC makers (and, in turn, users) can benefit from the LAN-on-a-chip technology; ENZO sells for only \$10 to \$25 (in OEM quantities), and it frees up a slot. DuBrow claims that U.S. Sage has received "strong inquiries" about ENZO and has sent out about a dozen evaluation kits, some to PC manufacturers.

—Jeffrey Bertolucci

Mike Will Replace Mouse, Apple Exec Says

The "ask and tell" interface will eventually replace the mouse and keyboard for many applications, and the microphone will play an important role in this new interface, says Apple Computer vice president of advanced technology Lawrence Tesler.

Newer, more advanced personal computer applications will require better interfaces, including speech input. "When you're not sure about something, you'll be able to ask, and when your system has some advice about how you can do something better, it will tell you," Tesler says.

Interacting with your personal

computer will change to "more of a dialogue, like what you might have with a colleague or assistant," he says. The microphone will become a standard feature of personal computers as speech input technology improves.

Apple says that's two or three years away. "It's pretty easy now to do single-speaker, limited-vocabulary recognition," says marketing director Michael Homer. "It's a lot more difficult to do a larger vocabulary—say, 2000 words of connected speech—where the system isn't trained to the particular speaker."

—Jeffrey Bertolucci

SEND US YOUR MICROBYTES. *Neural networks? Groupware? New laptop technology? New chips? If you, your company, or your research group is working on one of these exciting technologies or developing products that will significantly affect microcomputers and the way people work with them, please let us know. Phone us at (603) 924-9281. Or send a fax to (603) 924-2550. Or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. Or send E-mail to "microbytes" on BIX or to "BYTE" on MCI Mail. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.*

NOW YOUR SOFTWARE CAN TEST ITSELF.

NOW AVAILABLE IN
VGA

AND
PS2!!

Your customers expect software that works. All the time. The key to software quality is exhaustive testing. It's also an engineer's worst nightmare. But it doesn't have to be. Because now you can automate your software testing.

Introducing the Atron Evaluator. The first and only non-intrusive automated PC-based software testing tool.

The Atron Evaluator automatically runs your software regression testing programs. All of them. All day. All night. Giving you thoroughly tested, higher quality software.

The Atron Evaluator is hardware-based. And since it's non-intrusive, software behavior is tested without the risk of alteration. Once your tests have run, you can refer to automatically generated test reports to double-check test results.

The Atron Evaluator saves time. And time makes you money. Development cycles are shortened, so your software gets to market sooner. And while your test programs are running, you can be more productive. Start a new project. Or go home.

For more information about the Atron Evaluator, call us at 1-800-283-5933. And put an end to your worst nightmares. Automatically.

Circle 31 on Reader Service Card

Atron
A Division of CADRE Technologies

Saratoga Office Center
12950 Saratoga Avenue
Saratoga, California 95070

In Europe, contact:

Elverex Limited, Enterprise House
Plassey Technology Park, Limerick, Ireland
Phone: 061-338177

QA Training Limited, Cecily Hill Castle
Cirencester, Gloucestershire, GL7 2EF, England
Phone: (0285) 5888

Microsoft Word - SCHEDULE.DOC

File Edit View Format Window Help

Designer - P00001X.DWG

File Edit View Format Window Help

Daily Schedule

Thursday

08:30	Review Proposal with Tom
10:00	Finalize presentation
11:30	Lunch with Keith, Laura, Carl
2:30	Catch (Bill)
4:00	Scheduled arrival
4:45	Meeting with WWS Inc.

Microsoft Excel - 2451.XLS

File Edit Format View Window Help

Quarterly Sales



We've pulled the plug on 386SX technology.

The top of a desk is no longer the only place 386-based computing gets done. That's because we've come up with a battery-powered alternative that works anywhere.

It's known simply as the T3100SX.

First of all, we gave it a powerful 386SX processor. So it can handle multitasking operating environments like Windows 386 and OS/2 with ease.

Next, we devised an ingenious display system unlike anything you've ever seen on a battery-powered portable. It combines both VGA and gas plasma technology, boasts a 100:1 contrast ratio and can support both an internal display and an external monitor simultaneously.



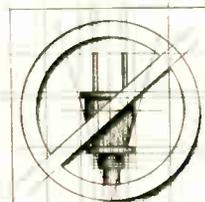
The T3100SX's slim case is only 3.15 inches thick and weighs just 14.9 pounds including its two standard batteries.

Finally, we gave it a 40MB hard disk, a 1.44MB 3.5" floppy disk drive and 1 megabyte of RAM, which you can expand up to 13MB. All in an easy-to-carry, 14.9-pound package that goes wherever your work is.

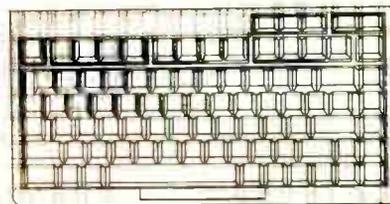
So now you can put the latest 386 computing power to work for you, even if there isn't a plug anywhere in sight.

The Toshiba T3100SX. Take it. See how far you can go.

T3100SX: 14.9 pounds, 16MHz 386SX with 80387SX math coprocessor socket; 40MB hard disk with 25msec access, two removable, rechargeable batteries; three dedicated Toshiba memory slots, one dedicated Toshiba modem slot, one Toshiba general purpose slot; 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales and 100:1 contrast ratio; 1.44MB 3 1/2" diskette drive. For more information call 1-800-457-7777.



Since the T3100SX is battery operated, you can utilize powerful 386 applications anywhere you choose.



The ergonomically-designed 86-key keyboard features eight dedicated cursor control keys, 12 function keys and a numeric keypad.

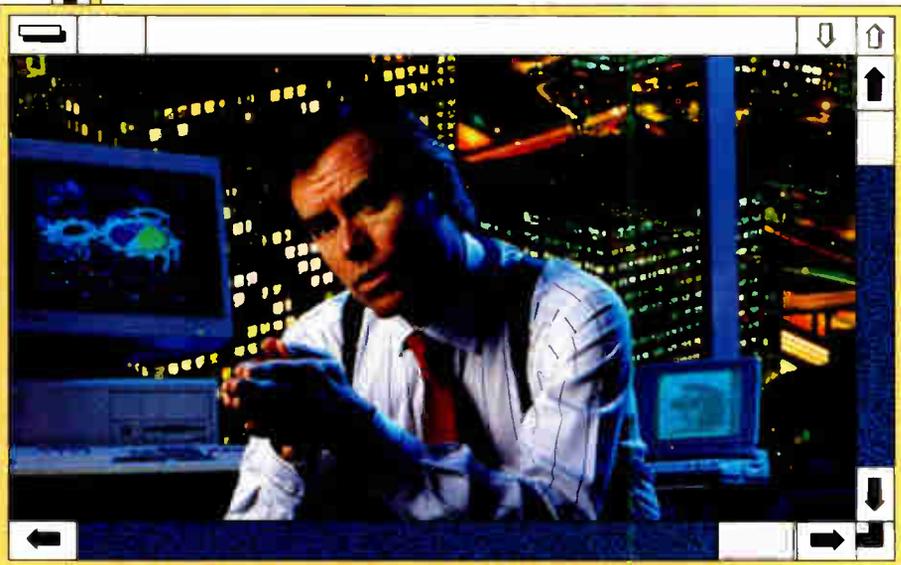
In Touch with Tomorrow
TOSHIBA

Toshiba America Information Systems Inc., Computer Systems Division

Circle 282 on Reader Service Card (DEALERS: 283)

"It's great to have a 386SX system that's ready for the future."

"And it's even more appealing when I can save \$200 right now."



ZENITH DATA SYSTEMS INNOVATES AGAIN™

The SX Appeal deal—\$200 instant savings on our Flat Technology Monitor when you buy our Z-386SX or SupersPort® SX.

SX Appeal™

Why does the Intel386SX™ microprocessor have so much appeal? It not only handles today's advanced applications, but assures compatibility with emerging software designed for graphical user interfaces—all with the affordability of a 286-based PC. And now for a limited time only, you can take advantage of our special *SX Appeal* deal.

Choose our Z-386 SX desktop PC that maximizes 386SX performance for ultra-fast processing speed. Or our SupersPort SX laptop PC with its *Page White* VGA display. Then for each system purchased, you'll receive \$200 savings on our award-winning Flat Technology Monitor—the revolutionary non-glare VGA color monitor with unsurpassed clarity that's the perfect match for graphical interfaces. This offer also applies to all our 386-based desktops and VGA laptops.

Just bring the attached \$200 Savings Certificate to your participating Zenith Data Systems Medallion Reseller before June 1, 1990. Additional certificates are available at each location. For the location nearest you, call:

1-800-227-4617

U.S. and Canada

**ZENITH
data systems**



Grøupe Bull



Graphics simulate Microsoft® Windows, a trademark of Microsoft Corp. Intel386 is a trademark of Intel Corp.

Circle 301 on Reader Service Card

World Radio History

© 1990 Zenith Data Systems



ASK BYTE

others in the In Depth section on sound and image processing very interesting. I once predicted that someday we'd reform our spelling in English to accommodate natural language processing (that prediction is as yet unfulfilled, of course). Now that commercial ASR systems require pauses between words, I suggest (but not predict) that we might change our manner of speech, pausing briefly between words, to accommodate ASR.

James L Wyatt, Chairman
Dept. of Modern Languages
and Linguistics
Florida State University
Tallahassee, FL

Helping the GUI User

If William Lee ("Heard It Through the Help Line," December 1989) thinks that giving customers advice over a help line is a nightmare with a textual interface, he should appreciate what I heard outside an office that had just installed Macs.

"Just a minute. I'll put you on the speakerphone. I can't balance a headset, type, and run the mouse at the same time!"

Voice on the phone: "Run the little mousey over the thing that looks like a praying mantis that got ironed in your shirt pocket. Go clicky, clicky. Did he turn into a new menu or that old flatiron thing again?"

"Neither. I think it's a shot glass."

"That's just wishful thinking. Could it be a wastebasket? One of those old wire ones?"

"What does a wire wastebasket look like?"

"Are you under 30? Did you ever see an old movie with a reporter's office? They always had one by the desk."

"Yeah, so what? Do you have to be over 40 to work this thing? It took me 15 minutes to figure out that the clockface wasn't a pie. I own a digital watch, like everyone else. Now I gotta know all about old movies to recognize these stupid pictures!"

"Go clicky, clicky on the shot glass and tell me if it turned back into the flatiron thing. If not, look for a real shot glass after work."

Joe Celko
Los Angeles, CA

You're Welcome

Thanks for starting David Fiedler's Unix /bin column. With Unix coming into play more and more in the workplace, it's a much-needed, gentle introduction to the subject. Keep it up.

Louis M. Pecora
Washington, DC

Too Much Protection

I am trying to run a program that I received with my Penman plotter almost two years ago, but a special security feature built into it has prevented me from doing so.

The name of the program is PENPLOT.EXE. The documentation failed to mention that I could make only one backup copy. It was clear, however, that the program had to be executed on the original disk. In the process of trying to redeem the situation, I also overwrote the original file (or else it automatically locked itself when I made a second backup copy).

Having looked at the executable file with my PCTOOLS file editor, I know that it is an unpublished work by the Vault Corp. I have been unable to find an address for the company, and Penman has gone out of business. Is it possible for me to defeat the backup security? It displays "Unauthorized Duplicate" any time I run Penplot on the original disk or either of the backups.

Larry D. Elliott
Moscow, ID

You're not the first person to have this problem, and I doubt that you'll be the last. Yes, it's possible to defeat the copy protection on your software, but making pirated copies of software is illegal and a practice that we at BYTE disapprove of. But with Vault's copy protection, it is often unnecessary.

Vault's scheme uses a physical mark on the floppy disk. You can reformat the disk, copy your software back onto it (from your backup), and the disk should be as good as new.

For obvious reasons, I won't tell you how to break Vault's scheme here, but I can tell you that several software utilities are available that will make copies of your disks. Before you spend your money, I suggest that you contact Vault's technical-support department (505 West Olive Ave., Suite 330, Sunnyvale, CA 94086, (408) 737-8474). The people there are very nice, and as long as you're holding a legitimate copy of the software, I'm sure that they'll be glad to help you out.

—H. E.

The Educated Computer

I am studying educational administration, and the theme for my upcoming thesis is "Computer-Assisted and Support Instruction—Its Planning, Implementa-

tion, and Evaluation." Could you suggest any source of information on this topic (including any computer software that is available)?

Oralia Eugenia Machuca Vaca
Mexico City, Mexico

First, I suggest that you explore your university library to see if it carries the Journal of Research on Computing in Education. If not, you may be able to obtain a subscription (either through your department or the library) by contacting the International Association for Computing in Education, 1230 17th Street NW, Washington, DC 20036.

As far as software goes, the public domain world is filled with educational and educational-support (which I take to mean record-keeping, student tracking, and so on) software. Try the Buyer's Mart at the back of BYTE and order a few catalogs.

Finally, here is a list of some books you can look for that describe specific instances of using computers in upper-level courses: APL Programs for the Mathematics Classroom by Norman Thompson (Springer-Verlag, New York, 1989); Calculus and the Computer by William F. Oberle (Addison-Wesley, Reading, MA, 1986); and Using Computers in Physics by John R. Merrill (Houghton Mifflin, Boston, MA, 1976).—R. G.

Speaking of Speech Recognition

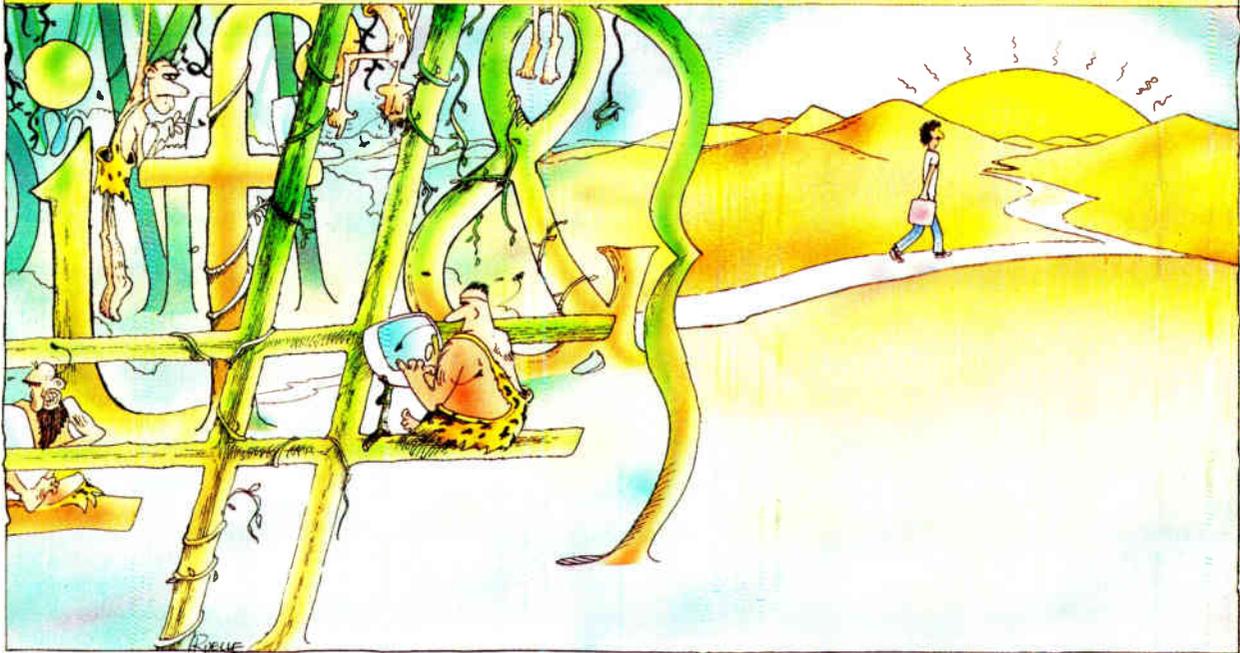
In the December 1989 Ask BYTE, David R. Brammer wrote asking about speech recording and playback hardware for the PC. Shortly afterward, we received a press release describing SoftSpeak, a software product from Quantech Ltd. SoftSpeak allows a 10-MHz PC (or any AT or PS/2) to produce speech through the standard speaker; no additional hardware is required. Mr. Brammer, if you're reading this, contact Quantech Ltd., 2a West View, Forest Hall, Tyne & Wear, NE12 0LJ, UK, 091-266-7007.

—Lab Staff

FIXES

- The mapping algorithm shown in "Configuring Parallel Programs" (December 1989) was developed by Shahid H. Bokhari for the Finite Element Machine, which was an early microprocessor array at the NASA Langley Research Center.
- The correct telephone number for Zenith Data Systems ("Zenith's EISA Does It," February) is (800) 553-0331. ■

Great Moments in C-Programmer Evolution



Code-dweller emerges from the jungle

“It’s a jungle in there,” said the programmer looking at the code for the user interface of an application. “Every year it gets worse.”

Don’t despair. Finally, there is a way out. Vermont Views™ 2.0.

From Complexity to Simplicity

Vermont Views 2.0 replaces the complexities of interface coding with the simplicity of the Vermont Views Designer. This powerful interactive forms designer works in concert with our comprehensive library of over 550 functions to make interface development and management quicker and easier than ever before.

Development Will Never Be the Same Again

With the Vermont Views Designer you will quickly create operational prototypes of an application interface—and enjoy doing it! Because design is fast and visual, you will involve your clients actively from the beginning. Last-minute change requests will be accepted without battles or escalating costs.

No longer will you throw away months of

prototype code—the prototype will become the implementation. And, integration and final

testing will go faster, because all Designer objects are tested for validity as they are created.



No More Maintenance Blues

Software maintenance typically accounts for over 50 percent of total lifecycle programming effort—and a higher percentage of headaches. With the Vermont Views Designer, you will always be able to revise the interface quickly and easily, seeing the changes as you make them.

The Vermont Views Difference

Screen generators for most C libraries require you to modify generated source code to create fully functional forms—after which you can no longer use the screen generator. Not so with the Vermont Views Designer. Designer forms and menus can incorporate any of the special capabilities of Vermont Views—such as nested menus, scroll bars, tickertape fields, scrollable form regions, choice lists, and memo fields—and still be revised interactively.

Message from the Jungle

“At a recent field staff meeting, we were able to get a consensus on what forms should look like by using the Designer on a big screen TV. Changes can be posted real-time, and a functioning prototype results from the exercise. The form designer is GREAT.”

—Randy Jones, Beta Tester

Globally Applicable

Use Vermont Views with any database or file manager with a C-language interface, such as Oracle, Informix, dBase, Clipper, dbVista, Btrieve, and C-tree. Maintain the same interface with the same source code under DOS, OS/2, UNIX, XENIX, and VMS.

Create interfaces for any roman-based language. Truly a global solution for your interface needs.

100% No-Risk Guarantee

We believe in our product. Try Vermont Views for as long as you want.

No limits. If not fully satisfied, return for a full refund.



Free Test Drive

Call now for a free DOS working copy of the Designer, lacking only the ability to save forms. Get out of that jungle!

Call 800-848-1248

Fax 802-848-3502



Vermont
Creative
Software

Pinnacle Meadows, Richford, VT 05476
Phone: 802-848-7731 Telex: 510-601-4160

WHAT'S NEW

HARDWARE • SYSTEMS

A 386SX for Less Than \$1000

The generically named 80386SX from Acma Computers includes a 16-MHz CPU, 1 MB of RAM (expandable to 8 MB), an American Megatrends BIOS, a 5¼-inch 1.2-MB or 3½-inch 1.44-MB floppy disk drive, a floppy/hard disk drive controller, and five 16-bit and two 8-bit expansion slots.

The chassis is either the small-footprint or standard AT size, respectively measuring 6½ by 17 by 16½ inches and 6½ by 21 by 16½ inches. The small-footprint version can hold one 3½-inch and three 5¼-inch half-height floppy disk drives. The standard-size system has room for five half-height 5¼-inch drives.

The VGA Executive Package includes color VGA graphics necessities, a printer, and printer accessories. Inside the computer, Acma supplies a 40-MB 28-ms hard disk drive and a 16-bit color VGA card. The package also includes a color VGA monitor and a Panasonic 1191 printer. Printer accessories include a cable, a stand, a surge protector, 10 disks, and computer paper.

Price: \$995; VGA Executive Package, \$2245.

Contact: Acma Computers, Inc., 117 Fourier Ave., Fremont, CA 94539, (800) 666-8898 or (415) 623-1212.

Inquiry 1121.

386SX Portables Come with Cellular Phones

Intelligence Technology has introduced two 386SX-based portables with removable cellular telephones that you can use for voice communication or for 2400-bps



Acma's 80386SX has all the basics and is expandable.

data communications.

The ITC 386 CEL and XCEL (for extra-lightweight cellular) systems both feature a built-in keyboard and monochrome VGA display, an MNP modem, and standard I/O ports. Power on both models comes from a removable 7.2-V rechargeable battery pack or any 12-V connection.

Weighing 9½ pounds (with telephone), the XCEL has 2 MB of RAM and a 20-MB hard disk drive. It measures 2½ by 12 by 11¾ inches.

The 15-pound (with telephone) CEL offers 4 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, a 40-MB hard disk drive, one 16-bit expansion slot, a full-size keyboard with a numeric keypad, and a built-in speakerphone. It measures 3½ by 13 by 12⅞ inches.

Price: XCEL, \$7495; CEL, \$8695.

Contact: Intelligence Technology Corp., 16526 Westgrove, Dallas, TX 75248, (800) 356-3493 or (214) 250-4277.

Inquiry 1122.

Inexpensive Desktops and a Laptop

Emerson Computer has introduced three inexpensive ATs: two desktops and a laptop.

The 8200 is a 12.5-MHz 286 small-footprint desktop system. It has 640K bytes of RAM (expandable to 4 MB on

the motherboard), five 16-bit full-length slots, a CGA controller, two 3½-inch disk drive bays (one internal), an Integrated Drive Electronics (IDE) hard disk drive controller, a 101-key keyboard, a 5¼-inch 1.2-MB floppy disk drive, and bundled software.

The 16-MHz 826ECV desktop ups the ante with 1 MB of RAM and a VGA controller but has only three full-length expansion slots.

The 550LTV laptop has a 12-MHz 286 CPU, a monochrome VGA controller, a 10-inch backlit VGA monitor, 1 MB of RAM (expandable to 4 MB), a socket for an 80287 math coprocessor, a 3½-inch 1.44-MB floppy disk drive, and a 20- or 40-MB hard disk drive. The laptop weighs 14 pounds without the hard disk drive but with the battery (which is good for 3 hours between charges).

Price: 8200, \$1349; 8200 with 20-MB hard disk drive, \$1669; 8286ECV, \$1699; 550LTV with 20-MB drive, \$2499; 550LTV with 40-MB drive, \$2699.

Contact: Emerson Computer Corp., 5500 East Slauson Ave., Commerce, CA 90040, (213) 722-9800.

Inquiry 1120.



Cellular phones let you talk from your ITC laptops.

The Shape of Monitors to Come

The Finlux ELM 640.350 is a compact flat-panel monitor that gives you yellow-on-black EGA (640-by-350-pixel) graphics and three levels of gray with electroluminescent display technology.

The ELM weighs only 3 pounds, measures 9½ by 7⅞ by 2½ inches (with a display area of 4½ by 7⅞ inches), and has a movable arm and table stand. Finlux says that the monitor emits no magnetic or electrical radiation and that it uses only 25 W, which is about one-fourth the power consumption of a normal CRT.

Price: \$1595.

Contact: Finlux, Inc., 20395 Pacifica Dr., Suite 190, Cupertino, CA 95014, (408) 725-1972.

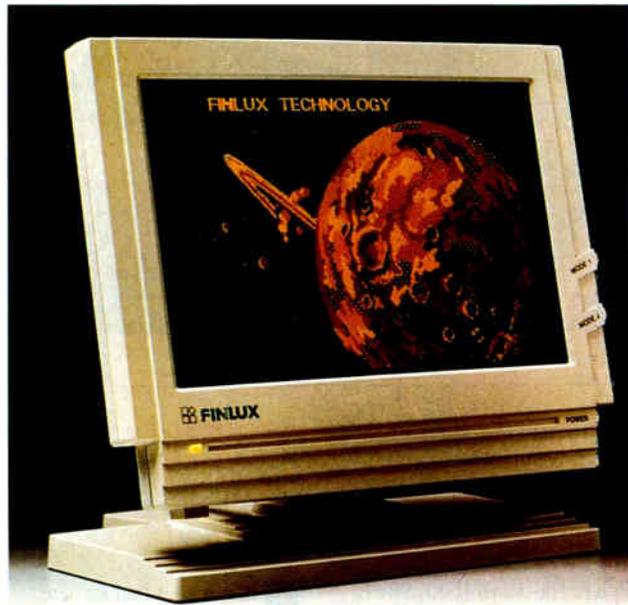
Inquiry 1128.

Two-Page Display for a Mac or PC

The Radius TPD/21 is a high-resolution 21-inch two-page monochrome/gray-scale display system for your PC compatible or Mac SE, SE/30, or II.

The flat-screen monitor features a maximum Macintosh resolution of 1152 by 882 pixels (effectively, 74 dpi) and a 71-Hz refresh rate. If you're using a PC, the refresh rate is 65 Hz and resolution is 1280 by 960 pixels.

Included in the price of the monitor is RadiusWare software for menus and drivers for DOS applications and for VGA-compatible applica-



The Finlux ELM 640.350 monitor has a movable arm and table stand.

tions. The video-controller card is optional.

Price: \$1795; TPD/PC controller, \$795; TPD/Mac controller, \$595; GS/C controller for Mac II, \$1895.

Contact: Radius, Inc., 1710 Fortune Dr., San Jose, CA 95131, (408) 434-1010.

Inquiry 1127.

Epson's New Wide-Carriage 24-pin Printer

The LQ-1010 is an inexpensive 24-pin letter-quality printer with a carriage wide enough for 136-column printing.

Features include print speeds of 180 cps in draft

mode and 60 cps in letter-quality mode, bidirectional printing in text mode, a slot for optional font modules, an 8K-byte buffer, built-in push-tractor feed, and automatic single-sheet loading. There's also a SmartPark paper-handling feature and 360-by-360-dpi graphics resolution.

Standard equipment also includes five resident fonts, four print speeds, and six character sets. The printer has a parallel interface, measures 5½ by 23½ by 13½ inches, and weighs 18 pounds.

Price: \$699.

Contact: Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505, (800) 922-8911.

Inquiry 1129.

SEND US YOUR NEW PRODUCT RELEASE

We'd like to consider your product for publication. Send us full information, including price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE has not formally reviewed each product mentioned. These items, along with additional new product announcements, are posted regularly on BIX in the microbytes.sw and microbytes.hw conferences.

Mondo Storage for Unix Fans

The MO Floppy drive for Unix systems features rewritable and removable 640-MB magneto-optic cartridges and is implemented on The Santa Cruz Operation's Unix 386/V operating system.

MO Floppy is based on Sony's SMO-S501 magneto-optic drive. You plug it into the host system via the included 1542A 16-bit SCSI controller by Adaptec.

Each MO Floppy includes a SCSI driver and operating software. The user interface has commands for formatting new cartridges and for copying files.

Price: \$7999.

Contact: Software Horizons, Inc., 501 McDonald Rd., Aptos, CA 95003, (408) 684-1375.

Inquiry 1130.

This Keyboard Is Designed for 3270 Applications

The 122-key KB 3270 Plus keyboard from Key Tronic has an 8K-byte RAM chip for IBM 3270 terminal emulation. It's plug-compatible with PCs, and an adapter is available for PS/2s.

Two main features are ScanEdit and ScanLoad, with which you can reprogram all 122 keys. Supported applications include Attachmate, Attachmate Extra, IBM 3270 Workstation, IBM 3270 Emulation, IRMA, IRMA/2, IRMAX Multisessions, Novell NetWare 3270, and PCOX.

Price: \$349.

Contact: Key Tronic, P.O. Box 14687, Spokane, WA 99214, (509) 928-8000.

Inquiry 1131.

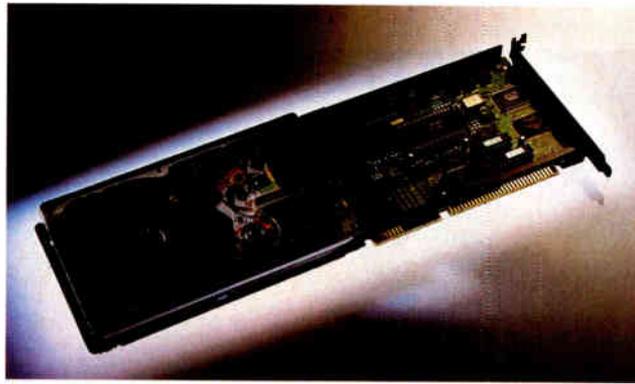
continued

Plus Development's Hardcard II Features 64K-byte Cache

Plus Development has announced a revamped version of its hard-disk-on-a-card product, Hardcard. The company says that the Hardcard II offers better performance but is designed to work only with 286- and 386-based systems.

Hardcard II comes in two models: the Hardcard II 80 and the Hardcard II 40, holding 80 and 40 MB of data, respectively. Both cards are full-length, single-slot cards that do not obscure other slots.

Both cards use 3½-inch hard disk drives and integrate a full 16-bit drive controller on the card. In addition, both use 1-to-1 interleaving and have an on-board 64K-byte cache to give them an effective access time of 19 ms, according to the company.



Each Hardcard II features a hard disk drive.

Hardcard II also features Plus Development's firmware to transparently trap bad sector information and map data elsewhere on the disk to minimize data loss.

Price: Hardcard II 40, \$849; Hardcard II 80, \$999; the company has also reduced prices of the original Hardcards to \$749 (20-MB model) and \$849 (40-MB model).

Contact: Plus Development Corp., 1778 McCarthy Blvd., Milpitas, CA 95035, (408) 434-6900.

Inquiry 1132.

Controller Doubles Your Hard Disk Capacity

Perstor says that its new ADRC-9008 hard disk drive controller, a half-length 8-bit card, almost doubles the capacity of modified frequency modulation (MFM) hard disk drives and significantly increases the capacity of run length limited (RLL) drives.

To achieve such dramatic

increases in capacity, the controller writes to 32 sectors per track (MFM usually uses 18 sectors, and RLL, 26). To keep errors from occurring more often, Perstor uses a proprietary 56-bit error-correction code that doesn't increase flex reversals.

The ADRC-9008 supports two hard disk drives. Any ST506/ST412 drive type with up to 1024 cylinders and 15 heads will work. For installation, Perstor provides a BIOS-resident autoconfigure setup and low-level formatting program.

The controller supports variable interleaving and operates at 9 Mbps. It has an 8-bit bidirectional bus-host interface but will operate in 286 and 386 systems.

Price: \$199.

Contact: Perstor Systems, Inc., 1335 South Park Lane, Tempe, AZ 85281, (602) 894-3494.

Inquiry 1133.

continued

Input and Manipulate Motion Video in Windows

You can now inexpensively input and manipulate full-motion video with your AT in Windows on your standard VGA monitor.

The DVA-4000/ISA works with today's analog technologies, such as videodisk, satellite feed, off-air TV, and video camera, and with digital storage technologies such as Digital Video Interactive (DVI), CD-I, and CD-ROM/XA.

The manipulation of these images requires a wider data path than is available on XT and AT computers. So VideoLogic designed the 32-bit Video Logic Media Bus, which can potentially support daughterboards.

Features of the ISA board include display at 30 frames per second (or, for PAL, 25

frames per second); software-controllable picture content (e.g., hue, saturation, contrast, and brightness); video, audio, and graphics mixing; image capture on magnetic or optical media; two switchable input sources; video windowing, scaling, and positioning; pictures within pictures; and multiple live video windows.

Price: For ISA or Micro Channel, \$2495.

Contact: VideoLogic, Inc., 245 First St., Cambridge, MA 02142, (617) 494-0530.

Inquiry 1134.

VideoWindows now integrates full-motion frame grabbing and VGA graphics overlay in Microsoft Windows and HP New-Wave environments, accord-

ing to New Media Graphics.

The AT-compatible board with an 80188 microprocessor continuously digitizes NTSC or PAL video signals in a frame buffer, which you can manipulate or position anywhere on the screen in real time. The full-motion (or still-frame) image that results is then converted back to an analog signal, decoded in RGB, combined with VGA or EGA graphics, and then displayed on your noninterlaced 60-Hz RGB monitor. You can also store images on a disk to be manipulated or displayed later.

Features include overlay with VGA graphics, in any proportion of graphics or video; automatically locking onto VGA with up to 256 colors at 640 by 480 pixels; zoom functions from 65 per-

cent to 200 percent; image compression to one-fourth and one-sixteenth of the screen; image storing in VideoWindows, PCX, or TARGA file formats; cutting and pasting portions of video into graphics screens; panning horizontally and vertically and fading in and out; programmable picture attributes like hue, saturation, intensity, comb filter, coring, and sharpness; and up to two simultaneous inputs (from broadcast TV, videotape, videodisk, still video camera, live video camera, cable, and satellite).

Price: \$1795; Microsoft Windows driver, \$195.

Contact: New Media Graphics, 780 Boston Rd., Billerica, MA 01821, (508) 663-0666.

Inquiry 1135.

DBMS Case Study:

The Exxon Valdez Disaster



March 24, 1989. Exxon VALDEZ tanker runs aground, creating the worst oil spill in U.S. history. 11,000,000 gallons contaminate the pristine waters of Alaska's Prince William Sound.

The Problem

Major disasters, like the Exxon Valdez spill, require quick response based on careful data analysis. Fortunately, an easy-to-use database was already being created which would help.

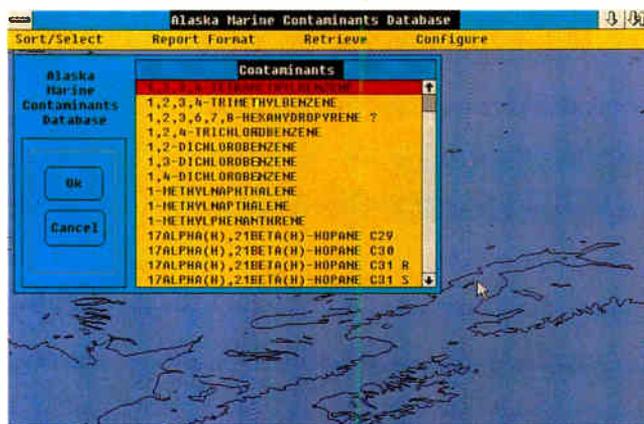
The Application

The Alaskan Marine Contaminants

Database lets oceanographic chemists easily access 60 megabytes of data covering the past decade. The database is provided free of charge on CD-ROM, and the Windows interface means they can get right to work, assessing damage to the ecosystems of Prince William Sound and other Alaskan waters.

The Solution

db_VISTA III is the only DBMS with the features this project required: C language support, Windows compatibility, royalty-free runtime distribution, quick performance in large databases, quality documentation and support. With the Alaskan Marine Contaminants Database, the difficult job of calculating the long-term effects of the Exxon spill is a little easier.*



A Microsoft Windows front end lets chemists select regions from a map to retrieve data. And, db_VISTA III's SQL-based query and report writer lets users perform complex SQL data searches.

Your DBMS problems may not make the headlines, but they are no less important and often no less challenging. If you develop applications for MS-DOS, MS Windows, UNIX, VMS, QNX, OS/2, Macintosh, and other environments, db_VISTA III is your solution.

Call 1-800-db-RAIMA (1-800-327-2462)

* Reprints of the story, as published in PC Week and Data Based Advisor, are available from Raima.

db_VISTA III™

Database Management System

Specifications: Complete C source code available. No Royalties
C Language Portability & High performance

Network Data Model. Relational B-tree indexing. Relational SQL query and report writer. Single & Multi-user. Automatic recovery. Built-in referential integrity. Complete revision capability. Supports: MS-DOS, MS Windows, UNIX, QNX, SunOS, XENIX, VMS, Macintosh. OS/2 compatible. Most C Compilers supported. LANs: 3COM, Novell, Banyan, Appleshare. Call for other environments.

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA (206)747-5570 Telex: 6503018237 MCI U/W FAX: (206)747-1991
International Distributors: U.K.: (0992) 500919 Germany: 07127/5244 Switzerland: (01)725 0410 Netherlands: (02159)46 814 Sweden: (013)124780 Italy: 045/584711 Norway: (02)44 88 55
Denmark: 2887249 U.S.S.R.: (812) 292-1965, (0132) 35-99-08 Australia: 02 419 7177 Japan: (03)473 7432 Taiwan: (02)511 3277 Mexico: (83) 57 35 94 Central America: 506 28 07 64
Argentina: 1 313 5371 Chile: 2 696 4308 Uruguay: 2 92 0959 Copyright Raima Corporation © 1990

Power Tools For C Programmers

RAIMA™
CORPORATION

db_VISTA III DBMS rated number #1

For Performance and Flexibility of DBMS Programming Tools-
PCWEEK Poll of Corporate Satisfaction, August 28, 1989.

Circle 243 on Reader Service Card

FOR \$1899, YOU CAN GET A LOT OF COMPUTERS.



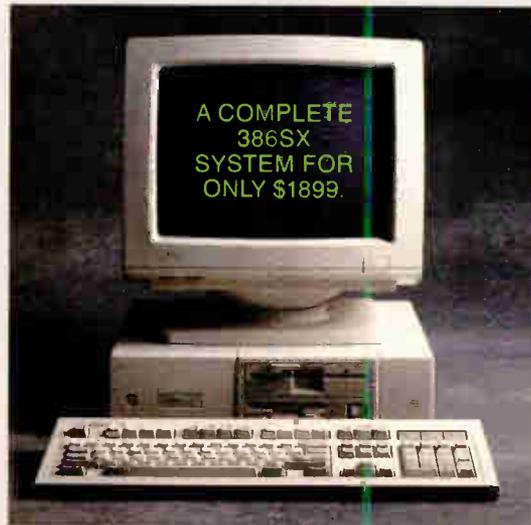
© 1995 Dell Computer Corporation. All rights reserved. "Dell" is a service mark of Dell Computer Corporation. "Dell" is a registered trademark of Dell Computer Corporation. "386" is a trademark of Intel Corporation. Other trademarks and trade names are used in this advertisement to refer to the entities claiming the marks and names of their products. Dell Computer Corporation does not claim any proprietary interest in trademarks or trade names of other companies other than its own. For information and a copy of Dell's 30-day Total Satisfaction Guarantee and Limited Warranty, write to: Dell Computer Corporation, 9505 Arboretum Blvd., Austin, TX 78759. *On-site service may not be available in certain remote locations.

ADCODE 11ED0

OR A LOT OF COMPUTER.

OK. So you don't have the biggest budget in the world.
But that doesn't mean you have to think small.

Introducing the Dell System[®] 316SX, 16 MHz 386[™] SX.



Now you can get into 32-bit computing with this complete 20 MB system. Including 512 KB of RAM, a VGA Monochrome monitor, and three 16-bit industry standard expansion slots. With a 5¹/₄" or a 3¹/₂" diskette drive.

More important, it's built by Dell. The computer company rated number one for overall customer satisfaction in the last four *PC Week* polls of corporate volume buyers.

Over IBM. Over Compaq.

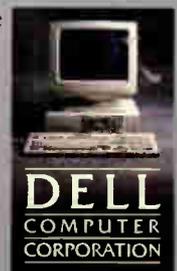
And every Dell System comes with a one-year warranty, toll-free technical support and next-day desk-side service provided by the Xerox Corporation.[^] So for \$1899, you don't have to buy a cookie cutter clone and go it alone.

Call Dell. You'll get a lot of computer.

With a lot of company.

800-283-1190

FOR NETWORK OR UNIX INFORMATION, 800-678-UNIX
For Dell in Canada, call 800-387-5752.



Circle 87 on Reader Service Card

A Mouse in Disguise

The MousePen is a Microsoft Mouse-compatible input device with two input buttons and ballistic control, yet you hold it like a pen and you don't need a mouse pad.

Inside the head of MousePen is a miniature mouse. The buttons are positioned for clicking with your index finger; the bottom button is the "point" or traditional "left" button. Resolution is 50 to 1000 dpi, and tracking speed is 18 inches per second. MousePen measures $\frac{7}{10}$ by $\frac{1}{2}$ by $\frac{6}{10}$ inches. Without the PS/2 cable or the serial cable for XT's and AT's, MousePen weighs 32 ounces.

Pop-up TSR menus for Lotus 1-2-3, dBASE III, and WordPerfect are included in the 10K- to 30K-byte main program. Also included is TelePaint, a color paint program with VGA support.

Price: \$129.

Contact: International Machine Control Systems, Inc., 1332 Vendels Cir., Paso Robles, CA 93446, (800) 448-1184 or (805) 239-8976.

Inquiry 1138.



The Microsoft Mouse-compatible MousePen offers you all the standard features.

Da Vinci Graphics Creates Penless Plotter

Da Vinci Graphics' new RasterPro 720 "penless plotter" looks much like a laser printer and operates eight to 10 times faster than conventional pen plotters. The RasterPro 720 uses a bidirectional print head and a four-color fabric ribbon.

Inside the plotter is a 68000 microprocessor and technology for converting vector-based plotter instructions to a raster printing format. Print resolution is 720 dpi, and the interfaces are parallel and serial.

The RasterPro 720 produces A-size (8½- by 11-inch) or B-size (11- by 17-inch) images. Unlike conventional plotters, the RasterPro 720 offers a high-speed draft mode at either 180 or 360 dpi in

color or monochrome.

The RasterPro 720 weighs 27 pounds and measures 4¾ by 22½ by 13¾ inches.

Price: With 512K bytes of RAM, \$3495; with 2 MB of RAM, \$3995.

Contact: Da Vinci Graphics, Inc., 870 Hermosa Dr., Sunnyvale, CA 94086, (408) 737-8800.

Inquiry 1137.

Measure Horizontal Frequencies on CRTs

Scan-Mate is a hand-held device that measures your monitor's horizontal frequency or the horizontal frequency of a video projector, using the magnetic fields that CRTs emit. It can measure monitors with screens as small as 9 inches or as big as 35 inches and display frequencies from 0 to 70 kHz. Power comes from a standard 9-V battery.

Price: \$250.

Contact: Inline, Inc., 625 South Palm St., La Habra, CA 90631, (800) 882-7117 or (213) 690-6767.

Inquiry 1142.

continued

Spoken to Your Spreadsheet Lately?

The Voice Master Key System II is a small external box that lets you add voice commands to DOS applications, thus replacing repetitive keystrokes or extensive mouse movements with macro voice commands. The interface is your parallel printer port, and there's a pass-through function that lets you keep your printer attached.

A TSR program is included that occupies about 64K bytes of RAM (or you can order an EMS version that requires only 6K bytes

of main memory). It's compatible with such programs as Lotus 1-2-3, AutoCAD, WordPerfect, dBASE III, and SideKick.

You teach it words by saying them twice and typing the prompt and the desired response. Other users can subsequently repeat the list of macros in their own voices and save additional voice templates to memory.

The program is divided into 16 levels, which can correspond to 16 different software packages. You can store up to 16 macros in each

level, with a macro as short as one keystroke or as long as 250. Any one of the maximum 64 voice commands can be assigned to activate a macro in any of the 16 levels, so a single voice command can have different meanings in different software applications, for example.

Other features include adjustments for recognition modes and sensitivities, testing sequences to adjust for background noise, display of your macros within applications, and recording and sending voice memos over

networks (with Voice Master Systems on each voice-memo workstation).

Also included is developer software for speech and sound recording and editing. Editing software lets you edit sounds for use in software programs or in external EPROMs. It allocates 64K bytes of RAM for input, variable to 576K bytes of RAM with data file links.

Price: \$219.95.

Contact: Covox, Inc., 675-D Conger St., Eugene, OR 97402, (503) 342-1271.

Inquiry 1140.

Get the latest Word from SCO.

Microsoft Word 5.0 for UNIX Systems.

You've come to depend on SCO™ for the latest UNIX® System software solutions for PCs. Industry standards such as SCO™ XENIX® 386 and SCO UNIX System V/386 Release 3.2. World-famous applications such as SCO Professional®, the 1-2-3® workalike, and SCO™ FoxBASE+™.

And now Microsoft® Word 5.0, the same full-featured word processing system that has defined power, speed and flexibility for MS-DOS® and OS/2™ users, is also available for SCO XENIX and UNIX Systems!

It's multiuser and multitasking. And it's ready to give you true workgroup benefits while maintaining keystroke and file compatibility with Word for MS-DOS and OS/2, preserving your investments in Word training and data.

With Microsoft Word 5.0 for UNIX Systems, you can share a single copy of Word — on a single PC — with an entire workgroup of 16, 32, or even more users on inexpensive terminals.

And your workgroup can share documents, style sheets, forms, macros, glossaries, and outlines — plus group review and editing features such as annotations and redlining — while sharing expensive

printers and other resources as well.

Of course, Microsoft Word 5.0 for UNIX Systems still gives you Word's advanced productivity features. Data, text, and graphics integrated in a single document. Text flow around graphics. Side-by-side columns. A vast array of fonts and sizes. Links to spreadsheets and other programs. Line and box drawing. Spell checker and thesaurus. Speedkeys. And a whole lot more.

And since it's compatible with SCO Portfolio™, Microsoft Word 5.0 for UNIX Systems supports the SCO Portfolio Clipboard, letting you copy and paste

data to and from other popular applications such as SCO Professional and SCO FoxBASE+.

Call ext. 8605 at SCO today for the SCO Authorized Reseller nearest you. And see for yourself that if you want your SCO XENIX or UNIX System running the best multiuser word processing available today, you'll have our Word on it.



Microsoft Word 5.0 joins SCO's powerful team of multiuser business applications.

SCO
THE SANTA CRUZ OPERATION

(800) SCO-UNIX (726-8649)
(408) 425-7222
FAX: (408) 458-4227
E-MAIL: ...!uunet!sco!info
info@sco.COM

SCO and SCO Portfolio are trademarks, and the SCO logo and SCO Professional are registered trademarks of The Santa Cruz Operation, Inc. UNIX is a registered trademark of AT&T in the U.S.A. and other countries. XENIX, Microsoft, and MS-DOS are registered trademarks of Microsoft Corporation. 1-2-3 is a registered trademark of Lotus Development Corporation. FoxBASE+ is a trademark of Fox Software, Inc. dBASE III PLUS is a trademark of Ashton-Tate. OS/2 is a registered trademark of International Business Machines Corporation.

© 1989 The Santa Cruz Operation, Inc. All Rights Reserved. The Santa Cruz Operation, Inc. 400 Encinal Street, P.O. Box 1900, Santa Cruz, California 95061 U.S.A. The Santa Cruz Operation, Ltd., Croxley Centre, Hatters Lane, Watford WD1 8YN, Great Britain. +44 (0) 923 816344, FAX: +44 (0) 923 817781. TELEX: 917372 SCOLON G

Circle 255 on Reader Service Card

Active Objects and Graphics Added to KBMS for OS/2

Two tools included in AICorp's new version of its Knowledge Base Management System (KBMS) for the OS/2 Presentation Manager let developers use graphics during the application development process and incorporate graphics in the resulting application.

Developer Graphics, a tool for designing, developing, and analyzing KBMS applications, has a graphical editor facility that lets you select an object, see the attributes defined for that object, and view the relationships among objects during the development process, AICorp says.

Active Objects lets you link rules with graphics, building knowledge-base applications with a graphical user interface. For example, you can use Active Objects to develop a course registration application in which users see a map of the U.S., click on a city where they want to take a course, and automatically register and update the underlying database, instead of filling out forms or using a text menu.

The Active Objects editor lets you choose shapes, colors, fonts, and other elements. You can also use bit-mapped images from other sources.

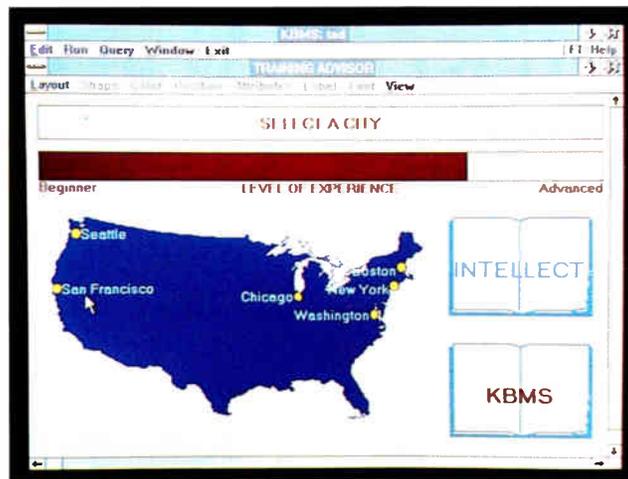
Price: \$7500.

Contact: AICorp, 100 Fifth Ave., Waltham, MA 02254, (617) 890-8400.

Inquiry 1143.

Better IPC for Unix, OS/2

XIPC (for Extended Interprocess Communications Facilities) is a software library designed to augment the interprocess communications



With AICorp's Active Objects, an expert system can display information graphically instead of relying on text only.

facilities of Unix, OS/2, and VMS. In the area of software engineering, XIPC supports on-line monitoring of all IPC activities of a live system, multiple views of the same system, interactive debugging, and browsing of message queues and shared memory of an active system. It also lets you configure and use multiple instances of XIPC without modifying the operating-system kernel, Momentum says.

The package adds a message queue facility that offers atomic multiple-queue operations by multiple processes, individual queue slicing, automatic overflow spooling, and many other functions.

XIPC provides for automatic portability of source code among operating systems, while supporting a superset of the functionality

of all supported operating systems.

The package will be available for OS/2, SCO Xenix, Unix System V, AIX, SunOS, Ultrix, and VAX/VMS.

Price: \$1495 and up.

Contact: Momentum Software Corp., 602 Fair Lawn Pkwy., Saddle Brook, NJ 07662, (201) 794-1462.

Inquiry 1146.

Spelling Checker for Programmers

SpellCode, a customizable spelling checker for programmers, can check both the text that end users will see and the contents of program files. SpellCode checks variable and constant names,

reducing the number of compiler or interpreter errors, says Geller Software.

SpellCode comes with an English dictionary and a dictionary of computer terms. The program knows the keywords used in dBASE languages and can check Ada, COBOL, PL/I, FORTRAN, and other languages. It can check the contents of character and memo fields in DBF data files or Lotus 1-2-3 worksheets.

SpellCode runs on the IBM PC with 256K bytes of RAM and DOS 2.0.

Price: \$99.95.

Contact: Geller Software Laboratories, Inc., 35 Stephen St., Montclair, NJ 07042, (201) 746-7402.

Inquiry 1144.

CUA Compliance for DOS

With Layout/CUA for DOS, a software development tool that works with Interactive Images' Easel/DOS graphical development tools, you can create applications that automatically comply with IBM's Common User Access guidelines. With Layout/CUA, you can add action bars and scroll bars, pull-down menus, and secondary windows to your DOS application.

Layout/CUA for DOS runs as an application under the OS/2 Presentation Manager. Once you've defined how the application will look, Layout/CUA automatically generates the necessary DOS code.

To run the system, you need an IBM PC with at least 640K bytes of RAM.

Price: \$1900; Easel/DOS Development System, \$7500.

Contact: Interactive Images, Inc., 600 West Cummings Park, Woburn, MA 01801, (617) 938-8440.

Inquiry 1147.

FORTRAN Subroutines for the Mac

IMSL has released three FORTRAN libraries for the Macintosh that provide more than 800 subroutines for solving mathematical problems, analyzing statistics, and special functions.

Features of the libraries include standard calling sequences, sophisticated error handling, and automatic allocation of workspace.

The libraries require a Mac II or SE/30 running Language Systems' FORTRAN compiler 1.2.1 and System 6.0.3.

Price: \$3250.

Contact: IMSL, 2500 Park-West Tower One, 2500 City-West Blvd., Houston, TX 77042, (800) 222-4675 or (713) 782-6060.

Inquiry 1145.

continued



Announcing the Sage Professional Editor - the editing environment for the 90's. The product of two years work by one of the most talented programming teams in the business. Right out of the box you'll be more productive with this editor than any you use today.

The instant installation, elegant mouse support, advanced user interface, and point-and-shoot help get you running immediately. If you prefer the commands and keystrokes of a popular editor, the turnkey emulations duplicate them precisely, and you still gain the Sage Professional Editor's advanced features, windowing capabilities and powerful engine.

Later you'll make this editor truly yours by configuring the interface as you prefer. Every feature can be turned on or off as you like - from a clean screen, to tiled windows, to overlapping windows in various colors,

pull-down menus, rulers, scroll bars, and line numbers - choose any or all and place them as you like.



*Works with or without a mouse.
Packaged with or without a Microsoft® Mouse.*

Announcing the Sage Professional Editor

Use the editor with or without a mouse - all functions are available without lifting your fingers from the keyboard.

Pop open the DOS window and the editor shrinks to just 4K. So you can back-task to compilers and other tools without leaving the editor.

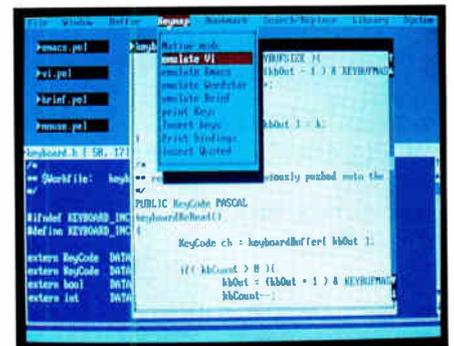
This package is stuffed with value. It includes MS-DOS, OS/2 and Dual Mode versions, templates for popular languages, and you can buy it with or without a bundled Microsoft® Mouse.

The core of the Sage Professional Editor is a powerhouse virtual memory system that allows you to edit huge files (up to 100MEG) in as many as 256 windows - over two billion lines. It makes maximum use of all available memory. All higher level services use this powerful VM scheme. Consequently, there are no size constraints on the macro library and no limit to Undo/Redo. You can have 1000 bookmarks, anchors and saved positions per buffer.

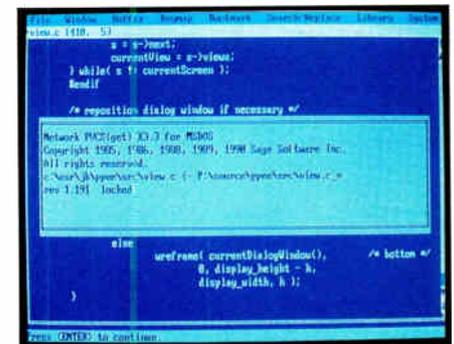
And then there's the extension language. The Sage Professional Editor uses a C-like extension language and compiler/ debugger that programmers find immediately intuitive. You can build the environment you want with the editor as the

front end to your favorite tools. The seamless integration of the Polytron Version Control System (PVCS) is a sterling example of how cleanly you can hook external programs.

Emulations of Vi, Brief, EMACS, and WordStar, were written with the extension language. The source code for emulation is included. Enter a new generation today by calling Programmer's Paradise.



Make our interface what you prefer, from clean screen to multi-window with drop-down menus and icons.



The editor environment provides seamless integration to the Polytron Version Control System (PVCS) or any other tool you care to connect.

	<u>List</u>	<u>Ours</u>
Single User Version	\$295	\$249
With a Microsoft Mouse	\$395	\$335
<i>Both packages include: MS-DOS, OS/2 and Dual Mode versions on 3 1/2" and 5 1/4" disks.</i>		

Circle 226 on Reader Service Card

1-800-445-7899
Programmer's Paradise



Service, Selection, Savings (800) 445-7899

Borland Spring Sale

	List	Ours
Paradox	725	479
Sidekick Plus	200	139
Turbo Assembler/Debugger	150	99
Turbo C 2.0	150	99
Turbo C Professional	250	159
Turbo Debugger & Tools	CALL	CALL
Turbo Pascal 5.5	150	99
Turbo Pascal Professional	250	169

LIST OURS

APPLICATION SOFTWARE

COMMUNICATIONS

BLAST	250	225
Carbon Copy Plus	199	129
DeskLink	170	129
Laplink III	150	99
PC Anywhere III	145	99
Procomm Plus	75	50
SideTalk	120	90

DESKTOP PUBLISHING

Adobe Illustrator	695	409
Corel Draw!	595	399
Gem Desktop Publisher	299	183
HALO DPE	195	139
Lattice HighStyle	375	319
MKS SQPS	495	479
PageMaker	795	509
Ventura Publisher	895	525

MATHEMATICS

Derive	200	179
MathCAD	495	315
Mathematica 386	695	625

SCIENCE & ENGINEERING

AutoCAD Release 10	3000	CALL
AutoSketch	150	95
ChiWriter	150	129
Control System Toolbox	495	375
CSS	495	469
DADISP	895	759
Design CAD 3-D	400	292
Drafix Windows CAD	695	CALL
EXACT	475	380
Generic CADD Level 3	300	179
LABTECH Acquire	195	179
LABTECH Chrom	995	779
LABTECH Notebook	995	779
MICRO-CAP III	1495	1269
Orcad PCB	1495	CALL
PC TEX	249	229
SCHEMA II+	495	449
STATGRAPHICS	895	586
Tango CAD Pack	995	949
Tango PCB Series II	595	559
TECH*GRAPH*PAD T ³	395	319
	595	479

UTILITIES

386 MAX	75	66
386 MAX Professional	129	115
above DISC	119	84
Command Plus	130	109
FASTBACK Plus	189	109
HeadRoom 2.0	130	109
Help Build	249	179
MACE GOLD	149	129
Magellan	139	99
Manifest 1.0	60	53
Memory Mate	70	47
MKS Toolkit	249	199
Move'em	89	79
Norton Commander	89	58
Norton Utilities	100	65
Norton Utilities Advanced	150	99
PC/Tools Deluxe	129	80
Pizazz Plus	149	79
QEMM/386	60	55
QRAM	80	69
SpinRite	89	69
XTreePro	129	109

PRODUCTS BY VENDOR

DIGITALK

Smalltalk/V	100	85
Communications	50	45
EGA/VGA Color Extension	50	45
Goodies #1, #2 or #3	50	45
Smalltalk/V 286	200	169
Smalltalk/V MAC	200	159
Smalltalk/V PM	495	395

LIST OURS

IGC	245	199
VM/386	895	819
VM/386 Multi-User	395	359
VM/386 Multi-User Starter	150	119

MICROSOFT

MS BASIC Prof. Devel. System	495	349
MS C	495	349
MS COBOL	900	629
MS FORTRAN	450	299
MS Macro Assembler	150	105
MS OS/2 Present. Mgr. Toolkit	500	349
MS OS/2 Softset	150	105
MS Pascal	300	209
MS Programmer's Library	395	275
MS QuickBASIC 4.5	99	69
MS QuickC 2.0	99	69
MS QuickC w/QuickAssembler	199	139
MS QuickPASCAL	99	69
MS Windows	99	69
MS Windows/386	195	139
MS Windows Development Kit	500	349
MS Word for Windows	495	349

MORTICE KERN SYSTEMS

MKS AWK	99	79
MKS LEX/YACC	249	197
MKS MAKE	149	119
MKS Programming Platform	665	599
MKS RCS	189	149
MKS Software Mgmt. Team	299	239
MKS SQPS	495	479
MKS Toolkit	249	197
MKS Trilogy	119	105
MKS Vi	149	125

POCKET SOFT

.RTLink	295	265
.RTLink PLUS	495	419

SAGE SOFTWARE/POLYTRON

C Beautifier	50	42
Dan Bricklin's Demo II Program	199	159
PFinish	295	259
Pfix86Plus	295	259
Plink86plus	495	395
PolyAWK	99	85
OS/2 Version	199	179
PolyBoost II	80	72
PolyDoc	199	169
PolyLibrarian	99	85
PolyLibrarian II	149	125
PolyMake 3.0	149	125
PolyShell	99	85
PolyXRef	99	85
Professional PVCS (Corporate)	495	419
w/ PolyMake for OS/2	695	589
PVCS/MAKE for OS/2	395	335

ZORTECH

Zortech C Video Course	300	269
Zortech C++ Compiler V2.0	200	165
w/ source	300	259
Zortech C++ Debugger V2.0	150	129
Zortech C++ Developer's Edition	450	399
Zortech C++ Tools V2.0	150	129
Zortech C++ Video Course	500	449

Programmer's Policies

Phone Orders

Hours 9 AM-7 PM EST. We accept MasterCard, Visa, American Express. Include \$4.00 per item for shipping and handling. All domestic shipments by UPS ground. Rush service available.

Mail Orders

POs by mail or fax are welcome. Please include phone number.

International Service

Phone number required with order. Call or fax for additional information.

Dealers and Corporate Accounts

Call for information.

Unbeatable Prices

We'll match nationally advertised prices. (Subject to same terms and conditions.)

Return Policy

30-day no-hassle return policy. Most manufacturer's products cannot be returned once disk seals are broken.

HELP/BUILD

An Automated Documentation System

HELP/BUILD is a complete help information and error screen generation tool. It allows you to develop any kind of pop-up help and error message system. You can create independent help systems which users call at the touch of a hot-key. You can link the help screens in any order to lead your users to the next information they should see. HELP/BUILD is menu driven and includes its own screen editor, optimizer, compiler, cross-reference generator and run module. Builds context sensitive help. Requires hard disk and 256K memory.



List: \$249
Ours: \$179

PACIFIC FIRMWARE MARKETING CORP.

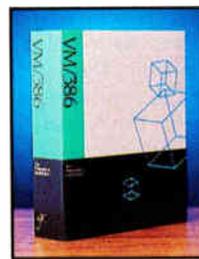
.RTLink/Plus

The only MS-DOS linker with CodeView support for multiple/nested overlays. Advanced technology allows more overlays, overlay areas, symbols, objects, classes, and sections than any other linker. Smart caching of most recently accessed overlay sections in conventional, expanded, and extended memory (new XMS specifications). Easy-to-use Profiler provides detailed performance statistics without source code modification. Run-Time Libraries (RTLs) speed development time and reduce disk space/modem-time requirements. Source code provided for overlay manager and Profiler's read-analysis utility. LIBLIST provides detailed information on inter-relationships between modules—great for optimizing and designing overlay schemes.

List: \$495 Ours: \$419

Pocket Soft Inc.

VM/386 & VM/386 NetPak



If you've ever had to wait for your computer to finish processing a task, you need VM/386. It lets you create lots of DOS sessions on your 386 PC, each running a different application on a full screen. All background sessions will continue to process whether you work in an application on your computer or go off to lunch. And with the addition of NetPak, each DOS session can interact with network files and peripherals. This is the only way you can multitask large programs without having to exit and re-enter the network.

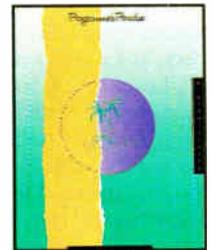


Make VM/386 & NetPak your choices for bullet-proof multitasking and easy network access.

VM/386: \$199
VM/386 NetPak: \$119 Together: \$299

The new
Programmer's Paradise[®]
catalogs have arrived!!

Call today for your
FREE copy.



International: 201-389-9228
Customer Service: 201-389-9229
Fax: 201-389-9227

New Corporate Phone #:
800-422-6507

Call or Write for Latest Free Catalog!

1-800-445-7899

Programmer's Paradise

A Division of Voyager Software Corp
1163 Shrewsbury Ave., Shrewsbury, NJ 07702

Circle 227 on Reader Service Card

Accounting with Database Orientation

A low-end accounting program called AXS (pronounced "access") Accounting Solutions features a database orientation that lets you work with accounting data interactively. The program's database structure lets you enter, edit, scroll, find, select, and take action on a data file, all from the same form, Computer Trends says.

When you write a check or make a deposit, you can use the payee, vendor, or customer name. If you're not sure of the exact name, you can enter the first few letters and scroll through the companies in the database that match.

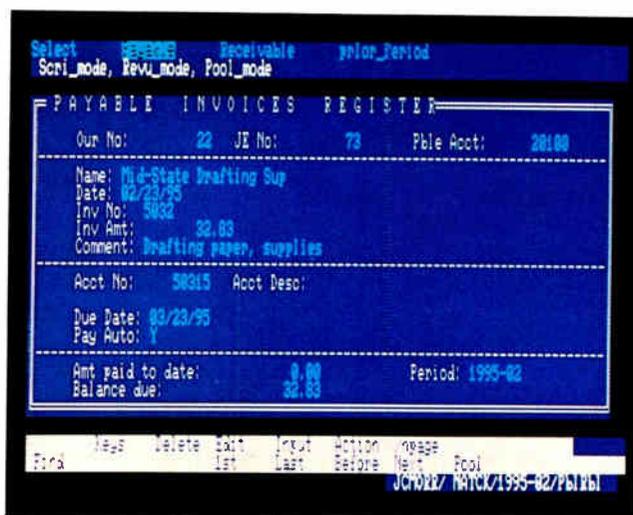
AXS updates reports as you enter transactions without requiring batching. The real-time system updates accounts instantly, so you can generate period-to-date financial statements at any time. You can also prepare activity reports (e.g., income statements, profit and loss statements, and balance sheets).

AXS Level 2 includes general ledger, accounts payable, accounts receivable, a check writer, and a mail manager. AXS Level 1 includes only general ledger (with a check-writing facility). AXS Accounting Solutions Level 2 version 2.0, scheduled for release this summer, will include payroll, inventory, job costing, and time billing modules. New features will include budgeting, comparative financial statements, exporting, and recurring transactions.

Price: Level 1, \$59.95; Level 2, \$139.95.

Contact: Computer Trends, 116 East Washington St., Ann Arbor, MI 48104, (800) 544-2597 or (313) 662-4430.

Inquiry 1148.



The AXS Accounting Solutions' database structure lets you perform a number of operations on a data file from the same form.

Four Accounting Modules for the Mac

Pro Plus Accounting consists of four modules that you can use as stand-alone programs or link to form an integrated system. The system features multiple-level password protection and can export reports in ASCII text, SYLK, and Excel format, its developer reports. The four modules are general ledger, accounts receivable, accounts payable, and inventory control.

To run the program, you need a Mac II or higher with a

hard disk drive.

Price: \$995; each module, \$350.

Contact: Pro Plus Software, Inc., 2150 East Brown Rd., Mesa, AZ 85203, (602) 461-3296.

Inquiry 1149.

Forms Software Does More Than Create Blanks

In addition to its ability to create fill-in-the-blank forms, a forms completion and management program called Blankity Blank works with your word processor's

mail-merge capabilities to create hundreds of forms and documents from databases and questionnaires. When used with the separate Blankity Blank DB-Link, you can import information needed to complete forms from up to five other external databases created by Blankity Blank or another DBMS.

The latest version, 3.0, features point-and-shoot screens, multiple simultaneous document and form completion, and one-pass laser printing, where a form and its associated data are printed at the same time.

Blankity Blank's math capabilities let you do addition, subtraction, rounding, and other basic mathematical operations automatically in a form. It can also convert the numeric form of a number to text.

The program runs on the IBM PC with 640K bytes of RAM.

Price: \$99.50; four-user network version, \$249.50; DB-Link, \$199.50 and \$449.50, respectively.

Contact: Softstream Technologies, Inc., 2740 Hollywood Blvd., Hollywood, FL 33020, (800) 888-9292 or (305) 920-9292.

Inquiry 1151.

continued

Streamline Organizational Writing with One Voice

Scandinavian PC Systems, publisher of the style-checking program Readability Plus, has released a new program that lets businesses create their own style models. An organization can thus establish and enforce writing standards based on its own best-written products. With Corporate Voice, you identify your company's stellar proposals, briefs, reports, and other documents; the program then uses these docu-

ments to create corporate style models that help staff writers replicate outstanding written products.

Corporate Voice uses the style models to evaluate similar documents. It identifies inappropriate sentences and determines the percentage of sentences that fit the selected style model. In addition, the program guides the writer through the revision process, after which the document will closely resemble its original style model.

Corporate Voice works directly with WordPerfect (including version 5.1), Microsoft Word, and WordStar. It can also read ASCII files. The program requires 256K bytes of RAM and will run on any DOS 3.0-compatible LAN.

Price: \$119.95.

Contact: Scandinavian PC Systems, Inc., 51 Monroe St., Suite 1101, Rockville, MD 20850, (800) 288-7226 or (301) 294-7450.

Inquiry 1150.



BUY A RACEHORSE... GET A WORKHORSE!



FAST!

850cps/240 lpm!

And It Runs . . .

And Runs . . . And Runs . . .

The fastest serial dot matrix printer on the market today!
The all new **850XL** offers a world of benefits!

- Lightning fast at 850 cps (240 lpm throughput)
- Continuous printing capabilities with no overheating or unnecessary downtime!
- Over 300 local service centers nationwide to keep your jobs running day and night!*

The waiting game is over, as the **850XL** takes on mountains of data, round the clock, with no duty cycle restrictions! Any printing application you need is handled with rapid-fire reliability:

- | | | |
|-------------------|-----------------------|------------|
| • Data Processing | • Bar Codes | • Labels |
| • Financials | • Spreadsheets | • Graphics |
| | • Near-letter Quality | |

*Call for availability in your area

Standard features are better than ever!

- | | |
|--|--|
| • 5 to 18.2 Pitch Printing | • 8K Data Buffers |
| • Front Panel Menu Programming (No DIP Switches) | • Serial & Parallel Ports |
| • Quietized Enclosure | • Convenient Front & Bottom Paper Feed |
| • EPSON, DEC, and IBM ProPrinter XL Emulations | • Full International Character Set |

OTC . . . An American Winner!
Call today for more details.

1-800-4-OUTPUT (8 am - 5 pm PST)
(468-8788)

Call me, I'm interested: Circle 208



Output Technology Corporation BV • Saturnusstraat 25 2' 32 HB Hoofddorp • The Netherlands
Telephone: (31) 2503 32599 • Telefax: (31) 2503 39555 • Telex: (844) 20000 REF MMC27.NLX505

E. 9922 Montgomery Drive, Suite #6
Spokane, WA 99206-4199
Telex #15-2269 OUTPUTSPOK
Fax (509) 922-4742
(509) 926-3855
1-800-468-8788

**Now You Can Lease
OTC Printers For
As Little As
\$52 / Mo.***
*Based on 60 Mo. Lease

Engineering Database for the Earth Sciences

Techbase, a relational DBMS for earth science engineering projects, combines graphics, modeling, and statistics with the ability to handle the large numeric data sets often encountered in mining, petroleum, and similar industries.

You can add or delete database fields at any time; files and tables within a database can vary in size; and you can store data in flat, polygon, cell, layer, or block format.

All Techbase modules have filtering capability to selectively retrieve data or regroup it in subsets for further analysis and graphing. The program can calculate common statistics such as mean and standard deviation, plus chi-squared and two-tailed t-distribution hypothesis statistics. It can also calculate correlation coefficients.

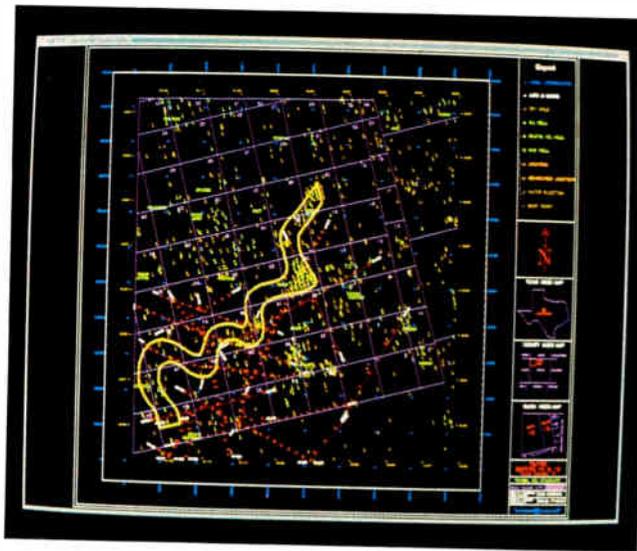
Techbase can generate four kinds of statistical plots: cumulative frequency plots, scatter plots, histograms, and ternary diagrams. You can annotate the graphs with text, lines, and graphics. Graphics capabilities include contouring, cross sections, digitizing, plotting, three-dimensional perspective, and vector. You can include up to 128 customized markers on a graph or plot.

Techbase runs on PCs and workstations from IBM, Sun, DEC, Hewlett-Packard, Silicon Graphics, and others. It requires a minimum of 640K bytes of RAM and a hard disk drive.

Price: Single-user, \$2840 and up; multiuser, \$5190 and up.

Contact: MINEsoft Ltd., 1801 Broadway, Suite 910, Denver, CO 80202, (303) 292-6449.

Inquiry 1160.



A map of blocks 19 and 18 in Taylor County, Texas, made with Techbase. In addition to the legend on the right, the base map includes state index, county index, and block index maps.

Data Acquisition with Graphing, OOP Language

LabOBJX combines data acquisition with math, statistics, and graphing. According to Scientific Software Tools, LabOBJX's programming language combines the object-oriented capabilities of Smalltalk with syntax similar to that of Pascal and Modula-2, letting you modify routines to fit your requirements in the laboratory.

The compiler, linker, editor, analysis, and interface tools are integrated in the run-time application environment, and at any time during execution you can create and integrate new commands or displays of data.

The program lets users work from the command line (for advanced lab personnel) or with pull-down menus (for novices). LabOBJX supports three-dimensional axonometric and mesh plots and several other types of graphs, including real-time display of signal traces.

To run LabOBJX, you need an IBM PC with 640K

bytes of RAM; a math coprocessor is recommended.

Price: \$1995.

Contact: Scientific Software Tools, Inc., Penn State Technology Development Center, 30 East Swedesford Rd., Malvern, PA 19355, (215) 889-1354.

Inquiry 1161.

Nonlinear Curve Fitting Added to Plotting Program

SigmaPlot 4.0, a scientific graphing program, lets you define almost any equation, or sets of equations, with up to 25 parameters and 10 independent variables, and fit the equation to your own data. In addition to the nonlinear curve-fitting capability, the company has added a pull-down menu interface and more graph types and has increased the program's worksheet capabilities.

Jandel Scientific says that it has expanded the SigmaPlot worksheet to 16,000 columns by 65,000 rows. The program directly supports Lotus spreadsheet files, including named ranges. It also supports DIF files and ASCII.

SigmaPlot 4.0 runs on the

IBM PC with 640K bytes of RAM and a hard disk drive.

Price: \$495.

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

Inquiry 1164.

Electromagnetic Analysis Added to FEA Program

A new version of Cosmos/M, a finite-element analysis system for IBM PCs, Mac IIs, and Unix workstations, includes a module for performing FEA of electromagnetic problems. Called Estar, the new module features nonlinear analysis and includes B-H material and permanent magnet demagnetization curves, its developer reports. (A B-H material curve refers to the magnetic flux density [B] versus magnetic field intensity [H] curve that's used to solve nonlinear material curve design problems.) The module can handle force calculations on ferromagnetic objects under externally applied fields and supports two- and three-dimensional magnetostatic modeling while including the current effects for the 2-D and axisymmetric cases under study.

In all, the program has 11 modules, including fluid, nonlinear static, heat transfer, linear dynamic, and linear static analysis. Cosmos/M 1.60 can solve problems of up to 15,000 nodes and 60,000 degrees of freedom. It requires a hard disk drive with at least 10 MB.

Price: \$995 and up.

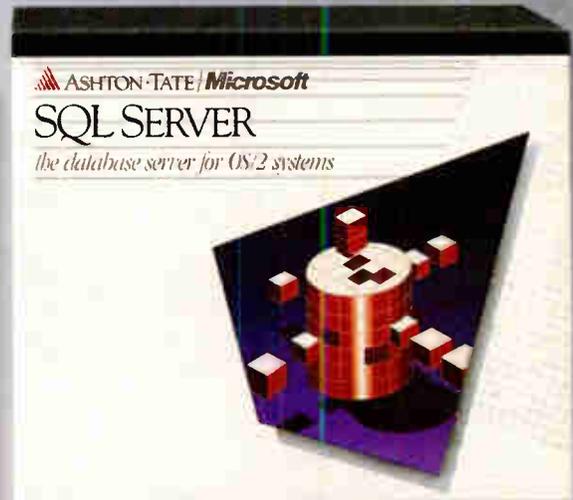
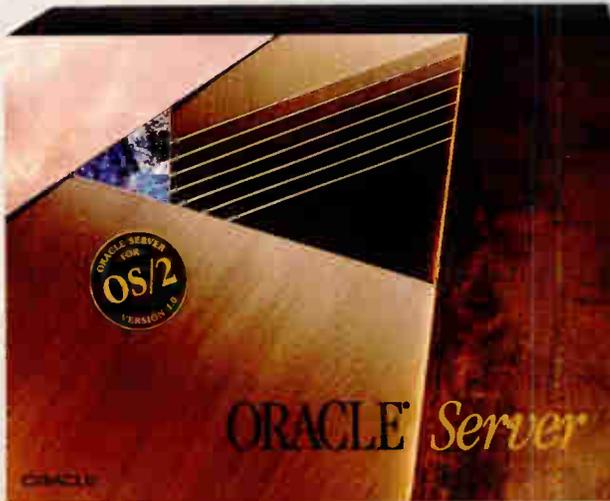
Contact: Structural Research and Analysis Corp., 1661 Lincoln Blvd., Suite 200, Santa Monica, CA 90404, (213) 452-2158.

Inquiry 1163.

continued

Open Server.

Closed Server.



Runs on every vendor's operating system:
OS/2,[™] VINES[®], UNIX,[™] VAX[®] VMS, IBM[®] MVS, etc.

Supports every vendor's local area network protocol:
Novell's[®] SPX/IPX,[™] NetBIOS, Named Pipes,[™] etc.

Transparent access to data in other vendor's databases:
IBM's DB2[™] and SQL/DS, and Digital's RMS.

Transparent data sharing between all your computers:
PCs, minis and mainframes.

Lotus 1-2-3[®] spreadsheets and dBASE[®] applications work with ORACLE Server today.

Developers have a complete and integrated family of portable tools for CASE, applications generation, report writing, etc.

Programmers can use interfaces from C, COBOL, and FORTRAN.

Certified by Codd and Date to run at 11.0 TPI transactions per second.

Runs only on OS/2.

Supports only Named Pipes.

Does not provide access to any other database.

Can't even transparently share data between two PCs running Ashton-Tate SQL Server.

Doesn't work with either Lotus 1-2-3 or dBASE just yet.

Supports only Focus.

Supports only C.

Ashton-Tate SQL Server's published benchmarks show it to be slower.

Oracle Client/Server Forums 1990 Schedule

Tuesday, April 3	Boston
Thursday, April 5	Philadelphia
Tuesday, April 10	Cincinnati
Thursday, April 12	Toronto
Tuesday, April 17	Newport Beach
Thursday, April 19	San Francisco

Call to register for the Oracle Client/Server Forum nearest you. Or order ORACLE Server for OS/2 for only \$2499 and get six months of phone support and upgrades for free (a \$500 value). Or try our Developer's Version (limited to 3 users) for only \$699.

ORACLE

Call 1-800-ORACLE1, ext. 4965. We're always open.

©1990 Oracle Corporation. ORACLE and ORACLE for 1-2-3 are registered trademarks of Oracle Corporation. ORACLE Server for OS/2 is a trademark of Oracle Corporation. IBM, OS/2 and DB2 are registered trademarks of International Business Machines Corporation. Novell is a registered trademark of Novell Corporation. SPX/IPX is a trademark of Novell Corporation. UNIX is a trademark of AT&T Bell Laboratories. Ashton-Tate, SQL Server, and dBASE are registered trademarks of Ashton-Tate Corporation. VAX is a registered trademark of Digital Equipment Corporation. Named Pipes is a trademark of Microsoft Corporation. VINES is a registered trademark of Banyan Corporation. Lotus 1-2-3 is a registered trademark of Lotus Development Corporation. Call 1-800-ORACLE1 for hardware and software requirements.

Animate Building Sites with VideoScapes

A video library for land planning professionals that works with Autodesk's Animator lets you take an image of a planned building site that's bereft of buildings, trees, people, and cars and create a full-color, animated presentation that shows how the proposed site will look upon completion.

Called VideoScapes, the library encompasses hundreds of images, including people, trees, plants, cars, and other objects, that you can size to fit a CAD drawing or insert into an Animator video image. VideoScapes includes building-face patterns such as brick, cedar, and other textures.

Using the animation capabilities of Animator, VideoScapes' cars can move across the screen, trees can grow, and people can walk through the site. With a video capture board, you can import a video of the proposed site, render a three-dimensional CAD drawing of the building with Animator and VideoScapes, and combine those separate elements into an animated presentation for a client.



With the VideoScapes library and Animator, cars can move, trees can grow, and people can walk through a building site.

VideoScapes comes in Animator and Targa formats.

Price: \$495.

Contact: LandCADD, Inc., 7519 East Highway 86, Franktown, CO 80116, (303) 688-8160.

Inquiry 1152.

Access COGO Reference Points Through Database

The AutoCAD release 10 add-in E.S. (for expert system) COGO lets you access COGO reference points through an external database instead of having to select the point on-screen. According to Applications Publishing, this feature is useful for engineers who need the hidden data and attributes of many

reference points in a large drawing. You can use more than 100 commands while working on the external database to retrieve information such as the distance between two reference points.

A new Universal Data Collector converts raw field data into a representative drawing, and the Master Symbol Library performs symbol insertion for each COGO reference point that you've entered via a description code.

E.S. COGO and E.S. COGO Contour (for contour mapping, plan and profile modeling, and other representations of data) each require extended AutoLisp and AutoCAD running on an IBM AT with 640K bytes of RAM and a hard disk drive.

Price: \$2500; E.S. COGO Contour, \$1000.

Autodesk Ships PM Version of AutoCAD

Autodesk's version of AutoCAD release 10 for OS/2 Presentation Manager (PM) is the latest in the company's introductions of AutoCAD for high-end platforms, including one for Unix (specifically, the SCO Xenix and SCO Unix System V/386 operating systems), and a DOS-extended, 386-specific version.

Autodesk says that the multitasking capabilities of OS/2 make it a natural plat-

form for AutoCAD. As is the case with other DOS programs ported to OS/2, many new features of AutoCAD for OS/2 are OS/2 features, such as multitasking, the PM graphical user interface, and Dynamic Data Exchange. Another feature is the ability to port AutoCAD files for OS/2 to any other platform running AutoCAD release 10, without file conversion. (However, this is a standard feature of all versions of

AutoCAD release 10.)

AutoCAD for OS/2 requires at least 4 MB of memory and an 80287 or 80387 coprocessor. It is compatible with either the Standard or Extended Edition of OS/2.

Price: AutoCAD for OS/2 and Unix, \$3000; for extended DOS, \$3300.

Contact: Autodesk, Inc., 2320 Marinship Way, Sausalito, CA 94965, (415) 332-2344.

Inquiry 1153.

Contact: Applications Publishing, Inc., One Harbor Dr., Suite 103, Sausalito, CA 94965, (415) 332-1111.
Inquiry 1159.

Ad Hoc Reporting, New Attributes Added to EASIMAP

EASIMAP (Equipment and Systems Installation Management and Planning) 3.0, a data-center facility-planning add-in for AutoCAD, features true ad hoc reporting capabilities and more than 60 new attributes per symbol. New attributes include leasing and maintenance, square footage of each machine, airflow in cubic feet per minute, operating temperature and relative humidity tolerances for each machine, and more.

With the ad hoc capabilities, you can sort up to three attributes and search up to four attributes concurrently. Some of the other EASIMAP attributes include British Thermal Units to air and water, weight, machine type, and serial number.

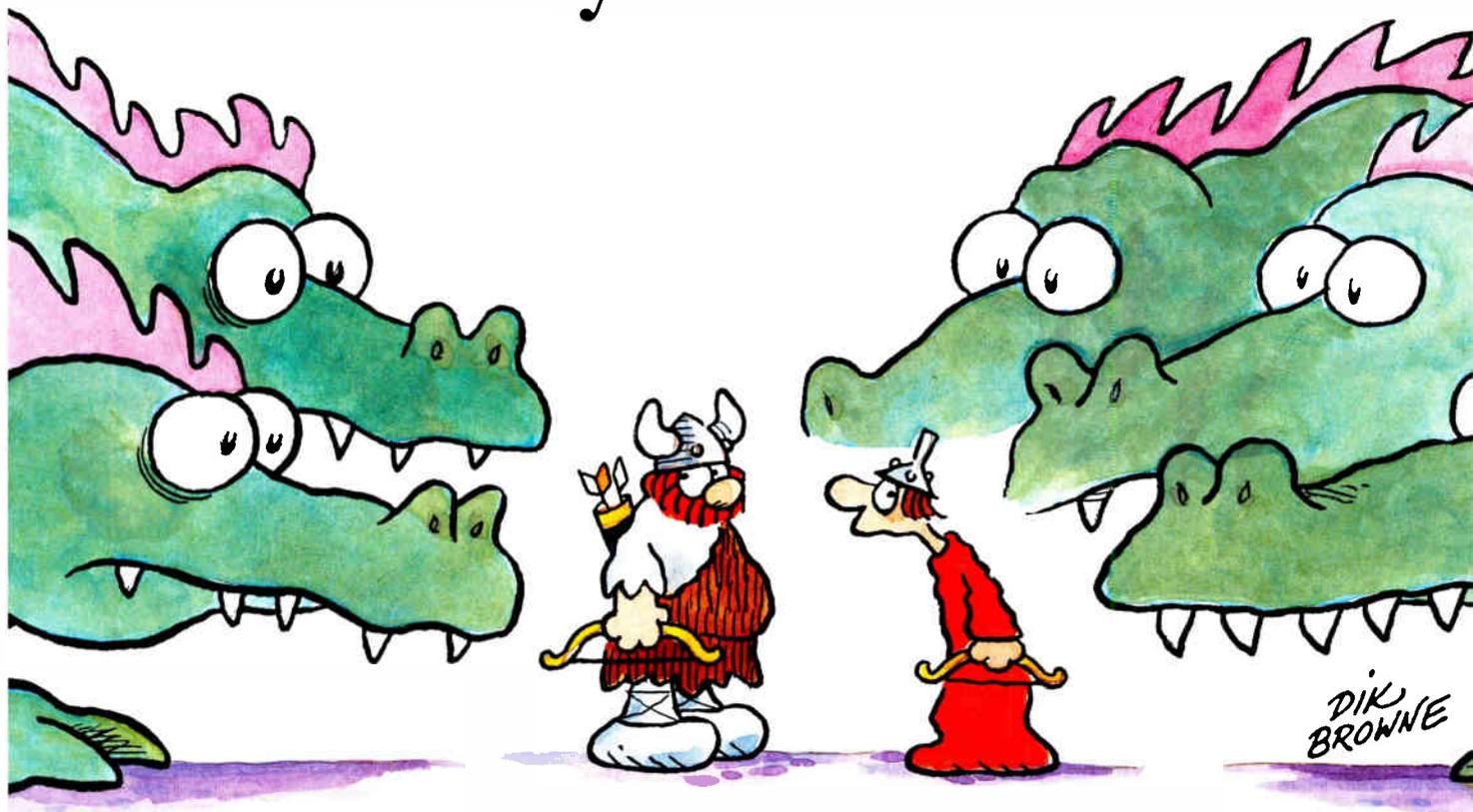
EASIMAP comes standard with three-dimensional symbol libraries for IBM, multi-layered/multicolored symbol libraries, and a DXF file translator. Additional symbol libraries are available for DEC, Cray, and other systems.

EASIMAP runs on the IBM AT, Mac II, and Sun and Apollo systems with AutoCAD release 9 or higher, a math coprocessor, and a hard disk drive with 3 MB of available space.

Price: \$2750 and up; additional libraries, \$275 each.
Contact: 21st Century Innovations, Inc., 23861 El Toro Rd., Suite 611, El Toro, CA 92630, (800) 327-4627 or (714) 768-8060.

Inquiry 1158.

Where's more power and speed
when you need it?



Introducing the IBM RISC System/6000



With the ultimate desktop

Whatever job you're setting off to conquer, from pioneering new electrical circuitry to getting a new airplane design off the ground, if you're always wishing your workstation could help you do it better and faster, you're a Power Seeker. And the new IBM RISC System/6000 family of POWERstations and POWERservers is for you.

Take our new POWERstation 320. It puts more than 7 MFLOPS of double-precision performance and over 27 MIPS right on your desk—more power than most floor-standing workstations. And those numbers soar as high as 13 MFLOPS and 41 MIPS in other models.

RISC System/6000	MIPS	MFLOPS (DP)	3D Vectors (K/SEC)
POWERstation 320	27.5	7.4	90

A processor that's ages ahead of its time. What makes all this possible? POWER Architecture—Performance Optimization With Enhanced RISC—IBM's second

family.



workstation for the power seeker.

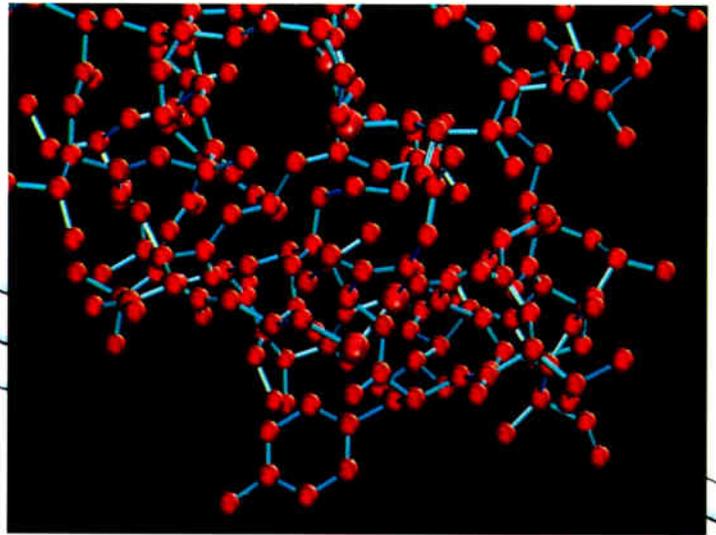
generation of RISC technology, and the heart of the RISC System/6000 family. POWER Architecture gives you up to four instructions per cycle, and it has a CMOS microprocessor built right in that leaves others in the dust. Plus, there's massive memory (up to 256MB) linked to the processor by high-speed internal bandwidth that handles data up to 480MB per second—so the POWER processor is free to attack larger tasks. All of which means solving a complex problem doesn't mean a long wait anymore.

Micro Channel™ conquers throughput barriers. This much raw processing power

needs lots of data transfer muscle, too. So we gave all these systems a new implementation of the Micro Channel bus with I/O throughput of up to 40 megabytes per second. And that's just the beginning. There'll be future implementations of Micro Channel that can double and even quadruple that data transfer capability, making the traditional, nonexpandable architectures seem primitive by comparison.

Add to all this the ability to take advantage of Micro Channel cards and adapters, IBM's new 320MB and 857MB high-performance disk drives and high-speed POWER processing, and throughput bottlenecks are ancient history.

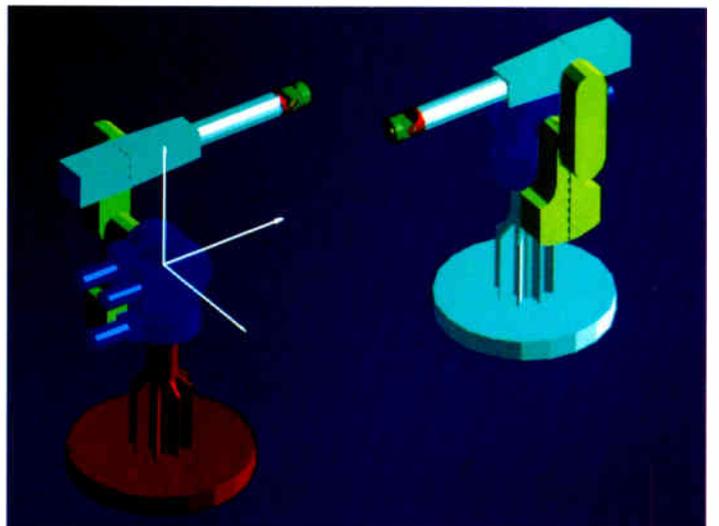
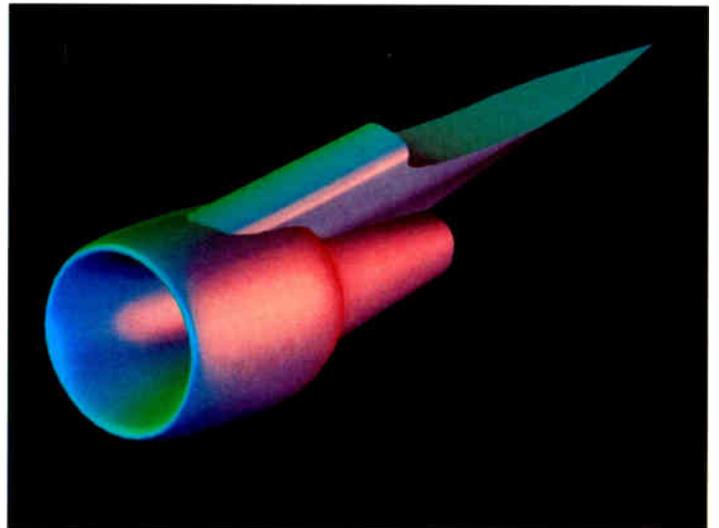
3D graphics performance



Rock-solid support for all UNIX® applications. All members of the RISC System/6000 family are industry-standard UNIX operating system processors all the way, with the AIX™ system, IBM's version of the UNIX operating system. And they'll run hundreds of applications in such diverse fields as engineering design, fluid dynamics, molecular modeling, structural analysis, securities trading, technical publishing and geophysical modeling, plus a wide selection of commercial applications.

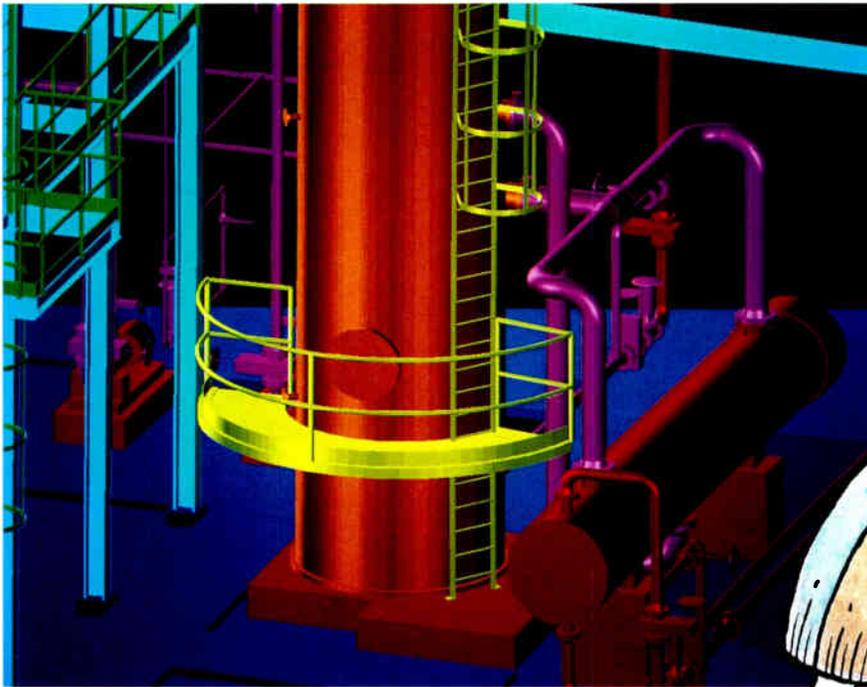
Your complete graphics arsenal. Every POWERstation in the family is built to give you high-speed, high-resolution graphics. Each can come complete with its own graphics processor, freeing up the driving speed of the POWER processor to rapidly create and analyze your designs. And all have screen resolution of 1,280 x 1,024 pixels for sharp, crisp, detailed images.

When it's time to call in the heavy artillery, there's our new Supergraphics POWERstation 730. It features IBM's new Supergraphics Processor Subsystem that's a lot of processors in one: a graphics control processor, a drawing processor and a shading processor, to let you smoothly shade and rotate complex 3D images.

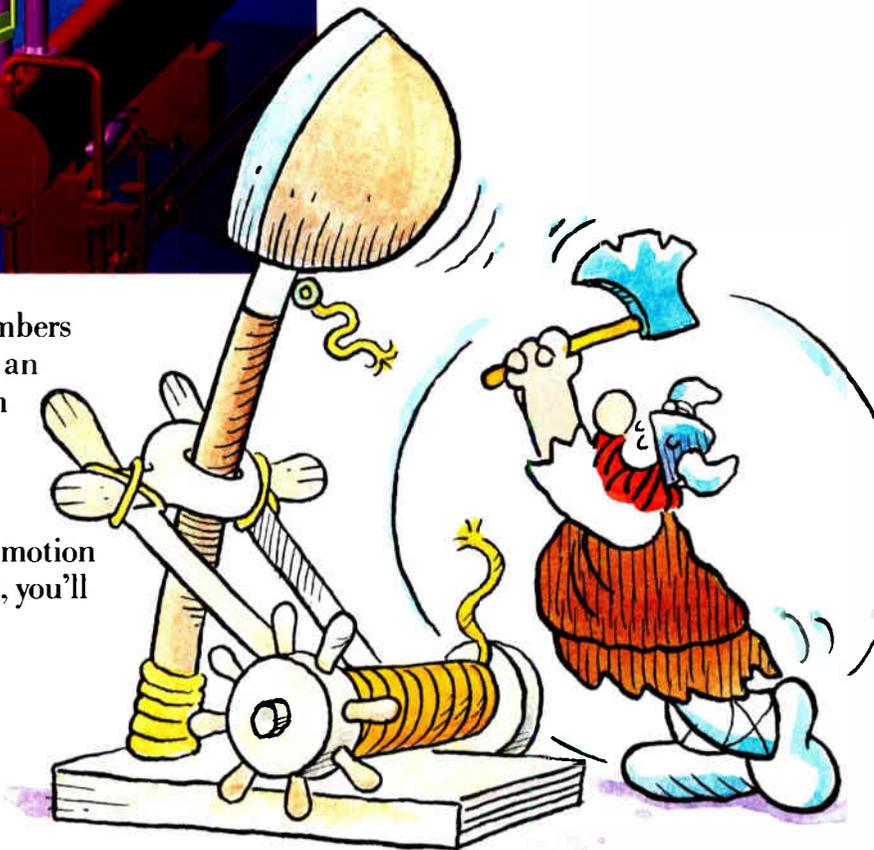


with tremendous impact.

The POWERstation 730 is an awesome combination of speed and performance. It can do nearly one million 3D vector transformations and 120,000 Gouraud Shaded Triangles per second, for realistic shading effects done amazingly fast. Great news for Power Seekers who work on animation, scientific visualization, medical imaging, applications using IBM graPHIGS™ and CAD applications like CADAM™ and CATIA™.



All these beautiful performance numbers yield even more beautiful results. You get an almost unimaginable palette of 16 million colors to work with, which gives you 3D images so realistic, they fairly leap off the screen. And POWER processing lets you view even complex creations in fast, fluid motion from any angle. With any POWERstation, you'll be catapulted into a whole new arena of graphics performance.



...and a whole lot more.



AIX brings different worlds together. Hardware this powerful deserves an operating system to match. So every system in the family can come preloaded with AIX, IBM's version of the UNIX operating system, which runs across the broadest range of platforms in the industry. And it supports major industry standards, as well as the programming languages C, FORTRAN, COBOL and PASCAL. And AIX has additional enhancements, like Advanced Optimizing Compilers, that give you the maximum benefits of POWER Architecture, enriched file system capabilities and support for real-time processing. To make things even easier, we've included on-line publications with hypertext search capabilities. Plus, you get leading industry graphical user interfaces: AIXwindows™—based on the popular X Windows System™ and OSF/MOTIF™—and NextStep™. AIX lets the RISC System/6000 family fit right into your installed UNIX base as well as your IBM SAA™ environments, giving you, quite literally, the best of both worlds.

A lot more power for a lot less loot. Power Seekers will be pleased with the surprisingly low price of our entry desktop POWERstation 320—with over 27 MIPS and 7 MFLOPS—as well as our floor-standing POWERservers. And the booty doesn't stop there. Included in the price of every system are software service and a full one-year warranty, plus the best documentation in the business. It's enough to satisfy even the most demanding.

A network with power to spare. And to share. The RISC System/6000 family is designed to connect to everything from big IBM mainframes to PS/2®s, as well as the full range of non-IBM systems. That means great connectivity and more open systems, so all users have the full power of the network at their command.



The RISC System/6000 family. Choose your weapon.

There's a RISC System/6000 POWERstation or POWERserver to conquer any need, from a single user's desktop requirements to the demands of an army of concurrent users. Each member of the family comes in a wide variety

of configurations, so you can choose among display sizes and disk storage and graphics processing capabilities. For low cost-per-user LAN solutions, there's even a new, high-performance IBM Xstation 120.

	RISC System/6000 POWERstations			
	320	520	530	730
Package	Desktop	Deskside	Deskside	Deskside
MFLOPS (DP)†	7.4	7.4	10.9	10.9
MIPS††	27.5	27.5	34.5	34.5
Maximum Memory	32MB	128MB	128MB	128MB
Internal DASD Capacity	640MB	2.5GB	2.5GB	2.5GB
Total Memory Slots	2	8	8	8
Total Micro Channel I/O Slots	4	8	8	8
Graphics 3D Vectors (K/sec)	90	90	90	990*
Graphics Shaded Polygons (K/sec)	10	10	10	120

	RISC System/6000 POWERservers				
	320	520	530	540	930
Package	Deskside	Deskside	Deskside	Deskside	Rack
MFLOPS (DP)†	7.4	7.4	10.9	13	10.9
MIPS††	27.5	27.5	34.5	41.1	34.5
Maximum Memory	32MB	128MB	128MB	256MB	128MB
Internal DASD Capacity	640MB	2.5GB	2.5GB	2.5GB	12GB
Total Memory Slots	2	8	8	8	8
Total Micro Channel I/O Slots	4	8	8	8	8

†MFLOPS are the results of the double-precision, all FORTRAN Linpack test.
 ††The Dhrystone version 1.1 test results are used to compute RISC System/6000 integer MIPS values, where 1757 Dhrystones/sec. is 1 MIPS (VAX 11/780).
 * Projected Performance

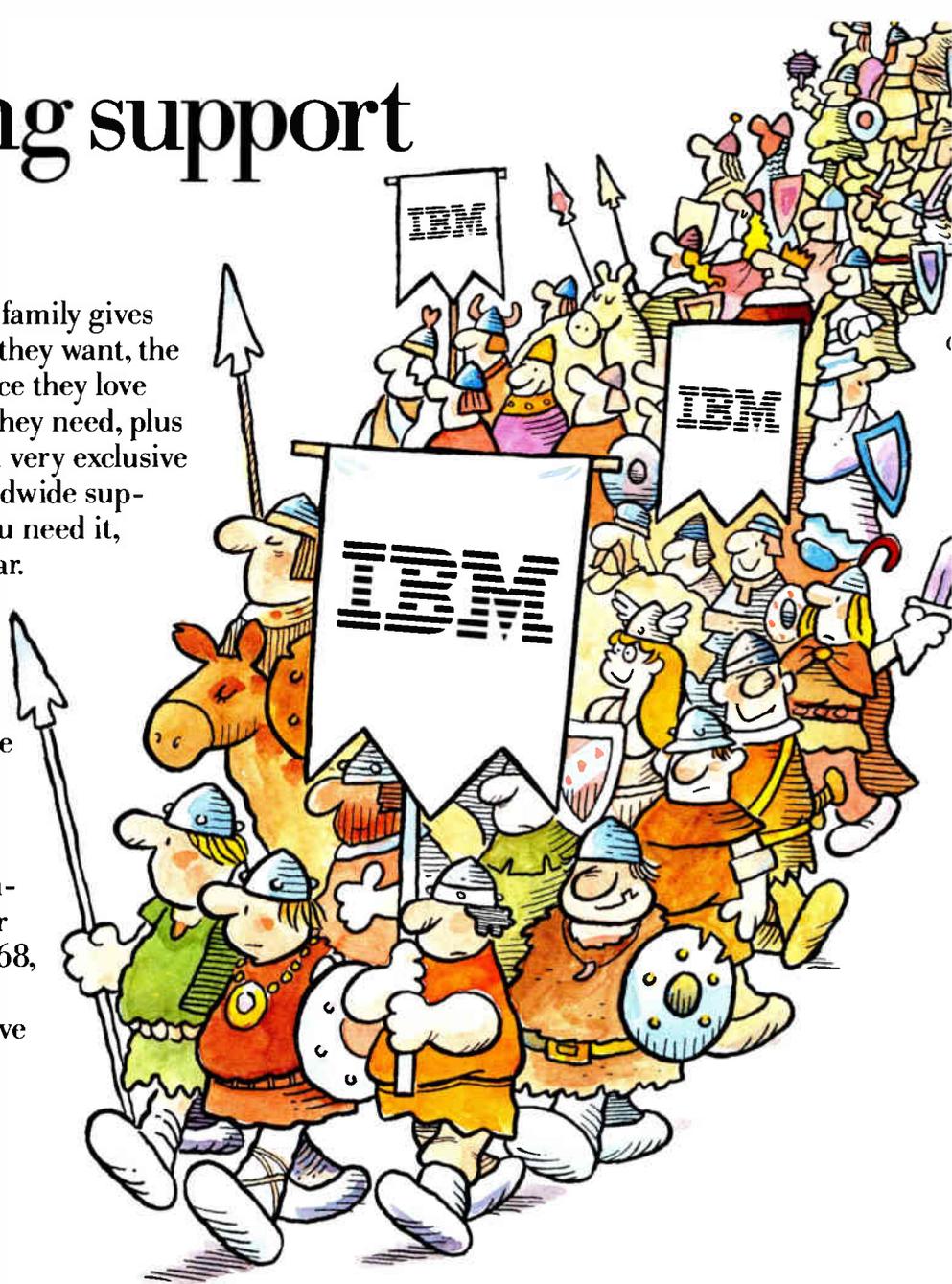


The strong support of IBM.

The RISC System/6000 family gives Power Seekers the raw power they want, the awesome graphics performance they love and the superb connectivity they need, plus one more very important and very exclusive feature: the unparalleled worldwide support of IBM. Service when you need it, 24 hours a day, 365 days a year. An IBM customer engineer can even come to your site and configure your network, install your machines and make sure all your systems are integrated, whether they're manufactured by IBM or not.

To find out more, call your IBM marketing representative or Business Partner. For literature, call 1 800 IBM-2468, ext. 224.

And find the power you've been seeking, and more.

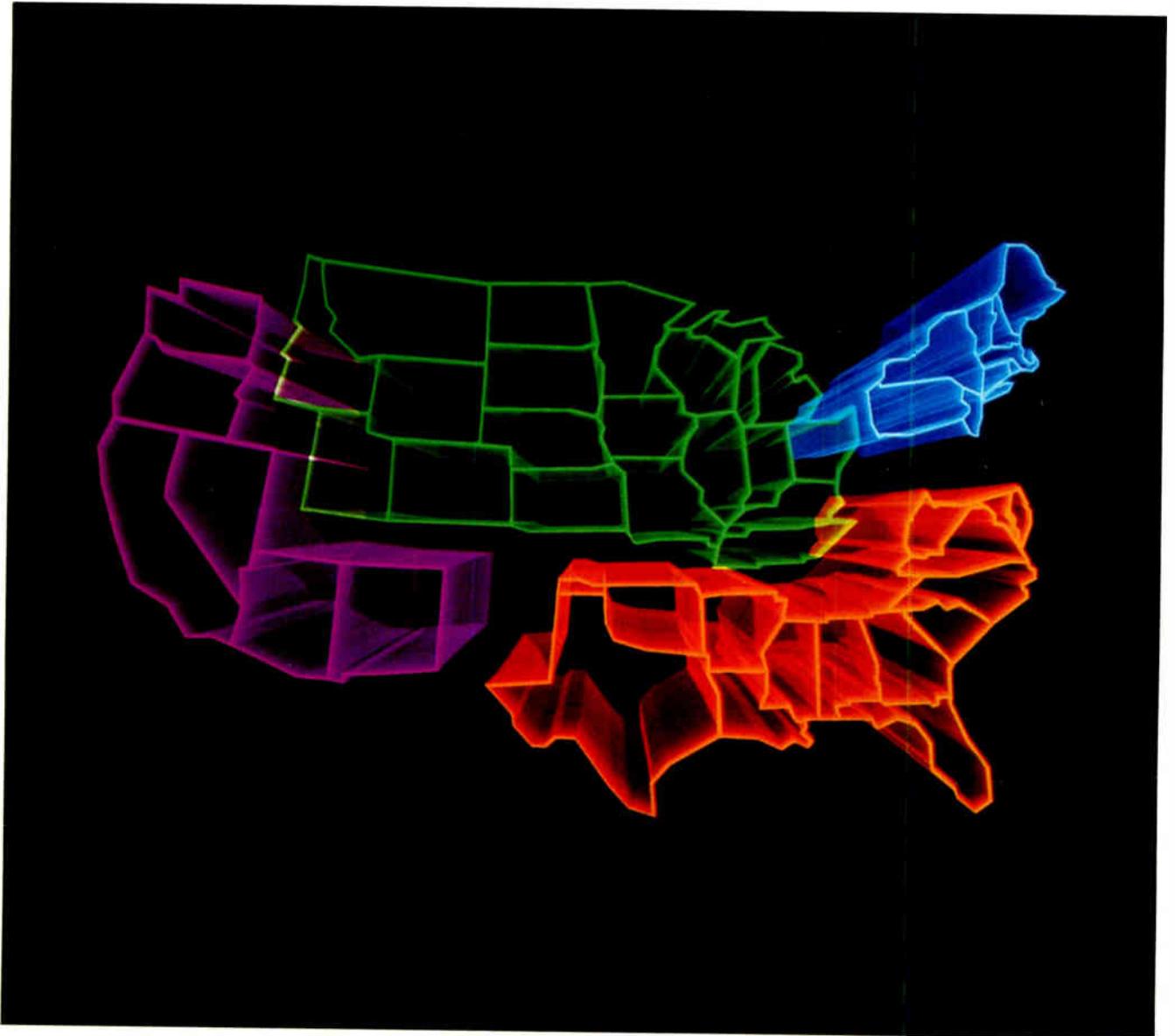


For the Power Seeker.

BYTE

REGIONAL

NORTHEAST



PHOTOGRAPHIC IMAGE: ALEX PIETERSEN © 1989

APRIL 1990 • B Y T E 52NE-1

WHAT'S NEW

METRO NEW YORK • NEW ENGLAND

Rotenberg Steps Up as Chairman of the BCS Board

Saying that the Boston Computer Society had grown beyond being a one-person operation and citing a need to expand the group's management team, Jonathan Rotenberg has stepped down from his position as president of the BCS and taken a new position as chairman of the board. Rotenberg, who founded the 30,000-member BCS in 1977, said the new position would let him pursue new projects. "There were a lot of areas I thought the BCS could be more active in," he said.

Rotenberg said some of the new projects might include de-

veloping new ways to reach out to the public, starting a program to distribute videos to members who can't attend BCS meetings, and lobbying, including providing a more focused way for end users to provide feedback to vendors and hardware and software manufacturers.

Tracy Licklider will succeed Rotenberg as the new president. Licklider will assume responsibility for day-to-day operations, including administration, finance, user-group coordination, and media relations. Currently, the BCS has about 50 individual users groups, 40 publications, 15 BBSes, and a \$2.2 million budget.

"In the BCS, Tracy has been a long-standing volunteer since 1979 and held just about every position," Roten-

berg said. Citing Licklider's extensive experience in information technology and two years of work with the Peace Corps, Rotenberg said the new president would bring "firsthand experience and sensitivity to volunteers." Licklider was most recently a group vice president for personal systems at AI Corp. **Contact:** The Boston Computer Society, One Center Plaza, Boston, MA 02108, (617) 367-8080.

Trenton Computer Festival Gets New Locale

The oldest computer festival still in existence has outgrown its former site, but it retains its name. The Tren-

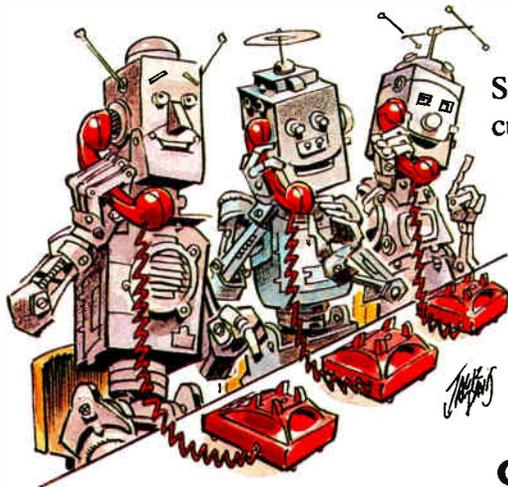
ton Computer Festival, formerly held at Trenton State College, will be held on April 21-22 at Mercer County Community College. A few of the festival's activities, such as the banquet, will still be held at Trenton State, festival organizers say.

The festival is sponsored by a consortium of users groups from New Jersey, New York, and Pennsylvania. Attendance for the two-day show is expected to be about 20,000. On Saturday, 11 sessions will be held; six to eight sessions are scheduled for Sunday.

Contact: The Amateur Computer Group of New Jersey, Inc., P.O. Box 135, Scotch Plains, NJ 07076, (609) 771-2487, (609) 771-2666, or (718) 539-3202.

continued

Customer Support BBS



...for the IBM PS/2, XT, AT and compatibles.

Support your customers via modem. Electronic mail between your customers and you gives them the answers they need, 7 days a week!

- They can upload questions and problem reports to you
- You can download updates and product information to them
- Multiple users may be online at once, on one computer
- SIGs, teleconferencing, and questionnaires too
- Very easy to install and configure, works under MS-DOS
- Works with COM1/COM2/COM3/COM4, or multi-port serial cards or multi-modem cards

Only \$59 for the complete 2-line software!

Call our "demo" system with your modem: (305) 583-7808

GALACTICOMM

© 1990 Galacticom, Inc. • 4101 S.W. 47th Avenue, Suite 101, Fort Lauderdale FL 33314 • Voice: (305) 583-5990



HARMONY COMPUTERS

1801 FLATBUSH AVE.. (BET. AVES. J & K) BKLYN, NY 11210

ORDER DEPT. ONLY 800-441-1144 OR 718-692-3232 — INFORMATION 718-692-2828

WE WILL BE
CLOSED
APRIL 10, 11
AND
APRIL 16, 17

10th Anniversary Specials

TOSHIBA T-1000 LAPTOP

\$619.00

H.P. LASERJET IIP

\$919.00

PANASONIC 1124

\$279.00

IBM PS/2 #30 (286) 20 Meg

\$1689.00

WORD PERFECT 5.1

\$244.00

NEC MULTISYNC 3D

\$569.00

"PRINTER SPECIALS"

Apple Image Writer II	439
Citizen GSX 140	339
Diconix Ink Jet 150 plus	314
Epson LX810	189
Epson FX 85C	334

Epson FX 1050	449
Epson LQ 510	329
Epson LQ 1070	439
Epson LQ 85H	489
Epson LQ 95H	489
Epson LQ 1050	669
Epson LQ2550	899
Hewlett Packard Desk Jet Plus	659



Hewlett Packard Laser Jet II P	919
Hewlett Packard Deskwriter (Apple Macintosh)	789

IBM AND COMPATIBLES

IBM PS 2 #30 (286) 1.44 Meg Dr	1399
As above w/ IBM 20 Meg	1689
As above with IBM 30 Meg	1799
IBM PS 2 Model 50Z (30 Meg)	2149
IBM PS2 Model 50Z (60 Meg)	2449
2 Meg Upgrade (PS 2-30 (286) 50Z 55SX 70 80	399
IBM PS 2 #55 SX 30 Meg (386SX)	2599
IBM PS 2 #55 SX 60 Meg (386SX)	2989
IBM P S 2 Color Monitor (8503)	209
IBM P S 2 Color (8512) Monitor	449
IBM P S 2 Color (8513) Monitor	539



TURBO 386 SYSTEM (20 MHZ) 1.2 Meg Drive Serial Parallel, 1 Meg. Video Card, Monitor	1249
TURBO 386SX (16 MHZ) 1.2 Meg Drive Serial Parallel, 1 Meg. Video Card and Monitor	899
TURBO AT 286 SYSTEM 12 MHZ, 1.2 Meg Drive Serial Parallel, 512K w/Monitor	699
TURBO XT SYSTEM 12 MHZ, Drive 512K Video Card and Monitor	549

Headstart 2 640K, 10MHZ, 5 1/4 & 3 1/2 Floppy Drives, Color Mono, Serial, Parallel, Game, DOS 3.3	799
Headstart 3 One Meg, 12 MHZ 5 1/4 & 3 1/2 Floppy Drives, 32 Meg H.D. Serial, Parallel, Game, Mouse, DOS 3.3, VGA Adapter	1899
Headstart Explorer, 3 1/2 Drive Color Monitor	769
Mitsubishi 386SX (16MHZ) 1.2 Meg. drive, 2 Meg. RAM Serial Parallel card, DOS 3.3	1599
EGA card with EGA Monitor	1599

LAPTOPS

NEC Prospeed 286 20 Meg.	2899
NEC Prospeed 286 40 Meg	3399
Toshiba T 1000	619
T 1000 768K Upgrade Card	269
T 1000 Carrying Case	49
Toshiba T 1000SE	1139
T 1000SE Carrying Case	49
Toshiba 1200 2 Drive (Backlit)	1399
Toshiba 1200 2D Meg (Backlit)	1899
Zenith 184-1 Supersport (2 Drive)	1269
Zenith 184-2 Supersport 20 Meg	1789
Zenith Supersport 286 (20 Meg)	2499
Zenith Supersport 286 40 Meg	2749
Mitsubishi 286L (20 Meg) with Case Modem M: Works	1749
Mitsubishi 286L (40 Meg) with Case Modem M: Works	2199
Toshiba 301 (24 Pin Portable Printer)	299
Diconix 150 P-24 Portable Ink Jet Printer	314
Fast Lynx Data Transfer Software 3.1 to 5.0	99
Laptop Modem 1200 Baud	129
Laptop Modem 2400 Baud	159

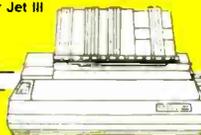


VIDEO CARDS

Hercules Monographic Plus w/Ramfont	154
Hercules Graphic Station	619
Genoa Super BI Res Plus	99
Genoa 6400 VGA w/512K	199
Video 7 VGA	169
Video 7 VGA 1024x 256K	209
Video 7 VGA 1024x 512K	259
Video 7 VGA VRAM (512K)	399
Orchid Peanut (VGA)	149
Orchid Pro Designer (VGA) 256K	219
Cirrhid Pro Designer (VGA) Plus 512K	269
STB VGA Extra EM 16 256K	189
STB VGA Extra EM 16 512K	239
ATI VGA Wonder 256K	189
ATI VGA Wonder 256K w/Mouse	209
ATI VGA Wonder 512K	239
ATI VGA Wonder 512K w/Mouse	259
Paradise Auto Switch (480)	99
Paradise VGA Plus	159
Paradise VGA Plus (16 bit)	189
Paradise VGA Professional 512K	229
Paradise VGA 1024	209
Paradise VGA 1024 (512K)	259
Paradise VGA 65145A	529
Everex Auto Sync (480) Deluxe	99
Everex Viewpoint VGA 256K	169
Everex Viewpoint VGA 512K	219
Harmony VGA (800 x 600)	119
Harmony VGA (1024 x 768)	139

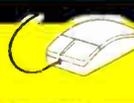


Hewlett Packard Laser Jet II	Call
Hewlett Packard Laser Jet III	1479
IBM Proprietary X24E	429
IBM Proprietary 3XL	559
IBM Preprinter XL24E	799
NEC P2200XE	299
NEC P5200	489
NEC P5300	629
Okidata 172	199
Okidata 182 Turbo	224
Okidata 183 (Wide Carriage)	229
Okidata 320	329
Okidata 321	469
Okidata 380	349
Okidata 390	469



MODEMS	
Hayes 1200 External	269
Hayes 1200B Internal	149
Hayes 1200B w/ Smartcom 2	174
Hayes 2400 External	324
Hayes 2400B Internal	199
Hayes 2400B w/ Smartcom 2	249
Hayes 2400P PS 2 50 60 70 80	429
Hayes 2400P Internal	89
ATI 2400 External	169
ATI 2400 Internal	199
Everex Interna 1200B	69
Everex 2400 Plus Interna	159
Everex 2400 E Plus External	199
Everex 2400 Internal PS 2 50 60 70 80	229
Everex Faxboard	269
Parkard Bell 1000 External	89
Prometheus 2400 External	169
Prometheus 2400 Internal	139
Prometheus 2400 Plus Interna	199
Cardinal 2400 Interna	99
Cardinal SendFax with 2400 BCI Modem	149
Falcon 2400 External	109
Laptop Modem 1200 Internal	129
Laptop Modem 2400 Internal	159

MICE	
Microsoft Mouse	99
Microsoft Mouse w/ Windows	139
Logitech H. Rez Mouse	84
Logitech Scanman Plus	179
Logitech Trackman	89
Genius 3 Button H. Rez Mouse	59



FAX MACHINES	
Sharp UX 110	499
Sharp UX #70	669
Sharp FO 230	649
Sharp FO 330	729
Sharp UX 350	999
Sharp FO 510	999
Sharp FO 550	1349
Panafax #120 w/ Answering Machine	799
Panafax #135	569
Panafax #140	659
Panafax #145	679
Panafax #155	689
Panafax #250	1199
Panafax #260	1349
Epson Priority Fax 1000	699
Epson Priority Fax 2000	799
Epson Priority Fax 3000	959
Everex Faxboard	269
Cardinal SendFax with 2400 Baud Modem	149
98 Foot Fax Paper (6 Rr) 1st	29
101 Foot Fax Paper (6 Rr) 1st	49
104 Foot Fax Paper (6 Rr) 1st	79



MONITORS	
Amdek 732 (VGA)	399
IBM 8503 Monochrome VGA	209
IBM 8512 Color VGA	449
IBM 8513 Color VGA	529
Princeton VGA Paperwhite	139
Princeton Max 15	139
Princeton Ultra Sync (16 inch)	869
Princeton Ultra Sync (14 inch)	489
NEC Multisync G.S. IIA (Paperwhite)	209
NEC Multisync 2A (VGA)	449
NEC Multisync 3D	569
Sony 1304 Multiscan (1024x768)	649
Sony 1302 Multiscan	599
Sony 1320 VGA	469
Seiko #1440 (Res. 1024 x 768)	589
Zenith 1492	589
Mitsubishi Diamondscan #1381A	469
Goldstar Superscan #1440 (800 x 600)	429
Goldstar #1430 VGA	359
Packard Bell (EGA) #1431	369
Packard Bell TTL Amber 12 inch #1272A	89
Packard Bell TTL Amber 14 inch #1472A	129
Packard Bell (RGB) #1452	249



Okidata 391	639
Okidata 393	979
Panasonic 1180	169
Panasonic 1191	224
Panasonic 1124	279
Panasonic 1624	409
Panasonic 1695	409
Panasonic 1524	529
Seiko Smart Label Printer	189
Star NX 1000 II	159
Star NX 1000R (Color)	209
Star NX 1500	289
Star NX 2410	279
Toshiba 301 (24 Pin Portable Printer)	299
Toshiba 321 SL	419



HARD DRIVES	
Seagate 20 Meg. w/controller	249
Seagate 40 Meg. w/controller	229
Seagate 40 Meg #251-1	339
Seagate 80 Meg #4096	579
Seagate 40 Meg #296N SCSI	519
Western Digital XT Controller (20, 40, 80 Meg)	79
Western Digital (AT) Controller	149
Seagate 40 Meg Hard Drive Card	349
Tandon 20 Meg Hard Drive Card	279
Plus Hardcard 2 40 Meg (AT PS2 25 30)	579
Plus Hardcard 2 80 Meg (AT PS2 25 30)	669
Seagate 40 Meg External (for Macintosh)	479
Seagate 40 Meg 3 1/2 inch #125N SCSI	299
Seagate 40 Meg 3 1/2 inch #125 SCSI	239
Seagate 40 Meg 3 1/2 inch #138N SCSI	339
Seagate 40 Meg 3 1/2 inch #138MFM	299
Seagate 40 Meg 3 1/2 inch #157N SCSI	339
Seagate 40 Meg 3 1/2 inch #157 SCSI	339
Host Adapter for SCSI Drives	49



IBM SOFTWARE	
Aldus PageMaker 3.0	479
Lotus 123 Release 3	369
Lotus 123 Version 2.0	324
D Base 4	459
Borland Paradox 3.0	499
Microsoft Excel	209
Microsoft Word 5.0	64
Microsoft Windows 286	129
Microsoft Windows 386	129
Microsoft Flight Simulator Ref. 4.0	44



Word Perfect 5.1	244
Word Perfect Library 2.0	69
O & A 3+	209
PF's Professional Write (1.1) with PFS Graph	129
PC Tools Deluxe 5.5	79
Norton Utilities 4.5	84
Norton Utilities Advanced 4.5	84
Copy 2 PC Deluxe Board	109
Wordstar Professional Ref. 1.5.5	179
Ventura Desk Top Publishing ver 2.0	499
Managing Your Money Release 5	119
Fast Lynx (Data Transfer Software end cables)	99
MS DOS 3.3 w/Basic	89
MS DOS 4.01 w/Basic	89

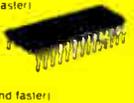
PC BOARDS, DRIVES, MEMORY CHIPS

IBM Original 5 1/4 Disk Dr (360K)	89
Toshiba 1 1/4 Floppy Disk Dr (360 K)	89
Toshiba 1 1/4 Floppy Disk Dr (720 K)	89
Toshiba 3 1/4 Floppy Disk Dr (1.44 Meg)	99
Toshiba 3 1/4 Floppy Disk Dr (1.2 Meg)	99
PS 2 5 1/4 360K External Drive	199
PS 2 5 1/4 1.2 Meg External Drive	249
EVEREX MULTIFUNCTION (PCXT)	89
EVEREX EMS MEMORY CARD (PCXT)	79
EVEREX RAM 3000 EMS MEMORY CARD (AT)	99
AST Six Pack Plus 64K	319
AST Rampage Plus (286) 512K	379

AST Advantage 512K	199
Intel above board 286 plus w 512K	379
Intel above board 286 Plus I/O Parallel Serial	429
Intel above PS 2 (50.60)	299
AST Rampage PS 2 (50.60) 512K	439
64K DRAM chips	Call
256K DRAM chips	Call
256K Simm Module	Call
One Meg DRAM cr ps	Call
One Meg Simm Module	Call

INTEL MATH COPROCESSORS

Intel 8087-3 (PC PC XT up to 6 MHz)	89
Intel 8087-2 (PC PC XT up to 8 MHz)	119
Intel 8087-1 (PC PC XT PS 2 up to 10 MHz) and faster	129
Intel 80287-3 (PCAT up to 6 MHz)	159
Intel 80287-8 (PCAT PS 2 up to 8 MHz)	189
Intel 80287-10 (PCAT PS 2 up to 10 MHz)	224
Intel 80387-16 (PCAT PS 2 up to 16 MHz)	339
Intel 80387-20 (PCAT PS 2 up to 20 MHz)	379
Intel 80387-25 (PCAT PS 2 up to 25 MHz)	479
Intel 80387-33 (PCAT PS 2 up to 33 MHz) and faster	569
Intel 80387 SX (For 8088/87 SX Computers)	299
Intel 80387	274



Visa, MasterCard and Discover welcome at no additional charge. For your protection we check for stolen credit cards. Shipping & handling extra. Defective merchandise will be replaced or returned at our discretion within the terms of our warranty. Price and availability subject to change without notice. We do not allow non-defective returns. For defective merchandise inquiries call customer service at 718/692-2828. We are not responsible for typographical errors.

Technology Conference Nanobytes

The Monadnock Computer Fair and Exposition, to be held on April 28 at Keene State College, will include exhibits and seminars by local users groups, vendors, computer publications, and educational institutions. The show will be held at the Spaulding Gymnasium from 10:00 a.m. to 4:00 p.m. **Contact:** Monadnock Music, P.O. Box 255, Peterborough, NH 03458, (800) 462-7536 or (603) 352-1130.

The spring MassCUE conference, sponsored by the Massachusetts Computer-Using Educators, will be held

on April 7 at the Apponequet Regional High School in East Freetown, Massachusetts. **Contact:** MassCUE, Inc., P.O. Box 82-188, Wellesley, MA 02181, (508) 668-5400 ext. 338 or (508) 238-3291.

An international conference on project management will be held on April 23-25 at the Boston University Center for Project Management in Tyngsboro, Massachusetts. **Contact:** Boston University Corporate Education Center, 72 Tyng Rd., Tyngsboro, MA 01879, (508) 649-9731.

Boston will be the site for the Custom Integrated Circuits Conference, which will be held on May 13-16. **Contact:** Laura A. H. Morihara, Convention Coordinat-

ing, 298 Ohina Place, Kihei, HI 96753, (808) 879-9128.

On April 8, Bangor, Maine, will be the site of the third annual Downeast Computer Fair. The fair is sponsored by the Island/Reach Computer Users Group and will be held at the Eastern Maine Vocational Technical Institute. **Contact:** Island/Reach Computer Users Group, P.O. Box 273, Deer Isle, ME 04627, (207) 367-5955 or (207) 348-6851.

East challenges West in the battle of computer smarts, as industry luminaries do battle at the second Computer Bowl. Last year, the East team won. This year, the Computer Bowl will be held on April 27 at the World

Trade Center in Boston. **Contact:** The Computer Museum, Museum Wharf, 300 Congress St., Boston, MA 02210, (617) 426-2800.

Kahn to Speak at New York Group

Philippe Kahn, founder and CEO of Borland, will be the featured speaker at an NYPC (Gotham New York Personal Computer User Group) meeting, the group reports. Kahn will speak on April 18 at the High School of Graphic Commercial Arts, located at 439 West 49th St. (between Ninth and 10th Avenues). **Contact:** NYPC, 40 Wall St., Suite 2124, New York, NY 10005, (212) 533-6972.

DIAL
(617)

L · A · P · T · O · P · S
5 2 7 8 6 7 7

We can add cellular phone communications to your laptop

NEW ENGLAND'S AUTHORITY ON LAPTOPS AND PORTABLE COMPUTING

OVER 20 LAPTOPS ON DISPLAY
OVER 300 LAPTOPS IN STOCK

FREE LOANERS DURING SERVICE*

Toshiba, NEC, Zenith, Sharp, Mitsubishi,
Texas Instruments, Panasonic

INTRODUCING . . .

Sleek new models from Toshiba!
Texas Instruments 6.7 pound, 286
powerhouse!
New Zenith models for the 90s

Laptop Rentals • GSA Schedule Pricing • Lease • 30-day exchange policy

Zenith Preferred Service Center **Toshiba Service Center** **NEC Premier Service Center**

* If CPU is purchased from us

LAPTOPS, etc. 164 HAMPSHIRE STREET, CAMBRIDGE, MA 02139 (617) 527-8677

In MA dial 1-800-966-METRO for service

Other Store Locations: Falls Church, VA • Washington, D.C. • Baltimore, MD

MYODA

MYODA computers are manufactured by PAO-KU Group, a highly respected, public-held corporation. The MYODA product line includes a full selection of desktop and laptop computers. Myoda is the one source supplier for customer looking for quality, service & price.

LT3500 \$2299 LT3200 \$1899

- INTEL 80286-12cpu
 - 0 wait state
 - 80287 coprocessor socket
 - 1MB on board (expandable to 4MB)
 - Gas Plasma 640 x 480 EGA mode, • 4 Gray scale
 - 40M HDD (28 ms)
 - 1.44MB FDD
 - 2 serial, 1 parallel port
 - 1 EGA/CGA /MGA CRT port
- INTEL 80286-12cpu
 - 1 wait state
 - 80287 coprocessor socket
 - 640 KB on board (expandable to 2.6MB)
 - Gas Plasma 640 x 400 CGA mode, * 4 Gray scale
 - 40M HDD (28 ms)
 - 1.44MB FDD
 - 1 serial, 1 parallel port
 - 1 CGA/MGA CRT port

NEW!

\$3799

LT5200CD

- INTEL 80386-25cpu
- 0 wait state
- 80387 coprocessor socket
- 1MB on board(expandable to 8MB)
- 32KB CACHE memory
- Gas Plasma640/480
- VGA mode, 16 gray scale
- 40M HDD(28ms)
- 1.44MB Floppy Drive
- 2 serial, 1parallel port
- 1VGA/EGA CRT port
- 2 full size expansion slots
- 90-260V auto switch power supply



LT5200NV \$2599

- INTEL 80286-16 cup/0 wait state
- 80287 coprocessor socket
- 1MB on board (expandable to 8MB)
- Other configurations are same as LT5200CD (no CACHE memory)

MYODA 16Bit VGA Card

512K, Res. 800/600

\$149



SALE!

Options:

Memory expansion board(2MB/3MB/4MB)
Expansion chassis(4 external expansion slots)
converter(12V-110V) for use in car

External FDD(360KB/1,2MB)
33Key keypad
5hr external battery

QUANTITY
DISCOUNT
PRICE

CALL!

1-800-562-1071

SPECIAL ON MOTHERBOARD

SUNTAC/VLSI 286-12
AMI 386-25/64 cache
MYODA 386SX-16

Vertical Case

Large, medium & small

MD3410 \$685 MD2000 \$319

- INTEL 80286-12cpu
 - 0 wait state
 - 80287 coprocessor socket
 - 1MB on board (expandable to 4MB on motherboard)
 - 101 key enhanced keyboard
 - 1.2 MB Floppy Drive
 - 1serial, 1parallel, 1 game port
 - 8 expansion slots
 - 1:1 interleave HFDC
 - 180W power supply
 - Baby AT case
- 8088-1(10MHZ) Microprocessor
 - 4.77/10 MHZ Clock Speed
 - 256KB installed, Expandable to 640KB on Board
 - One 360 KB Floppy Drive with Controller
 - Four 1/2 Height Drive Bays
 - Turbo Switch & LED
 - Reset Switch
 - Hard Drive Access LED
 - 150W Power Supply
 - 101 key enhanced Keyboard

Options:

Hard Drive 20MB(65me) \$219 40MB(28me) \$339 80MB(28me) \$559 120MB(28me) \$659
MYODA 14"VGA Monitor \$339 12" Monochrome Monitor \$75 MGP \$41



\$859

MD5030

- INTEL 80386SX-16cpu
- 80387 coprocessor socket
- 1MB on board (expandable to 8MB on motherboard)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1serial, 1parallel, 1game port
- 8 expansion slots
- 200W power supply
- 1:1 erleave HFDC



\$2399

MD7240

- INTEL 80386-25cpu
- 0 wait state
- 80387 coprocessor socket
- AMI CACHE386-25 MarkII
- 64 KB cache memory
- 4MB on board (expandable to 16MB)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1serial, 1parallel, 1 game port
- 8 expansion slots
- 220W power supply
- 1:1 interleave HFDC

For Regional Distrib. Centers, please call: 1-800-562-1071

Illinois: (708) 860-2290 Fax: (708) 860-7760

Volume Buyers Welcome

pao-ku international co., ltd.

241 James St. Bensenville, IL. 60106

This team created your next generation editor. Tell us if you agree.



From left to right: **Jim Besemer**, Project Manager. Specification & Design, User Interface; **Skip Russell**, System Primitives, Function Library, Error Recovery, Operating System Interface, Configuration and Setup; **Pat Thompson**, Extension Language/Compiler and Debugger; **Robynne Major-Jones**, **Howard Mercier** (not shown) Quality Assurance and Testing; **Eric Johnson**, Editor Core, Help Facility; **Milo Wadlin**, User Documentation.

We talk to developers every day. New development environments and the size and complexity of projects are making their 80's editors obsolete. They told us they need a new editor for the 90's. So for two years this team worked in secret to create it.

We believe they succeeded magnificently. Now we'd like to know what you think.

Try the Sage Professional Editor for thirty days with no risk. Pound on it. Compare it to any editor you've ever used. Then call our team at 1-800-547-4000 and tell them how you like it. There's no risk to you, no obligation. Not much risk for us either. We won't be able to pry it away from you.



Works with or without a mouse.
Packaged with or without a Microsoft® Mouse.

Announcing the Sage Professional Editor

Right out of the box you'll be more productive with our editor than any you use today. The

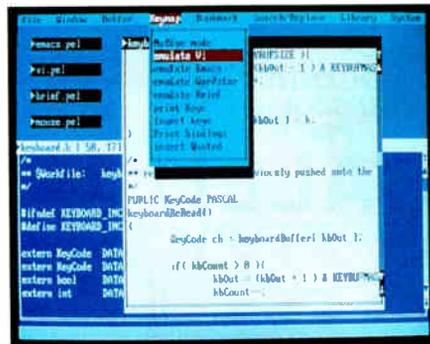
instant installation, elegant mouse support, advanced user interface, and point-and-shoot help get you running immediately. If you prefer the commands and

keystrokes of a popular editor, our turnkey emulations duplicate them precisely, and you still gain the Sage Professional Editor's advanced features, windowing capabilities and powerful engine.

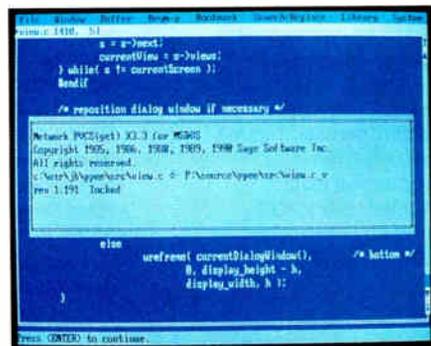
Later you'll make this editor truly yours by configuring the interface as you prefer. Every feature can be turned on or off as you like - from a clean screen, to tiled windows, to overlapping windows in various colors, pull-down menus, rulers, scroll bars, and line numbers - choose any or all and place them as you like.

Use the editor with or without a mouse - all functions are available without lifting your fingers from the keyboard. But

the click-select windows, scroll bars, zoom, shrink-to-icon, block text selects, and other speedy mouse actions make editing extremely efficient.



Make our interface what you prefer, from clean screen to multi-window with drop-down menus and icons.



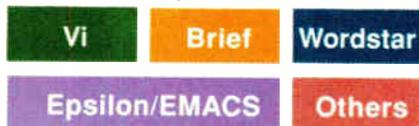
The editor environment provides seamless integration to the Polytron Version Control System (PVCS) or any other tool you care to connect.

Pop open the DOS window and the editor shrinks to just 4k. So you can back-task to compilers and other tools without leaving the editor.

This package is stuffed with value. It includes MS-DOS, OS/2 and Dual Mode versions on both 5 1/4" and 3 1/2" disks, templates for popular languages, and you can buy it with or without a bundled Microsoft® Mouse.

But the reason you will become addicted to the Sage Professional Editor is the power behind that pretty face. We looked under the hood of other editors and found wimpy editing engines dressed up with all sorts of bells and whistles. Unacceptable. We wanted an industrial strength engine. So we started with a powerhouse virtual memory system that allows us to edit huge files (up to 100MEG) in as many as 256 windows - over two billion lines. It makes maximum

TurnKey Emulation Of



use of available memory (including EMS) and uses advanced processes to safely minimize file I/O. All higher level services use this powerful VM scheme. Consequently, there are no size constraints on the macro library and no limit to Undo/Redo. You can have 1000 bookmarks, anchors and saved positions per buffer.

Sage Software, Inc. has acquired Polytron, the company that brought you PVCS and PolyMake. Now this group proudly introduces their Professional Editor under the Sage banner.



Circle 549 on Reader Service Card

"When I saw how well my mouse works with this new editor I had to try it. I became a convert when I saw the power of the extension language. This editor can be whatever I need it to be. I couldn't give it up."

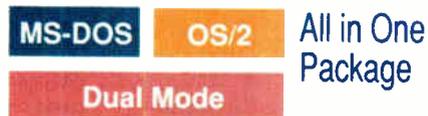
*Terry Ham,
ImageBuilder Software*

And then there's the extension language. The Sage Professional Editor uses a C-like extension language (100 percent PolyAWK compatible) and compiler/debugger that programmers find immediately intuitive. The function library gives access to nearly everything. From mouse click to menu, from word processing to external hooks. You can build the environment you need or want with the editor as the front end to your favorite tools. The seamless integration of the Polytron Version Control System (PVCS) is a sterling example of how cleanly you can hook external programs.

Emulations of Vi, Brief, EMACS, and WordStar, were written with the extension language. The source code for each is included. If you are addicted to some obscure editor you can modify a copy of emulator source and quickly make your own. Source for the menuing system, mouse interface, help and many other services is also included, so you can deeply modify the editor to be exactly what you want. Brief users who have a library of macros can use our translator to recompile them into our more useful and powerful C-like extension language.

It's easy to make the Sage Professional Editor a standard for your team or even the entire company:

1. Turn-key emulation means every programmer can use it immediately. Macros written to aid users apply to all emulations.
2. Provides a framework for integrating all your development tools into a single, consistent operating environment.
3. MS-DOS, OS/2 & Dual Mode versions are all included in the same box so *your* team can move into the 90's with the same editor.
4. Licenses are available for you, your team, division or company. The initial cost is low, and you continue to save as you add users.



\$295 U. S. List Prices.
Single User Version.

\$395 Includes a
Microsoft® Mouse.

Specify serial, bus or PS/2 mouse. A 5-User License (without mice) is only \$1,032.50. Call for prices on larger licenses. **Visa, MC & P.O.** orders:

1-800-547-4000

30 Day Money Back Guarantee



SAGE
SOFTWARE

APRIL 1990 • BYTE 52NE-7

Integrated Software for Small Businesses

Enable/BP integrates word processing, a spreadsheet, a relational database, business graphics, and telecommunications with the ability to open up to eight windows at once, Enable Software reports. The program, available in single-user and LAN versions, lets you copy data and graphics among windows and supports more than 20 formats for importing and exporting files.

The 65,000-cell spreadsheet, compatible with Lotus 1-2-3, includes a macro facility. You can update and display graphs and spreadsheets simultaneously. The word processor supports mail merge and graphics and includes an 80,000-word spelling checker.

Enable/BP requires 384K bytes of RAM for DOS 2.1 and 448K bytes for DOS 3.0 and higher.

Price: Enable/BP, \$199; Enable/BP LAN (four-user version), \$495.

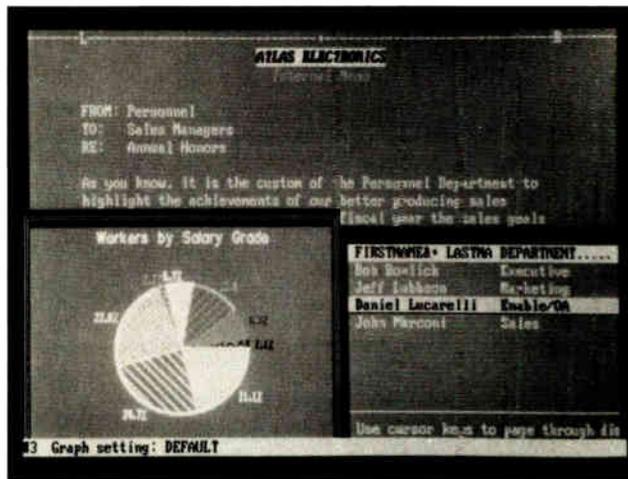
Contact: Enable Software, Northway Ten Executive Park, Ballston Lake, NY 12019, (518) 877-8600.

Inquiry 1007.

Desktop Publishing for Under \$60

Spinaker Software has released version 5.0 of its BetterWorking Word Publisher. It lets you work in text or graphics mode, allowing you to edit text in a WYSIWYG environment. The program combines word processing with the ability to create documents using fonts, columns, boxes, lines, and clip-art images.

Other enhancements include the ability to scale documents to large, distorted,



With Enable/BP, you can open up to eight windows at once.

normal, reduced, and other sizes. You can also pick any column height and the program automatically reformats the text, the company says. The program includes a spelling checker, outliner, and cut-and-paste capabilities. To run the program, you'll need an IBM PC with 512K bytes of RAM and a hard disk drive.

Price: \$59.95.

Contact: Spinnaker Software Corp., One Kendall Sq., Cambridge, MA 02139, (617) 494-1200.

Inquiry 1008.

Create 32 Graphs and Charts

With QuickGraph, you can create 32 types of charts and graphs from data you've imported from Lotus 1-2-3, dBASE III, ASCII, and ASCII delimited files. QuickGraph lets you chart up to 2250 data points (up to 15 columns wide and 150 rows deep) in one chart. You can hot-link a chart to data, and once you create a chart, you

can export it directly to a word processor.

The program supports standard bar, column, line, and other charts. Variations include clustered, overlapped, stacked, and unstacked. Chart styles include pie-column, scatter, table, pie-pie, and others. You can also create comparative charts with dual y-axes.

Other features include text annotation, automatic scaling, and a variety of line styles and colors.

QuickGraph consumes about 415K bytes of RAM and runs on the IBM PC.

Price: \$99.95.

Contact: Sumak Enterprises, 39 Dawson Dr., Sudbury, MA 01776, (508) 443-0205.

Inquiry 1012.

Graph-in-the-Box for Executives

New England Software's newest version of Graph-in-the-Box supports 15 different types of charts and uses disk swapping, so that the program requires only 10K bytes of RAM when not activated. The Executive version, a TSR program that captures data and text directly from the screen, lets you manipulate, display, and print it as a graph or chart.

In addition to three-dimensional effects and nine fonts, the program offers 57 data manipulation functions and 16 statistics. The program automatically detects the graphics standard in your IBM PC and supports the EMS specification. When active, Graph-in-the-Box requires about 300K bytes of RAM on a PC.

Price: \$299.95.

Contact: New England Software, Inc., Greenwich Office Park 3, Greenwich, CT 06831, (203) 625-0062.

Inquiry 1011.

Accelerate AutoCAD VGA Performance

A new display list driver for AutoCAD release 10 accelerates the performance of AutoCAD, when used with a VGA board, by an average of two to 10 times over that of the driver that is supplied by Autodesk, Panacea reports. DLD-VGA uses Panacea's proprietary display list technology to let you quickly pan, zoom, and redraw your AutoCAD drawings.

DLD-VGA supports all 100 percent IBM-compatible VGA boards at the 640-by-480-pixel resolution. In addition, it supports the VESA Standard 800-by-600-pixel VGA resolution and Super VGA boards from

Video Seven, Paradise, ATI, Tecmar, Orchid, STB, and Willow.

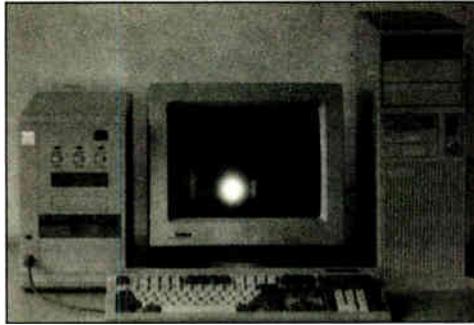
DLD-VGA is compatible with AutoSketch, AutoShade, and AutoCAD, supporting pull-down menus, multiple viewports, and transparent commands. The driver can use expanded and extended memory and the disk for storing the display list information while accelerating AutoCAD.

Price: \$99.

Contact: Panacea, Inc., Londonderry Sq., 50 Nashua Rd., Suite 305, Londonderry, NH 03053, (800) 729-7420 or (603) 437-5022.

Inquiry 1010.

LET US BE THE MASCOT FOR YOUR TEAM!!!



Mascot Turbo AT 286

For Heavy Duty or Business Use
Name Brand & High Quality Parts Only
18 Months Labor & Parts Warranty
8/16 MHz Performance Rating
1 MB, 4MB Expandable on Board
Fancy Mini Vertical Case, Speed Display, Turbo, Reset, Keylock, 3 LED
200 Watts, 110/220V Power Supply
Teac 1.2MB High Capacity Floppy
Dual Hard/Floppy Controller
101 Enhanced Tactile/Click Keyboard
OS/2, Xenix, Novell Ready

14" Mono Flat 720 x 350

Basic System	\$829
20 MB, 65ms	\$1034
40 MB, 28ms	\$1174
80 MB, 18ms	\$1264

14" Mono VGA 720 x 350

Basic System	\$929
20 MB, 65ms	\$1134
40 MB, 28ms	\$1274
80 MB, 18ms	\$1364

14" Color VGA 640 x 480

Basic System	\$1180
20 MB, 65ms	\$1385
40 MB, 28ms	\$1525
80 MB, 18ms	\$1615

14" Super VGA 1024 x 768

Basic System	\$1330
20 MB, 65ms	\$1535
40 MB, 28ms	\$1675
80 MB, 18ms	\$1765

Mascot 386SX

For Heavy Duty or Business Use
Name Brand & High Quality Parts Only
18 Months Labor & Parts Warranty
8/20 MHz Performance Rating
1 MB, 4MB Expandable on Board
Fancy Mini Vertical Case, Speed Display, Turbo, Reset, Keylock, 3 LED
200 Watts, 110/220V Power Supply
Teac 1.2MB High Capacity Floppy
1:1 High Speed Hard/Floppy Controller
101 Enhanced Tactile/Click Keyboard
OS/2, Xenix, Novell Ready

14" Mono Flat 720 x 350

Basic System	\$1049
40MB, 28ms	\$1394
80MB, 18ms	\$1629
150MB, ESDI	\$2129

14" Mono VGA 720 x 350

Basic System	\$1149
40MB, 28ms	\$1494
80MB, 18ms	\$1729
150MB, ESDI	\$2229

14" Color VGA 640 x 480

Basic System	\$1399
40MB, 28ms	\$1744
80MB, 18ms	\$1979
150MB, ESDI	\$2479

14" Super VGA 1024 x 768

Basic System	\$1579
40MB, 28ms	\$1924
80MB, 18ms	\$2159
150MB, ESDI	\$2659

Fancy Vertical Case/250W power add \$80

Mascot 386-25

For Heavy Duty or Business Use
Name Brand & High Quality Parts Only
18 Months Labor & Parts Warranty
28/34.5 MHz Performance Rating
1 MB, 8MB Expandable on Board
Middle Vertical Case, Speed Display, Turbo, Reset, Keylock, Light, 3 LED,
2 Serial/1 Parallel port
200 Watts, 110/220V Power Supply
Teac 1.2MB High Capacity Floppy
1:1 High Speed Hard/Floppy Controller
101 Enhanced Tactile/Click Keyboard
OS/2, Xenix, Novell Ready

14" Mono Flat 720 x 350

Basic System	\$1588
40MB, 28ms	\$1933
80MB, 18ms	\$2168
150MB, ESDI	\$2668

14" Mono VGA 720 x 350

Basic System	\$1688
40MB, 28ms	\$2033
80MB, 18ms	\$2268
150MB, ESDI	\$2768

14" Color VGA 640 x 480

Basic System	\$1938
40MB, 28ms	\$2283
80MB, 18ms	\$2518
150MB, ESDI	\$3018

14" Super VGA 1024 x 768

Basic System	\$2118
40MB, 28ms	\$2463
80MB, 18ms	\$2698
150MB, ESDI	\$3198

386-25 64K cache add \$550

- We accept MasterCard & Visa, 3% surcharge.
- COD Order based on Cashiers Check, Money Order.
- 10% Restocking fee within 30 days from invoice date.
- All returns are subject to our approval.

Mascot Computer Corp.

Tel: (718) 321-1944 Fax: (718) 321-0136 Open 7 days 10:00 A.M. to 6:00 P.M.
42-20 College Point Blvd., Flushing, NY 11355 (5 minutes from Shea Stadium)
VARS Welcome

Excellent prices with:

- *Fast service and one-year parts/labor warranty
- *30 Day money back guarantee (less shipping)
- *Free shipping and no surcharge for VISA/MC

80386-33 MHz

64 KB cache RAM
 4 MB RAM memory
 1.2 + 1.44 floppy
 153 MB 18ms ESDI NEC
 1:1 Interleave+ D. Cache
 16 bit super VGA card
 512K RAM, 1024 x 768
 14" VGA color monitor
 1 parallel & 2 serial
 101 key keyboard

\$3999

80386-20 MHz

1 MB RAM memory
 1.2 or 1.44 floppy
 42 MB 28ms MFM drive
 16 bit 256K VGA card
 14" VGA color monitor
 1 parallel & 2 serial
 101 key keyboard

\$1999

80386-25 MHz

64 KB cache RAM
 4 MB RAM memory
 1.2 + 1.44 floppy
 68 Meg 23ms RLL Toshiba
 1:1 Interleave+ D. Cache
 16 bit super VGA card
 512K RAM, 1024 x 768
 14" VGA color monitor
 1 parallel & 2 serial
 101 key keyboard

\$2899

80386-16-SX

1 MB RAM memory
 1.2 or 1.44 floppy
 42 Meg 28ms MFM drive
 16 bit 256K VGA card
 14" VGA color monitor
 1 parallel & 2 serial
 101 key keyboard

\$1699

80386-20 MHz

4 MB RAM memory
 384K shadow RAM
 1.2 + 1.44 floppy
 68 Meg 23ms RLL Toshiba
 1:1 Interleave+ D. Cache
 16 bit super VGA card
 512K RAM, 1024 x 768
 14" VGA color monitor
 1 parallel & 2 serial
 101 key keyboard

\$2399

80286-12 MHz

1 MB RAM memory
 1.2 or 1.44 floppy
 22 Meg 38ms MFM drive
 16 bit 256K VGA card
 14" VGA color monitor
 1 parallel & 2 serial
 101 key keyboard

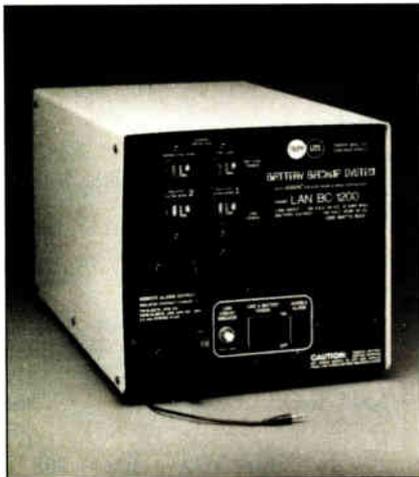
\$1449

Orders: (708) 628-0344
 Tech-Support: (708) 628-0304
 Order Status: (708) 628-0323
 Fax Orders: (708) 543-1859
 Telex: 590369

Micro Image International Inc.

1010 W. Fullerton, Unit G
 Addison, Illinois 60101

Call for custom configurations. Prices subject to change.



**450, 750,
 1200 & 2000
 WATT MODELS**

LOWEST PRICED LAN BATTERY BACKUP

**TRIPP LITE BATTERY BACKUP
 DESIGNED SPECIFICALLY TO PROTECT
 FILE SERVER SYSTEMS**

**Approved for use with NOVELL,
 ALTOS, 3 COM, UNIX**

- Supports Lan Systems UPS monitoring functions to allow unattended system shutdown
- Larger batteries for longer backup times
- Isobar® Surge & Noise Filter built-in
- Ideal for unattended file servers



**CALL OR WRITE
 FOR PRICING**

**PROPER CABLING & SOFTWARE
 AVAILABLE FOR ANY
 NETWORK SYSTEM**



"THE POWER PEOPLE"

500 N. Orleans
 Chicago, IL 60610
 312-329-1777
 Fax 312-644-6505

Knowledge Man/2.

NOW SUPPORTING
SQL SERVER



The other guys.



No other application development package puts so many tools at your fingertips.



KnowledgeMan/2 combines a relational data base, SQL Server support, and a fourth-generation programming language with a set of development tools that the other guys can't match. All of these tools are seamlessly integrated, too, so you'll never need to exit one before using another.

The result is a dramatic reduction in development time and costs that can help you eliminate your application backlog and stay ahead of the game—perhaps for the first time.

What's more, KnowledgeMan/2 was designed to make real application development possible on as little as 640K, and provide an upward migration path to OS/2, LAN and VAX environments. It wasn't ported

Some of KnowledgeMan/2's seamlessly integrated tools:

- Forms management with painter
- Custom report generator
- Full color graphics
- Text processing
- Remote communications
- Full-featured spreadsheet
- Natural language interface capabilities
- Real-time event handling
- Microsoft Code View®-style debugger
- Extensible through any Microsoft supported language
- Small load image (320K)
- Permits windowed applications
- Context-sensitive help
- On-line tutorials

down from larger systems like others.

KnowledgeMan/2 users around the world have found that the difference between being viewed as a hero instead of a bottleneck isn't a matter of working harder. It's a matter of having all the right tools.

The price of the industry's most complete toolbox? Just \$795 for the single-user MS DOS version. Call **1-800-344-5832** for the whole story. In Indiana, call (317) 463-2581.

With KnowledgeMan/2, missing tools will never throw a wrench in your schedule again.

KNOWLEDGE
man/2

KG Software Division of **mdbs**[®]
KnowledgeMan/2 • GURU • MDBS IV • Object/1
Two Executive Drive, P.O. Box 248, Lafayette, IN 47902

Circle 539 on Reader Service Card (DEALERS: 540)

APRIL 1990 • BYTE 52NE-11

CAD Display Controller Zooms Four Times Faster

Nth Graphics' Nth Engine/550 display controller zooms and pans up to four times faster than the company's previous Nth Engines and comes with 4 MB of on-board display list RAM, expandable to 8 MB.

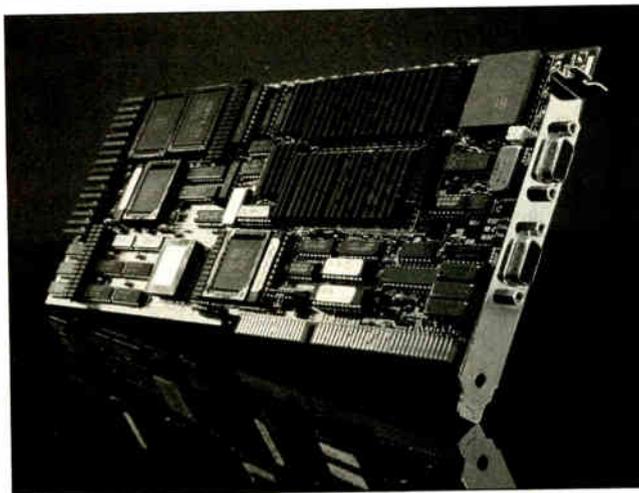
The AT-bus-compatible board comes with Hydra, the company's visualization software that reads in three-dimensional wire frames produced in AutoCAD directly from your hard disk drive, the company reports. It then uses the controller's 20 MIPS and 3 MFLOPS of processing capability to shade and rotate models. You can use Hydra to "walk through" wire-frame and surface-shaded models.

The board is also bundled with Nth View, a stand-alone program that lets you view, plot, and save two-dimensional and wire-frame drawings without having the CAD software that created the drawing (for distribution of drawings across networks and via modem). Some of the other free software includes a GIF file-exchange utility, an interactive palette editor, and enhanced display list drivers.

Price: 1024- by 768-pixel, \$4995; 1280- by 1024-pixel, \$5995; extra RAM, \$350 per MB.
Contact: Nth Graphics, Ltd., 1807-S West Braker Lane, Austin, TX 78758, (800) 624-7552 or (512) 832-1944.
Inquiry 1013.

Hypertext Word Processor

Hyper-Word, a hypertext word processor for the IBM PC, contains a number of features that may interest programmers. In addition to



The Nth Engine/550 displays 256 colors from a palette of 16.7 million and supports extended DOS and AutoCAD Xenix.

the program's ability to interconnect documents by linking a calendar, memos, contracts, and outlines, it can link related source files to display a function or subroutine from any reference.

Zaron Software says that Hyper-Word can use its hypertext ability to make quick work of a program mock-up or a set of interrelated screens that show how a proposed program will look and flow. First, individual screens are drawn and then interlinked using Hyper-Word's link function. You can jump to a screen that shows the next logical display in program operation.

Of course, Hyper-Word is not just for programmers. Other features include a readability index and an integrated spelling checker. You can search multiple files with one command, and the program can function as a personal information manager, linking the calendar, daily log, and documents. The program prints multiple columns, labels, and form letters.

Hyper-Word runs on the IBM PC with 512K bytes of RAM and a hard disk drive.

Price: \$249.95.
Contact: Zaron Software, 13100 Dulaney Valley Rd.,

Glenn Arm, MD 21057, (301) 592-3334.

Inquiry 1016.

Property-Mapping Software

LAN/SCAN's L-Plot 5.0 is a property-mapping program for title attorneys, real estate companies, and anyone else involved with property descriptions. It lets you automatically generate a map of a property by typing in a description of the land. You can plot any legal description by metes and bounds, township and range, or a combination of both, LAN/SCAN reports.

Each file can include up to 250 closed tracts. The program includes a library of mapping symbols; automatic labeling of calls; copy, move, and rotate functions; and a font editor. Area and error-of-closure are automatically calculated, the company says. Maps are automatically updated when you change data.

L-Plot 5.0 runs on the IBM PC and requires 640K bytes of RAM. The stand-alone program can export files in DXF format.

Price: \$299.
Contact: LAN/SCAN, Inc., P.O. Box 6863, Abilene, TX 79608, (915) 672-2901.
Inquiry 1014.

Canvas Adds Enhanced Bézier Curves

A new version of Canvas, the drawing program for the Macintosh Plus or higher, features enhanced Bézier curve editing, the ability to create four-color separations, and a 100,000-word spelling checker.

New editing features of the Bézier curve tool include adding control points anywhere on the curve, creating sharp edges without adding control points by manipulating the control handles independently, and splitting curves at any location.

Price: \$299.95.

Contact: Deneba Software, 3305 Northwest 74th Ave., Miami, FL 33122, (305) 594-6965.

Inquiry 1015.

Dynamic String Handling for C

For programmers who want to build dynamic strings in C, KBM Communications has released the bStrings Library, which provides dynamic string-handling capabilities similar to BASIC, without the difficulties of heap management and without fragmenting memory, the company says.

The library provides more than 130 string-manipulation routines that KBM says duplicate almost every string function available in BASIC.

Price: \$89.95.
Contact: KBM Communications, 2401 Lake Park Dr. NW, Suite 160, Atlanta, GA 30080, (800) 227-0303 or (404) 333-0303.
Inquiry 1017.

continued

RESOURCE CONCEPTS COMPUTER OUTLET

MONITORS

12" GREEN MONOCHROME NEW 90 DAY WNTY.	\$54.95
12" VGA MONO PAPER WHITE PHOSPHORUS NEW 90 DAY WNTY. \$59.95 DEMO 30 DAY WNTY. \$49.95	
14" VGA COLOR MONITOR .41 DOT DEMO UNITS LIKE NEW/90 DAY WNTY.	\$225.00
14" VGA COLOR MONITOR .31 DOT DEMO UNITS LIKE NEW/90 DAY WNTY.	\$245.00
MITSUBISHI 14" EGA COLOR MONITOR DEMO UNITS LIKE NEW/90 DAY WNTY.	\$210.00

MOTHER BOARDS

8088/10 MHZ XT (PIM-TB10)	83.00
286/10MHZ AT MINI (PTM-1030)	174.00
286/12MHZ AT MINI (2 SER/1PAR) (PTM-1230C)	247.00
286/12MHZ AT MINI (UP TO 4 MB) (PTM-1230S)	247.00
286/16MHZ AT MINI AT (PHOENIX BIOS) (PTM-1630C)	327.00
286/12MHZ AT MINI (UP TO 8 MB) (PTM-1233C)	260.00
386/20MHZ (PEM-2000)	767.00
386/20MHZ MINI (PEM-2030)	794.00
386/25MHZ (PEM-2500)	1327.00
386/33MHZ (PEM-3300)	2134.00
386/SX 16MHZ (PPM-1630)	367.00

RAM UPGRADE

	150NS	120NS	100NS	80NS-
256K x 9 IBM SIMM	17.00	25.00	31.00	38.00
1M x 9 SIMM	—	—	95.00	105.00
1M x 1 DIP	—	—	9.25	9.50
256K x 1 DIP	2.00	2.25	2.50	3.25
256K x 4 DIP	—	9.00	9.25	9.50
64K x 1 DIP	1.00	1.35	1.65	—
64K x 4 DIP	3.00	3.50	3.95	—

COPROCESSORS

V-30 REPLACES 8086	5.00	80287-10 (10MHz)	219.00
8087-3 (5MHz)	85.00	80387-16 (16MHz)	310.00
8087-2 (8MHz)	119.00	80387-20 (20MHz)	360.00
8087-1 (10MHz)	159.00	80387-25 (25MHz)	460.00
80287-6 (6MHz)	129.00	80387-33 (33MHz)	575.00
80287-8 (8MHz)	199.00		

ADD ON CARDS

MONOCHROME TEXT ONLY CARD (MTO)	6.00	640K RAM CARD XT (P11-129)	22.00
MGP (P11-143C)	35.00	386 RAM CARD EXP TO 8M (PEI-301)	74.00
CLOCK CARD (P11-146)	22.00	ARCNET CARD (PCI-001P)	74.00
COLOR GRAPHIC PRINTER	35.00	ACTIVE HUB (PCI-002)	167.00
RS 232 CARD XT/AT (P11-108)	19.00	ETHERNET CARD	167.00
NO SLOT CLOCK ON CHIP XT	20.00	GAME CARD (P11-116)	12.00
PRINTER CARD PAR XT/AT (P11-109)	12.00	ELUMINATOR GAME CARD (GRAVIS)	31.33
AT/XT I/O S (OPTIONAL PAR)	30.00	AT IDE CONT WITH S/P/G (PTI-217)	69.95
AT/XT I/O S (OPTIONAL PAR/GAME)	26.00	AT IDE HD/FD CONT (PTI-215)	100.00
FDC XT W/CABLE (P11-101)	19.00	JOY STICK PC/XT/AT ROC	13.33
XT/AT HI DEN FC 12/1.44 (P11-151B)	34.00	ANALOG JOYSTICK XT/AT (GRAVIS)	45.00
XT/AT HI DEN 4 DRIVES (P11-158)	43.00	EMBEDDED H/D CONT. AT (PTI-216)	47.00

SPECIALS

SERIAL MOUSE WITH DR HALO III	35.00
IBM AT 512 MEMORY EXP BOARD HAS 512 K MEM. FOR 5170 AT	50.00
MICROSOFT WINDOWS/386	50.00
XT FLOPPY CONTROLLER OEM PK	14.00
KEYTRONICS 101 KEYBD XT/AT	50.00
KEYTRONICS 101 KEYBD PS/2	50.00
COMPUTER CLOCK BATTERY, RAYOVAC 4.5V 200W POWER SUPPLY AT	50.00
WD 1007A ESDI CONTROLLER, OEM PK	125.00
MONITOR TILT & SWIVEL BASE	3.95
HARD DRIVE MOUNTING KIT 3.5 TO 5.25	7.00
AT HARD DRIVE RAILS	2.25
MITSUBISHI 1.2 FLOPPY	65.00
SONY 1.44 FLOPPY W/5.25 MOUNTING BRACKET	75.00
PARADISE EGA CARD OEM PK.	70.00

GRAPHIC BOARDS

EGA I - HERC. COMP. AUTO. SWITCH, XT/AT	79.00
EGA MIII - 640x480, 16 COLORS, 132 COL., HERC. COMP.	91.00
VGA 640 - 640x480 W/256K 8 BIT	103.00
AVGA - AUTOSWITCHING VGA 800x600 W/256K 8 BIT	115.00
VGA 800/16 - 800x600 W/256K 16 BIT	128.00
EVGA-16/256K - 800x600 W/256K, 16 COLOR UPGRADE TO 512K & 1024x768	176.00
EVGA-16/512K - 1024x768 W/512K, 16 COLOR	212.00
ML-VSI - 800x600 W/256K-EXP TO 512K & 1024x768, 16BIT	215.00
ML-ADV - 640x480 FASTEST 8BIT AVAILABLE XT/AT/PS2	130.00

DTK BAREBONE SYSTEMS

DTK-1000, 8088/10 MHZ, 0 WAIT STATES, 0K RAM, 150 WATT P/S, AT STYLE CASE, 1 YR. WARRANTY **\$180.00**

DTK-1230C, 80286/12 MHZ, 0 WAIT STATES, 0K RAM, 2 SER/1 PAR, 200 WATT P/S, MINI AT CASE, 1 YR. WARRANTY **\$380.00**

DTK-1230D, 80286/12 MHZ, 0 WAIT STATES, 0K RAM, 2 SER/1 PAR (full size), 200 WATT P/S, AT CASE, 1 YR. WARRANTY **\$395.00**

DTK-2000, 80386/20 MHZ, 0 WAIT STATES, 0K RAM, 2 SER/1 PAR, 200 WATT P/S, TOWER CASE, 1 YR. WARRANTY **\$1060.00**

DTK-2030, 80386/20 MHZ, 0 WAIT STATES, 0K RAM, 2 SER/1 PAR, 200 WATT P/S, MINI 386 CASE, 1 YR. WARRANTY **\$1000.00**

ACCESSORIES

SURGE PROTECTORS & POWER CENTERS

6 OUTLET W/SURGE METAL (WP002A)	9.26
6 OUTLET WALL MOUNT W/LIGHT (WY1031)	10.60
6 OUTLET W/EMI-RFI NOISE FILTER (WP003AN)	12.67
6 OUTLET EMI/RFI & MODEM (WP003C)	15.93
POWER CENTER 5 LIGHT ROCKER SWITCHES (WP005)	23.93

SWITCH BOXES

AB PARALLEL (CE362)	15.93	AA/BB PARALLEL	
AB SERIAL (CE252L)	15.93	CROSSOVER (CE36X)	23.33
ABCD SERIAL (CE254L)	22.60	AB 2 CENT 1 DB25 (CE25362)	19.95
AA/BB SERIAL (CE25X)	22.50	AB 2 DB25 1 CENT (CE36252)	19.95

STANDS

CPU STAND (UNIVERSAL) PLASTIC (CPUP)	7.33	PRINTER STAND 2 PC. PLASTIC (PLP)	7.93
CPU STAND (UNIVERSAL) METAL (CPUM)	15.93	MONITOR STAND 14" TILT & SWIVEL (41588)	3.95
CPU STAND W/CASTERS METAL (CPUMC)	23.93	METAL SWING ARM COPY HOLDER 80 COL (CH80A)	14.60
KEYBOARD DRAWER OVER COUNTER (OCKBD)	33.00	METAL SWING ARM COPY HOLDER 132 COL (CH132A)	18.60
KEYBOARD DRAWER UNDER CARRIAGE (UCKBD)	23.95	COPY CLIP PLASTIC (CHSA)	3.93
KEYBOARD SLIDE AWAY (KSA)	32.33	COPY HOLDER 80 COL (CH80)	7.33
PRINTER STAND 80 COL METAL (PSTM80)	9.26	COPY HOLDER 132 COL (CH132)	11.33
PRINTER STAND 132 COL METAL (PSTM132)	10.60	MOUSE PAD	3.33

OTHERS

MONITOR STATIC PROTECTOR (SB)	5.95	DISK BOX 5 1/4 100 PCS W/LOCK (S4100L)	7.33
11 PC TOOL KIT (TK10)	13.27	DISK BOX 3 1/2 80 PCS W/LOCK (31280L)	7.13
COMPUTER SER. KIT W/VAC (TK25)	27.93	DISK HAND CARRIER 5/4 (DHC5410)	9.27
COMPUTER CLEANING KIT (CCK)	15.93	DISK HAND CARRIER 3 1/2 (DHC3210)	7.93
MINI VACUUM CLEANER (VAC)	7.00	LAPTOP COMPUTER CARRY CASE	44.00

GENDER CHANGER

9F/25F	3.86	9M/25F	3.86	36M/36M	5.26	25M/36M	4.66	25F/36F	4.66
9F/25M	3.86	9M/25M	3.86	36F/36F	5.26	25F/36M	4.66	25M/36F	4.66
9M/9M	2.80	9F/9F	2.80			25M/25M	3.10	25F/25F	3.10

CABLES

KEYBOARD EXT (KB-0506)	2.86	SER. MOD. 9F/25M 6' (SR-06)	4.20
MONITOR EXT (MR-0906)	3.93	VGA EXT CABLE (PS15M15F)	8.67
PAR. PRINTER 6FT (PA-1806)	3.50	LINE CORD (LC)	3.00
PAR. PRINTER 10FT (PA-1810)	4.95	MONITOR/CPU POWER EXT	2.87
PAR. R/A 6FT (PRM-2506)	5.95	XT HARD DRIVE (XTHD) 2 PC	3.95
RS232 M/F 6FT (RSA-2506)	5.00	AT HARD DRIVE (ATHDFD) 3 PC	5.00
RS232 M/M 6FT (RSA-2506M)	5.00	SCSI 50P/50P (SCSI 50)	6.00
RS232 M/M 10FT (RSA-2510M)	6.33	SCSI 50P/25P (SCSI 25)	10.60
SERIAL F/F 10FT (RSA-2510F)	5.50	MONITOR EXT CABLE (MR 0906)	3.93

AD# 9009

CALL OR WRITE FOR FREE CATALOG

ORDER TOLL FREE 800-962-7795

WE BUY EXCESS AND OVERSTOCK INVENTORIES!!! SEND LIST OR CALL!!!

P.O.s Accepted from Government, Universities and Fortune 500 Companies Only

Ram Prices Subject to Change W/Market

15203 Midway Road • 1 Block North of Beltline • Addison, TX 75244 • FAX (214) 386-5642 • Phone (214) 386-5515

TEXAS RESIDENTS ADD SALES TAX • PRICE MAY VARY FROM RETAIL STORE • PRICES SUBJECT TO CHANGE WITHOUT NOTICE • SOME ITEMS LIMITED TO STOCK ON HAND • TERMS: COD, CASH, MC, VISA OR PRE-PAY

"World's Fastest PC"

—BYTE, IBM Special Edition, Fall 1989

64K cache-memory motherboard sizzles at Landmark 52.7, upgradable to 150.2 with 486/33 daughter board

Optional caching disk controller runs up to 15 times faster than standard

Removable, washable air filter protects against killer dust

350 watt power supply and thermostatically-controlled fans for trouble-free operation

AMI BIOS features built-in setup and diagnostics; and 100% compatibility with Novell, XENIX and OS/2

Plug-in motherboard/adaptor cage lifts out for fast bench service

Ruggedized tower design with hinged and lift off side and front panels for faster maintenance

Look through the tower of our SIA 386/33—or our new 486/33C (Convertible)—and you'll find a few of the reasons why *BYTE* said:

*"The 'world's fastest PC' is one that lets you finish your work in the least amount of time. Since this is what the BYTE application index measures, the SIA 386/33 has the most right to the claim." **

Thanks, *BYTE*. But we're a lot more than just fast. We provide our resellers with a full line of PC platforms that consistently beat the "big guys." Custom configurations delivered in weeks rather than months. And American-

made components, 50+ hour burn-in, AT hardware interchangeability, and AMI BIOS to ensure compatibility and reliability.

And we support our resellers. With exclusive channels, excellent margins, five-color brochures, double boxing, and 12-month warranties.

Our complete line of four 386 and five 486 high-performance PCs fits your serious VAR applications in CAD, imaging, publishing and networking.

So if you and your clients worry about performance, reliability and speed, call SIA today at (312) 440-1275.

* *BYTE* Editors, "Megahertz Madness," *BYTE IBM Special Edition* (Fall 1989): p. 13.

Systems Integration Associates.
The high-performance choice
for the serious reseller.



Systems Integration Associates
222 East Pearson
Chicago, Illinois 60611

Circle 550 on Reader Service Card (DEALERS: 551)

New: "Convertible" option
can be upgraded to a 486/33
with Landmark of 150.2!

Create Expert Systems with DBMS

A program for application developers called Guru FirstStep combines a relational DBMS, a fourth-generation programming language, and Structured Query Language support with the ability to create expert systems.

The program, developed by Micro Data Base Systems (mdbs), combines all the capabilities of KnowledgeMan/2 2.6, the company's information management system, with an expert-system development platform that supports up to 30 rules with one level of nesting.

Other features of the program include a forms manager, natural-language interface, custom report generator, color graphics, text processor, remote communications, and spreadsheet. A debugger lets you view source code through pop-up windows.

Guru FirstStep runs on the IBM PC with 640K bytes of RAM and a hard disk drive. **Price:** \$895.

Contact: mdbs, Inc., KG Software Division, P.O. Box 248, Lafayette, IN 47902, (800) 344-5832 or (317) 463-2581.

Inquiry 1020.

NCR's PC486/MC Exploits Micro Channel

A bus-mastering SCSI controller and 128K bytes of cache memory are just two of the high-performance features of NCR's new top performer, the PC486/MC.

The heart is an Intel i486 CPU. The motherboard can accept up to 16 MB of RAM and offers four Micro Channel architecture slots. The cache is contained in a pair of custom application-specific IC cache

chips that permit read-and-write-back operation.

NCR will offer an optional bus-mastering graphics coprocessor board made by GSS (and based on a Texas Instruments 34010) that provides high-speed 1024- by 768-pixel graphics independently of the CPU. The PC486/MC comes standard with Super VGA (800- by 600-pixel) graphics.

NCR will deliver the PC486/MC in four configurations. The base system has 1 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, and the Super VGA. The most powerful system has 8 MB of RAM and a 200-MB SCSI hard disk drive.

Price: \$9995 to \$16,995.

Contact: NCR Corp., 1700 South Patterson Blvd., Dayton, OH 45479, (800) 225-5627 or (513) 445-5000.

Inquiry 1022.

Image Manipulation Times Three on the Mac

Enhance, an image-enhancement program that offers 256 levels of gray support for filtering operations, lets you create up to three versions of the same image so that you can experiment with image filters without corrupting the original image. MicroFrontier says that the program offers real-time filters for brightness/contrast, gamma, gray-scale toning, and color/gray-scale thresholding.

With the program's cut-and-paste function, you can copy among the different versions of an image. Once you cut from one image, you can align it automatically or display it as a semitransparent overlay. An undo feature lets you convert an altered

image to its original state.

The program supports 256 colors for painting and drawing, offering airbrush, pencil, smudge, and smooth tools.

Enhance runs on the Mac II with 2 MB of RAM, an 8-bit video card, and a gray or color monitor. It supports TIFF, EPS, and PICT image formats.

Price: \$375.

Contact: MicroFrontier, Inc., 7650 Hickman Rd., Des Moines, IA 50322, (515) 270-8109.

Inquiry 1021.

Price Drop from Eighty/20

The Eighty/20 family of contact-management software just got less expensive: In addition to announcing an international version, the company reduced the price of the single-user, advanced, and network versions of its programs.

With Eighty/20, you can organize time, track activities, process mass mailings, record and report expenses, dial customers automatically, and generate reports.

Eighty/20 Exped 1.0 is the entry-level package. It requires 460K bytes of RAM.

Eighty/20 International has customizable formats for international dates, times, and sorts, including international address and phone fields.

The German version is now available; French and Spanish versions should be available shortly, the company says.

Price: Exped, \$189; Advanced, \$395; network version, \$995; international version, \$495.

Contact: Eighty/20 Software, 555 Third Ave. NE, Hutchinson, MN 55350, (800) 635-8020 or (507) 345-8020.

Inquiry 1019.

Retrieve BBS Documents with Graphics

With BulletFax, you can access documents from a DOS-based BBS and have those documents sent to any fax machine, Nuntius reports. The program works on any BBS that has drop to DOS (doorway) capability. Callers to the BBS can search, scan, tag, and fax out documents. If the BBS is single-line, the document is faxed as soon as you hang up; dual-line BBSes can fax documents while you're still on-line.

With BulletFax, a BBS can transmit a document created using desktop scanning equipment, Aldus PageMaker, or Ventura Publisher with graphics intact (the program also supports ASCII). BulletFax supports batch processing, the ability to create documents from existing databases. For example, while you're on-line, you can create an inventory list with the most up-to-date information and then transmit it to any fax machine immediately.

BulletFax works with single-line versions of TBBS, FIDO, OPUS, RBBS, Wildcat, and WWIV, and it supports BBSes that run under the DESQview/DoubleDOS environment. It requires an IBM PC with DOS 3.0 or higher and a 40-MB hard disk drive. If an Intel Connection CoProcessor 2400-bps modem is used, the BBS can receive faxes as well.

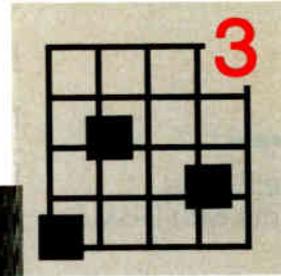
Price: BulletFax only, \$249; with Intel board, \$950.

Contact: Nuntius Corp., 1904 Merrill Dr., St. Charles, MO 63301, (314) 768-0109.

Inquiry 1018.

continued

INTRODUCTORY SPECIAL!



THE SQUARE³ 25 MHz **80386** PROCESSOR, 1 MB RAM VGA GRAPHICS WITH **COLOR MONITOR** 40 MB-**19 MSEC** HARD DRIVE, 1.2 MB FLOPPY

For more than three years, we've been a major supplier of PC-compatible computers to the OEM and European markets.

Now we've applied our experience and expertise to business computers, and after a year of testing, we're introducing the SQUARE line of 80386-based business computers—four models, plus custom configurations, to address every business need. To help introduce the SQUARE line, we're offering this special

\$2,295

SQUARE³ package—complete with VGA graphics and high-resolution color monitor and a remarkably fast hard disk. Plus

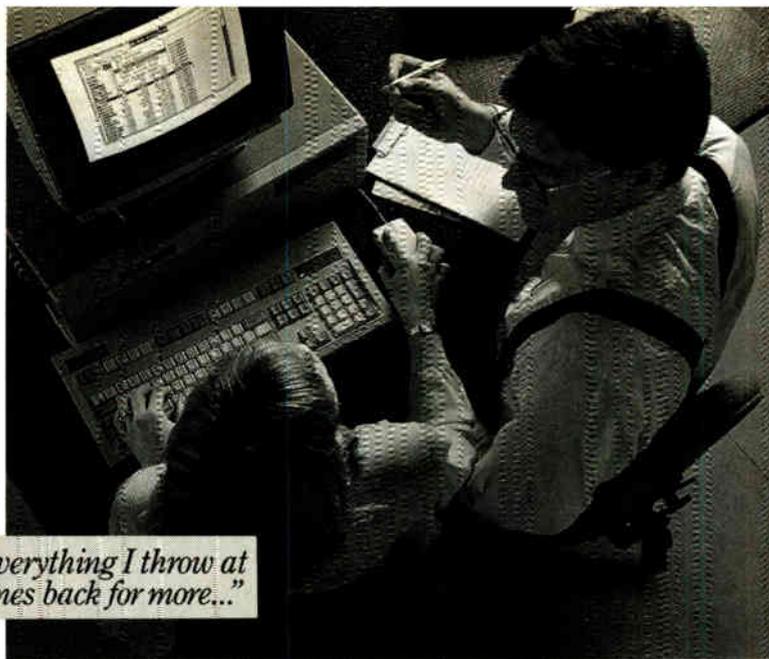
this system comes with MS DOS loaded, tested, and ready to run so getting started is as easy as plugging it in. And every SQUARE is backed by a 1-year warranty and a 30-day money-back guarantee. Call today to order your SQUARE³ or for more information on the entire line of SQUARE computers.

REASON TECHNOLOGY

The solution...Reason.

NOW CALL
TOLL-FREE
1-800-542-2049

290 Coon Rapids Blvd., Minneapolis, Minnesota 55433 • 612-780-4792 FAX 612-780-4797



"It takes everything I throw at it and comes back for more..."

YOU'VE BEEN SAYING OUTRAGEOUS THINGS ABOUT OUR 386-33MHZ COMPUTER.

Recently, when customers, potential customers and industry experts called us, they said something strange. They said, "Your PC-Link 386-33MHz computer works!" This was hardly cause for celebration. But then we heard that the other 386 machines have bugs. And that they're very expensive. (Now *that's* outrageous.) And that even compared to the Compaq Deskpro 386/33, our computer was the best choice for a 386-33MHz.

Get a Copy of our Report Card
In InfoWorld's 386/33 product comparison, we were rated "Excellent" in categories including CPU Speed and Hard Disk Access (sequential and random). "Very Good" described our software compatibility. And we shared the top rating for Value. Call us for a reprint of the InfoWorld report card and judge for yourself.

Ready to Work at \$5995
PC Link features a 33MHz PC/AT compatible—complete with 4MB of RAM and a 159MByte hard drive with 16ms access time and a 10MHz ESDI interface—for \$5995. For those with a large byte appetite, we also offer a 33MHz system with a 16ms 330MByte hard drive for \$6995.*

Compatibility
Thanks to its data bus speed of 8.33MHz, the PC Link 386-33MHz is fully compatible with IBM PC/AT expansion connectors. Which means our computer runs expansion cards for the PC/AT such as VGA cards, modems, network cards and the Bernoulli Box. Our compatibility list goes on to include DOS, OS/2, Windows/386, UNIX V, DESQview 386 and

off-the-shelf software. This computer takes everything you throw at it!

Speed

With the Intel 80386 microprocessor running at 33MHz, you can make very, very fast work of spreadsheet, desktop publishing and CAD/CAM applications. (To boost your math intensive applications, get our optional 33MHz 387 math coprocessor or Weitek Abacus chip.) Get your hands on our mighty zero wait state system with 64K Cache RAM—and never look back.

Quality

(Look what BYTE Says)
We've assembled an all-star team of Made in U.S.A. components for our 386-33MHz model. It features the acclaimed Hauppauge 386 Motherboard/33MHz (with one 32-bit, six 16-bit and one 8-bit expansion slot) and the Award Software Modular 386 ROM BIOS. BYTE Magazine wrote: "PC Link has done a good job balancing the price/performance equation. Nothing spectacular, perhaps, but a solid machine at a reasonable price."

— *Stanford Diehl,*
BYTE, 1989 IBM Special Edition

In addition to our new 386-33MHz PC, we offer the 386-16MHz and the 386-20MHz. All three systems have excellent reliability.

33MHz Standard Features:

- Intel 80386-33 microprocessor
- 4MB of RAM expandable to 64MB using a dedicated high-speed 32-bit memory slot
- 159MB 16 ms ESDI Hard Disk
- 64KB of high-speed static RAM cache
- 64K Shadow (BIOS) memory
- 16 bit VGA Adapter
- Sockets for 33MHz 80387 and 33MHz WEITEK 3167 math coprocessors
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive
- Dual diskette and hard disk drive controller
- Enhanced 101 key keyboard
- 1 parallel and 1 serial port
- 220-watt power supply
- MS DOS 3.3 or 4.0

16 and 20 MHz Standard Features:

- Intel 80386-16 microprocessor or 80386-20
- 640K DOS memory
- 320K Extended memory
- 64K Shadow (BIOS) memory
- Award Software connector BIOS
- 4-way interleaved RAM
- 0 wait states
- PC/AT compatible
- One 8/32-bit expansion slot
- Four 8/16-bit expansion slots
- Three 8-bit expansion slots
- 3 Programmable timers
- One 5.25" 1.2 MB or 3.5" 1.44 MB disk drive
- Dual diskette and hard disk drive controller
- Enhanced 101 key keyboard
- 1 parallel and 1 serial port
- 220-watt power supply
- Bundled with public domain utility, disk caching and system set-up software.

PC LINK Warranty

PC Magazine said: "The components are good enough to make you forget about the 1-year parts-and-labor warranty."** Still, it's here if you need it.

Call PC Link for a true 386-33MHz computer that actually works. Ask for a reprint of InfoWorld's 386/33 Report Card. Call: **1-800-221-0343**. In New York: (212) 730-8036. For information on our complete product line, request our brochure!

PC LINK

PC Link Corp. 29 West 38th St., New York, NY 10018, (212) 730-8036

*Monitors not included with systems **Reprinted from PC Magazine, May 30, 1989 Copyright © 1989 Ziff-Davis Communications Company
Trademarks: IBM PC XT, AT, PS/2; IBM, Intel, Windows, 386; Microsoft; DESQview; Quarterdeck

Rapid Systems' Waveform-Averaging Software

With Rapid Systems' R2 software and multichannel waveform digitizers, you can display up to 16 channels at once and average from two to 1000 waveforms per channel, the company says.

Digitizers that R2 supports can handle one to 16 independent channels, sample rates from 0.01 Hz to 20 Hz, data buffers of 128K bytes per channel, and 8 or 12 bits of A/D resolution.

Some of the features of R2 include digital scope display and the ability to display amplitude in engineering units of your choice. You can control acquisition and display parameters from pull-down menus.

R2 runs on the IBM XT or higher with 640K bytes of RAM. It is included with a Rapid Systems digitizer.

Price: \$1995 to \$6495, depending on the hardware. Contact: Rapid Systems, Inc., 433 North 34th St., Seattle, WA 98103, (206) 547-8311.

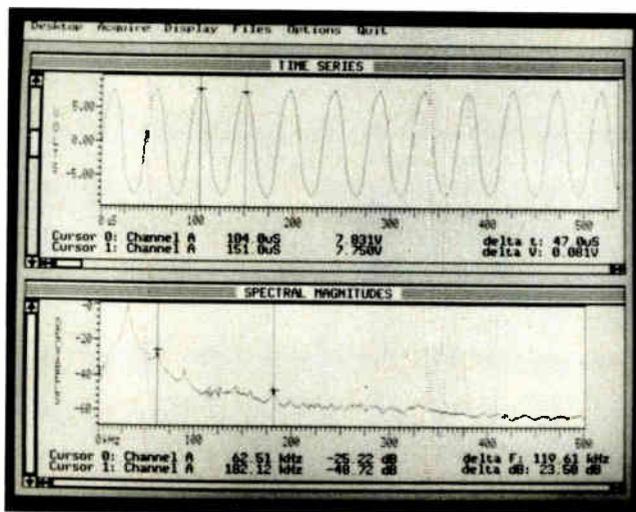
Inquiry 1023.

Flat-File Database for Under \$100

Ultra:Base is a flat-file DBMS designed for the novice user or someone who doesn't want to spend too much time reading manuals, the company says. You set up the database in folder format, with each folder containing up to 32,200 records.

Features of the program include a memo pad and an alarm clock, a calculator, global update, an amortization program, and an automatic phone list.

Ultra:Base runs on the IBM PC with 384K bytes of RAM.



R2 showing its split-screen capabilities: The top shows the time information associated with an electrical waveform, while the bottom shows the same waveform's frequency information.

Price: \$79.95.

Contact: International Distributors & Marketing, 24 North Hibbert St., Suite 6, Mesa, AZ 85201, (602) 644-1067.

Inquiry 1025.

Front-Line Security for the Mac

Magna's scaled-down version of Empower II, a security system for the Macintosh, limits access to your machine by accepting registered users only. Unlike its predecessor, however, Empower I doesn't provide for levels of access privileges.

Once inside the system, you can open any folder, but you still need a password to get into the system (that's what Magna means by "front line"). Empower I can optionally prevent start-up of the Mac from a floppy disk and control the use of floppy disks after start-up.

Security administrators are the only users who can add or delete registered users and change security options, the company says. A key icon can immediately blank the screen from prying eyes

when you're dealing with sensitive data, and a timed lock-out feature lets you blank the screen after a period of inactivity. The program can also log activity.

Empower I runs on the Mac Plus or higher.

Price: \$169.

Contact: Magna, 2540 North First St., Suite 302, San Jose, CA 95131, (408) 433-5467.

Inquiry 1024.

Manage PROM Programming on the PC

The PROM Master Support Program 1.10, an interface between the IBM PC and a PROM programmer unit, lets you edit and display PROM images in terms of the addresses the target machine sees, so that you don't have to do manual address conversions.

The program allows direct serial data transfers between Data I/O and Bytek PROM programmers of 19,200 bps and 9600 bps and the PC.

PROM Master Support Program 1.10 can automatically program PROMs for multiple PROM word widths of any multiple of 8 bits. The program verifies PROMs end

to end. It directly loads Intel object files produced by Intel (Santa Clara, CA) or Systems and Software (Costa Mesa, CA) locaters.

Price: \$99.95.

Contact: Roth Enterprises, 925 H Kirsten Court, Rohnert Park, CA 94928, (707) 586-9237 or (707) 762-2703.

Inquiry 1026.

Better Function Testing Through Talis

Auto Function Tester is a structured testing tool for C that Talis Computer Service says is designed to eliminate random testing and throwaway test cases. AFT supports relative timing, regression testing, and any function that takes parameters, the company says. With the tool, you can run hundreds of tests on your function with only one compile/link cycle. The program is self-documenting, saving all test data, output, and code. Test case coverage reports help you design better test cases, Talis says.

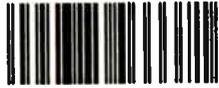
With the Source Code Catalog (SCAT), you can organize your functions in a database so that you can find functions by category, external reference, or description. The database is language-independent and supports Auto-Add functions in batch or interactive modes from C or dBASE source code and Microsoft-compatible libraries. The program comes with stand-alone and TSR versions. You can also search or view any file and paste function calls and paths.

Price: AFT, \$199; SCAT, \$99; SCAT network version, \$199.

Contact: Talis Computer Service, Inc., P.O. Box 1539, Nevada City, CA 95959, (916) 265-5777.

Inquiry 1027.

100% Ctn. Denim



0 94385 03337 1

100% Ctn. Denim



0 94385 03337 1

100% Ctn. Denim



0 94385 03337 1

100% Ctn. Denim



0 94385 03337 1

100% Ctn. Denim



0 94385 03337 1

100% Ctn. Denim



0 94385 03337 1

100% Ctn. Denim



0 94385 03337 1

Announcing: the A.B.C. of Business Competitiveness

A. DIRECT EDI BY EDWIN™ to Get Your Business on Line with Electronic Data Interchange

NO MORE hardware/software hassles with prices over the roof.
NO MORE indirect "Third Party" mailbox arrangements adding more expenses and more confusion to your business.

NO MORE struggles trying to understand the impossibles.

Install direct connection to your trading partners with:

- Edwin ALL-SYNC™ board (Cost: \$1,295) meeting EDI and popular communication standards (Bell 208A/B, 201C, 224, and CCITT v.22; sync or Async) with 3270/2780/3780 emulation software (Cost: \$325).
- DIRECT EDI BY EDWIN™ software package including Control Program and three standard functions: Purchase Order, Functional Acknowledgment and Shipping Notice (Cost: \$795).
- Additional Functions are available (Cost: \$295/Function).

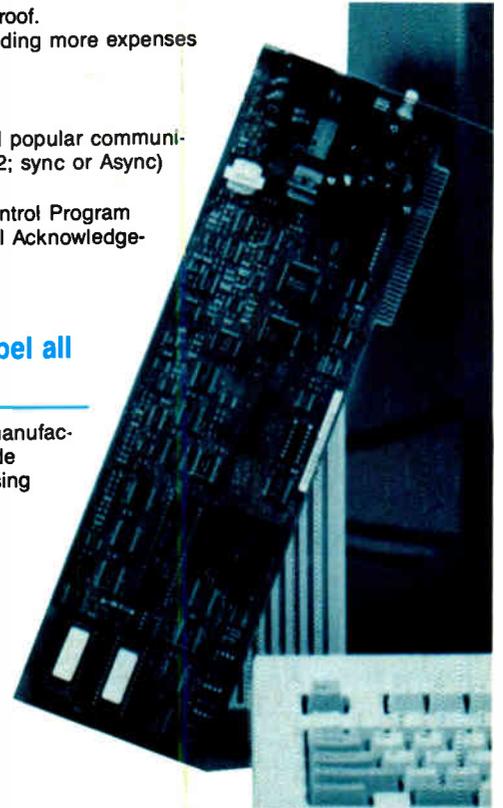
B. QUICK UPC BY EDWIN™ to Label all Your Products with Universal Product Code

Low cost UPC bar code product labelling solution for all manufacturers/importers/wholesalers/retailers. Prints UPC-A bar code labels on common office printers (9 & 24 pin and laser) using inexpensive office label stock (Cost: \$295).

- (8.5" x 11" label page) Prints 3x11, 4x11 and 5x11 on 9 and 24 pin printers.
- (8.5" x 11" label page) Prints 3x10, 4x10 and 5x10 on laser printers.
- (Address label) Prints 2 across or bar code with up to four text lines.

#18011 CHAMBRAY RUTH DOUGLAS TM

 BLUE, SIZE: 'S'
 100% COTTON 9oz
 0 94385 18011 2 SHERPA LINED



C. EDWIN 386™ SERIES to Complete Your Data Processing Requirements

Fast 32-bit micro-computers designed, built and tested for heavy duty business use, with layout(s) and configuration(s) suitable for data communication, file server and networking.



	16 MHZ 386-SX	20 MHZ 386-20	25 MHZ 386-25	33 MHZ 386-33	25 MHZ* 486-25
Internal Memory	2 Megs	4 Megs	4 Megs	4 Megs	4 Megs
Cache RAM	—	—	—	64K	128K
1.2 5¼" Drive	Y	Y	Y	Y	Y
1.44 3½" Drive	Y	Y	Y	Y	Y
Hard Disk	40 MB	80 MB	80 MB	150 MB	150 MB
	28 ms	28 ms	28 ms	18 ms	18 ms
16 Bit VGA Card	Y	Y	Y	Y	Y
512K 1024x768					
Color Monitor 14"	Y	Y	Y	Y	Y
1024x768					
1 Parallel &	Y	Y	Y	Y	Y
2 Serial Ports					
101 Key HQ Keyboard	Y	Y	Y	Y	Y
Controller Card	1:1	1:1	1:1	ESDI	ESDI
Commercial H.D.	Mini or	Mid Size	Mid Size	Full Size	Full Size
Vertical Case	Mid Size				
Power Supply	200W	200W	200W	275W	275W
MS DOS 3.3 or 4.01	Y	Y	Y	Y	Y
NET COST FOB NYC:	\$2,495	\$2,795	\$2,995	\$4,795	CALL*

*Available 3rd quarter, 90.

Edwin Systems Corp., 22 Steuben St. 2/F, Brooklyn, NY 11205, USA

Tel: (212) 575-7747, (718) 522-7285 John/Lionel/Paul

Fax: (718) 522-7289, (212) 575-7997

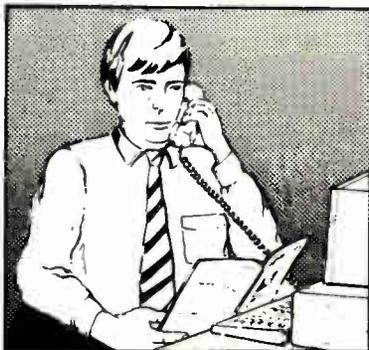
(Distributors/Reps/Consultants/Agents/Exporters Inquiries Welcome. Prices Subject to Change without Notice.)

Circle 530 on Reader Service Card (DEALERS: 531)

Made in USA

APRIL 1990 • B Y T E 52NE-19

Buy with Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- How long has the company been in business?
- Does the company offer technical assistance?
- Is there a service facility?
- Are manufacturer's warranties handled through the company?
- Does the seller have formal return and refund policies?
- Is there an additional charge for use of credit cards?
- Are credit card charges held until time of shipment?
- What are shipping costs for items ordered?

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

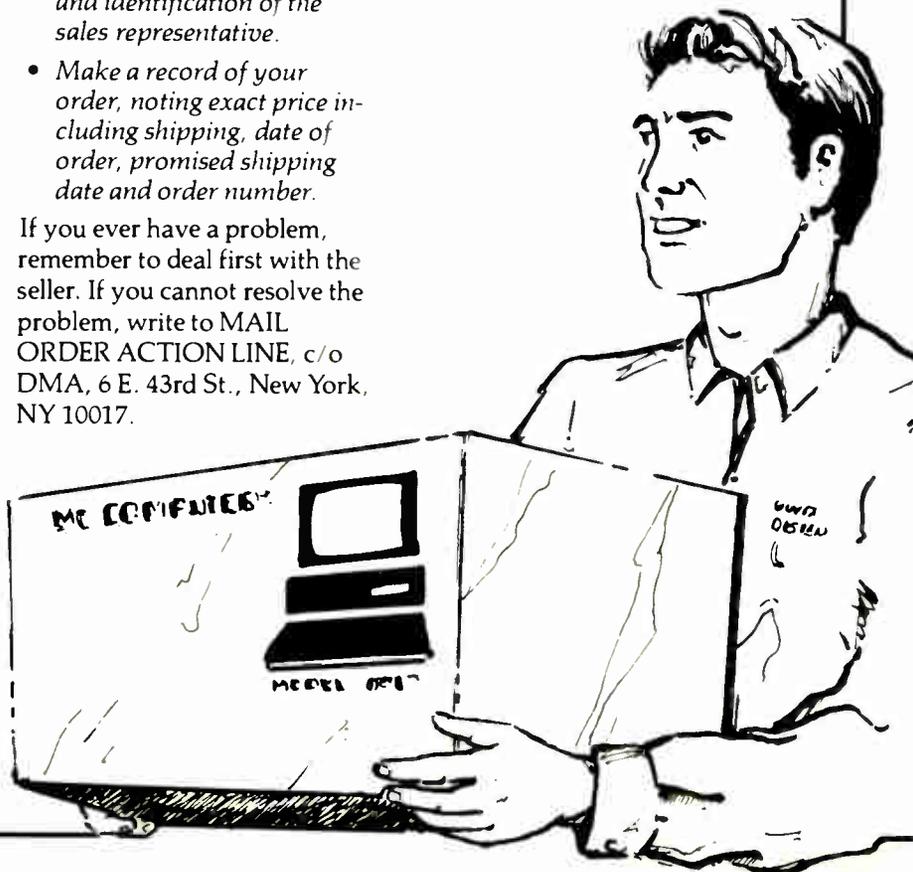
- State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.
- Establish that the item is in stock and confirm shipping date.
- Confirm that the price is as advertised.
- Obtain an order number and identification of the sales representative.
- Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing
Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMG
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association, Inc.



BUY DIRECT

FROM DIRECT FACTORY DISTRIBUTOR



CALL
TOLL FREE: **1-800-631-7111**
IN NEW JERSEY: 201-444-7367

**\$AVE HUNDREDS\$
OFF LIST PRICES**

Full U.S.A. Warranty & Service



**FOR HOME OR OFFICE,
BEGINNER OR ADVANCED,
WE HAVE THE SYSTEM
FOR YOU!**

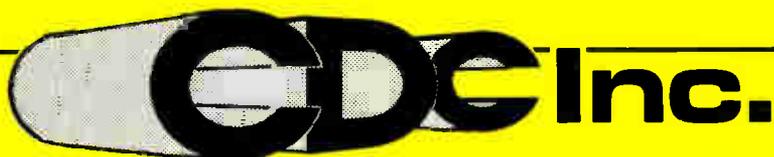


**COMPLETE COLOR VGA
"ULTIMATE SYSTEMS"**

- 1 Meg. of Ram (Standard)
- 1.2 Meg Floppy
- 40 Meg Hard Drive
- 16 Bit VGA Board/256 Video Ram
- 14" VGA Color Monitor
- 1 Parallel & 2 Serial Ports
- 1 Game Port
- 101 Keyboard
- 1 YEAR PARTS & LABOR

286 16 MHz	\$1699
386SX 16 MHz	\$1899
386 25 MHz 2 Meg Ram	\$2399
386 33 MHz 64 Cashe 8 Meg Ram	\$3499

ALL SYSTEMS AVAILABLE WITH CUSTOM CONFIGURATIONS



SPECIALS

EPSON COMPUTERS

EQUITY 1 +	\$599
EQUITY 1E	\$649
EQUITY 2 +	\$899
EQUITY 2E	\$969
EQUITY 386	\$2199

**TOSHIBA LAPTOP
CALL FOR
LOWEST PRICE**

SEAGATE DRIVES

ST-225	20MEG	\$199
ST-238R	30MEG	\$229
ST-251	40MEG	\$329
ST-277R	60MEG	\$429
ST-4096	80MEG	\$569
ST-4144R	120MEG	\$619

HEADSTART III

**COMPLETE COLOR
VGA SYSTEM
\$1988**

PANASONIC COMPUTERS

FX-1650	\$449
FX-1750	\$549
FX-1900	CALL
FX-1950	\$1499

PANASONIC PRINTERS

KX-P1180	\$179
KX-P1191	\$229
KX-P 1124	\$299
KX-P 1624	CALL
KX-P 4450	\$1299

HEWLETT PACKARD PRINTERS

HPIIP	\$999
HP11	\$1650
DESK JET +	\$689
PAINT JET	\$989

**COLOR VGA 256K
16 BIT VIDEO CARD**

Special **\$149**

OPEN 10 AM to 8 PM MONDAY THRU SATURDAY – TEANECK OPEN SUN. 11-5

PARAMUS 770 RT. 17 NORTH
PARAMUS, N.J. 07652
201-444-7367

TEANECK

506 CEDAR LANE
TEANECK, N.J. 07666
201-836-6666

Prices and availability subject to change without notice. Prices are for mail order only. In store prices may vary. \$4.95 minimum shipping, handling and insurance charge. All major credit cards accepted.

Comdek MONITORS TO GO



MAINBOARD AVAILABLE ALSO!

80386-20 MAINBOARD

80386-25 MAINBOARD

80386 SX MAINBOARD

80286 VLSI MAINBOARD

80286 SUNTAC MAINBOARD

DUAL SUPER VGA COLOR MONITOR SUPER VGA 1024x768 DISPLAY CARD

When it comes to monitors and related products, you don't need to think in initials, just remember one word: COMDEK. From our start in 1983 we've been making excellent color monitors with outstanding graphics capabilities. Later, we expanded our research and development, and now we produce a reliability MOTHERBOARD and high resolution VGA DISPLAY CARD.

With COMDEK, you always get what you want, when you want it—the latest technology and steady supplies. Contact us today for more information about our products. You owe it to yourself!

820 LONG HILL ROAD, GILLETTE, N.J. 07933, U.S.A.

TEL. NO: 201-647-7478 FAX NO: 201-604-8576

Microcomputer News On-Line

In this fast paced industry, can you afford to wait a week or a month for information that may affect you today?



MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983

Laptops!

LA-30A

2 Expansion Slots and Battery Operated!



- 12 MHz / 6 MHz 80286-12 Microprocessor, 80287-8 Coprocessor Socket
- 640 x 400 pixel graphics display, connector for external monitor
- Video Mode: MGC, CGA, MDA
- 1.44 MB 3.5" Floppy Disk Drive
- 20 MB 28 ms Hard Drive
- Two Expansion Slots (one 16-bit bus and one 8-bit bus)
- 1 MB RAM standard on board (optional 2 MB/5MB) extendable to 16MB, 64 KB ROM with setup utility
- 82-Key low profile keyboard with 12 function keys
- Internal sealed Ni-Cd battery
- External AC power
- 12.8" (W) x 3.1" (H) x 16.0" (D), 14 lbs.

20 MB
Part # 28-030

\$1999

40 MB
Part # 28-031

\$2199

Prices include carry case.

MITSUBISHI

"Boffin Bundle"



The mp286L which doesn't compromise on readability, speed, power, or expandability for the sake of portability gives you FREE "THE BOFFIN BUNDLE" - a copy of Microsoft MS Works, Microsoft DOS Manager, a 2400 baud modem, and a carrying case.

\$800 Retail Value FREE!

20MB. . \$1899 40MB** . \$2299

**Includes EGA



COMPARE:

FORA LP-286C	COMPAQ SLT/286	FEATURES	TOSHIBA T3200	FORA LP-286B
\$4195	\$5399	LIST PRICE	\$5299	\$3695
80C286	80C286	CPU	80C286	80C286
16 MHz	12 MHz	SPEED	12 MHz	16 MHz
1 MB	640 KB	ON-BOARD RAM	1 MB	1 MB
8 MB	3.6 MB	MAX. RAM	4 MB	5 MB
LCD / 32 GRAY	LCD / 16 GRAY	DISPLAY	GAS PLASMA	GAS PLASMA
VGA 640 x 480	VGA 640 x 480	DISPLAY	EGA	EGA
20/40 MB	20/40 MB	HDD	40 MB (38 ms)	40 MB (28 ms)
86 KEY (DETACH)	82 KEY (DETACH)	KEYBOARD	85 KEY	84 + 10 FUNCTION
14 LBS	14 LBS	WEIGHT	18.7 LBS	15.4 LBS
13.7" x 8.5" x 4.3"	13.5" x 8.5" x 4.1"	DIMENSIONS	14.6" x 3.9" x 15.6"	14.8" x 3.7" x 13.4"

The FORA LP-286C and LP-286B Laptops offer superior features at a much more affordable price than either the Toshiba T3200 or COMPAQ SLT/286.

New!



LP-286B

\$2695

FORA

LP-286C

\$2795

Toshiba is a registered trademark of Toshiba of America, Inc. Compaq is a registered trademark of Compaq Computer, Inc. FORA, the Fora logo and FORA character are trademarks of FORA, Inc.

PACKARD BELL



20MB **PB286LP** 40MB
\$1995 **\$2199**

- 12 MHz 80L286, 1 MB / 5MB RAM
- 1.44 MB FD, 20/40 MB 27 ms HD
- External FD Port
- Serial (RS-232) Port, Parallel Port
- Paper White High Res. Display CCFT double supertwist LCD panel
- 12V 4.0 Ahr Nicad Battery Pack
- 2400 Baud Modem. . \$199

TEXAS INSTRUMENTS



Light & Bright



TEXAS INSTRUMENTS

- Weighs 6.7 lbs.- inc. battery & 20MB HDD
- 12 MHz 80C286, 1 MB / 4 MB RAM
- Supertwist backlit LCD display
- Full-size AT-style keyboard
- MS-DOS 3.3 and Lap-Link in ROM
- Optional removable 3.5" high-density diskette and internal modem
- Black-on-white VGA display-defined graphics
- 12 MHz 80C286, 640K / 3.64 MB RAM
- 20 MB or 40 MB internal hard disk
- Internal 3.5" diskette drive
- Internal battery
- Full-size AT-style keyboard

Model 12. . \$2699

Model 25. . \$3399

Model 45. . \$3599

MEMORY

From Apricorn

T1600, T3100e, T3200SX, T5100	
2 MB	\$595
T5200 2 MB	\$495
T3200 3 MB	\$695
Zenith SupersPort 286 1MB	\$349
LA-30A	
1 MB/4 MB	\$349 / \$989
Mitsubishi	
2 MB	\$499
Packard Bell	
1 MB / 4 MB	\$249 / \$849
Texas Instruments	
Model 12, 1 MB LIM	\$549
Model 25 & 45, 1 MB EMS/Extended	\$749
Model 25 & 45, 2 MB	\$899

AUTHORIZED SERVICE CENTER:

AST, Chaplet, Epson, Hyundai, Toshiba, Zenith



Sales Offices

Washington D.C. Area:
703-444-0973

Denver Area: **303-752-1382**

Dallas Area: **214-788-4771**

Chicago Area: **708-823-9292**



The #1 Source!

THE
CORPORATE
SOURCE

800-255-4012

FAX: 612-894-6175
In MN: 612-894-0595

2500 W. COUNTY RD. 42 • #5 • BURNSVILLE, MN 55337

BOFFIN

L I M I T E D

Circle 525 on Reader Service Card (DEALERS: 526)

APRIL 1990 • BYTE 52NE-23

MANCHESTER & NEC EQUIPMENT COMPANY

WHY NOT THE BEST?



WHY MANCHESTER

- High quality industry standard products at unbeatable prices.
- Multi-million dollar inventory assuring you prompt delivery.
- 17 years of quality and dependability in the computer business.
- Knowledgeable sales reps who help you plan, design, implement and manage your computing environment.
- 15 step burn-in and test procedure on all equipment.
- A service department that maintains your equipment in first rate condition.
- Support specialists in sophisticated applications such as Networking, CAD/CAM, Desktop Publishing and Connectivity.
- Risk free corporate evaluations, both in house and on location; demonstrations on the newest and most innovative products.

WHY NEC

- Recognized as the standard in providing quality products, high performance rates and user reliability.
- An industry leader in the research and development of computer products for the past three decades.
- Outstanding desktop engineering systems designed for high user performance and growth potential.
- Industry Standard Architecture (I.S.A) and Extended Industry Standard Architecture (E.I.S.A)
- 24 Billion dollar a year company with an on-going multi-million dollar commitment to research and development.
- State of the art design with an extensive family of feature rich products.
- All systems designed with the end-user in mind.

DOUBLE YOUR COMPUTING POWER

with the only two names you need to remember, MANCHESTER and NEC. Give us a call today and find out more about the NEC POWERMATES. Why not work with the best! Let MANCHESTER satisfy all your system needs and lead your company through today's computer world and beyond.

Authorized NEC Computer and Printer Dealer

MANCHESTER EQUIPMENT CO., INC.

"The Computer Supply and Equipment Experts"

SYSTEMS INTEGRATION ■ NETWORKING ■ CONNECTIVITY ■ CAD/CAM ■ DESKTOP PUBLISHING
50 MARCUS BOULEVARD ■ HAUPPAUGE, NEW YORK 11788
(516) 435-1199 ■ (516) 434-8700 ■ FAX (516) 435-2113

New York City
(212) 629-6969

Ft. Lauderdale
(305) 491-7660

Tampa
(813) 962-8088

Boston
(617) 739-1555

For additional information, ask for Dan Kalata



CHAOS MANOR AWARDS

Jerry presents his annual awards for the best products of 1989

Well, it's year's end and time for the annual Chaos Manor Awards. Of course, this is the April issue, but there's no help for that; by me, a year ends in December when I write this column.

First the ground rules: these are *my* awards. This year for the first time we'll be giving out certificates—the basic design was done by Mrs. Pournelle with considerable help from the BYTE editorial staff—that bear the BYTE logo; what that means is that BYTE approves of my giving awards; however, they remain *my* choices, not those of the BYTE staff.

There are two award categories: the Chaos Manor Best of the Year User's Awards, which go to products that I consider the best in their respective categories *and that are in use at Chaos Manor*, and the Chaos Manor User's Choice Awards. In both cases, the awards go to products I use myself.

In addition to the awards, there's the Chaos Manor Orchid and Onion Parade for products, companies, and deeds that I think deserve praise or opprobrium.

Languages

I have for years said that small computers will come of age when programming languages are at the point where programming skill, per se, isn't as important as the ability to think up things for the machines to do. I tend to look for developments that move us in that direction.

One of those is object-oriented programming, of which a prime example is Borland's Turbo Pascal 5.5, which provides the simplest introduction to OOP that I know of. I've said enough about Turbo Pascal that I needn't repeat it

here; I really had no trouble deciding that Turbo Pascal 5.5 has earned the Language of the Year User's Choice Award.

I have to add that it was not the only significant user-oriented language development last year. It had two very serious competitors. One of them, Microsoft BASIC 7.0 Professional Development System, didn't get here until mid-December, and while that's technically in 1989, it hasn't been around long enough to be in this year's running. However, I have had it long enough to know I like it.

BASIC 7.0 is revised BASCOM with a world of new features. It's thoroughly integrated with CodeView, the Microsoft debugger. My late mad friend Dan MacLean really hated BASIC as a programming language because of its lack of structure, but I'm sure he'd share my enthusiasm for the new BASIC 7.0. He would, however, insist that it isn't really BASIC. BASIC in his day required line numbers, had few control structures and no declarations, and generally required liberal use of GOTO statements to build useful programs. Now, not one of those criticisms applies.

Microsoft's BASIC 7.0 compiler has a lot of interesting features. For one thing, it breaks the 64K-byte string space limit. For another, it can automatically use EMS memory, which means that on a 386 with a memory manager such as Quarterdeck's QEMM-386, you can have very large programs without kludges. There are already several commercial games that are written in compiled BASIC; now there will be even more. Microsoft BASIC 7.0 looks very good indeed as a language for developing large and complex programs quickly and easily.

There's a significant development in the other direction, as well. I described Crescent's P.D.Q. library for Microsoft QuickBASIC 4.5 in the February column: with P.D.Q., you can build small, fast programs in BASIC, including TSR programs; P.D.Q. has already earned its User's Choice Award. Equally impor-

tant, Crescent is revising their entire line of professional BASIC tools and routines to work with the new Microsoft BASIC 7.0; those should be out by the time you read this. The result is a truly professional capability that provides a highly friendly and productive environment.

Microsoft and Crescent have taken several giant steps toward the world I envisioned 10 years ago, in which anyone could write and debug decent programs. A world in which you concentrate on what you want the computer to do, rather than how to persuade it to do it. True, behind that kind of "user programming" there have to be some very sophisticated people writing software tools in assembly language—which is fine by me. I don't really know how my books are printed and bound, either.

Follow the Dots . . .

When I got old Ezekial, my first computer, about half the cost was for a Diablo daisy-wheel printer. Later I upgraded to an NEC Spinwriter. It's faster than the Diablo and uses a thimble rather than a daisy wheel, but otherwise it's not a lot different from the old Diablo: big, clunky, loud, and pretty slow.

I solved the whole problem by going to the Hewlett-Packard LaserJet; I got one of the very first ones, and I loved it. I'm told my raving about the thing helped HP's sales a lot, and I sure hope so. Incidentally, I still have it and still use it. It was upgraded to a LaserJet Plus, but that's the only service or maintenance it ever got, and it will be used to print out this column when I'm done.

I do use the old NEC Spinwriter once a month: when it comes time for the ritual known as The Paying of the Bills. I have an accounting program (I wrote it) that lets me enter the checks and credit-card expenditures and such into my General Journal; after which another program reads the Journal and writes the checks. The checks themselves come printed on

continued

tractor-feed paper, so there's no way they can be fed into the LaserJet. As a consequence, every month I drag the Spinwriter out of a closet and fire it up for the half hour it takes to write checks, and then I stuff it away again.

Then last fall I met someone from the printer division of Seikosha. "I need a little printer," I said. "The smallest tractor-feed printer you have."

"That's no problem," he said, making a note, "but don't you want a *real* dot-matrix printer as well?"

I'd never thought about it; what I really wanted was freedom from the Spinwriter. Still, Don Hawthorne, our writer apprentice at Chaos Manor, lives out back in the old apartment suite, and when he needs to print, he has to bring in a disk. That sounded like a fair test to Seikosha, and a few days later there arrived two Seikosha printers: a perfectly wee little thing called the SP-2000, which weighs under 8 pounds and is about as small as anything incorporating a tractor feed could be, and the SL-230AI, which is about 25 pounds and fully as large as the NEC Spinwriter.

These arrived when I was about to go

off on a trip. I didn't even open the SL-230AI; I just pointed Don Hawthorne at it, handed him a printer cable, and told him to see if he could get it running with his Tandon AT compatible. It seemed a fair test: Don has much experience as a copy editor and proofreader, and he knows a good bit about typography and typesetting; but his hands-on experience with small computers is almost nil.

Don has used that printer to print out and sell enough stories that it's not really accurate to call him an apprentice any longer. He got the printer to work with Q&A and a roll of Avery labels to make up the labels for our Christmas greetings list; he does a good bit of my correspondence with it; and in general, he uses the printer daily. No glitches.

Dot-matrix printers have come a long way in the past few years. The SL-230AI is fast and relatively quiet, and best of all, the output doesn't look like dot matrix. Italic is *italic*, boldface comes out **boldface**, and so forth. They're quieter, too, not much louder than most office equipment.

I still prefer laser printers for both speed and print quality, but I have to say,

modern dot-matrix printers are plenty good enough. Incidentally, hooking up the SP-2000 so it would do the NEC Spinwriter's job took about 5 minutes; and it sure takes up a lot less room. Now my only problem is, what do I do with an old NEC Spinwriter?

Clearly, the Seikosha dot-matrix printers have earned their User's Choice Award.

UPS of the Year

Ever since the Great Power Spike (see my August 1989 column), I have been sensitized to the need for power conditioning; in fact, not only have I had all my systems connected to surge protectors, but my major systems are connected to uninterruptible power supplies, usually called UPSes.

I have come to the conclusion that if you are serious about the value of the work you do on your small computer, you simply must get a UPS; it's as important as backing up your hard disk. If you run Unix, it's even more important, because Unix talks to the disk from time to time even if you're not around, and if

continued

Frequent Flyers.



If a portable computer has improved the way you do business away from the office, think what a portable modem can do for you. With it, you'll be able to send and receive data, and even faxes, anytime you want. In or out of the office.

The WorldPort family gives you a choice of four portable modems, including an MNP® error-correcting modem and an electronic fax/data modem.

Each is no more than 8 ounces and can fit in a shirt pocket. They're small but tough

and capable, built for the rigors of business on the road.

They connect to practically any telephone, public or private, via standard RJ-11 jacks or an optional acoustic coupler. They adhere to Bell and CCITT standards world-wide so you can connect to other modems (or fax machines) almost anywhere. They're powered by a single 9-volt battery or through an AC outlet, whichever is more convenient. And, they're easily shared as external peripherals among co-workers.

The WorldPort family of modems. They're built for travel, whether it's to extreme environments, to exotic locations or just down the hall.

Call us today for the dealer nearest you:

800-541-0345.

(In New York, 516-261-0423.)



Touchbase Systems, Inc.
160 Laurel Avenue
Northport, NY 11768
(516) 261-0423
Fax (516) 754-3491

MNP is a registered trademark of Microcom, Inc. WORLDPORT and TOUCHBASE SYSTEMS are trademarks of Touchbase Systems, Inc. © 1989 Touchbase Systems, Inc.

Erasable Optical Or Write-Once,



The Right Ones Are Right Here.

Today, there are important places for both erasable and write-once optical storage. But Storage Dimensions is the *one* place to find the right optical solution for you. Erasable *and* write-once. Plug-and-play. For every popular PC environment—DOS, Macintosh® and Novell®.

Applications such as image management, database distribution and back-up are naturals for high performance erasable optical storage. It's no coincidence that our new LaserStor™ Erasable Optical subsystem, with its nearly one gigabyte cartridge capacity and 35 ms average seek time, is *the* industry performance standard.

For archiving, document storage/retrieval and microform replacement, write-once optical

clearly makes the most sense. And the clear winner again is LaserStor, the number one desktop seller. That position will only get stronger with our newest write-once offerings. First, a 940-megabyte subsystem that combines high capacity with impressively high-speed throughput. And second, our compact, internally mountable half-high, 786-megabyte package.



LS800H Half High.
With Host Adapter.

The right optical products—Erasable and Write-Once—are right here, right now. So give us a call, right now. 408/879-0300. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.



STORAGE DIMENSIONS

Call me, I'm interested; circle 270

Please send literature; circle 271

LaserStor is a trademark of Storage Dimensions, Inc. © 1990 Storage Dimensions

B-1.S1

there's a power glitch while Unix is doing whatever mysterious things it does, you can lose *everything*.

Anyway, we've been collecting and testing UPS systems for several months now. Naturally, the only kind I'd even consider testing do power conditioning as well as provide emergency power. That eliminated several. Some we tried didn't work properly. I'd plug the Zenith Z-248 (286) computer into the UPS, get Q&A Write going, and yank the UPS power

cord. If the computer had any problems at all, that UPS went back to its manufacturer. Then I plugged the UPS into a Variac and ran the voltage down; if the UPS didn't kick in before the computer noticed, we got rid of it. That got rid of a *lot* more UPS boxes.

Eventually we were down to just two brands of UPS. Both had come through the initial tests all right.

One surviving UPS is a small desktop unit, a cute little thing with convenient

switches and flashing lights, a lot prettier than its Clary competition. It's also quieter; the Clary desktop UPS has a fan sound squarely in a frequency I'm sensitive to. Mind you, that's not a real flaw for most people; I have a condition commonly known as "artillery man's ear," which means serious hearing losses in scattered frequencies, no losses at all in others. The result is that I don't hear my own voice very well, and many conclude I'm deaf as a post; but in fact I hear high frequencies better than most people, so that things that sound normal or quiet to my friends are sometimes loud to me.

In any event, I chose the Brand X UPS (I don't name it for reasons I'll give later) to sit on my desk, and Don Hawthorne got the little desktop Clary, which, incidentally, he loves, but that's getting ahead of the story.

I plugged Big Cheetah, a 386/387 with a Distributed Processing Technology disk drive controller, a Priam 330-mega-byte hard disk drive, and 4 MB of memory, into the UPS. I plugged in the Zenith Flat Technology Monitor (FTM). Then into the outlet labeled "printer" I plugged in a four-outlet box, into which I plugged the USRobotics modem, a CD-ROM drive, and the Maximum Storage WORM (write once, read many times) drive. That's three items, leaving the fourth outlet on the strip empty. The UPS fired up, and everything seemed to be working properly.

It was that way for weeks; then one day the housekeeper plugged a vacuum cleaner into that empty fourth outlet on the power strip. For about 2 minutes nothing happened; then, Whammo!, the system sounded horrible warnings, and everything shut down. Clearly, overloading that UPS was *not* the thing to do. I unplugged the vacuum cleaner and restarted. Nothing. A glass cartridge fuse had blown, and until it was replaced, the UPS was dead. Once the fuse was replaced, everything seemed all right—

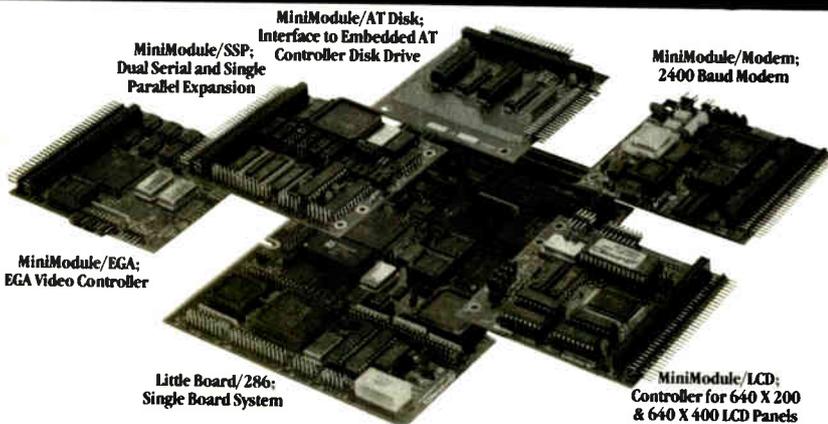
Until a couple of weeks ago. We've been having rain in Los Angeles. Rain does odd things here. Power spikes. Miniblackouts in which lights flicker. And every time the lights flickered, Big Cheetah reset. He came right back up OK, but he had *reser*. Fortunately, my habit is to save early and often, so nothing was lost; but this clearly was not why you want a UPS!

Time for some investigation. I had Don Hawthorne bring the little Clary UPS from his room and plugged Big Cheetah into it.

The Clary UPS has fewer switches and

continued

Build your embedded PC or AT any way but big.



Little Board™ plus Minimodules™

Embedded applications. Ampro's Little Board PC and AT compatible single board systems are ideal for embedded or dedicated applications. Specifically, applications which demand small size, high reliability, rugged design and low power consumption. Now, Ampro MiniModules allow you to build Little Board systems into a wider range of applications while meeting these same requirements.

Little Board/PC or /286. Take your pick. PC compatible or AT compatible. Both single board systems are equivalent to a motherboard and four expansion cards in a single 5.75" X 8" card. Both offer low power consumption, single 5V supply operation and 0 to 70°C operating range.

MiniModule Expansion. Extend your Little Board based embedded system using Ampro MiniModules. These compact 3.5" X 3.8" boards provide CGA or EGA video interfaces,

LCD or EL panel controllers, Arcnet LAN controller, 2400 baud modem, serial/parallel port expansion or an interface to hard disks with embedded AT controllers. Stack 'em vertically or side by side. Build a big system in small space.

Complete information. Fast. Call us at the number below. We'll immediately forward specifications and details on the Little Board family of single board systems and MiniModules. Then, you can build your embedded system. Any way but big.

All trademarks are the property of their respective owners

408-734-2800

AMPRO

SINGLE BOARD SYSTEMS
Ampro Computers, Inc., 1130 Mountain View/Alviso Road
Sunnyvale, CA 94089. FAX (408) 734-2939. TLX 4940302

Distributors: Regio: USA - contact AMPRO for the name of your nearest rep. Australia - 61 3 720-3298. Austria - 43 222/3109110. Canada - (604) 438-0028. Denmark - 455 5166 20 20. Finland - 358 0 585-322. France - 331 4842-2222. Germany, West - 49 6151 7405-35. Hong Kong/P.R.C. - 5 861 5118. Israel - 972 3 49-16-95. Italy - 39 6811-9906. Japan - 81 3 257-2630. Netherlands - 31 10-411 8521. Norway - 46 8 28-72-86. Sweden - 46 8 28-72-86. Switzerland - 41 1 740-41-05. United Kingdom - 44 2 964 35511

Series 4 Assemblers/Simulators/Compilers

Assembler:

Full listing control, conditional assembly and built-in cross-referencing. User-defined sections. Linker & Librarian. Listings can be relocated by the Linker to reflect actual run-time addresses.

Outputs:

IntelHex, Extended IntelHex, Motorola s19, s28 and s37 file formats. Supports the most commonly used symbol table formats.

Simulator-Debugger:

Address, memory and register breakpoints with optional pass count. Read/write and write-only memory trapping. Single step, trace, undo, and multiple scrollable hex windows. Supports all symbol table and file formats output by 2500 A.D. Linker.

Compiler:

Supports in-line assembly language, ROM-able code and full floating point. Includes Macro Preprocessor, Assembler, Linker, Librarian, C and Assembly Libraries, and Simulator-Debugger (except Z280 & 68020). C-Library source extra.

Memory:

Series 4 products require a 640K MSDOS system.

Processor	All products are available for MSDOS, OS/2 and XENIX			
	Macro Assemblers	Simulator-Debuggers	C Compilers	Library Source
Super 8	200.00	150.00	600.00	250.00
Z-8	200.00	150.00	600.00	250.00
Z-80	200.00	150.00	600.00	250.00
Z-280	300.00		500.00	250.00
Z-8000	300.00			
1802	200.00			
6301	200.00	150.00	600.00	250.00
64180	200.00	150.00	600.00	250.00
6501/02/C02	200.00	150.00		
65816	300.00			
6800,2,8	200.00	150.00		
6801,3	200.00	150.00	600.00	250.00
6804	200.00			
6805	200.00	150.00		
6809	200.00	150.00	600.00	250.00
68C11	200.00	150.00	600.00	250.00
68000,8,10	300.00	200.00	700.00	250.00
68020	400.00		600.00	250.00
8400/C00	200.00			
8044/51/52	200.00	150.00	600.00	250.00
80410/710	200.00	150.00	600.00	250.00
80451	200.00	150.00	600.00	250.00
80515	200.00	150.00	600.00	250.00
8080	200.00	150.00		
8085	200.00	150.00		
8086/88	100.00			
8096	200.00			
80186/286	200.00			
80386	300.00			
8748	200.00	150.00		
87751	200.00			
740	200.00			
NSC800	200.00	150.00	600.00	250.00
PDP-II	300.00			

Name _____
(Please Print)

Company _____

Address _____

City _____ State _____ Zip _____

Phone _____

Product _____ Operating System _____

Series _____ Amount \$ _____

Shipping \$ _____ Total \$ _____

Signature _____

Check COD (U.S. Only)

MC/VISA/AMEX # _____

Expiration Date _____

Educational discount available.
To order, call toll free in U.S. (including HI, PR and VI):

1 800 843-8144

In Colorado: (719) 395-8683

TELEX: 752659/AD FAX: (719) 395-8206

For more details, ask for a free brochure.

(Shipping is \$31.00 per unit for overseas orders. Toll Free number does not apply to overseas. 2500AD pays COD charges.)

Circle 8 on Reader Service Card

2500AD SOFTWARE INC

109 Brookdale Avenue
 P.O. Box 480
 Buena Vista, Colorado 81211

Call us for a free AnthroCart catalog: 800-325-3841



Anthro®
Technology Furniture®
 3221 N.W. Yeon St.
 Portland, Oregon 97210
 (503) 241-7113

Anthro, AnthroCart and Technology Furniture are registered trademarks of Anthro.

controls than the other one does; but it also has one thing the others lack, a line of lights, first green, then red. As you draw more current from the UPS, more and more of the green lights come on, until you overload it, and you get one green and one red; then, no green and two red, at which point it simply cuts things off and tells you in no uncertain terms that you can't overload it this way.

It did that with Big Cheetah. The interesting part is that it is rated for as much power as the UPS I'd been using on Big Cheetah—which *let me use it* but wasn't reliable. The Clary UPS, in other words, knew it was overloaded and was not about to fool me into thinking it was doing its job when it wasn't.

"You've had your Tandon 286 plugged into this Clary during the bad weather, haven't you?" I asked Hawthorne.

"Sure have. Never noticed a thing."

"Even when the lights blinked?"

"Nothing. I remember once I was writing and I'd just finished something and was saving it when the lights blinked. The Clary box screamed for a second, but then the lights came on, and no problem. I just went on working."

He just went on working, while Big Cheetah, supposedly protected by the other UPS, reset itself.

So, as I write this it's raining outside, and I have a lash-up. Big Cheetah is still plugged into the other UPS, but *that* is plugged into a big, hairy extension cord, which runs across the Great Hall to the soundproofed electronics closet; and in that closet the big extension cord is plugged into the *big* Clary UPS, their 1.25-kVA OnGuard system. As I wrote this, I deliberately did *not* save the last paragraph.

I walked over to that closet and yanked the cord that plugs the Clary UPS into the wall. It howled. I waited a moment and plugged it back in. Then I stood there and *jiggled* the plug, plugging it in and out as fast as I could about nine times. Came back here. As you see, the paragraph remains intact. Things plugged into a Clary UPS never know that you're torturing the poor thing.

The Clary 1.25-kVA UPS is in a closet because it is much louder than its little brother; it puts out a high-pitched sound that even my wife finds too much to be close to. That's all right. It doesn't need attending, and we'll never hear it in the cable closet. It would be all right in almost any kind of cabinet for that matter, but it's pretty big, and it's convenient to have it remotely located. Tomorrow, I'll string a power cable under the floor.

continued

SUNDAY 10-5 **PROMPT DELIVERY**

LAPTOPS	PRINTERS	MOUSE	EVEREX
COMPAQ LTE 2999 99	Diconne 150 Plus 299 99	Logi Track 74 99	2620 Int w/HP 5 100 99
Pro Series 286/40 3699 99	CALL	Microsoft Mouse 229 99	2400 Ext w/HP 5 320 99
MITSUBISHI 1590 00	CALL	Acorn Laser II NT 434 99	U.S. INDUSTRIES 575 00
286/ 20 MB 1999 00	CALL	Epson FX 850 639 99	Counter 901 9600 899 00
286/ 40 MB 2899 00	CALL	Epson LX 850 184 99	4851 9600 Dual 248 99
NEC 2599 00	CALL	Epson LX 105 J 409 99	4851 9600 Plus 339 99
Pro Series 286/40 3699 00	CALL	Epson LX 2400 294 99	WORLDPORT 248 99
Pro Series C50 100 5499 99	CALL	Epson LX 3400 599 99	2400 Ext w/HP 5 339 99
SHARP 1549 99	CALL	Fujitsu P-2201E 449 99	PHONE DEPT.
P. 4841 3085 43 HD 2399 99	CALL	NEC P-2200IE 454 99	Panas KXT 1472 57 99
PC 4211 226 43 HD 2399 99	CALL	NEC P-5300 599 99	Panas KXT 1450 65 99
TOSHIBA 1590 00	CALL	NEC P-5300 599 99	Panas KXT 1455 69 99
1 1700 5F 2349 99	CALL	NEC P-5300 599 99	Panas KXT 1460 79 99
1 2000 1E 2449 99	CALL	NEC P-5300 599 99	Panas KXT 1470 89 99
1 1600 4040 HD 3699 99	CALL	NEC P-5300 599 99	Panas KXT 3142 99 99
1 3108 40 HD 3699 99	CALL	NEC P-5300 599 99	Panas KXT 3145 132 99
1 3100 5X 3699 99	CALL	NEC P-5300 599 99	Panas KXT 3170 30 99
1 3200 5X 3699 99	CALL	NEC P-5300 599 99	Panas KXT 2335 41 99
1 5102 100 HD 3699 99	CALL	NEC P-5300 599 99	Panas KXT 2342 53 99
1 5202 100 HD 3699 99	CALL	NEC P-5300 599 99	Panas KXT 2355 59 99
ZENITH	GRAPHIC CARD	FACSIMILE (FAX)	COMBLES PHONE
Minisport Model 20 1599 00	ATI VGA W/HP 254K 199 99	World Port 2890 299 00	Freedom II 1770 99 99
Superport Model 20 2249 99	ATI VGA W/HP 512K 279 99	Everex Interim 469 99	Freedom II 1775 129 99
Superport 286 20 2599 99	Paralle 1024 512K 279 99	Workport 3500 429 00	Panas KXT 3834 82 99
Superport 386 51 389 99	Video 7 1024 512K 799 99	Workport 3500 429 00	Panas KXT 3832 84 99
Superport 386 51 100 389 99	Canon Fax 23 709 99	Workport 3500 429 00	Panas KXT 3842 124 99
MONITORS	Canon Fax 35 709 99	Workport 3500 429 00	Panas KXT 3842 124 99
Mish Osm 5.9 1649 99	Canon Fax 120 614 99	Workport 3500 429 00	Panas KXT 3890 139 99
Mish 6005 20 2249 99	Panas KXT 220 614 99	Workport 3500 429 00	Panas KXT 4200 159 99
NEC QM 2 A 459 99	Panaltax UF 150 1249 99	Workport 3500 429 00	HAND SCANNERS
NEC Multisync 2 A 584 99	Panaltax UF 250 1249 99	Workport 3500 429 00	HS 3001 Plus 159 99
NEC Multisync 3 A 1129 99	Panaltax UF 280 729 99	Workport 3500 429 00	HS 3001 Plus 159 99
NEC Multisync 4 A 1699 99	Sharp FO 230 899 99	Workport 3500 429 00	Log Scanner Plus 174 99
NEC Multisync 4 A 1699 99	Sharp FO 330 899 99	Workport 3500 429 00	
NEC Multisync 4 A 1699 99	Sharp FO 519 724 99	Workport 3500 429 00	
Princeton Ultra-sync 16 619 99	Sharp FO 580 824 99	Workport 3500 429 00	
Zenith Zrm 492 1599 00	Toshiba 3400 724 99	Workport 3500 429 00	
	Toshiba 3150 824 99	Workport 3500 429 00	

FAX # 212-463-8335
TOLL FREE 1-800-874-1235
FREE (800) 223-6779
IN N.Y.S. (800) 223-6779
S & W COMPUTERS & ELECTRONICS
 31 West 21 Street, New York, N.Y. 10010
N.Y.C. (212) 463-8330
 Hours Sun. 10-5
 Mon-Thurs. 9-6
 Sat. Closed

DISCOVER • M.L. VISA C.O.D. w/Deposit • No surcharge
 for credit cards. Ship & handle 5% + \$5.00. City Ltd.
 subject to change without notice. Returns
 in our written authorization. Free parking
 Sunday Meter parking available.

PRICES HARD TO MEET — SERVICE HARD TO BEAT! World Wide Inquiries Promptly Filled

THE NEW STANDARD FOR HIGH PERFORMANCE STATISTICAL SOFTWARE

CSS

**COMPLETE STATISTICAL SYSTEM
WITH DATA BASE MANAGEMENT
AND GRAPHICS**

A powerful, comprehensive, elegant, and super-fast statistical package for IBM (PC, AT, PS/2) and compatible computers. ■ The CSS optimized user interface with fast hierarchical menus incorporates elements of artificial intelligence; even complex analyses require only a few keystrokes (batch processing is also supported). ■ CSS features comprehensive, state of the art implementations of: *Basic statistics, Multi-way frequency tables, Nonparametric statistics, Exploratory data analysis with analytic graphs, Multiple regression methods, Time series analysis with modeling and forecasting (incl. full ARIMA), General ANOVA/ANCOVA/MANOVA, Contrast analysis, Discriminant function analysis, Factor analysis, Principal components, Multidimensional scaling, Item analysis/Reliability, Log-linear analysis, Cluster analysis, Non-linear estimation, Logit/Probit analysis, Canonical analysis, Survival and Failure Time analysis (Censored data), Quality Control analysis, and much more.* ■ All statistical procedures are integrated with fast data base management and instant, presentation quality graphics (over 100 types); full support for all mono and color graphics boards (incl. VGA) and over 100 plotters and printers (incl. the HP and Postscript standards). ■ All CSS screen output is displayed via customized Scrollsheets™ (i.e., dynamic, user controlled, multi-layered tables with cells expandable into pop-up windows); all numbers in a Scrollsheet™ can be instantly converted into a variety of presentation quality graphs; contents of different Scrollsheets™ can be instantly aggregated, combined, compared, plotted, printed, or saved. ■ The flexibility of the CSS input/output is practically unlimited: CSS offers an intelligent interface (read/write) to all common file formats (Lotus, Symphony, dBase, dBase III+, dBase IV, SYLK, ...) and special utilities to easily access data from incompatible programs; graphics can be saved in files compatible with desktop publishing programs (Aldus, Ventura). ■ CSS data files can be as large as your operating system (DOS) allows; OS/2 version coming soon. ■ CSS precision exceeds the standards of all common precision benchmarks. ■ *Technical note: The CSS user interface and all I/O were written in Assembler and bypass DOS; graphics and data management were written in Assembler and C; the computational algorithms were written in Assembler and optimized Fortran.* ■ \$495 (plus \$5 sh/h); 14-day money back guarantee.

Circle 267 on Reader Service Card



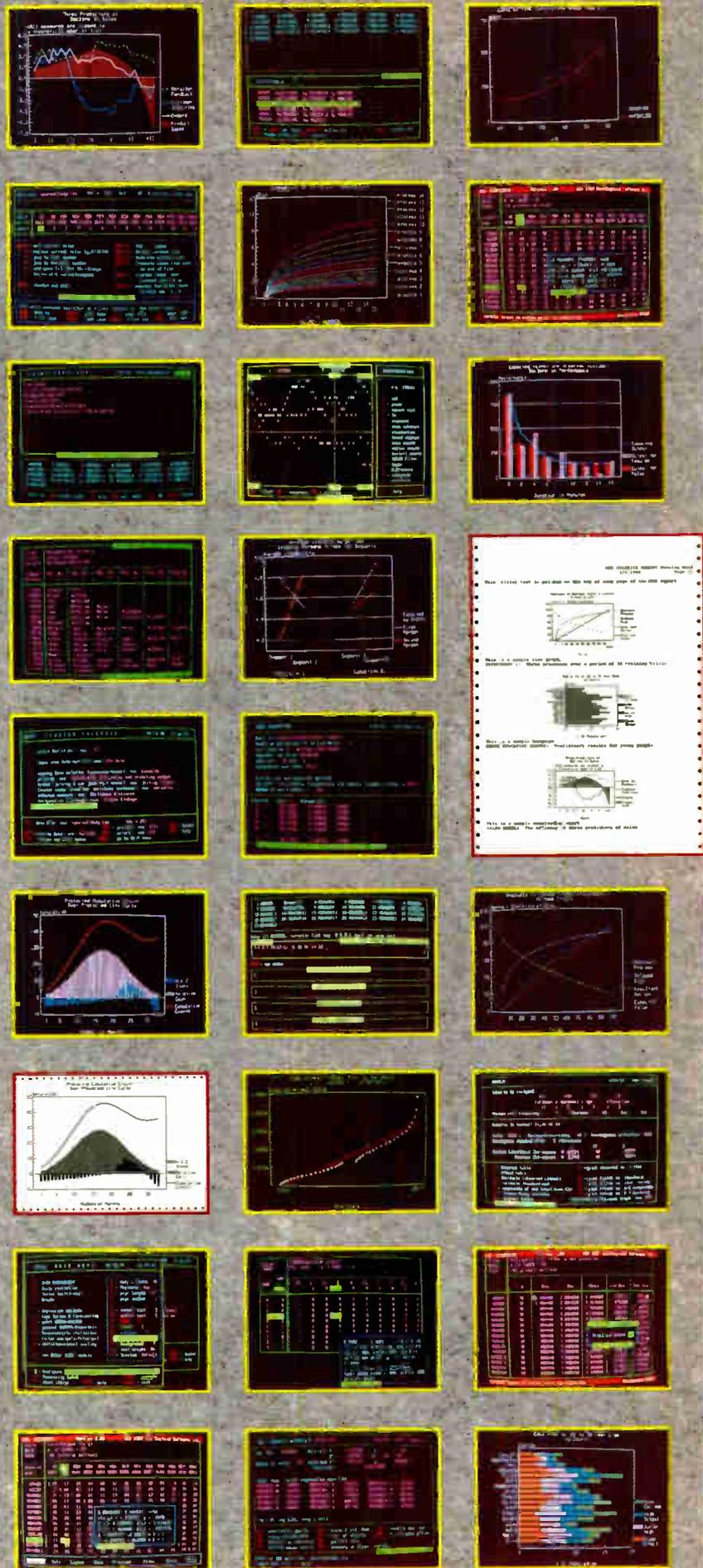
StatSoft

2325 East 13th Street ■ Tulsa, OK 74104 ■ (918) 583-4149

Fax: (918) 583-4376

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: 613-497-4755, fax: 613-499-7410, StatSoft Canada-CCO (Ontario), ph: 416-849-0737, fax: 416-849-0918 Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: Lemax BV 02968-94210; France: Conceptel (1) 45669700; Sweden: AkademiData 016-696201; Korea: Geul Bang (02) 272-1973.

World Radio History



As to why the other UPS is still on my desk, I have deadlines and it's a perfectly good power-distribution box. Besides, the monitor is sitting on it and I like the height. I'll change that tomorrow, too. I don't name this box because it's a perfectly good UPS if you don't overload it. After all, it did pass my preliminary tests. Its only real problem is that it doesn't tell you when it's overloaded.

But the clear winner of the Chaos Manor UPS of the Year User's Award is

Clary. I have no hesitation in trusting my work to Clary.

Dance of the Planets

There isn't much science education software, and a lot of it isn't very good, which is surprising, since computers are getting faster and their graphics better. Once in a while, though, comes a program that will simply blow you away.

Dance of the Planets is like that. It has an infuriating user interface that's hard

to learn unless you know a lot about astronomy. The view it gives you when you first fire it up isn't very intuitive. Even after you use it for a while, it will do things you didn't expect, and you'll have vexing problems trying to get it to do something simple. But none of that matters at all.

Dance of the Planets simulates the solar system. Once you've mastered it, you can move around from one viewpoint to another. Stand well back and watch all the planets go about the Sun. Set a date, past or future, to see where the planets are. Add the asteroids, and look again. This part of the program alone makes it an absolute *must* for me: I have several science fiction stories set in the asteroid belt, and it used to drive me nuts calculating where the various flying mountains were relative to each other and to the major planets. Now I just crank up Dance of the Planets.

Once you've looked at the solar system, zoom in on a planet, Jupiter, for instance, and see all the moons, plus the great bands on Jupiter itself. Now go look at Saturn as it appeared from *Voyager*. And on. It's not the easiest program to learn, but it's sure worth learning it.

Dance of the Planets works on EGA systems, but it's prettier on VGA. We've had it up on a Tecmar VGA card with a Zenith FTM, and a Samna VGA card with the 19-inch Electrohome monitor; you haven't lived until you've seen Saturn's rings on a 19-inch color monitor! A fast 386 with no coprocessor will run it fairly well, but a slower 286 with an 80287 math chip will be faster: this is a simulation program, and it has to calculate where all those objects are. A 33-MHz 386 with an 80387 really screams.

If you have the slightest interest in astronomy and the solar system, get this program, which I'm giving the Best Science Education Program of the Year User's Choice Award. Try it. You will love it.

Games

There are two kinds of games: those that you think you *ought* to enjoy, and those you just plain like. Chess falls in class 1 for me: I used to be a good chess player and even played successfully for money when I was in the army. I still follow the tournaments, and I guess I still think of myself as a chess player; but the fact is that I haven't played much in the past few years. I'm not sure why.

But, if I do play chess against a computer, the game to beat is Chessmaster 2100 from The Software Toolworks,

continued

C compiler
software simulator
source level debugger
macro assembler—development board
IBM-PC MSDOS—Sun, Apollo,
Dec UNIX—VAX VMS—Apple Macintosh

AVOCET

68000
68010
68015
68020
68030
68040
68050
68060
68070
68080
68090
68010
68020
68030
68040
68050
68060
68070
68080
68090

AVOCET
SYSTEMS, INC.

The Source For Quality Embedded-System Tools

Avocet Systems, Inc., 120 Union St., P.O. Box 490, Rockport, ME 04856
In Maine, or outside U.S., call (207) 236-9055
TLX: 467210 Avocet CI / FAX: (207) 236-6713
Call today for free catalog 1-800-448-8500

LET'S GET RIGHT TO THE POINT.

The point is: today's applications require a great pointing device. PC-TRAC™, our newest advanced-design trackball, gives you precision control over every move your cursor makes. Without cramping your desk, your style or your hand.

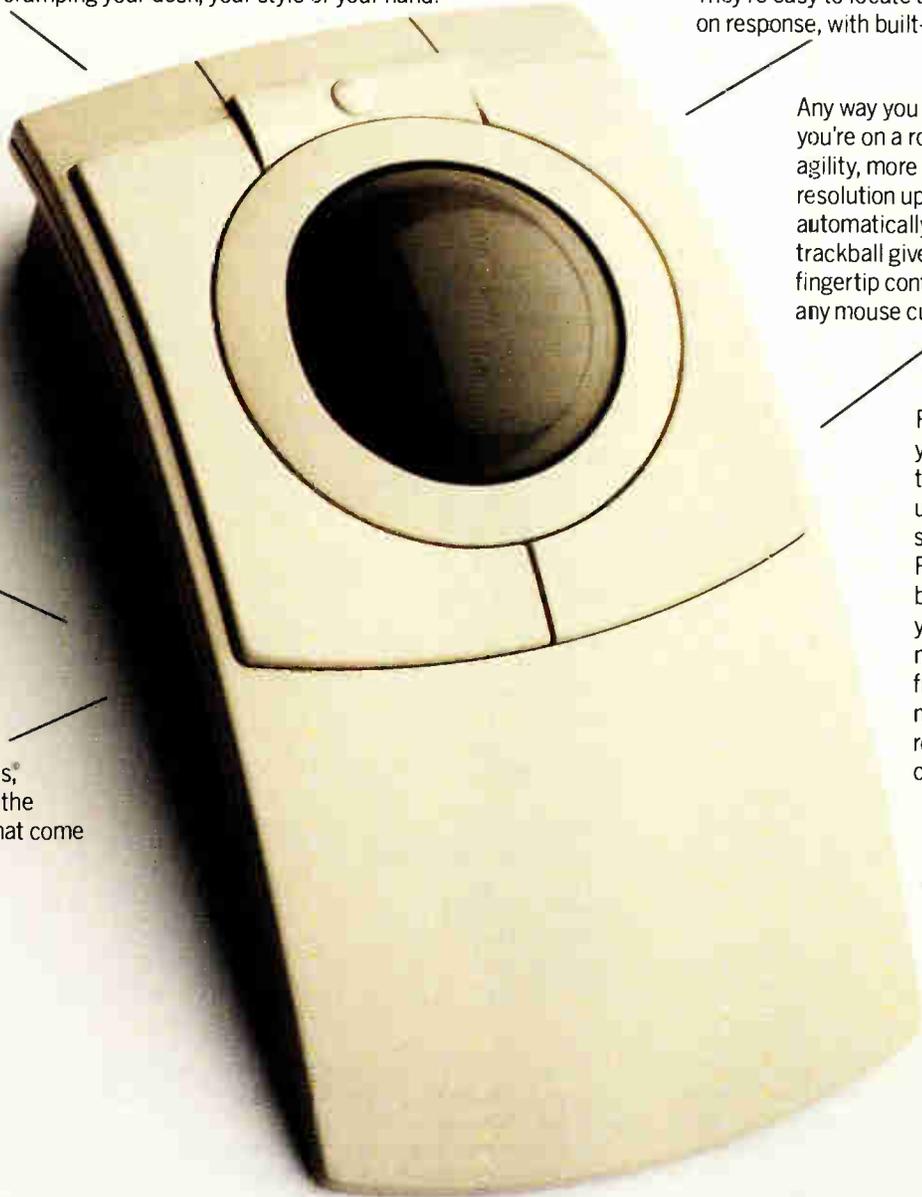
Click with your thumb or fingertips on PC-TRAC's wrap-around buttons. They're easy to locate and unexcelled on response, with built-in drag lock.

PC-TRAC is the most comfortable pointing device you'll ever lay a hand on. Relax your entire hand, while your fingertips master the power of touch with incredible ease. Control the ball and buttons with your fingertips. If mice ever made you feel like you're all thumbs, wait till you try PC-TRAC.

Any way you use PC-TRAC, you're on a roll with more agility, more precision, and resolution up to 1,000 dpi—automatically. And since the trackball gives you direct fingertip control, there's never any mouse cursor creep.

Just plug PC-TRAC in and perform. Minimal set up. No waiting. PC-TRAC is 100% Microsoft® Mouse or PS/2® Mouse compatible. For Lotus, dBASE®, or WordPerfect®, use the included software utilities that come in the box.

PC-TRAC fits beside your keyboard in less than 4 inches. And, unlike a mouse, it stays put in one spot. PC-TRAC gives you back the desk space your mouse and mouse pad took away from you. Now no mouse rowing, no mouse cleaning.



PC-TRAC. A great pointer. Check it out for performance, style and an unbeatable price.

PC-TRAC available in Serial, Bus, PS/2 and InPort™ versions. Suggested Retail Price \$119, bus version slightly higher.

MICRO SPEED
1-800-232-7888

International and California call (415) 490-1403 FAX (415) 490-1665

Circle 188 on Reader Service Card (DEALERS: 189)

ITEMS DISCUSSED

APX-5200 \$3575 Maximum Storage 5025 Centennial Blvd. Colorado Springs, CO 80919 (719) 531-6888 Inquiry 991.	Nemesis, the Go Master \$79 Toyogo, Inc. 76 Bedford St., Suite 34 Lexington, MA 02173 (617) 861-0488 Inquiry 997.	SL-230AI \$1149 SP-2000 \$329 Seikosha America, Inc. 10 Industrial Ave. Mahwah, NJ 07430 (800) 338-2609 (201) 327-7227 Inquiry 1003.
Chessmaster 2100 \$49.95 The Software Toolworks 19808 Nordhoff Place Chatsworth, CA 91311 (818) 886-5912 Inquiry 992.	Onguard PC-1.25k UPS \$2390 Clary Corp. 320 West Clary Ave. San Gabriel, CA 91776 (818) 287-6111 Inquiry 998.	Spectre GCR \$299.95 Gadgets by Small 40 West Littleton Blvd., Suite 210-211 Littleton, CO 80120 (303) 791-6098 Inquiry 1004.
Courier HST Dual Standard ... \$1595 USRobotics, Inc. 8100 North McCormick Blvd. Skokie, IL 60076 (708) 982-5010 Inquiry 993.	Palindrome 80 megabytes \$1295-\$1595 150 megabytes \$2295-\$2695 2.2 gigabytes \$7995-\$8095 Palindrome Corp. 850 East Diehl Rd. Naperville, IL 60563 (708) 505-3300 Inquiry 1000.	Sword of Aragon \$39.95 Strategic Simulations, Inc. 675 Almanor Ave. Sunnyvale, CA 94086 (408) 737-6800 Inquiry 1005.
Dance of the Planets 1.5 \$195 A.R.C. Software P.O. Box 1974 Loveland, CO 80539 (303) 663-3223 Inquiry 994.	Paper White VGA Monochrome Monitor \$199 Goldstar Technology, Inc. 3003 North First St. San Jose, CA 95134 (408) 432-1331 Inquiry 1001.	Turbo Pascal 5.5 \$149.95 Borland International, Inc. 1800 Green Hills Rd. Scotts Valley, CA 95066 (408) 438-8400 Inquiry 1006.
Macintosh IIX \$5269 Apple Computer, Inc. 20525 Mariani Ave. Cupertino, CA 95014 (408) 996-1010 Inquiry 995.	P.D.Q. \$99 Crescent Software 11 Grandview Ave. Stamford, CT 06905 (203) 846-2500 Inquiry 999.	
Microsoft BASIC 7.0 \$495 Microsoft Mouse \$150 Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073 (800) 426-9400 (206) 882-8080 Inquiry 996.	Premier 9000 \$5895 Premier Innovations, Inc. 10310 Harwin Dr. Houston, TX 77036 (800) 347-1777 (713) 995-4433 Inquiry 1002.	

only I don't win very often. Old-time readers will remember that The Software Toolworks was Walt Bilofsky's company distributing really nifty utility programs in ZipLoc bags back in S-100 CP/M days. The company has gotten a bit larger, and the packaging is slicker nowadays. There's been no drop in quality of products, either. Chessmaster 2100 is as good as chess programs come.

Go is intermediate between the games I think I ought to like and the games I like. I play more go than I play chess, and I like it more; indeed, if I were condemned to play only one game for the

rest of my life, I'd choose either contract bridge or go, depending on who I'd get in my bridge foursome.

There are two major go programs: Cosmo Go and Nemesis, the Go Master. Both are awfully good, and each has beaten the other in a computer go tournament. I believe that Nemesis is ahead this month. Overall it's hard to choose between them, but I find that when I play go against a computer, I almost always choose Nemesis, which tells me something. There are versions for both the Macintosh and the PC. I generally play on the Mac, but I keep the PC version on

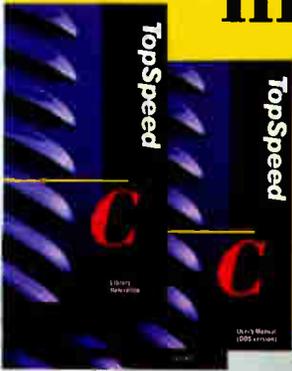
my Zenith 286 SupersPort laptop.

Finally, there's a game of no redeeming social value at all; it was just plain *fun*, and I played a lot of it last year: Sword of Aragon from Strategic Simulations. This is a game of medieval fantasy. The fantasy elements are good, but that's not what I really liked about this game. What I really liked was that you could quite realistically simulate medieval warfare, build combined-arms armies and use them properly, and win the game without letting magic dominate it at all.

Anyway, on reflection, I'm giving

continued

Can your compiler meet the challenge?



We invite you to take an existing program and compile it using TopSpeed C. Then, compare the overall performance with the compiler

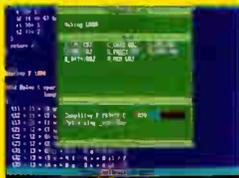
you now use. If you are not 100% satisfied, return the entire package to us, and we will refund all of your money.

	TopSpeed™ C Version 1.00	Microsoft™ C Version 5.1	Turbo C™ Version 2.0	Watcom™ C Version 7.0
100% ANSI compatible*	✓			
Integrated environment	✓		✓	
Pass parameters in registers	✓			✓
Expand any function as inline code	✓			
Supports DS/2	✓	✓		
DOS Dynamic Link Libraries <i>(overlays code linked at load-time)</i>	✓			
Smart linking <i>(only referenced code and data linked into .EXE)</i>	✓			
Type-safe linking <i>(function parameters and memory model checked at link-time)</i>	✓			
Fully automatic make works across libraries	✓			
Time-sliced scheduler for multi-tasking under DOS	✓			
Short pointers in any segment	✓			
Hypertext help with library online	✓		✓	

*Written by Neil Martin of the British Standards Institution (BSI) and printed in Personal Computer World June 1987, page 241

TopSpeed®

TopSpeed's seamlessly integrated multi-windowed environment.



VIO (Visual Interactive Debugger) a source-level, multi-windowed symbolic debugger.



In England & Europe contact:
Jensen & Partners UK Ltd.
c/o Clerkenwell Road
London EC1M 5NP
Phone: (01)253-4333
Fax: (01)251-1447

C Standard Edition £149;
C Extended Edition £295;
C OS/2 Edition £370.

Call on handling & VAT charges, and TopSpeed Modula-2 product prices.

Standard Edition —

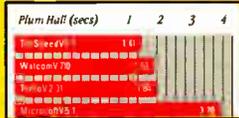
Optimizing DOS compiler, integrated source-level debugger, smart linker, automatic make, complete ANSI library, 6 memory models, BGI Interface, time-sliced scheduler, MS-DOS/BIOS interface, superset of MS and Turbo C libraries, and more.

Extended Edition —

Standard Edition plus full source code to libraries, post-mortem debugging, MS Windows support, support for DOS DLLs (overlays), assembler, disassembler, profiler, DOS call monitor, and more.

OS/2 Edition —

Extended Edition (except for DOS compiler) plus ability to generate DOS executables, full support of OS/2 Kernel & PM calls, OS/2 smart linker, fully automatic generation of DLLs, source for protected mode libraries, and more.



Downloaded from www.computers.com
Copyright © 1995, PC Business
Microsoft and OS/2 are registered trademarks of Microsoft Corporation.

TopSpeed C:

Standard Edition \$199
(DOS Compiler & VID)

Extended Edition \$395

OS/2 Edition \$495

64-page TopSpeed C Technical Specifications booklet available upon request

Call on TopSpeed Modula-2 compiler (with objects) & toolkits.

To Order:

In the U.S., call:
1-800-543-5202
In Canada, call:
1-800-543-8452

Call on shipping & handling charges & volume discounts. VISA/MC accepted.

30-day unconditional money-back guarantee.



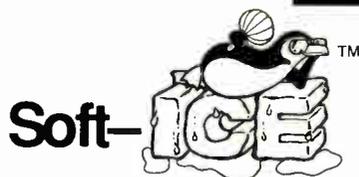
Jensen & Partners International

1101 San Antonio Road, Ste. 301
Mountain View, CA 94043
Phone: (415) 967-3200
Fax: (415) 967-3288

TopSpeed and TopKit are trademarks of Jensen & Partners International. Other brand and product names are trademarks or registered trademarks of their respective holders.

FINALLY. A debugging tool tough enough to handle the DOS Nasties.

New Version 2.0



Nasty over-write? No sweat!

Soft-ICE memory range break points help you track down memory over-write problems whether you are doing the over-writing or another program is over-writing you.

Hung program? No problem!

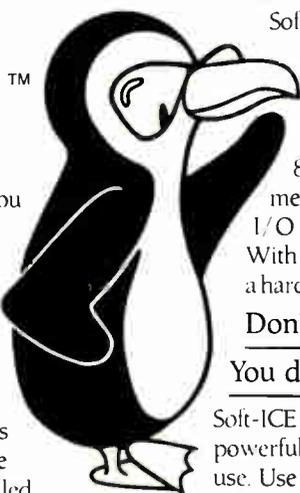
When the system hangs, you now have hope. With Soft-ICE you can break out of hung programs no matter how bad the system has been trashed. And with Soft-ICE's back trace ranges you can re-play the instructions that led up to the crash.

Program too large? Not with Soft-ICE!

Soft-ICE runs entirely in extended memory. This means you can debug even the largest DOS programs. And since your program runs at the same address whether Soft-ICE is loaded or not you can find those subtle bugs that change when the starting address of your code changes.

System debugging? Soft-ICE is a natural!

Soft-ICE is ideal for full source level debugging of TSRs, interrupt service routines, self booting programs, DOS loadable device drivers, real-time kernels, non-DOS O/Ss and ROMs. Soft-ICE can even debug within DOS & BIOS.



How Soft-ICE Works

Soft-ICE uses the power of the 80386 to surround your program in a virtual machine.

This gives you complete control of the DOS environment, while Soft-ICE runs safely in protected mode. Soft-ICE uses the 80386 to provide real-time break points on memory locations, memory ranges, execution, I/O ports, hardware & software interrupts. With Soft-ICE you get all the speed and power of a hardware-assisted debugger at a software price.

Don't want to switch debuggers?

You don't have to!

Soft-ICE can run stand-alone or it can add its powerful break points to the debugger you already use. Use your favorite debugger until you require Soft-ICE. Simply pop up the Soft-ICE window to set powerful real-time break points. When a break point is reached, your debugger will be activated automatically.

MagicCV with Soft-ICE

Using Soft-ICE with CodeView gives you the features necessary for professional level systems debugging. MagicCV and Soft-ICE can work in concert with CodeView to provide the most powerful debugging platform you will find anywhere.

"These may be the only two products I've seen in the last two or three years that exceeded my wildest expectations for power, compatibility and ease-of-use."

— Paul Mace

Paul Mace Software

Soft-ICE	\$386
MagicCV	\$199
MagicCV for Windows	\$199
Buy Soft-ICE & MagicCV(W)	—Save \$86.
Buy MagicCV and MagicCVW	—Save \$100.
Buy All 3	—Save \$186.

30 day money-back guarantee
 Visa, MasterCard and
 AmEx accepted



New Product/New Idea

Finds overwrites and un-initialized pointers automatically

All the protection of a protected O/S under DOS

Bounds Checker - \$249



Nu-Mega
 TECHNOLOGIES

CALL TODAY (603) 888-2386
 or FAX (603) 888-2465

RUN CODEVIEW IN 8K MagicCV



CodeView is a great integrated debugger; but it uses over 200K of conventional memory. MagicCV uses advanced features of the 80386 to load CodeView and symbols in extended memory. This allows MagicCV to run CodeView in less than 8K of conventional memory on your 80386 PC.

NEW—Version 2.0 includes EMS 4.0 driver.
Attention Windows Developers!
 Version available for CVW.

P.O. BOX 7607 ■ NASHUA, NH ■ 03060-7607

Circle 207 on Reader Service Card

World Radio History

CHAOS MANOR

Chaos Manor User's Choice Awards to Chessmaster 2100 and Nemesis, the Go Master; but the 1989 Chaos Manor Game of the Year User's Award goes to Sword of Aragon.

Monitors

The all-around best monitor in the business is Zenith's FTM, which has already got plenty of awards, including mine as monitor of the year two years running. It's crisp and clean and has no flicker. You can see it in all conditions of ambient light, from late night with other lights in the room to a bright, sunny afternoon with a window behind you. It's the monitor of choice for VGA systems.

However, it's also big, bulky, and comparatively expensive. Moreover, some people don't need color. I'll argue that if you can possibly afford it, the Zenith FTM is worth the money in what it saves you in eyestrain, even if you use it only as a monochrome monitor; but I also know that some won't agree.

We've looked into a lot of low-cost monitors this year, and one was outstanding: the Goldstar Paper White VGA Monochrome Monitor. It's about as low in cost as you'll find for anything of decent quality. It has crisp, clear images and no flicker. It's light in weight and cool-running. I used monochrome for years before I thought color was sharp enough to stare at all day; and the monitor I had then wasn't anywhere near as good as the Goldstar Paper White VGA monitor, which gets a Chaos Manor User's Choice Award.

Backup System

A lot of people seem to think that when I say something is "good enough" I am damning it with faint praise. Not so. In my judgment, "good enough" is high praise: it means I can use it without worrying about it; that it has all the features I need to get the job done.

There's one problem with starting off with hardware or software systems that are good enough: there's little incentive to experiment with anything else. This is fine when I'm thinking like a user, but it's not so hot when I'm looking for something new to write about. It's even worse for the people trying to get me to look at something new.

Most of you know that I'm partial to WORM drives in general, and the Maximum Storage WORM drive in particular. I've had a Maximum Storage WORM drive for a couple of years now, and it's more than good enough. I'll recommend the Maximum Storage WORM drive to anyone; and I've often said that if you're

serious about the value of what you do on your computer, you'll get a UPS and a WORM drive, because anything less is gambling in ways you'll regret. The Maximum Storage WORM drive got a year's best award last year, and it has improved considerably since; it more than deserves its User's Choice.

A WORM drive is great for a single user. It's pretty good when a couple of users share it, for instance through an Applied Creative Technology Systematizer. As the number of users goes up, though, while it's important to have at least one WORM drive—it's still the absolutely best way to be sure you have kept and can retrieve every version of your work—using a single WORM drive to back up the work of many people becomes difficult, while setting up and enforcing a centralized plan for ensuring that all valuable work is saved and cataloged becomes nearly impossible.

Last year was supposed to be the Year of the LAN. I don't think it was, and I don't think this year will be, either, but it does seem clear that networked microcomputers are getting more important as time goes by, and they already are stealing large portions of a market that used to be the private preserve of the minicomputers, including VAXen. Now, one of the strengths of VAX systems was the ability of the MIS to set up and enforce backup plans whereby, like it or not, *everyone's* work was systematically copied off and archived. It was something you couldn't do with linked microcomputers.

That's no longer true. Comes now Palindrome, a network-archiving system for Novell and Novell-compatible LANs, which will do just about everything a VAX backup system can do. Palindrome is software and firmware to run an automated 2.2-gigabyte Exabyte tape cartridge backup system.

Palindrome first goes out and backs up everything; depending on the size of the network, this could take all night the first time you run it. Once it has done that, Palindrome then works iteratively, copying anything that changed since the last backup. It uses a sophisticated tape-changing scheme so there's no chance of losing everything; and, of course, you can periodically send tape cartridges off-site so that you have a chance to revive your company even if the place burns to the ground. It also records what it has done and catalogs the files it has archived.

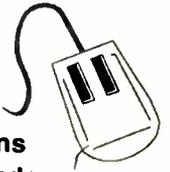
Palindrome comes as a complete system with an Exabyte tape drive, or, if you already have an Exabyte tape drive but

continued



#1 PROGRAMMABLE EDITOR

- Mouse support
- Pull-Down Menus
- Columnar Blocks
- Compiler Support
- Regular Expressions
- Best Multi-Level Undo
- DOS, XENIX and FlexOS
- Also VEDIT \$69, VEDIT Jr. \$29



FREE Evaluation Copy Call 1-800-45-VEDIT

After VEDIT hit the pages of BYTE magazine in 1980 it became the #1 programmer's editor virtually overnight. In January 1982, VEDIT was the first editor available for the revolutionary IBM PC. Since then, nearly 100,000 programmers, engineers and writers have been enthusiastic users of VEDIT.

The new VEDIT PLUS version 3.2 offers stunning performance, versatility and ease of use. Completely written in assembly language, it's lightning fast and small (66K). New features include 1000 level undo, columnar blocks, regular expressions, pull-down menus with "hot" keys and context sensitive help. You also get multiple file editing, windows, unlimited keystroke macros, automatic indenting and total configurability.

Source level debugging and easy assignment to keystrokes are just two reasons our macro language is the most powerful and practical available. The integrated compiler support is menu driven, highly flexible and ready to use for Microsoft, Borland and many other compilers and assemblers.

Only VEDIT PLUS lets you edit really large files of up to 8 million lines and 8000 chars/line. Installation is easy; VEDIT.EXE is all you need — no overlays, no environment variables.

Join the legend. The new VEDIT PLUS is the productivity breakthrough you have been looking for. \$185.

CompuView

P.O. Box 1586, Ann Arbor, MI 48106
(313) 996-1299 • Fax (313) 996-1308

don't have software as good as Palindrome—and I don't know of any that is—you can get the firmware and software alone. Either way, if you are running a Novell network system or contemplating one, I strongly recommend Palindrome, the Chaos Manor Data Backup System of the Year User's Choice.

MNP and ARQ

Sometimes I think I have the noisiest telephone lines in the U.S.; at least when it rains in Los Angeles, I get world-class line noise. There is, however, a remedy. Not all communications networks have it. Tymnet doesn't, for instance, and BIX has it on only a few direct-dial lines. MCI Mail has it, though, as does GE's GENie. I refer to a hardware error-correcting protocol system called MNP and ARQ. I confess I haven't the remotest idea of what those stand for, and what, if any, is the difference between them.

What I do know is that the new USRobotics modems can be set to use these protocols automatically. Once properly set, the modem sends a special signal to any modem it connects with. If it gets the proper return, the two go into communi-

cations in error-correcting mode—and you are not bothered by line noise no matter how bad the lines are. Moreover, when the lines are not noisy, the data transmission is much faster.

I don't have space for the technical details. But as a user, I find that MNP and ARQ pretty well solve the line-noise problems and speed up data transmission as well; and the USRobotics Courier HST Dual Standard modem wins hands down the Chaos Manor Modem of the Year User's Award. I love this thing.

Gadgets

I love gadgets; there's even a "gadgets" topic in the new technology conference that's part of my new exchange on BIX. There were a lot of really neat gadgets last year: the Atari Portfolio, a pocket-size DOS computer that I really like except that I can't get mine away from my son Alex; the Sharp Wizard; the Casio Boss; the Selectronics Word Finder; and a number of other dedicated special-purpose computers developed by Mike Weiner at Microlytics.

On reflection, though, one stands out: the Spectre GCR. Add this to an Atari

ST, and you have, for all practical purposes, a Mac Plus. Add it to Atari's neat full-function portable ST, and you have a low-cost portable Mac Plus. The Chaos Manor Gadget of the Year User's Choice Award goes to Dave Small of Gadgets by Small for the Spectre GCR.

Mice

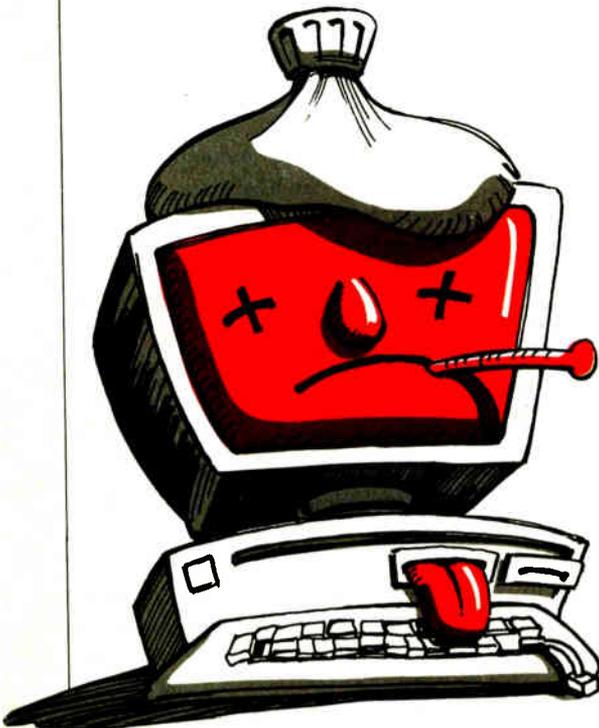
Like it or not, a good pointing device is becoming a necessity. I make no secret that I keep searching for new substitutes for the mouse. One product I mightily wanted to support was Logitech's TrackMan trackball system. Alas, for me it didn't quite make it. It was a good step in the right direction, but I find that the pointing device I prefer, and use at Chaos Manor, is not the TrackMan but Microsoft's "Dove-bar-shaped" Mouse. It fits the hand, looks nice, is easy to use, and gets this year's Chaos Manor User's Choice Award.

Orchids

Every year on BIX I ask for nominations for the Chaos Manor Orchids and Onions Parade: people, events, and things re-

continued

What's Wrong With This Computer?



- Memory Problem?
- CMOS Setup Error?
- Interrupt Conflicts?
- Unreliable Floppy Drive?
- Bad Disk Controller?
- Communication Port Bug?

Check✓It™ is the best, most complete PC Diagnostic program ever developed. Check✓It will run a comprehensive series of tests on your computer and report the results. Check✓It includes tests for the CPU, memory (base, extended and expanded), hard and floppy disk drives, video sub-system, communication ports, printer, keyboard, mouse and joystick(s). Check✓It is an easy-to-use software program that runs on all types of systems including PC, XT, AT, 386, PS/2 and compatibles.

Check✓It also displays complete information about the hardware and software installed on your PC, the IRQ assignments, DOS device drivers, and the CMOS table information. Check✓It will even perform benchmarks on your computer, showing how it compares to other standard models. Check✓It will print a report on the configuration, tests and benchmarks or save the results in a disk file.

Has your computer been acting funny lately? Get a copy of Check✓It at your local dealer or call TouchStone Software TODAY! The PC you save could be your own!

CALL NOW!
 (800)-531-0450
 or (213) 598-7746



TouchStone
 Software Corporation
 909 Electric Avenue, Seal Beach, CA 90740

Copyright © 1990 TouchStone Software. Check It is a registered trademark of TouchStone Software Inc. All other trademarks are of their respective manufacturers.

“Xerox this memo.”

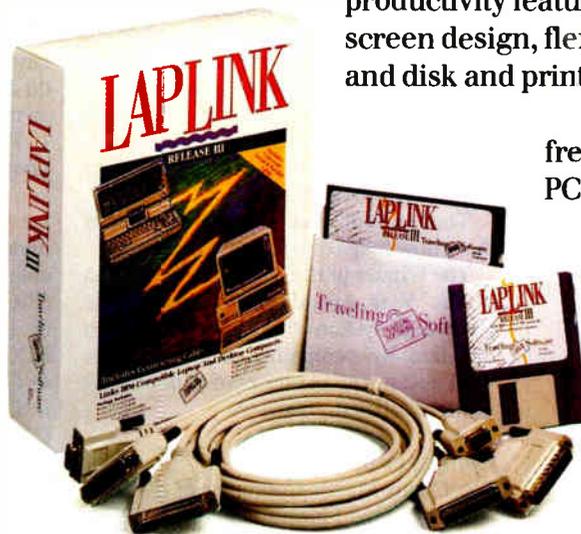
“FedEx this proposal.”

“LapLink these files.”

When something becomes a standard, using it becomes second nature. That's true about LapLink. It's so effective that it has become the most popular laptop-to-desktop and desktop-to-desktop file transfer program ever.

And now Release III improves on the original with added power—while preserving the simple design that has made LapLink the choice of more major corporations.

LapLink III offers both serial and parallel file transfer, and you can take advantage of parallel transfer speeds of 500,000 baud or higher. It comes with a “six headed” universal cable that provides you with everything you need to use both serial and parallel modes.



And LapLink III will even install itself automatically on a remote computer.

That's in addition to ease-of-use and productivity features like our popular split screen design, flexible transfer options, and disk and printer sharing.

For the same fast, error-free file transfers between PCs and Macintoshes, get LapLink Mac. And for more information about any Traveling Software product, call us at (800) 662-2652.

LapLink III. The standard in file transfer software.

Suggested Retail Price **\$149.95**

LAPLINK III



Traveling Software, Inc.
18702 North Creek Parkway, Bothell, WA 98011
(206) 483-8088

Traveling Software Europe
Lords Court, St Leonards Road, Windsor
Berks, SL4 3DB, England
(44) 0753 831855

LapLink is a reg. trademark of Traveling Software, Inc., Xerox is a reg. trademark of Xerox Corporation, FedEx is a reg. trademark of Federal Express Corporation. © 1989 Traveling Software, Inc. All Rights Reserved

Circle 287 on Reader Service Card

World Radio History

File Manager

For **C**

C Programmers choose db_FILE because it's fast and flexible.

The combination of relational B-tree indexing and network model database technology delivers better performance than file managers using relational technology alone. Build simple B-tree/ISAM applications or complex database applications. You decide how to optimize runtime performance.

SQL Support included.

db_RETRIEVE – the SQL-based relational Query and Report Writer is now included in this special offer.

Applications completely portable.

Free lifetime phone support.

C source code is now included!

No royalties.

SPECIAL LIMITED OFFER

db_FILE, db_RETRIEVE and source code for each – at one low price!

Single-User Package \$295.00

A \$1780 value.

Multi-User Package \$595.00

A \$2890 value.

db_FILE™

File Manager 2.2

File Structure: Relational B-tree indexing and network database model. Use independently or in combination for real power.

Transaction processing supported

Not RAM resident

Operating Systems: MS-DOS, UNIX, XENIX

C Compilers: UNIX, XENIX, Microsoft,

Lattice, TurboC

Major LANs Supported

For your nearest distributor call:
1-800-db_RAIMA (1-800-327-2462).

RAIMA™

CORPORATION

BY040FM

lated to the computer community that made us happier and deserve orchids—and of course the stuff that deserves recognition for causing us problems.

A lot of good things happened last year. My orchid list includes:

Bill Gates, for his support of CD-ROMs. He has almost single-handedly built the market for this product; without his support, it certainly would not be where it is now and might not even exist.

American Express for their customer service: not just the AI programs that help their people make *fast* decisions on credit approval, but the whole card member privilege and support services they provide.

Tymnet, which, for all its problems, does listen and works on fixing things.

All of the above deserve orchids; but the Chaos Manor Orchid of the Year goes to Nolo Press, which is doing as much as anyone to help deliver the nation from its plague of lawyers.

Onions

The onion list is long, too; enough so that I'm going to omit the minor irritations and get right down to the real baddies:

Gould of Seattle, which makes disk mailers that are almost impossible to open; and once you have opened them, they have a horrible glue guaranteed to adhere on contact to any part of the disk that the container was supposed to "protect." I have lost three floppy disks to this outfit's mailers.

Those awful voice-synthesizer gizmos that allow magazine ads to talk to you.

The winner of the Chaos Manor Onion of the Year Award goes to electronic voice-mail systems that have clearly been installed by companies that no longer want customers and deserve to have their wishes fulfilled.

Computer of the Year

The Chaos Manor Computer of the Year is the machine I have found most useful; and that's always a tough choice, because I always have a whole bunch of computers that are more than good enough. I do tend to use the best and fastest machine I have, but I don't lightly switch from one to another.

I am still using Big Cheetah, the 386; but that's almost a fluke. The truth is, I would have changed to the Premier 9000, a 33-MHz 386, if I hadn't been promised a 486 machine in the very near future. The Premier 9000 is the fastest and cleanest-running machine at present in Chaos Manor, and by a good bit. It has been used as the primary test machine for odd software; it was used as a net-

work server for a while; it has had OS/2 installed and taken off again; it was used to test Quarterdeck's *wonderful* new version of QEMM-386 and Manifest—if you have a 386, run, don't walk to get these—and in between times the Premier 9000 was put to use as the general-purpose workhorse for everything except writing books.

It's only fair, then, that the Premier 9000 is designated the 1989 Chaos Manor User's Choice DOS machine.

However: I give my awards for utility; and while I write all my books on DOS machines, I do an awful lot of my other work on Macs, which puts me in a genuine dilemma. I know I could do my books on the Mac. I'm not at all sure I could do my briefing charts and maps on a PC. Therefore, the Premier 9000 has to share the Computer of the Year Award with the Mac IIx, which generated the briefing charts we took to the White House; and I can honestly say that I'm glad I don't have to choose one or the other machine. They're both useful for the kind of work I do.

Winding Down

I've made a dent in the list of worthy software, but I see there's a lot more than I have space for. I don't know what I can do about that except rejoice that there's so much good stuff to work with.

The shareware of the month is Hieroglyphics for the Atari ST; this will let you write your name and history in genuine hieroglyphics that could have been understood by the pharaohs. It's available from the author, William Bentley (P.O. Box 2203, Santa Ana, CA 92707), or in the "tojerry/listings" section on BIX. The book of the month is *Nowhere to Go: The Tragic Odyssey of the Homeless Mentally Ill* by E. Fuller Torrey (Harper Torchbooks, 1989). It will tell you a lot you need to know about that problem.

Next month the mixture as before: a lot of good stuff came in yesterday. I sure love these little machines. ■

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

*Raima reserves the right to discontinue this promotion at any time without notice, so please check pricing when you call.
Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA
(206)747-5570 Telex: 6503018237 MCI UW FAX: (206)747-1991
Texas: (214) 231-3131 International Distributors: U.K.: (0992) 500919
Germany: 07127/5244 Switzerland: (0)1725 0410 France: (0146092828
Benelux: 31(02159)46 814 Sweden: (013)124780 Italy: 045/584711
Norway: 47 244 88 55 Denmark: (2)887249 Singapore: 468 3888
Australia: (02) 959 5122 Japan: (03)473 7432 Taiwan: (02)511 3277
Mexico: (83) 57 35 94 Brazil: (0192) 52 9770 Colombia: 57 1 218 9245
Argentina: 54 1 313 5371 Chile: 56 2 696-4308 Uruguay: 92 19 37
Caribbean: (809) 834 4069 Central America: (506) 28 07 64
© Copyright Raima Corporation 1989

"Optical-ability"

Pinnacle Micro is the world's leader in removable, erasable, optical storage systems.

The expanding line of Pinnacle drives offers real solutions to mass storage problems and a whole new set of data handling capabilities.

Removable, Erasable, Opticalabilities.

Access-archivability.

Access your archives quickly and easily. Why wade through stacks of floppies or miles of tape to find a single file?

Platform-compatibility.

Interface kits are available for Macintosh, Sun, DEC, HP, IBM-XT, AT, PS/2 and compatibles, plus advanced applications such as Unix, A/UX, Xenix and Novell NetWare.

Infinite-storability.

Store huge files-CAD/CAM, multi-media, pre-press, 32-bit color. Each cartridge holds up to 650 megabytes. If one isn't enough, add another.

Data-securability.

Carry your world wherever you go. Put your operating system, applications, and data files on a single cartridge. Keep your data safe and secure or move it from place to place.

Interface kits available for MAC, SUN, DEC, HP, IBM A/T, X/T, PS/2 and compatibles from \$495.

Upscale-ability.

Start with a single or dual-disk system for your network today. Move up to a 25 disk, 16 gigabyte system tomorrow. Your cartridges and your data will easily move up with you.

Crash-avoidability.

Eliminate crash anxiety, with laser technology there are no heads to crash. If your hard drive goes down your optical system will put you back on-line immediately.

Mass-movability.

Distribute massive amounts of data in limited quantities. CD-ROM's are great, but not if you need a reduced amount.

Problem-solvability.

Learn how to put these and other opticalabilities to work for you, call today for the name of your nearest authorized dealer.

 (800) 553-7070



Trademark Owners; REO-650, REO-1300 and Pinnacle Micro of Pinnacle Micro, Inc. Sun of Sun Microsystems. HP of Hewlett Packard. A/T, Xenix, IBM, PS/2 of International Business Machines Corporation, Network of Novell. Macintosh of Apple Computer, Inc.

PINNACLE MICRO

THE ERASABLE OPTICAL STORAGE COMPANY™

15265 Alton Parkway • Irvine, CA 92718 • In CA (714) 727-3300 • FAX (714) 727-1913

Circle 222 on Reader Service Card

World Radio History

"The MKS Toolkit is an amazingly faithful replication of a System V UNIX™ environment." - UNIX Review



"The entire MKS documentation package proved excellent in every respect"

Daniel McAuliffe, IEEE Computer, Jan. 1990

Powerful UNIX™ Tools for DOS and OS/2.

We can tell you that MKS Toolkit offers both experts and novices the purest form of UNIX utilities in a DOS or OS/2 environment. Fortunately, we don't have to. Software reviewers, universities, and major corporations all over the world are discovering MKS Software and how it can help their programmers and software developers make the most of their creative talents.

Reduce Keyboard Shock

With our proprietary code, the MKS Toolkit offers you more than 150 UNIX System V.5-compatible tools for DOS or OS/2. With MKS Toolkit, your computer or clone becomes a comfortable environment for shells, string matching, editing, file manipulation, and more. Productivity increases because all the familiar commands are at your fingertips.

"MKS software is absolutely the best in its class. Don't mix environments without it."

Grover Righter Director Hybrid Systems,
Novell Netware Product Division

Site Licences

MKS Toolkit reflects its users' needs. Organizations such as AT&T, H-P, ITT, and NCR - all heavily committed to the UNIX system - use MKS Toolkit to create a standard operating environment. Universities, from Harvard to UCLA, use MKS Toolkit to enrich personal research computing environments and double the bandwidth of their PC teaching labs. The National Institute of Standards and Technology uses MKS Toolkit as a standard operating environment for experts and as a POSIX training tool for neophytes.

Interconnectivity

MKS Toolkit interacts well on standard PC and PS/2 networks. Combined with Novell Netware™, the most popular LAN for PCs, MKS Toolkit creates a UNIX time sharing system in DOS or OS/2 organizations. UNIX shops can now hook up all their PC's using PC-NFS™) and MKS Toolkit, enabling you to use a PC as a Unix workstation and off-load your mini or main machine.

POSIX Tools

MKS is an active participant on the POSIX 1003 standards committee. This involvement reflects MKS's commitment to tracking the shells and utilities standard to the fullest extent possible under DOS or OS/2. Apart from multi-tasking and constraints on file names under DOS or OS/2, MKS Toolkit follows the POSIX standard. MKS achieves this by building the underlying POSIX system on DOS or OS/2 before moving utilities.

POSIX Training

Government departments and organizations choose MKS Toolkit as a cost-effective means of familiarizing personnel with the POSIX environment - now a Federal government standard for computing.

Cost-effective Learning Tool

If your organization is committed to moving into the UNIX environment, then MKS Toolkit is the perfect learning path. DOS or OS/2 users retain the familiar world of the PC keyboard and programs and move effortlessly to a UNIX environment on their desktop. Exposure to new commands and functionality now becomes an integral part of the novice's working day.

"With this package, you can become familiar with the UNIX environment on your microcomputer, with DOS only a keystroke away."

Byte Magazine, May 1989

MKS Programming Platform

MKS Toolkit is the heart of the MKS Programming Platform. MKS Platform helps smooth out the details of programming and software development by adding time-saving utilities such as: MKS RCS (Revision Control System), MKS Make™ (automated program builder), MKS LEX & YACC™ (compiler learning and construction tools). Also available is MKS SQPST™ an enhanced version of the Documentator's Workbench™ with complete troff typesetting capabilities.

In all, you simply cannot find a more complete set of commands and utilities to get you from DOS or OS/2 to UNIX or POSIX. With MKS Toolkit or Platform, you get there fast, stress-free, and with no extra investment in hardware.

 Full 30 day money back guarantee.

For more information, or to order, call: 1-800-265-2797 (continental U.S. only)
1-519-884-2251 (outside continental U.S.) 1-519-884-8861 (FAX)

35 King Street North, Waterloo, Ontario, Canada N2J 2W9

MKS, MKS Make, MKS Toolkit, MKS RCS, MKS LEX & YACC are trademarks of Mortice Kern Systems Inc. UNIX is a trademark of AT&T.

Put The Power Of UNIX In Your PC.

Circle 195 on Reader Service Card
World Radio History

GETTING UUCP RUNNING, AND OTHER STORIES



The details of setting up Unix communications can be overwhelming without a little direction

There's a good reason for the wry title of this month's column. Trying to set up UUCP (Unix-to-Unix copy) has gotten many people running—as far away as they can get from even the *thought* of Unix!

Luckily, things are better these days. Many systems have automatic UUCP setup scripts or menus that make the process a lot easier. But without automatic setup, it's still an intricate mechanism of tables and daemons (background programs).

This month, I'll go over some of the inner workings of the UUCP subsystems, with particular reference to the mundane aspects of setting it up and getting it running. I will assume, for this column, that a setup script is *not* available; it doesn't often do what you want, anyway.

Hard Facts

The first hurdle to clear in your race for intersystem communications is hooking up your modem. While most modems will work (at a minimal level) with factory configurations on most computers, this is not what you want, except perhaps when you initially test the modem.

On single-tasking operating systems, you generally operate the modem manually by dialing out, using a telecommunications program. This gives you direct control over what the modem is doing. But a Unix system will place and receive its own calls whether you're there or not. So the full complement of modem-control signals must be used, especially Data Terminal Ready (DTR) and Data Set Ready. These correspond to pins 20 and 6, respectively, on a stan-



dard DB-25 connector. If this is not done, your modem may stay on-line for hours after a call has failed, running your phone bill way up.

Generally, the pins that should be connected (straight through from one end to the other) are pins 1 through 8, and pin 20. Some modem/computer combinations have to be cross-wired: 2 on one side to 3 on the other, 4 crossed with 5, and 6 with 20. This is known as a "null-modem" cable and can be used to connect two computers directly, back-to-back. But test your regular cable first.

If all this talk of pins confuses you, just make sure you use a modem-to-computer cable with at least nine internal wires. Test the connection as described below; if your modem operates satisfactorily, all is well.

Talking to the Modem

You need both read and write permission on the modem port to test the connection.

On some systems, you may have two different names for the same physical port: one with the modem-control signals and one without. If so, test both, but use the modem-control device for "real" work whenever possible.

In the following examples, I've used the actual entries from my own SCO-based system; be sure to substitute the correct port names and data transfer rates for your machine.

On my system, I've found through trial and error that the only way to get my modem to operate correctly with all my communications programs is to allow dial-ins on the modem-control port (`/dev/tty1A`) and to perform dial-outs on the non-modem-control port (`/dev/tty1a`). The `uudemon.hour` shell script (the one that performs UUCP dial-outs) disables log-ins until UUCP is done and then reenables them. It may not be standard, but it works on my machine!

continued

Getting to Know cu

It's time to edit some files in the `/usr/lib/uucp` directory. In the current HoneyDanBer (HDB) version of UUCP, the file that describes what port to use for dial-outs is called `Devices` (previous UUCP versions called it `L-devices`). A typical entry in this file might be `Direct tty1a - 2400 direct`. This lets you talk directly to the modem port via the `cu` program. Except for the port number and data transfer rate, it should look the same on your machine. If you want to talk to the modem at different speeds, make similar entries at different speeds.

Test your `Devices` entry by typing `$ cu -l /dev/tty1a`. You should get a Connected message from `cu`, indicating only that you've reached the modem port. Now type `AT` (it may not echo), and if all goes well, you should receive an `OK` from the modem if it's been set up to respond with status messages (and it should have been).

You can now type `ATDT5551234` (replace the digits with the telephone number of an operating, answering computer) to connect to another machine. Once you connect, you're acting as a re-

mote terminal to that computer. When you're done, type `~`. (a tilde followed by a period) to end the `cu` session. The modem should hang up, and its DTR light should go out, showing that your modem control (at least from the DTR side) is working.

For UUCP, as well as dialing by name from `cu`, you will have to make another entry in the `Devices` file to tell the system about dialing capabilities. Mine looks like this:

```
ACU tty1a - 300-19200 dialTBIT \\D
```

This signifies that I have an automatic calling unit (ACU) on port `/dev/tty1a`. The first dash takes up space for a field naming a separate dialer port (an antiquated method). The usable data transfer rate (or range, in this case) follows.

The next field, `dialTBIT`, references the name of the modem for dialing purposes. This can be a separate program but is usually an entry in the `Dialers` file, which describes the protocol involved in getting a phone number to the dialer. The `\\D` simply means, "Use the system phone number exactly as found in the

`Systems` file." A `\\T` would mean to translate the number passed to the dialer, using information found in the `Dialcodes` file (I've never personally had any luck using `Dialcodes` files).

Now, you should be able to dial another computer by simply typing `$ cu 5551234`.

Finally, We're Getting Somewhere

From here to full UUCP capabilities is only a short step. The `Systems` file (`L.sys` in previous versions of UUCP, with a slightly different format) tells UUCP the names of the systems you can call, plus their phone numbers and log-in information. A typical entry looks like this:

```
lizard Any2300-0700 ACU 2400
19165551234 \\
"" \\d\\r gin:--gin:-BREAK-gin:
nuucp sword: foolyou
```

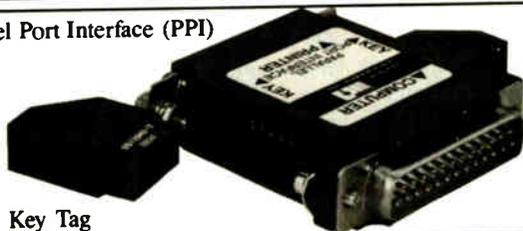
This lets my system call the "lizard" system on any day from 11 p.m. to 7 a.m. (when the phone rates are lowest); that it dials out (ACU) at 2400 bps; and that lizard's phone number is 1-916-555-1234.

continued

World Class Software Security



Parallel Port Interface (PPI)



Key Tag

The parallel port interface (PPI) connects between the printer port on a PC and the printer cable. The PPI holds two Key Tags, one on each side. Each Key Tag contains a secure custom chip which is pre-programmed by Glenco to only work with the assigned software package. A second Key Tag can be employed to protect another package, or may be used to turn other software packages "on", remotely or on-site.

- **STANDARD KEY TAG** - Software is protected for an unlimited number of executions. They are pre-programmed to include a sequentially assigned S/N.
- **COUPON KEY TAG** - Software is valid for a preset number of executions. The Coupon count can be reset remotely or on the customer's site by using a second update Key Tag.

- **READ/WRITE KEY TAG** - With programmable memory. Perfect for companies which have multiple products or a product with several optional modules. By having several packages protected using one Key Tag, your costs are lowered.
- **DURATION KEY TAG** - Has a clock on board. (Available late '89)

Secure software and data with reliable, effective protection products that won't burden honest users.

Glenco is a world leader in the area of software security products and services. Our copy protection products and data security products are second to none. They are designed to function on a wide variety of third party hardware. We have over 3500 satisfied software firms utilizing our products. We also have a full line of disk based protection systems.

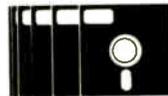
- MACHINES SUPPORTED - IBM PC/XT/AT & PS/2, Macintosh
- OPERATING SYSTEMS - MS-DOS, XENIX, Network, Finder, & Multifinder.
- LANGUAGES/COMPILER - Over 50, including runtime packages, data bases and spread sheets. We have a non-programmers interface as well.

Call or write for more information.

GLENCO
ENGINEERING INC.
SERVING THE SOFTWARE INDUSTRY SINCE 1979

721 W. Algonquin Road, Arlington Hts., IL 60005, (312) 364-7838, FAX 364-7698

In Europe contact: SDC Security Systems, The Netherlands
Tel: +31-45-441535, FAX: +31-45-444747



4GL OR C

NOW THE CHOICE IS SIMPLE.

USE THE FAIRCOM® TOOLBOX AND GET BOTH 4GL SPEED AND C SOURCE CODE POWER.

Whether you need the development speed and convenience of 4GL programming or the low-overhead power capabilities of C source code, the FairCom ToolBox can meet the requirements of any professional developer!

INDUSTRIAL STRENGTH TOOLS

Develop applications the way you want with The ToolBox's industrial strength tools.

Development Environment by d-tree™

- Prototype generation
- Data dictionary
- Dynamic resource swapping
- Screen management
- Overlapped windows
- File restructuring
- Runtime portability
- Menu management

File Management by c-tree®

- Variable length records
- Key compression
- Client/Server architecture
- Ascending/Descending key segments
- Dynamic space reclamation

- Portable. Used in over 100 environments
- Variable length key fields
- High speed B+ trees

Report Generation by r-tree®

- Complex multi-line reports
- Multi-file access
- Complete layout control
- Conditional page breaks
- Nested headers and footers
- Unlimited control breaks
- Dynamic format specifications
- Horizontal repeats
- Powerful set functions

POWER AND FLEXIBILITY

Now you can create applications using the methods you like — whether it's 4GL convenience or C source code power. You can have it all with FairCom's introduction of The ToolBox Special Edition. And at \$695 you get this power at a price you can afford.

ORDER TODAY

Order the FairCom Development ToolBox and use it for 30 days. No risk. If the FairCom ToolBox doesn't meet your development needs, just return the entire package for a full refund.



THE TOOLBOX

CALL 1-800-234-8180 TODAY FOR YOUR FAIRCOM TOOLBOX

The ToolBox, Professional Edition \$1,095.00
DOS, Unix, Xenix, VMS, OS2 Full source, single and multi-user support.

The ToolBox, Special Edition \$695.00
Microsoft, Borland, Xenix, OS2 Object Libraries, single user only.

Upgrade to Professional Edition \$400.00
Includes overnight delivery.



FAIRCOM
corporation

4006 West Broadway
Columbia, Missouri 65203
(314) 445-6833
FAX (314) 445-9698

The rest of the line is a so-called "chat script" that alternates between strings to be expected from the other system and strings sent to the other system. The chat script begins executing once connection is made to the remote system. When you call a system using `cu`, the chat script is ignored.

The null string (i.e., the pair of quotes) means to initially expect nothing. It serves as a placeholder. The `\\d\\|r`, meaning "Delay one second, then carriage return," is then sent out to the remote system. This expect/send pair is useful for goading systems that would otherwise wait too long to send their log-in prompt.

The next string, `gin:--gin:-BREAK-gin:`, anticipates the last characters of the log-in prompt from the remote machine. The double dashes request that another null string (actually a linefeed) be sent out if the first `login:` is not received within a few seconds. If this fails to produce the prompt, a `BREAK` goes out on the assumption that the other system is prompting at a different data transfer rate (sending a break at log-in time will generally cycle data transfer rates on Unix).

If these three tries fail, then the chat script fails.

However, if the other system is running properly, one of these combinations should elicit the desired `login:` prompt, at which time the script knows to send out the UUCP log-in name of your computer (in this case, `nuucp`). Then, you expect to get a `Password:` prompt (again, you just look for the last few characters), at which time your system sends the message `foolyou`.

Then the fun begins, as UUCP connects to the other system and begins exchanging any mail and news that each system may have queued up for the other. To watch all this happen, run `/usr/lib/uucp/uucry lizard` or `/usr/lib/uucp/uucico -r1 -Slizard -x9`. You won't want to do this all the time, but it's essential for debugging chat scripts, and it's interesting when you're just getting started.

UUCP will block calls to systems if certain lock or status files exist, so you should remove them before testing. In HDB, these are `/usr/spool/uucp/LCK*` and `/usr/spool/uucp/.Status/system` (where `system` is the name of the

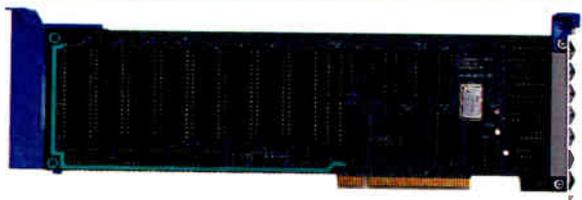
system you're trying to call). Status files in earlier versions of UUCP are named `/usr/spool/uucp/STST.system`.

Finally, to make sure pending mail, news, and UUCP requests get processed, you must ensure that the `uucico` program executes once or twice an hour. The shell script `/usr/lib/uucp/udemon.hour` should run from the cron task scheduler by the user `uucp`. Either `/usr/lib/uucp/uusched` or `/usr/lib/uucp/uucico -r1` should be in the `udemon.hour` script.

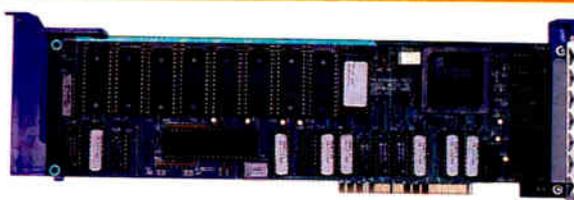
Next month, I will finish up the UUCP discussion with some more hints and tricks, and delve into some public domain programs that help make E-mail and UUCP a bit more interesting, if not easier. ■

David Fiedler is publisher of the Unix Video Quarterly and the journal Root, as well as coauthor of the book Unix System Administration. He can be reached on BIX as "fiedler."

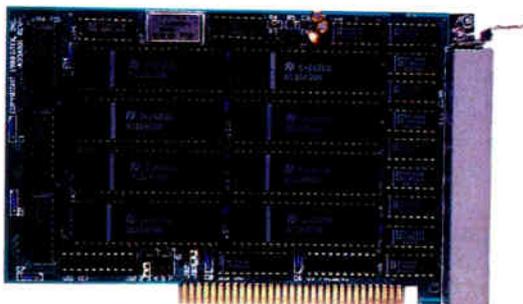
Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



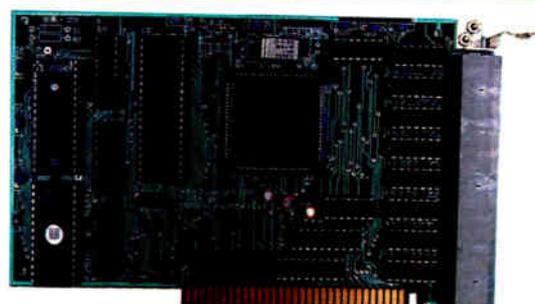
Now, COM1 through COM8 for Micro-Channel computers! Our **MCSS-8TX** can add up to 8 DOS compatible serial ports. The **MCSS-8TX** is operationally compatible with the **PCSS-8TX** and also supports the IBM extended serial ports, COM3-COM8. **PCSS-8X** software can now run on Micro-Channel computers.



The **MCSS-9IM** is GTEK's newest intelligent card for the Micro-Channel. The **MCSS-9IM** provides 9 channels and comes with 32K of **Dynamemory** that can be upgraded to 1 Megabyte. **Dynamemory** is real time allocation of on-board buffer ram to queues as needed. Micro-Channel equivalent of the **PCSS-8I**



The **PCSS-8TX** is GTEK's workhorse multi-channel serial I/O card with compact RJ-11 telco jacks. The **PCSS-8TX** provides 8 standard uarts arranged as either COM1/COM2, or memory mapped. Also available is the **PCSS-8X** with DB-25 connectors. For SCO™ XENIX® order the **PCSS-8TH**



The **PCSS-8I** is GTEK's most popular intelligent serial I/O card with compact RJ-11 telco jacks. It provides 8 serial channels for PC/XT/AT/PS2-286 and is DOS Compatible. The **PCSS-8I** has 32K of **Dynamemory**, user upgradeable to 128K bytes. Driver available for SCO™ XENIX®

ORDER TOLL FREE 1-800-282-GTEK (4835)
FAX: 1-601-467-0935
MS & TECHNICAL SUPPORT 1-601-467-8048

GTEK INC.

Circle 130 on Reader Service Card (DEALERS: 131)
DEVELOPMENT HARDWARE & SOFTWARE
P. O. BOX 2310
BAY ST. LOUIS, MS 39521-2310 U.S.A.

Ten Ports to Automatically Share Printers, etc.

...Fast, Easy, and Inexpensive



SL \$550 with 256KB
\$700 with 1MB

PC Magazine [July 1989, Page 263]:

"The Buffalo SL peripheral sharing device is simple enough to use immediately yet sufficiently flexible to form the center of a fairly complex network. It's a good choice..."

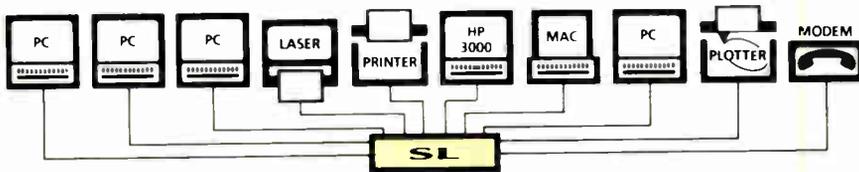
The SL Saves Money By Sharing Resources

Using the SL™ is the inexpensive way to let everyone share lasers, printers, plotters and modems. Greater access by more users reduces unproductive idle time and the need to purchase more of these expensive peripherals. An SL with memory improves PC productivity by allowing all users to simultaneously send their print jobs and quickly release their PCs to continue working. The SL is an alternative to a LAN at a fraction of the cost.

Shielded Cables & Telephone Adapters



- **Ten Channels:** four parallel and six serial, all can be software configured as either input or output; automatic conversion from parallel to serial, serial to parallel, or serial to serial parameters; automatic switching and queuing of jobs
- **115,200 bps:** our software allows virtually all PC applications to send data serially to the SL twelve times faster than normal 9,600 bps serial
- **PC to PC Serial File Transfer Utility:** available free
- **Pop-up Menu via Hotkeys:** keyboard selection of printers, macros and many other control functions
- **Simple Installation:** just plug in the cables and run the menu-driven installation software for the Pop-up Menu
- **User Upgradable Memory:** from 0 to 4MB buffer



Smaller Switches



All Parallel Ports

AS-41 4 inputs to 1 output automatic switch without any buffer for only \$200.

XE 2 automatic inputs to 2 electronic switch-selectable outputs from 256KB up to 2MB buffer, from \$250 to \$450.

45 Day Money Back Guarantee
CALL TOLL FREE TODAY

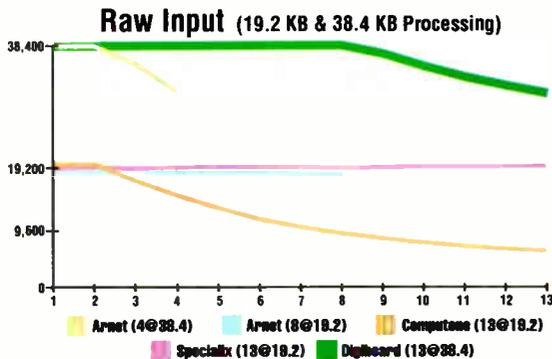
(800) 345-2356

Buffalo Products, Inc.
2805 19th St. SE
Salem, OR 97302
(503) 585-3414
FAX (503) 585-4505

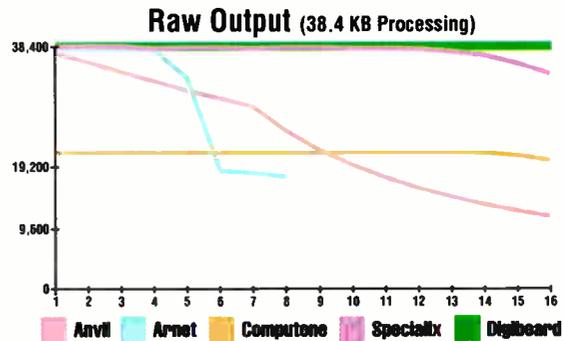
Circle 53 on Reader Service Card

World Radio History

The new DigiCHANNEL series out-performs all other leading multi-user communications boards.

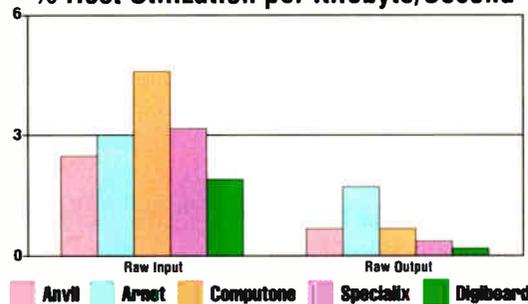


Raw Input: Primarily data received via host-to-host communications. The higher the better.

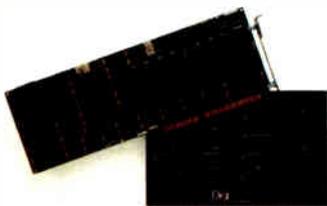


Raw Output: Processed data from host applications to terminal users (spreadsheet, word processing, etc.) The higher the better.

% Host Utilization per Kilobyte/Second



Processor Overhead: Percentage of host CPU time utilized for I/O processing tasks. The lower the better.



The new DigiCHANNEL series of multi-user communications boards sets the new performance standard for terminal response time, especially under heavy user-load conditions. The key to this performance is the synergy between our hardware and our new Front End Processing real-time Operating System (FEP O/S 5.4) software.

The proof is in the numbers, and a good example is the DigiCHANNEL PC/16i. In benchmark tests, it beats every other leading board in the two critical areas that determine board performance: *data throughput* and *processor overhead*.

Data throughput is calculated by measuring the total amount of data that a board can handle per port and per system. The higher the data throughput, the faster the response time for each user on the system.

Processor overhead is the amount of additional

processing imposed on the CPU to handle the data input/output being controlled by the communications board. The less time the CPU needs to spend on I/O chores, the more time it can spend processing applications for terminal users.

Call for our FREE technical white paper with all the details on our benchmark testing. While you're at it, ask for our FREE booklet, *How to Do Multi-User Right*.

No matter how simple or complex your multi-user systems, you can trust DigiBoard to put you at the head of the pack. And keep you there.

DigiBoard
Plugging you into tomorrow

6751 Oxford Street • St. Louis Park, MN 55426
1-800-344-4273 • In Minnesota (612) 922-8055





CD-ROM TO THE RESCUE

If your business needs complete and accurate information in a hurry, databases on CD-ROM may fill the bill

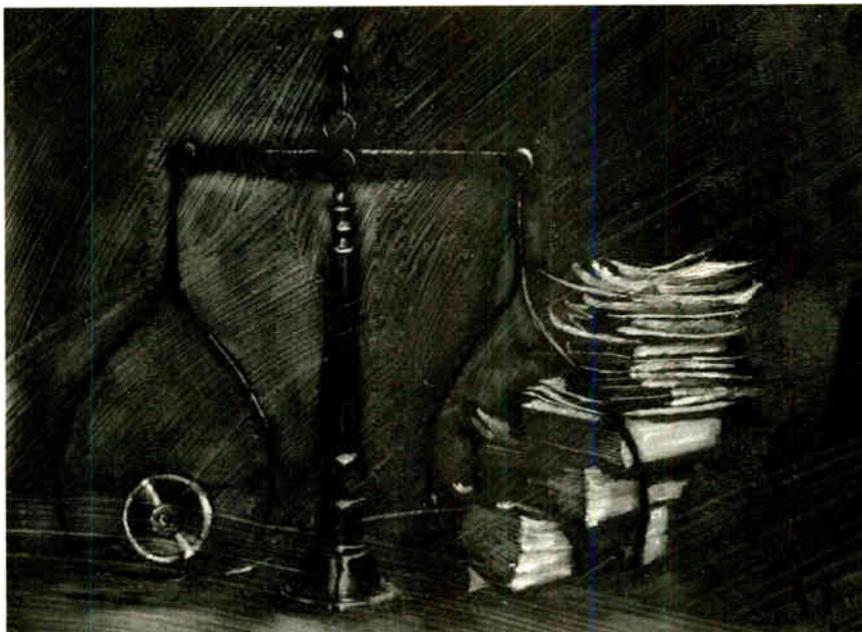
Jim had a problem. A new client wanted to talk to his boss about a project that was being relocated to a remote site in the Pennsylvania mountains. Unfortunately, his boss was in a small hotel in Zambales in the Philippines, and it was now 3 a.m. there. Jim knew that overseas telephone calls are not always reliable and are not always answered in the wee hours. He also knew that his boss was leaving soon to see the new client, but at the old site.

Fortunately, Jim also knew that the international telex networks are quite reliable and immune to the interruptions that plague voice telephone traffic overseas. He knew that nearly every hotel in the world that caters to business travelers has a telex number. All he had to do was find the telex number for the hotel in the Philippines and send a message.

Unfortunately, this is easier said than done. While telex directories do exist, they are expensive; they normally cover only a few of the many networks in any area; and the thorough, accurate ones are massive, due to the hundreds of thousands of listings they must contain. Few businesses want to deal with the bulk, the expense, and the uncertain coverage of paper telex directories.

Jim's boss, of course, had no idea his client had a new site or where it was located. Thus, Jim knew he would have to find a source that would tell him about Pennsylvania and locate the new site's proper county and town.

Jim grabbed a copy of Time-Space Research's Supermap disk, inserted it into



the CD-ROM drive on his PC clone, and loaded a list of the counties in Pennsylvania. This source provides information on localities and the demographic business and physical information about them. When he found the correct county, he looked at a map of the state, which had the county highlighted. It was clear from the map that the site had to be near Pittsburgh. With that in mind, Jim turned to the problem of the telex number.

Finding the telex number was even easier. Jim used the Jaeger+Waldmann worldwide CommDisc package, which provides every telex and teletex number and many fax numbers. Despite the vast quantity of information it contains—it takes two CD-ROMs to hold it all—the J+W CommDisc allows speedy search and retrieval. You can search by the name of the telex subscriber (or a portion of the name), its address, or its city or country. If you know only part of the information (e.g., the hotel name but not

the city), you can search on what you do know. You will have to look at a few more entries, but it can be surprisingly few if you're careful what you ask for.

The CD-ROM telex directory includes the capability to display company logos, advertisements, and information beyond the telex number. Many companies also include a fax number, for example. The telex number listing includes the name of the telex network as well as the subscriber's answerback.

Within minutes, Jim was able to compose a message to his boss explaining the change in plans. With the information he had obtained from the CD-ROM, Jim gave his boss particulars about the new site, the name and location of the airport he needed to fly into, and the specifics of the meeting arrangements. Without the information on the disk, Jim's task would have been difficult, if not impossible.

Not every business needs a listing of

continued

ITEMS DISCUSSED

CDU-510\$895

Sony Corp. of America
Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000

Inquiry 1101.**Day-Timers Quick Trip****Carryall**\$135

Day-Timers, Inc.
One Day-Timers Plaza
Allentown, PA 18195
(215) 395-5884

Inquiry 1102.**J+W CommDisc telex and fax directories** \$1850

Universal Media Division,
Shamgar, Inc.
212 Broadway
Bethpage, NY 11714
(516) 433-6767

Inquiry 1103.

or

Jaeger + Waldmann GmbH
P.O. Box 11 14 54
Birkenweg 8-10
1600 Darmstadt 11, West Germany
49 (6151) 3302-0

Inquiry 1104.**Supermap U.S. Census Data and Mapping Companion** \$4500

Chadwick-Healey, Inc.
1101 King St.
Alexandria, VA 22314
(703) 683-4890

Inquiry 1105.

or

Time-Space Research Pty Ltd.
668 Burwood Rd.
Hawthorn, East Victoria, 3123
Australia
61 3813-3211

Inquiry 1106.

all the telex numbers in the world. Likewise, not all of them need access to maps and demographic information like that provided in Supermap. The fact remains, though, that as businesses learn to meet the challenges of international growth, the need for information of all types has grown dramatically.

Once, all the information that most businesses needed was printed on paper. Most of it still is. Unfortunately, the amount of information has grown, while staffs have shrunk and the necessity for rapid response has increased. You no

longer have the luxury of looking up information at your leisure, unless you want the competition to get there first.

One answer to this need for immediate access to great quantities of information is the CD-ROM. The demand for more and more information has resulted in significant growth in the quantity and variety of information available in this format. Where once reference material was limited to Microsoft Bookshelf, CD-ROMs are now available with contents ranging from the CIA's World Factbook to facts about additives in fast food. Many of these items are public domain information that has been packaged on CD, so the cost is surprisingly low.

Horizontal and Vertical Markets

The CD-ROM marketplace contains a great deal of vertical-market software and information. For reasons that I'll cover next month, this area of information is becoming very attractive to companies that need to provide large quantities of information for their customers.

Information for the horizontal market is aimed at a variety of businesses. Companies that publish horizontal-market packages on CD-ROM try to provide information that many types of businesses will use, and then they try to sell it to businesses in general. A CD-ROM reader similar to the Sony unit I looked at for this column now costs about \$600. If you think that your business needs this type of resource more than a few times a year, you can probably justify the cost in terms of the staff time you will save and the accuracy you will achieve.

CD-ROMs intended for business use normally include search software optimized for the data on the CD-ROM. Frequently, this is in the form of a full-text database package that supports flexible queries with partial information. These packages are usually based on menus and are quite easy to use.

Are They for You?

Whether your business needs CD-ROMs depends on several factors. Some packages are quite expensive, although usually less so than their paper counterparts would be. They do require the installation of an additional drive and the addition of another internal circuit card. Most CD-ROM drives can play music and include a headphone jack and volume control. This is handy for long nights in the office, but it's more important as a way to include audio information as a part of the CD-ROM. This is especially useful in applications such as training. The Sony CDU-510 that I used for this

column didn't have that capability, although Sony says it can be added.

One way to realize a greater return on your investment is to use CD-ROMs as a centralized resource, such as on a network. One company, CBIS (Norcross, GA), makes a CD-ROM server, although I haven't had a chance to use one yet.

The kind of business you have will determine the merits of moving to CD-ROMs for reference support. The economic feasibility of such a move depends on the equipment you already have—including existing computers that could be outfitted with a CD-ROM drive—and whether you're likely to use the information that is available. Once you have answered these questions, you can take the next step, which is to decide whether immediate access to this kind of information is important to your business.

Travel Update

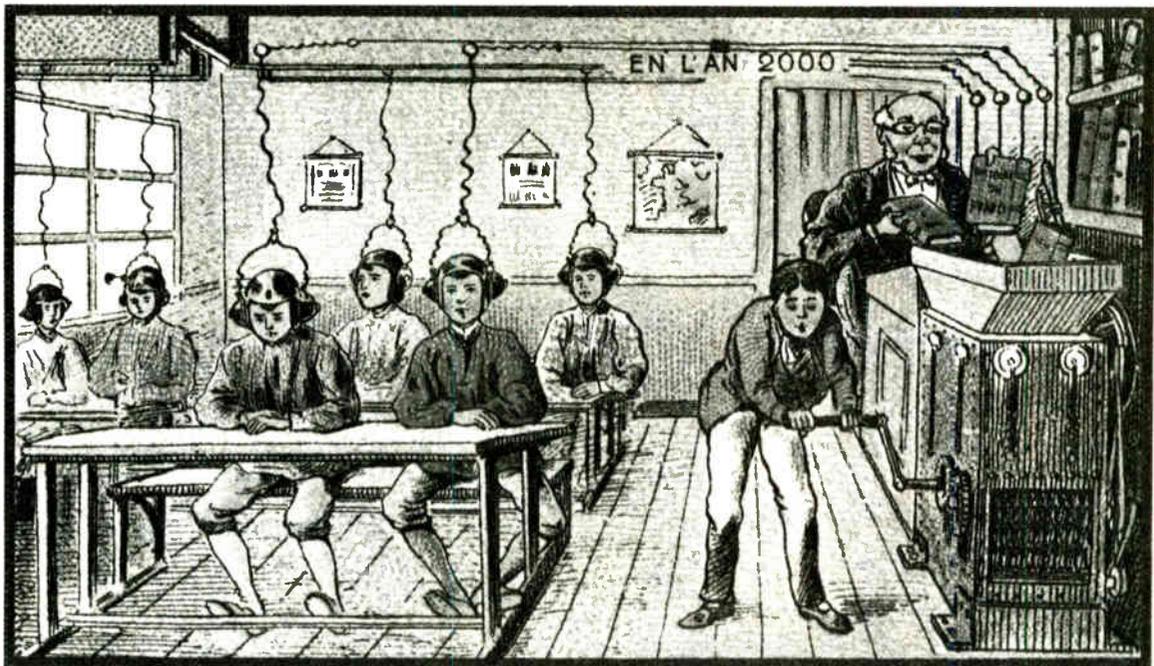
In my September 1989 column, I wrote about some changes that were on the horizon for users who traveled with their computers. Since that time, some of those changes have happened, but some haven't. The most important is that the FAA didn't ban laptop computers from being carried on airplanes. What it did do, however, is begin enforcing the two-item limit for carry-on luggage. This means that you can no longer carry your computer along with your briefcase and an overnight bag. One of those has to be checked or left at home.

Fortunately, Day-Timers has introduced its new Quick Trip Carryall, a fabric briefcase that will hold a laptop computer, as well as a full complement of briefcase junk, a few spy novels, and the like. I was able to carry either Roberta Pournelle's Zenith SupersPort or the Zenith MinisPort that I took to Comdex. Each one fit with room to spare. Since notebook-size computers don't seem to come with rugged carrying cases and they don't leave much room for anything else in a standard briefcase, the Day-Timers Quick Trip Carryall, or something like it, is a must. ■

Wayne Rash Jr. is a contributing editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

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

Microsoft creates software giants in laboratory.



A class at Microsoft® University will go straight to your head.

Reason being, your course instructors work for us, Microsoft. The country's leading developer of software.

Better still, they do their teaching in a laboratory setting that gives you two big advantages: Hands-on experience. And software you've developed that's yours to keep.

It's the fastest way to learn the latest technology being utilized in today's popular programs. Giving you, and your corporation, a big jump in developing software.

Courses are offered in several power-

ful systems platforms, including Microsoft OS/2, Microsoft OS/2 Presentation Manager and Windows.™ And innovative networking technologies like LAN Manager and Microsoft SQL Server.

To get more information and a free copy of the Microsoft University catalog, call (800) 541-1261, Dept. K88.

As a graduate, you'll soon be writing better applications, faster.

Making your career, and your company, grow by leaps and bounds.

Microsoft University!

The rules for AAMC are fairly clear and reasonably flexible. Each team works with its Apple higher education representative and has a \$2000 budget (also supplied by Apple, and separate from the donated hardware). The team plans, puts together, and executes a specific marketing plan at its school. Each team uses the budget as it sees fit to buy advertising. Similarly, the teams can use the Mac SEs any way they choose. Most teams use the computers to design ads, plan schedules, write ad copy, produce radio commercials, and create storyboards for TV ads. Some choose to give away one or both of the SEs as part of the plan; others barter or sell one or more of the SEs to increase their budget.

Results of the competition are judged in a single-day presentation in front of a group of 10 judges selected from the computer industry. Each team spends 20 minutes presenting its campaign in any way it chooses, trying to convince the judges that its plan has been created and executed to perfection, and relying on Mac-generated multimedia to enhance the presentations. I recently spent a very enjoyable two days judging an AAMC in Chicago, so my memories of the whole process are clear.

The winner of the Chicago competition, the University of Missouri-Columbia, blew away the judges with the completeness of its campaign, how well it integrated the Mac into its campaign, and its preparation. On top of that, this team was a wonder at its presentation. In short, it was the only team to convince me and the other judges that we should hire it as our ad agency. And it did so by subtly influencing us with the technology of the Mac, its interface, and the ease with which the team pulled the whole thing off.

These kinds of competition change the way that personal computers are thought about and used in a broader range of careers. Apple deserves kudos for this, as well as our encouragement for future AAMC-style programs. If personal computing is ever going to live up to the promises made for it, such programs will have to become the standard, not the exception.

Personal computing is not about making a lot of money, nor about buying and using all the latest gear. Personal computing is about people using a malleable machine that can fit their work patterns theoretically better than any Swiss Army knife ever made. Apple has begun something significant with the Mac that goes way beyond user interfaces. Its revolutionary view of how personal computing

ITEMS DISCUSSED

Prograph 1.2.....\$195
TGS Systems
1127 Barrington St., Suite 19
Halifax, Nova Scotia
Canada B3H 2P8
(902) 429-5642
Inquiry 981.

is conceived is just now starting to take off and spread to others in the industry with a parallel vision. With programs such as AAMC, Apple has proven that it still maintains the conceptual lead over its competitors.

A Darker Side

Having said all that, you still can't lose sight of the building blocks that make up the revolution. The personal computing revolution started by the Mac and fostered by Apple each year (much better this year than in previous years) is based on the Mac's user interface. Without that now-familiar Mac Desktop, we wouldn't be worrying about stuff like Motif, X Window System, Presentation Manager, Open Look, NewWave, and others.

The problem with the Mac has always been the paradox of software development. While the Mac user interface can be seen as the first ease-of-use win for personal computing users, it has been a royal pain for software developers. People who have been developing for the Mac since 1984 still complain about twiddling with the Mac's esoteric Toolbox ROM calls (which get more complex with each new CPU), its complex development system (MPW), and its arcane user-interface guidelines (which Apple regularly violates while nearly terrorizing developers into adhering to).

The problem of software development on the Mac is going to get worse. As System 7.0 rolls out this year, and Apple gets close to a CPU with 1 megabyte of ROM code, developers will be screaming for help. Apple should take a serious look at overhauling its developers' tools, probably by scrapping MPW (or rewriting it) and refining its MacApp object-oriented programming (OOP) tools.

Apple also needs to produce a lower-level developers' system that could be built on the ideas popularized in HyperCard and announced in AppleScript. It should include some of the nice prototyping features of Plus and Supercard, with structure and language editors on a par with Prograph and QUED. It wouldn't even have to be all Apple. The company

could license parts of other systems for both the lower-level system (I call it the Mac User's Software Kit [MUSK]) and the professional system (I'll call it the Mac Professional Developer's Software Kit [MPDSK]).

Regardless of how Apple breaks these out and how it puts them together, the need is certainly there. Apple must make it easier for pros, semipro, and power users to roll their own applications and to distribute them to other Mac aficionados. Apple also needs to give MPDSK users the ability to cross-develop their software for other platforms. The "not invented here" syndrome won't do at all. Other graphical user interfaces (GUIs) are here to stay, no matter how many lawsuits get filed. Applications need to be developed with more than one computer in mind, and the translation between environments needs to be made as transparent as possible for developers.

Here is another one of those golden opportunities for Apple to take the lead in the personal computing revolution that it started. Just as it has recaptured the higher education market with innovative cooperative programs like AAMC, an Apple-developed cross-GUI programming system would set the pace for others to follow.

Tip of the Month

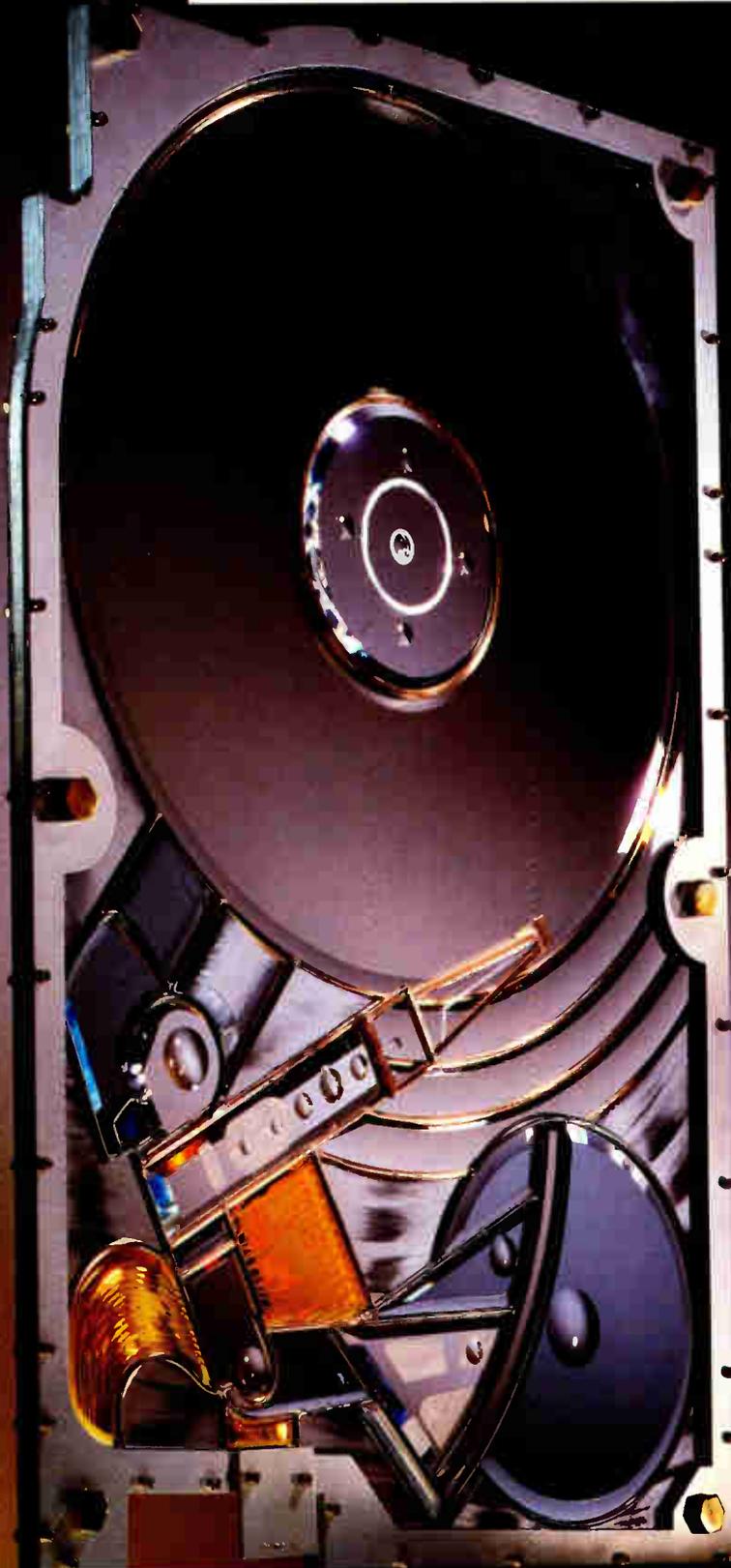
Speaking of development systems, I've been using a new one lately, called Prograph, from TGS Systems. So far, this graphically oriented OOP system lacks a compiler, but that should be completed by the time you read this. The Prograph system combines an OOP environment with a GUI programming environment that relies on visual programming metaphors (e.g., HyperCard). To this interesting mix, TGS Systems adds familiar data-flow diagrams.

While Prograph 1.2 won't replace MPW or even Symantec's Think compilers, it's an important new kind of development system. If you've toyed with the idea of Mac software development before, but you were put off by the weaknesses of HyperCard and the complexities of MPW, look at Prograph. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

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

THE FINE ART OF DISC DRIVES



*Beveled Glass Window by
Thomas Tisch & Andreas Lehmann
Oakland, California*

Even to the experienced observer, a disc drive is a technological marvel. With discs spinning at 60 revolutions per second, the mechanics involved are astounding. It takes a company with a unique level of skill and experience to produce drives in volume that perform reliably year after year. A company like Seagate.

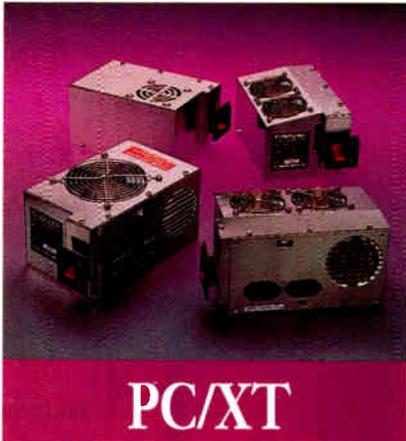
Our 3.5" ST1096 family is a great example of Seagate craftsmanship. Featuring a choice of 42, 60 or 83 formatted megabytes, these high performance (24 msec average access time) drives are ready for demanding PC and Apple® applications. The family offers ST412/MFM and SCSI interfaces for application flexibility. And they all feature a 50,000 hour mean-time-between-failure rate.

Like the artist who spends years perfecting his craft, Seagate has spent the past decade mastering the fine art of disc drives. For more information on our multi-faceted product line, contact your authorized Seagate distributor, or call Seagate directly at 800-468-DISC, or 408-438-6550.

 **Seagate**

Apple is a registered trademark of Apple Computer, Inc.
Seagate and the Seagate logo are registered trademarks of Seagate Technology, Inc.
© 1989 Seagate Technology, Inc.

Power Packed & Built To Last.



PC/XT

STANDARD 150 \$69

Economical This UL approved, fully tested unit is one of the best generic 150s available. Ideal for basic systems.

SILENCER 150 \$129

Ultra-Quiet Stop that irritating whine with the Silencer 150. Its large, low speed, West German fan keeps your system 5° to 15° cooler and 84% quieter. Virtually inaudible! Great in the executive suite or home office.

TURBO-COOL 150 \$149

High Performance Upgrade your PC/XT with our popular, UL approved Turbo-Cool 150. Its patented twin fan, sloped-cover design keeps your system 25° to 40° cooler and 50% quieter. Prevents intermittent data errors and other heat-related problems. Meets the demands of a fully loaded system.

TURBO-COOL 200 \$189

Maximum Performance Put AT power and 200% more cooling under the hood of your PC/XT with our UL approved Turbo-Cool 200. Its twin fans keep your system 30° to 45° cooler for maximum expandability. Perfect for hot rod PCs and Mini ATs!

Silencer, Turbo-Cool, and Turbo 375 are trademarks of PC Power & Cooling, Inc. Compaq and Deskpro are registered trademarks of Compaq Computer Corporation.



AT/386/486

STANDARD 220 \$99

Economical This UL approved, fully tested unit is one of the best generic 220s available. Ideal for basic systems.

SILENCER 220 \$149

Ultra-Quiet Unrattle your nerves with the Silencer 220. Its high-efficiency, adjustable-speed fan offers 69% less noise with standard cooling. Quieter than most hard drives. Great in the executive suite or home office.

TURBO-COOL 250 \$189

High Performance Protect your investment! Upgrade your AT/386 with our powerful, UL approved Turbo-Cool 250. Its high-capacity, adjustable-speed fan keeps expansion cards, hard drives, and other valuable components 20° to 35° cooler for up to three times longer life. Perfect for a fully loaded system.

TURBO 375/450 \$299-\$369

Maximum Performance The choice of PC professionals, our Turbo 375 and Turbo 450 feature built-in line conditioning, autoselect input, independent regulation, external DC voltage adjustment, remote switch option, enhanced cooling. UL/CSA/TUV approval, 50,000 Hr MTBF, and 2-year warranty! Ideal for workstations and network file servers.



COMPAQ

CP160 \$169

Original Portable Upgrade Give your Portable greater reliability and 100% more power with our direct replacement CP160. Allows 286, 386, and hard disk upgrades.

CD270 \$249

Deskpro Upgrade The power user's power supply! Our direct replacement CD270 gives your 8086/286/386 Deskpro up to 70% more power and the reliability it deserves. Prevents nuisance rebooting. Advanced design includes autoselect 110V/220V. 2-year warranty.

Our power supplies feature:

- Full-rated power
- UL/FCC compliance
- 110V/220V input
- 4 drive plugs (min)
- Heavy-duty components
- Low output ripple
- OVP, OCP, SC protection
- Installation instructions
- Rigorous testing
- 1-year immediate replacement warranty (2 years where noted)

"You could buy cheaper no-name power supplies almost anywhere, but don't. PC Power and Cooling's units are better made and more reliable than anything in the field."

*PC/Computing
January, 1989*

Most orders shipped same day. We accept Visa, MC, COD or PO on approved credit.

PC POWER & COOLING, INC.

31510 Mountain Way, Bonsall, CA 92003 • (619) 723-9513 • FAX (619) 723-0075

Circle 216 on Reader Service Card

World Radio History



LIVING WITH OS/2 1.2

Incremental improvements are a sign that OS/2 is maturing

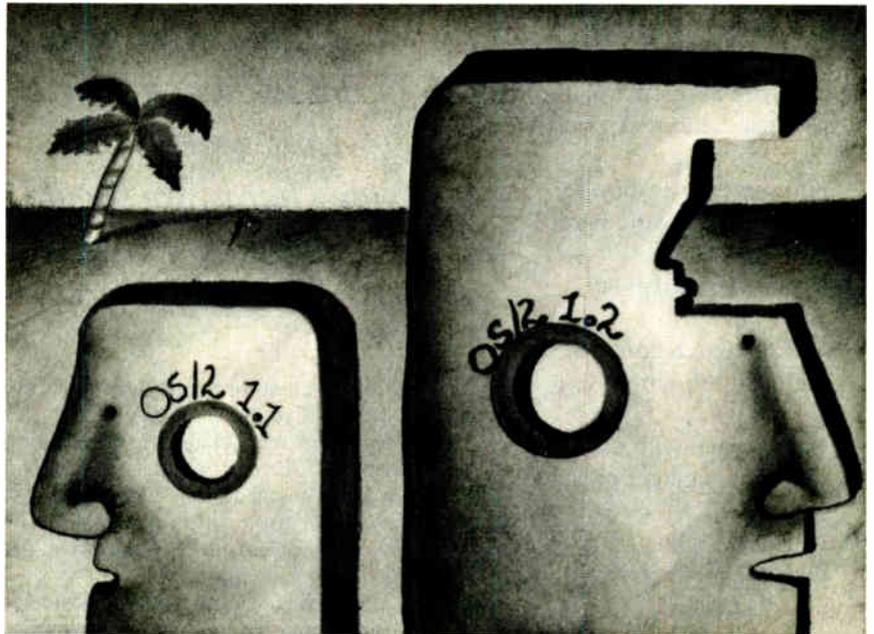
I told you about using the High Performance File System (HPFS) last month. Now I'll look at OS/2 1.2 in general. I've been living with this new version for a while, and for those of you who are still thinking of taking the plunge, here are some of the things you'll find.

Compatibility

It appears that just about anything that ran version 1.1 will run version 1.2. As before, one of my OS/2 workstations has a DTK motherboard with the Phoenix BIOS 3.06 (you may recall that the DTK BIOS doesn't seem to work with OS/2). My Micronics 386 motherboard, as before, will not boot version 1.2. That's probably because this early Micronics motherboard required a daughterboard to use an 80387, and something about the daughterboard upsets OS/2, or so I am told.

I don't have a later motherboard to test this claim on because Trillian Computer, the company I bought the system from, has washed its hands of this particular computer—you see, the company doesn't sell Micronics motherboards anymore. Micronics has no suggestions, either, alas, so for now I've got to advise caution when buying Micronics motherboards for use with OS/2.

Of course, 1.2 runs on the IBM machines that I've tested it on, although running it on either the PS/2 Model 30 286 or the 50 Z is a joke: version 1.2 takes about 10 megabytes of disk space, about the same as 1.1, and both computers ship with 20-MB drives. I suppose



that means that the official low-end IBM OS/2 machine will be the Model 50 Z, but most folks I know who are doing real work on OS/2 end up with the 386SX-based PS/2 Model 55 SX or the 386-based PS/2 Model 70.

If you're a Big Blue-only person, I'd suggest (reluctantly, as it's expensive) that you look at the PS/2 Model 80. It is built around a 386, can be gotten with the large hard disk drives that OS/2 really needs, and has numerous slots. You'll want the slots for the 8-plus MB of RAM that is needed for the Extended Edition or some other communications/database product.

Performance

I hate to say it, because I love the features that I get from OS/2 (e.g., large memory and multitasking), but it's *still* slow. For example, I do a lot of work with three object-oriented graphics packages: Generic CADD, a regular DOS application that

creates its own graphical environment; Micrografx Designer, one of the best (if not *the* best) Windows-based object-oriented drawing programs; and Designer/PM, a beta version of Micrografx Designer for use with the Presentation Manager (PM).

The difference in speed of screen handling is remarkable and instructive. Because it does its own screen management, Generic CADD runs respectably on an 8-MHz 8088 machine. Designer, requiring Windows, needs at least a 10-MHz 286 to look decent. This isn't the fault of Micrografx: I've run many Windows programs, and they're *all* slower than their non-Windows counterparts. For another example, compare PC Paintbrush with PC Paintbrush for Windows. Both were written by ZSoft, but the non-Windows version is much faster.

The benefits of Windows are counterbalanced by its overhead. That's why

continued

TCP/2™

TCP/IP Networking for OS/2®

- Support for Ethernet,™ Token Ring, and SLIP
- Network accessibility from protected and real modes
- Full server operation for telnet, ftp, rsh, and rexec
- IP gateway capability
- VT102® emulation for telnet and rlogin
- Coexistence with other protocol manager packages
- Developer's kit with socket library

A
Dan Lanciani
Product

TCP/2...\$475 Dev. kit...\$750
OEM inquiries are invited.

For further information contact:

Essex Systems, Inc.
One Essex Green Drive
Peabody, MA 01960
(508) 532-5511 (orders)
(508) 532-5510 (info)

TCP/2™ is a trademark of DLD Consulting. Ethernet™ is a trademark of Xerox Corporation. OS/2® is a registered trademark of International Business Machines Corporation. VT102® is a registered trademark of Digital Equipment Corporation. TCP/2 is based in part on work done by the University of California at Berkeley.

Windows was renamed Windows/286; you can certainly run Windows/286 on an 8088 machine, but you really don't want to. However, Windows looks positively snappy compared to PM: Everything takes forever on a 286. PM's overhead must be tremendous. And 1.2 has not solved the problem. I suppose it's an-

I just
wonder how long
it will be before OS/2
runs without delays.
Next-generation
video hardware should
solve the problem.

other argument for not buying below 386 machines if you're running OS/2.

Don't get me wrong, I'm not beating up on OS/2. I'm just wondering how long it will be before it runs without delays. Next-generation video hardware will solve the problem, if PC vendors can get together on a standard.

The problem stems from the basic approach to putting graphics on the screen. Suppose a program wants to put a circle on the screen. With the popular graphics boards (i.e., CGA, Hercules, EGA, and VGA), the program describes the circle as a series of commands to place dots, or pixels, on the screen. Basically, it does a pile of calculations that are familiar to students of trigonometry: sines, cosines, and the like. (That's why a numeric coprocessor improves the performance of most graphics programs.)

This pixel-by-pixel approach is, as you'd imagine, quite compute-intensive. It's also video-board-type-specific: You have to know how many pixels exist on a VGA to write a VGA driver, how many on an EGA for an EGA driver, and so on.

The newest video boards take high-level graphics commands independent of board resolution. The width and height of the screen are defined as 1.0, and a point can be placed anywhere from (0.0, 0.0) to (1.0, 1.0). For example, the center of the screen would be (0.5, 0.5).

Nor must the program direct the board to place pixels in order to define a circle.

Instead, the program just tells the video board to place a circle on the screen, centered on a given point and extending for a given radius. It's a more efficient system because the video board has a microprocessor on-board that's been optimized for this kind of work.

Texas Instruments and Intel make chips that are intended for just this kind of thing; the problem is that no big PC vendor has popularized the idea enough to make it cheap. The TI34010 graphics chip isn't exactly new and untried at this point. Why not embrace it? Perhaps someday soon. If the slowness of the PM's screen handling isn't enough to spur the development of such products, I don't know what is.

Needed Fixes: Fonts and the Spooler
Two really annoying features of 1.1 were the buggy spooler and the hidden fonts. The spooler, as I've mentioned in previous columns, was pretty useless under 1.1. Version 1.2's spooler seems better, and now there are printer drivers for PostScript and Epson printers, Hewlett-Packard plotters, and a number of IBM printers.

The Times Roman and Helvetica fonts are now also preloaded into the PM, so there is no more wandering through the Control Panel. With 1.1, you got (in addition to the usual monospace Courier font and the proportional Helvetica-like System font) those ever-popular mainstays of desktop publishing, Times Roman and Helvetica.

Unfortunately, the fonts were *copied* to the hard disk by the automatic installation procedure, but not *installed*—the two actions are separate under both Windows and PM, and it takes some digging in the manuals to figure out what must be done and how to do it. You probably needn't worry about it here, however, as 1.2 preloads the fonts—a nice touch, and a needed one.

Improvements

Here are some more welcome changes that I found in version 1.2.

Command history. Many of you no doubt use a program like DOSEDIT or CED under DOS to remember previous commands. Such a program lets you recall the last 20 or so commands, edit any command, and reissue it just as if you'd typed the whole line.

For those who don't use something like that now, let me tell you, it's indispensable, because it saves retyping lines entered in error and simplifies repetitive tasks. A public domain "command

continued

**MICROVITEC DISPLAYS
GIVE GREAT IDEAS THE GOOD
LOOK THEY DESERVE.**

Today's computer graphics require a new way of looking at things. For the latest in leading-edge displays, look to Microvitec.

Our new CAD-Scan monitor shows every detail from edge-to-edge through its unique 17" flat square, .26mm dot pitch screen. It scans from 48 to 64 kHz for compatibility with high-end graphics cards. And its small-footprint, tilt/swivel stand saves precious space on the desktop.

In fact, our entire range of displays provide features for applications from financial trading and the factory floor to the office, school and home. For all types of PCs and workstations, interactive video systems, Uniplex and ANSI operating environments.

Whether you need one display or one thousand, take a look at Microvitec. What you see might surprise you.

Microvitec Plc. Bolling Road, Bradford, West Yorkshire,
BD4 7TU, UK. Tel: (+44) 274-390011
Microvitec, Inc., Atlanta, USA. Tel: (+1) 404 991 2246
Microvitec GmbH, West Germany. Tel: (+49) 211 24 30 51

MICROVITEC

**Circle 190 on Reader Service Card
(DEALERS: 191)**

Our new CAD-Scan monitor displays your sharp ideas through its high-resolution 17" flat square screen. It's compatible with high-end 48 and 64 kHz graphics cards for IBM® and Apple® PCs and leading graphics workstations.



VP-Planner® 3D

The Spreadsheet with more power,
more features, and better performance

... at the **best price!**

	VP-Planner 3D	1-2-3® Rel 3.0	1-2-3® Rel 2.2	Quattro Pro®
SPREADSHEET				
Runs on a 384K PC	✓		✓	✓
3D Worksheets in Memory	✓	✓		
3D Worksheet Rotation	✓			
3D Worksheet Group Operations	✓	✓		
Reduces Worksheet Size in RAM	✓			
Hot Links to Files on Disk	✓	✓	1/2	✓
Integrated Worksheet Auditing	✓			
Worksheet Mapping	✓	✓		✓
Multiple Step Undo	✓			
Multiple Step Redo	✓			
1-2-3 Release 2.2 Compatible	✓	✓	✓	
Expanded Memory Support	32 Mb	32 Mb	4 Mb	8 Mb
Virtual Memory Support	4 Mb			
LAN Support with File Locking	✓	✓	✓	
Laser Printer Support	✓	✓	✓	✓
GRAPHICS				
3D Graphing	✓			✓
Print Graphs and Text on Same Page	✓	✓	✓	✓
Multiple Linked-Graphs and Worksheet Data on Screen	✓			✓
Built-in Word Processor	✓			
DATABASE				
Create New dBASE® Datafiles from Worksheet Data	✓			
Retrieve dBASE Records Based on Selected Field Criteria	✓	✓		
Cross-Tab Database Records	✓	✓		
Sort/Pack dBASE Files on Disk	✓			
Multidimensional Database Files	✓			
Suggested Retail Price	\$295	\$595	\$495	\$495



Paperback Software International
2830 Ninth Street, Berkeley, CA 94710
(415) 644-2116

All Product and company names are trademarks
or registered trademarks of their respective holders.

history" program for OS/2 named Alias has been around for a while, but it's nice not having to hunt around for Alias every time I set up a system. Thanks, Microsoft and IBM. How about putting this feature in DOS?

On-line documentation. Rather than having to hunt around for the manual to look up some obscure syntax, there is now an on-line command reference that is installed (optionally) by the Install program. Take my advice and install it. You see, you don't get a manual with IBM OS/2 1.2 that completely describes the commands. You must install the command reference on-line or buy the separate command reference book from IBM (lesson number 457,199 in "how to annoy customers").

The command reference is as complete as the old OS/2 manuals. Since there are new options for several commands, take a look at the on-line reference before going too far with OS/2. Oh, and a hint on using the reference: You'll see a command syntax tree showing each option, but no description of what each option does. What you must do to get more information is to click, hypertext-like, on the option itself—you'll get the whole story then.

No more unnecessary disk checks. Version 1.1's file manager had an incredibly annoying habit. When it started up, it checked each floppy disk drive to see if there was a disk in the drive. As there generally is *not* a disk in the drive, the file manager waited a minute or two for each drive to time-out, and believe me, that minute got longer every time you loaded the file manager. No more.

Dual boot. Dual boot has been needed for some time, and it's a welcome addition. One problem with dual boot was setting up the directories for both DOS and OS/2: OS/2 left the root directory a real mess, with some basic system device drivers required to be in the root directory. But that's all fixed.

The change from 1.1 to 1.2 was more evolutionary than revolutionary (save, of course, for the HPFS), but perhaps that's because OS/2 is starting to mature. We'll see just *how* mature when the 386 version appears. ■

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

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

More Powerful Than Ever ... Up To 5 KVA



MINUTE MAN[®]
UNINTERRUPTIBLE POWER SUPPLIES

STANDBY UPS MODELS

- 250 To 1600 Watt Output
- Synchronized Sinewave with 1 msec Switching Time
- Full One Year Warranty

ON-LINE UPS MODELS

- 1000 To 5000 VA Sinewave Output
- True On-Line — Total Isolation
- Static Bypass Switch Standard

SHUTDOWN SOFTWARE

- Auto Shutdown of Local Area Networks for Unattended Operation
- Compatible with SCO XENIX 2.2.3 and above
- Novell ELS 2.12 and above
Advanced Netware 2.11 & above
SFT Netware 2.11 and above



STANDBY UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
250 WATT	\$ 379.00	\$ 429.00
300 WATT	\$ 549.00	N/A
500 WATT	\$ 699.00	\$ 799.00
600 WATT	\$ 899.00	\$1049.00
900 WATT	\$1249.00	N/A
1200 WATT	\$1499.00	\$1749.00
1600 WATT	\$1999.00	\$2299.00

TRUE ON-LINE UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
1000 WATT	\$2249.00	Available
3000 WATT	\$5495.00	Available
5000 WATT	\$8950.00	Available



LISTED

FOR L.A.N.
NOVELL LABS
TESTED AND
APPROVED
NetWare Compatible

PARA SYSTEMS, INC.

1455 LeMay Drive
Carrollton, TX 75007

Telephone:
(214) 446-7363

1-800-238-7272

FAX: (214) 446-9011

TELEX: 140275 OMEGA

Circle 213 on Reader Service Card

World Radio History

April 1st is funny.



Adobe Systems ... NCP
 Streamline Windows 1.0—Converts your bitmapped images to PostScript format. Imports TIFF, PNT, and PCX formats. Exports to EPS, Illustrator, Corel Draw and Micrografx Designer. \$229.

- 3 1/2" format available from us. Specify when ordering.
 - package includes both 5 1/4" and 3 1/2" disks.
 - 3 1/2" format available from manufacturer by request. Call us for details.
- CP—copy-protected; NCP—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.



Corel Systems ... NCP
 Corel Draw 1.1—You get over 100 typefaces and over 300 pieces of clipart free! Change colors, rotate, stretch, copy, combine fill with patterns and fountains—the possibilities are endless and exciting. \$329.

- Adobe Systems ... NCP**
 6591 *Illustrator Windows 1.0* \$279.
 6590 *Streamline Windows 1.0* 229.
- Aldus ... NCP**
 1332 *PageMaker 3.0* 499.
- Alpha Software ... NCP**
 5104 *Alpha Four 1.1* 319.
 4103 *Alpha Works 2.0* 89.
- Application Techniques ... NCP**
 1214 *Pizazz Plus 1.3* 69.
- Ashton-Tate ... NCP**
 4450 *dBASE IV 1.0* 499.
- Autodesk ... NCP**
 4519 *Autosketch 2.0* 95.
 6119 *Autosketch Animator 1.0* 189.
- Avery ... NCP**
 6006 *Label Pro 1.0* 49.
- Bitstream ... NCP**
 Fundamentals: Reports and Proposals, Presentations or Spreadsheets each 159.
 Headlines (1 to 6) each 99.
 Individual Fonts each 99.



Alpha Software ... NCP
 Alpha Four 1.1—The award-winning fully relational database management & application development system for business people, not programmers. Offers sophisticated reports and customized applications \$319.

- Chipsoft ... NCP**
 1663 *TurboTax for 1989 Taxes 7.0* \$45.
 Individual States each 34.
- Chronos Software ... NCP**
 4387 *Who•What•When 1.09* 119.
- Concentric Data Systems ... NCP**
 6575 *R & R Relational Report Writer 3B* 109.
- Corel Systems ... NCP**
 5506 *Corel Draw 1.1* 329.
- Crosstalk Communications ... NCP**
 2908 *Crosstalk XVI 3.7* 109.
 5611 *Crosstalk for Windows 1.0* 129.
- DacEasy ... NCP**
 1748 *DacEasy Accounting 4.0* 89.
- Data Storm ... NCP**
 4798 *PROCOMM PLUS 1.1* 52.
- Delrina Technology ... NCP**
 4325 *PerFORM 2.0* 169.
- Delta Technology ... NCP**
 5829 *Direct Access 4.1* 52.
- Digital Composition Systems ... NCP**
 5876 *db Publisher Report Maker 2.0* . 185.
- Dow Jones ... NCP**
 5494 *News/Retrieval Membership Pkg.* 24.
- 5th Generation ... NCP**
 2762 *Mace Utilities 1990* 89.
 3950 *Fastback Plus 2.09* 109.
- FormWorx ... NCP**
 5810 *FormWorx with Fill & File 2.5* 85.
- Fox Software ... NCP**
 6188 *FoxPro 1.0* 489.
 2233 *Foxbase Plus 2.1* 199.
- Funk Software ... NCP**
 2228 *Sideways 3.21* 42.
 4479 *Allways 1.0* 85.
- Generic Software ... NCP**
 2265 *Generic CADD Level 3 1.13* 169.
- Great American Software ... NCP**
 4880 *One Write Plus Accounting Sys. 2.0* .179.
 5825 *Money Matters 1.0* 55.
- Harvard Associates ... NCP**
 2324 *PC Logo 3.0* 59.
- Hayes ... NCP**
 2293 *Smartcom II 3.0* 89.

- Bloc Publishing ... NCP**
 1447 *FormTool 2.01* 55.
 6245 *PopDropPLUS 1.0* 59.
- Borland International ... NCP**
 4330 *Turbo C Professional Pack 1.0* 175.
 4332 *Turbo Pascal Professional Pack 1.0*. 175.
 6242 *Quattro Pro 1.0* 289.
 1514 *Paradox 3.0* 469.
- Brightbill-Roberts ... NCP**
 5408 *Hyperpad 1.0* 89.
 5843 *Show Partner FX 3.5* 229.
- Broderbund ... CP**
 1434 *New Print Shop (NCP)* 39.
 1433 *Memory Mate 3.01 (NCP)* 45.
- ButtonWare ... NCP**
 6419 *PC-File 5.0* 75.
- Caere ... NCP**
 6004 *Omnipage 386 2.1* 599.
- Central Point ... NCP**
 5039 *PC Tools Deluxe 5.5* 77.
 5038 *Copy II PC 5.0* 27.



Microcom ... NCP
 Carbon Copy Plus 5.2—Links two PCs, their keyboards, screens, and disks. You can have complete control of a remote PC's application software from your own PC. \$115.

April 15th means money.

- Hilgraeve ... NCP**
 2323 @HyperACCESS/5 1.0 (DOS & OS/2) \$115.
- IBM ... NCP**
 6187 @Storyboard Plus 2.0 239.
 6599 □Current 1.0 239.
- Individual Software ... NCP**
 2408 □Professor DOS 4.0 27.
 6222 □Resume Maker 1.0 29.
- Intuit ... NCP**
 2426 @Quicken 3.0 39.
- Lord Publishing ... NCP**
 5191 @Ronstadt's Financials 1.02 145.
- Lotus ... NCP**
 5417 □1-2-3 3.0 call
 5653 □1-2-3 2.2 call
 5134 @Magellan 1.0 149.
 4131 @Agenda 1.0 275.
 2660 □Freelance Plus 3.01 345.
- MECA ... NCP**
 4603 @Andrew Tobias' Tax Cut 1989 45.
 2798 □Managing Your Money 6.0 119.
- Microcom ... NCP**
 2775 □CarbonCopy Plus 5.2 (2 req.) 115.
- Micrografx ... NCP**
 6294 @Draw Plus 1.0 289.
- Micro Logic ... NCP**
 2968 □Tornado 1.8 55.
- Microlitics ... NCP**
 2731 □GOter 2.0 (new version) 45.
- Microsoft ... NCP**
 2860 □Learning DOS 2.0 35.
 2899 □Windows 286 2.1 69.
 2904 □Works 2.0 99.
 2900 □Windows 386 2.1 129.
 2901 □Word 5.0 209.
 6195 @Word for Windows 329.
 2856 @Excel 2.1 (req. 80286/80386) call
 6133 @Excel for OS/2 1.0 339.
 5188 □QuickPascal 1.0 69.
 2894 □QuickBASIC 4.5 69.
 2895 □QuickC 2.0 69.
 2853 @C Compiler 5.1 299.
- Multisoft ... NCP**
 4925 □PC-Kwik Power Pak 1.5 79.

- New England Software ... NCP**
 4337 □GB-Stat 1.5 \$159.
- Nolo Press ... NCP**
 2982 □WillMaker 3.0 35.
- Norton-Lambert ... NCP**
 4928 □Close-Up Customer 3.0 135.
 4929 □Close-Up Support 3.0 165.
 5420 @Close-Up Lan (8 user) 529.
- Paperback Software ... NCP**
 6358 □VP-Planner 3D 1.0 169.
- PC Globe ... NCP**
 5902 □PC Globe 3.0 39.
 5900 □PC USA 1.0 39.
- Personics ... NCP**
 3126 @SeeMORE 2.0 54.
 4328 @Look & Link 1.1 59.
- Peter Norton ... NCP**
 3152 @Norton Commander 3.0 89.
 3146 @Advanced Utilities 4.5 89.
 6397 @The Norton Backup 1.0 89.
- Precision Software ... NCP**
 6600 @Superbase 4 for Windows 459.

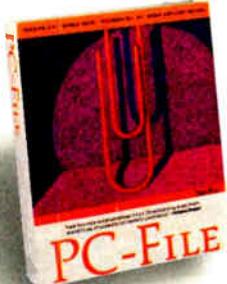


Quarterdeck ... NCP
 □QRAM 1.0—Manage your memory to it's fullest with QRAM. If you have an EMS 4.0 or EEMS board, QRAM can use it to free up more memory within the 0-640k area. \$49.



Norton-Lambert ... NCP
 Award-winning Close-Up connects two PCs via modem, linking screens & keyboards. Ideal for remote support & training.
 □Close-Up Customer/Terminal 3.0 \$135.
 □Close-Up Support/ACS 3.0 165.

- Samna ... NCP**
 5799 @Ami Professional 1.0 319.
- Softlogic Solutions ... NCP**
 3546 □Disk Optimizer 4.05 45.
 3542 □Software Carousel 3.01 55.
- Softview ... NCP**
 3474 @MacInTax for Windows (1989 taxes) 65.
- Software Publishing ... NCP**
 6289 @Draw Partner 1.0 59.
 3499 □PFS:First Publisher 2.1 89.
 3478 □PFS:First Choice 3.02 105.
 3496 @Professional Write 2.12 149.
 3493 @Professional File 2.01 199.
 3482 □Harvard Graphics 2.13 339.
- Symantec ... NCP**
 3427 □Q&A Write 1.01 139.
 3425 □Q&A 3.0 229.
 3431 □Timeline 3.0 399.
- Systems Compatibility ... NCP**
 6568 □Word Exchange 4.0 55.
 6564 □Software Bridge 4.1 79.

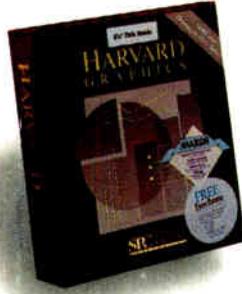


ButtonWare ... NCP
 @PC-File 5.0—The most friendly, comprehensive database available. It includes letter-writing with mail merge, business graphing, and a powerful report writer. It also works directly on dBase files \$75.

- Quarterdeck ... NCP**
 3221 □Expanded Memory Mgr. 386 5.0 59.
 3220 □DESQView 2.26 79.
 4586 □DESQView 386 129.
 6400 □Manifest 1.0 39.
 6422 □QRAM 1.0 49.
- Reality Technologies ... NCP**
 6572 @WealthBuilder 1.1 145.
- Reference Software ... NCP**
 4396 @Grammatik IV 1.0 52.
- Revolution Software ... NCP**
 4480 @VGA Dimmer 2.01 (screen saver) 19.
- RightSoft ... NCP**
 4155 @RightWriter 3.1 54.

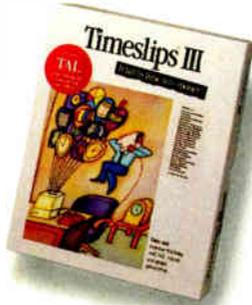
1-800/776-7777

MMC **PC Connection** 718
 6 Mill Street
 Marlow, NH 03456
SALES 603/446-7721 FAX 603/446-7791



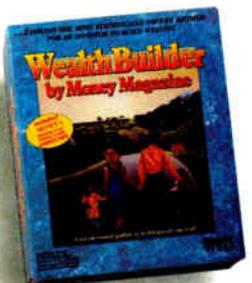
Software Publishing ... NCP
 □Harvard Graphics 2.13—Be "free and easy" with the industry's best-selling presentation graphics package. Now includes Draw Partner drawing accessory FREE (normally \$149 List). Graphically the best choice.... \$339.

We've got what it takes



Timeslips ... NCP
 Timeslips III 3.4—Track every minute's efforts, then print the invoice and log the receivable all from the convenience of Timeslips III. Menu-driven and memory resident, this is a must for your service business. . . . \$169.

- Timeslips ... NCP**
 2987 Timeslips III 3.4 169.
- Timeworks ... NCP**
 6253 Publish-It! 1.1 115.
- TOPS ... NCP**
 3726 TOPS Network Bundle 3.0 159.
 3720 Flashcard 2.1 (AppleTalk network card; 1 year warranty) 179.
- Traveling Software ... NCP**
 4190 Battery Watch 2.0 (3 1/2" only) 35.
 5179 LapLink III 3.0 85.
- True BASIC ... NCP**
 3561 True BASIC 2.1 52.
- Vericomp ... NCP**
 3765 SoftBytes 2.0 35.
- WordPerfect Corp. ... NCP**
 3799 WordPerfect Library 2.0 75.
 3804 WordPerfect 5.1 265.
- WordStar USA ... NCP**
 2825 WordStar Prof. Release 5.5 229.
 5000 Upgrade to Release 5.5 89.

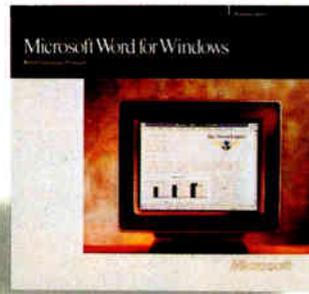


Reality Technologies ... NCP
 WealthBuilder by Money Magazine 1.1—Save & invest wisely. Set financial goals & achieve them. Plan for retirement, a child's education, a home. Optimize your portfolio & track all of your investments \$145.

- Xerox ... NCP**
 3812 Ventura Publisher 2.0 \$529.
 6505 Formbase 1.0 319.
- XTREE ... NCP**
 6161 XTreePro Gold 1.3 75.
- XYQUEST ... NCP**
 4393 XyWrite III Plus 3.55 229.

RECREATIONAL/EDUCATIONAL

- Broderbund ... CP**
 1417 Where/Europe Carmen Sandiego? 32.
 5701 Where/Time Carmen Sandiego? 32.
- Electronic Arts ... NCP**
 6436 Hunt for Red October 35.
 4659 Chessmaster 2100 (CP) 35.
 5804 Deluxe Paint II (Enhanced) 89.
- Microprose ... CP**
 4454 F-19 Stealth Fighter 39.
 5823 Red Storm Rising 39.
- Microsoft ... NCP**
 2858 Flight Simulator 4.0 39.



Microsoft ... NCP
 Word for Windows—Combines the power of Word for the PC with ease of use and WYSIWYG accuracy of Microsoft Windows. Integrate graphics and data from Windows applications into your documents. . . . \$329.

- Parlor Software ... CP**
 3159 Bridge Parlor 2.3 49.
- Sierra On-Line ... CP**
 6023 Leisure Suit Larry III 39.
 5695 Manhunter: San Francisco 33.
 4456 Police Quest II 39.
 5106 Space Quest III 39.
 6022 Colonel's Bequest 39.
- Spectrum Holobyte ... NCP**
 5993 Welltris (Tetris sequel) 22.
- Spinnaker ... CP**
 5580 Sargon IV 32.
- Stone & Assoc. ... NCP**
 3435 My Letters, Numbers, Words (2 to 6) 22.
 3438 1st Math (ages 5 to 8) 22.
 3439 2nd Math (ages 7 to 16) 27.
 5231 Phonics Plus 22.
- Sublogic ... NCP**
 6190 Air Transport Pilot 33.
- True BASIC, Inc. ... NCP**
 Kemeny/Kurtz Math Series:
 10 titles each 45.



Intel ... 5 years
 Connection CoProcessor—Award winning fax-modem includes a free copy of Fax-it software from Intel. Send and receive information in the background from within many popular applications. New low price \$529.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

- AST Research ... 2 years**
 1299 SixPakPlus 384k C/S/P 189.
 4107 RAMpage Plus 286 512k 419.
- Brother International ... 1 year**
 5787 HL-8e Laser Printer 1799.
 5788 HL-8Ps PostScript Laser Printer 2949.
- Compucable ... 2 years**
 1604 2-Position switch box 25.
 1605 3-Position switch box 35.
- Corvus ... 1 year**
 6184 ReadyNet Starter Kit 319.
 6183 ReadyNet Add-On Kit 165.
- Cuesta ... 1 year**
 1608 Datasaver 400 Watt (power backup) 429.
- Curtis ... lifetime**
 1690 Diamond Plus SP-1 + 41.
 1694 Emerald SP-2 36.
 1707 Ruby SPF-2 (6 outlets) 55.
 1708 Ruby-Plus SPF-2 Plus 65.
- Diconix ... 1 year**
 5655 150 Plus Printer (Parallel) 359.
- Epson ... 1 year**
 We are an authorized Epson Service Center.
 1906 FX-850 (80 col., 264 cps, 9 pin) 369.
 1904 FX-1050 (136 col., 264 cps, 9 pin) 479.
 5183 LQ-510 (80 col., 180 cps, 24 pin) 349.
 1930 LQ-850 (80 col., 264 cps, 24 pin) 519.
 1917 LQ-1050 (136 col., 264 cps, 24 pin) 725.
 4116 LQ-2550 (136 col., 333 cps, 24 pin) 989.
 5184 LX-810 (80 col., 180 cps, 9 pin) 199.
 1052 Printer-to-IBM cable (6 feet) 15.
- 5th Generation ... 1 year**
 3952 Logical Connection 512k 529.
- Hayes ... 2 years**
 2307 Smartmodem 2400 349.
 2308 Smartmodem 2400B (w/Smartcom II) 249.



to make the best of both.

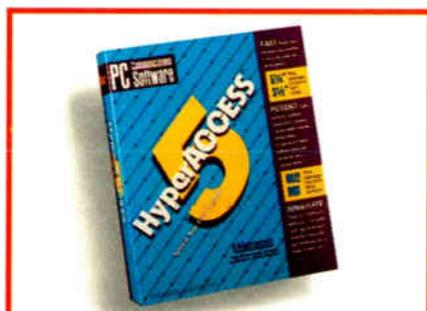
Don't get fooled again.



Intel ... 5 years
2400EX MNP Modem—The newest member of Intel's modem family. MNP/Level 5 provides error-correction for reliable communications, as well as data compression for faster data throughput \$229.

- Hercules ... 2 years**
 2318 Graphics Card Plus 189.
- Hewlett-Packard ... 1 year**
 6583 Laserjet II (w/toner) 1739.
 6582 Laserjet IIP (w/toner) 1039.
 6581 Deskjet Plus (w/ink cartridge) 719.
- Intel ... 5 years**
 4696 2400B Internal Modem 159.
 2352 2400B Internal Modem 2 (for PS/2) 249.
 5119 2400 Baud External Modem 179.
 6420 2400EX MNP Modem 229.
 2346 Inboard 386/PC w/1 Meg (w/free Ami) 579.
 4266 Above Board Plus 512k 419.
 4267 Above Board Plus I/O 512k 449.
 5336 Above Board Plus 8 2 Meg 599.
 5342 Above Board Plus 8 I/O 2 Meg 629.
 4272 Above Board 2 Plus 512k 469.
 5396 Above Board MC 32 0k 359.
 4275 Connection CoProcessor (w/Fax-it) 529.
 4857 Visual Edge (graphics enhancement for the HP LaserJet II) 449.
- MATH COPROCESSORS**
 2370 80287-8 (for 8 MHz 80286 CPU's) . 199.
 2369 80287-10 (for PS/2 Models 50 & 60) 229.
 4750 80387SX (for 80386SX CPU's) . . . 309.
 2371 80387 (for 16 MHz 80386 CPU's) . . 349.
 2372 80387-20 (for 20 MHz 80386 CPU's) 399.
- Kensington Microware ... 1 year**
 2582 Masterpiece Plus 109.
 5697 Expert Mouse (Trackball for PS/2) . 115.
- Keytronic ... 3 years**
 4518 101 Plus Keyboard 99.
- Kraft ... 5 years**
 5801 New Game Adapter (2 game ports) . 27.
 5800 3 button Thunder Joystick 29.
 5802 Trackball 69.
- Logitech ... limited lifetime**
 5464 Series 2 Mouse (C9 for PS/2's) 69.
 5151 HiREZ Mouse (C9) 85.
 6029 Trackman (Trackball) serial 85. bus 89.
 4297 ScanMan Plus (hand scanner) 185.
- Micron Technology ... 2 years**
 6005 Ascend 4 Meg Brd. for Compaq 386 699.
 6013 Beyond Mem. Brd. for Model 50 (512k) 359.

- Microsoft ... lifetime**
 2897 Mouse with Paintbrush \$109.
 2898 Mouse with Windows 286 2.1 139.
- MicroSpeed ... 1 year**
 6007 PC-TRAC Trackball serial 75. bus 85.
 6010 FastTRAP 3D Trackball serial 99. bus 109.
- Mouse Systems ... lifetime**
 5845 White Mouse (bus or serial) 69.
 5997 Trackball (1 yr. wrnty.) serial 75. bus 85.
 4306 PC Mouse II w/PC Paint+ 89.
- NEC ... 2 years**
 4799 Multisync 2A (VGA Monitor) 499.
 5085 Multisync 3D Monitor 689.
- Orchid Technologies ... 4 years**
 4690 ProDesigner VGA (800 x 600) 249.
- PC Power & Cooling Sys. ... 1 year**
REPLACEMENT POWER SUPPLIES
 3202 Turbo Cool 150 (25° - 40° cooler) 129.
 3200 Silencer 150 (84% noise reduction) 115.



Hilgraeve ... NCP
 HyperACCESS/5 1.0—Blasts data through your modem faster than any other program. Potent, agile, civilized. An automation breakthrough ... it learns your work! Contains versions for DOS and OS/2. \$115.

- Practical Peripherals ... 5 years**
 3101 1200 Baud Internal Modem 69.
 3100 1200 Baud External Modem (mini) . 77.
 3103 2400 Baud Internal Modem 139.
 3102 2400 Baud External Modem 179.
 5286 2400 Baud Int. MNP Modem (Lev. 5) 175.
 5285 2400 Baud Ext. MNP Modem (Lev. 5) 209.
 4542 2400 Baud Internal Modem for PS/2 . 229.
- Safe Power Systems ... 2 years**
 4561 Safe 250W (standby power bkup) 249.
 4562 Safe 425W (standby power bkup) 369.
- SOTA Technology ... 2 years**
 5111 SOTA 286i-12 (12 MHz accelerator) 269.
 5402 SOTA 386i-16 (16 MHz accelerator) 389.
- Targus ... lifetime**
 4899 Nylon Laptop carrying case 55.
 6037 Premier leather carrying case 199.

1-800/776-7777

MMC PC Connection 710B
 6 Mill Street
 Marlow, NH 03456
SALES 603/446-7721 FAX 603/446-7791



TheComplete PC ... 2 years
TheComplete Communicator—It's a 9600 bps fax. It's a 2400 bps modem. It's a sophisticated voice messaging and processing system. It's a scanner port. It's TheComplete solution! \$559.

- TheComplete PC ... 2 years**
 5598 TheComplete Half Pg. Scanner 400 189.
 5140 TheComplete Page Scanner 549.
 4887 TheComplete Fax 9600 429.
 5828 TheComplete Communicator 559.
- Toshiba ... 1 year**
 3684 T1000 Laptop (80C88, 6.4 lbs.) . . . 669.
 6332 T1000SE Notebook Laptop (5.9 lbs.) . 1269.
 4958 T1600 Laptop (12 MHz, 20 Meg) . 3249.
- Tripp Lite ... 2 years**
 6201 Isobar 8 (8 outlets, 12 ft. cord) . . . 69.
 6019 LS 600 Line Stabilizer 85.
 6018 LC 1200 Line Conditioner 159.
- Video 7 ... 7 years**
 5883 1024i VGA (includes 512k) 289.
 4931 VRAM VGA 512k 449.

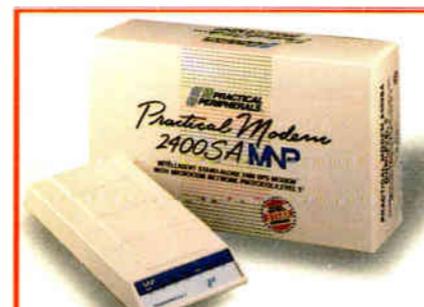
DRIVES

- DTC ... 1 year**
 6248 AT Floppy/Hard Drive Controller . . 129.



Targus ... lifetime
Premier Leather Carrying Case—Establishes a new standard of quality for business related luggage. This dual purpose case combines a luxurious, feature rich, leather briefcase together with a functional laptop carrying case \$199.

- IOMEGA ... 1 year**
 5116 Bernoulli II Single 44 Meg Internal \$995.
 5117 Bernoulli II Dual 44 Meg External 1969.
 5113 44 Meg Cartridge Tripak (5 1/4") . . . 249.
 2499 PC2 Card (controller required) . . . 169.
- Mountain Computer ... 1 year**
 2917 40-60 Meg Internal Tape Drive. . . . 379.
 5502 83-152M Ext. Tape Drive 759.
 5500 83-152M Int. Tape Drive 629.
 6153 DC2120 Cartridge (5 pack) 135.
 5190 DC2000 Pre-formatted Cartridges ea. 35.
- Pacific Rim ... 1 year**
 5010 1.2 Meg External (for PS/2's) 215.
 6602 1.44 External (for PC/XT/AT) 239.
- Plus Development ... 2 years**
 3105 Hardcard 20 Meg (49 ms) 529.
 3106 Hardcard 40 Meg (28 ms) 599.
 6424 Hardcard II 80 Meg (19 ms) 699.
- Seagate ... 1 year**
FREE PCTV® Hard Drive Installation
 Tape with purchase of 20, 30 or 40 Meg Seagate drive for the IBM PC (not for AT, Beta or VHS).
 2285 20 Meg Internal Hard Drive ST225 (w/controller and cables, 65 ms) . . 275.
 2286 30 Meg Internal Hard Drive ST238 (w/controller and cables, 65 ms) . . 289.



Practical Peripherals ... 5 years
2400SA MNP—Fully supports error-free MNP Level 5 data transmission, giving you more confidence in your communications. Also supports Hayes compatible 2400 bps standard operation. \$209.

- 4554 40 Meg Int. HD ST251-1 (28 ms) . . 359.
 2287 40 Meg Int. HD for PC ST251-1 (w/controller and cables, 28 ms) . . 419.
 4624 80 Meg Int. HD ST4096 (28 ms) . . 619.
- TEAC ... 1 year**
 4950 PC, XT 360k Drive (5 1/4") 79.
 4951 720k Drive (specify XT or AT, 3 1/2") . 79.
 4670 1.44 Meg Drive for XT (3 1/2") 99.
 4326 1.44 Meg Drive for AT (includes Bastech software utilities, 3 1/2" copy prot.) . 119.

MISCELLANEOUS

- Checkfree**
 6360 CheckFree Xpress 25.
- CompuServe**
 1676 CompuServe Information Service . . 24.

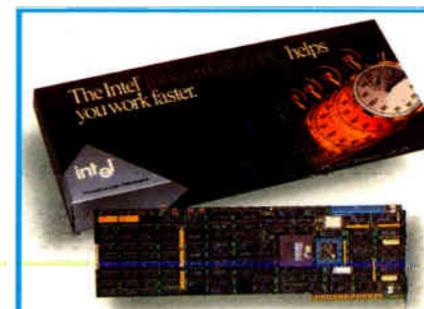
- Cables ... lifetime**
 1019 Smartmodem-to-AT cable (10 feet) \$15.
 5511 Right Angle Printer cable (6 feet) . . 15.
 1050 Parallel Printer cable (15 feet) 19.

DISKS

- All disks have a lifetime warranty.
- 5 1/4" DS/DD Disks (360k)**
 3291 Sony (10 disks per box) 12.
 2789 Maxell MD2-D (10 disks per box) . . 13.



XTREE ... NCP
 XTreePro Gold 1.3—A treasure of advanced disk management features—Directory Tree Display, Application Menus, Archive Management, Autoview & Enhanced View. Single keystroke commands for all operations. \$75.



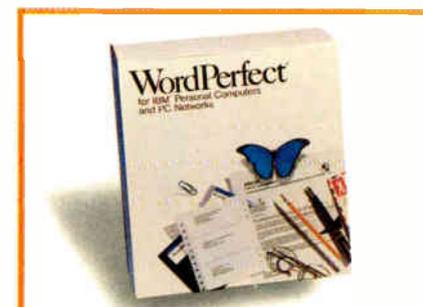
Intel ... 5 years
Inboard 386/PC—Brings advanced computing power to your PC/XT system. Includes 16Mhz 80386 processor and 1Mb RAM. Flexible 32-bit memory expansion options are also available \$579.

- 5 1/4" DS/HD Disks (1.2 Meg)**
 3292 Sony (10 disks per box) 19.
 2790 Maxell MD2-HD (10 disks per box) . 19.
- 3 1/2" DS/DD Diskettes (720k)**
 3297 Sony (10 disks per box) 14.
 2792 Maxell (10 disks per box) 15.
- 3 1/2" DS/HD Diskettes (1.44 Meg)**
 3298 Sony (10 disks per box) 29.
 2793 Maxell (10 disks per box) 29.

- MEMORY**
 3248 256k DRAMs (120 nanosecond) . . . call
 4366 1 Meg x 9 SIMMs (100 nanosecond) call
 5510 1 Meg x 9 SIMMs (80 nanosecond) call
 5746 1 Meg Chips (80 nanosecond) call

OUR POLICY

- We accept VISA and MASTERCARD only.
- No surcharge added for credit card orders.
- Your card is not charged until we ship.
- If we must ship a partial order, we never charge freight on the shipment(s) that complete the order (in the U.S.).
- No sales tax.
- All U.S. shipments insured; no additional charge.
- APO/FPO orders shipped 1st Class Mail.
- International orders U.S. \$250 minimum.
- Upon receipt and approval, personal and company checks now clear the same day for immediate shipment of your order.
- COD max. \$1000. Cash, cashier's check, or money order.
- 120 day limited warranty on all products.*
- To order, call us Monday through Friday 9:00 AM to 1:00 AM, or Saturday 9:00 AM to 5:30 PM. You can call our business offices at 603/446-3383 Monday through Friday 9:00 AM to 5:30 PM.



WordPerfect Corp. ... NCP
 WordPerfect 5.1—Mix both text and graphics with this "high-end" word processor/publisher. Multiple new features including "hot links" to 1-2-3, Excel, and PlanPerfect along with networking—all built in . \$265.

SHIPPING

- Note:** Accounts on net terms pay actual shipping.
- Continental US:**
- For heavy hardware items such as printers, monitors, Bernoulli Boxes, etc. pay actual charges. Call for UPS 2nd-Day & Next-Day-Air.
 - For all other items, add \$3 per order to cover UPS Shipping. For such items, we automatically use UPS 2nd-Day-Air at no extra charge if you are more than 2 days from us by UPS ground.
- Hawaii:**
- For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add \$3 per order.
- Alaska and outside Continental US:**
- Call 603/446-3383 for information.



PC Cultivation.

Silicon salad days.
(Or, how we mind our Peas & Cukes.)

Way up north in the fertile crescent of Marlow, NH (pop. 562), we know how to dig down deep. Which is pretty difficult (even for our celebrated 20 mole team) since the bedrock's just inches below the surface and the growing season's shorter than the day is long. But, with the winds of change blowing non-stop through the micro fields, you can't just scatter your seed any which way. You have to put down roots! We ought to know—we were the first company to sell peripherals and software exclusively for IBM personal computers. So when customers call us for product specs, prices, or

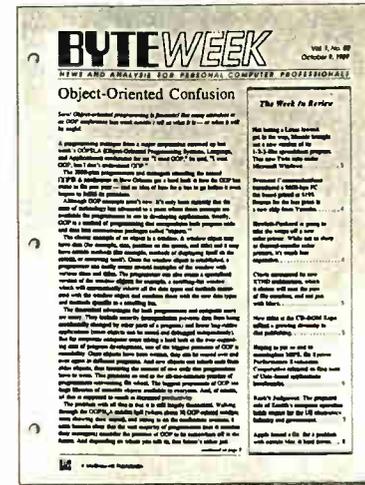
technical assistance, they're dealing with a company that has its paws (and peas) planted firmly in the ground. **A window-based system you can grow with.** Up here in Marlow, our imagination isn't the only thing that's fertile. In fact, it's small potatoes compared to our PC Connection Mint Garden which comes complete with soil and seeds for growing a luscious crop of Spearmint, Peppermint and Lemon Balm right on your favorite window. Put a fresh sprig in your favorite beverage and we're sure it will add a delightful *je ne sais quoi* (which means that we have no idea what it will add—but it'll taste good). It's free to everyone who places an order of \$500 or more between now and June 30.



Grow your own in a PC Connection Mint Garden. Offer not available outside the Continental U.S. or to accounts on net terms. One per customer.

The Cream.

The Crop.



There are plenty of places to get information in this industry. Too many. But if you want the best quality information, there's only one that rises to the top: **BYTEWEEK.**

BYTEWEEK is a weekly newsletter from the same professionals who produce BYTE Magazine. Each week, the most important news and information from the previous week is presented in a readable and concise manner. BYTEWEEK offers you what no other publication can: timely news on the rapidly-evolving computer industry as it happens with the interpretation and evaluation that only BYTE's experienced editorial staff can provide.

Subscribe now and take advantage of a special subscription rate of \$395 (\$495 outside the U.S. and Canada). Your subscription to BYTEWEEK also includes a free subscription to BIX, BYTE's exclusive on-line conferencing system. *Don't miss this opportunity!*

For fastest service, call toll-free 1-800-258-5485 (in N.H., call 603-924-9281) and charge to a major credit card or we'll bill you.

BYTEWEEK

One Phoenix Mill Lane, Peterborough, NH 03458.

BYTEWEEK offers a money-back guarantee if you are not completely satisfied.

Clip Coupon Here



YES! Sign me up as a subscriber to the Cream of the Crop, BYTEWEEK at the special subscription rate of \$395 a year for 50 issues (\$495 a year outside the U.S. and Canada).

Name _____
 Title _____
 Company _____
 Mail Address _____
 City/State/Zip _____
 Business Phone _____

MasterCard VISA
 Check enclosed Bill me

Card # _____
 Exp. _____
 Signature _____

BYTEWEEK

One Phoenix Mill Lane
Peterborough, NH 03458

PC CONNECTION



FARAWAY LANs

LAN remote-access schemes are the next-best thing to being there

The last few years have tugged many of you in two directions at once. LANs have drawn you to central locations, while the growing use of portable computers and the move toward people working at home have pushed you geographically apart.

We're suffering from this dilemma ourselves. Our main LAN, with its crucial data and applications, is in our lab at Mark's house. We currently run NetWare on that LAN because it lets us link the 20 or so Macintoshes and PCs in the lab to the same servers. The problem is that, while we often work together in the lab, Bill also often works in his home office. We also spend a lot of time traveling, usually armed with one of the eight or so Mac and PC portables in the lab.

A recent bout of travel, coupled with some bad weather, forced us to consider ways to get to the lab's LAN from other locations. While our situation is admittedly unusual (few organizations have a 10-to-1 computer-to-employee ratio), the solutions that we found will work for any group that needs to provide remote access to its LANs.

Move the Mountain

The most obvious solution is to move any LAN data you need to a remote system. Just run a communications program and a modem on a machine on the LAN, and use that machine to transfer files. All you need is a reasonable file transfer protocol, such as ZMODEM, XMODEM, or Kermit. Until fairly recently, this was our answer: Kermit in server mode on a PC.

But this approach has several draw-



backs. It ties up a PC, it doesn't let the remote user run important LAN applications like E-mail, and it abandons the whole notion of sharing live LAN data.

Create Two Mountains

The disadvantages of moving data to a remote system suggest another obvious solution: Make the remote computer a full participant in the LAN, so that it can share LAN data in the usual ways. Basically, you extend the LAN over telephone lines by using a LAN spanning product such as a bridge or router. Then neither the remote system nor any of the other machines on the LAN, including the server, are aware that the LAN is not all in one location.

On the remote side, you connect a PC to a null Ethernet (or another network), which in turn connects to the bridge or router. On the LAN side, you connect another bridge or router to the Ethernet. Many vendors now offer remote bridges

and routers for both PCs and Macs.

Unfortunately, these products are impractical for single PCs, because they require a pair of bridges and high-speed modems, as well as a leased line or its equivalent. That will cost from \$5000 to \$10,000 up front and hundreds of dollars a month in line charges.

Bridges become cost-effective when you need to connect a remote group of PCs to a central LAN because you can spread the cost over all the remote PCs. Bridges work best when most of the LAN traffic is on the two separate LAN segments, with only occasional messages passing between them.

Move Mohammed

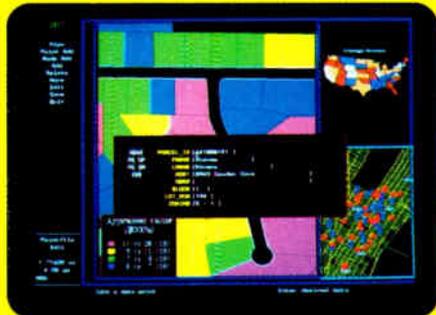
The final solution is to leave the data where it is. You just dedicate a local PC to the remote user and run a remote-access program on that PC. Those programs run the LAN applications on the

continued

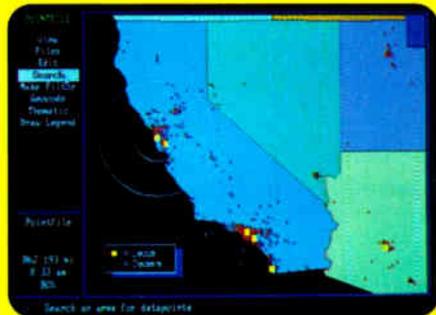
See Your Data



MapInfo software can find, display and analyze your data geographically. See your prospects, customers, facilities—anything in your database. Find addresses by street, ZIP code, city, etc. (We can even supply the maps.)



Any point or region on the map can have a complete record of data behind it. See your *actual* dBASE data in a window to view, edit, and print. Draw your own boundaries. Add titles and legends for high quality presentations.



Perform analyses on your data to sum, average, or count your database records by location. Color sales territories by volume of orders, ZIP codes by numbers of leads, countries by your demographic data.

From street-level to worldwide, MapInfo can merge your databases with maps. Play visual "what if" with your data. See patterns, trends, and opportunities you never knew existed. If you need to map your data, MapInfo can do it for as little as \$750.

MapInfo now includes a map of the world and the U.S. with all ZIP code locations. Runs on IBM PCs or compatibles with 640K memory, a hard disk drive, and graphics, and comes network-ready.

MapInfo Corp.

Changing The Way The World Looks At Information™

200 Broadway, Troy NY 12180
To order, call 1-518-274-8673
or 1-800-FASTMAP Toll free.

MapInfo is a trademark of MapInfo Corp. dBASE is a trademark of Ashton-Tate.

NETWORKS

ITEMS DISCUSSED

NETremote +\$350 per server
Brightwork Development, Inc.
766 Shrewsbury Ave.
Jerral Center West
Tinton Falls, NJ 07724
(800) 552-9876
(201) 530-0440
Inquiry 1071.

QL 1002 (for the PC).....\$645
QL 2201A (for the AT).....\$1125
Cubix Corp.
2800 Lockheed Way
Carson City, NV 89706
(702) 883-7611
Inquiry 1072.

Timbuktu/Remote ..\$195 per Mac
Farallon Computing, Inc.
2000 Powell St.,
Suite 600
Emeryville, CA 94608
(415) 596-9000
Inquiry 1073.

Computing of Emeryville, California, is a popular Mac remote-access program. Because it works with Macs, Timbuktu/Remote sends mouse commands as well as keystrokes to the slave Mac. It transfers screen images as QuickDraw commands; this approach speeds graphics transfers and lets the remote and slave Macs use different-size monitors.

One More Wrinkle

The above approach still requires a dedicated PC or Mac, with a modem, to handle the telephone connection. That's fine for folks who need to get to their office systems from a home computer or a laptop on the road, but it means buying another whole system if the remote user doesn't normally have an office PC. That additional slave PC costs extra money and consumes precious space.

Cubix Corp. addresses this problem by putting a dedicated PC into a PC-based server. The firm's PC-on-a-card product requires only a standard AT slot and is available in both NEC V40 and 286 versions. It lets you put up to four PCs on a card and up to four such cards in one server—so you can have as many as 16 PCs hiding in your server. This approach can save a lot of desk space.

We put one of Cubix's QL 1002 cards, which contains two V40 processors, in our Samsung NetWare server. (The card will also work with Network OS.) The server's standard AT bus acts as the "network" between the server's CPU and the CPU on the card. The QL 1002 includes NetWare drivers for this "bus" network, so neither the server nor the PC can tell that it's not just another system on the LAN. (The server sees the bus as just another LAN medium, much as a single NetWare server can contain and work with both Ethernet and Token Ring cards.)

The PCs on the card use a NetWare shell that also comes with the card. You also have to create a boot-image file for these PCs, such as we described in our December 1989 column "When One Drive Is Enough." You then boot the PC-on-a-card from the server. By attaching a terminal to it, you can operate that PC just as if it were a diskless workstation.

You also can use the PC-on-a-card to solve our problem by running a remote-access package on it. You can make the entire process automatic by starting that program in the PC-on-a-card's AUTO-EXEC.BAT file in the boot image. Attach an external modem to the card (which has the necessary serial ports); and you can access the PC-on-a-card

continued

local PC and send to the remote PC only the screen output of those applications. The idea of transferring only screen information is not new to LANs; PC and Mac remote-access programs have been around for years.

One interesting LAN remote-access product is NETremote+ from Brightwork Development of Tinton Falls, New Jersey. NETremote+ adds LAN capabilities to Co/Session, a PC remote-access package from Triton Technologies of Red Bank, New Jersey.

NETremote+ runs as a TSR program on the slave PC on the LAN. It detects screen changes as they happen and sends them to the remote PC. The remote PC runs a special, complementary terminal emulator that uses those changes to update the screen. That emulator also sends any keystrokes from the remote PC to the LAN slave PC, making it appear as if you had typed them in on the slave. The program can even send graphics screens, albeit slowly.

Co/Session provides most of these features. NETremote+ goes a step beyond normal remote access by letting the slave PC control any other PC on the LAN.

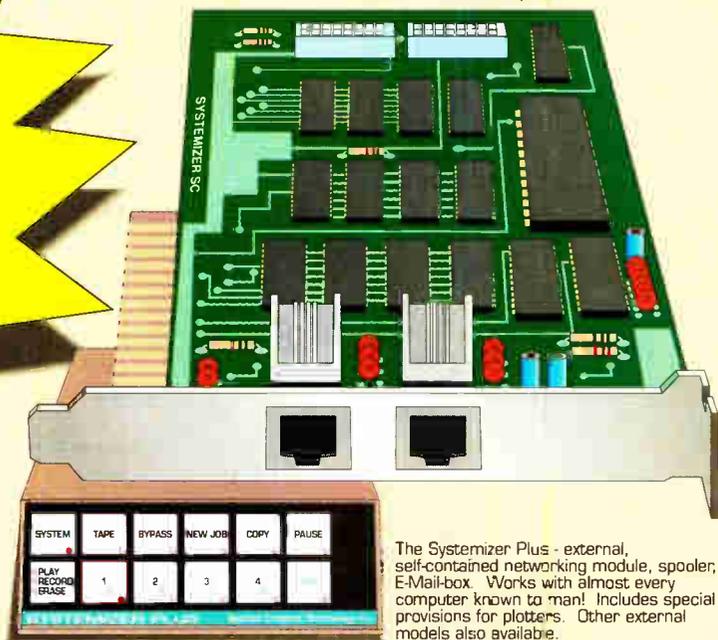
The result of running NETremote+ is that the remote PC acts as if it were the slave PC on the LAN.

While fewer remote-access products exist for the Mac than for the PC, the Mac products work in basically the same way. Timbuktu/Remote, from Farallon

NEW Slot Card Systemizer SC!

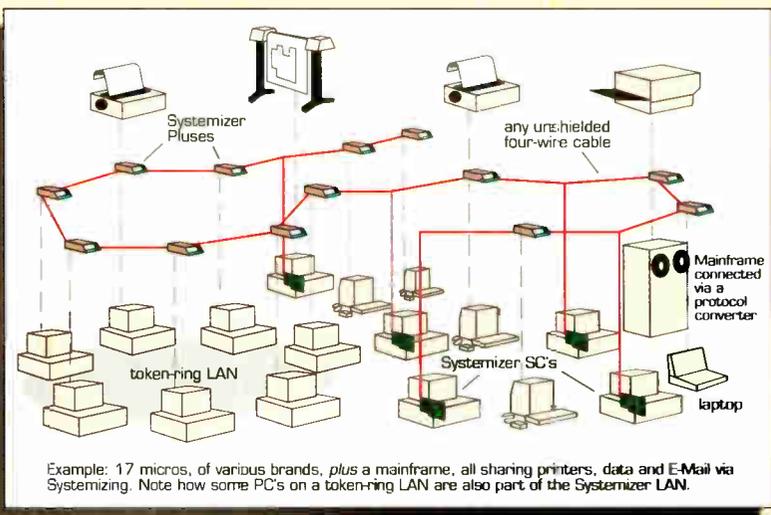
Systemizing The truly universal LAN alternative...

The Systemizer SC - features memory resident printer controller, spooling, E-Mail and file transfer. For all MS-DOS® PC's and compatibles.



The Systemizer Plus - external, self-contained networking module, spooler, E-Mail-box. Works with almost every computer known to man! Includes special provisions for plotters. Other external models also available.

- Up to 31 users can...**
- Share Printers
 - Share Plotters
 - Share a Modem
 - Exchange E-MAIL
 - Transfer Datafiles



Systemizing has become the connectivity standard at many of the world's largest corporations and throughout the federal government. Ten's of thousands are already in use. The new Systemizer SC is the latest model in Applied Creative Technology's line of Systemizing products, and it delivers what 95% of corporate computer users want from a Local Area Network— at far less cost and complexity, and yet with much more versatility.

Corporate computing managers prefer Systemizing over other connectivity methods because it offers:

- Guaranteed software/hardware compatibility.
- Ability to mix PC's, LAN's, mainframes, laptops.
- Easy owner installation. Low cost cabling.
- 5 min. user training with no support needed after.
- Flexibility; readily accomodates growth and changes.
- Distributed processing for high speed and reliability.

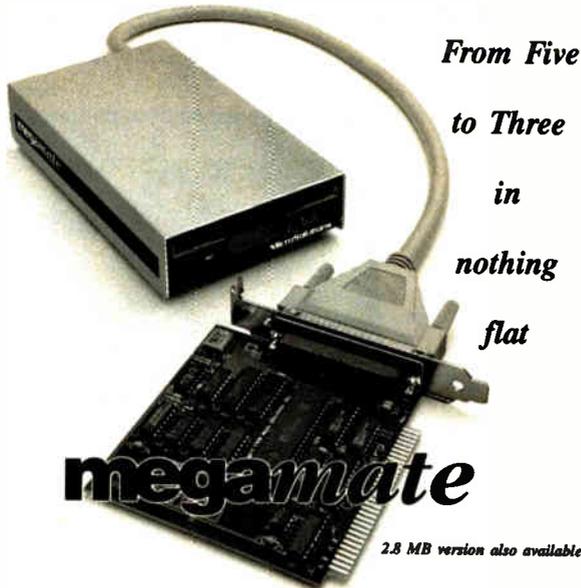
And with the new SC, everyone can afford to Systemize!

Call 1-800-433-5373 to get a FREE demo!

The **CONNEXPERTS**SM
A Division of Applied Creative Technology Inc.
8333 Douglas Ave., Suite 700
Dallas, Texas 75225 U.S.A.
(214) 739-4200

Copyright 1989 by Applied Creative Technology Inc. Systemizer Plus and Systemizing are trademarks of Applied Creative Technology Inc. Patent applied for.

Circle 72 on Reader Service Card



From Five
to Three
in
nothing
flat

megamate

2.8 MB version also available

Megamate includes everything you need to add tomorrow's disk drive to today's computers. Installation is a snap, just plug in the card, plug in the drive, and run the setup software (4 keystrokes and you're done). Megamate is easy to use, just like a 5 inch drive. It works with PCs, XT's, and AT's, and you can add it to any computer because it's external.

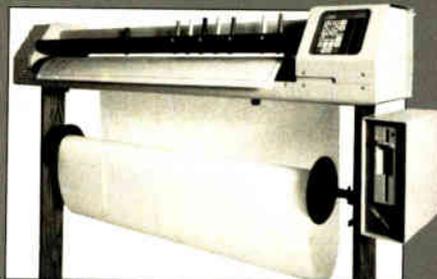
Megamate gives your customers compatibility with IBM computers that use 3.5 inch diskettes, both the 720KB laptop diskettes and the 1.4MB PS/2 diskettes. It automatically determines which type of diskette is being used.

- Installs in minutes
- Handles any 3.5 inch IBM disk, 720KB or 1.4MB automatically
- Complete package — for any PC, XT, AT, or compatible
- Attractive and compact, barely bigger than a diskette
- One year warranty

MicroSolutions
Computer Products

132 W. Lincoln Hwy.
DeKalb, IL 60115
815.756.3411

Save
Now



The Ioline LP4000™ with Roll Feed and PlotServer Plus™ file server offers full-featured, large-format plotting for close to half the cost you might otherwise pay.

SPECIAL OFFERS ON HIGH-PERFORMANCE PLOTTING SOLUTIONS

Continuous-Plotting Package
\$4995

- A-E size LP4000 8-pen plotter with servomotor and Roll Feed
- Auto paper advance for continuous plotting
- Customized plot setups
- Accurate media alignment

Off-line Plotting Package
\$5495

- A-E size LP4000 8-pen plotter with servomotor and Roll Feed
- File server to plot off line from PC
- Auto paper advance for unattended plotting
- Software for queuing 15 files

OFFER ENDS JUNE 29, 1990

Act Now. This unique opportunity ends soon so talk to your local Ioline dealer today or call us at (206) 821-2140 Ext. 318 for details.

IOLINE
PLOTTING SYSTEMS

A Great Return on Your Investment™

IOLINE CORPORATION 12020 - 113TH AVE. NE KIRKLAND, WA 98034 FAX (206) 823-8888

from a remote PC just as if you were using a regular PC on the LAN.

The PC-on-a-card approach saves both physical space and network bandwidth. You can use it whenever you would use a dedicated PC on the LAN; for example, it makes a nice asynchronous modem pool server. But there are some drawbacks to using a PC-on-a-card. These cards can't work with any other boards in the server because they see the server's bus as a network, not a normal bus. These boards cannot, therefore, work with such important server resources as 3270 gateways. The PC-on-a-card also isn't particularly cheaper than a dedicated inexpensive PC clone—Cubix's AT-on-a-card lists for more than \$1100.

Line Problems

The solutions that we have described should sound familiar: We've just reinvented the minicomputer, complete with terminals (graphics terminals for Macs).

It shouldn't be surprising, then, that these techniques also suffer from the biggest problem plaguing minicomputer terminals—the speed of telephone lines. If you've ever used a minicomputer or an on-line service like BIX, you know that 2400 bps is slow. The problem is even worse for PCs and Macs, where applications update the screen constantly.

Higher-speed 9600-bps modems help quite a bit. CCITT V.32-class modems with V.42 data compression are even better. Still, even the best modem yields screen performance far below what you have come to expect from PCs. The 65,536-bps speed of ISDN will help even more, but remote access will probably never be as nice as being there.

The bottom line is that you sacrifice PC responsiveness to gain remote LAN access. As a result, for the foreseeable future, remote LAN access is best for occasional use for applications such as E-mail and data exchange. Save the heavy database work until you're in the office and can either sit down at your desktop LAN system or plug your laptop into a Xircom external Ethernet adapter or an AppleTalk connector. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

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



Our Printer Sharing Unit Does Networking!

An Integrated Solution

Take our **Master Switch™**, a sophisticated sharing device, combine it with **MasterNet™** networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

Versatile

Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The

MasterLink™ utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

Other Products

We have a full line of connectivity solutions. If you just want printer sharing, we've got

it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

Commitment to Excellence

At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.



Call now for literature or more information.
(800) 333-9343

Give a Rose to your computer

P.O. Box 742571 • Houston, Texas 77274 • Tel (713) 933-7673 • FAX (713) 933-0044 • Telex 4948886

Circle 247 on Reader Service Card

SHORT TAKES

BYTE editors' hands-on views of new and developing products

LaserJet III

Photoshop

Toshiba 1200XE

R:base 3.0

Lotus 1-2-3/G



Hewlett-Packard's Laser Counterattack

With the introduction of the **LaserJet III**, Hewlett-Packard has thrown down the gauntlet, making it clear to competitors that it's not about to sit back and give others the advantage in the hot battle for laser-printer market share. The long-awaited successor to the venerable LaserJet Series II, the LaserJet III brings new meaning to the term "more for less," and it's sure to make users sit up and take notice. I certainly did.

HP claims that the LaserJet III is completely compatible with the Series II. So what's the big deal, besides a sleek new look? Well, there's plenty of cutting-edge technology under the hood.

If you've purchased a laser printer recently, you've probably found that few are very useful without a bunch of options. It's like buying a stripped-down car.

But HP has packed enough standard features into the LaserJet III to make it immediately useful. With a megabyte of RAM, I could print out a full page of graphics. Even more useful is the LaserJet III's selection of fonts. The 14 internal bit-mapped fonts are just the

beginning. It also comes with CG Times and CG Univers typefaces from AGFA Compugraphic. Both typefaces come in regular, boldface, italic, and boldface italic. You can scale these eight fonts from 1/4 point (too small to read) to 999.75 points (larger than a standard sheet of paper).

Thanks to the III's new PCL (Printer Control Language) 5, which incorporates vector graphics, those fonts can be stretched, rotated, and overlaid in addition to being scaled. All these features are impressive, but what places the LaserJet III in a solitary spotlight is a proprietary feature called *resolution enhancement*. Yes, it is still a 300- by 300-dot-per-inch printer, but HP has put a patented circuit before the print engine that makes all the dif-

ference. Resolution enhancement performs the tricky task of modulating the laser beam in the print engine, varying both the size and placement of the individual dots. It works strictly on the edges of graphics and characters, and it does a superb job of eliminating jaggies, the stair-step edges that are particularly noticeable on graphics and large fonts.

I noticed the difference on the first sheet I printed; the III's output has a pronounced crispness that's lacking on the output from other laser printers. Since resolution enhancement is also switchable (in case you're using add-in cards that depend on an unmodified print engine), I turned it off and printed a page of unenhanced graphics. The difference is striking, and, under a magnifying glass, the

III's ability to produce what's effectively the look and feel of typeset quality is even more discernible.

While many laser printers are rated at 8 ppm, that's a theoretical maximum for plain text. The reality—especially for printing graphics—is often considerably less. But in the LaserJet III, HP has tweaked the hardware and software to make the data really move. The company claims overall I/O performance has been increased by nearly 50 percent. And although I didn't use any formal benchmarks, my subjective impression is that the LaserJet III gave my computer back to me (and started printing) considerably faster than the Series II. It was very noticeable when I printed graphics.

At \$300 less than the LaserJet II, the LaserJet III's price is impressive.

You can use all the add-ons designed for the Series II plus some new ones. Add a 2-MB memory board, a PostScript-emulation cartridge, and an AppleTalk interface, and for \$4355, you have a full-fledged Macintosh laser printer for considerably less than Apple's own. In addition, you get resolution enhancement.

I was disappointed that the LaserJet III lacks a second paperfeed tray. But when you couple the printer's standard features, resolution enhancement, and rock-bottom price, the LaserJet III comes out as not only an unbeatable deal, but a truly trailblazing product. And since other laser-printer manufacturers will be burning the midnight oil to answer HP's challenge, the LaserJet III's ultimate feature may turn out to be "competition enhancement."

—Stan Miastkowski

THE FACTS

LaserJet III
\$2395

Options:

1-MB memory board, \$495;
2-MB memory board, \$990;
PostScript cartridge, \$695;
AppleTalk interface, \$275.

Hewlett-Packard Co.
19319 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Inquiry 985.

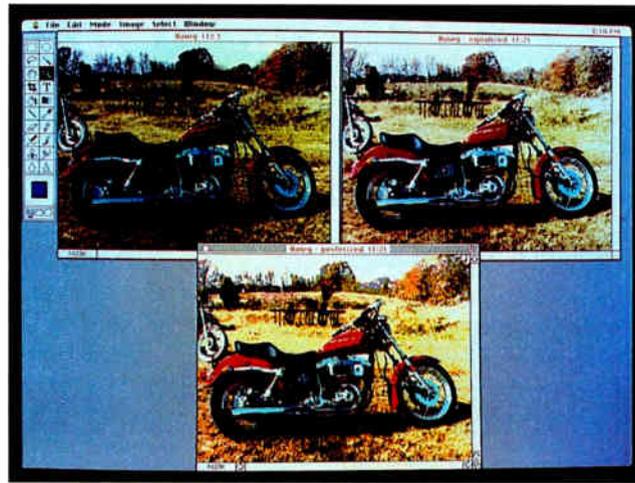
Photoshop Is Picture-Perfect

With the advent of 32-Bit QuickDraw and a variety of 24-bit color boards, Macintoshes can view and work with large images that contain millions of colors. This opens the door for Mac applications like Adobe's new **Photoshop**, which can perform the electronic equivalent of darkroom image manipulation on your Desktop.

Photoshop comes well-equipped to import, process, and export images from various computers. It reads PICT2, TIFF, MacPaint, PixelPaint, and the preview image in EPS files. Other files that it can handle are TGA (TARGA format), GIF, PIXAR, and Amiga IFF/ILBM files. For the hard cases, there's also a "Raw" option that lets you specify certain file characteristics so that Photoshop attempts to generate an image from the data. And Photoshop's list of image-saving formats is equally exhaustive. It has its own Photoshop format, plus PICT2, PICT2 resource, TIFF, EPS, Amiga IFF/ILBM, GIF, MacPaint, and PIXAR formats.

Photoshop supports black-and-white bit-mapped, grayscale, RGB, HSL (hue, saturation, and lightness), HSB (hue, saturation, and brightness), and CMYK (cyan, magenta, yellow, and black) images. You can convert images between each image type, within limits.

A variety of tools on a floating palette window provides all sorts of ways to work with an image. There are painting, viewing, editing, and selecting tools. You can also make color correc-



tions to an image by adjusting its brightness, contrast, and color balance. You can flip, rotate, and skew images. There's a host of filtering functions that blur or sharpen an image, apply high-pass filtering, diffuse and despeckle it, or add noise. These changes are applied to the entire image or just the portion that you select with one of the selection tools.

Photoshop can print an image using CMYK-process colors or Color PostScript, or as a halftone, where you can specify the screen frequency, dot shape, and screen angle. Images can be printed as composites (all the colors together) or as separations. Photoshop can send the pixel data either as ASCII hexadecimal (the standard PostScript method) or in binary form for speed.

I used a beta version of Photoshop 1.0b6 on a Mac II equipped with 4 megabytes

of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a 19-inch SuperMac monitor and Spectrum/24 Series III video board. I worked with an assortment of scanned images, ranging from 8 to 24 bits deep and 75 to 300 dots per inch, that I acquired from either Howtek or Sharp color scanners.

Photoshop's user interface is very slick and clean: Adobe used Apple's MacApp object-oriented libraries to implement it. You can have multiple windows open, and each window's title descriptively names the image's source file, size ratio, and memory usage. Unlike some other image editors, Photoshop didn't care what the Mac's screen depth was: Whether it was 4 or 24 bits deep, Photoshop drew the images. Better still, with a 24-bit-deep display, you can open windows to the same image and place them side by

side to compare the effects of color corrections—a very nice feature that I've yet to see elsewhere.

Photoshop is fast. It does not take long to open 24-bit PICT2 images. And it applies color modifications and rotations rapidly to an image; there was none of the dawdling that I've come to expect with PhotoMac 1.1. Photoshop had no problems importing a TIFF file from a NeXT Computer, and it accepted Amiga IFF and HAM files that I downloaded from BIX. For the HAM file, a dialog box informed me that the original image's pixels were rectangular and asked if it should rescale the image for the Mac's square pixels. It's small but significant touches such as these that save designers and illustrators headaches and that makes Photoshop a superior product.

I used Apple's LaserWriter 6.0 driver with a LaserWriter and a QMS-PS 810 Turbo laser printer to print images, with good results. Printing with binary encoding reduced the printing times by a third. Certain networks and printers choke on binary PostScript data, in which case you'll have to check ASCII encoding in the printer dialog box. Photoshop also implements its own virtual memory system so that you can work with files larger than physical memory.

This version of Photoshop looks excellent. The tools worked smoothly, and the virtual memory let me work on 6-MB files easily. If your work runs to heavy-duty image processing or color prepress, then Photoshop promises to be a must buy for the job.

—Tom Thompson

continued

THE FACTS

Photoshop
\$895

Requirements:
Mac Plus, SE, SE/30, or II
with 2 MB of RAM,
System 6.0.3 or higher,
and a hard disk drive.

Adobe Systems, Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA 94039
(800) 922-3623
Inquiry 986.

The No-Compromise Notebook Computer

For laptop systems—perhaps the most personal of personal computers—everybody seems to have strong opinions on what features ought to be included. We all have our own notions of the ideal display type, processor, hard disk size, weight, and, of course, price. In the past, the small size and weight required that you make some significant compromises. This has been particularly true for the lightweight notebook computers that have appeared recently. But fortunately, as time goes on, new systems exhibit fewer and fewer compromises. And the new Toshiba T1200XE is perhaps the first notebook system that frees you from any major compromise.

At first glance, it looks as if Toshiba has crammed all the goodies of its T1600 laptop into a notebook format. This is quite a feat, since the T1600 weighs almost 12 pounds, and the new T1200XE weighs in at less than 8 pounds, including a battery pack. Despite this rather low weight, the system includes a 12-MHz 286 processor, a 20-megabyte hard disk drive, a 3½-inch floppy disk drive, and a high-contrast LCD screen. There is even room inside for up to 5 MB of memory (1 MB is standard); this is important for OS/2 users. And while most companies charge more for their smaller systems, Toshiba has bestowed upon the T1200XE a price that is significantly lower than that of its older, larger relative, the T1600.

Of course, the new Toshiba computer does not set any records for low weight. Lighter laptops are available, notably the impressive Com-



paq LTE/286, which has the same features as the Toshiba system but weighs in at a full pound less.

Nevertheless, the T1200XE has a larger screen, a more comfortable keyboard, and a lower price tag.

In my test of a prototype T1200XE, the system performed quite well. Its large 640-by-400-pixel CGA-style backlit LCD is almost exactly like that of the T1600 and is a real pleasure to view. Likewise, the keyboard is almost an exact copy of that on the T1600 and is very easy to become accustomed to. The many T1000 users out there—including myself—should have no trouble at all easing into this system.

A somewhat hidden feature of the new system is a 100-pin connector on the back panel. Toshiba has stated that it will soon offer a “base station” for the T1200XE that will include, among other things, room for two full-size expansion slots.

Another nice feature of the back panel is an RGB

monitor connector—important for those who need to make presentations or demonstrations.

Other hidden features of the system include Toshiba's traditional assortment of laptop frills. These include AutoResume, a feature that lets you turn the system on and immediately resume what you were doing when you last powered the computer down.

Toshiba has a number of interesting new laptops available. The new T1000SE and the T1000XE (with a hard disk drive) deserve particular note. I found these systems to be excellent, but some users may prefer a bit more power.

Eventually, we will probably see notebook systems based on the 386SX microprocessor. But until then, if you're going to hit the road and can't compromise on power—or anything else, for that matter—the T1200XE seems to be an excellent choice.

—Rich Malloy

R:base Goes for the Gold

Ever since its first appearance, R:base's forte has been ease of use coupled with power. In its newest incarnation, R:base 3.0 from Microrim, it is even easier to use and more powerful and comes with a raft of new features.

It's nearly impossible to list even a small fraction of the features available in an application package as sophisticated as R:base 3.0. Its menu interface is improved and now looks like those in other database packages. But overall, the software makes creating, editing, and doing real work with data much less of a chore than other database managers I've used.

While QBE (Query By Example) is a customary (and necessary) feature in all relational databases, R:base 3.0 adds a number of handy bells and whistles to it. In competing high-end packages, the all-too-necessary ability to browse through existing data—to mark, edit, or print needed information—isn't always easy. But R:base 3.0 has made browsing chores easy to do with just a few keystrokes.

Another time saver is R:base's ability to do global search and replace. By way of comparison, in Borland's Paradox 3.0, the only way to do a search and replace is by writing a custom utility using the package's proprietary language.

Most of the people who actually use databases in their day-to-day work aren't technically sophisticated. So in order to be truly powerful, a database manager must provide the ability for the resident database expert to create easy-to-use finished applications with custom forms and menus. R:base 3.0's application-generation facilities are some of the

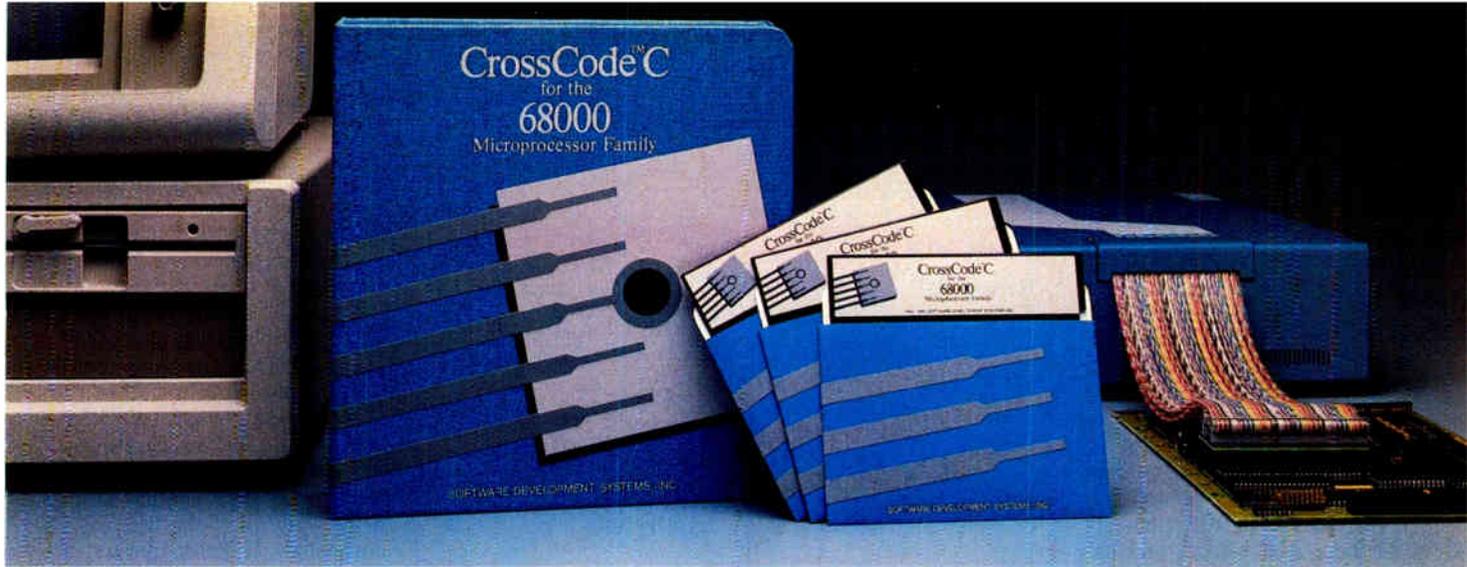
continued

THE FACTS

Toshiba T1200XE
\$3999

Toshiba America
Information Systems
Computer Systems

Division
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
Inquiry 987.



Embedded systems designers have already used CrossCode C in over 577 different applications.

CrossCode C has twelve important features to help you program your 68000-based ROMable applications

It's the one 68000 C compiler that's tailor-made for embedded systems development

CrossCode C is designed specifically to help you write ROMable code for all members of the Motorola 68000 family. It comes with these twelve special features to help you get your code into ROM:

1. A 100% ROMable Compiler: CrossCode C splits its output into five memory sections for easy placement into ROM or RAM at link time.

2. Integrated C and Assembler: You can write your code in any combination of C and assembly language.

3. Readable Assembly Language Output: The compiler generates assembly language code *with your C language source code embedded as comments*, so you can see each statement's compiled output.

4. Optimized Code: CrossCode C uses minimum required precision when evaluating expressions. It also "folds" constants at compilation time, converts multiplications to shifts when possible, and eliminates superfluous branches.

5. Custom Optimization: You can optimize compiler output for your application because *you* control the sizes of C types, including pointers, *floats*, and all integral types.

6. Register Optimization: Ten registers are reserved for your register variables, and there's an option to automatically declare all stack variables as *register*, so you can instantly optimize programs that were written without registers in mind.

7. C Library Source: An extensive C library containing over 70 C functions is provided in source form.

8. No Limitations: No matter how large your program is, CrossCode C will compile it. There are no limits on the number of symbols in your program, the size of your input file, or the size of a C function.

9. 68030 Support: If you're using the 68030, CrossCode C will use its extra instructions and addressing modes.

10. Floating Point Support: If you're using the 68881, the compiler performs floating point operations through the coprocessor, and floating point register variables are stored in 68881 registers.

11. Position Independence: Both position independent code and data can be generated if needed.

12. ANSI Standards: CrossCode C tracks the ANSI C standard, so *your* code

will always be standard, too.

There's More

CrossCode C comes with an assembler, a linker, and a tool to help you prepare your object code for transmission to PROM programmers and emulators. And there's another special tool that gives you symbolic debugging support by helping you to prepare symbol tables for virtually all types of emulators.

CrossCode C is available under MS-DOS for just \$1995, and it runs on all IBM PCs and compatibles (640K memory and hard disk are required). Also available under UNIX, XENIX, and VMS.

CALL TODAY for more information:

1-800-448-7733
(ask for extension 2003)

Outside the United States, please dial

PHONE: **1-708-971-8170**
FAX: **1-708-971-8513**

SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 23
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

CrossCode™ is a trademark of SOFTWARE DEVELOPMENT SYSTEMS, INC. MS-DOS® is a registered trademark of Microsoft. UNIX® is a registered trademark of AT&T. XENIX® is a registered trademark of Microsoft.

neatest I've seen. I was able to design a custom mailing-list application in a little over a half hour. (It took nearly a full day's work with Paradox.) R:base 3.0 also supports a mouse. And that made the job even easier.

For everyday applications, R:base's powerful built-in ability to handle a large variety of labels is particularly handy. And once I had designed the mailing-list application to my liking, I used the CodeLock utility to convert the application into a stand-alone executable file.

Of course, the R:base 3.0

THE FACTS

R:base 3.0
\$725 (Network Six-Pack, \$995; unlimited network license, \$2695)

Requirements:
IBM PC, AT, PS/2, or compatible with 640K bytes of RAM, DOS 3.0 or higher, and a hard disk

drive (with at least 4 megabytes of available space).

Microrim
3925 159th Ave. NE
P.O. Box 97022
Redmond, WA 98073
(206) 885-2000
Inquiry 988.

developers haven't forgotten the needs of dyed-in-the-wool database aficionados. The package's command language has been extended and

enhanced with a number of new features. Most notable is a selection of ANSI Level II Structured Query Language commands. And for those of

us for whom SQL is still an inscrutable mystery, I found R:base 3.0's extensive on-line help (called Prompt by Example) an invaluable learning tool that saved me considerable time and effort.

While R:base users are an enthusiastic lot, the package has never managed to make much of a dent against the heavyweights in the heavily competitive RDBMS market. In many ways, R:base 3.0 has taken a giant leap ahead of its competition, but it's still going to be a tough horse race for Microrim.

—Stan Miastkowski

Lotus Goes Graphical

Lotus's snazzy new three-dimensional Lotus 1-2-3/G spreadsheet for Presentation Manager (PM) takes full advantage of OS/2's power, yet manages to retain compatibility with earlier character-based versions of 1-2-3. It also upholds an OS/2 truism: If you want multitasking, large memory, and the ease of use of a graphical user interface (GUI), you must be prepared to pay a price in hardware and performance.

Many of the program's advantages (i.e., WYSIWYG screens and live links to external files) accrue from OS/2 and PM. To make the transition to OS/2 even more appealing, Lotus greatly improved graphics and added 20 levels of undo. A utility called the Solver lets you model equations for optimal results based on a defined set of inputs and criteria.

Lotus 1-2-3/G is based on the feature set and 3-D model used in 1-2-3 release 3.0. A single spreadsheet file can contain up to 256 layers, and normal @ functions and ranges can stretch along the z-axis.

In addition, you can open up to 16 spreadsheet and graphics windows on the desktop at the same time. Because OS/2 is multitasking,

you can recalculate a spreadsheet in one window while printing from another and editing in a third.

One of 1-2-3/G's strengths is that it conforms to PM standards while preserving the keystroke sequences that are familiar to current 1-2-3 users. To mimic 1-2-3's hierarchical menu in the GUI environment, Lotus devised enhancements to PM, including cascading menus and multiple-choice dialog boxes.

Among the new graphics features are 3-D bar graphs and the user's ability to directly manipulate graphs with the mouse. Most of the new features are in the Graph Tool, a separate part of the

program from the main menu.

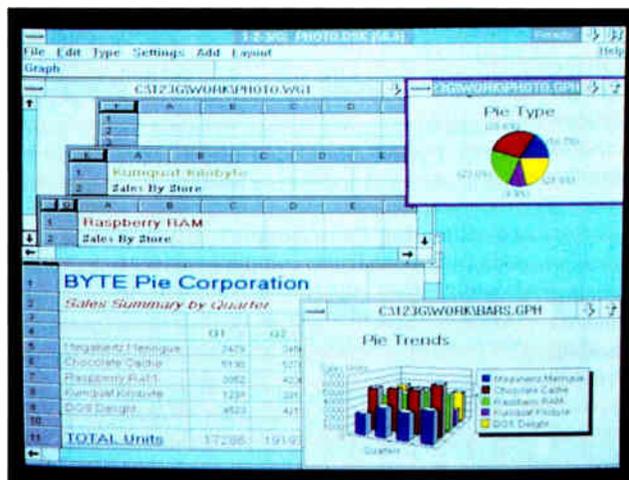
With the powerful Solver utility, you can model problems backward to obtain a desired output. Instead of trying repeated what-if scenarios, you enter variables and constraints into the spreadsheet and let the 1-2-3/G Solver feature optimize an output like profit or resource utilization.

I was very impressed with most capabilities of 1-2-3/G. My only reservation concerned a conceptual clash between the 3-D model of release 3.0 and the windowing model of PM. In maintaining file and keystroke compatibility, I don't think

1-2-3/G makes the best use of the mouse. This is clearest when a window contains stacked sheets in the style of release 3.0.

While PM lets you click between windows, resize them, and so forth, sheets within a window don't follow the same rules—in fact, you can't even zoom in on them as you can in release 3.0. As a result, you spend more time with the keyboard than the mouse, but for 1-2-3 traditionalists, this is probably preferable anyway. ■

—Andrew Reinhardt



THE FACTS

Lotus 1-2-3/G
(price not available)

Requirements:
A 386 computer with 4 megabytes of RAM, OS/2 1.1 or 1.2 Standard or Extended Edition, a hard disk drive with at least 10 MB of free space, and EGA, VGA, or 8514/A graphics.

Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Inquiry 989.

Here's How We Protect Your Software And Profits Better.

**MEMORY KEY
ALSO AVAILABLE
FOR
MACINTOSH***

We'll Never Tell.

Because our key-interrogation routines are *encrypted*, and our hardware is custom-wired to distinguish each of our clients' keys, our clients have the highest degree of security available.

Unlike other manufacturers, our routines assume responsibility for all hardware, software and timing issues. And what this means is that your engineering time and money won't be wasted reinventing protection schemes.

We offer two high security products for copy control: the KEY™ and the MEMORY KEY™.

Our protection devices can also be used for serialization techniques, software leasing,

modular software management, creative revenue collection, demo control and a path for future upgrades.

The information stored in the MEMORY KEY can be conveniently reprogrammed by your application software or at the end user's site via software disk or modem.

All our products attach conveniently to the printer port, are transparent and allow for unlimited back up copies.

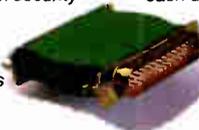
For serious software protection, call now. And start protecting your profits.

Hands down, we're better.

Encrypted routines provide the highest degree of security

Custom hardware and software for each developer

No batteries to fail or replace



No programming adapters necessary

Can be dynamically reprogrammed at the user site via diskette or modem.

Over 55 languages supported in DOS, XENIX and OS/2



In EUROPE:

Microphar, 42, Ave. Sainte Foy 92200, Neuilly Sur-Seine FRANCE
Tel: 33-1-47-38-21-21 Fax: 33-1-46-24-76-91
Call to obtain distributor addresses in:
BELGIUM, IRELAND, ITALY, NETHERLANDS, PORTUGAL,
SPAIN, SWITZERLAND, U.K. & W. GERMANY.

**PROTECH
MARKETING, INC.**

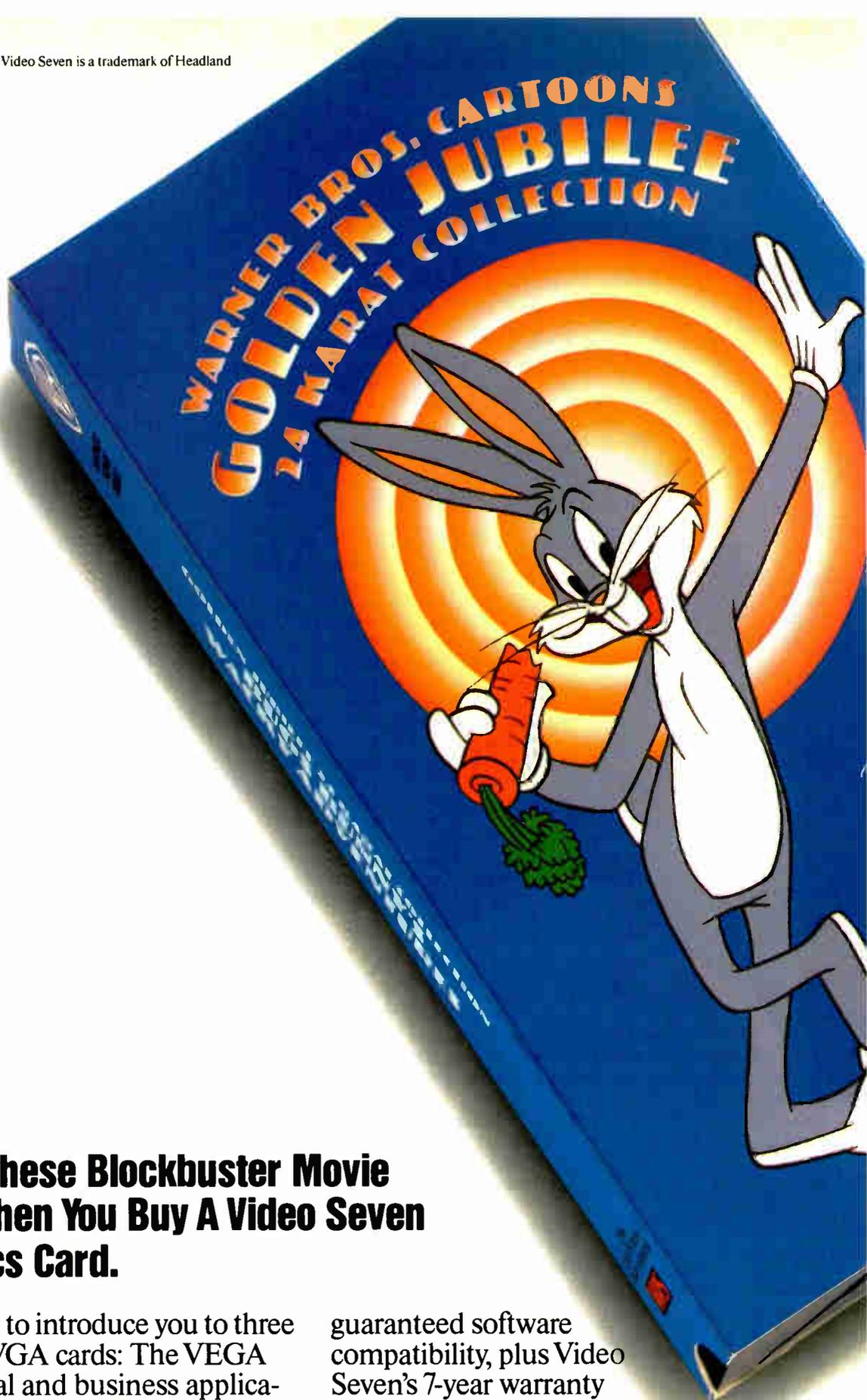
1-800-843-0413 *Se Habla Español*

In the U.S., the AMERICAS & the PACIFIC:
ProTech, 9600-J Southern Pines Blvd. Charlotte, NC 28217
Tel: 704-523-9500 Fax: 704-523-7651
Hours: Mon-Thurs: 8:30-7:00 ET, Fri: 8:30-5:30 ET
FOR A DEMONSTRATION PACKAGE OR ADDITIONAL
INFORMATION, PLEASE WRITE OR CALL.

Macintosh is a registered trademark of Apple Computer, Inc.

For Europe Circle 230 on Reader Service Card

For Americas & Pacific Circle 231 on Reader Service Card

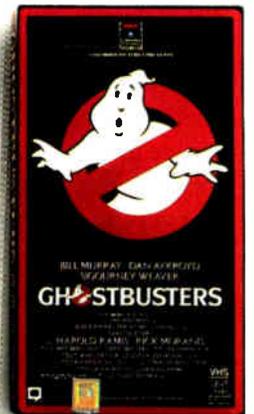
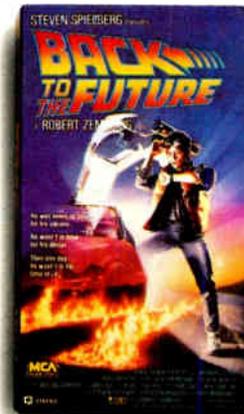
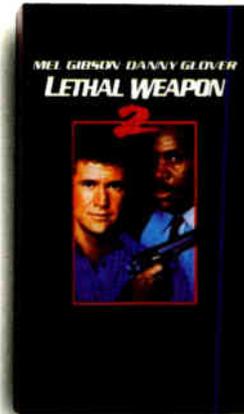
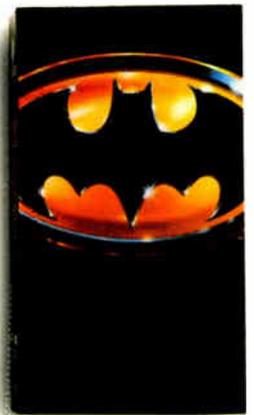
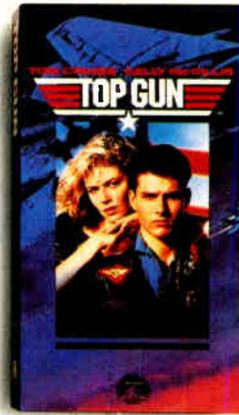


Get One Of These Blockbuster Movie Hits FREE When You Buy A Video Seven VGA Graphics Card.

What a great way to introduce you to three of the very best VGA cards: The VEGA VGA for personal and business applications; the VGA 1024i for advanced business applications; and the V-RAM VGA for CAD/CAM and graphics applications. All three give you razor sharp resolution and

guaranteed software compatibility, plus Video Seven's 7-year warranty and exclusive support package. Buy any of them between March 1st and May 15th and we'll send you one of these all-time favorite movie videos, free.

HERE'S A HAREBRAINED IDEA FROM VIDEO SEVEN.



Send me my free movie video. Here's my receipt and completed registration card from my new VEGA VGA, VGA 1024i or V-RAM VGA card. Please send me:

TITLE _____
 VHS _____ Beta _____
 Name _____
 Address (no P.O. boxes, please) _____
 City _____ State _____ Zip _____
 Dealer name and address _____
 City _____ State _____ Zip _____
 Date of purchase _____ B-4/90

All coupons must be received by May 31, 1990. Offer expires June 1, 1990. Allow 4 to 6 weeks for delivery. Product must be purchased between March 1 and May 15, 1990.

Just fill out the coupon and send it along with your receipt and the completed product registration card to: Seven Videos From Video Seven, P.O. Box 24527, San Francisco, CA 94124. For information: Inside CA 800-962-5700; outside CA 800-238-0101; Canada 800-548-0624.

Circle 296 on Reader Service Card

VIDEO SEVEN

Best of Seven

A Headland Technology Inc. brand

Everything You Ever Wanted In UNIX. And Less. \$99.95*

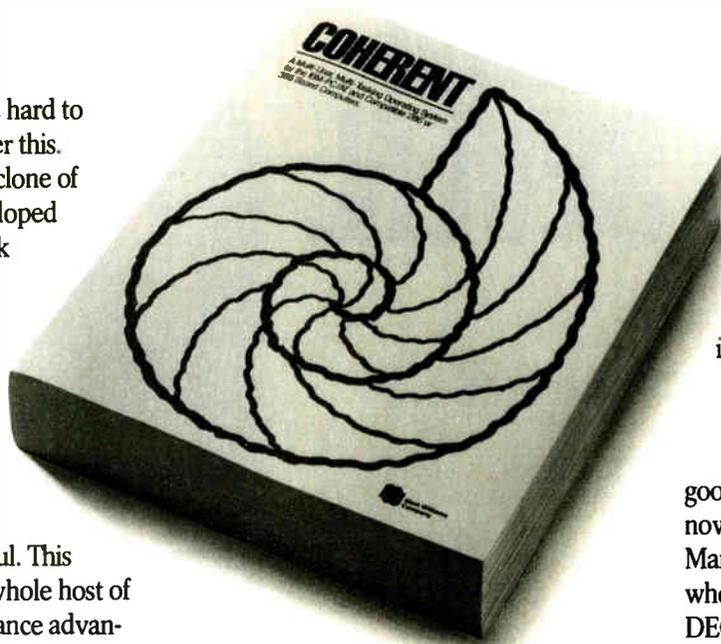
OK. We know it's hard to believe. So just consider this. Coherent™ is a virtual clone of UNIX. But it was developed independently by Mark Williams Company. Which means we don't pay hundreds of dollars per copy in licensing fees.

What's more, Coherent embodies the original tenet of UNIX: small is beautiful. This simple fact leads to a whole host of both cost and performance advantages for Coherent. So read on, because there's a lot more to Coherent than its price.

SMALLER, FASTER...BETTER.

Everybody appreciates a good deal. But what is it that makes small so great?

For one thing, Coherent gives you UNIX capabilities on a machine you can actually afford. 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. You can also have it running faster, learn it faster and get faster overall performance. All because Coherent is small. Sounds beautiful, doesn't it?

But small wouldn't be so great if it didn't do the job it was meant to do.

EVERYTHING UNIX WAS MEANT TO DO.

Like the original UNIX, Coherent is a powerful multi-user, multi-tasking development system. With a complete UNIX-compatible kernel which makes a vast world of UNIX software available including over a gigabyte of public domain software.

Coherent also comes with Lex and Yacc, a complete C compiler and a full set of nearly 200 UNIX commands including text processing, program development, administrative and maintenance commands.

And with UUCP, the UNIX to

UNIX Communication Program that connects you to a world-wide network of free software, news and millions of users. All for the cost of a phone call.

We could go on, but stop we must to get in a few more very important points.

EXPERIENCE, SUPPORT AND GUARANTEES.

Wondering how something as good as Coherent could come from nowhere? Well it didn't. It came from Mark Williams Company, people who've developed C compilers for DEC, Intel, Wang and thousands of professional programmers.

We make all this experience available to users through complete technical support via telephone. And from the original system developers, too!

Yes, we know \$99.95 may still be hard to believe. But we've made it fool-proof to find out for yourself. With a 60-day money-back no-hassles guarantee.

You have to be more than just a little curious about Coherent by now. So why not just do it? Pick up that phone and order today.

You'll be on your way to having everything you ever wanted in UNIX. And for a lot less than you ever expected.

1-800-MARK WMS
(1-800-627-5967 or 1-708-689-2300)
60-DAY MONEY BACK GUARANTEE!



**Mark Williams
Company**

601 N. Skokie Highway
Lake Bluff, IL 60044

*Special introductory price good through July 31, 1990. Coherent is a trademark of Mark Williams Company. UNIX is a trademark of AT&T. XENIX is a trademark of Microsoft.

LESS IS MORE!	Coherent For the IBM-PC/AT and compatible 286 or 386 based machines.	Santa Cruz Operations XENIX 286, Version 2.3.2
No. of Manuals	1	8
No. of Disks	5	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Recommended Memory	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	\$99.95	\$1495.00

*Byte Execel benchmark, 1000 iterations on 20 MHZ 386.

Apple's Special fx

The code name for Apple's new Mac IIfx was "F19," which sounds like a name for a jet fighter plane or rocket. Indeed, the Mac IIfx is one "wicked fast" computer, as the machine's product manager, Frank Casanova, describes it. Powered by a 68030 CPU and a 68882 math coprocessor operating at a clock speed of 40 MHz, this new Mac leaves its predecessors in the dust.

Apple's two most recent machines in the Mac II product line, the IIfx and IIfx, were compact models with only three NuBus slots. The Mac IIfx, however, is a six-slot machine like the Mac II and Mac IIfx. In addition, the Mac IIfx includes a Processor Direct Slot that is similar to the slot used in the Mac SE/30, which operates independently of NuBus and therefore offers a direct and higher-performance interface for third-party peripherals such as graphics and network controllers. The 120-pin PDS is a superset of the Mac SE/30 PDS and accepts add-in cards designed for the SE/30. Use of the PDS disables one of the six NuBus slots on the logic board, so six slots remain.

Not only does the Mac IIfx have a much faster clock speed than its Mac II cohorts, it has new features specifically designed to boost performance. To help minimize main memory and disk accesses, the Mac IIfx comes with a cache memory consisting of 32K bytes of 25-nanosecond static RAM. To ease the burden of the main processor, the IIfx has a new controller for DMA to SCSI devices like the hard disk drive, and two Peripheral Interface Controllers (PICs) for controlling the floppy disk drives, the Apple Desktop Bus, and the system's two serial ports.

Each PIC controller consists of a 10-MHz 6502 processor surface-mounted to the logic board. You might recall that the 6502 is the CPU of the Apple IIe. In this new machine, two of those IIe processors are used as peripheral controllers. The

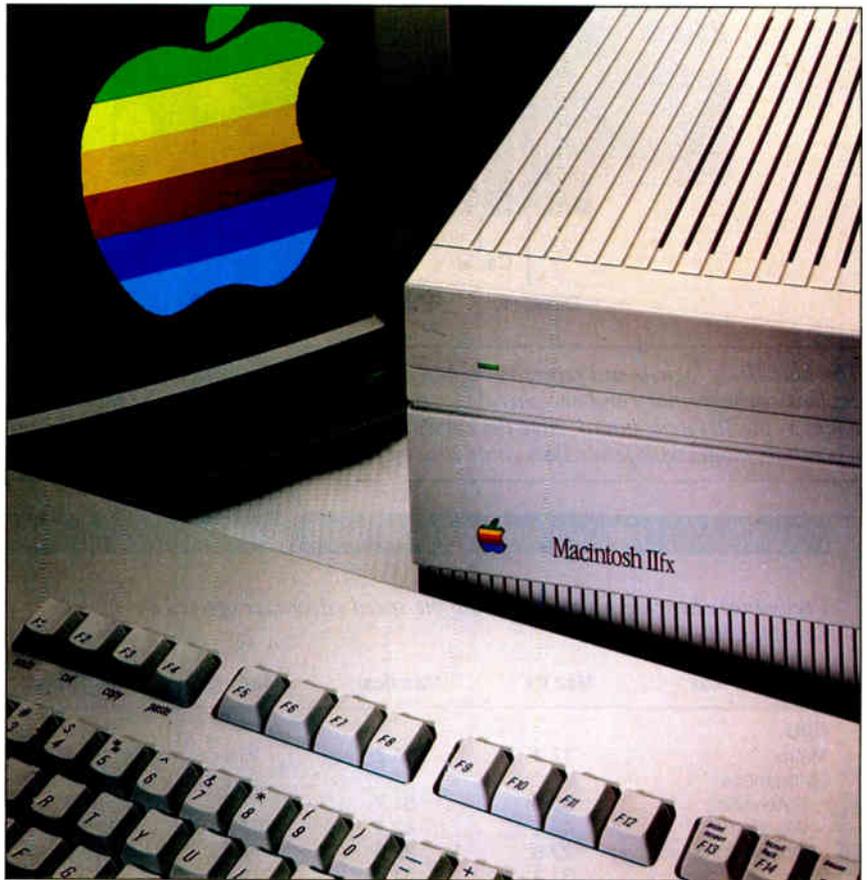


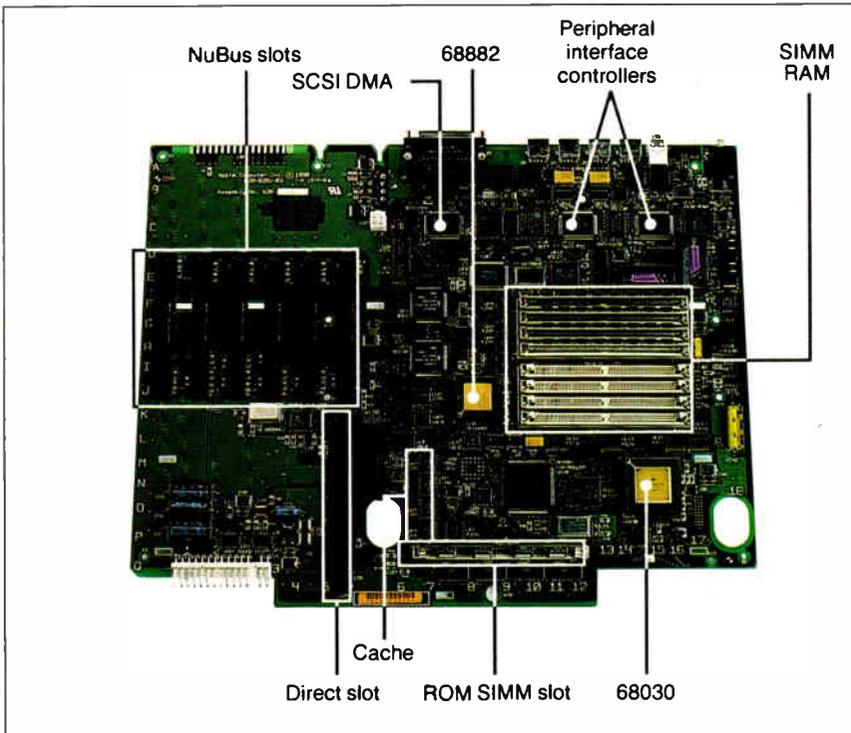
photo on page 112 shows the new logic board of the IIfx.

The purpose of the SCSI DMA and PIC controllers is to take over tasks that previously were performed by the central processor. Coupled with these I/O and SCSI controllers, the increased clock speed and cache memory of the machine result in a dramatic improvement in system performance, with faster disk access and processing during serial and floppy disk drive operations. Based on some benchmarks that I ran on a preproduction machine, the Mac IIfx is two to four

continued

The 40-MHz IIfx
sets new Macintosh
speed records

■ Nick Baran



The Mac IIx's logic board represents a new design. Although it has new functions such as cache memory and peripheral controllers, the IIx board has the same chip count as the IIfx logic board. Note the empty real estate on the board, suggesting that a compact model with fewer slots could also be produced.

times faster than the Mac SE/30 or Mac IIfx, depending on the operation. On the average, the Mac IIx is about 60 percent faster than the Mac IIfx (see the table). With the SCSI DMA controller, disk seeks of 32 blocks are about seven times faster on the Mac IIx than on the Mac SE/30. In a briefing at Apple, the IIx executed a complicated spreadsheet and graphics routine, involving recalc and cut-and-paste operations and scrolling graphics, almost twice as fast as the Mac IIfx did.

Along with its new superfast Macintosh, Apple announced a new version of its flavor of Unix, A/UX 2.0 (see the text box "A/UX 2.0: Unix with Mac Interface Not Ready Yet" on page 113), and a new series of 24-bit color graphics boards (see the text box "24-bit Graphics with a Bang" on page 114). Clearly, Apple planned these announcements together with the rollout of the Mac IIx to position the machine as its main platform for the high-end engineering and CAD workstation markets, where the two key components are Unix and high-speed graphics.

The Mac IIx comes with either 4 or 8 megabytes of RAM. However, these are nonstandard 80-ns, 1-megabit single inline memory modules. Rather than standard off-the-shelf 32-pin SIMMs, the Mac IIx uses 64-pin-wide SIMMs, which are designed to support a memory-access technique called *latched read/write*. Basically, the phrase means that read and write accesses to memory can overlap, with a "holding area" in the form of 64-bit words for managing the overlapping read/write operations. According to Casanova, Apple is patenting its latched read/write technique. While the technique was designed to improve performance, the drawback is that users who wish to upgrade their systems will have to buy these 64-pin SIMMs from Apple at Apple's premium prices. Perhaps worse, current Mac IIfx or IIfx users will not be able to reuse their memory if they decide to upgrade their machines to the IIx logic board. But that's the price of high performance, I guess. It should also be noted that Apple will eventually offer 4- and 16-Mb SIMMs, allowing memory expansion of up to 16 and 32 MB, respectively.

While the logic board has been completely redesigned (it has the same chip count as the Mac IIfx in spite of new cache chips, the I/O and DMA processors, and some new custom application-specific ICs), the IIx looks just like the Mac IIfx or the Mac II, and many of its

continued

PRELIMINARY BYTE BENCHMARK RESULTS

Preliminary benchmark results reveal the speed advantage offered by Apple's new Mac IIx.

Low-level test	Mac IIfx	Mac IIfx	Mac IIfx	Mac IIx
CPU				
Matrix	17.1	16.2	10.4	6.4
String move				
Byte-wide	82.1	81.7	51.3	31.9
Word-wide	42.1	42.1	26.5	16.1
Doubleword-wide	22.8	22.9	14.2	8.2
Sieve	31.3	31.4	19.6	12.1
FPU				
Math	151.5	149.9	93.2	45.0
Sine(x)	72.7	73.9	45.2	21.6
e ^e	96.6	98.7	60.8	29.1
Disk I/O				
Sub-Finder seek				
1-sector read	13.9	14.2	14.7	14.3
32-sector read	35.6	27.1	25.4	24.7
Video				
Text				
TextEdit	4.7	4.6	3.3	2.5
DrawString	1.6	1.6	1.1	1.2
Graphics				
Slow test	52.8	52.5	18.5	9.9
QuickDraw	0.3	0.3	0.2	0.1

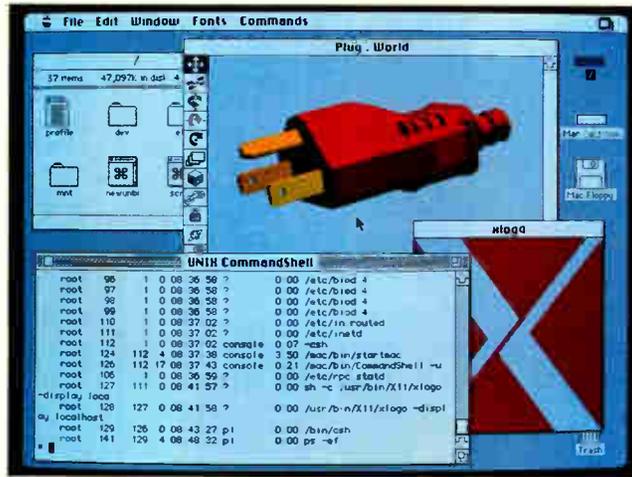
A/UX 2.0: Unix with Mac Interface Not Ready Yet

Although Unix is one of the oldest of the operating systems in use today, there is little doubt as we enter the 1990s that it is the operating system of choice for scientific and engineering applications. Any computer manufacturer who wants to compete in the federal and technical markets has to offer a version of Unix—one that has a good graphical interface.

Apple sees an opportunity to make major inroads into the Unix market by offering a version of Unix that looks to the user just like the Macintosh interface, which is probably still the premier graphical interface on the market today. Except for the NeXT computer's NextStep interface, no full-fledged, Unix-based graphical interface exists that is completely integrated with the operating system like the Macintosh interface. The Open Software Foundation's Motif and Sun's Open Look are the other major Unix graphical interface contenders, but neither of them is a complete end-user interface at this point. They are still developers' tools that will lead to end-user interfaces in the next year or two.

In conjunction with the introduction of the Mac IIx, Apple has introduced A/UX 2.0, which is indeed a version of Unix (System V release 2 with BSD 4.3 extensions) with the Mac desktop interface. As you can see from the photo, A/UX 2.0 lets you run Unix and Macintosh applications simultaneously and exchange data between them from the Clipboard. You can configure the hard disk drive with two partitions—one for Unix and one for the Macintosh System—and applications are transparently accessed from either partition. Note, however, that multiple tasks under MultiFinder will not run reliably in conjunction with A/UX. According to Apple's product managers for A/UX, the Unix preemptive scheduler can "bring down MultiFinder."

You use the Macintosh Chooser to



A/UX 2.0, as demonstrated at an Apple press briefing. Note the familiar Mac interface controlling Unix, and the simultaneous display of both Unix and Macintosh applications on the screen.

select printers and file servers. A dialog box called the Commando provides a point-and-click interface for issuing Unix commands, which are automatically routed to the Unix console window. The Apple menu is used to hide running applications that you can recall with a simple mouse-click. In addition, A/UX comes with a mouse-driven text editor and support for TCP/IP networking protocols and the X Window System. Using the Macintosh Toolbox, programmers can develop "hybrid applications" that run under Unix but take advantage of Macintosh desktop features. It's all very elegant.

Nonetheless, A/UX 2.0 isn't ready. According to A/UX product managers, it won't be ready until mid-1990. The version that was demonstrated at the press briefing looked like early alpha software, and it crashed repeatedly. Although Apple demonstrated A/UX 2.0 on a 4-megabyte Mac, it was clear that you need 8 MB of memory to run any significant applications simultaneously.

There are other concerns. While it is undoubtedly an elegant interface that lets you execute Unix and Macintosh applications simultaneously, A/UX 2.0 needs third-party applications. Some off-the-shelf Unix character-based applications may run under A/UX, but

Apple supports only the QuickDraw screen-imaging model. Although the X Window System is supported in A/UX 2.0 and can run in a separate window, Unix software developers will still have to port graphics-based applications to run under QuickDraw. At this time, Apple does not support any three-dimensional graphics standards, such as PHIGS, GKS, or RenderMan. As a result, third-party developers can't write three-dimensional applications for A/UX using those standards.

On the other hand, the major appeal of A/UX 2.0 is that you can run both Unix and all the third-party Mac-based applications at the same time. An obvious use of A/UX 2.0 would be for a Unix network such as NFS (Network File System) with simultaneous access to Macintosh software, or for the development of vertical-market Unix-based applications with links to standard Mac software.

Another question is price. At the time of this writing, Apple declined to disclose its price for A/UX 2.0; but A/UX 1.0 costs about \$400, and Product Manager Carol Clettenberg stated, "We have lots of additional value in this." That implies that it will cost substantially more than \$400. And the price of the software is only the beginning. A/UX takes up most of an 80-MB hard disk drive. That means that you need at least an additional 80-MB hard disk drive or, preferably, an even larger hard disk drive, to store your applications and data. Add to that the cost of a fully configured 68030-based Mac II with high-resolution graphics and 8 MB of RAM, and you're looking at a very expensive system, probably in the neighborhood of \$15,000 or more.

Although it's expensive when you add it all up, A/UX 2.0 looks very impressive. Now, the question is whether Apple can deliver a working product and whether software developers will write applications for A/UX 2.0

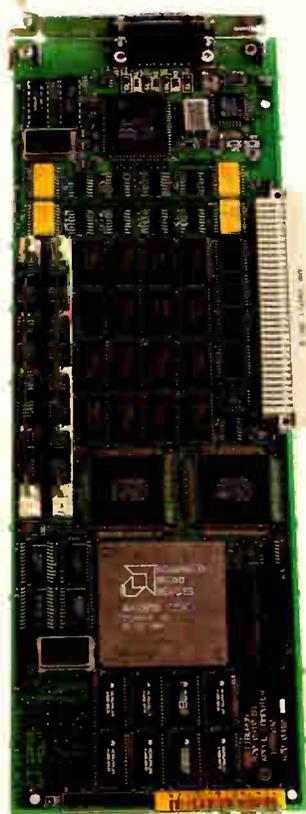
24-bit Graphics with a Bang

If you're going after the workstation markets, you need Unix and high-speed graphics. A/UX 2.0 is one side of the equation. The other side is Apple's new 24-bit graphics accelerator board (see the photo). Called the Macintosh Display Card 8/24 GC, the board is powered by an AMD29000 RISC processor running at 30 MHz. The accelerated version is part of a new family of color cards based on Apple's new "custom color chip," which is a single-chip replacement of the series of digital-to-analog converter chips that were used in previous Apple color boards. The board requires one NuBus slot, 2 megabytes of main memory, and version 6.0.5 of the Mac OS.

The 8/24 GC board comes with 2 MB of video memory and can be expanded to 4 MB of RAM. In color mode, the board can display images with 8 or 24 bits per pixel and has a screen resolution of 640 by 480 pixels. In gray-scale mode, the board supports 1, 2, 4, or 8 bits per pixel at a resolution of 1152 by 870 pixels. The board supports a refresh rate of 66.7 to 75 Hz depending on the resolution of the display. It also supports the RS-170 timing standard for interlaced video devices such as TVs and VCRs. However, the 8/24 GC does not have a video input port. The board automatically configures its display mode and resolution according to the display to which it is connected.

With the AMD 29000 processor, which is rated at about 20 million instructions per second at the 30-MHz clock speed, the 8/24 GC provides excellent performance for complex and colorful graphics applications. In a demonstration at an Apple press briefing, the board offered blazing speed for everything from text scrolling to movement and refreshing of 24-bit images on the screen. Apple claims that the 8/24 GC accelerates color display from five to 30 times the normal speed of color applications. The company declined to give a definite price for the 8/24 GC but said that it would cost approximately \$2100.

In addition to the 8/24 GC, Apple announced less powerful color boards called the Display Card 4/8 and the Display Card 8/24. The 4/8 version is an 8-bit color board that you can up-



The 8/24 GC graphics accelerator board. Note the AMD29000 RISC processor, which operates at 30 MHz. The board comes standard with 2 MB of video RAM and includes a 64K-byte static RAM instruction cache.

grade to a 24-bit 8/24 card by adding video memory to it. These cards have essentially the same features as the 8/24 GC but without the accelerator board. The boards will be priced at about \$700 and \$1000 for the 8-bit and 24-bit versions, respectively.

The 8/24 GC is an impressive top-of-the-line graphics board; the other new entries are more conventional color cards, although they support 24-bit color. However, Apple faces stiff competition from such third-party graphics board suppliers as Radius, RasterOps, and SuperMac, all of which offer 24-bit color graphics accelerators at very competitive prices.

components are the same. The AppleTalk speed is still 230 kilobits per second. The Apple sound chip is still the same 8-bit 44.1-kHz chip. And the system has the same floppy and hard disk drive options as the other Mac II models.

One improvement worth mentioning is a larger, but much quieter, cooling fan (whose diameter is 92 millimeters instead of 80 mm), which has a variable speed controller, allowing the fan to adjust speeds according to the cooling load required by the system. You can barely hear the fan with two NuBus boards installed in the machine, according to Casanova. (This was hard to tell in the briefing room, which had seven or eight machines running, along with video projectors.)

The new 512K-byte ROM SIMMs in the Mac IIfx are a superset of the ROM used in the IIfci. The new ROM has hooks for System 7.0, says Casanova, and it requires a new version of the operating system (System 6.0.5) to handle the new I/O controllers.

At the time of this writing, Apple had not established a price for the Mac IIfx. Needless to say, it won't be cheap. The Mac IIfx will be offered in 4- and 8-MB configurations with only one SuperDrive floppy disk drive or with 80- or 160-MB hard disk drives. Casanova says a base system would start at between \$10,000 and \$12,000. In addition, Apple will be offering logic board upgrades to current Mac II and IIfx users. As mentioned earlier, the upgrade will be costly because you won't be able to use the same memory modules as the earlier Mac II/IIfx models use. Apple did not disclose prices for the logic board upgrade.

The Mac IIfx is built for speed, pure and simple. It looks like the machine of choice to run advanced graphics, network-server, and A/UX applications. It's the latest top-of-the-line product in an increasingly crowded Mac II product line. We now have the IIfx, the IIfci, the IIfcx, the IIfx, and the good old Mac II. But if you're looking for the fastest Macintosh on the market, the IIfx is the one. ■

COMPANY INFORMATION

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 1090.

Nick Baran is BYTE's West Coast bureau chief. You can contact him on BIX as "nickbaran."

Other laser
printers
play with
one standard
dot size.

Circle 134 on Reader Service Card

HP makes it a

ASTRONOMY IS **LOOKING UP**

THE HIRSCH REPORT OF THE SKIES VOL. 8, NO. 4, FALL 1990

STAR SHORTS

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make me-

teor-burst communication a practical and economical alternative to the use of tele-

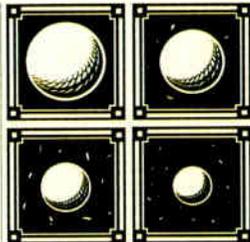
(continued on page 2)

You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to

an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo-

(continued on page 3)



More on planetary explosions inside.

NO BLACK HOLES?

Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

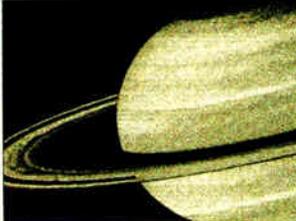
(continued on page 3)

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele-

(continued on page 5)

Voyager's Last Picture Show: When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.



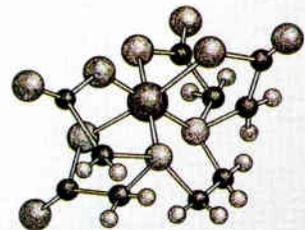
CHAIN REACTION

BAGOT'S CHEMICAL LETTER

JUNE 9, 1990

VOLUME FOUR

ISSUE THREE



New Leaps in Metal-Organic Chemistry

Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA above (containing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. *(continued next page)*

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! *(continued next page)*

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. *(continued next page)*

Fifty Years Ago

Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf-stable C ration. Don't believe all rumors.

Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

The rules have changed. Now the name of the game is Resolution Enhancement technology. You'll call it the best thing to happen to laser printing since the very first HP LaserJet printer. It gives you clearer resolution. Curves that really curve. And edges that are never jagged.

Instead of a "one-size-fits-all" dot, HP's built-in intelligence varies dot sizes. So they can fill areas where

they could never go before. For clearer, more professional-looking documents.

Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

FREE UPGRADE TO WINDOWS 3.0 COMPATIBILITY! CALL FOR DETAILS.

Windows menu system means you'll learn fast. If you can use Windows you can quickly use Windows CAD.

Multiple viewports allow you to work on up to four views of your drawing at the same time.

Sophisticated drawing features include associative dimensioning/cross-hatching and much more.

Mouse prompts tell you exactly what each mouse button does.

Color-coded prompts guide you through the design process.

Status line gives you instant access to colors, linetypes, layers, snaps and "quick zooms".

FINALLY, CAD FOR WINDOWS. DRAFIX® WINDOWS CAD.™

At last the power of true, high performance CAD is available for Windows. Drafrix Windows CAD. With features that take you far beyond any Windows drawing package you currently use.

Powerful CAD. Windows CAD is the first and only Windows software to provide all of the designing and editing functions demanded by engineers, drafters, architects and other serious CAD users. It offers multiple interactive viewports, allowing you to work in four views simultaneously. Associative dimensioning, associative crosshatching and a powerful macro programming language are just a few of its features—and that's just the beginning.

Quick to learn, easy to use. Windows CAD lets you take full advantage of your Windows experience. If you already use Excel, Pagemaker, Micrografx Designer, or any Windows package, Windows CAD will have you doing precise, accurate CAD design in no time. And of course you can use all of the plotters, printers and video devices that work with Windows.

From a proven line of CAD products. Windows CAD is the latest in a full line of highly rated CAD software that includes Drafrix CAD Ultra, Drafrix CAD QwkStart and Drafrix 3-D Modeler.

Order your copy of Drafrix Windows CAD today! Now if you have Windows you can have the full power of true CAD. Drafrix Windows CAD. Only \$695. For more information call us today at **1-800-231-8574** or **(816) 891-1040**.

Drafrix Windows CAD has features you usually find in packages costing 5 times as much!

Item Attributes 256 layers 8 colors 9 linetypes Up to 60 database attributes to any entity Multiple line widths

Drawing Features Lines: single, double, tangent, parallel, perpendicular, multiple width Arcs/Circles Curves/Splines Polygons and Polylines Ellipses Pointmarkers Freehand sketching

Input Methods Windows menu system Keyboard equivalents Ortho lock 10 item and grid snaps, including endpt, midpt, tangent and more Keyboard entry of coordinates OOPS (Undo) feature Dynamic Drag Quick zoom/pan Multiple viewports, all active

Powerful Editing Features Trim entities to each other Stretch Fillet (round) Chamfer (bevel) Erode Copy Move Mirror Rotate Arrays Select items by region, entity, attribute or combinations

Associative Dimensioning Linear, Radius, Diameter Single, Continuous, Baseline Ordinate, Elevation or Bearing format 23 terminator types Any alignment Tolerancing English and metric Fraction or Decimal

Associative Crosshatching and Solid Fill 15 crosshatch patterns, ANSI specs 64 solid fills

Text Editing Word processing window Multiple font styles

On-Line "Help" system

Macro Programming Language

System Requirements '286 or '386 processor Microsoft Windows 2.1 or later 1 Mb internal memory or greater Windows-supported mouse

File Compatibility Autocad DXF Drafrix CAD HPGL CDE, SDF for database information

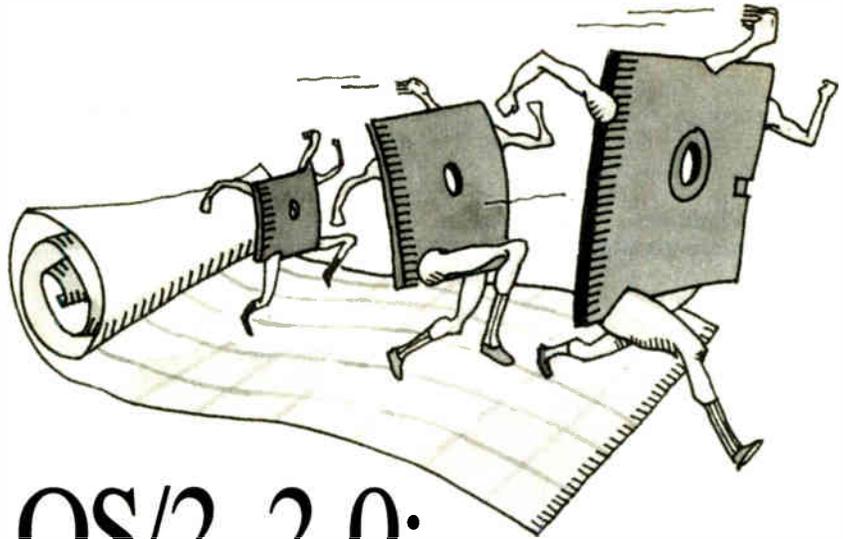


**Foresight Resources Corp.
1-800-231-8574**

Excel, Pagemaker and Micrografx Designer are trademarks of their respective companies.

"Drafrix Windows CAD packs many of the features of such top-notch programs as AutoCAD and CADkey at a fraction of the cost" - PC Magazine

32-bit OS/2
forges ahead, with
DOS and Windows
in tow



OS/2 2.0: It's a Family Affair

■ Jon Udell

It's going to be a flat world after all. Microsoft's long-awaited 32-bit OS/2 2.0 joins the list of 386 operating systems—Unix, NetWare 386, 386|DOS-Extender—that have abandoned segments in favor of the flat model. Of course it isn't a flat world yet. Thirty-odd million DOS systems, several million Windows systems, and a few hundred thousand OS/2 systems run segmented programs today and will continue to do so for a long time to come.

Can OS/2 2.0 inherit the features of its three 16-bit predecessors and still realize its 32-bit destiny? I don't see why not. OS/2 2.0 runs 1.x binaries and offers both 16- and 32-bit application programming interfaces (APIs). More important, it features DOS support that far outperforms the 1.x compatibility box. OS/2 2.0 can multitask DOS and even Windows sessions, each in an OS/2 screen group or Presentation Manager (PM) window and scheduled as a normal OS/2 process.

The Unix-style memory model and DOS multitasking add up to a "hit 'em high, hit 'em low" strategy. At the high end, OS/2 can now compete strongly as a server platform. LAN Manager 2.0's HPFS-386 (High Performance File System) is a crucial ingredient, but OS/2 2.0's ability to run 32-bit applications on the server with paged virtual memory completes the picture. Microsoft can't realistically expect to dominate the server market. Today, nearly half of the server-class machines that cost between \$15,000 and \$350,000 run Unix; the

other half run IBM, DEC, or other proprietary operating systems; less than 1 percent run OS/2. Still, an OS/2 freed from its 16-bit shackles should be able to carve out a significantly bigger piece of the midrange pie.

Farewell to Segments

In view of that goal, Microsoft's choice of the flat memory model is a strategic decision, not merely a technical one. Segments, per se, aren't evil. What gave them a bad name was that, on the 286 with its 16-bit registers, segments were too small—just 64K bytes. On the 386, with 32-bit registers, a segment can span 4 gigabytes. An operating system can organize kernel and process-address spaces as one or several of those segments. That choice determines whether segment-oriented or just page-oriented mechanisms can protect the kernel from user processes, and processes from one another.

Experts differ on what's best, but segments have advantages, notably limit-checking, that OS/2 2.0 forgoes. Why toss them completely? Technically, they're inconvenient. Even with fewer, larger segments, there's inefficiency associated with loading selectors. Programmers are just plain tired of them, but strategically, they're a disaster. Competitive Intel-based operating systems don't use the segmentation hardware, and most other 32-bit processors don't even have segments. Although the flat model won't make OS/2 applications portable to other operating systems and processors, at least it will make them less

nonportable. It makes reverse migration feasible as well. The prophesied union of OS/2 and the FORTRAN/COBOL code base may yet come to pass.

Battle for the Desktop

At the low end, it's a different story. Here, OS/2 contends for desktop supremacy in a market that Microsoft already dominates. Although the Macintosh finds wide favor, and the romance between Unix and 386 PCs continues to heat up, these systems, like OS/2 itself, compete mainly with DOS and Windows. To judge OS/2 a failure because users still cling to DOS, or because there aren't more OS/2 applications, begs the question. The DOS desktop market is huge; its inevitable upward migration will be glacially slow. As users do move, they'll have to make a choice. OS/2 2.0's competitive 32-bit capabilities and strong DOS support will make it a likely candidate. Microsoft wins to the extent that users will choose OS/2.

The imminent Windows 3.0, which Microsoft acknowledges will run Windows applications in protected mode and so give them access to large memory, clearly complicates matters. Those who have used OS/2 know that memory management is just one of its advantages over Windows. Windows rests on a shaky foundation, namely DOS, and it won't ever match the multitasking, multi-threaded capabilities of OS/2. Nevertheless, users who don't yet see OS/2's superiority will, in the short term, almost

continued

certainly make Windows 3.0 a successful applications platform. More trouble for OS/2? Again, only if users, when they migrate, don't choose it.

OS/2 and Windows: An Applications Strategy

Although OS/2 2.0 won't run Windows binaries, its ability to run Windows in a DOS session will help keep users in the family. Even more helpful would be a way to simplify porting Windows applications to PM. Despite their conceptual similarity, the two programming environments differ radically in their implementation. Today, a port from Windows to PM can be a painful exercise. Microsoft is therefore at work on a "mapping layer," analogous but unrelated to Micrografx's Mirrors, designed to ease the Windows-to-PM transition. Microsoft hopes to add the still-unnamed tool to a future release of the 2.0 Software Development Kit (SDK). It's not version-specific, though; Microsoft expects it to work for current and future versions of Windows and OS/2.

Developers will, in theory, be able to port Windows applications in gradual stages. Minimally, they'll have to touch perhaps 10 percent of their code in order to meet the requirements of the mapping layer's interface. Mainly, that means converting interrupts to system calls. The emulator would then enable OS/2 to run the Windows application, with an estimated 5 percent to 10 percent performance penalty. The Windows program could even exploit features of the kernel—threads, interprocess communication, scalable fonts, and HPFS. Ultimately, of course, a full PM port is best, but the emulator should lower the threshold of resistance and help OS/2 capture the still-burgeoning Windows applications market.

The 2.0 SDK

Microsoft announced shipment of the 2.0 SDK on the last day of last year and began filling orders in quantity about six weeks later. It's the usual deal. This time, developers will have to pony up \$2600 to get the series of releases leading up to the final 2.0. What are they paying for? In Microsoft's view, tools, on-line support, and a head start on building 32-bit applications. In the eyes of some developers who have already invested thousands of dollars in previous OS/2 SDKs, the opportunity to alpha-test yet another new operating system. Obviously, the big players won't blink. To what extent this policy alienates the "little guy," and so impedes the flow of OS/2's lifeblood ap-

plications, we may never know. In any event, when a final version of 2.0 ships sometime this year, everyone can join the party—for the price of a compiler upgrade and an OS/2 toolkit.

The SDK version of the operating system, fat with debugging instrumentation, wants 6 megabytes of RAM. Microsoft expects the final version to run in 4 MB, and, given that 2.0's more efficient paged virtual memory system will make more of the kernel swappable, that seems attainable. In its current incarnation, the system looks and feels just like OS/2 1.2. The SDK includes 32-bit versions of Microsoft C and MASM (Microsoft Macro Assembler). The C compiler, called Microsoft C 5.2, isn't the new 6.0 compiler that was in beta test at the time of this writing, but rather a 32-bit adaptation of Microsoft C 5.1. However, the SDK does include a prerelease version of CodeView 3.0, the debugger that's bundled with Microsoft C 6.0. Eventually, 6.0 and its Programmer's Workbench should work with OS/2 2.0, but Microsoft hasn't yet committed to a release date.

In other respects, the SDK is a typical OS/2 toolkit. It includes the resource and help compilers; icon, dialog box, and font editors; and sample code. Like the 1.2 toolkit, which began shipping around the time of the 2.0 announcement, it will also include the Dialog Manager, which supports COBOL- and FORTRAN-generated screens in the PM environment, and IBM's CUA (Common User Access) style guide. These components testify to OS/2's key role in IBM's plan to integrate applications across platforms, which is known as SAA (Systems Application Architecture).

The New Memory Model

OS/2 2.0 accomplishes the shift to a 32-bit programming model gracefully. De-

velopers familiar with version 1.x needn't worry about API shock. The vast majority of kernel and PM function calls don't change. Dual 16- and 32-bit support takes the form of 16- and 32-bit dynamic link libraries (DLLs) and header files that control parallel name spaces. You will still write `DosOpen` and `DosCreateThread`; when compiling for 32-bit mode, those names will become `Dos32Open` and `Dos32CreateThread`. Those functions that manipulate segment selectors, such as `DosAllocSeg` and `DosAllocHuge`, are gone. But few programmers will shed many tears for them.

The new unit of memory allocation is called a "memory object" and is simply a contiguous set of 4K-byte pages in the linear address space. Flags to the allocation routines specify access permissions: read, write, execute, or guard. Guard pages facilitate the use of "sparse memory objects." OS/2 2.0 distinguishes between *allocating* and *committing* memory. To allocate memory means to reserve linear address space; to commit it means to map physical pages into that reserved space and possibly trigger page swapping. Guard pages enable the system (or the programmer) to commit memory dynamically to an allocated region; stacks are the most obvious use for the technique. When there's a reference to a guard page, the processor generates a guard-page fault; a system- or user-defined exception handler can then commit a physical page and make the next page a guard page.

Since there's no way to defragment the linear address space or reallocate memory, sparse memory lets programmers allocate ridiculously large chunks—limited only by the backing store—without involving the virtual memory subsystem until it is actually needed.

Threads, Semaphores, and Other Enhancements

OS/2 threads, or "lightweight processes," offer huge advantages to the applications that use them. Threads support multitasking not only between, but within, applications. Unfortunately, in version 1.x, threads proved notoriously tricky to use. Programmers had to allocate stack memory for threads. Because threads share process memory, programmers relied heavily on semaphores to coordinate access to that shared memory, and these were in short supply. Semaphore semantics were confusing, and the behavior of semaphores was unreliable in some cases. However, OS/2 2.0 should help to improve matters.

continued

OS/2
*threads, or "lightweight
processes," offer
huge advantages to
the applications that
use them; they also
support multitasking.*

PCterminal/286

PCterminal/286

PCterm

G/NOVELL



SAMSUNG/NOVELL

PCterminal/286



SAMSUNG

PCterminal/286

SAMSUNG/NOVELL

PCterminal/286



SAMSUNG/NOVELL

PCterminal/286



SAMSUNG/NOVELL®
386AE FILE SERVER

How to plan your LAN.

You'll need a pencil.

That's to write down the telephone number on the bottom of this page. Which will connect you with Samsung's nationwide network of resellers. And the Samsung/Novell co-labeled line of LAN hardware.

With one call you can plan on substantial savings over the big name computers which, despite high clock rates and even higher price tags, are not really optimized for networking.

And you can plan on 100 percent compatibility with all versions of Novell's NetWare®, because Samsung's LAN hardware was co-designed by Novell.

THE TESTING WENT IN BEFORE THE LABEL WENT ON.

Samsung's 386AE and PCterminal/286 have been tested exhaustively and certified by Novell for compatibility with all popular networking products. In fact, Samsung's 386AE is one of 3 file servers certified by Novell to run NetWare 386.

Novell's engineers successfully tested the PCterminal/286 in 1200 network configurations...with 50 units running at once! No other computer manufacturer can make that claim.

NETWORKING VS. NOTWORKING.

What's the difference? Take our 386AE Fileserver. It includes Novell's Advanced BIOS and 8 expansion slots to accommodate multiple network interface cards and disk controllers. Plus an oversize power supply for driving dual high capacity hard disks and tape backup system. Plus 4 megabytes of memory for disk caching.

Then there's Samsung's PCterminal/286 Diskless Workstation with a built-in Ethernet interface and Remote Boot EPROM.

And not to be overlooked is our 16-bit SE2100 Ethernet Interface Card which provides up to twice the throughput for the price of an 8-bit card.

CALL TODAY.

For the name of the Samsung reseller nearest you, call us today at 1-800-624-8999, ext. 851.

WINNER OF
LAN TIMES
**READERS
CHOICE**
SAMSUNG/NOVELL
PCterminal/286



The 386AE and PCterminal/286. More than affordable.



SAMSUNG

Circle 252 on Reader Service Card (DEALERS: 253)

The system now dynamically allocates stack memory for threads using the guard-page feature. The semaphore functions are new and are incompatible with the 1.x functions. Semaphores in 2.0 come in three flavors: event, mutual exclusion (mutex), and multiple wait (muxwait). Event semaphores provide a basic interthread signaling mechanism. The mutex semaphores work similarly but are designed for serializing critical sections of code in multiple threads. The muxwait semaphores permit a thread to wait on multiple semaphores, all of which must be of either the event or mutex variety. All semaphores are now handle-based and reside outside an application's address space.

Other enhancements include built-in floating-point emulation (a DLL that's not loaded on an i486 or if an 80387 is present), improved exception-handling capabilities that language extensions can make available to users, new device helpers (DevHlps) to enable device drivers to communicate with the linear address space, and a general relaxation of system limits. OS/2 2.0 supports more threads (4000, versus 1.2's 512 and 1.1's 256),

and vastly more semaphores—64,000 per process.

There's one major omission. OS/2 2.0 does not support the VIO/KBD/MOU packages, which bypassed PM to give 1.x developers direct control of the keyboard, screen, and mouse. So there's no middle ground anymore. It's either PM or printf (primitive teletype-style I/O).

MVDM: Multiple Virtual DOS Machines

There's no shortage of 386 DOS multitaskers these days. DESQview, VM|386, and VP/ix are notable examples of programs that use the V86 mode of the 386 to good effect. But OS/2's MVDM facility exploits an advantage that is uniquely Microsoft's. Other DOS multitaskers run off-the-shelf MS-DOS. MVDM's designers grabbed the DOS 4.0 source code, threw away the file system and other nonessentials, and ended up with an OS/2 2.0-specific version of DOS that leaves more than 620K bytes of RAM free for real-mode applications.

It's eerie to see DOS programs like Lotus 1-2-3, WordPerfect, and even Flight Simulator running in overlapped

PM windows, side by side with PM applications. A DOS program can run in the background as an icon. DOS programs can even use the PM clipboard. For example, you can cut a block of numbers out of 1-2-3 using PM's mouse and paste the numbers into WordPerfect or the PM version of Excel. MVDM will allow a full-screen DOS program to write straight to the display. And it supports EMS memory. Tunable parameters, such as task priority and idle detection, aren't in the first SDK version of OS/2 but will be made available.

MVDM comes with "virtual device drivers" for the standard character devices: video, keyboard, printer, and communications port. There won't be VDDs for block devices (at least initially), so DOS programs won't be able to talk directly to network adapters, CD-ROM readers, tape drives, and the like. You'll have to depend on OS/2's support for such devices—and that's been a sore point with OS/2 thus far. There aren't many OS/2 network drivers available yet, and, despite Microsoft's commitment to CD-ROM publishing, there's no OS/2 CD-ROM driver yet.

Word Publishing...Word Processing &

DeScribe™—Word Publisher bridges the gulf between word processing and desktop publishing—the next generation word processor. DeScribe is the first WYSIWYG word processor for IBM's powerful OS/2 Presentation Manager. What's on the screen is what prints on the paper. And you control it all with a friendly point and click mouse and menu interface in multiple windows.

OS/2

DeScribe, Inc.

IBM® is a registered trademark and Operating System/2™, OS/2™, and Presentation Manager™ are trademarks of the International Business Machines Corporation. DeScribe™ is a trademark of DeScribe, Inc.

Circle 88 on Reader Service Card

World Radio History

You won't be able to run DOS-extended programs, such as the DOS versions of Lotus 1-2-3 release 3.0, AutoCAD 386, Mathematica, and IBM Interleaf Publisher, under 2.0's MVDM. OS/2 2.0 doesn't, and won't, support VCPI (Virtual Control Program Interface). Options are to use dual-boot or wait for PM versions of these programs—which, in the case of 1-2-3 and AutoCAD, have already appeared. Although Microsoft acknowledges a need for DOS programs under MVDM to use extended memory better than EMS memory allows, there's no announcement yet of a plan to accomplish that.

Royal Fonts

Although Royal fonts aren't included in the first SDK release of 2.0, Microsoft has demonstrated the technology. Apple licensed the Royal font format to Microsoft. In the near term, this means that OS/2 2.0 and the forthcoming Macintosh System 7.0 will be able to exchange and use identical, high-quality, scalable display fonts. When Royal printers appear, both operating systems will be able to operate with them as well.

COMPANY INFORMATION

Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
Inquiry 880.

Royal is especially well suited to OS/2's GPI (Graphics Programming Interface). OS/2 defines its own vector-font API, which need not change to accommodate Royal. OS/2 features a unified imaging model that makes virtually no distinctions between screen and printer graphics. OS/2 2.0 defines no new APIs for Royal, because it doesn't need to. From an application writer's perspective, the necessary tools are already in place.

It's (Almost) the Real Thing

OS/2 is finally growing up. Flat addressing, paged virtual memory, an extremely powerful and flexible file system, an excellent graphical user interface, DOS

multitasking, and a unified imaging model: It all adds up to certain success in the long run. How long? That may not matter; Microsoft can afford to wait. So long as there isn't a mass exodus to alternate platforms—and the next couple of years admittedly will be critical—2.0 will be there to greet users who grow weary of wrestling with DOS and its extensions.

But the picture isn't completely rosy. OS/2 2.0 is still wobbly; a final release is many months away. OS/2 device driver support remains spotty—in some cases, such as printer control language and CD-ROM, unconscionably so. Applications are few. Development tools aren't what they should be. And the proliferation of Microsoft systems—DOS, Windows, 16-bit OS/2, and now 32-bit OS/2—fragments the finite pool of programming talent to an alarming degree. We'll see how it all plays out. But I've seen the system that I want to install on my 386 PC. It's OS/2 2.0. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

Desktop Publishing Together At Last.

Use DeScribe to create professional quality documents; anything from a quick memo to a textbook. Price: \$595.
DeScribe, Inc.; 4047 North Freeway Blvd,
Sacramento, CA 95834 Tel: 916/646-1111 Fax: 923-3447
In Europe: P.O. Box 36, Twyford, Berkshire,
England RG10 9TQ Tel: 44-734-34-2972



Sizzling RISC Systems from IBM

■ Andy Reinhardt and Ben Smith



IBM's POWERstation 320 desktop and POWERstation 530 desktide systems. The desktop unit (left) is showing a ray tracing generated by the high-performance three-dimensional graphics board. The desktide system (right) is running OSF/Motif.

Last year saw an explosion of interest in Unix workstation computing, but IBM's position in the market remained a big question. How would the company upgrade its lackluster RT system? In December, BYTE was invited to preview the answer, the RISC System/6000 family of high-performance workstations and servers. Codeveloped by IBM's Yorktown, New York, and Austin, Texas, research labs under the code name "RIOS," these machines are IBM's new Unix flagships.

The RISC System/6000 sets a new performance standard, boasting speeds of 28 million instructions per second on the desktop and over 40 MIPS in the fastest models. Preliminary benchmarks for the entry-level system appear to show performance 2.5 times that of the Sun SPARCStation 1; the machines have enough power to emulate an Intel 8086 *in software* and still run DOS applications faster than an AT. Most important, the RISC machines are designed not just for technical users but also for multiuser commercial applications, which speaks volumes about IBM's commitment to the Unix market.

The pricing is also very aggressive. An entry-level machine sells for \$12,995 and includes a 120-megabyte hard disk drive, 8 MB of RAM, a 19-inch 1280- by 1024-pixel monochrome display, an Ethernet card, a keyboard, a mouse, AIX and OSF/Motif software, and a one-year warranty. A desktop server model has a 240-MB hard disk drive and sells for \$14,945.

Variations on a CPU

The product line includes nine RISC machines based around a common CPU architecture, plus an array of add-ins and a low-cost X terminal (see the table). IBM is also releasing a new version of AIX—its home-grown Unix variant—with the machines.

The new AIX 3 has a file system that can span physical devices and change in

IBM's new family of RISC-based Unix systems offers tremendous power

size while the system is being used. It also includes PC-Simulator, an IBM product that allows the RISC machines to run DOS programs.

The systems are packaged in three basic models: desktop, deskside (or tower), and rack-mount. The desktop and deskside units are available as workstations or servers, while the cabinet-size rack-mount model is a server only. Many subsystems, including memory boards, mass storage, and graphics and communications cards, are common across the product family. In this article, we will focus on the entry-level platforms.

The 32-bit superscalar CPU is constructed of seven to nine CMOS chips containing more than 6 million transistors. Its architecture, which IBM calls "second-generation RISC," includes separate fixed-point, floating-point, and instruction/branch units that operate in parallel, for a total execution rate of up to five operations per cycle. In addition, the chip set includes separate data cache, storage control, and I/O control units. Depending on the model, the CPU oper-

ates at 20, 25, or 30 MHz. (See the figure.)

The new processor can access a vast amount of memory. Full 32-bit memory addressing allows it to directly address up to 4 gigabytes of real memory, and 52-bit virtual address generation permits access to a whopping 4 petabytes (i.e., 4 million gigabytes) of virtual memory. Real memory is located on a special high-speed synchronous bus that passes data to the cache on a 64- or 128-bit-wide path, depending on the model, at speeds of between 160 and 480 megabytes per second.

All the systems include an enhanced version of IBM's Micro Channel bus that uses data streaming to allow burst-mode transfers at up to 40 MBps, twice the speed of the bus in the PS/2s. The sustained throughput is 25 to 30 MBps. The new Micro Channel also specifies a 77 percent larger card size to allow more complex designs, and it performs parity checking on all data; however, it still accepts the smaller boards engineered for PS/2s. All the new high data-rate cards

available for the systems, such as graphics, SCSI, and network interfaces, have on-board I/O processors and are bus-mastering.

To boost system reliability, all members of the family include error-detection and correction capabilities unprecedented in workstations, including a suite of 80 to 100 power-on self tests, parity checking on all buses and boards, bad-bit-swapping, and memory scrubbing.

The RISC CPU is a uniprocessor and isn't designed to allow closely coupled multiprocessing like many minicomputers. However, with an eye to distributed computing, IBM has built-in support for a 20-Mbps optical link that lets systems share data in clusters. This technology will be implemented in the future.

Desktop POWERhouse

The entry-level RISC systems are called the POWERstation 320 and POWERserver 320. (POWER is an acronym for performance optimization with enhanced RISC.) Both use the same polycarbonate

continued

SYSTEM CONFIGURATIONS FOR THE RISC SYSTEM/6000 FAMILY

IBM's new RISC System/6000 consists of six models, all of which use essentially the same proprietary RISC CPU.

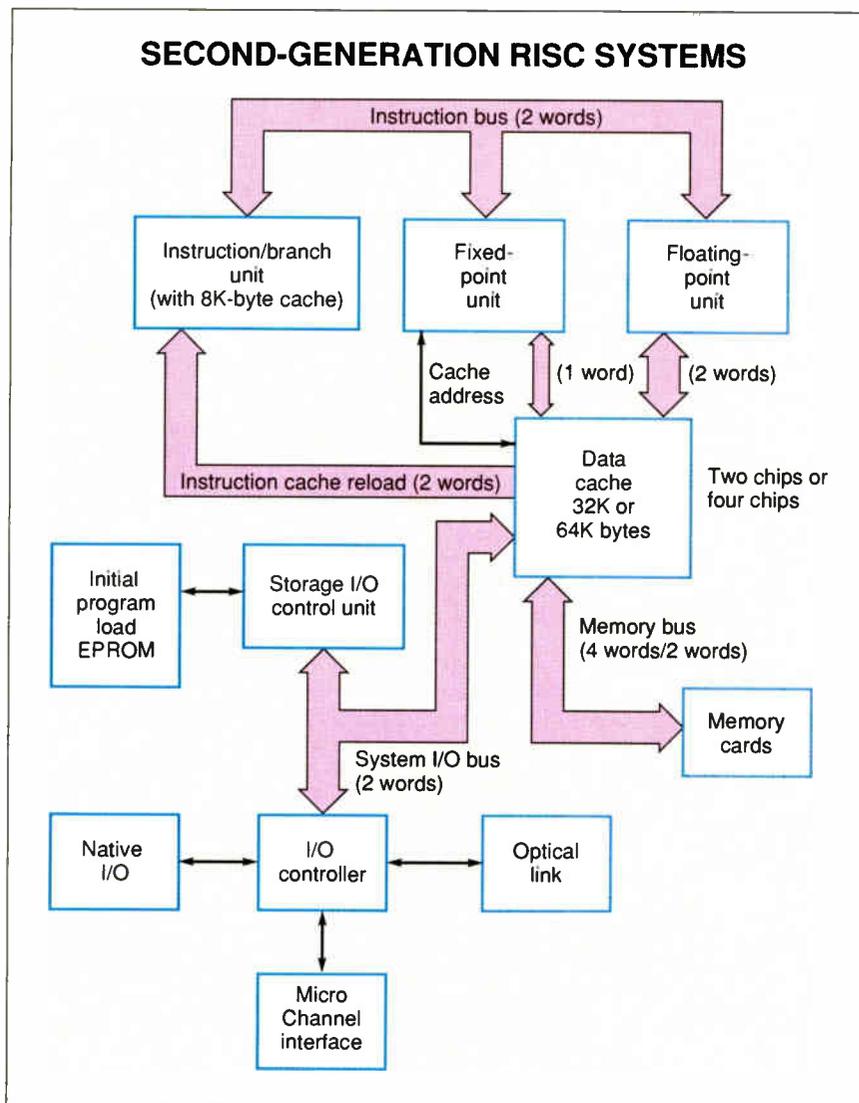
Model	Packaging	CPU/cache	Memory slots	Standard RAM	Maximum RAM (1-Mb/4-Mb SIMMs)	Micro Channel slots available	Storage bays (full-/half-height)	Standard storage ¹
320	Desktop	20 MHz/32 KB	2	8 MB	32/128 MB	4	0/2	120 MB
520	Deskside	20 MHz/32 KB	8	8 MB	128/512 MB	7	3/6	355 MB
530	Deskside	25 MHz/64 KB	8	16 MB	128/512 MB	7	3/6	355 MB
540²	Deskside	30 MHz/64 KB	8	64 MB	128/512 MB	7	3/6	640 MB
730³	Deskside	25 MHz/64 KB	8	16 MB	128/512 MB	6	3/6	355 MB
930²	Rack-mount	25 MHz/64 KB	8	16 MB	128/512 MB	6	4/8 per drawer	670 MB

¹Storage: internal hard disk drives: 120-MB (desktop only), 320-MB (3½-inch); 355-MB, 670-MB, and 857-MB (5¼-inch); backup: 8-millimeter digital audio tape-recording system (internal/external), and ¼-inch and ½-inch tape (external); other: External 5¼-inch floppy disk drive and internal CD-ROM drive.

²POWERserver only.

³POWERstation only.

Notes: All systems include one 3½-inch 1.44-MB floppy disk drive and the following ports: keyboard, mouse, tablet, external floppy disk drive, parallel, and two serial. Deskside systems include one 4-Mbps SCSI adapter; the 930 has two. The 730 includes a two-slot graphics card.



Block diagram of RISC CPU architecture. Note the separate units for fixed-point, floating-point, and instruction/branch operations. All memory access flows through the data-cache unit, while the storage I/O control unit and I/O "combo" chip control Micro Channel and bus access.

plastic enclosure, but the server version will sport more storage.

The desktop unit is a little larger than an IBM AT: It measures 6 $\frac{1}{2}$ inches tall, 18 inches wide, and 20 $\frac{3}{8}$ inches deep, and it weighs between 28 and 34 pounds. Inside the unit are a *system planar* (the motherboard [see photo 1]) and a *CPU planar* (see photo 2) that plugs into the unit perpendicularly. Both boards use an advanced eight-layer construction, with four signal and four power/ground layers; the CPU board is practically devoid of passive components.

The desktop CPU uses a seven-chip complex that operates at 20 MHz and includes two 16K-byte data-cache chips, or

32K bytes of cache. (Larger systems use a nine-chip set that has 64K bytes of data cache.) In addition to the CPU slot, the system planar has two memory slots, four Micro Channel slots, a "direct attach" hard disk drive connector, 192K bytes of self-test and boot EPROM, and an assortment of I/O ports. Rounding out the interior are a quiet cooling fan and a 265-watt, auto-sensing power supply with its own fan.

The standard memory allotment is 8 MB of 80-nanosecond RAM, configured as eight 1-MB single in-line memory modules on a single memory board. Double-sided 2-MB SIMMs are also available that would allow each memory

board to hold 16 MB, for a total system memory of up to 32 MB. When 4-mega-bit DRAM chips become available in the future, the desktop unit will be able to hold 128 MB of real memory. For mass storage, the desktop includes two 3 $\frac{1}{2}$ -inch 120-MB hard disk drives mounted in a special carrier and plugged into the hard disk drive slot, and a 3 $\frac{1}{2}$ -inch 1.44-MB floppy disk drive.

For commercial installations, IBM provides a range of multiport asynchronous cards to connect ASCII terminals. For graphics applications, IBM offers four cards: gray-scale and color two-dimensional boards and two three-dimensional color options, which will be discussed later in the article. You can choose from 13 displays that range from a 12-inch, 640- by 480-pixel monochrome model to a 23-inch, 1280- by 1024-color unit, or you can use previously purchased displays.

The deskside systems, which look like small minicomputers, share similar packaging and internal design, but they vary in performance and configuration. In these models, the system and CPU boards are on the same plane, attached end to end (see the table for specifications).

Reestablishing the Lead in RISC

IBM invented RISC in 1975 with the 801 processor. The 801 was almost used as the heart of the IBM DisplayWriter, but, instead, it evolved into the CPU for the IBM RT, which was introduced in 1986.

The RT's anemic floating-point and graphics performance prompted IBM to design a new-generation CPU. The RIOS project had a major design objective: to achieve an execution rate of less than one cycle per instruction. Hand-in-hand were commitments to use 1-micron VLSI CMOS technology for low-power and cooling requirements, to offer large virtual memory and real-time interrupt handling, to develop optimized Unix compilers, to use industry standards, and to provide the best price/performance ratio on the market.

IBM's definition of RISC relies less on a small instruction set—there are 184 instructions, comparable to some complex-instruction-set computer architectures—than on optimizing them to execute in a single cycle or less. To achieve this, the RISC CPU uses parallelism and pipelining. At the heart of the CPU are three separate processor chips: the instruction/branch unit (ICU), the fixed-point unit (FXU), and the floating-point unit (FPU).

The ICU is responsible for doling out

instructions to the FXU and FPU and for resolving branch conditions. Instructions are pulled from an 8K-byte cache located on the same chip, which is in turn fed from memory through the data cache in 64-bit increments. The ICU can execute two operations internally while at the same time issuing orders to the FXU and FPU.

The ICU has two particularly powerful capabilities. First, it contains a special 32-bit register that is used to track the status of up to eight branch conditions. Using this register and instruction look-ahead, the ICU can *presolve* branches and execute them as soon as conditions permit. This so-called "zero-cycle" branching is more efficient than the methods that are used in other RISC architectures.

Second, the ICU contains special registers into which the complete machine state is stored in the event of an interrupt. This permits the system to vector quickly to an interrupt service routine without using a time-consuming stack operation that would involve FXU address generation and memory access.

The FXU is less remarkable in its design, but it plays an important role in generating and translating addresses and controlling the data cache. What is significant is that these tasks have been off-loaded from the usual RISC CPU. The FXU performs all integer arithmetic and logical operations and contains the segment registers for memory addressing. One unusual feature for a RISC system is that the FXU supports special string instructions for handling null-terminated strings (used in C) or length-specified strings (used in Pascal) with minimal overhead.

The key to RISC performance is that the FPU receives instructions concurrently with the FXU and executes them at the same rate. The FPU has a 64-bit path from the data cache and conforms to IEEE floating-point standards. A pipelined design lets it spit out a double-precision result every cycle with only a two-cycle latency.

The FPU also has one special instruction (multiply/add) that executes in the same time required for simple adding or multiplying. This single instruction permits the system to execute the equivalent of five operations per cycle, even though only four are dispatched at a time.

All the chips in the CPU are implemented in VLSI CMOS using 1-micron technology. The packages, roughly 1 inch on a side, have between 184 and 293 pins each and are socketed for easy replacement. For reliable cooling, each

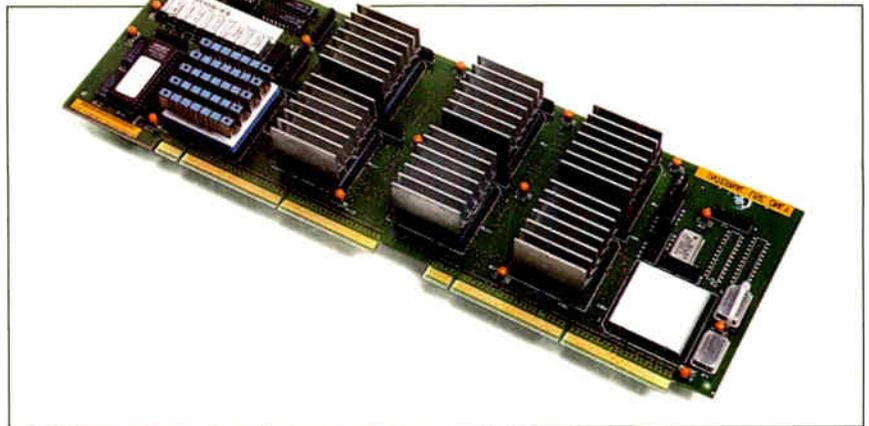


Photo 1: The 20-MHz CPU planar for the desktop. The CPU plugs into the slot on the system planar. Note the heat sinks on top of the chips.

chip is topped with an aluminum heat sink. Most of the rest of the components in the system are surface-mounted.

Data Paths

The cache is the interface to the main memory, and it feeds instructions to the ICU and data to the FXU and FPU. In-

stead of off-the-shelf static RAM components, IBM uses a custom cache design that is two- or four-way associative. The company claims that this design permits a hit rate that is equal to a direct-mapped static RAM cache two times as large.

The entry-level desktop and desktide
continued

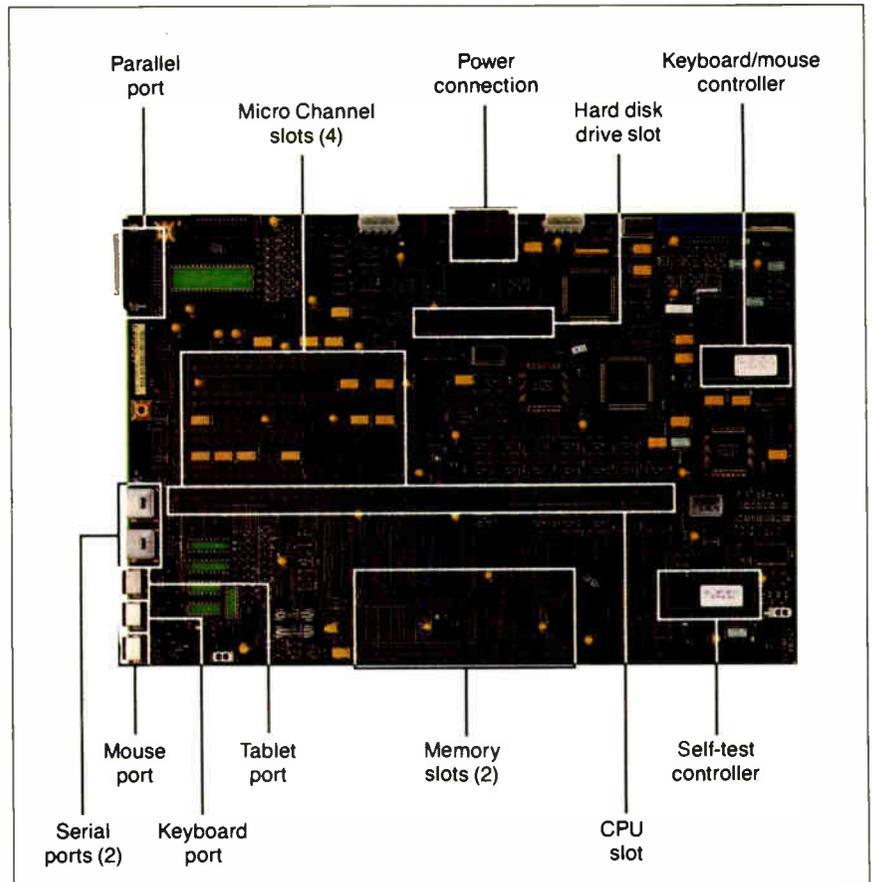


Photo 2: The desktop system planar. The system planar has slots for the CPU, memory, hard disk drive, and Micro Channel cards, plus a host of I/O connectors.

BLACKSHIP COMPUTERS

Your "BEST BUY" Company



"... remarkably strong 386 performance at bargain prices. PC WORLD's Best Buy recommendation."

— PC WORLD, June 1988

"... its price/performance ratio easily justifies PC WORLD's Best Buy recommendation."

— PC WORLD, August 1988

"A reasonably priced system (Blackship 386/33) that performed well... it's easy to recommend this computer."

— BYTE IBM Special Edition, Fall 1989

"The Blackship offers low price 33-MHz performance... we rate it a very good value."

— INFOWORLD, July 1989

SYSTEMS

The Best Price/Performance and Service Available for Networking and CAD/CAM.

Introducing '486/25 MHz ... \$7,249
'386/33 MHz System \$4,949
'386/25 MHz System \$4,595

ALL SYSTEMS INCLUDE:

- 4 Mb RAM Memory
- ESDI 2 FD/2 HD Controller
- 150 Mb ESDI Hard Disk
- 1.2 Mb Floppy Disk Drive
- 16 Bit VGA Card
- Multiscan Monitor (1024 x 768)
- 2 Serial, 1 Parallel, and 1 Game Port
- Keytronic 101-Key Keyboard
- 8 Expansion Slots
- Clock/Calendar with Battery Backup
- Tower Case with 220 Watt Power Supply
- MS DOS 3.3 or 4.01

For all your 286/386 requirements and all your other computer needs, call:

1-800-877-6249



BLACKSHIP
COMPUTER SYSTEMS, INC.

Your System Integrator

4031 Clipper Court • Fremont, CA 94538
Tel: 415-770-9300 Fax: 415-770-8674

PLEASE CALL OR FAX

YOUR VALUABLE ORDERS NOW!
ASK FOR OUR NEW CATALOG.

Limited time offer. Prices subject to change.

COMPANY INFORMATION

IBM
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 890.

systems have 32K bytes of two-way associative cache and a 2-word, or 64-bit, path width from main memory. (The actual data bit width from each memory card is 80 bits—including error-correction and redundant bit lines—while there are 50 lines for 32-bit addresses plus control and parity.) With a CPU speed of 20 MHz, the memory bus bandwidth is 160 MBps.

The nine-chip systems have a 64K-byte four-way associative cache and a memory path width of 128 bits, or 210 bits including addressing and error-correction. The 25-MHz models have a memory bandwidth of 400 MBps, and the 30-MHz model transfers at 480 MBps.

The systems use a segmented memory architecture and support memory locking to prevent processes from interfering with one another. Physically, memory is four-way interleaved and scattered so that no more than 1 bit of each word is located in a single DRAM chip. Logically, memory is split into 4K-byte pages, and real addresses are calculated using a translation look-aside buffer and a page-frame table.

Graphic Evidence

Any of the systems can accept one of several 2-D and 3-D graphics adapters announced with the RISC family. The "entry-level" board is available in two flavors: 4-bit gray-scale (16 shades) or 8-bit color (256 colors from a palette of 16 million). This card uses a single frame buffer and can draw 75,000 2-D vectors per second.

The High-Performance 3-D Color Graphics Processor, codeveloped by IBM and Silicon Graphics, uses technology from the Personal Iris system. The two-slot card is available in 8-bit or 24-bit color versions to allow, respectively, 256 or 16 million colors from a palette of 16 million. It can draw 90,000 2-D vectors and 90,000 3-D vectors per second, and with an optional daughtercard, it can draw 10,000 Gouraud-shaded triangles per second. A second daughtercard option provides z-buffering.

Impressions

To go from the back of the Unix pack to being a leader requires more than snappy

hardware. Users want standards, and they need applications. IBM has poured a vast effort into the compiler technology that lets applications take advantage of the RISC CPU. But the company has also chosen to sidestep the popular movement toward a common Unix by enhancing its nonstandard AIX.

To encourage wary third-party developers to port applications to the RISC System/6000, IBM has set up a special porting lab in Austin and will establish others in the U.S. and all over the world. The laboratories are staffed by trained engineers dedicated to each port, and developers are given ample equipment and security. Hundreds of Unix applications have already been ported. The costs of running the centers is no doubt staggering, but they are indicative of IBM's commitment to this product line and to the Unix market.

IBM's previous venture in workstations was unsuccessful, and the company knows it is at least two years behind in the marketplace. To catch up, IBM has thrown everything into the RISC System/6000, including years of engineering, extensive training, and what promises to be a major marketing effort. From our early look, we think the RISC System/6000 stands a good chance of success.

Our technical reservations are few. Will the Micro Channel, even with its improvements, be fast enough for large multiuser applications or very data-intensive graphics? Will AIX suffer in the market for its incompatibility with Unix System V release 4 and lack of multiprocessing support? Will there be enough applications available soon enough? The main concern is whether IBM will be sufficiently nimble to succeed in the fast-paced workstation market. The RIOS project has been marked from the beginning by vacillation and delays. To compete in the RISC market against Sun, Hewlett-Packard, MIPS, and Digital Equipment, IBM can't afford to be risk-averse.

IBM has bested the SPARCStation's price/performance ratio by 2 to 1. Since IBM has hinted at less-expensive members of the RISC System/6000 family in the future, the price/performance ratio will continue to challenge not only competing workstations but high-end PCs as well. ■

Andy Reinhardt is a BYTE associate news editor. Ben Smith is a BYTE technical editor. You can contact them on BIX as "areinhardt" and "bensmith," respectively.

FREE FREE

FREE FREE FREE FREE FREE FREE

The 1990 Image Processing Handbook

1990 Image Processing Handbook

For your free copy,
fill out and return the
card at right, or call
the Data Translation at
(508) 481-3700

- DT-Connect™ products
- Software compatibility for PC and PS/2
- Real-time image processing boards and software
- Automated inspection
- Documentary stories

To receive your free copy of the *1990 Image Processing Handbook*, fill out and return this card.

Name _____

Title _____

Company _____

*Address _____ m/s _____

City _____ State _____ Zip _____

Tel (_____) _____

**No PO boxes please*

World headquarters: 100 Locke Drive, Marlboro, MA 01752-1192 USA

• Tel: (508) 481-3700 • FAX: (508) 481-8620 • Telex: 951646

Data Translation is a registered trademark of Data Translation, Inc.

BYTE 4/90



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 100 MARLBORO, MA 01752

POSTAGE WILL BE PAID BY ADDRESSEE

DATA TRANSLATION[®]

100 Locke Drive
Marlboro, MA 01752-9902



BYTE

SAVINGS CERTIFICATE

This certificate entitles you to BYTE at a savings of up to 52% off the cover price. You'll also receive the extra annual IBM PC Special Issue as part of your subscription.

Check one:

- 1 year (12 issues) for \$24.95
(Save 40% off the newsstand cost!)
- 2 years (24 issues) for \$44.95
(Save 46% off the newsstand cost!)
- 3 years (36 issues) – \$59.95
– SAVE 52% off the newsstand cost (20% off the basic subscription price)
- Payment enclosed**
- Bill me**

Name _____

Company _____

Address _____

City/State _____

Zip _____

IBK0807

**SAVE
UP TO
52%**

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it!

Single copy \$3.50. The basic annual subscription rate is \$29.95.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE:

BYTE

Subscription Department
P.O. Box 558
Hightstown, N.J. 08520-9409



Now you can grab, store, and process 16 images in Real Time on the PC AT.



The many faces of Fred Molinari, President

The DT2861 Arithmetic Frame Grabber can process 4 times as many images as any other frame grabber built for the PC AT.

With a built-in processor, the DT2861 also lets you process 4 images in parallel, or switch display instantaneously from as many as 16 images. The DT2861 grabs images off virtually any video source,

including CAT scanners, scanning electron microscopes, line-scan cameras, as well as ordinary video cameras and VCRs. It even ships with IRIStutor™ software—free!

For more information about the Frame Grabber that's 4 times better than anything else made for PCs, give us a call today.

Call (508) 481-3700.
In Canada, call (800) 268-0427.

**FREE 1990
Image Processing
Handbook**



Image Processing Board	Computer	Resolution	Gray Levels	RS-170, NTSC, BS-330, CCIR, PAL Compatible	VCR Compatible	Slow Scan	Number of Video inputs	Real-Time Frame Grab	On Board 8-bit ALU	Memory-Mapped Frame-Store Memory	Zoom, Pan, Scroll	Software Support	Price
DT2861 Frame Grabber	IBM PC AT	512x512	256	Yes	Yes	0-12 MHz	8*	Yes	Yes	16 buffers 512x512x8 each (4 Mbytes)	Yes	DT-IRIS IRIStutor Image-Pro	\$4995
DT2862 Frame Grabber	IBM PC AT	512x512	256	Yes	Yes	0-12MHz	8*	Yes	Yes	4 buffers 512x512x8 each (1 Mbyte)	Yes	DT-IRIS IRIStutor Image-Pro	\$2995

*With DT2859 1/2 size multiplexer board (\$399).

DATA TRANSLATION®

World Headquarters: Data Translation, Inc., 100 Locke Drive, Marlboro, MA 01752-1192 USA, (508) 481-3700 Tlx 951646
United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG1 2QJ U.K. (0734) 793838 Tlx 94011914
West Germany Headquarters: Data Translation GmbH, Stuttgarter Strasse 66, 7120 Bietigheim-Bissingen, West Germany 07142-54025
International Sales Offices: Australia (2) 662-4255; Belgium (2) 466-8199; Canada (416) 625-1907; China (1) 868-721 x4017; Denmark (42) 274511; Finland (0) 372144; France (1) 69077802; Greece (1) 361-4300; Hong Kong (5) 448963; India (22) 23-1040; Israel (52) 545685; Italy (2) 824701; Japan (3) 502-5550, (3) 348-8301, (3) 555-1111; Korea (2) 756-9954; Netherlands (70) 99-6360; New Zealand (64) 9-545313; Norway (2) 53 12 50; Portugal (1) 545313; Singapore (65) 7797621; South Africa (12) 8037680/93; Spain (1) 455-8112; Sweden (8) 761-7820; Switzerland (1) 723-1410; Taiwan (2) 702-0405.

IRIStutor and DT-IRIS are trademarks and Data Translation is a registered trademark of Data Translation, Inc. All other trademarks and registered trademarks are the property of their respective holders.

Circle 83 on Reader Service Card
World Radio History



The Heart and Soul

The right motherboard provides the foundation for high-performance, 25-MHz 386 systems

Steve Apiki, Rob Mitchell, and Stan Wszola

With all the emphasis these days on high-performance storage and video subsystems, it's easy to forget that the ultimate performance enhancement is a new system board. The fastest SCSI drive won't give your applications the boost you expect if the real culprit is a slow CPU or memory architecture.

Virtually all 386 motherboards are designed to run at or close to zero wait states. But the presence of cache memory, or support for interleaving or fast-page-mode DRAM chips, can make a big difference in how a motherboard performs. Of course, performance isn't the only factor separating 386 motherboards. Other features, such as pricing and expandability, vary considerably.

How do the different 386 motherboard designs stack up? To find out, we examined 23 motherboards from 16 different vendors (see tables 1 and 2). All the motherboards support a 25-MHz CPU and include a 25-MHz Intel 80387 math coprocessor. Last year's cutting-edge performers, systems built around the 25-MHz 386, have dropped in price to become an attractive high-performance 386 platform.

Why Test Motherboards?

Replacement motherboards are an appealing alternative to budget-conscious

users of XT- and AT-class machines who are looking for an inexpensive way to move up to a 386. Depending on your existing hardware, you could save substantially over the cost of a new system. But you might have some problems integrating the new motherboard into a system with components that are designed for older, slower systems.

If you plan to build a system from the ground up, the savings will probably be disappointing. Major PC clone vendors buy components by the truckload and can offer assembled systems for less than the retail cost of all the parts. The main advantage of assembling your own system isn't monetary; it's an intimate understanding of what's in your machine and how it fits together. You can build your system to your exact specifications using the components that will produce the best performance or greatest economy.

But the relative merits of 386 motherboards aren't just topics for the do-it-yourselfer. If you're thinking of buying a system, you will find that third-party motherboards offer an excellent basis of comparison among clone machines. Many PC clone vendors pride themselves on using name-brand graphics adapters, monitors, and hard disk drives. But the motherboard isn't as likely to be from a well-known manufacturer—and even when it is, information about a given motherboard is often hard to find.

We tested both cached and noncached designs and both XT- and AT-size motherboards. You won't find all these motherboards at the corner computer store, or even in the back pages of *BYTE*. Intel and Mylex, for example, sell only to value-added resellers (VARs). But other vendors, such as Jameco and JDR Microdevices, sell both directly to end users and through dealers.

Most vendors offer a bare-bones motherboard configuration that includes a 25-MHz Intel 386 CPU and no DRAM. If the motherboard includes a cached-memory system, it includes at least 32K

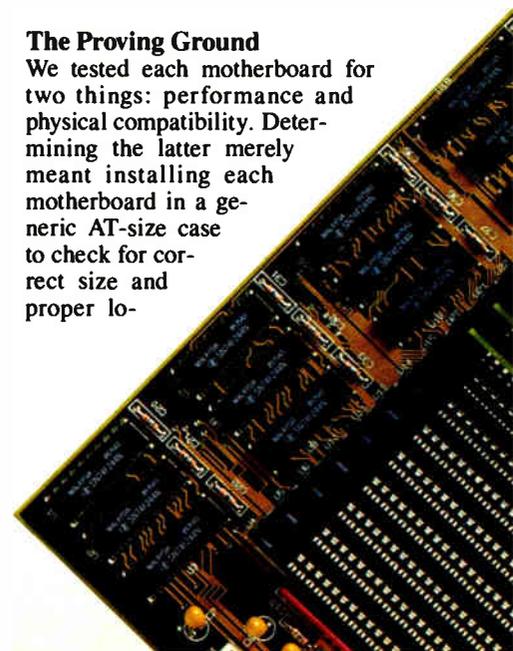
bytes of static RAM.

List prices vary, depending on configuration, vendor reputation, and distribution channel. Cache motherboards cost more than noncached models, and name-brand motherboards like Mylex's MWS 386-25 and Jameco's JE3026 (which is actually made by American Megatrends, Inc. and is identical to 25-MHz AMI motherboards found in many compatibles) cost substantially more than lesser-known brands. Motherboards sold through dealers and VARs have higher list prices than boards available directly from the manufacturer, but they generally sell at a discount.

To make comparisons easier, we've made two features tables: table 1 for caching motherboards, and table 2 for noncaching motherboards. Most of those with a cache ranged in price from \$1100 to \$2000 with no RAM. The least-expensive cached product was Nascent's NT-386-25 (\$1049), and the most expensive was Intel's Model 302 (\$4091), which included 2 megabytes of RAM. Noncaching boards started at \$765 and went up to \$2095 for the Seattle STD 386XT, which comes standard with 1 MB of RAM.

The Proving Ground

We tested each motherboard for two things: performance and physical compatibility. Determining the latter merely meant installing each motherboard in a generic AT-size case to check for correct size and proper lo-



of a PC Compatible

cation of the holes for mounting stand-offs and screws. Every board fit into the case, although some just squeaked by our AT's disk drive housing.

To test performance, we set up a test system consisting of the following peripherals: a 250-watt power supply, a Western Digital WD1006V-MM1 hard disk drive controller card, a Seagate ST-251-1 40-MB hard disk drive, a Jameco JE1077 floppy disk drive controller/serial/parallel card, a TEAC FD-

55GFR 5¼-inch 1.2-MB floppy disk drive, an AST VGA Plus video card, a Key Tronic KB 101 keyboard, and one of several color VGA monitors.

We hooked each motherboard into this test-bed in turn. We tested each board under DOS 3.3 with an Intel 80387 coprocessor and at least 2 MB of memory installed. If the minimum interleaved configuration required 4 MB, we installed 4 MB. The BYTE benchmark results in table 3 show the CPU, FPU, and video bench-

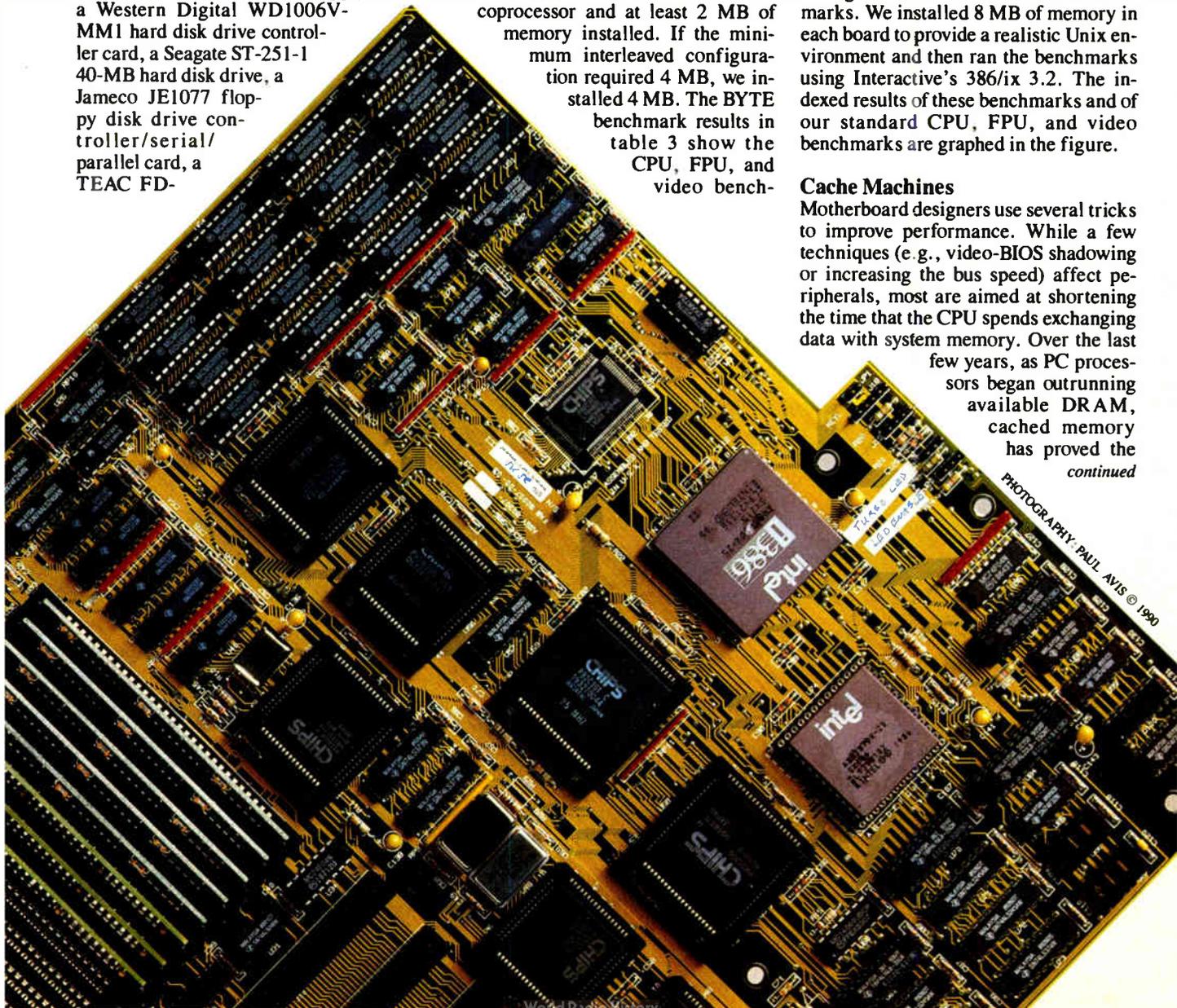
mark indexes and ratings from the conventional Dhrystone and Livermore Loops tests.

To gauge the effectiveness of these boards when running large, protected-mode applications, we also put them through a run of the BYTE Unix benchmarks. We installed 8 MB of memory in each board to provide a realistic Unix environment and then ran the benchmarks using Interactive's 386/ix 3.2. The indexed results of these benchmarks and of our standard CPU, FPU, and video benchmarks are graphed in the figure.

Cache Machines

Motherboard designers use several tricks to improve performance. While a few techniques (e.g., video-BIOS shadowing or increasing the bus speed) affect peripherals, most are aimed at shortening the time that the CPU spends exchanging data with system memory. Over the last few years, as PC processors began outrunning available DRAM, cached memory has proved the

continued



386 MOTHERBOARDS

CACHING 25-MHz 386 MOTHERBOARDS

Table 1: Features of caching 25-MHz 386 motherboards. Boards are differentiated by nonperformance features (e.g., expandability and flexibility of configuration) as well as by performance-enhancing features (● = yes; ○ = no).

Motherboard	Manufacturer	List price	Board size (inches)	CPU speeds (MHz)	System bus speed (MHz)	Expansion slots	Math coprocessors ¹	ROM BIOS (date)	BIOS Shadow RAM	Video Shadow RAM	386 chip set
Atronic ATI-386/B	Atronic International	\$1295 ³	18½ × 12	8, 25	8	2 8-bit, 6 16-bit, 1 32-bit	80387-25, 1167-25, 80287-10	AMI EC&T 5286 (4-20-88)	●	○	ATI
C ² M-386-25	C ² Micro Systems	\$1300	12 × 13¾	6, 8, 25	8	2 8-bit, 5 16-bit, 1 8-/32-bit	80387-25, ⁴ 1167-25	Award M386-25/33 (8-25-89)	●	●	Discrete logic
Cache 386-25	Cache Computers	\$1100	12 × 13¾	8, 25	8, 8.3, 12.5	1 8-bit, 7 16-bit	80387-25, 3167-25	AMI E307 6063 (9-15-89)	●	●	C&T
DTK Cache 386-25	DTK Computer	\$1649 ⁵ \$2149 ⁶	12 × 13¾	10, 25	6, 12	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	DTK 4.25 (6-12-89)	○	○	Discrete logic
Intel Model 302	Intel	\$4091 ⁷	12 × 13¾	8, 25	8	1 8-bit, 5 16-bit, 2 8-/16-/32-bit	80387-25, 3167-25	Phoenix 1.10 04.C1 (1-15-88)	●	●	Discrete logic
Jameco JE3026	AMI	\$1900	12 × 13¾	8, 25	8	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	AMI DAMI 3607 (4-25-89)	●	●	Discrete logic
Jameco JE3525	Elite Group	\$1200	8½ × 13	8, 25	8	1 8-bit, 4 16-bit, 1 32-bit	80387-25, 3167-25	AMI EC&T 1131 (8-30-89)	●	●	C&T
JCS 386c	JC Information Systems	\$1100	8½ × 13	8, 25	8	1 8-bit, 5 16-bit, 1 8-/32-bit, 1 16-/32-bit	80387-25, 3167-25	Phoenix 1.10.02 (1-15-88)	●	●	C&T
JDR C386-25	Modular Circuit Technology	\$1199 ⁹	8½ × 13	16, 25	8	3 8-bit, 4 16-bit, 1 32-bit	80387-25, 3167-25	AMI EC&T 1131 (2-25-89)	●	●	C&T
Micronics 80386-I Cache	Micronics Computers	\$1500	12 × 13¾	6, 8, 25	8.3, 12.5	2 8-bit, 5 16-bit, 1 32-bit	80387-25, 3167-25 ¹⁰	Phoenix 1.10.10A (1-15-88)	●	● (EGA only)	Discrete logic
Monolithic MicroFrame 386CT	Monolithic Systems	\$1945	8½ × 13	10, 25	8.3, 10, 12.5	6 16-bit, 2 8-/16-/32-bit	80387-25, 3167-25	Quadtel CS8231 3.03.03 (8-09-89)	●	●	C&T
Mylex MWS 386-25	Mylex	\$2100	12 × 13¾	8, 25	6.25, 8.33, 12.5	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25 ¹⁰	Phoenix 1.10.10 (11-15-88)	○	○	Discrete logic
Nascent NT-386-25	Nascent Technology	\$1049	12 × 13¾	8, 25	8	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	AMI 1400 (8-15-88)	○	○	Discrete logic
OEM 386-25MX	OEM	\$1295	12 × 13¾	8, 25	8, 10	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 1167-25	AMI 5301 (12-15-88)	●	●	C&T
Orchid Privilege 386/Cache	Orchid Technology	\$1398	12 × 13¾	8, 25	8	2 8-bit, 5 16-bit	80387-25, 3167-25	AMI DC&T 5025 (4-30-89)	●	●	C&T

Note: Base price includes CPU.

¹All motherboards support only one math coprocessor at a time unless footnoted.

²Tested type listed first.

³Base price includes 1 MB of RAM.

⁴Supports both coprocessors simultaneously.

⁵64K-byte-cache version.

⁶256K-byte-cache version.

most effective method for enhancing high-speed board performance.

Not surprisingly, cached boards in our tests decidedly outperformed their non-cached counterparts. On both DOS and Unix CPU tests, the 16 caching models finished well ahead of the seven that did not use caches. The trend continued for our Dhystone tests as well.

While some cache is always better than no cache, a clear winner among

caching schemes is not easy to find. The boards that we benchmarked employed a handful of common caching methods, and different tests favored different methods.

All caches work by keeping frequently accessed data in a small amount of very fast static RAM. They are effective because, statistically, programs tend to spend most of their time within a small range of memory addresses. Cache im-

plementations differ, however, in how they organize data, when they write to main memory, and how large a cache they require.

About one-half of the cached boards (nine) used a direct-mapped cached organization; the remainder used two-way set-associative caches. Although other types exist, these two are by far the most common in current PCs.

Direct-mapped caches assign a dis-

386 MOTHERBOARDS

Memory							Cache memory					Warranty (years)	Source
Geometry	Package	Speed (ns)	RAM types ²	Interleave	Maximum on-board RAM (MB)	Maximum 32-bit RAM (MB)	Controller	Cache organization	SRAM speed (ns)	Tested size (bytes)	Other size (bytes)		
256K x 9 1Mb x 9	SIMM	80	RAS/CAS, page-mode, static-column	○	8	16	Proprietary	Direct-mapped write-through	25	64K	32K	1	Dealers, VARs
1Mb x 1	DIP	100	Page-mode, RAS/CAS	○	4	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct, VARs
256K x 9 1Mb x 9	SIMM	80	RAS/CAS, static-column	○	16	16	C&T 82C307	Two-way set-associative posted-write	25	32K	None	1	Dealers, VARs
256K x 1 256K x 4 1Mb x 1 256K x 9 1Mb x 9	DIP SIP	80	RAS/CAS, page-mode, static-column	○	8	16	Proprietary	Direct-mapped write-back	25	64K, 256K	None	1	Direct, dealers, VARs
256K x 9 1Mb x 9	SIMM	100	Page-mode, RAS/CAS, static-column	○	8	40	Proprietary	Direct-mapped posted-write	35	64K	None	1	VARs
1Mb x 1 256K x 1 256K x 9 1Mb x 9 ⁸	DIP SIMM	70	RAS/CAS, page-mode, static-column	●	8	24	Proprietary	Direct-mapped write-through	25	64K	None	1	Direct
256K x 9 1Mb x 9	SIP	80	RAS/CAS	●	0	16	Intel 82385	Two-way set-associative write-through	35	32K	None	1	Direct
256K x 4 1Mb x 1 1Mb x 9	DIP	100	Page-mode	○	0	32	C&T 82C307	Two-way set-associative write-through	25	32K	None	1	Direct, dealers, VARs
256K x 1 1Mb x 1	DIP	60	RAS/CAS	●	0	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct
256K x 1 1Mb x 1	DIP	80	RAS/CAS, page-mode, static-column	○	0	16	Intel 82385	Direct-mapped posted-write ¹¹	35	32K	64	1	Direct, dealers, VARs
256K x 9 1Mb x 9	SIP	100	Page-mode	○	8	24	C&T 82C307	Two-way set-associative posted-write	25	32K	None	5	Direct, dealers, VARs
256K x 9 1Mb x 9	SIMM	80	RAS/CAS	○	8	16	Proprietary	Direct-mapped write-through	25	64K	None	1	Dealers, VARs
256K x 9 1Mb x 9	SIMM	80	RAS/CAS	○	8	16	Proprietary	Direct-mapped write-back	25	64K	256K	2	Dealers, VARs
256K x 4 256K x 1 ⁸	DIP	70 ¹²	Page-mode	●	8	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct
256K x 9 1Mb x 9	SIMM	80	RAS/CAS	●	16	16	Intel 82385	Two-way set-associative posted-write	35	32K	None	2	Dealers, VARs

⁷Base price includes 2 MB of RAM.

⁸Motherboard will support 4-megabit chips when available.

⁹Memory board required, not included (\$99).

¹⁰Optional daughtercard supports both Intel 80387 and Weitek 3167 coprocessors.

¹¹Can be configured as two-way set-associative with additional static RAM.

¹²80-ns chips are standard.

tinct set of memory locations to each cache *line* (a line is 4 bytes long for these boards). The main memory locations mapped to each cache slot are grouped by the least significant part of their addresses; the effect is that each cache location can contain data only from each *n*th memory address, where *n* is the length of the cache in lines. Each memory location, therefore, has only one corresponding cache slot; the processor need only

check one location to determine if a hit or a miss has occurred. This fast hit/miss determination is the strength of the direct-mapped method. Unfortunately, because each memory location must share a cache slot with several other main memory addresses, it's possible that some useful data will get bumped out, forcing the CPU to access main memory.

Two-way set-associative cache designs reduce the likelihood of this prob-

lem by having two slots available for each memory location. A cache of this kind is like two direct-mapped caches in parallel. This system has two disadvantages: First, each set is only half the size of an equivalent direct-mapped cache; and second, the processor must look in two places to determine whether a hit or a miss has occurred.

Memory-write methods also affect

continued

386 MOTHERBOARDS

NON-CACHING 25-MHz 386 MOTHERBOARDS

Table 2: Features of noncaching 25-MHz 386 motherboards. As with table 1, boards are often differentiated by nonperformance features (● = yes; ○ = no).

Motherboard	Manufacturer	List price	Board size (inches)	CPU speeds (MHz)	System bus speed (MHz)	Expansion slots	Math coprocessors ¹	ROM BIOS (date)	BIOS Shadow RAM	Video Shadow RAM	386 chip set
C ² MBI386A+	C ² Micro Systems	\$765	12 × 13¾	16, 25	8.3, 10.3	1 8-bit, 6 16-bit, 1 32-bit	80387-25, 1167-25 with 80287-8 socket ³	AMI EC&T 1164 (3-03-89)	●	●	C&T
C ² Baby 386 Mainboard	C ² Micro Systems	\$775	8½ × 12¾	20, 25	8.3, 6.7	3 8-bit, 4 16-bit, 1 16-/32-bit	80387-20	AMI EC&T 1030 (3-03-89)	●	●	C&T
JCS 386i	JC Information Systems	\$850	8½ × 13	8, 25	8	2 8-bit, 5 16-bit, 1 16-/32-bit	80387-25, 1167-25	Phoenix 1.10.02B (1-15-88)	●	●	C&T
JDR M386-25	Modular Circuit Technology	\$799	8½ × 13	16, 25	8	2 8-bit, 5 16-bit, 1 32-bit	80387-25	AMI EC&T 1131 (3-03-89)	●	●	C&T
JDR 386-MB-25S	Modular Circuit Technology	\$799	12 × 13¾	16, 25	8.3, 12	3 8-bit, 5 16-bit	80287-8, 80387-25, 3167-25	AMI EC&T 1102 (3-03-89)	●	●	C&T
Pioneer VMB-386/25	Pioneer Computer	\$789	8¾ × 12	8, 25	8	2 8-bit, 5 16-bit	80387-25, 3167-25	AMI 6802 (9-15-89)	●	●	C&T
Seattle STD 386XT	Seattle Telecomm and Data	\$2095 ⁴	8½ × 12	8, 25	8	3 8-bit, 4 16-bit, 1 8-/32-bit	80387-25 ⁵	Quadtel CS2386 3.04.01 (9-20-89)	●	●	C&T

¹All motherboards support only one math coprocessor at a time unless footnoted.
²Tested type listed first.
³Motherboard will support 4-megabit chips when available.

⁴Base price includes 1 MB of RAM.
⁵80387 and 386 in daughtercard plugged into 386 socket. 80287 socket is an option.

cache performance. A cache can follow a simple write-through policy, in which each write operation is carried out to both cache and main memory. A more sophisticated approach, *posted write-through*, frees the main processor after the cache write; the main memory write is carried out independently by the cache controller. Write-back, the most complex scheme, updates main memory only when a modified entry is dumped from the cache.

Cache size is the last critical factor. Large caches mean better performance, but there is a very steep diminishing-returns curve after a certain size. That critical size differs for each application, but several manufacturers statistically estimate a 95 percent cache hit rate for 32K-byte caches.

Six of the boards that we tested used Intel's 82385 cache controller. Although the 82385 can be configured for either direct-mapped or two-way set-associative operation, only the Micronics board ran the unit in direct-mapped mode. Micronics lets you set the cache organization as an option, but you must double the standard static RAM to 64K bytes to use a two-way set-associative cache.

JC Information Systems' JCS 386c, the Monolithic MicroFrame, and the Cache 386-25 used Chips & Technologies' 82C307 cache/memory controller

instead. The 82C307 also allows two-way set-associative cache control of up to 32K bytes.

The other boards went with proprietary cache designs, all of which were direct-mapped. Intel, ironically, passed over its 82385 in favor of a proprietary cache controller design for the Model 302. DTK's board lets you install a cache of up to 256K bytes, and it and the Nascent are the only models to implement a write-back cache.

Our benchmarks show some correlation between cache type and effectiveness, but the presence or absence of a cache is still a much stronger indicator of performance. DOS tests, which are relatively small programs, reacted more favorably to the smaller, two-way set-associative caches than to the large direct-mapped designs. The top six finishers on our DOS benchmarks (the top six in table 3) all used this design.

Jameco's JE3525 and the Mylex MWS 386-25 performed significantly poorer in the DOS benchmarks than other cached boards. The aberration is surprising, considering that their basic memory configuration is similar to that of boards that outperformed them. These two suffered the most on low-level string move operations, but they handled algorithms like the Sieve of Eratosthenes almost as well as other cached boards.

The Dhrystone test showed more of an affinity for cache size than for cache type. DTK's 256K-byte board finished on top, and the two next highest performers had 64K-byte caches. These three also shared a write-back cache.

Under Unix, large, direct-mapped caches seemed to fare better than they did under DOS. All the cached boards clustered very tightly on these tests, however, and the difference in scores between the best and the worst cached boards is far less than the gap between the slowest caching unit (the Mylex MWS 386-25) and the best noncached board (the JDR 386-MB-25S).

The Interleave Alternative

Noncached boards are an attractive alternative to the pricier cached models, if top performance isn't your driving requirement. The least expensive of these boards can be had for \$765, and, of course, any of these boards will still run rings around an AT.

The seven noncached boards that we tested all make use of memory-bank interleaving to strengthen memory performance. Several of the cached boards also use interleaving to back the cache.

One of the critical delays in accessing DRAM is recharge time, which must occur between successive accesses to the same chip. The interleave solution puts

Geometry	Package	Speed (ns)	Memory			Maximum on-board RAM (MB)	Maximum 32-bit RAM (MB)	Warranty (years)	Source
			RAM types ²	Interleave					
256K x 4 256K x 1 1 Mb x 1	DIP	80	RAS/CAS, page-mode, static-column	●	10	16	1	Direct, VARs	
256K x 9 1 Mb x 9	SIP	80	RAS/CAS, page-mode	●	8	16	1	Direct, VARs	
256K x 4 1 Mb x 4 256K x 9 1 Mb x 9	DIP SIMM	80	Page-mode	●	8	16	1	Direct, dealers, VARs	
256K x 9 1 Mb x 9	SIP	80	RAS/CAS	●	8	16	1	Direct	
256K x 9 1 Mb x 9 1 Mb x 1	SIP DIP	80	RAS/CAS	●	16	16	1	Direct	
256K x 9 1 Mb x 9	SIMM	60	Page-mode	●	8	8	2	Dealers, VARs	
256K x 9 1 Mb x 9	SIP	60	Page-mode	●	8	16	1	Direct	

one-half of the addresses (even) in one bank and the other half (odd) in another; if reads or writes occur sequentially, one bank can be recharging while the other is being accessed. Unfortunately, boards that use this scheme require that you fill the memory banks in pairs. On many boards, this means that you must have either 2 or 8 MB of memory to get reasonable performance. In some preliminary tests, we found that the difference between interleaved and noninterleaved performance was 15 percent to 20 percent.

Pioneer's VMB 386/25, Seattle Telecomm's STD 386XT, and the JCS 386i use *page-mode* DRAMs for added speed. Normal (row address strobe/column address strobe, or RAS/CAS) DRAM chips require that both row and column select lines be strobed for each access. *Page-mode* DRAMs can skip the RAS pre-charge time when making successive reads or writes to memory locations with the same row address (i.e., in the same "page"). Pages are 2K bytes in size for 256K-byte DRAMs; this gives you a 2K-byte range of consecutive addresses that can be accessed much more quickly than with normal DRAMs. Boards that interleave *page-mode* DRAMs interleave not addresses but entire pages, for a much higher probability of fast access.

Some of the cached boards also use, or can also accept, *page-mode* DRAMs.

C²'s MBI386A+ board and several cached models will also accept *static-column* RAM, which is like *page-mode* memory but doesn't require a column address strobe between successive reads. Intel claims a 7 percent improvement for *static-column* over *page-mode* DRAM and a 7 percent performance difference between *page-mode* and normal DRAM.

Our benchmarks show little correlation between use of *page-mode* DRAMs and superior performance. The seven noncaching boards, *page-mode* or not, performed very much alike under Unix. Under DOS, five of the motherboards were nearly identical, while the (*page-mode*) STD 386XT and (standard) C² MBI386A+ boards were disappointingly slow.

Beyond the CPU

Fast memory architecture could not make as much of a contribution to our floating-point and video benchmarks. As a result, the cached/noncached distinction is not nearly as severe.

DOS FPU benchmarks showed a smooth transition between cached and noncached units, with cached models still somewhat faster. The two results that stand apart are negative: Atronic's ATI-386/B was surprisingly weak for a cached board, and the noncaching C² Baby 386 Mainboard, which could run

its 80387 at only 20 MHz, finished dismally far behind the rest of the pack. Unix Float benchmark results confirmed the DOS numbers.

The Livermore Loops test, which doesn't concentrate on pure 80387 instructions quite as much as our FPU benchmark does, showed a similar but slightly broader spread. Again, C²'s Baby 386 Mainboard lagged.

Our final test was BYTE's video suite. Originally, we intended it to be a measure of bus throughput, but instead it pointed out the effectiveness of video BIOS shadowing.

The graphics portions of our test ran similarly on all the boards. Since all buses were configured at or near 8 MHz, there was little room for variation.

But our text tests, which rely heavily on the BIOS, showed drastic differences from board to board. The benchmark uses cursor-positioning BIOS calls to move the cursor around the screen; on this test, the difference between shadowed and not-shadowed performance was on the order of 2 or 3 to 1.

Installation Basics

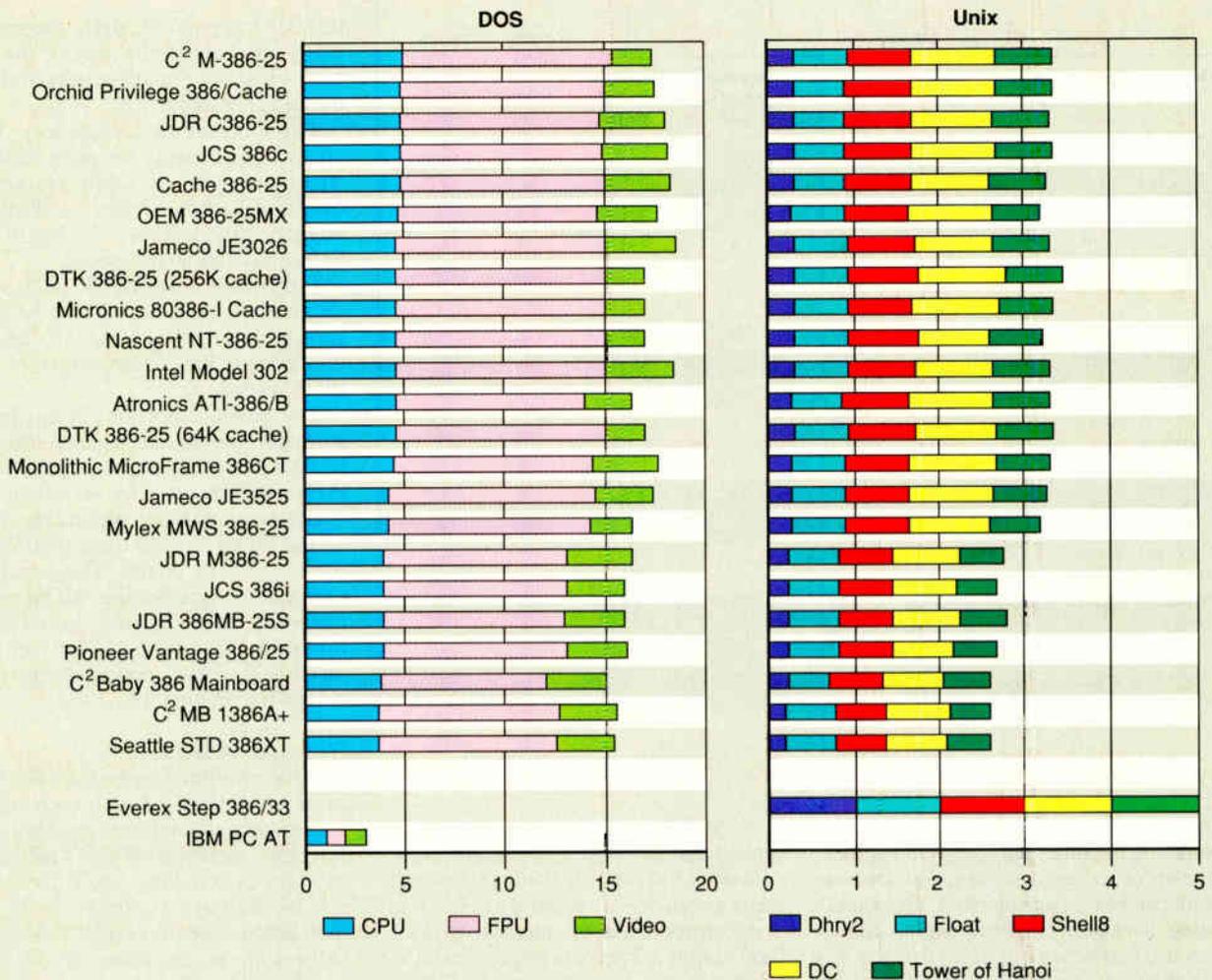
All the motherboards that we tested came preconfigured with each vendor's recommended memory configuration. But since most boards don't include any memory as standard, you'll face a variety of memory options. A 25-MHz motherboard requires fast RAM, typically with access times of 60 to 100 nanoseconds. Your best bet is to stick with the vendor's recommendations here. You can use slower, less expensive RAM chips, but that adds CPU wait states, which defeats the purpose of buying a fast computer. If you're upgrading to a board that will accept dual-in-line package (DIP) DRAMs, don't give in to the temptation to reuse 150-ns RAM from that old AT—the cost savings isn't worth the performance penalty that you will pay.

A few motherboards, such as C²'s M-386-25 and the JCS 386c, require *page-mode* DRAMs. Other motherboards accept standard RAS/CAS or *page-mode* DRAMs, but the slight increase in performance that you'll get by buying *page-mode* DRAMs probably isn't worth the extra cost. Several vendors also support even faster—and more expensive—*static-column* DRAMs as an option.

Most of the motherboards that we tested support 16 MB of 32-bit memory through a combination of on-board RAM and 32-bit memory boards. That is no coincidence. Most manufacturers used

continued

DOS AND UNIX BENCHMARK RESULTS



Note: Indexes show performance relative to baseline machines at the bottom of the graph. For the DOS benchmarks, the baseline machine is an 8-MHz IBM PC AT; for Unix, the baseline machine is an Everex Step 386/33 running Xenix 2.3. Cumulative system performance is indicated by the length of the stacked bar.

DOS and Unix benchmark performance for each motherboard, shown here ranked by DOS CPU index. While Unix test results showed less difference than DOS tests, both clearly indicate the value of cached memory.

Chips & Technologies' 386/AT chip set, which can address up to 16 MB of 32-bit RAM. While Chips & Technologies' 82C307 cache/memory controller can address up to 64 MB of RAM, none of the motherboards that used it supported that much memory. The Cache 386-25 accepted 16 MB, while the Monolithic MicroFrame and JCS 386c supported 24 MB and 32 MB, respectively. Intel's Model 302 had the largest memory capacity. It used two 32-bit expansion slots to support up to 40 MB of RAM. Pioneer's VMB-386/25 motherboard, on the other hand, didn't have any 32-bit expansion slots and supported only the 8 MB that will fit on-board. Other boards that put all the system memory on the

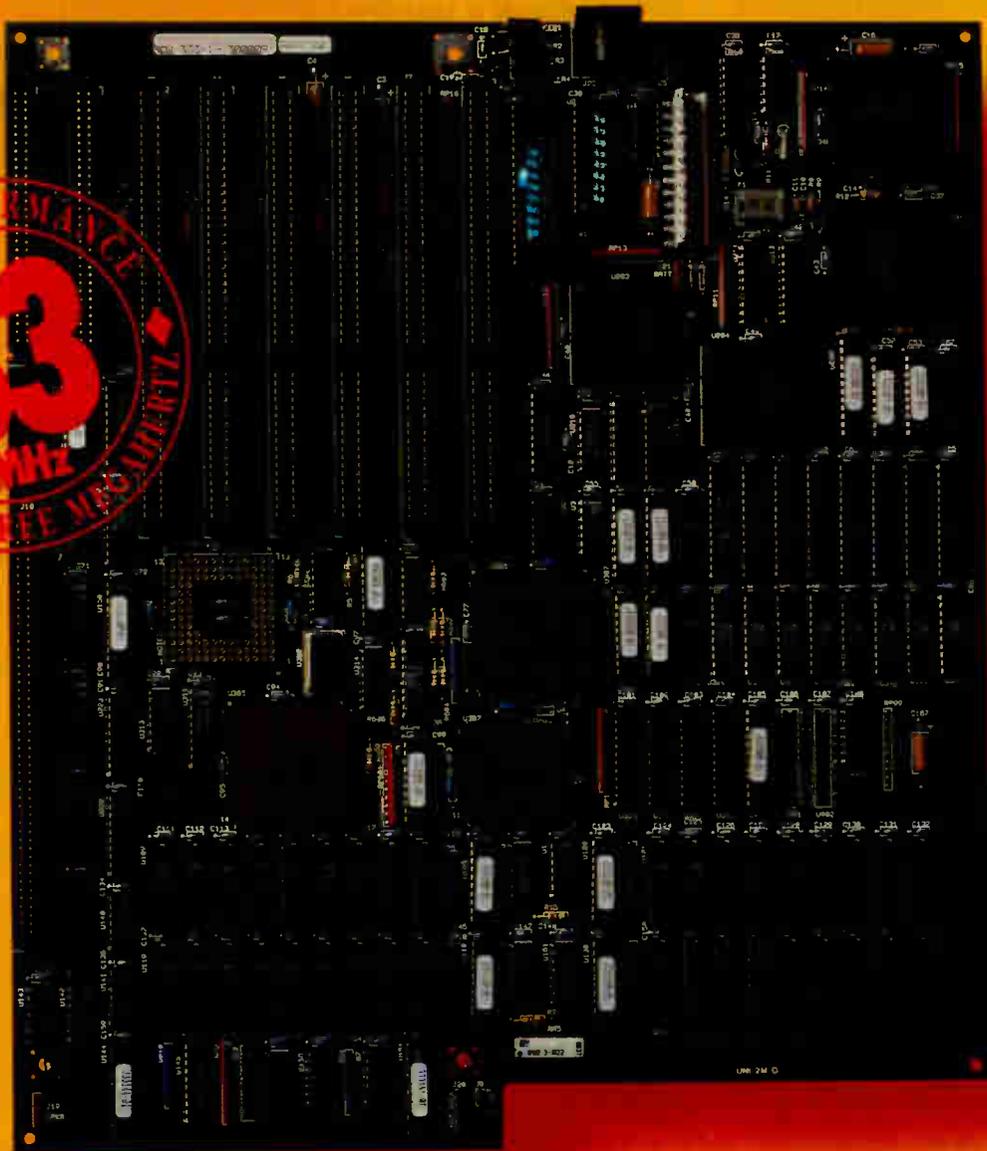
motherboard—the Orchid Privilege 386/Cache and the Cache 386-25—accommodated 16 MB of on-board RAM. The most common memory ceiling on the boards that we tested was 8 MB of on-board RAM and 8 MB on a 32-bit add-in card. But some manufacturers put all system memory on add-in cards and used 256K-byte or 1-MB single in-line memory modules (SIMMs) or single in-line package (SIP) modules to save space. Jameco and JC Information Systems included an empty memory card with their base systems. Micronics' base model also had a memory card, but if you need more than 8 MB, you have to buy a piggyback card (which comes with 4 MB of RAM) for \$795. JDR Microdevices

charges an additional \$99 for its memory board with no RAM.

Unfortunately, when it comes to 32-bit memory cards, there is no standard; you can't use one company's 32-bit memory card in another motherboard's 32-bit memory slot. With the rapid advances in motherboard technology and the high turnover in new versions of motherboards, you should consider getting a 32-bit memory card when you purchase your motherboard. Delaying the purchase may make getting an expansion card difficult or impossible.

Most boards accepted some combination of DIPs and either SIMMs or SIPs. Both of C²'s full-size entries, JDR's

continued



IT Hz SO GOOD!

INTRODUCING HAUPPAUGE'S 33MHz SYSTEM BOARDS.

If your computer feels slow, we know where it hertz. For a fast cure, get our new 386 MotherBoard/33MHz. We've built in 4 Megabytes of high speed RAM, 64K of RAM cache, and both 387 Weitek math coprocessor sockets. This board makes your 386 computer the fastest PC available!

Network Savvy. With the 386 MotherBoard/33MHz, you can build a file server or workstation that makes Novell networks *scream*. Enjoy compatibility with Token Ring, Arcnet, Ethernet, and other network cards.

The UNIX Engine. Great for VARS, Systems Integrators and UNIX OEMs, the Hauppauge 386 MotherBoard/33MHz runs SCO Xenix, Interactive 386/ix and AT&T's UNIX System V. With its PC/AT compatible I/O system, our 33MHz board accommodates the latest in disk control, graphics, and network I/O cards.

CAD Capability. Do your AutoCAD and other CAD programs seem slow? The 386 MotherBoard/33MHz boosts your math and graphics applications, and supports the high speed 387-33 and 33MHz Weitek math coprocessors.

Technical Features.

- The 386 MotherBoard/33MHz includes:
- 4 Megabytes of high speed 32-bit memory, expandable to 64 Megabytes
 - 64K of 20 nsec cache memory
 - Six 16-bit expansion slots, one 8-bit and one 8-bit/32-bit slot
 - PC/AT compatible I/O system for support of OS/2 and UNIX.

Yes, send me your product information!

Name _____

Company _____

Address _____

City, State, Country _____

Telephone _____ Zip Code _____

Mail Coupon to:

Hauppauge Computer Works, Inc.
175 Commerce Drive
Hauppauge, New York 11788, U.S.A.
Tel: 01-516-434-1600
Fax: 01-516-434-3198

or: Hauppauge Computer Works, GmbH
Hansaallee 201
4000 Dusseldorf 11, West Germany
Tel: 0211-594320
Fax: 0211-593908

For more information call Hauppauge,
(516) 434-1600. In Europe: (49) 211-594320.

Hauppauge!
Hauppauge Computer Works
Your high performance 386 Supplier

Circle 132 on Reader Service Card

BENCHMARK RESULTS

Table 3: BYTE benchmark results. Conventional benchmarks and indexes provide a quick summary of performance, while the raw numbers for our CPU benchmarks give a clearer picture of where differences lie. For example, low-level operations like byte-wide moves show considerably greater difference from board to board than high-level algorithms like the Sieve of Eratosthenes.

Motherboard	BYTE CPU benchmarks						Indexes			Conventional			
	Matrix	String moves				Sieve	Sort	CPU	FPU	Video	Dhrystones (Dhry./sec.)	Livermore Loops (MFLOPS)	
		Byte-wide	Word-wide		Doubleword-wide								
			Odd	Even	Odd								Even
C ² M-386-25	2.70	16.77	22.46	8.40	16.48	4.20	14.22	10.71	4.94	10.46	1.97	8130	0.2135
JDR C386-25	2.69	17.08	22.98	8.55	16.59	4.28	14.23	10.71	4.89	9.88	3.26	7987	0.2037
Orchid Privilege 386/Cache	2.71	17.10	22.92	8.57	16.58	4.29	14.23	10.72	4.89	10.18	2.43	7987	0.2101
JCS 386c	2.71	16.72	22.90	8.37	16.64	4.17	14.72	10.98	4.88	10.03	3.31	7987	0.2082
Cache 386-25	2.72	16.70	22.92	8.35	16.69	4.18	14.68	11.02	4.88	10.12	3.34	7987	0.2084
OEM 386-25MX	2.80	18.27	24.62	9.13	18.03	4.56	14.35	10.78	4.69	10.01	2.89	7788	0.2083
Jameco JE3026	2.67	20.23	23.16	10.13	17.19	5.08	14.03	10.63	4.64	10.44	3.45	8064	0.2157
DTK Cache 386-25 (256K-byte cache)	2.62	21.18	22.90	10.57	17.60	5.31	14.28	10.71	4.58	10.50	1.94	8431	0.2158
Nascent NT-386-25	2.61	21.42	22.81	10.71	17.41	5.38	14.28	10.63	4.57	10.46	1.96	8347	0.2158
Micronics 80386-I	2.71	20.95	23.69	10.47	16.53	5.22	13.93	10.62	4.57	10.47	2.00	8051	0.2165
Intel Model 302	2.69	21.50	23.59	10.73	18.02	5.38	14.04	10.66	4.53	10.47	3.41	8130	0.2150
Atronics ATI-386/B	2.77	20.71	22.70	10.38	17.59	5.18	14.74	11.02	4.53	9.51	2.27	7776	0.1974
DTK Cache 386-25 (64K-byte cache)	2.66	21.86	23.29	10.89	17.80	5.44	14.30	10.67	4.51	10.58	1.93	8264	0.2155
Monolithic MicroFrame 386CT	2.75	21.03	24.11	10.51	16.79	5.27	14.77	11.04	4.46	9.87	3.29	7911	0.2076
Jameco JE3525	2.75	26.47	23.73	13.23	17.25	6.63	14.28	10.78	4.19	10.30	2.93	7587	0.2144
Mylex MWS 386-25	2.79	24.88	24.80	12.47	18.59	6.20	14.94	11.37	4.16	10.07	2.07	7407	0.2035
JDR M386-25	3.62	23.66	22.67	11.83	16.73	5.95	16.26	14.81	3.88	9.25	3.17	6459	0.1920
JCS 386i	3.59	23.76	22.85	11.88	16.83	5.95	16.29	14.83	3.87	9.20	2.84	6410	0.1918
JDR 386-MB-25S	3.63	23.76	22.85	11.92	16.82	5.95	16.29	14.83	3.86	9.12	2.94	6410	0.1918
Pioneer VMB-386/25	3.66	23.75	22.85	11.90	16.83	5.95	16.29	14.83	3.86	9.17	3.04	6410	0.1919
C ² Baby 386 Mainboard	3.70	23.74	23.68	11.92	16.80	5.99	16.35	15.00	3.82	8.26	2.93	6321	0.1695
C ² MBI386A+	3.82	24.81	23.25	12.41	17.01	6.21	16.63	15.93	3.71	8.98	2.92	6150	0.1884
Seattle STD 386XT	3.90	24.82	24.08	12.43	16.97	6.22	16.73	16.09	3.67	8.93	2.89	5767	0.1886
IBM PC AT	11.69	80.41	80.41	40.26	N/A	N/A	73.65	84.39	1.00	1.00	1.00	1721	0.0237

All CPU benchmark times are in seconds. For indexes, Dhrystones, and Livermore Loops, higher numbers indicate better performance. N/A = Not applicable.

cached model, and the OEM and Micronics boards accepted only DIPs. Convertible DIP sockets allow some boards, like those from DTK and OEM, to accept either 256K by 4-bit or 256K by 1-bit DRAMs. Except for the OEM 386-25MX, all the boards that we tested could be configured for either 256K or 1-megabit memory devices. Jameco and OEM claim that their boards will support 4-Mb DRAMs when they become available.

SIMMs and SIPs are only slightly more expensive than DIPs and are more convenient to install. But if one chip fails, you must replace the entire SIMM or SIP module rather than one chip. The main attraction of modular memory is for board designers, who exploit their space-saving design to squeeze 8 MB or more of RAM onto an XT-size board.

Adding memory was sometimes problematic. SIP modules on the C² Baby 386 Mainboard were located behind expansion slots and could cause problems if

you installed full-length add-in cards. On Jameco's JE3525, SIP modules protruded horizontally from the memory card, blocking the adjacent 16-bit slot (to Jameco's credit, the company doesn't count the blocked slot in its advertisements). Nascent requires that you obtain a new set of programmable array logic chips (PALs) when you're upgrading from 256K parts to 1-Mb parts. (There's a \$25 charge for the upgrade, and you have to return the old PALs.) And, most critically, one bank of SIPs on JDR's 386-MB-25S motherboard wouldn't fit under the metal drive bay in our generic AT-size case, effectively limiting the motherboard to 4 MB of on-board RAM.

Getting Compatible

All the motherboards that we tested let you insert wait states to lower the effective speed of the CPU. This may be necessary if you're using older software that doesn't work at 25-MHz CPU speeds. Surprisingly, not all offer the de facto

compatibility speed of 8 MHz. Several boards ran at alternate speeds of 10 or 16 MHz; C²'s Baby 386 Mainboard runs at 20 or 25 MHz.

Bus speed was more consistent. All but one of the motherboards ran at or close to 8 MHz, and about half of the motherboards could also run at 10 or 12.5 MHz to support higher-speed add-in cards such as caching hard disk drive controller cards or Ethernet LAN cards. DTK's PEM 2500 Cache 386-25 motherboard didn't offer an 8-MHz bus speed: it ran at 6 or 12 MHz. Unfortunately, if your add-in cards won't run faster than 8 MHz, you will have to run them at 6 MHz—25 percent slower than normal.

System Logic

Some vendors used discrete chips to implement the 386 system logic, and one vendor—Atronics—had its own VLSI chip set. But the majority opted for Chips & Technologies' 386/AT chip set.

continued

A 486 With Zero Wait.

If you've been waiting for the right 486 system to come along, wait no more.

Configured with either the Industry Standard (ISA) bus or the Extended Industry Standard (EISA), CSS Laboratories MaxSys™ systems are the right choice in multi-user file servers.

Compare our features with anybody else's.

- 12 slot motherboard for maximum expandability, longer return on investment
- Systems with 5 or 10 half-height drive bays — enough for the most storage-intensive applications
- 400-watt power supply and two cooling fans for reliable performance under the heaviest workloads
- Proven to run Novell® Netware™, SCO Xenix™, IBC Dux™, IBM® OS/2®*, Microsoft® OS/2™, Quarterdeck™ TFS™
- Exclusive CSS Silent Memory Bus™ trade grounded for maximum reliability
- Up to 64 MB RAM*
- On-board support for the Intel® 486 math co-processor
- Zero-wait state cache memory access — plus a special 32-bit Burst Mode memory transfer that outperforms zero-wait state in sequential applications
- 25 or 33 MHz available**

With features like these available today, why wait? Call a CSS representative today for more information on the MaxSys line as well as our other product families, including network B&W and color laser printers, desktop workstations, and more.

CSS
LABORATORIES, INC.
A Solid Investment.

In the U.S.A. (714) 852-8161
In Canada (416) 882-0260

*64 MB with EISA, 16 MB with ISA.
**33 MHz availability based on Intel chip release.

In the U.S.A.: Intel, McGraw-Hill, Hewlett-Packard, CA 95714, TEL: (714) 852-8161, FAX: (714) 852-8166. In Canada: 60 Main St., Suite 1, Richmond Hill, Ontario L4B 3H8, TEL: (416) 882-0260, FAX: (416) 882-0461. AT is a registered trademark of International Business Machines. Silent Memory Bus, MaxSys and the CSS logo are registered trademarks or trademarks of CSS Laboratories, Inc. All other names or product names are trademarks or registered trademarks of their respective companies. © 1990 CSS Laboratories, Inc.

Circle 78 on Reader Service Card
(DEALERS: 78)

COMPANY INFORMATION

Atronic International
(ATI-386/B)
1830 McCandless Dr.
Milpitas, CA 95035
(408) 942-3344
Inquiry 1074.

C² Micro Systems
(M-386-25, MBI386A+,
Baby 386 Mainboard)
1205 Fulton Place
Fremont, CA 94539
(415) 683-8888
Inquiry 1075.

Cache Computers, Inc.
(386-25)
46714 Fremont Blvd.
Fremont, CA 94538
(415) 226-9922
Inquiry 1076.

DTK Computer, Inc.
(PEM 2500 Cache 386-25)
15711 East Valley Blvd.
City of Industry, CA 91744
(818) 333-5429
Inquiry 1077.

Intel Corp.
(Model 302)
3065 Bowers Ave.
Santa Clara, CA 95052
(800) 538-3373
Inquiry 1078.

Jameco Electronics
(JE3525, JE3026)
1355 Shoreway Rd.
Belmont, CA 94002
(415) 595-2664
Inquiry 1079.

**JC Information
Systems Corp.**
(JCS 386c, JCS 386i)
161 Whitney Place
Fremont, CA 94539
(415) 659-8440
Inquiry 1080.

JDR Microdevices
(C386-25, M386-25,
386-MB-25S)
2233 Branham Lane
San Jose, CA 95124
(408) 559-1200
Inquiry 1081.

Micronics Computers, Inc.
(80386-I Cache)
935 Benecia Ave.
Sunnyvale, CA 94086
(800) 234-4386
(408) 732-0940
Inquiry 1082.

Monolithic Systems Corp.
(MicroFrame 386CT)
7050 South Tucson Way
Englewood, CO 80112
(303) 790-7400
Inquiry 1083.

Mylex
(MWS 386-25)
47650 Westinghouse Dr.
Fremont, CA 94539
(415) 683-4600
Inquiry 1084.

Nascent Technology, Inc.
(NT-386-25)
1630 Oakland Rd., Suite A112
San Jose, CA 95131
(408) 441-7500
Inquiry 1085.

OEM, Ltd.
(386-25MX)
75 Kingsland Ave.
Clifton, NJ 07014
(201) 614-7030
Inquiry 1086.

Orchid Technology
(Privilege 386/Cache)
45365 Northport Loop W
Fremont, CA 94538
(415) 623-0300
Inquiry 1087.

Pioneer Computer, Inc.
(VMB-386/25)
49066 Milmont Dr.
Fremont, CA 94538
(415) 623-0808
Inquiry 1088.

**Seattle Telecomm
and Data, Inc.**
(STD 386XT)
2735 152nd Ave. NE
Redmond, WA 98052
(206) 883-8440
Inquiry 1089.

Implemented in seven VLSI chips, the CS8230 chip set lets manufacturers build smaller 386 motherboards with as few as 40 additional chips (excluding memory). By contrast, the Intel Model 302 motherboard, which uses LSI parts for most of its system and cache controller logic, has well over 150 ICs. Chips & Technologies' CS8230 chip sets support page-mode, interleaved memory. Three vendors, JC Information, Cache, and Monolithic, used Chips & Technologies' CS8231 set, which includes the 82C307 cache/memory controller and does not support interleaved memory. Both sets allow shadowing of BIOS ROMs to main memory to speed performance.

AMI's 386 BIOS, installed on 13 motherboards, was the most popular choice among board manufacturers. AMI's BIOS displays the system configuration on boot-up and offers built-in diagnostics and setup screens. Other BIOSes offered most setup options in ROM, but a few required going to a floppy disk for certain tasks, such as setting the CPU speed or running diagnostics. This was particularly true for boards that used older BIOS ROM versions. Some BIOSes also support shadowing of video ROM, which boosts performance for

graphics-intensive applications. If you have a preference, most vendors will substitute another BIOS at no extra charge.

Except for C²'s Baby 386 Mainboard, every board supported Intel's 80387. But one board—Seattle's STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn't much of an issue.

Most motherboards also supported the 25-MHz Weitek 3167 or 1167 FPU. A few specifically claim to support the Integrated Information Technology IIT-3C87 and Cyrix CX83D87 math coprocessors. But these should work in any FPU socket that supports Intel's 80387. Some motherboards, including the STD 386XT and JDR's 386-MB-25S, have a separate socket that accepts an 8-MHz 80287. C²'s M-386-25 supports the 80387 and a Weitek chip at the same time. Several other motherboards, including the Mylex and Jameco's JE3026, offer an optional daughtercard that offers the same feature. If you need to crunch

numbers with software written for both coprocessors, you may want to look into this option.

Expanding Your Horizons

Whether XT or AT size, all motherboards offered either seven or eight expansion slots. The type and usability of the slots, however, varied. Most motherboards had one or two 8-bit slots, four or five 16-bit slots, and one 32-bit slot that also accepted an 8- or 16-bit card. The Cache 386-25 had seven 16-bit slots—the most on any board.

Several products, including two of the JDR Microdevices boards and the Seattle STD 386XT board, had three 8-bit slots. None of the motherboards exhibited any bus compatibility problems during our tests. But some slots weren't optimally designed. For example, ROMs positioned just behind the two 8-bit slots in JDR Microdevices' C386-25 prevented them from accepting some 8-bit cards or some video boards designed to fit in either 8- or 16-bit slots.

Fit and Finish

All the motherboards appear to be designed well. A few have one or two wire

continued

You don't have to be a rocket scientist to program in BASIC.



Granted, with Microsoft's BASIC Professional Development System, rocket scientists can work wonders every day of the week.

But if you want to work better in this stratosphere, Microsoft® QuickBASIC is all you need.

Instead of an I.Q. test, you get a step-by-step printed tutorial that guides you through a complete working program. And our handy on-line electronic manual lets you put your finger on anything you want to know instantly, or copy and paste sample code into your program window.

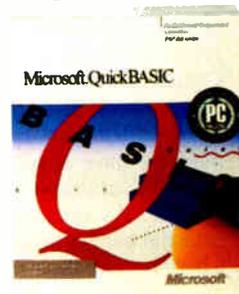
Meanwhile, our on-line training and Easy Menus make you feel at home in your new environment in minutes — not hours. And to simplify things even more, our intuitive interface offers context-sensitive help. Plus a debugger that gets your program up and running in record time.

Naturally, this BASIC also turns out code at record speed — 150,000 lines per minute.

Not surprisingly, *PC Magazine* called it "... perhaps one of the greatest software programs ever written" and gave it their Editor's Choice Award.

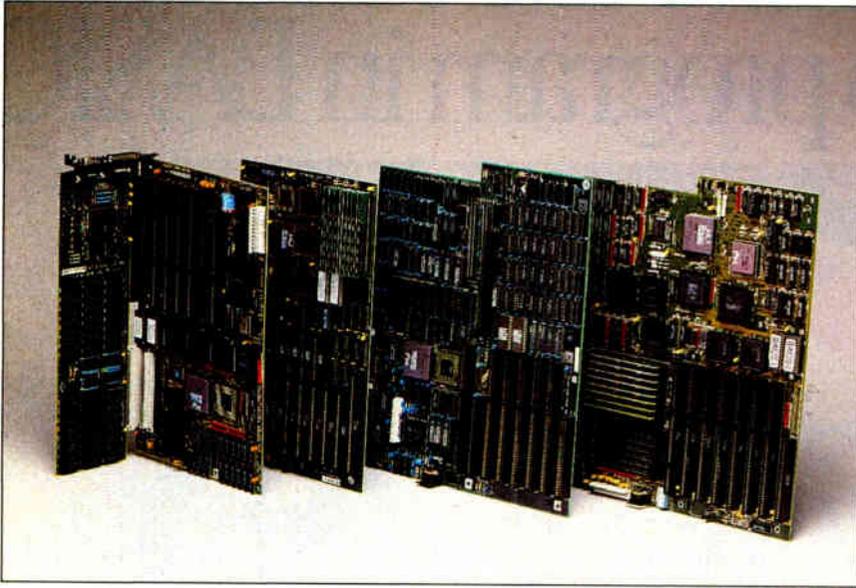
All of which only goes to prove one thing: you don't have to be a rocket scientist to conquer new frontiers.

Just smart enough to get a hold of our Microsoft QuickBASIC.



Microsoft
Making it all make sense™

Customers within the 50 United States, call (800) 426-9400. Customers in Canada, call (416) 673-7638. Outside the U.S. and Canada, call (206) 882-8661. © 1990 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and Making it all make sense is a trademark of Microsoft Corporation.



Top performers: JC Information Systems' JCS 386c, JDR Microdevices' M386-25, DTK Computer's PEM 2500 Cache 386-25, and Cache Computers' 386-25.

traces. All are logically laid out and are relatively easy to set up and configure. One vendor, Monolithic, mounts its SIP modules between expansion slots on the motherboard, which makes them tough to install or remove—but once they're in, they work just fine. The SIP problem on JDR's 386-MB-25S, on the other hand, is a limitation that we could live without.

The Seattle STD 386XT's FPU setup is also a little awkward. It runs without any problems, but the daughtercard just clears the drive bay housing in our AT case and is an uncomfortably close fit.

Other details are relatively minor. All the boards except the Seattle STD 386XT and C²'s MBI386A+ and M-386-25 offer a connector for a turbo-mode LED, and all the boards have connectors for keyboard lock and hard reset switches and for an external speaker. Many motherboards have a soldered battery for CMOS memory but also include a connector for an external battery as a backup. Two boards—the Atronics and DTK models—have a soldered battery only, but DTK claims a 10-year life for the module. As often as not, vendors with external battery connectors don't include a battery with their motherboard.

Other Considerations

If you're planning to install one of these motherboards yourself, don't count on learning the finer points of assembly from the manuals. Most of the documentation that we received was disappointing. The text often consists of loose, photocopied pages that you are expected to

insert into your own three-ring binder. OEM and JDR sent documentation that was written for previous versions of their motherboards. In one case, the motherboard described didn't look anything like the motherboard we received. Other vendors don't document jumper settings or other specifications. Most of the manuals seem unable to keep up with the rapid design changes that are made to these boards.

On the whole, bigger-name manufacturers provide better documentation: Mylex and AMI (via Jameco) provide readable, informative manuals, and Micronics' bound book is especially good. The standout was Intel's Model 302 manual. This 228-page paperback was professionally printed and exhaustive in detail. It included a full description of all specifications, a glossary, an index, and plenty of illustrations. Not even this excellent document, however, is immune to being a few revisions out of step with the product.

If you have trouble with a motherboard and can't find the answers in the manuals, the vendor may have a help line. Some companies, such as JDR Microdevices and Jameco, offer technical assistance over the phone. Others, including Intel and Mylex, refer you to a local dealer or VAR. None of the manufacturers has a toll-free help line.

Most vendors guarantee their motherboards against defects for one year. Unlike the case with fully assembled PC clones, on-site service is not an option. The user must pay shipping costs to the

manufacturer. Orchid, Pioneer, and Nascant all offer a two-year warranty, but Monolithic's five-year warranty is the longest offered by far. One vendor, Atronics, will let you extend its warranty from one to two years as an option. As with most nonmechanical devices, failures tend to come early in the product's life, so a one-year warranty is probably sufficient.

First Choice

It's hard to pick one winner from this group. Several boards came out on top in our DOS tests. The Unix benchmark results were consistent with the DOS benchmark results, but the numbers were much closer. The one exception was DTK's PEM 2500 Cache 386-25 with a 256K-byte cache. Moving from 64K bytes to 256K bytes of cache memory didn't make much difference under DOS, but it produced a marked improvement under Unix. Unfortunately, the extra static RAM also makes the board one of the most expensive that we tested.

Of the five best-performing motherboards on our DOS benchmark tests (see the photo at left), the JCS 386c and Cache 386-25 offered the most bang for the buck. The Cache, a full-size board, was our favorite overall. It was about as fast as the C² M-386-25 and JCS 386c on the CPU test, but it did much better than either on the video tests and had seven 16-bit slots instead of the usual five or six. If you're looking for an XT-size board, the JCS 386c is just \$1100 and accepts up to 32 MB of 32-bit memory. The Orchid Privilege 386/Cache and JDR C386-25, the two other top performers, were slightly more expensive.

If \$1100 sounds like more than you're willing to spend, consider one of the noncaching boards. JDR Microdevices' XT-size M386-25, the fastest noncaching motherboard that we tested, is \$799. The Pioneer VMB-386/25 was on par with the JDR Microdevices M386-25's performance and was slightly less expensive. It was, however, limited to 8 MB of 32-bit RAM. The other noncaching boards had certain drawbacks. The C² Baby 386 Mainboard ran its FPU at 20 MHz instead of 25 MHz, JDR Microdevices' 386-MB-25S wouldn't fit into our AT case with all its SIP sockets filled, and the Seattle STD 386XT board was relatively slow and expensive. ■

Steve Apiki and Stan Wszola are testing editors for the BYTE Lab. Rob Mitchell is a BYTE technical editor. They can be reached on BIX as "apiki," "stan," and "rob_mitchell," respectively.

FasMath Your 386!

Running in our Number Smasher-386/25 AT accelerator, the FasMath delivers 5.5 megawhetstones of numeric throughput.



CYRIX CX83D87 FasMath™ Coprocessor

This new numerics coprocessor from Cyrix Corporation is a high performance CMOS 80387 compatible device.

Its features include a 91 bit wide architecture that results in improved speed and accuracy and an idle cutoff that reduces power consumption, making it ideal for laptops. Long running operations such as square root, division, transcendental, exponents and logs run between 2 and 4 times as fast as identical functions on an 80387. The improved accuracy results in faster convergence when used with error sensitive routines. Driven by NDP Fortran-386, the FasMath delivers 3.72 Megawhetstones at 25 MHz and 5.05 Megawhetstones at 33 MHz.

Number Smasher 386/25™

The new Number Smasher is the fastest PC accelerator brought to market to date. It replaces the 80286 in any AT or compatible with an 80386 running as an asynchronous emulator (see BYTE "PC Accelerators" Nov. 1986 Stephen Fried).

Cyrix, FasMath, and CX83D87 are trademarks of Cyrix Corp., MicroWay and Number Smasher are registered trademarks of MicroWay, Inc., 80386, 80387, 80486 are trademarks of Intel Corp.

**Micro
Way**



Unlike the Inboard, which only accelerates 8 MHz ATs, the Number Smasher runs in 6, 8, 10 and 12 MHz 286 motherboards! Standard production is currently available at 20 or 25 MHz, with a list of options that include sockets for up to 8 megabytes of 32

bit RAM, Intel, Cyrix and Weitek Coprocessors, a 64 Kbyte Cache and interface cables for any of the 3 possible 80286 sockets. Running at 25 MHz with the CX83D87, the number Smasher generates 3.7 Megawhetstones, which is a factor of 30 improvement over an 80287 running in an 8 MHz AT.

NDP 386 Compilers

MicroWay's NDP Fortran, C and Pascal are available in 386, 386SX and 486 versions. They are all mainframe quality globally optimizing compilers that have been specially optimized for the 386/486 family using intel, Cyrix or Weitek coprocessors. They support the most common dialects, such as UNIX System V or ANSI C with Microsoft extensions, Fortran 77 with VAX VMS extensions, and ISO Pascal. All include the MicroWay GREX graphics library and run under UNIX, XENIX and the popular 386 DOS Extenders.



World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, UK, 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

More Box For The Buck.



DTK 386 systems deliver superior performance at prices that are hard to beat. **33MHz.** Take our KEEN-3300 Series for example. Its innovative high speed write-back cache memory and 80386-33 microprocessor combine to deliver zero wait state performance and a MIPS rating of 8.2.

PC Magazine said: "The excellent processor performance and expansion capability of the KEEN-3304 make it a very good network file server."

25MHz. The KEEN-2500 Series has the same lightning fast cache memory scheme as the 33MHz and delivers 6.2 MIPS. It's Novell Certified for use with NetWare, and XXCAL Labs

certified for compatibility with a long list of hardware, operating systems and, of

Key Features	KEEN-3300 Series	KEEN-2500 Series	KEEN-2000 Series	PEER-1630 Series
Processor	80386-33	80386-25	80386-20	80386SX-16
Configurations				
Tower Model	KEEN-3304	KEEN-2503	KEEN-2000T	—
Desktop Model	KEEN-3302	KEEN-2500	KEEN-2000D	PEER-1632
Mini-AT Model	—	—	—	PEER-1630
DRAM on Motherboard	Up to 8MB	Up to 8MB	Up to 1MB	Up to 5MB
32-bit DRAM (max.)	16MB	16MB	17MB	5MB
Cache Memory	64/256KB	64/256KB	—	—
Landmark Rating	59MHz	44MHz	27MHz	20MHz

course, the latest high-performance software.

Personal Workstation said: "The caching strategy and overall cache and board design undoubtedly affect system performance, boosting the DTK (KEEN-2500) to one of our top performers... one of the best high-performance bargains we've seen."

20 and 16MHz.

DTK also offers you a choice of dependable, top-performing 20MHz 386 and 16MHz 386SX models. They're among the fastest and most flexible systems in their class.

All systems are backed with DTK's one year parts and labor warranty.

So when you're looking for a top-rated 386 with "take it to the bank" dependability and savings to match, look to DTK.

Call or write
DTK Computer Inc.,
15711 E. Valley Blvd., City of

Industry, CA 91744. Tel: (818) 333-7533 Fax: (818) 333-5429 BBS: (818) 333-6548

Branch Offices:

City of Industry, CA
(818) 333-7533
Miami, FL
(305) 477-7440
Elk Grove Village, IL
(708) 593-3080

Edison, NJ
(201) 417-0300
Houston, TX
(713) 568-6688



Clearly superior.

DTK, Intel 386, Novell, NetWare and XXCAL are registered trademarks of Datatech Enterprises Co Ltd.; Intel Corporation; Novell, Inc. and XXCAL, Inc. respectively.

Circle 101 on Reader Service Card (DEALERS: 102)

World Radio History



Color Hits the Streets

NEC's pioneering ProSpeed CSX brings color to portables for the first time, but at a steep price

*Mark L. Van Name
and Bill Catchings*

Last October, NEC delivered its ProSpeed CSX, the first commercially available laptop with a color liquid crystal diode (LCD) display. Although it's nice to see a color laptop, the CSX's price and display quality leave much to be desired.

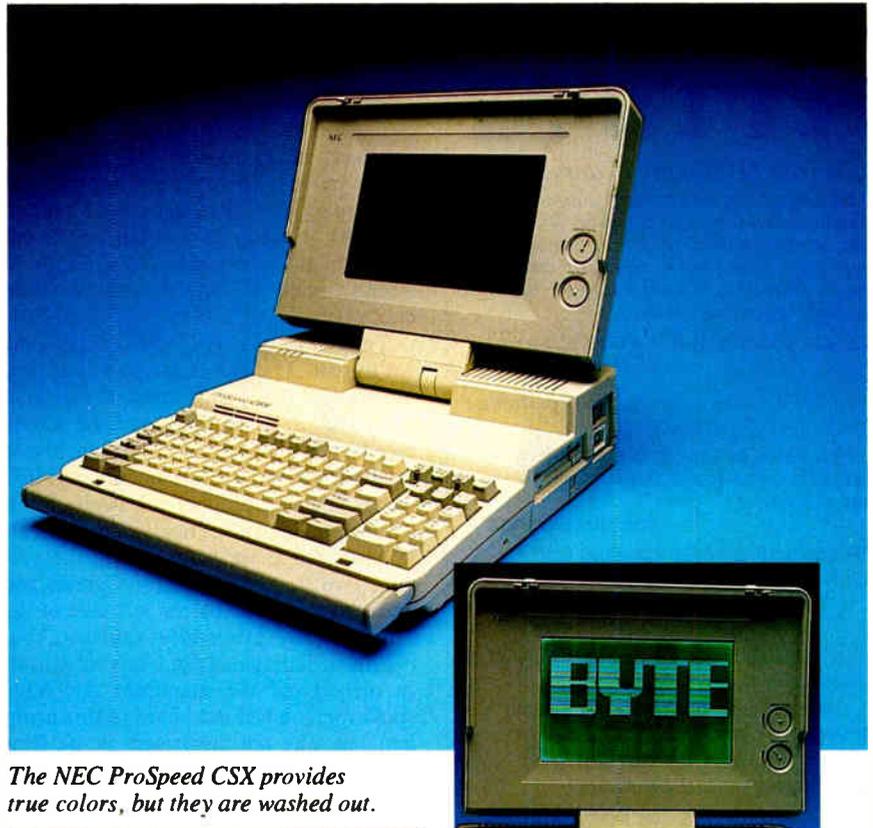
Our evaluation unit was a standard ProSpeed CSX, with a 16-MHz 386SX, a socket for a 16-MHz 80387SX math coprocessor, 2 megabytes of memory, a 42-MB hard disk drive, a 3½-inch 1.44-MB floppy disk drive, one serial and one parallel port, an external floppy disk drive connector, an external VGA monitor connector, and an 8-color VGA LCD screen with 256K bytes of video RAM. The CSX requires AC power. Bundled with the system were MS-DOS 3.3, GW-BASIC 3.3, and Windows/386 2.1.

This package costs a hefty \$8499. You can also get a model with a 100-MB ESDI hard disk drive for \$9499.

The Wide World of Color

At these prices, you really have to want color. The system's display supports all EGA options but only some VGA display models. In VGA text mode, you get a full 25-row by 80-character display. The CSX's 640- by 400-pixel resolution,

continued



The NEC ProSpeed CSX provides true colors, but they are washed out.

NEC ProSpeed CSX

Company

NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 632-4636
(508) 264-8000

Components

Processor: 16-MHz Intel 386SX; socket for 16-MHz Intel 80387SX math coprocessor
Memory: 2 MB of 80-ns DRAM in 1-megabit SIMMs, expandable to 4 MB; 128K bytes of BIOS ROM
Mass storage: 3½-inch 1.44-MB floppy disk drive; 42-MB 28-ms modified-frequency-modulation hard disk drive

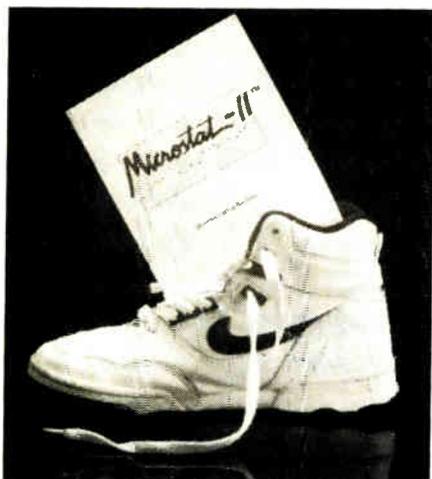
Display: Color, 9¾-inch, cold cathode fluorescent tube, backlit, compensated twisted nematic LCD internal display with direct matrix addressing
Keyboard: 89-key, with modified separate numeric keypad embedded
I/O interfaces: One 9-pin serial port; one 25-pin parallel port; two proprietary expansion slots

Price

Base system: \$8499

Inquiry 852.

FREE



FITTING

Try a free Microstat-II demo-pack and see if it isn't a perfect fit for your statistical computing needs. You'll get your work done faster, easier, without costly training. Microstat-II is easy to use - there's no complex command language to learn. You'll be running Microstat-II in minutes rather than weeks.

"... using Microstat-II is a breeze!"
PC Magazine

Microstat-II has what you need, from descriptive statistics to multivariate analysis.

"Microstat-II by Ecosoft is a genuinely excellent menu-driven statistics package at a moderate price!"

Computer Language

"Microstat-II provides you more tools at less than half the competition's price."

Review Responses
InfoWorld

Microstat-II is up to eight times faster than other packages without compromising accuracy.

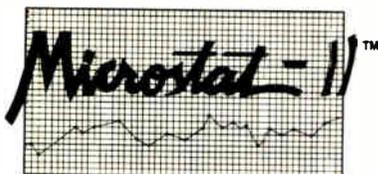
"... one of the fastest IBM PC statistical packages we have tested!"

InfoWorld

"Results are unusually accurate."

Computer Language

Try our free Microstat-II demo and see if it can't simplify your statistical workload. This free demo offer is good only while supplies last, so order yours today!



Ecosoft Inc.

6413 N. College Drive
Indianapolis, Indiana 46220
1-317-255-6476 (Info.)
1-317-251-4604 (FAX)

1-800-952-0472 (Orders)

ECOSOFT

REVIEW

COLOR HITS THE STREETS

The color screen costs you a great many things. Two immediately obvious costs are the system's size and power requirements.

however, hurts you on VGA graphics, where you lose 80 pixels off the bottom of the display. You also get only 8 colors, although 16 colors are available on an external monitor, courtesy of a Chips & Technologies 82C455 flat-panel video controller.

The image quality of the LCD display isn't great. The colors are true, but they are washed out. Large areas of the same color tend to be mottled, and the screen bleeds when it scrolls. You can lose a mouse if you move it too quickly, as NEC warns you in a product release bulletin. The screen ghosts vertically a great deal.

Also, while we were testing the system, two vertical lines (one green and one red) appeared on the left side of the screen. They eventually vanished, but not immediately and not when we initially turned off the machine. An NEC spokesperson had not heard of this problem but was not surprised by it. (For more details on the display, see the text box "Competing Color LCD Display Technologies" on page 148.)

The Cost of Color

The color screen also costs you a great many things. Two immediately obvious costs are the system's size and power requirements. It's larger than most laptops by an inch or two in all dimensions, thanks primarily to the thick display and the 70-watt power supply necessary to support the color screen.

Another obvious cost is money. The CSX runs \$1904 more than NEC's own monochrome \$6995 lunchbox PowerMate SX. Worse, a comparable Dell System 316LT monochrome 386SX portable, which can run off batteries, costs \$3999—\$4500 less than the CSX. To be fair, the CSX will probably have a street price well below its list, while the Dell

will not, but the price difference between the two systems is still likely to be large.

You also pay a performance premium, because the CSX's display is slow. The CSX was nearly three times slower on the BYTE video benchmarks than the desktop IBM PS/2 Model 55 SX, a reasonable but not particularly fast 386SX system. The CSX's anemic video performance also hurt the system's overall application index, which was about 8 percent below the Model 55's. That's too bad, because the CSX performed reasonably well in other areas, including the CPU and hard disk drive tests, where it beat the Model 55 by 11 percent and 15 percent, respectively.

Spotless Compatibility, Good Keyboard

You may give up performance with the CSX, but you lose nothing in compatibility. The system successfully ran all our test programs, including Borland's Paradox/386 2.03, Quattro 1.0, SideKick Plus 1.00A, SuperKey 1.16A, Turbo C 2.0, and Turbo Pascal 4.0; Digital's Smalltalk/V 1.2; Foresight's Drafrix CAD Ultra 3.03C; Lotus 1-2-3 release 2.2; MicroPro's WordStar 4.0; Microsoft's Windows/386 2.11 and Word 4.0; Novell's NetWare 2.15; the Norton Utilities 3.00; the public domain Kermit 2.32/A; Quarterdeck Office Systems' DESQview 2.00 and QEMM-386 1.10; Symantec's Q&A 1.1; and WordPerfect 5.0. The CSX also worked with our test hardware, which included a Microsoft Serial Mouse and an external Xircom Pocket Ethernet Adapter.

You also sacrifice little with the Pro-Speed CSX's keyboard, which has a good feel and 89 full-size keys, including a modified separate numeric keypad. The keyboard basically follows the AT Enhanced keyboard layout, minus the central arrow and cursor-position clumps, and with two keys (/ and Enter) missing from the numeric keypad.

Going Inside

Open the CSX, and the first thing you notice is its power supply, a collection of analog parts and circuits that spans the rear of the machine. There's also a fan, one of the few we've seen in a clamshell portable.

The disk drives sit in front of the power supply—the hard disk drive on the left, and the floppy disk drive on the right. The 3½-inch NEC hard disk drive has a 28-millisecond average access time. It runs off a National Computer ST506 controller that sits on a small

continued



NEC ProSpeed CSX

NEC ProSpeed CSX **8.8***

APPLICATION-LEVEL PERFORMANCE

WORD PROCESSING

XyWrite III + 3.52	Medium/Large
Load (large)	:12
Word count	:04/:28
Search/replace	:07/:28
End of document	:02/:17
Block move	:10/:10
Spelling check	:11/1:24
Microsoft Word 4.0	
Forward delete	:19
Aldus PageMaker 1.0a	
Load document	:12
Change/bold	:33
Align right	:28
Cut 10 pages	:22
Place graphic	:06
Print to file	2:18

Index: **2.11**

SPREADSHEET

Lotus 1-2-3 2.01	
Block copy	:04
Recalc	:02
Load Monte Carlo	N/A
Recalc Monte Carlo	N/A
Load rlarge3	:05
Recalc rlarge3	:02
Recalc Goal-seek	:05
Microsoft Excel 2.0	
Fill right	:07
Undo fill	2:38
Recalc	:02
Load rlarge3	:30
Recalc rlarge3	:02

Index: **1.89**

DATABASE

dBASE III + 1.1	
Copy	:26
Index	:08
List	2:43
Append	2:12
Delete	:03
Pack	1:28
Count	:05
Sort	:55

Index: **1.96**

SCIENTIFIC/ENGINEERING

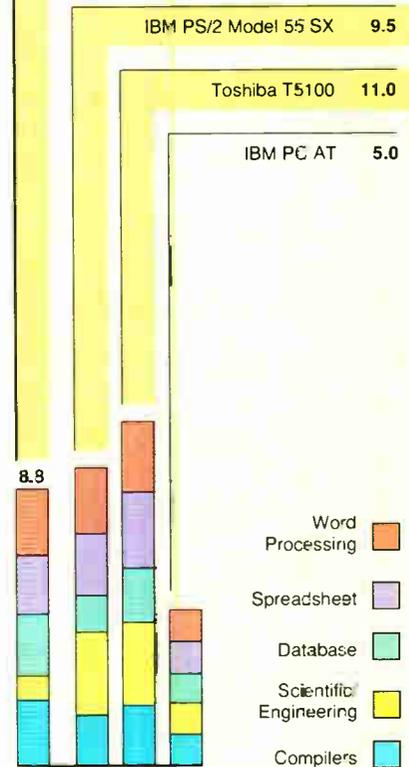
AutoCAD 2.52	
Load SoftWest	2:42
Regen SoftWest	2:30
Load StPauls	:46
Regen StPauls	:42
Hide/redraw	36:16
STATA 1.5	
Graphics	1:43
ANOVA	:55
MathCAD 2.0	
IFS 800 pts.	1:29
FFT/IFFT 1024 pts.	1:45

Index: **0.78**

COMPILERS

Microsoft C 5.0	
XLisp compile	4:56
Turbo Pascal 4.0	
Pascal S compile	:05

Index: **2.09**



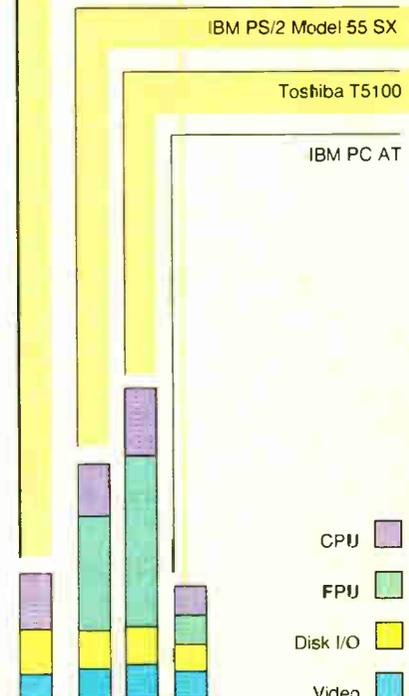
*Cumulative application index. Graphs are based on indexes at left and show relative performance.

All times are in minutes.seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT = 1

LOW-LEVEL PERFORMANCE¹

NEC ProSpeed CSX

CPU		DISK I/O		VIDEO	
Matrix	7.07	Hard Seek³		Text	
String Move		Outer track	3.30	Mode 0	17.03
Byte-wide	41.54	Inner track	3.28	Mode 1	17.03
Word-wide:		Half platter	6.72	Mode 2	17.41
Odd-bnd.	43.26	Full platter	10.00	Mode 3	17.41
Even-bnd.	20.78	Average	5.83	Mode 7	N/A
Doubleword-wide:		DOS Seek		Graphics	
Odd-bnd.	29.42	1-sector	13.93	CGA:	
Even-bnd.	19.06	32-sector	35.09	Mode 4	2.58
Sieve	36.36	File I/O⁴		Mode 5	2.58
Sort	32.33	Seek	0.21	Mode 6	2.86
Index: 1.98		Read	0.83	EGA:	
FLOATING POINT²		Write	0.92	Mode 13	4.88
Math	N/A	1-megabyte		Mode 14	5.55
Error		Write	5.47	Mode 15	N/A
Sine(x)	N/A	Read	3.66	Mode 16	5.54
Error		Index: 1.57		VGA:	
e^x	N/A			Mode 18	5.77
Error				Mode 19	2.80
Index: N/A				Hercules	N/A
				Index: 0.92	



N/A = Not applicable.

¹ All times are in seconds. Figures were generated using the 80386/8086 and 80386 versions (1.1) of Small-C.

² The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

³ Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

⁴ Read and write times for File I/O are in seconds per 64K bytes.

⁵ For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

CONVENTIONAL BENCHMARKS

LINPACK	2918.41
Livermore Loops ⁵	
(MFLOPS)	0.01
Dhrystone (MS C 5.0)	
(Dhry./sec.)	3612

For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

Competing Color LCD Display Technologies

There are currently two major basic color liquid crystal diode (LCD) display technologies. NEC's ProSpeed CSX uses a technique known as direct (or passive) matrix addressing. The competing approach is called indirect (or active) matrix addressing or, sometimes, thin film transistor (TFT). (We will explain these terms below.)

These two color LCD display technologies have much in common, as well

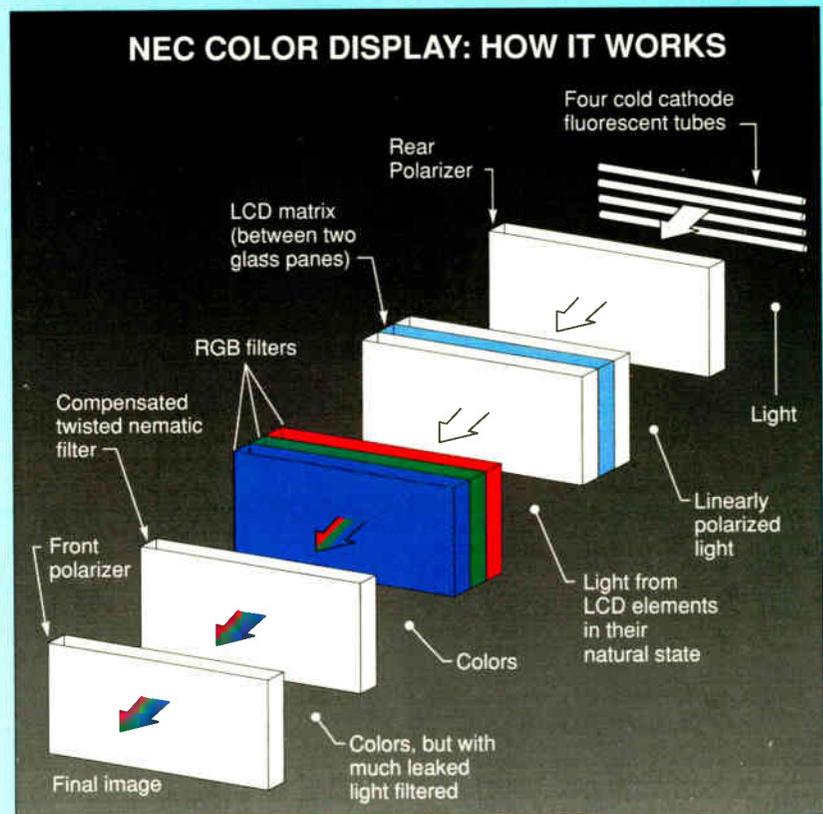
Follow the bouncing light rays. From its original source, the light passes through a rear polarizer, which allows properly oriented light to pass to the LCDs. The LCDs react to the light, blocking some of it. What passes goes to the RGB polarizer, which has red, green, and blue filters that combine to form one of the eight available colors. Another layer blocks "leaked" light, and the remaining light passes through a final polarizing layer and to the viewer.

as a few key differences. The easiest way to understand them is to follow the light through the many layers that both types of displays typically contain (see the figure).

The rearmost layer is the light source. In the CSX, four cold cathode fluorescent tubes provide the display's backlighting.

Directly in front of the light source is the rear polarizer, which lets through

only light that is oriented perpendicularly to the LCD display's crystals. This linearly polarized light passes to the third layer, a sandwich with two panes of glass surrounding a matrix of LCDs. In their natural, twisted state, these LCD elements pass through the polarized light. If you apply current to them, however, they straighten and block the light. The LCD sandwich contains three elements for every screen pixel.



daughtercard between the hard and floppy disk drives. This design, while unusual in a laptop, makes it easy to upgrade to the ESDI controller of the CSX's optional 100-MB hard disk drive. The NEC floppy disk drive uses a Western Digital controller chip on the motherboard.

There's plenty of room for that chip on the motherboard, which is the biggest (by about an inch in depth) and most crowded motherboard we've ever seen in a 386SX system, desktop or laptop. Not counting memory, the motherboard has over 100 chips, including two Zymos

POACH (for "PC on a Chip") application-specific ICs.

The ProSpeed CSX's standard 2 MB of 80-nanosecond DRAM are soldered to the motherboard in 1-megabit single in-line memory modules. The system uses a paged/interleaved architecture to avoid wait states most of the time.

The 386SX CPU and the socket for the 80387SX are on a small card under an expansion area cover on the bottom front of the machine—a nice touch that makes it easy to add a math coprocessor. Also under that expansion cover are two proprietary expansion slots, one for a 2400-

bps modem and one for an additional 2 MB of DRAM.

Odds and Sods

It's almost easier to add those expansion options than it is to set up the machine. First, you must run the Setup program to make sure that the system's CMOS accurately reflects its configuration. Then you must do a high-level disk format, and, finally, you install DOS. Fortunately, both the Setup program and the system's documentation are good, so this process isn't hard.

If you do run into problems, the CSX

The next layer, the RGB polarizer, houses one filter for every LCD element. Each screen pixel gets one red, one green, and one blue filter for its three LCD elements. By using all possible combinations of these three filters, you get the eight colors possible with the CSX: black, white, red, green, blue, cyan, magenta, and yellow.

You could produce 16 colors by using a fourth LCD element for each screen pixel. The filter in front of that element would be white and would function much like the intensity signal of some color monitors.

LCD displays tend to "leak" some of the light they're trying to block, so the CSX next uses a compensated twisted nematic layer that removes much of the leaked light. Finally, the light passes through another polarizing layer and then out to the viewer.

This design has a problem: Much as dots on CRT screens fade after they are activated, LCD elements relax and begin to lose intensity after they are charged. Direct and indirect addressing displays deal with this problem differently.

In direct matrix addressing, the driver circuit connects directly to each LCD element. The driver circuit then addresses one row of LCD elements at a time, in sequence from top to bottom on the screen (much as the electron gun scans a CRT screen). Unfortunately, as soon as the driver circuit leaves a row, that row's LCD elements begin to relax to their inactivated state. The result is bleeding, or ghosting, as well as a lower contrast ratio.

Indirect matrix addressing produces better images and avoids most of the

ghosting by keeping current supplied to every LCD element. To do so, it inserts a memory transistor between the driver circuit and each LCD element. The driver connects only to the transistors (hence the "indirect" in the name), which supply the LCD elements with current while the driver scans the display.

Active matrix sounds so much better that you have to wonder why NEC didn't use it in the CSX. The reason is cost.

An active-matrix display requires one transistor per element. To get eight colors and the full VGA 640- by 480-pixel resolution, it would need at least 640 by 480 by 3 (3 pixels per element) transistors—that's 921,600 transistors in a continuous, thin 10-inch layer. (That's the source of the "thin-film transistor" name.) No one can yet mass-produce such a dense screen with high enough yields to make the manufacturing process cost-effective. An NEC spokesperson estimated that a TFT display today would cost buyers at least \$2000 more than the CSX's already expensive display.

These technologies also require much more power than monochrome LCD displays need. In part because of the many filters, the color panel transmits only about 20 percent to 25 percent as much light as a typical paper-white LCD display would. The many transistors of a TFT display demand even more power.

Both technologies are, at least for now, considerably more expensive to produce than standard monochrome LCD displays. We must hope that future developments will make good color LCDs affordable.

comes with a one-year parts-and-labor warranty. While NEC normally directs repair requests to its dealers, the CSX is so new that few dealers will have such crucial spare parts as extra displays; consequently, for now, you must ship the CSX to NEC for repairs.

Your NEC dealer remains your first line of technical support. You can also call NEC technical support if you are unhappy with your dealer's support.

The Color of Money

Some machines are hard to peg, but the NEC ProSpeed CSX isn't one of them.

At least for now, it's the only color laptop around.

If you've absolutely got to have a color laptop, go for the NEC ProSpeed CSX. Otherwise, you should wait for the day when color laptop technology matures enough to give us vibrant, quick displays at reasonable prices. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

IOtech includes IEEE 488 device driver software with all of our interfaces. So you'll be up and running fast using our familiar and powerful commands.

We pioneered this easy-to-use device driver technique and we continue to offer the most features and the best performance in the industry.

We also back all of our IEEE 488 products with a 30-day money back guarantee, two-year warranty, and free applications support. So not only are IOtech products easy to use, they're easy to own.

Call us today for your free IEEE 488 Technical Guide: 216-439-4091.

IBM PC, AT, 386, and PS/2 IEEE Products

Macintosh IEEE Products

Sun and DEC Workstation IEEE Products

Serial/IEEE Converters and Controllers

Analog and Digital I/O Converters to IEEE

IEEE Analyzers, Converters, and Extenders

IOtech

IOtech, Inc. • 25971 Cannon Road
Cleveland, Ohio 44146
PHONE 216-439-4091 • FAX 216-439-4093

Circle 145 on Reader Service Card



Just Being Fast Isn't Good Enough... Micronics 25 MHz and 33 MHz motherboards allow you to maneuver in the 386 fast lane!

Some manufacturers push components and designs to improve performance and reduce their costs. Pushing components, even a little bit, creates the kind of heat and stress that cause systems to crash and data to be lost forever.

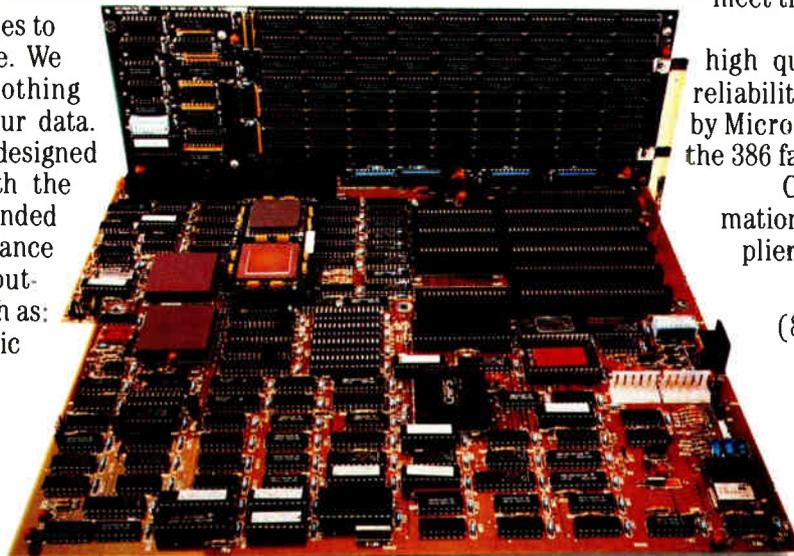
Micronics refuses to give in to this practice. We recognize there is nothing more valuable than your data. Our motherboards are designed and manufactured with the kind of reliability demanded by today's high performance computers. These computers require devices such as: cache memory, fast static RAM and coprocessors originally used only in mainframes. Advanced operating systems

including UNIX and OS/2 require high levels of design sophistication. Large databases, spreadsheets and multiuser applications also have complex critical timing requirements. Micronics motherboards are built to meet these needs.

Advanced engineering, high quality, and unequalled reliability: motherboards created by Micronics to help keep you in the 386 fast lane!

Call now for more information and the Micronics supplier nearest you.

National WATS
(800) 234-4386
California
(408) 732-0940
FAX
(408) 732-6048



MICRONICS
COMPUTERS INC.

Fully Utilizing the Power of the 386.
935 Benecia Avenue, Sunnyvale, California 94086

386 is a trademark of Intel Corp.

Circle 186 on Reader Service Card



Svelte Scanner Is No Fistful of Dollars

Sharp's low-cost scanner delivers high-quality color images to those who can afford to wait

Tom Thompson

The Sharp Electronics Personal Color Scanner's svelte size gives the impression that it's a hand-held scanner. It's not. It's a diminutive (6½ by 12½ by 1½ inches) flatbed scanner about the size of an add-in board's carton, and its weight is equally modest at just over 3½ pounds. There is a serial interface for communicating with a computer, so no interface boards are required to connect it to a Mac II, a PC, or an Amiga.

The \$995 JX-100 produces high-quality images at several resolutions and in a variety of modes (black and white, gray scale, and color). But this convenience has a price. Because of its small size, the scanner handles only small images, and color scanning can be time-consuming.

A Hardware Tour

The JX-100 is a stationary flatbed scanner, unlike its much larger cousin, the JX-450, whose bed moves from side to side. Transparent panels make up most of the JX-100's top and bottom. A white rectangle on the bottom panel delineates the scanning area. Original images must be no greater than 3.93 by 6.29 inches; thus, the scanner is suitable for typical 4- by 5-inch snapshot prints.

A compact scanning head with a sensor strip travels inside the transparent panels to acquire image data. For color



images, the scanning head must make three passes over an original, which explains why color scanning can take so long (see the text box "Inside the Personal Scanner" on page 152).

To hook the scanner to a Mac, you'll need the DB-9-to-mini-DIN-8 adapter cable supplied with the Mac scanning software. The scanner's serial cable ends in a DB-9 serial connector for an IBM AT. The scanner works with a PC, a Mac II, or an Amiga, but only the Macintosh software was available as of press time.

Power comes from a 12-volt power-supply brick. An adapter cable from this brick plugs into a special connector on the serial cable. The scanner has no on/off switch; you handle that detail by plugging in or unplugging the power supply.

Scanning Software

The JX-100 handles Mac II scanning with Imagenesis's ChromaScan 100 application software, a modified version of the Sharp JX-450 scanner application. ChromaScan requires 32-Bit QuickDraw, so you can use the software and scanner only on the Mac SE/30 or Mac

II-family computers. ChromaScan saves the captured image data in memory, so your Mac needs at least 4 megabytes of RAM; Imagenesis recommends 8 MB.

ChromaScan lets you scan an image in black and white with a user-selectable threshold (a brightness value that determines whether a pixel is white or black). You can also do color scans either as indexed colors (256 colors maximum, using a byte value that corresponds to a color table entry) or as direct colors (the pixel holds the actual color data and can be 16 or 32 bits in size). Indexed colors can be based on the default system color table or on a custom color table sorted by ChromaScan for the best-fit 256 colors. While direct color scans can display more colors, they also take up more memory and more disk space. All captured images are saved in the Mac's PICT2 format, which allows other applications to use them.

ChromaScan's preview mode makes a fast gray-scale scan of the original and then presents it in a special preview window. Here you can drag slider bars over

continued

Sharp JX-100 Personal Color Scanner**Company**

Sharp Electronics Corp.
Systems Division
Sharp Plaza
Mahwah, NJ 07430
(201) 529-9500

Hardware Needed

Mac SE/30 or Mac II-family computer with at least 4 MB of RAM and a hard disk drive (SE/30s must have a color monitor set up as the main screen); versions for the IBM AT and Commodore Amiga are planned

Software Needed

System 6.0.3 or higher with 32-Bit QuickDraw

Price

\$995

Inquiry 851.

the window to choose what part of the image you want to scan in detail. A Mode window lets you select the resolution (50, 100, or 200 dots per inch, or user-selectable), type of scan (indexed or direct color, gray scale, or black and white), and dithering. A Tone Control window lets you fine-tune the brightness, contrast, and color balance of the incoming data. Once you've adjusted the settings to your satisfaction, you start the scan via keyboard command, by menu selection, or by clicking on a Scan button.

When the JX-100 completes its scan, a window displays the captured image. You can save the image to a file or print it. ChromaScan allows multiple open windows (as much as memory allows) and even opens previously scanned files. However, there are no editing tools for tinkering with the image, and all the tone-control settings apply only to the scan in progress.

Field Test

I put the JX-100 scanner to work on a variety of snapshots, magazine covers, and photos from books. I used a Mac II running System 6.0.3 and equipped with 5 MB of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a SuperMac 19-inch monitor and Spectrum/8 video board. Installation takes only about 3 minutes: You plug the serial cable into the Mac's modem port, plug in the scanner's power supply, and copy the software to the Cobra drive.

The scanner's viewfinder and ChromaScan's preview window made scanning a snap. I selected what I wanted to scan and what type of scan with just a few mouse-clicks. Previews took only a minute, and 100-dpi gray-scale scans took 2 minutes, 10 seconds. The quality of the color images was excellent, even at 200 dpi. I hadn't expected such quality in the

continued

Inside the Personal Scanner

How did Sharp cram so many capabilities into such a small unit as the JX-100? The scanner's compact size and weight result from a combination of tiny components and a clever design that builds on techniques used in Sharp's JX-450 color scanner.

However, the JX-450 acquires an image by moving its bed from side to side, which moves the original over a stationary sensor strip built into the housing (see "Full-Spectrum Scanners," April 1989 BYTE). By contrast, the JX-100 lies atop the original image and remains stationary during the cap-

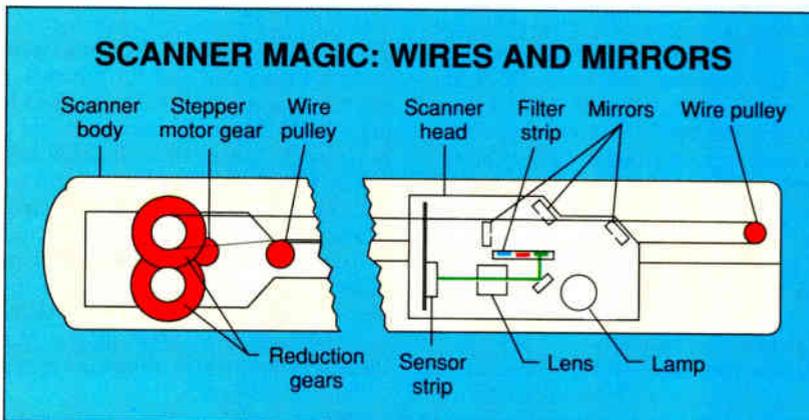
ture process. Inside the JX-100's housing, a scanner head rides on two rails. A precision stepper motor drives a wire pulley that moves the head in precise steps across the image. As the scanner head travels from one end of the housing to the other, a sensor strip inside it captures the image a line at a time (see the figure).

A minuscule fluorescent lamp inside the scanner head illuminates the image. Four mirrors route light reflected from the image through color filters and a lens and then onto a charge-coupled-device sensor strip with 1024 elements.

Each element samples the light intensity that corresponds to a spot on the image. While each element can detect 256 different light levels, the accuracy of the sample is good only to 6 bits.

The scanner head samples monochrome image data. With the use of color filters, color scans are possible. The original is scanned three times to collect red, green, and blue information. A clever lever mechanism switches a filter strip inside the scanner head from one color to the next. Each time the scanner head returns to start a new scan, a shaft engages a projection inside the housing that advances the filter strip to the next color.

Inside the Mac, software combines the data from each scan into a color image. For indexed color images, the information is reduced to the 256 best-fit colors. For direct color images, the information is assembled into pixels. For 16-bit scans, a pixel contains 15 bits of color information that can represent 32,768 colors. For 32-bit scans, a pixel contains 24 bits of color information that can represent a possible 16.8 million colors. However, since the accuracy of each color pass is limited to 6 bits, the actual number of colors captured by the JX-100 is 262,144. Nevertheless, this range of colors should be adequate for most color desktop publishing work.



To produce a color image, wire pulleys move the JX-100's scanner head over the original three times to sample red, green, and blue information.



Introducing a better way to protect your whole family.

New network savers from Emerson UPS.

However you use your network, a file server power problem can really cost you.

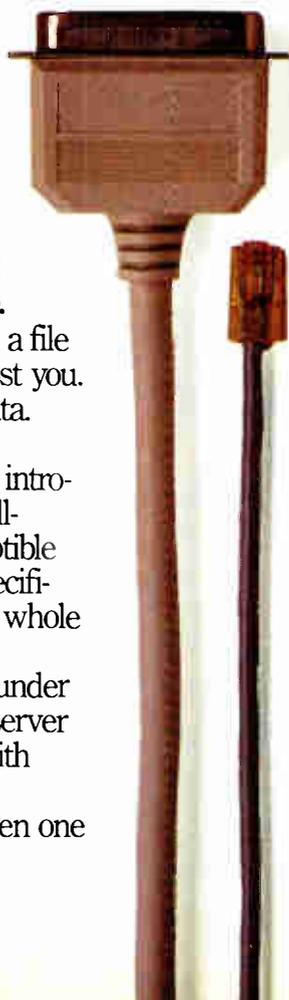


In downtime. Lost data. And frustration.

That's why we've introduced two new Novell-compatible uninterruptible power systems (UPS) designed specifically to protect your file server, your whole network and your data.

They're compact enough to fit under a desk. Powerful enough for a file server or your entire LAN—even those with multiple drives and terminals.

And they're priced less than even one hour of downtime.



Most important, the UPS 600 and UPS 1250 come from Emerson, the most reliable name in computer power protection. Backed by a network of support from local dealers and distributors. And nationwide service from the leading supplier of UPS systems.



See how easy it can be to protect your whole family. Just call us at 1-800-Back-UPS today.

EMERSON UPS

We protect the ones you love.

© 1989 Emerson Computer Power, a division of the Emerson Electric Co.

Circle 105 on Reader Service Card (DEALERS: 106)

REVIEW

WORD PROCESSING IN WINDOWS

because after you add some pictures and formatting to a page, Word for Windows becomes as slow as the others. Its layout mode can be glacial.

Meanwhile, printing speeds for all the packages were sometimes three to five times slower than those for Ventura Publisher (see the figure). Remember that all three packages did fine with straight word processing tasks—it's when you start making graphics-oriented demands that they wilt. But what's the point in go-

ing to the trouble of installing Windows and switching to a graphics-based word processor unless you can actually make use of the graphics? You might as well just stick to the old method of creating the text any way you want—any shareware word processor will do—and then importing the text into a desktop publishing package.

The culprit, of course, is Windows. While Windows gives each application automatic access to RAM above the PC's

traditional 640K-byte barrier, that extra memory is really just disk emulation. What counts is the "conventional" memory below 640K bytes, where program modules are swapped in and out as they are needed. Basically, you have a large object (the code of these programs) being crammed into a small space (the RAM that Windows can allot to each is below 640K bytes). Of course, things aren't going to work as well as they might.

Ami Professional comes with unpublished Windows settings to change the way Windows allocates memory and thus, you hope, improve performance under certain circumstances. The other two vendors also have plenty of advice to offer. (Windows/286, for instance, may be faster than Windows/386, and it's best to use as much memory as you can for the disk buffer.) Using their suggestions did help somewhat.

But there's hope. Noises emanating from Microsoft indicate that Windows 3 is in the works and will make up for everything. It promises to do away with the 640K-byte barrier and give each application its own "virtual machine" with its own protected range of RAM. Everything will run faster because the applications won't be distracted by the constant need to juggle fragments of code in and out of slivers of RAM. Meanwhile, we remain stuck in the present, with three software packages offering much potential, shackled to the performance problems of the current versions of Windows.

If you control the data processing in a large organization, then Word for Windows with its document production features and its macro language will appeal to you—assuming you're already using Windows. If you're a professional who's interested in coaxing the maximum use out of your personal computer, then Ami Professional will appeal to you. It offers a wealth of features, and the integration possible with Windows is just what a self-reliant professional needs.

If you want something simpler—if you just want correspondence with "high impact"—or if your glasses are getting too thick, you might consider Legend. It lacks DDE and a macro language, but if you're more interested in using your computer than configuring it, you may never notice. Either way, these three packages prove that PC word processing has an exciting future—as soon as it can escape from its past. ■

Lamont Wood is a computer journalist, desktop publisher, and data broker living in San Antonio, Texas. You can reach him on BIX as "lwood."

PROLOG DEVELOPMENT CENTER PRESENTS...

PDC PROLOG™

SMASH SEQUEL TO TURBO PROLOG!

SPECIAL UPGRADE OFFER
 Owners of Turbo Prolog (any version) may upgrade to PDC Prolog for \$79 (DOS version) or for \$429 (DOS & OS/2 versions) before July 1, 1990.
 Owners of the Turbo Prolog Toolbox may upgrade to the PDC Prolog Toolbox for \$40.

STARRING

- Over 50 new predicates—database, file-handling and more! • Command-line compiler option
- Support for network file-sharing • BGI graphics included • Expanded program control of built-in editor
- OS/2 version available now • Upgraded toolbox with new predicates also available
- Free technical support, including BBS

PDC Prolog Compiler
 For MS-DOS \$249
 For OS/2 (includes DOS version) \$599
PDC Prolog Toolbox \$125
 Shipping & handling extra.
 Visa & MasterCard accepted.
 To order, call 1-800-762-2710

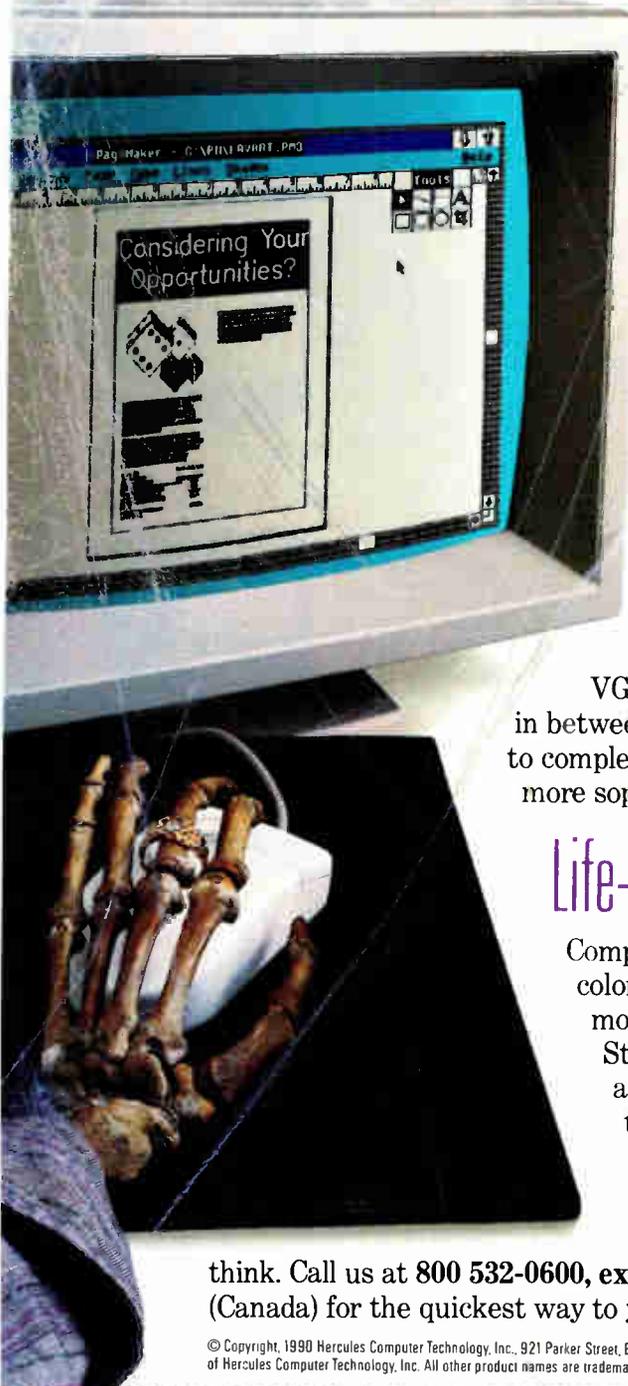
Prolog Development Center/Atlanta
 568 14th Street, N.W.
 Atlanta, GA 30318
 (404) 873-1366
 FAX: (404) 872-5243
 BBS: (404) 872-5358
 MCI Mail: PDC-Atlanta

Outside USA and Canada, contact:
Prolog Development Center, ApS
 H.J. Holst Vej 5 A
 DK-2605 Broendby, Denmark
 Telephone: +45 36 72 10 22
 FAX: +45 36 72 02 69
 MCI Mail: PDC Copenhagen

PDC Prolog is a Trademark of Prolog Development Center.
 Turbo Prolog is a Registered Trademark of Borland International, Inc.

The New Hercules Graphics Station Card

Introducing the Hercules Graphics Station Card. With more features than any card in its class. And more power. The company that took the monotony out of monochrome now puts more zip into analog monitors.



Fast Graphics

In today's competitive business world, time is more precious than ever. But Windows applications like PageMaker, Excel, and Corel Draw can make you wait while they work. Not with the Hercules Graphics Station Card—it'll run Windows up to five times faster than a regular VGA card. At higher resolutions, too.

The secret is the on-board Texas Instruments 34010 graphics processor. It frees the CPU from the drudgery of graphics functions and screen memory control so you won't have to wait for your screen to catch up with you.

From VGA on UP

A whole megabyte of video memory lets the Hercules Graphics Station Card offer a full range of modes—from VGA up to 1024 x 768 resolution with 256 colors, and plenty in between. So it will run all your software—from general business to complex design programs. And as your software needs become even more sophisticated, you won't need to shop for a new video card.

Life-like Images

Computer images can look realistic when software can access more colors. The 16- and 24-bit color modes on the Hercules Graphics Station Card allow any standard analog monitor to display up to 16.7 million colors for high quality photo-realistic images.



And best of all, you can have all these features for less than you'd

think. Call us at 800 532-0600, ext. 190 (U.S.) or 800 323-0601, ext. 191 (Canada) for the quickest way to your Hercules dealer.

© Copyright, 1990 Hercules Computer Technology, Inc., 921 Parker Street, Berkeley, CA 94710. Hercules and Hercules Graphics Station Card are trademarks of Hercules Computer Technology, Inc. All other product names are trademarks of their respective owners. Circle 133 on Reader Service Card



Takes the wait out of Windows!

FoxPro 1.00

Company

Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162

Hardware Needed

IBM PC or compatible with 512K bytes of RAM, one floppy disk drive, and a hard disk drive with 3 megabytes of free disk space

Software Needed

DOS 2.1 or higher

Price

\$795

Inquiry 886.

the main documentation. It's nice knowing the changes made, but I wish the company had integrated the information directly into the manuals, where it belongs, even if it meant delaying the program's release.

I had never seen my project's code before, so the first thing I did was sic FoxPro's integrated documenter, FoxDoc, on it to see what it could make of the hundred or so procedures and 50 programs. About 3 minutes later, I was looking at a system summary that included a complete tree structure, a variable cross-reference list, and summaries of indexes, formats, labels, procedures, and report files. FoxDoc prettied up the code and added comments that included file and procedure calls and listings of all called data and format files. This was a world of improvement over the documentation that came with my program—none. For this alone, I can highly recommend FoxPro to the legion of dBASE code repairers.

After going through the code, I then began tuning it up and adding the new programs required to expand the system's capacities. Again, FoxPro proved to be a godsend. It let me easily jump from watching the program's output to tracing the code and then to watching my debugging routines while dynamically setting variables and breakpoints.

Compared to previous FoxBASE re-

leases, FoxPro has expanded support for user-defined functions. It's still not the equal of Clipper in this respect, though. You can't directly link C or assembly code for that extra performance edge. For this application, however, I could live without that ability.

FoxPro's internal editor is a good one, but I missed the WordStar-compatible commands of Ashton-Tate's editor. Still, it has one outstanding feature that I wish more true word processors had: It lets you retrieve any text deleted during an editing session. On the minus side of the balance, while the editor lets you move and copy text from window to window, it requires an extra step to do it. In theory, FoxPro allows you to call an outside editor in place of its internal editor. In practice, there wasn't enough memory left over for WordStar 5.5, my editor of choice.

Quick and Compatible

Despite its graphical user interface, FoxPro is impressively quick. A first look at FoxPro might make you think that it would be as slow as many Microsoft

continued



Finally. OS/2 debugging help has arrived.

Introducing MultiScope™, an OS/2, multi-language, CodeView™-compatible debugger, like nothing you've seen before.

For a start, it provides 13 views of your program: Source—Data—Graphic Data—Assembly—Thread—Breakpoint—Watch—Register—Module—Call—Memory—Log—and Output.

Other unique features include: run-time and post-mortem debugging options; OS/2 text mode and Presentation Manager user interfaces; and even a graphical representation of your data structures!

Call toll free 800-231-7717.

In CA 800-552-8885. Fax 415-792-8901.

**MULTISCOPE™
DEBUGGER**

From LOGITECH Software

Circle 171 on Reader Service Card (DEALERS: 172)



Check out
HI's new DL series

**Large format,
Big features,
Small price.**

- ✓ Eight-pen changer **NEW**
- ✓ LCD user interface display **NEW**
- ✓ One-year warranty **NEW**
- ✓ Plot optimization **NEW**
- ✓ "Quick scale" feature **NEW**
- ✓ Standard media up to 36" x 48"
- ✓ Sizzling speed up to 40 ips
- ✓ High resolution of 0.0005 inch
- ✓ Roll-feed option **NEW**
- ✓ Scanner option
- ✓ 1 Mb buffer option

These are just some of the many standard features packed into HI's new DMP-60 DL series of pen plotters. Based on the popular DMP-60 line, the new DL series delivers a blend of proven performance and state-of-the-art innovation. At a surprisingly low price.

Top of the line. Heavy duty. Large format. Loaded with standard features. Priced as low as \$4,895.*

Check it out by calling
1-800-444-3425 or 512-835-0900.

**HOUSTON
INSTRUMENT™**
A DIVISION OF **AMETEK**

8500 Cameron Road, Austin, TX 78753

* U.S. suggested retail price. Subject to change.
Houston Instrument is a trademark of AMETEK, Inc.

Circle 141 on Reader Service Card

Windows-based programs. That's because its text-mode windows require only a fraction of the display memory that a true GUI requires. The end result is one of the smoothest and fastest windowing interfaces around.

The Browse command is also better than previous implementations. It now has two types of window formats. The first is the usual spreadsheet-like format, while the other corresponds to an Edit window. You can toggle between the two

layouts at will. The real strength of the new-and-improved Browse is the ability to dynamically choose what fields or subsets of fields will be displayed, their size, and the order in which they will be displayed.

Despite some difficulties, mostly with Clipper commands that FoxPro doesn't support, I was able to finish the project in about half the time it would have normally taken me—and that includes learning time. There is one caveat to this. I was

using a mouse. If I had relied on the keyboard alone to get my work done, it would have gone much more slowly. It's not that the program's key selections are poor, it's just that the program is at its best when mouse-driven.

FoxPro proved to be perfectly compatible with the dBASE III Plus dialect of dBASE. A series of tests on a number of dBASE IV programs that I had lying about revealed no problems with the newer language variant. Unlike its Ashton-Tate predecessor, FoxPro proved to be bug-free.

The program also has no trouble dealing with dBASE IV's database and index structures, with the exception of dBASE IV's master index format (.MDX). Make no mistake about it, though, FoxPro is a superset of dBASE. Its indexes and its memo formats are not backward compatible with Ashton-Tate's products.

In particular, FoxPro's new memo format is not like anything seen before in dBASE. New memo fields are unlimited in length. If you want to have a megabyte-size memo, you can. To make these monstrous memos more manageable, they can be searched and manipulated by several of the more important string functions, including the AT() and SUBSTR() subroutines. This goes a long way toward making memos more tractable for serious applications. FoxPro can also store binary data in string or memo fields. You can keep digitized images, sounds, and executable files all within the database. Putting binary data to use in the system isn't easy. For this release, the feature is more of a neat trick than a useful tool.

Pluses and Minuses

One thing you can always count on in any new dBASE program is that its makers will claim that their new index structure is smaller and faster than its forerunners. The makers of FoxPro are no exception. But while it may have the fastest indexing routines, they're not always the most efficient in terms of space. FoxPro indexed my files as much as 47 percent faster than dBASE IV with only a minimal amount of expanded memory (see table 1). However, file size was more of a toss-up. For simple index expressions, FoxPro made files an average of 10 percent smaller than dBASE IV's. When an index was based on a long, compound string key, dBASE IV was marginally more efficient.

I based my comparisons on eight indexes—six for a database with 837 records (Database 1) and two for a database

continued

"Compiler Ads Are Confusing."

They all claim that their products are the fastest and most powerful. Buzz words like optimized, integrated, and modular are everywhere—never meaning quite the same thing.

We'd like to be more direct. We'll tell you what you can do with our compiler—then you make the comparisons.

- **DUAL PERFORMANCE** You have two compilers in one integrated package—Quick for speed applications development and optimizing for the best code generation—with a simple menu option to move between the two.
- **FLEXIBILITY** You can interface directly with C or any other language. Write only one set of sources for DOS and OS/2, run the most complex applications with no change.
- **COMPATIBILITY** You can generate code compatible with Microsoft Windows, using all window facilities. And develop Presentation Manager applications with no additional software.
- **OPTIMIZATION** You get true global optimization, using data flow analysis and proprietary techniques, not just the standard peephole optimization and automatic assignment of variables to registers.
- **ENVIRONMENT** You have many features you won't find in any other environment—like the ability to organize your code into separate libraries and set compiler options both globally and on a per-module basis. And a make facility that is so well integrated, you don't even know it's there.
- **TOOLS** You get a debugger, profiler, object librarian and overlay linker with unique capabilities. And a runtime library with surprises like interrupt driven serial communications, true multitasking, graphics, and mouse interface modules.

Stony Brook Professional Modula-2 (both the Quick and optimizing compilers for DOS and OS/2) for \$295. Stony Brook QuickMod (for DOS or OS/2) for \$95.

Stony Brook—we eliminate the confusion.

■ The fine print version of this information with all the details, including our benchmark performances, will be mailed to you within 24 hours if you call our 800 number.

800/624-7487 805/496-5837 California and International

805/496-7429 Fax 187 East Wilbur Road, Suite 9
Thousand Oaks, CA 91360

Stony Brook
SOFTWARE

Your Partner
in Software Development

© 1989 Gogesch Micro Systems, Inc.

A PROMOTION THAT PROVES WE DON'T MAKE ALL PAPERWORK OBSOLETE.



Now when you buy BASF diskettes you can win up to \$10,000 in our Keyboard Kash Sweepstakes. You'll find a scratch-off card in every specially marked box. You have a better than 1 in 10 chance to win cash.

And BASF diskettes offer unsurpassed data protection. So you can take a chance at \$10,000 without taking a chance with your data. This offer is for a limited time only. Call your BASF dealer today.

Try it. Depend on it.  **BASF**

INDEX PERFORMANCE: FOXPRO VS. DBASE IV

Table 1: FoxPro averaged about 30 percent faster than dBASE IV, but the efficiency (i. e., size) of the files created was more of a toss-up.

	Database 1 indexes						Database 2 indexes	
	1	2	3	4	5	6	1	2
Time to create (seconds)								
FoxPro	6.0	5.6	3.8	4.8	8.5	7.1	5.0	5.7
dBASE IV	11.3	7.0	6.8	5.6	10.4	8.8	8.7	9.1
Index file size (bytes)								
FoxPro	15,360	10,752	10,752	8192	72,192	72,192	43,520	20,480
dBASE IV	19,456	14,848	14,848	11,264	70,656	70,656	45,568	21,504

Note: Indexes were created based on the following expressions:

Database 1:

1. index on str(year(date),4)+str(month(date),2)+str(day(date),2)+tape_no to date
2. index on trim(tape_no) to number
3. index on trim(format)+trim(tape_no) to format
4. index on trim(location)+trim(tape_no) to location
5. index on trim(subject)+trim(tape_no) to subject
6. index on trim(title)+trim(tape_no) to title

Database 2:

1. index on trim(key) to keys
2. set unique on index on trim(key) to uniq_key

BENCHMARK DATABASE MAKEUP

Table 2: Of the two databases used to compare FoxPro and dBASE IV, the first consisted of 837 records using several key fields, while the second contained 1470 records and only one key field.

Field name	Field type	Length
Database 1		
Date	Date	8
Format	Character	3
Location	Character	3
Subject	Character	60
Tape_No	Character	4
Title	Character	60
Database 2		
Key	Character	20

with 1470 records (Database 2). The names, types, and lengths of the fields used are shown in table 2.

I ran the tests on an Austin 286 AT compatible running at 12.5 MHz with 640K bytes of conventional memory and 384K bytes of expanded memory. The system also had an 80-MB Plus Development Hardcard II disk drive with a BIOS disk access speed of 28 milliseconds and a 128K-byte hardware disk cache.

There are two points where dBASE IV still has the edge. The first is automatic screen generation—Ashton-Tate's product is easier to handle. The second is the report generator: I rate FoxPro's as equal to dBASE's except for one significant shortcoming. The other dBASE variations let you directly edit a report's

code; you can't do this with FoxPro.

The company claims that its report generator is so complete that you'll never need or want to meddle directly with the code. Wrong. Expert dBASE programmers will still want to get their hands dirty working directly with the report's format. Still, for the computerphobes in the office, the nonprocedural, object-/event-oriented front end of FoxPro's report generator is easier to approach than dBASE's.

One of the more remarkable things about FoxPro is that it manages to perform its tricks in as little as 512K bytes of RAM and on your typical 70-ms, slow-as-death, XT-class hard disk drive. It's not fun, mind you, and the program really slows down, but you can do it.

FoxPro sings, however, when used with a fast chip and EMS 4.0 memory—the more of the latter, the better. FoxPro will also put any 80x87 math coprocessors in your PC to good use. One thing to be noted, though, is that FoxPro is very sensitive to its environment. Even a small reduction in RAM, either normal or expanded, can make a big difference in its performance.

Of course, FoxPro isn't perfect. The program claims to "compile" files, but it doesn't. FoxPro creates and runs object code faster than it runs source code. You can create true run-time programs only with the purchase of the not-yet-available FoxPro unlimited run-time package, which will set you back an additional \$500. You can't simply buy a professional developer's package.

The current package isn't ideal for LAN use, either. However, Fox Software says that it is working with Novell to produce FoxPro/LAN for NetWare.

FoxPro is not a relational database manager and doesn't support Structured Query Language. This is a problem. The relational database model is the wave of the future. SQL, the language of the relational database management system, provides fundamentally stronger query and manipulation tools than dBASE, but good microcomputer SQL implementations are still hard to find. The company says that the next major release of FoxPro will include a SQL interface, but it will take more than that to make a DBMS relational. It is a step in the right direction, though, and I look forward to seeing the revision.

If you just want to get at your data quickly or whip up a simple report, you will be very happy with Fox Software's new product. FoxPro brings more than just a Mac look to the DOS environment. You can master the bread and butter of simple database design (i.e., data entry and report generation) quickly and easily in FoxPro. The program would make a fine choice for most offices.

FoxPro stretches the single-user, single-machine flat-file database model about as far as it can go. I wish it included SQL and improved LAN suitability, but despite these reservations, I plan to use FoxPro for most of my dBASE applications development. ■

Steven J. Vaughan-Nichols is a programmer/analyst for Bendix (Lanham, MD) whose work currently includes designing a database that takes data from a Goddard Space Flight Center telephone digital switch. You can contact him on BIX as "sjvn."



PC BRAND'S
386/20

386/25...

"FASTER THAN
A SPEEDING
BULLET!"

-Computer Shopper, Cover Story
November, 1988

20MHz
FROM \$1349
25MHz
FROM \$1499

"The Best Low-Cost Alternative Around!"

-PC Magazine, 25MHz 386 PC's, Feb. 14, 1989

PC BRAND 386/20 _____ \$1349

20 MHz Clock, Zero Wait Operation,
Norton SI 23.0 Landmark Speed 26.1MHz,
1024K RAM, 1.2MB or 1.44MB Drive, 101-Key-board,
2 Serial and 1 Parallel Ports

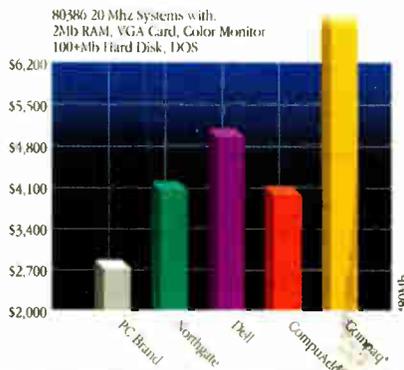
PC BRAND 386/25 _____ \$1499

25 MHz Clock, Zero Wait Operation,
Norton SI 28.2-Landmark Speed 33.6MHz,
Norton SI 31.6-Landmark Speed 43.5 w/Cache,
1024K RAM, 1.2MB or 1.44MB Drive, 101-Key-board,
2 Serial and 1 Parallel Ports

"The PC Brand 386/25
is a fascinating machine.
It offers flexible configura-
tion...at a bargain price..."

"and the company backs
it all with what may be the
longest warranty on the
market...PC Brand makes
it possible to buy two com-
plete systems for less than
most competitors charge
for just one."

- PC Magazine, 25MHz 386 PC's
February 14, 1989



Standard System Features:

- True 20MHz or 25MHzZ Intel 80386 CPU Operating with Zero Wait States
 - 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
 - 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
 - FCC Class "A", Intended for business use
 - High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
 - 1:1 Interleaving Hard Drive/Floppy Drive controllers, 1Mb/Second disk transfer rates on all 100Mb drives or larger
 - Enhanced 101-key Click/Tactile Keyboard
 - 2 serial & 1 parallel ports on std-configurations
 - High Capacity 200Watt System Power Supply
 - Real Time Clock/Calendar with 5 Year Battery
 - 80287, 80387, or Weitek Co-Processor Support
 - AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 5COM compatibility
 - 8 Slot motherboard design (5 16Bit & 3 8Bit)
 - Medium foot print case w/6 Disk Drive bays
- Options:**
- Low profile Slim-Line Case w/3 Disk Drive bays available at no extra charge
 - Full Size Tower® Case w/6 Disk Drive bays
 - Mini Size Tower® Case w/4 Disk Drive bays
 - LCD or VGA Plasma Portable Case
 - Custom configurations w/Name Brand peripherals of your choice

PC BRAND 386/20

with Hard Disk Drive, Monitor & Video Card

Hard Drives:	40/25	66/25	100/25	200/19
Mb/Ms				
No Video	\$1779	\$1959	\$2099	\$2549
Mono	\$1899	\$2079	\$2219	\$2669
VGA-Mono	\$2079	\$2259	\$2399	\$2849
VGA-Color	\$2309	\$2489	\$2629	\$3079
SVGA/Color	\$2419	\$2599	\$2739	\$3189

PC BRAND 386/25

with Hard Disk Drive, Monitor & Video Card

Hard Drives:	40/25	66/25	100/25	200/19
Mb/Ms				
No Video	\$1929	\$2109	\$2249	\$2699
Mono	\$2049	\$2229	\$2369	\$2819
VGA-Mono	\$2229	\$2409	\$2549	\$2999
VGA-Color	\$2459	\$2639	\$2779	\$3229
SVGA/Color	\$2569	\$2749	\$2889	\$3339



30-DAY
MONEY BACK
GUARANTEE

FREE FREIGHT
TOLL-FREE
SERVICE AND
SUPPORT

ON-SITE SERVICE
BY TRW*

24 or 36 MONTH
LEASING

AND A 5-YEAR
WARRANTY

Best "Executive Decision"
System.

*-Personal Computing,
Best Bargain Systems,
Dec, 1989*

"The PC Brand 386/SX-16
performed at least as well
as the far costlier Compaq...
We simply began marveling
at what is surely the big-
gest bargain in personal
computing"

*-Computer Buyer's Guide,
Cover Story, Oct, 1989*

Intel 386 Technology at 286 Prices the 386 SX-16 Only \$899

PC BRAND 386/SX-16 \$899

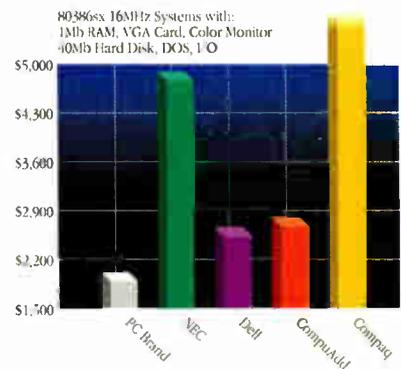
16 MHz Clock, Zero Wait Operation • Norton SI 18.7 Landmark™ 18.3MHz,
512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboards, 2 Serial and 1 Parallel Ports

Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaved Hard/Floppy Drive controllers, 1 Mb/Second disk transfer rates on all 100 Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports on std-configurations
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/ 6 Disk Drive bays (Shown in optional Mini Size Tower ® Case)

Options:

- Low profile Slim Line Case w/ 3 Disk Drive bays at no extra charge
- Mini Size desk top Tower ® Case w/4 Disk Drive bays (as pictured above)
- LCD or Plasma Portable
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice



PC BRAND 386SX-16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	\$1229	\$1329	\$1509	\$1619
Mono	\$1349	\$1449	\$1629	\$1769
VGA-Mono	\$1529	\$1629	\$1809	\$1949
VGA-Color	\$1759	\$1859	\$2039	\$2179
SVGA/Color	\$1869	\$1969	\$2149	\$2289

Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200.
We are open Mon. thru Fri. 9am to 6pm Central Time. MasterCard, VISA, Discover, Checks
and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**



Find Out Why We're Rated No.1 for Service & Support.

"PC Brand is the LL Bean of personal computer mail order...

...PC Brand wants no unhappy customers, ...it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies, Feb. 1989



286 SYSTEMS FROM \$599

PCBRAND 286/12 _____ \$599

12 MHz Clock, Zero Wait Operation,
Norton SI 15.3 Landmark™ Speed 15.1 MHz,
512K RAM, 1.2MB or 1.44MB Drive, 101-Key-board,
2 Serial and 1 Parallel Ports

PCBRAND 286/16 _____ \$749

16 MHz Clock, Zero Wait Operation,
Norton SI 19.0 Landmark™ Speed 20.6 MHz,
512K RAM, 1.2MB or 1.44MB Drive, 101-Key-board,
2 Serial and 1 Parallel Ports

PCBRAND 286/20 _____ \$899

20 MHz Clock, Zero Wait Operation,
Norton SI 23.0 Landmark™ Speed 26.7 MHz,
512K RAM, 1.2MB or 1.44MB Drive, 101-Key-board,
2 Serial and 1 Parallel Ports

Standard System Features:

- 80286-12, 80286-16, 80286-20 operating at 12 MHz, 16MHz, or 20MHz w/Zero Wait
- 512K RAM expandable to 8MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaved Hard/Floppy Drive Controller, 1Mb Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports on std-configurations
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS w/full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0EMS hardware
- User configurable I/O timing permitting compatible operation w/older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/6 Disk Drive bays

Options:

- Low profile Slim Line Case w/3 Disk Bays available at no extra charge (pictured above)
- Mini Size desk top Tower® Case w/4 bays
- LCD or Plasma Portable
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice

PC BRAND 286/12

w/512k, Hard Disk Drive, Monitor & Video Card				
Hard Drives:	20/40	40/25	66/25	100/25
No Video	\$929	\$1029	\$1209	\$1349
Mono	\$1049	\$1149	\$1329	\$1469
VGA-Mono	\$1229	\$1329	\$1509	\$1649
VGA-Color	\$1459	\$1559	\$1739	\$1879
SVGA/Color	\$1569	\$1669	\$1849	\$1989

PC BRAND 286/16

w/512k, Hard Disk Drive, Monitor & Video Card				
Hard Drives:	20/40	40/25	66/25	100/25
No Video	\$1079	\$1179	\$1359	\$1499
Mono	\$1199	\$1299	\$1479	\$1619
VGA-Mono	\$1379	\$1479	\$1659	\$1799
VGA-Color	\$1609	\$1709	\$1889	\$2029
SVGA/Color	\$1719	\$1819	\$1999	\$2139

PC BRAND 286/20

w/512k, Hard Disk Drive, Monitor & Video Card				
Hard Drives:	20/40	40/25	66/25	100/25
No Video	\$1229	\$1329	\$1509	\$1649
Mono	\$1349	\$1449	\$1629	\$1769
VGA-Mono	\$1529	\$1629	\$1809	\$1949
VGA-Color	\$1759	\$1859	\$2039	\$2179
SVGA/Color	\$1869	\$1969	\$2149	\$2289



PC BRAND
COMPUTERS...

UNTOUCHABLE
QUALITY,
UNBELIEVABLE
PERFORMANCE,
OUTSTANDING
SUPPORT.

AT
ROCK BOTTOM
PRICES.

In Our Business, the most important thing is Your Bottom Line.

You're reading a magazine with hundreds of "look-alike" ads for IBM Compatible Computers, they all claim similar performance, outstanding quality, low price and great support.

How do you make your choice?

Price: Some show unusable entry level or giant overkill units, and sock-it-to-you on the drives, monitors and video cards you really need. Some add outrageous freight, handling and customization charges. We don't. We advertise the industry's largest selection of complete drive and video configurations all unbelievably priced. All priced delivered to your door.

Quality: Some claim quality but offer only a 30, 60 or 90 day warranty. Our 5 year program is the best and longest in the business...

...PC Magazine, PC Buyers Guide, Computer Shopper, Byte, and Personal Computing all say the same thing about PC Brand in their reviews: "Outstanding quality... Rock Bottom Price." We couldn't have said it better ourselves.

Support: Everybody claims it, but check our facts: 30 Day Money Back Guarantee (no RMA's required), Toll Free Technical Support, Toll Free Customer Service, On-Site Service, On-Site Installation, Leasing and Customized "Built to your Specs" configurations. Even our FAX's are on Toll Free Lines. *Our support is so good it wins us Awards.*

Put it all together and it spells our commitment to you, the *Bottom Line*, the *Best* one in the Business. Call us at 1-800-PC Brand Today.

PC BRAND OFFERS A FULL RANGE OF COMPUTER SYSTEMS

NAME BRAND PERIPHERALS AT THE LOWEST PRICES

FREE FREIGHT
TOLL-FREE SERVICE & SUPPORT
5-YEAR WARRANTY †
30-DAY MONEY BACK GUARANTEE

ON-SITE SERVICE BY TRW*

24-36 MONTH LEASING

PC BRAND™

Turn page for PC Brand Systems...

readings. It's a hefty package that tells you just about everything you'd want to know about C++. The examples are the usual simple text editor and drawing applications. The MacApp documentation is very complete.

I like the Think C manuals. They are very clean, and it's easy to find what you need. The Class documentation lists each TCL class with its ancestors and descendants. Each method is listed with its parameters. A complete manual of stan-

dard C library functions is also included.

What do you need to harness these tools? For Think C, you'll need 1 MB of memory (2 MB to use the symbolic debugger), 1.5 MB of hard disk storage or two 800K-byte floppy disks, and Finder 4.2/System 6.0 or higher.

MPW C++ requires the MPW Shell, MPW C 3.1, SADE for debugging, at least 2 MB of memory (realistically, you'll need 5 to 8 MB), an additional 2 MB of disk space over what the MPW

Shell uses, and, again, Finder 4.2/System 6.0 or higher.

Objectively Speaking

As I've pointed out, these are two different languages. They can both function to merely compile C code, but that's not what should compel you to buy one over the other. I think of Think C as the Swiss Army knife of compilers. It does so many nice things. I can't imagine wanting to write an INIT in assembly language when I can use Think C. Think C makes building cdevs easy, too, and you can use the debugger on them. It's quick and simple for writing printf's to a window. For the price, you can't beat it. When I need to get something done in a hurry, I turn to Think C. In some cases, I use it to prototype methods of large C++ applications because of its sheer speed.

Why use C++ with MacApp? If you really want to exploit object-oriented programming, there's no substitute. MPW C++ is the real McCoy, and the MacApp library is very complete. They have been under development for over five years. They can save you from unexpected crashes and will manage memory segments. C++ comes with ViewEdit for creating everything from simple to extravagant and complex views.

I like both these products very much. If Think C had an improved class library, I'd be tempted to use it for everything, in spite of my dislike for its limited subset of C++, its editor, and its Rmaker resource compiler. I tend to use it more for its non-object-oriented features, but I do use the TCL for "light" applications. If you're on a budget, Think C is the way to go. You can get everything out of it that you would get from MacApp with a little more work.

For product development, I rely on MPW C++ and MacApp. In concert with their tools, I feel pampered. They are slower than Think C, but I don't run into problems building views because ViewEdit lets me create predictable results. For Macintosh interfaces, views are everything, and MacApp gives you much to work with. The MacApp library is very stable and has evolved past the TCL.

No matter which one you choose, I think you will be pleased. These are modern tools for modern times. This is your chance to get a jump on the next wave of programming trends. ■

Matt Mashyna is a software developer living in Pittsburgh, Pennsylvania. He can be reached on BIX c/o "editors."

King of Arts

Studio-quality animation comes to your desktop PC with GRASP. Create slide shows, demos, interactive tutorials, and animated performances. Control art, text, color, sound, timing, mouse and keyboard. Use the animation techniques developed for arcade games and television production. Add Grasp animations to C, Pascal, Basic, and Assembler programs.

Now Grasp includes Pictor, a paint program fully integrated with Grasp; and Artools, a unique set of animation generators. Artools creates the in-betweens for professional effects like image warping, transformations, and cross-fades—automatically!

GRASP version 3.5 — \$199.



400 Williamson Way — Ashland, OR 97520
800-523-0258 503-488-2322

"GRASP is clearly the hands-down winner in terms of sheer power, flexibility, and speed. Nothing else even comes close."

—PC Magazine

BAYTECH MULTIPLExER- CONTROLLERS

*14 Years of Quality
Multiplexing*

CONTROL & DATA ACQUISITION

Enter the picture...the BayTech H-Series Multiport Controllers—stand-alone multiplexers that connect one host computer to as many as 23 peripheral devices. By cascading, the number of devices you can connect is practically unlimited. Full duplex transmission of asynchronous data is provided at speeds up to 38,400 bps. These intelligent multiports will operate with any RS-232C serial computer or peripheral device. (Optional RS-422A).

The H-Series models have been used extensively in each of these areas:

- security and environmental sensing, to improve monitoring capabilities for large and small businesses

Security



Courtesy Honeywell Protection Services.

- medical data monitoring environments, where speedy responses are vital and critical information must reach the host computer immediately

*Medical
Data Systems*



Courtesy Siemens Life Support Systems.

- industrial robotics-control environments, where multiple numerical or assembly-line machines can be centrally controlled

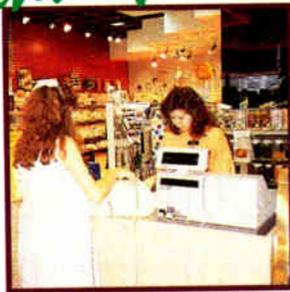
*Process
Control*



Courtesy Ford Motor Company.

- data exchange among point-of-sale devices, through which a myriad of business equipment can be operated from one computer

Point of Sale

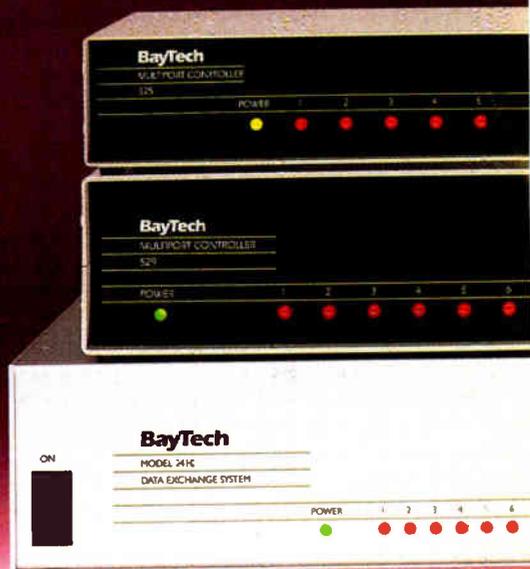


Courtesy Hugin Sweda.

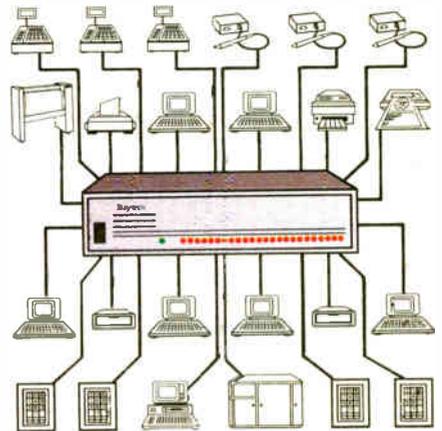
SIX MODES OF MULTIPLExING

To meet individual needs, these flexible, multifunctional devices are easily tailored by selecting one of six modes of multiplexing: time-division, port expansion/sharing, and four modes of buffered message multiplexing. In a typical application, the host port may be connected to a

Circle 43 on Reader Service Card (DEALERS: 44)
World Radio History



computer and the peripheral ports may be connected to such devices as: bar code readers, cash registers, fire alarms, numerical machines, modems, plotters, printers, security systems, and terminals (see illus.).



PRODUCT SUPPORT

BayTech offers unlimited hotline technical support before and after you purchase a unit. Designed and manufactured in the USA, the reliable H-Series is UL- and CSA-listed and fully covered by a one-year warranty.

So put yourself into the picture...call us today to learn about the many ways the H-Series Multiplexer-Controllers can benefit your business.

BayTech

Bay Technical Associates, Inc.
Data Communications Products Division
200 N. Second Street, P.O. Box 387
Bay St. Louis, MS 39520 USA
FAX: 601-467-4551
Phone: 601-467-8231 or toll-free

800-523-2702

count on an overhead of almost 2 minutes for each file that must include the MacApp headers. The folder that contains my MacApp files is around 7 MB in size. The price of C++ does not include the cost of the MPW Shell, MPW C, MacApp, or the SADE debugger. Perhaps by the time you read this, Apple will have a much faster version of MPW C++ that uses precompiled headers. That should diminish the compile time penalties for using MacApp.

If it sounds like I'm discouraging you from using C++, I'm not. Sure, it's expensive, but when you have all the required elements, the MPW shell with all its tools and flexibility is second to none. Those people who are used to working in a Unix environment will like it. The shell can be bent into the shape that suits you. You can even define shell scripts and variables. The Make facility is also much like Unix. Combining object code from different source languages is a snap. You can create your own tools to help you in your development. If you need a grep (pattern match) utility, just write your own and make it a part of the shell.

The MPW shell with all its tools and flexibility is second to none.

The Need for Speed

I don't think that speed is very important. It's more useful to know how the products compare as development tools. I took the basic, empty shells from Think C and MacApp and created an application with a scrolling, sizable, and zoomable window that did open, close, and save documents—all the basic things you'd want—and built an application with only these lines in the Draw methods:

```
MoveTo(10,10);
DrawString("\pHello, world");
```

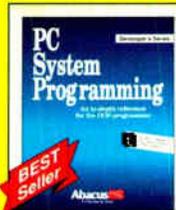
The first time, Think C took 4 minutes, 50 seconds to compile on my Mac

II. When I recompiled my application, document, view, and main files, the program took 29 seconds. Linking the project into an executable file took 12 seconds. The executable file size came out to be 57K bytes.

With MPW C++, the first compile, Rez, and Link took 2 minutes, 22 seconds. The next compile took 2 minutes, 7 seconds. The executable file size came out to be 92K bytes in nondebug mode and 254K bytes in debug mode. Note that the C++ source program was in a single file that was considerably smaller than the Think C source files, but the point of the comparison is to show the minimal source compile times using the basic frameworks of each class library. Because the integration of C++ and MacApp is not in its final state, Apple recommends that you include all source files in the main file so that, by including them only once rather than in many source compilations, you reduce the time to load the MacApp headers.

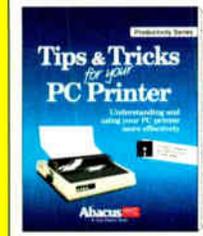
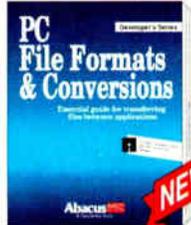
As for documentation, MPW C++ includes the standard AT&T C++ product manual, library manual, and selected *continued*

We Sell Know-How



PC System Programming for Developers is an encyclopedia of PC technical and programming knowledge. Features parallel working examples written in Pascal, C, assembly and BASIC. Explains memory layout, DOS operations, using extended, expanded memory, writing device drivers, hard disks, PC ports, mouse drivers, fundamentals of BIOS, graphics and sound, TSR programs, complete appendices. 920+ pp w/2 disks, over 1 meg of programs in compressed format. ISBN 1-55755-036-0. 920+ pages with 2 disks. \$59.95

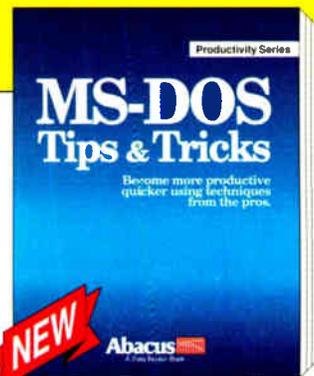
PC File Formats and Conversions is for every PC user who ever wanted to know how to exchange file formats. Describes in detail file formats for major software applications. Use IMPORT/EXPORT functions in many applications. Includes conversion program. Companion disk included. ISBN 1-55755-059-X. 280 pages. \$34.95



Tips & Tricks for your PC Printer is subtitled "understanding and using your PC printer more effectively". Takes the hassle out of working with PC printers. You'll learn how to setup and connect your printer. You'll learn to use the many features that are built into the popular printers, but rarely used because they're so difficult to understand. The companion disk has several practical printer utilities: online printer HELP, printer control aid, printer font editor and more. 400 page book includes companion disk. ISBN 1-55755-075-1. Suggested retail price: \$34.95

MS-DOS Tips & Tricks shows you how to become more productive quickly with DOS.

Contains dozens of hints and tips from DOS experts. Learn how to find any file on hard disk quickly and painlessly; how to copy data from a backup without the RESTORE command; learn to protect your data and PC from unauthorized access; how to cold-start your PC from a batch file and much more. ISBN 1-55755-078-6. 210 pages. \$17.95. Companion disk available: \$14.95



PC TOOLS Complete - The total reference guide to the best-selling PC TOOLS Deluxe software. Shows you how to master all of the utilities and applications, many techniques, hints and tips. Learn advanced features that will make your computing sessions easier and faster. Covers Version 5.5 of PC TOOLS Deluxe. ISBN 1-55755-076-X. 450 pages. \$22.95



PC TOOLS Companion Quick Reference - A durable, hardcover guide filled with all of the essentials for using PC TOOLS Deluxe Version 5.5 more effectively. Contains the correct syntax organized logically for you to quickly and easily get your job done. ISBN 1-55755-012-3. Hardcover. 220 pages. \$12.95



Coming in April **Turbo Pascal Internals for Developers**. Available at B Dalton Booksellers, Waldens, and Software Etc. nationwide. In the UK contact Computer Bookshops 021-706-1188. In Canada contact Addison Wesley 416-447-5101.

Dept. B4, 5370 52nd Street SE • Grand Rapids, MI 49512
Phone: (616) 698-0330 • Fax: (616) 698-0325

In US and Canada add \$4.00 postage & handling. Foreign orders add \$12.00 postage per book. We accept Visa, Master Card or American Express. Call or write for your free catalog of more PC books.

In US and Canada call TOLL FREE: 1-800-451-4319

The Pocket LAN Adapters for Token Ring, Ethernet and Arcnet.

Innovation comes in all shapes and sizes. At Xircom we believe it should fit in your pocket. Our Pocket LAN Adapters are revolutionary products developed for PC users who want the most convenient access to Token Ring, Ethernet or Arcnet networks.

What makes the Pocket LAN Adapters revolutionary? They require no internal slots, connecting through the parallel port of any IBM-compatible PC. All come supplied with certified drivers for a trouble-free solution that will have you connected in less time than it takes you to read this ad!

The Xircom approach has left the press full of praise: "The image of perfection—the way computers should be," wrote Steve Gibson in InfoWorld; "Incredibly easy to use...easy to install, easy to carry...a very clever device," according to Aaron Brenner at LAN Magazine.

You may think that all this "perfection" and convenience comes with a hefty price tag. It doesn't—in fact the Xircom family of LAN adapters costs about the same as the more traditional methods which it is quickly rendering obsolete.

It's living proof that with innovation on your side or in your parallel port, a little can take you a very long way.

Call Xircom today at (818)884-8755.

Xircom

LAN solutions for laptops.

22231 Mulholland Hwy., Suite #14
Woodland Hills, CA 91364
(818)884-8755 • FAX (818)884-1719

Arcnet is a registered trademark of Datapoint Corp.

**LAP
TO
LAN
IN
ONE
EASY
CONNECTION**



MPW C++ 3B1

Company

Apple Computer
Programmers and Developers Assoc.
20525 Mariani Ave, Mail-Stop 33G
Cupertino CA, 95014
(800) 282-2732

Hardware Needed

Mac Plus, SE, SE/30, or II with 2 MB of memory and a hard disk drive

Software Needed

System 6.0.2 or higher; MPW Shell and C Compiler Bundle 3.0 (\$400); MacApp 2B9 is optional (\$100)

Price

\$175

Inquiry 888.

Switching Channels: MPW C++

Apple calls MPW C++ "beta," but it is shipping the product unrestricted to end users, nonetheless. It consists of Apple's port of AT&T's Cfront preprocessor 2.0 (the latest) coupled with the standard MPW C compiler. As a bonus, the C++ package also includes version 3.1 of the C compiler, which has bug fixes over 3.0. This is a nice compiler with detailed warnings and error messages that tell you what went wrong and what it expected for arguments. Converting files from version 2.0 to 3.0 or 3.1 requires several changes, but Apple throws in a conversion tool that takes most of the pain out of converting.

A lot of the glue has been changed with respect to using call-by-reference versus call-by-value. You can count on making calls-by-reference, now, when *Inside Macintosh* says that the Pascal call uses a VAR. I also like the fact that it gives you many errors, depending on the severity, before it quits. I hate having to do fixes and then compiling the code over and over to catch each error.

To compare these products more evenly, I've combined C++ with MacApp. MacApp is Apple's object library. C++ does not come with a Mac-specific object library. MPW C++ is a complete C++ implementation, and it packs more punch than other object-oriented C compilers. Think C comes with its own Think Class Library. TCL is close to an older version of MacApp (1.1).

Both TCL and MacApp provide you with the basic objects that you'll need to get started, but MacApp is more refined. For example, setting up a scrolling region is effortless using MacApp, but

Think C 4.0

Company

Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600

Hardware Needed

Mac Plus, SE, SE/30, or II with 1 MB of RAM and a hard disk drive; debugger requires 2 MB of RAM

Software Needed

System 5.0 or higher; debugger requires MultiFinder

Price

\$249

Inquiry 889.

using TCL, it can be a trying experience, at least the first time. MacApp has a Scroller object that takes care of scrolling any view that is embedded in it. TCL uses the older style of windows, scroll panes, and scroll bars that can be a hassle to coordinate. TCL also lacks some of the deluxe features that MacApp provides, like `TextListViews`, which displays scrolling lists of nearly any number of lines.

Stacking Them Up

These two products diverge after their object-orientedness. Think C has some features that I love. It's so easy to create INITs in C. It's also great to make inline assembly calls rather than link another assembled object module, because you can reference your C variables more easily in the assembly code. Another helpful item is Think C's console interface. It allows you to directly port Unix (and other) code that routes I/O calls through `stdin`, `stdout`, and `stderr`. MPW still doesn't do this outside of an MPW tool, and even then, it doesn't work well.

The Think C compiler is also very fast. The ability to include precompiled headers greatly reduces the time needed to read all the header files that are regularly included in your source files. I'm also a big fan of the symbolic debugger. You can't write debugging shell scripts, but it's nice to simply debug applications and `cdevs`. (It's a straightforward debugger with twin windows—one for source and another for data [see photo 1]. You can watch data and easily set breakpoints, with or without conditions. It reminds me of Microsoft's CodeView.)

The Symbolic Application Debugging Environment (SADE) debugger has scripting and other powerful features, but its primitive interface is more difficult to master (see photo 2).

Besides the TCL shortcomings, Think C lacks the ability to create code segments over 32K bytes. It also pales in comparison to MPW's resource compiler. I also don't care for the giant project sizes that it creates. Since the compiler keeps all the object code handy in the project file, the compile/link time is fast, but I think I'd rather share object code between projects and keep them small. When you initially compile a project that uses the TCL, it takes a long time. After your project has been compiled once, though, the TCL doesn't need to be compiled again, and compile time dramatically decreases thereafter. The TCL can't be compiled into its own object-code library, because you would lose the ability to use the debugger on TCL classes.

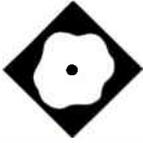
The MPW editor has features that the Think C editor lacks (e.g., searching backward and marking text for quick reference). Most Unix C++ professionals will not like the fact that it is not C++. It is more akin to MPW's Pascal with object extensions.

As for MPW C++, its biggest feature is that it is *real* C++. You can take Unix C++ programs and expect them to compile. You gain C++ 2.0's multiple inheritance—the ability to combine components of different objects into one—the standard C++ I/O streams, and function and operator overloading (defining multiple functions with the same name). The features of C++ are many, and its power is great. I can't stress enough that these two products are not the same language.

A great virtue of MacApp is its debugging mode. MacApp creates executable files in two modes: debug and nondebug. In debug mode, you can examine your objects and browse through them via an Inspector window. This can be a big help when your object relationships are complex. The Think C debugger allows you to examine your objects, but it's not as handy. With just a few mouse-clicks and without cluttering the screen with data windows, the MacApp inspector gives you a lot of useful information based on the type of object that you're interested in.

When you get a lot of power in a product, you pay a price. The price for using C++ is time, space, and dollars. The compile time using MacApp can hurt. I

continued



Two compilers bring object-oriented power to the Mac

Matt Mashyna

Apple has been dedicated to object-oriented programming—so dedicated that a substantial portion of System 7.0 is being developed in it. Object-oriented code is easier to control, from a software engineering point of view, and the Macintosh's interface suits it very well. Objects that respond to your actions with little dependency or knowledge of other objects free you from worrying about which window or area received a mouse-click or keystroke. The objects know what to do because the framework tells them when to handle an event and when to pass it on.

Apple started by adding object extensions to its Pascal compiler. Then Apple developed an application framework called MacApp. MacApp provided Pascal programmers with a fast development system that gave the programmer all the basic functions—text editing, scrolling lists, and views, to name a few—in self-contained objects. None of the objects required changes to be fully functional, and they were easily changed to meet new needs.

Now C objects are accessible to Mac programmers in two varieties: Symantec's Think C 4.0 and Apple's MPW C++ 3B1.1. Both compilers offer objects, but they are very different animals. Think C is a complete environment that meets the needs of the majority of programmers, while C++ is a more robust, powerhouse language for the MPW Shell.

C Compilers Have Different Strengths

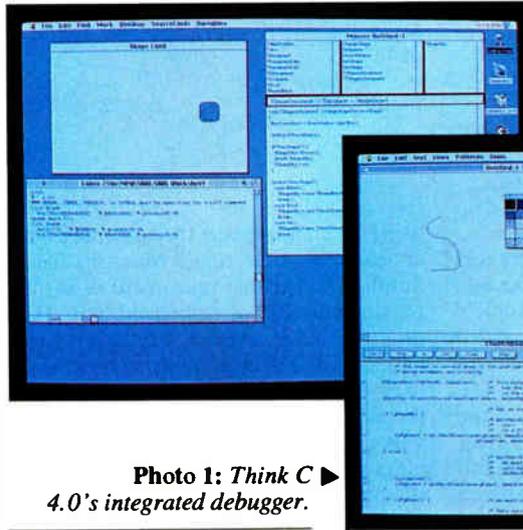
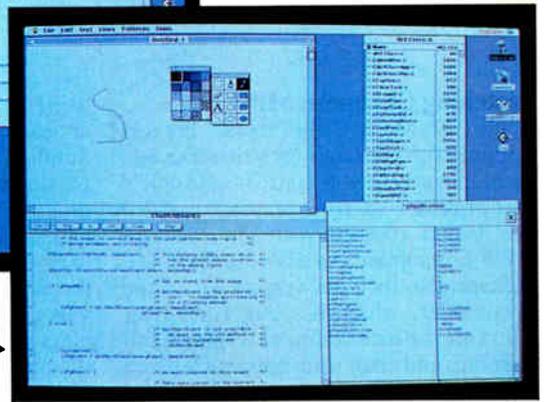


Photo 1: Think C 4.0's integrated debugger.

Photo 2: Apple's Symbolic Application Debugging Environment debugger running with MPW C++.



A Closer Look: Think C

The Think C environment is inviting, and it is streamlined for C development. The object extensions (make no mistake, Think C is not C++) provide you with tools to tame the Macintosh. The program offers a number of improved features, along with the object extensions, over version 3.0.

The new ANSI library supports all the ANSI standard functions. This is nice for portability. It replaces the Unix libraries from earlier versions. It also eliminates some old, peculiar functions in favor of more standard ones. Functions like `c1alloc` and `m1alloc` and non-standard string-to-number conversions are gone.

ANSI prototyping is now supported. This makes for better programs by forcing the compiler to check arguments in function calls and by forcing programmers to properly cast variables. In-line assembly is available, too, and it now accepts all MC68020 and MC68881 instructions and addressing.

A nice feature is the "Once only headers" that lets you define a preprocessor symbol at the top of your header files to

prevent multiple inclusion. The rule is that if you define a symbol beginning with `_H_` followed by the name of your include file, without the `.h` extension, it will not be processed a second time if it is included by other header files. For instance, the statement

```
#define _H_foo
```

within the file `foo.h` stops it from being included again, in case other header files also include `foo.h`.

Think C makes it easy to build multi-segment code resources for desk accessories and device drivers and provides the ability to address globals using register A4 without affecting other applications' A5 addressing.

Another feature that I like is cdev debugging. Symantec has implemented a cdev object. The basic methods are already done, which means you only need to worry about the specifics of your cdev. An example with two projects is included. One project builds a real cdev, and the other builds an application with which you can use the debugger.

continued

In the 1990s, code will be generated by the click of a mouse or a tap of a key. With Matrix Layout 2.0 you can do that now. And the results will surprise you.

Preview the 1990s with Layout

In Layout, you create programs by designing an object-oriented flowchart, with all the options of traditional programming. It's a technology we call desktop programming.

Once you're done, simply choose the language you want for the finished program. There's Microsoft C, Lattice C, and Turbo C, as well as Turbo Pascal and Microsoft QuickBasic. You can even create a .EXE file that's ready-to-run on any IBM PC or compatible.

1990s Power without 1980s Pain

Because Layout works with today's standards, you can painlessly take advantage of the power behind Layout – object oriented programming, CASE (Computer Aided Software Engineering) technology, hypertext databases, and graphical user interfaces. All without giving up your favorite computer language.

An Architecture for the 1990s

Layout comes with objects that produce real code for everything traditional computer languages can do – math, branching, variable management, complex data structures – and it extends each language to include powerful user interface and hypertext database capa-

bilities. But best of all, you can extend Layout past the 1990s by building your own objects – BlackBoxes – that can do anything you imagine. Added together, Layout cuts your development time by up to 70%.

Welcome to the 1990s

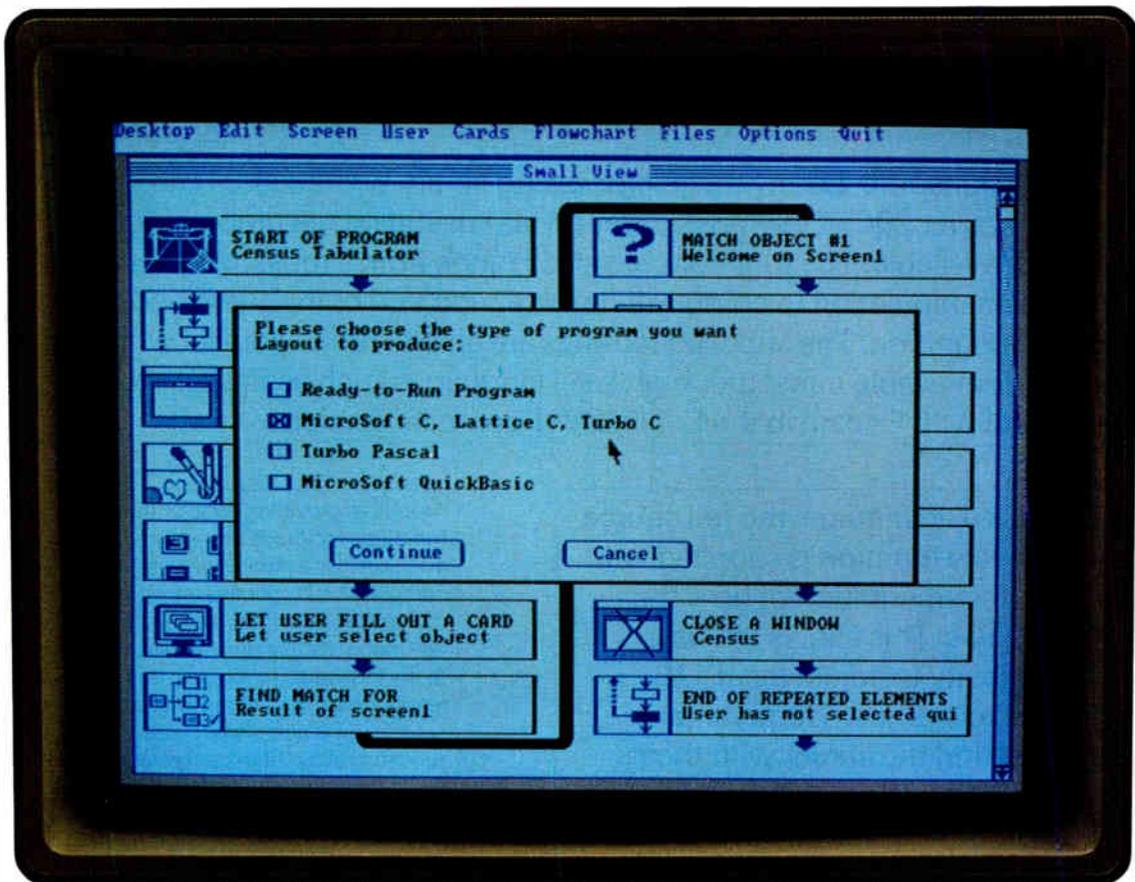
Ready to jump into the 90s? Get Layout today. It's available for just \$199.95. Or for a glimpse of the 90s, see the Layout video tape for just \$9.95. Give us a call at

1-800-533-5644

In Massachusetts call (617) 567-0037.



In the 90s, this is how you'll write code.



Matrix Software Technology Corporation • One Massachusetts Technology Center • Harborside Drive • Boston, MA 02128

Matrix Software Technology Ltd. • Matrix House, Derriford Business Park • Derriford, Plymouth • Devon PL6 5QZ, England • 0752-796-363

Matrix Software Technology Europe N.V. • Geldenaaksebaan 476 • 3030 Leuven, Belgium • 016202064.

All trademarks and registered trademarks are of their respective companies.

Circle 178 on Reader Service Card (DEALERS: 179)



PARALLEL IMAGE PROCESSING



High Speed Parallel Processing

IPLIB is a transputer based image processing library written in C. The library consists of over 200 of the most common and useful image processing functions available. The functions supplied range from simple row, column and pixel manipulation to complex line extraction and component and texture recognition. The supplied routines are able to run in parallel with the commonly available transputer high level languages such as Pascal and Fortran and with Occam in the D705/D711 compiler versions.

As an added advantage, the full source code of every function is supplied with detailed documentation of how the system works. This allows the user great flexibility to adjust the IPLIB functions to their own requirements and to expand the library with their own routines.

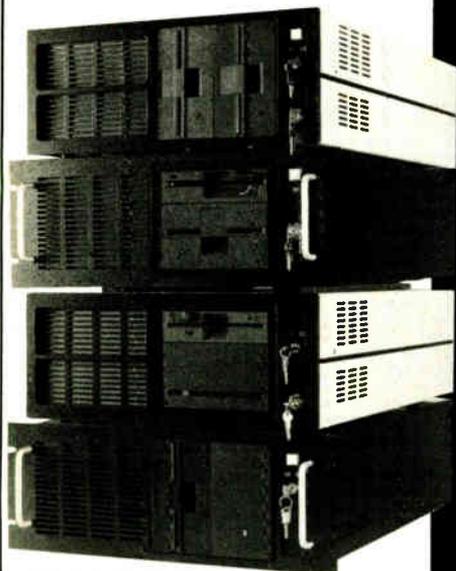
As well as providing large numbers of functions for image processing IPLIB also provides a parallel processing harness which operates transparently to the user. Functions are supplied that will automatically allocate data packets to the individual processors and then reassemble the resulting image after processing is complete. These functions allow high performance parallel systems to be constructed quickly and easily.

For details of availability and application please contact: Steven J. Doyle
National Engineering Laboratory East Kilbride, Glasgow G75 0QU, U.K.
Telephone: East Kilbride (03552) 20222 Telex: 777888 Fax: (03552) 36930

Circle 202 on Reader Service Card

Rack & Desk PC/AT Chassis

Integrand's new Chassis/System is not another IBM mechanical and electrical clone. An entirely fresh packaging design approach has been taken using modular construction. At present, over 40 optional stock modules allow you to customize our standard chassis to nearly any requirement. Integrand offers high quality, advanced design hardware along with applications and technical support *all at prices competitive with imports*. Why settle for less?



Rack & Desk Models

Accepts PC, XT, AT Motherboards and Passive Backplanes

Doesn't Look Like IBM

Rugged, Modular Construction

Excellent Air Flow & Cooling

Optional Card Cage Fan

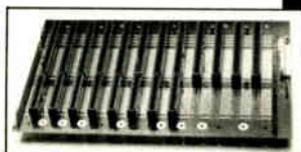
Designed to meet FCC

204 Watt Supply, UL Recognized

145W & 85W also available

Reasonably Priced

Now Available
Passive Backplanes



INTEGRAND

RESEARCH CORP.

Call or write for descriptive brochure and prices:
8620 Roosevelt Ave. • Visalia, CA 93291

209/651-1203

TELEX 5106012830 (INTEGRAND UD)

FAX 209/651-1353

We accept Bank Americard/VISA and MasterCard

IBM, PC, XT, AT trademarks of International Business Machines. Drives and computer boards not included.

176 B Y T E • APRIL 1990

be able to perform all the basic functions of your application. The Agent automates tasks by using this task language, even though much of the work is performed by the application.

Since most Windows programs were

NewWave
*isn't easy to port to,
but then, nothing
worth doing
should come easily.*

not written with a command language in mind, creating a complete one can be a difficult job in itself. HP suggests that you use its YACC (a spin-off from the Unix Yet Another Compiler Compiler, for which HP includes an advertising flyer) to generate the parser for the language. The manuals give examples of task languages and what to do with them, but using the examples causes some basic structural changes to your program. All commands can be processed by the same function. If you use dialog boxes—and who doesn't—you will have to make a number of changes. The dialog boxes should just return command codes for the main command processor to execute. You will not be performing much other than entry validation in the dialog box functions.

The CBT support lets you write automated tutorials for your program. Again, it requires changes to your main window procedure so that it can monitor what the user is doing and supply actions when necessary. HP supplies a limited animation capability for CBT that helps make things a little more interesting. Creating the animation is a tedious job at best, though. I didn't have time to do more than look at the code changes necessary to support this, and they are considerable.

One of the more interesting features of NewWave is the data sharing, with which a view of your applications data can be pasted into another application. This view is wholly maintained by your application, but support is implemented by handling another set of messages that HP has defined. Again, the code to support this can be rather large. The examples

given in the NewWave documentation were not very clear on what it takes to do this.

Another area in your application that will require modifications is the print support. NewWave objects print themselves using a different technique than is normally used by a Windows program. NewWave performs all printing by way of metafiles. The window procedure receives a message indicating that it should print a single page to the given metafile. After each page is done, the window procedure sends a message back to NewWave asking for the next page's metafile, and another message is sent when printing has completed. Since you are printing to metafiles, the normal Windows spooler isn't needed, and NewWave installation disables it by default. A side effect of this is that your normal Windows applications will print more slowly. If you are going to be doing much printing from a normal Windows application, you will probably want to reenable the spooler. Make sure you disable the spooler afterward; otherwise, the (effectively) doubled spooling will make the system seem slow.

Likable, but a Lot of Work

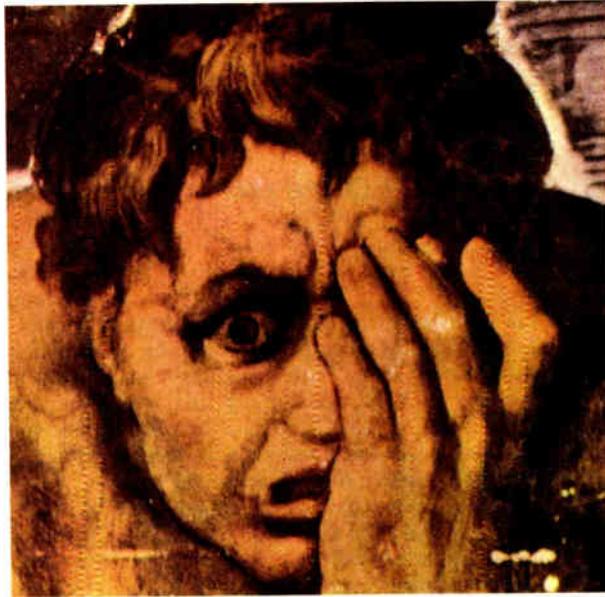
Overall, I liked using the NewWave interface. The icon-/object-oriented interface is easy to use and learn. When more applications are available, it should be a nice environment. I like the idea of sharing views of data between programs. This could make some of my normal bookkeeping a lot easier.

However, modifying an existing program to use is difficult at best. If you don't perform a complete conversion, there is no real advantage to the environment. If you do a complete conversion, you must rewrite major portions of your application. If you are planning to convert your application to the NewWave environment, you should sit down and figure out just what portions of it you need to or can support. The HP NewWave Environment Programmers Guide gives a good (although incomplete) description of how to convert an existing application.

The manuals need some help. If you run into a snag, the support line is good. In any case, expect to spend a lot of time reading the manuals and testing what you've written. NewWave isn't easy to port to, but then, nothing worth doing should come easily. ■

John Lussmyer is a software developer living in Troy, Michigan. He can be reached on BIX as "jlussmyer."

Death Taxes Software Piracy



We can save you from one of them.

Sorry. Death we can't do anything about. As for taxes, when you use our product you'll probably wind up paying more. But software piracy: there we offer some help. Our family of software protection devices (dongles) have improved unit sales for over 2,000 companies around the world. Our products can be used in the MS-DOS, OS/2 and Macintosh environments.

Build Your Own Custom Protection Environment

Use our patented "dual-locking" ASIC chip as the basic building platform. Next, add options like: on-the-fly read/write memory, write-once or multiple-write locking codes, and encryption shells. Then add your

own programming creativity to build a protection environment best suited to your product.

Users attach the device to their parallel port, and programs won't run without it. Back-up copies, hard disk and LAN operation are not interfered with.



Your Intellectual Property Belongs To You

And if you don't protect it, who will? Our products offer the most equitable way to protect your interests without sacrificing the rights of your customers. Call us today for information and demonstration units.

Software Security



1011 High Ridge Road - Stamford, CT 06905
1-800-333-0407 ext. 101

203-329-8870 Fax 203-329-7428 BBS 203-329-7253
AppleLink™ D2379

Macintosh is a trade mark of Apple Computer Inc., Activator, Mactivator are trade marks of Software Security, Inc. illustration: detail from Michelangelo's Last Judgement

Circle 265 on Reader Service Card

PostScript® Language Just Got More Affordable!



NEW

PRICING:

GoScript: \$19~~X~~
(13 fonts)
is now only \$149

GoScript Plus: \$39~~X~~
(35 fonts)
is now only \$299

GoScript allows you to print PostScript language text and graphics on the most popular laser, ink jet and dot matrix printers.

NEW

**VERSION 3
FEATURES:**

- EGA and VGA screen drivers give you screen preview capabilities.
- GOPRINT™ printing utility allows you to use our scalable fonts to print plain text files.
- An expanded Bitmap Save option allows the bitmap image to be saved in TIFF or PCX format.
- Send back the registration card to receive 4 extra fonts.

For Catalogs, Brochures, Benchmarks, Compatibility Lists, Print Samples & Ordering Information, contact us at:

1-800-955-FONT

or

**LaserGo, Inc.
Attn: New Products
9369 Carroll Park Drive
Suite A
San Diego, CA 92121**

GoScript is a registered trademark of LaserGo, Inc. GoPrint is a trademark of LaserGo, Inc. PostScript is a registered trademark of Adobe Systems, Inc. All other product names are trademarks of their respective manufacturers.

In addition, you must set up a function to handle the OMF HAS_METHOD messages. This simply returns True or False, depending on whether your application supports that particular NewWave method. A method is just a name for a particular type of NewWave message. I do not understand why the company didn't provide a standard Window sub-

I had a
*number of objects just
disappear until I told
NewWave to straighten
up the screen
and realign by rows.*

classing function to handle the NW_MessageFilter, WM_SYSCOMMAND, and HAS_METHOD handling. It looks like these handlers might be identical for all applications. The OMF already has all your HAS_METHOD information from your .IN\$ file (a file similar to the Windows .DEF file).

HP has given quite a few style guidelines for NewWave developers to follow, one of which is that during activation, you get the title of the object being activated and display it in the title bar of the application. You also must obtain the filename and path from OMF and load the file. For BixWin, my objects are just a minimal specification of which conference, topic, and message are to be viewed. Since I wasn't doing this in the original Windows version, I had to add a menu item and code to read and write to the files. The menu that was most affected by this was the Conference View menu. I added Remember, which creates a NewWave object. When this object is activated, it starts a view of the message that was remembered. It is not an easy task to create a new object from within a program. You can only invoke the NewWave dialogue that the user normally uses. The user still has to fill in the blanks in the dialogue. There doesn't seem to be a way to simply create a new object of the same type that is executing.

In addition, do not use the undocumented Windows function ExitWindows from your application. NewWave will

prompt with a message box that asks whether you really want to exit (which is probably what you were trying to avoid). It will also end up confused about the state of any objects on the screen. I had several objects just disappear until I told NewWave to straighten up the screen and realign by rows.

By the time you do a minimal conversion, your code will look considerably different. Your normal Windows initialization won't actually display the window. You will have added several new functions to process OMF messages, along with a bunch of calls to OMF function for initialization and termination.

HP recommends that you add the line EXETYPE WINDOWS to your .DEF file for proper operation. You also have to create an .IN\$ file that gives NewWave some environment-specific information about your program. This includes a list of files that make up the executable file, whether default data files get copied when a new object is created, what methods are supported, and the name of your application.

Going All the Way

At this point, your application will be more NewWave tolerant, but it won't yet fully exploit the new features. The second part of conversion will bring you up to a full NewWave application. This is the heart of the NewWave API: It supports the on-line help facility, Computer Based Training (CBT), and the Agent. I did not have time to perform a full conversion on my large BixWin application. I read the manuals and worked with the supplied sample programs. Each of the sections of the API requires extensive changes to the average application. HP tells you that setting up the Help facility requires no programming; then, a few pages later, there is a list of messages that you must process for Help to work. The Help facility looks nice when it is done. The major problem is writing Help text that makes sense.

Adding the last bit of NewWave functionality to an application renders it even more unrecognizable. You must add calls to quite a few API functions to determine if you are going to process the message, and if so, what to do with it. HP provides sample code sections that can be copied verbatim into your code. These are more correct, you hope, than the usual Windows sample code. Again, it looks like HP could have performed many of these functions by just subclassing the window when you create it. Most of these changes are to support a task language that is

continued

HOW TO COMBINE SPEED, POWER AND GRACE WITH BRUTE FORCE.



AUTOCAD® 386. Zoom faster. Pan faster. Draw faster. AutoCAD 386 combines world-standard CAD performance with full-force 32-bit workstation power — right on your 80386*-based PC.

AutoCAD 386 is built for speed. It loads, redraws, and saves drawings up to 62% faster than before. It accesses up to 16 megabytes of RAM and 4 gigabytes of virtual memory, making more room available for larger AutoLISP* and other applications programs, memory-resident drivers, network interfaces and other utilities — which translates directly into more speed.

Quick! Call Autodesk now to arrange a power-demo at the authorized Autodesk reseller nearest you. And upgrade your present version of AutoCAD for as little as \$300.

Autodesk, the Autodesk logo, AutoCAD and AutoLISP are registered in the U.S. Patent and Trademark Office by Autodesk, Inc. 80386 is a registered trademark of Intel Corporation.



AUTODESK

2320 Marinship Way, Sausalito, CA 94965
800-445-5415 Ext. 65

Circle 32 on Reader Service Card

World Radio History

NewWave 1.0**Company**

Hewlett-Packard Corp.
Santa Clara Information Systems
Division
3410 Central Expy.
Santa Clara, CA 95051
(408) 749-9500

Hardware Needed

A 286 or 386 PC with 3 MB of expanded memory (EMS 4.0), a 20-MB hard disk drive, an EGA or VGA monitor, and a Hewlett-Packard or other Microsoft Windows-supported mouse

Software Needed

DOS 3.2 or 3.3; Microsoft Windows/286 version 2.11

Price

NewWave and support pack: \$195
NewWave developer's kit: \$895

Inquiry 887.**The Trouble with Windows**

I had just finished installing Microsoft Windows 2.11 when I found the README file on the NewWave installation disk 1. Some of the instructions in this file tell you to replace certain files on the Windows installation disks with ones supplied by HP. So I made the changes and reinstalled Windows. If you ever have to reinstall Windows after you have installed NewWave, you must make some minor changes to the Windows installation.

This time when I ran the NewWave installation, everything seemed to run properly. A Windows/NewWave program performs a large part of the NewWave installation. This means that the installation runs slowly with long delays between disk swaps.

Problems began almost immediately after starting NewWave. Most of the Windows utility functions (e.g., Calc, Notepad, and HeapWalker) would not run. They aborted with a "not enough memory to run" message. One of the NewWave tools, Agent (an object that records and plays back user actions), just told me "Agent tool can't be opened in this release." Why was it installed? Every now and then, my NewWave session would inform me that it couldn't find one of its system files and to put it in drive A. Right. I didn't even know which distribution disk it was on. I *knew* that it was on the hard disk drive, but NewWave couldn't find it. I had to either put it on a disk in drive A or use the three-finger

salute to reboot (losing any work in progress).

I called the NewWave technical-support line again, and this time I was quickly connected to a person. It turns out that the company has a new phone system and has had some problems with it, but the technical-support person was surprised to hear that no one had called me back. She was quite helpful and answered a few questions I had but couldn't figure out what was going on. The manuals had left me with the impression that NewWave worked only with EGA and VGA, which is wrong; it should work with any Windows-compatible video card, although NewWave has only been tested with EGA and VGA. She also verified that NewWave won't work with Windows/386. This was never explicitly stated in the manuals.

Within a couple of hours, the technical-support person called me again to get more information on my system. An hour or so later, she called and had another person there to help. We finally found that Windows 2.11 doesn't work with my Novell network. So I got on Microsoft's On Line support service and found that Microsoft had a fix for the problem, a new KERNEL.EXE (On Line knowledge base message Q44660). After downloading this and reinstalling Windows, everything started working fine.

Converting Applications for NewWave

A couple of days after getting NewWave running, I received the HP NewWave developer's pack. This is a set of disks with five binders' worth of manuals and another copy of the application notes.

The manuals are not especially helpful. HP really needs a book similar to Charles Petzold's *Programming Windows* (Microsoft Press, 1988) for NewWave. The most helpful manual is the HP NewWave Environment Programmers Guide. It describes how to convert an existing Windows application into a NewWave application, although it explains only a minimal conversion.

I did a minimal conversion of my Windows-based BIX conference viewer. My goal was to create a BixWin object that is a view of a specific portion of the message database. The changes required to even minimally convert an existing Windows application to work in the NewWave office are extensive. If your application makes use of the command line, you will have problems. NewWave has its own internal use for the command line, and, as far as I can tell, you cannot invoke an application from the DOS com-

mand line. It really wouldn't make sense in the NewWave object environment to do so. Any special command-line options you have will need to be implemented in some other fashion.

You must change two main functional groups of program code: those groups that use the Object Management Facility (OMF) and those that use the NewWave application programming interface (API). The NewWave OMF consists of a group of messages and functions that you must work with to handle NewWave objects. NewWave will invoke your application when the user (or another program) activates an object belonging to your application. This makes for some changes to the normal menu structure. The normal File menu is renamed Action, and some of the functions are changed. You will no longer have a New item; that function is handled by OMF. You can select Objects and then Create a New from the Office window. The function Save As will also create a new object.

Your application will also have more possible states of execution. A stock Windows application is either running or it isn't. Under NewWave, it can be inactive (not running at all), active, or open. When it's active, it creates its window but doesn't display it. A window is only displayed when the application is brought up to open status. This additional state requires changes to the application's initialization functions. You will always create the window, but you don't perform the ShowWindow or UpdateWindow function calls until NewWave sends you an OMF_OPEN message (which it may never do). To create a window, the NW_CreateWindow function is called, which replaces the existing CreateWindow. The initialization code also has to call the OMF_Init function to tell OMF what your window handle is. NewWave makes extensive use of property lists to maintain information about a window.

After you have called OMF_Init, you start getting OMF messages, and you must modify your main window procedure to properly handle them. The first thing your Window procedure must do with each message is call NW_MessageFilter. If this function returns True, you must immediately return to Windows with a value given to you by this function. You will also have to process some of the various WM_SYSCOMMAND messages. For SC_MAXIMIZE and SC_RESTORE, NewWave provides special functions that should be called. All other WM_SYSCOMMAND messages should be passed on to DefWindowProc.

continued



Windows Rides a New Wave

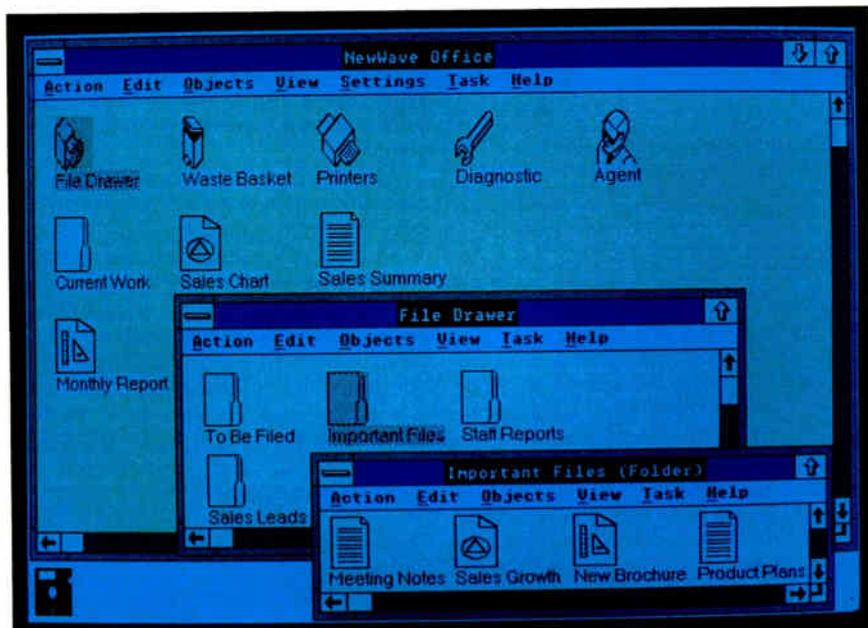
Hewlett-Packard's NewWave is nice, but is it too hard to use?

John Lussmyer

When Microsoft Windows was first introduced, it started people thinking about the potential of a DOS-based graphical user interface. Still, even now, it seems that something is missing. While Windows provides a programming interface and a platform for graphics-based applications, it offers little in the way of amenities to users. Furthermore, while object-oriented paradigms apply well to GUIs, Windows' programming interface does not include many hooks that allow interface elements to be handled as objects.

NewWave, Hewlett-Packard's layered enhancement for Microsoft Windows, promises to change all that. Announced over two years ago, NewWave is supposed to bring a more robust feel to Windows. The goal was to make Windows easier to use and expand the range of functionality available to Windows applications. In this review, I'll examine NewWave, both the user interface and the programming tools, and weigh the benefits it brings against the hardships it creates.

NewWave is much more demanding than Windows. My system, an NEC PowerMate 386/20 with 4 megabytes of RAM and a 40-MB hard disk drive, just barely met the requirements of NewWave. On a 386 system, you need at least 4 MB of RAM and 8.5 MB of disk space. That's a tall order, but moving some files to the Novell network cleared up enough disk space.



The top level of NewWave, the icon-based "office." Even minimal conversions of Windows applications to the NewWave office are not trivial.

The NewWave installation program decided that my system was not set up correctly, wrote out a lengthy error file, told me to read it, and quit. I would have preferred an explanation of the failure on the screen. The error file listed several problems with the way my system was set up. The error messages were fairly verbose and contained references to various application notes; I had a little trouble finding those notes. According to the error messages, my system didn't have any EMS bank pages above 640K bytes, it didn't have enough EMS RAM (installation had found only 80K bytes), it didn't have enough EMS RAM for banking (this time installation found 2528K bytes), the proper version of Windows was not installed, I did not specify a TEMP directory in my environment, and I did not have enough free disk space. If you didn't already know, NewWave is a

very demanding, finicky environment.

I fixed the first problem by changing my 386Max installation. I never understood why NewWave saw only 80K bytes of EMS RAM, so I ignored the error. Decreasing the size of the disk cache gave me enough EMS RAM for banking. I had Windows 2.10 in my path; NewWave requires version 2.11, so I installed a newer copy. I then set up a TEMP directory. Finally, I made room on my hard disk drive, and NewWave was satisfied.

I had some questions about NewWave's use of EMS and called the HP NewWave support hotline. After a few levels of voice-mail recordings, I got another recording telling me that all the support people were busy and to please leave a message. I did, but no one returned my call.

continued



ACMA offers "...performance, expansion possibilities, better-than-average warranty, and reasonable prices. This is an impressive machine." "...our favorite is the ACMA 386/25 Business System." *PC Magazine 11-28-89*

Urgent News:

Acma Slashes Prices

45 Day "Risk Free" Money-Back Guarantee -- Two Year System Warranty* -- Unlimited Lifetime "Toll-Free" Technical Support -- Replacement Parts Shipped Air Express FREE! -- Fastest Delivery In The Industry -- Flexibility Makes Ownership Easy -- Hearing And Speech Impaired TDD Service -- Commercial Leasing -- On-Site Service Available!



Get all the hardware you need to start computing today!



Complete 286 Business Package Now! \$1,265

FREE Surge Protector and Printer Stand

ACMA's 286/12 with Intel's 80286/12MHz CPU - New Enhanced AT ChipSet - AMI BIOS - 0 wait state - page mode interleaving - 512K RAM expandable to 8MB - 80287 math coprocessor support - ROM based setup - shadow RAM - 1.2MB or 1.44MB floppy drive - 20MB hard drive - dual hard/floppy controller - parallel and serial ports - eight expansion slots - 200Watt UL approved power supply - enhanced 101-key keyboard - monochrome monitor and video card - Panasonic 1180 printer (192/38 cps) *PC Magazine Editor's Choice Nov. 14, 1989* - 6' parallel printer cable - ten diskettes - computer paper - User's Guide and "Easyview" stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

286/12 Now! \$745

- 45 Day Money-Back Guarantee!
- Intel 80286-12 CPU running at 6/12MHz (keyboard switchable)
- Chips & Technologies "NEAT" CHIPSet, and AMI BIOS
- 512K RAM, expandable to 8MB on system board
- 0 wait state with page mode interleaved architecture
- 384K Shadow RAM w/1MB option
- Eight expansion slots
- 200W UL, CSA & TUV approved power supply (110/220V)
- Supports EMS/LIM 4.0
- Supports 80287 math coprocessor
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy disk controller
- Parallel, serial & game ports
- Clock/calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible.
- Choice of Mini or Standard case (Vertical case \$150)
- 2 year warranty

386SX Only! \$995

- 45 Day Money-Back Guarantee!
- Intel 80386SX-16MHz CPU
- Intel Chipset and AMI BIOS
- 1MB 32-bit high-speed RAM
- 0 wait state with page mode interleaved architecture
- Shadow RAM for system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80387SX math coprocessor
- Seven expansion slots
- 200W UL approved power supply
- ROM-based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock/calendar w/ battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible
- Choice of Mini or Standard case (Vertical case \$150)
- 2 year warranty

386/20 Now! \$1,295

- 45 Day Money-Back Guarantee!
- Intel 80386-20 CPU running at 6.8/16/20MHz
- AMI BIOS
- 1MB 32-bit high-speed RAM, expandable to 16MB
- 0 wait state with page mode interleaved architecture
- Shadow RAM for lightning-fast system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80287, 80387 and Weitek math coprocessors
- Eight expansion slots offer tremendous growth
- 200W UL, CSA & TUV approved power supply (110/220V)
- Built-in ROM based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock/calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible
- Standard case (Vertical case \$150)
- 2 year warranty

386/25 Now! \$1,495

- 45 Day Money-Back Guarantee!
- Intel 80386-25 CPU running at 6.8/16/25MHz
- AMI BIOS
- Cache Upgrades: 32K or 64K cache options available
- 1MB 32-bit high-speed RAM, expandable to 16MB
- 0 wait state with page mode interleaved architecture
- Shadow RAM for lightning-fast system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80287, 80387 and Weitek math coprocessors
- Eight expansion slots offer tremendous growth
- 200W UL, CSA & TUV approved power supply (110/220V)
- Built-in ROM based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock/calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible
- Standard case (Vertical case \$150)
- 2 year warranty

Complete 386SX Package Now! \$1,799

FREE Surge Protector and Printer Stand

ACMA's 386SX with Intel's 80386SX-16MHz CPU - AMI BIOS - Intel ChipSet - 0 wait state - page mode interleaving - 1MB RAM - 80387SX math coprocessor support - eight expansion slots - 200Watt UL approved power supply - 40MB/28ms hard drive - 1.2MB or 1.44MB floppy drive - parallel and serial ports - enhanced 101-key keyboard - monochrome monitor with tilt/swivel stand and monochrome video card - Panasonic 1191 printer (240/48 cps) - 6' parallel printer cable - ten diskettes - computer paper - User's Guide and "Easyview" stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

Complete 386/20 Power Package Now! \$2,650

FREE Surge Protector and Printer Stand

ACMA's 386/20 with Intel's 80386/20MHz CPU - AMI BIOS - 0 wait state - page mode interleaving - 1MB RAM expandable to 16MB - 80387 math coprocessor socket - built-in ROM based setup - 1.2MB or 1.44MB floppy drive - 65MB (28ms) hard drive - 1:1 interleaved hard/floppy controller - parallel, serial and game ports - eight expansion slots - 200 watt UL approved power supply - enhanced 101-key keyboard - 16 bit VGA card - Color VGA monitor - Panasonic 1124 printer, 24 pin Near Letter Quality (NLQ), *PC Magazine Editor's Choice Nov. 14, 1989* - 6' parallel printer cable - ten diskettes - computer paper - User's Guide and "Easyview" stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

With Monitor & Video Board	Mono	EGA	VGA	With Monitor & Video Board	Mono	EGA	VGA
40MB/28ms	\$1,229	\$1,529	\$1,629	65MB/28ms	\$1,695	\$1,995	\$2,095
65MB/28ms	\$1,369	\$1,669	\$1,769	120MB/28ms	\$2,095	\$2,395	\$2,495



NEC 3D Monitor, & ATI Video Card With Mouse (PC Mag. Editors Choice 6/89) \$890
Hyundai Color VGA Monitor & Acma VGA Video Card \$458
Hyundai EGA Monitor & Acma EGA Video Card \$419



Only \$95

Now, for a limited time, get PFS: First Choice for \$95 when you purchase any Acma computer. You save almost 43% off the regular retail value of \$149!

With Monitor & Video Board	Mono	EGA	VGA
65MB/28ms	\$1,895	\$2,195	\$2,295
120MB/28ms	\$2,295	\$2,595	\$2,695

With Monitor & Video Board	Mono	EGA	VGA
65MB/28ms	\$2,095	\$2,395	\$2,495
120MB/28ms	\$2,495	\$2,795	\$2,895

Open 7 Days A Week!

800-456-1818

Hearing & Speech Impaired TDD 800-456-8898
Mon - Fri 7am to 6pm, Sat - Sun 9am to 3pm PST



117 Fourier Ave., Fremont, CA 94539 (415) 623-1212 (415) 623-0818 Fax

We accept Visa, Mastercard (no surcharge), American Express, C.O.D. via certified check, qualified P.O.'s, money orders, wire transfers, and personal checks (allow 7 days to clear). Cash, check or wire transfer prepayments get 1% discount. Add 3% for shipping and handling (\$3 min.), or 4% for second day air on systems. In California add 7% sales tax. Call for shipping costs for Military addressed (APO/FPO), or if outside the continental United States. 45 day money back guarantee does not include monitors, accessories, return shipping and handling. Software, accessories, printers, monitors and shipping are not refundable. Replacement parts are cross-shipped via 2nd day air at Acma's expense with an approved RMA. Customers assume all responsibilities and costs for returning defective parts to Acma. We are not responsible for errors in typography or photography, and reserve the right to substitute equivalent, or better, parts. Prices and specifications are subject to change without notice, and all brand names are registered trademarks of their respective companies. *Two year system warranty - 1st year parts and labor, 2nd year labor. Products not made by Acma are covered by the manufacturer's warranty. Commercial leasing is for qualified businesses only, and the amount listed is based on a 36 month, zero down, 10% purchase option lease on basic configurations. ** Free shipping of Video Combos is by UPS ground, and covers the monitor and video card when purchased separately from any other products.

Circle 11 on Reader Service Card

CHEETAH GOLD 425™

Cheetah Gold 425/D™

- INTEL 25MHZ i486 CPU/FPU
- FULL 16MB of 70NS System Memory
- Tower Case with 450/W Power Supply
- ESDI Caching Disk Controller with Dedicated Processor and 512K Memory
- Super Fast 383 MB ESDI Hard Drive
- 1024 x 768 Premium VGA Card
- 14" Premium VGA Color Monitor
- 1.2MB & 1.44Mb Floppy Drives
- 2 Serial & 2 Parallel Ports
- 101 Key Keyboard
- Cheetah Gold 425/D \$9,995 !
(Other models from \$5,995)
- Price subject to change
- 20% Refundable deposit required
- Subject to availability of INTEL 25MHZ 80486 chips. A surcharge may apply if Cheetah's cost of i486 chips exceeds \$950 each.
- VISA, MasterCard and American Express add 4%
- Delivery date subject to the availability of i486 chips.

AWESOME . . . PERIOD

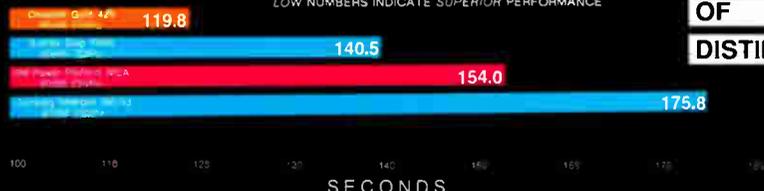


1989

BYTE
AWARD
OF
DISTINCTION

BENCHMARKS

LOW NUMBERS INDICATE SUPERIOR PERFORMANCE



Cheetah International, Inc.
1003 West Cotton Street
Longview, TX 75604

1-800-CHEETAH
(1-800-243-3824)
1-214-757-3001
1-214-753-0589 FAX

Source: Byte Magazine, December 1989. Benchmark numbers are the average of Software Engineering, Engineering, and Future from the AMT Benchmarks - 80486 program.

Cheetah Gold 425™ with 80486 processor and 16MB system memory. All other trademarks are the property of their respective owners.

"PC BRAND 386/33 HAS FLAWLESS COMPATIBILITY, LOWEST PRICE"

InfoWorld, Product Review,
January 8, 1990

FROM \$2299

InfoWorld 386/33 Review Scores:



PC Brand _____ 8.0
Compaq _____ 7.1
Gateway 2000 _____ 7.1



386/33 CACHE _____ \$2299

33 MHz Clock, Zero Wait Operation,
Norton SI 45.9 • Landmark 58.7 MHz,
1024K RAM, 1.2MB or 1.44MB Drive, 101-Key Keyboard,
2 Serial and 1 Parallel Ports

"Here's a price \$2799...
[Now \$2299] Must be
stripped to nothing, Right?
Wrong..You don't sacrifice
quality for low price either.
The PC Brand machines
are an efficient combi-
nation of in-house engi-
neering and top-notch
off-the-shelf Parts."

-PC Magazine, 33MHz 386 PC's,
October 31, 1989

"... great value. Period.
...excellent price perform-
ance ratio; high quality."

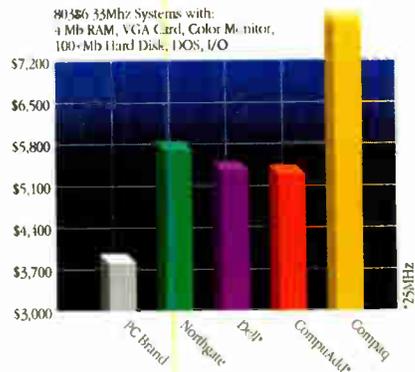
-Computer Buyers Guide,
Product Review,
February, 1990

Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating w/ Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385 33 Cache Processor with 32K 25NS Static RAM Standard
- 1024K RAM Standard Expandable to 16MB
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive/Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports 2 serial, 1 parallel
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS with Full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- EMS and Disk Cache in ROM
- 8 Slot motherboard design
- Medium foot print case w/ 6 Disk Drive bays

Options:

- Full size Tower ® Case w/6 Disk Drive bays (as shown above)
- Custom configurations w/Name Brand peripherals of your choice
- Factory Ram Upgrades



PC BRAND 386/33 CACHE

with Hard Disk Drive, Monitor & Video Card

Hard Drives Mb/Ms	40/25	66/25	100/25	200/19
No Video	\$2679	\$2859	\$2999	\$3449
Mono	\$2799	\$2979	\$3119	\$3569
VGA-Mono	\$2979	\$3159	\$3299	\$3749
VGA-Color	\$3209	\$3389	\$3529	\$3979
SVGA/Color	\$3319	\$3499	\$3639	\$4089

Turn the page for Portables & Peripherals

Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 951 W. Washington St., Chicago, IL 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200
We are open Mon thru Fri: 9am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**



Portables With More Power than Desktops.

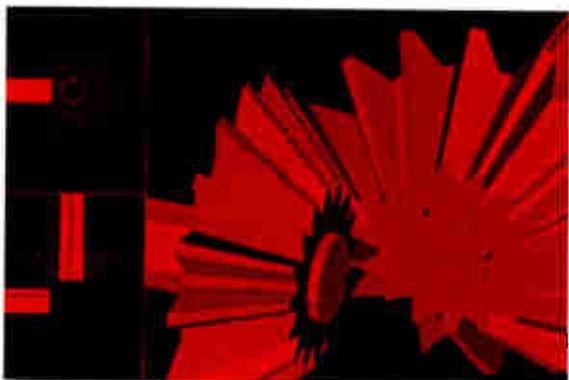


512K (286,386/sx) or 1024K (386) RAM Serial and Parallel Ports, 1.2MB or 1.44MB Floppy, 86-key keyboard

The power, reliability and performance of our desktop system motherboards combine with our portable casing to make our system technically unique!

We support 3 built-in, externally accessible disk drives, enabling dual (3.5" and 5.25") floppies for total media compatibility. Including tape (CD-ROM drives or other devices to deliver desktop functionality in a Portable Unit.

Simultaneous internal AND external monitor support, VGA functionality, 2 open card slots and our unique 3 drive support, permit this family to be used as a complete "in the office system" which you can pick up and take anywhere.



Actual VGA PLASMA Screen Image

Standard System Features:

- All performance and compatibility features as in desktops featured on previous pages
- 16 Grey Scale 640x480 VGA Plasma or 4 Grey Scale 640x400 CGA/Mono Graphics

Standard Features Continued:

- 3 Accessible Drive Bays for (2) 5.25" and (1) 3.5" Units
- 2 Available Peripheral Card Slots
- Simultaneous internal & external displays
- 200 Watt Auto Voltage Switching Power Supply

VVGA Gas Plasma Portables

Drives	1 Floppy	40-25	100-25	200-19
286/12	\$2595	\$2995	\$3495	\$3960
286/20	\$2795	\$3195	\$3595	\$4100
386/SX-16	\$2895	\$3295	\$3695	\$4260
386/20	\$3350	\$3750	\$4150	\$4710
386/25	\$3550	\$3950	\$4350	\$4910
386C/25*	\$4000	\$4400	\$4800	\$5360
386C/33*	\$4300	\$4700	\$5100	\$5600

*32K Cashed

LCD Backlit Portables

Drives	1 Floppy	40-25	100-25	200-19
286/12	\$1745	\$2145	\$2545	\$3110
286/20	\$1945	\$2345	\$2745	\$3310
386/SX-16	\$2045	\$2445	\$2845	\$3410
386/20	\$2495	\$2895	\$3295	\$3855
386/25	\$2695	\$3095	\$3495	\$4055
386C/25*	\$3145	\$3545	\$3945	\$4505
386C/33*	\$3445	\$3845	\$4245	\$4805

*32K Cashed

Monitors

NEC	
GS-2A 14" MultiMono (to 800x600)	\$249
2A 14" SVGA (800x600)	479
3D 14" SVGA/EGA (1024x768)	649
4D 16" SVGA/EGA (1024x768)	1150
5D 20" SVGA/EGA (1280x1024)	2350
Cornerstone Technology	
19" Dualpage Display (1660x1280)	\$1950
19" Dualpage 16 level (1660x1280)	2795
Imtek/Samsung	
14" VGA Color .31DP (640x480)	\$369
14" VGA Color .41DP (640x480)	299
14" SVGA Color (to 1024x768)	419
Magnavox	
Newest Models	Call
Mitsubishi	
13M1 14" Diamond Scan (to 800x600)	\$499
HL6605 16" SVGA/EGA (to 1280x1024)	1195
HL6905 20" SVGA/EGA (to 1280x1024)	2095
Panasonic	
C1391 PanaSync (to 800x600)	\$489
M1500 15" Mono DTP with adapter	1208
M1900 19" Mono DTP with adapter	1498
Princeton Graphics	
Max15 14" Mono (to 1024x768)	\$249
UltraSync 14" SVGA/EGA (800x600)	520
UltraSync 16" SVGA/EGA (1024x768)	879
Princeton Publishing Labs	
Multiview 15" Mono DTP with adapter	\$890
Relisys	
9503 14" VGA Mono (640x480)	\$135
9513 14" VGA Color (640x480)	369
1520 15" SVGA (1024x768)	679
Seiko	
1440 14" SVGA (1024x768)	\$599
1450 14" SVGA (1024x768)	779
Sony	
1304 14" SVGA (to 1024x768)	\$689
GDM-1606 16" CADD (1280x1024)	Call
GDM-1953 19" CADD (1280x1024)	Call
Zenith	
ZCM1492 VGA FlatScreen (640x480)	\$619

RAM/I/O/Accelerator Boards

Intel	
Aboveboard Plus 512K	\$419
Aboveboard Plus I/O	469
Inboard 386PC with 1M	595
Inboard 386 AT with 0K	859
PC Brand I/O Cards	
AT 1P/25/1G	\$49
XT 1P/15/1G/Clock/Calendar	49

Video Cards

ATI	
VGA Wonder 256K/512K	\$259/339
VGA Wonder V-RAM	Call
NEC	
Graphics Engine (1024x768) 512K/1M	\$999/1349
Paradise	
EGA Autoswitch 480	\$139
VGA+ with 256K (8 bit)	219
VGA+ with 256K (16 bit)	249
VGA Professional	349
VGA 1024 with 512K	239
8514/A Plus	569 with VGA

PC BRAND VGA Cards

VGA 256K (8 bit)	\$99
VGA 256K (16 bit)	139
VGA 512K (16 bit)	189

"an outstanding device... compared with the 15 high performance VGA cards tested in PC Magazine's July 1989 issue."

PC Magazine, Product Review, Oct 31, 1989

Video Seven

1024I VGA with 256K	\$259
VRAM VGA with 512K	495

Fax Cards

Complete PC	
4800/9600	\$249/399
Complete Communicator	
Intel	
Connection Coprocessor	\$699
Quadram	
4800/9600	\$199/509

Modems

ATI	
2400ETC Internal with MNPS	\$165
2400ETC External with MNPS	205
Hayes	
1200B Internal with Smartcom	\$189
2400B Internal with Smartcom	249
1200 External	256
2400 External	359
PC Brand (100% Hayes Compatible)	
1200 Internal with software	\$49
1200 External	70
2400 Internal with software	89
2400 External	129
2400 Internal with MNPS	129
US Robotics	
Courier HST 14,400 External	\$599
Courier V.32 9600 External	889
Courier HST/V.32 External	995
Courier HST 9600 Internal	579

Tape Backups

Archive	
ST600 60MB Internal with controller	\$590
FT60 60MB External with controller	590
FT1501 150MB Internal with controller	895
VP1501 150MB Internal Novell certified	925
VP150E 150MB External Novell certified	1175
VP402 Interface Board for VP Series	Call
VP409 PS/2 Interface Board for VP Series	Call
Colorado Memory Systems	
DJ-10 Jumbo 40/80MB Internal	\$249
KE-10 External (chassis Kit with interface)	139
Maynard	
Maynstream 60MB Portable	\$889
Maynstream 150MB Portable	1395
Maynstream 2200HS 2.2GB Portable	4350

Floppy Disk Drives

500K 5.25" Half Height Black	\$75
720K 3.5" Half Height Black	80
1.2M 5.25" Half Height Grey	85
1.44M 3.5" Half Height Grey	95
CMS 5.25" 360K PS 2 Internal	199
Sysgen	
Bridge-File 5.25" 360K/1.2MB External	\$229
Bridge-File 3.5" 720K/1.44MB External	229
Bridge-File PC/AT Adapter	59

Hard Disk Drives

Compaq/Connor IDE Upgrades	
100M 28ms	\$159
100M 25ms	\$679
200M 19ms	1249
Imego	
B1201 20M Internal	\$765
B1441 40M Internal	995
B244X Dual 5.25 44M External	1995
PC2/50 Nonbootable Card	230
PC2B/50 Bootable Card	230
Plus Hardcards	
Hardcard 20 M bit	\$539
Hardcard 40 M bit	599
Hardcard 40 16 bit	599
Hardcard 80 16 bit	695
Seagate	
20M 65ms ST225 Half Height	\$209
20M 35ms ST125 Half Height	245
30M 35ms ST138 Half Height	310
40M 28ms ST251-1 Half Height	349
40M 24ms ST151 Half Height	419
80M 28ms ST4096 MFM	590

Add \$50 for XT Kit for ST1xx, ST2xx

Co-Processors

Intel	
8087-1	\$189
8087-10	229
8087-16	349
8087-25	479
8087-2	\$129
80387 SX	309
80387-20	399
80387-33	639

NAME BRAND PERIPHERALS AND SOFTWARE AT THE LOWEST PRICES.

PC Brand Internal Modem
(100% Hayes Compatible)



CD-ROM

Amdek	
Laserdeck 2000 500MB External Kit	\$619
Microsoft	
Bookshelf 1.0	\$195
Stat Pack	\$99
Programmer's Library	\$295
NEC	
CDR77 External	\$555
CDR80 Internal	\$499
XT/AT Interface Kit	\$129
Clipart 3D	\$285
Image Folio	\$285
Sony	
CDU510 Internal Kit	\$665
CDU1701 External Kit	\$779

Printers

(Numbers in Parentheses Indicate Draft/LQ/CPS)

Brother	
HL8c Laser	\$1875
HL8PS	\$3295
Canon	
BJ130c 15"	\$761
LBP4 Laser	\$1025
LBP8-III Laser 8PPM	\$1725
Citizen	
GSX 140 (192)	\$339
Color Kit	\$49
Epson	
LX810 (180/30)	\$179
FX1050 (244/55)	\$439
LQ510 (180/60)	\$329
LQ850 (330/88)	\$495
LQ950 (264/88)	\$495
LQ1010 (150/50)	\$439
LQ1050 (330/88)	\$665
LQ2550 (400/108)	\$899
EPL6000 6 PPM	\$939
Kodak Diconix	
150Plus (150/50)	\$315
300WP (310/73)	\$439
Hewlett Packard	
Deskjet Plus	\$710
LaserJet IIP	\$1025
LaserJet II	\$1720
LaserJet IID	\$2995
LaserJet III NEW!	Call

Laser Jet Accessories

Pacific Data Products	
Plotter in Cartridge	\$249
25 in 1 Cartridge	\$285
Postscript Cartridge	\$449
Turn your LaserJet into a Postscript Printer!	

CPI	
Superfont Cartridge	\$295
1M Memory Kit	\$269
2M Memory Kit	\$549

Princeton Publishing	
PS-388 Postscript board	\$2250

Call about 400dpi Postscript Compatible Laser Printers

NEC	
P220XE 192/54CPS	\$335
P9XL 400/190CPS	\$1030
LC890 8PPM Postscript	\$1390
LC890XL 8PPM 4MB	\$495
SilentWriter II Printers	Call
Okidata	
ML320 (300/62)	\$345
ML321 (300/62)	\$479
ML380 (180/60)	\$359
ML390 (270/90)	\$475
ML391 (270/90)	\$655
ML393 (450/120)	\$995
Okidata Okilaser 400 4PPM	\$1010
Panasonic	
1180 (192/30)	\$189
1191 (240/48)	\$245
1124 (192/63)	\$299
1624 (192/63)	\$429
1695 330 wide	Call
4420 Laser	Call
Logical Connection Print Buffers	
256K	\$449
512K	\$529

*Oversized Monitors, Plotters, Laser Printers, and Portables excluded from Free Freight

Networking Hardware

Gateway	
G/Ethernet AT	\$435
for PS/2	\$435
G/Ethernet (8 bit)	\$265
LanTastic	Call for Prices
Standard Micro	
PS110 Board for PS/2	\$439
PC500WS 16 Bit for WS	\$375
PC500FS 16 Bit for Server	\$449
PC550WS 16 Bit Twisted Pair for WS	\$395
PC550FS 16 Bit Twisted Pair for Server	\$495
PC270E Twisted Pair	\$139
PC130 Arcnet Board	\$135
ARCNET passive hubs / active hubs	\$72/\$59
ARCNET intelligent hub coax	\$495
ARCNET intelligent hub twisted pair	\$609
Synoptics	
5051TP Transceiver	\$139
1000 Concentrator	\$2575
2500 Workgroup Concentrator	\$839
3Com	Call for Latest Prices
Tiara	
4 port hubs	\$49
8 port hubs	\$285
LanCard/A 8 bit ARCNET	\$89
LanCard/A 16 bit ARCNET Board	\$249
LanCard/E 8 bit Ethernet	\$199
LanCard/E 16 bit Ethernet Twisted Pair	\$339
LanCard/E 8 bit Twisted Pair	\$329
Tops	
Repeater	\$125
Flashcard	\$155
Western Digital	
Ethercard+	\$219
A (PS/2)	\$320
Ethercard+ Twisted Pair	\$319
Xircom	
Pocket ARCNET Adapter Coax	\$295
Pocket ARCNET Adapter Twisted Pair	\$295
Pocket Ethernet Adapter Twisted Pair	\$489

Plotters

CalComp	
1023	\$3450
10+3DM	\$5700
Houston Instruments (call for Prices)	
DMP52	\$1495
DMP52MP	\$1275
DMP61DL	\$2750
DMP62	\$1050
DMP62DL	\$1050

Scanners/Digitizers

Complete PC Scanners	
Full Page	\$499
Hall Page	\$189
Hand Scanner	\$165
Kurto	
Is/One 12X12	\$355
Is/One 12x17	\$509
Microtek	
MSF 300G	\$1495
MSF 300Q	\$1275
MSF 400x	\$2750
MSF Edge Feed	\$1050
Summasketch Digitizers	
12x12	\$335
12x18	\$599

Input Devices

CalComp WIZ	Call
Logitech	
Hi-Rez C9 Mouse	\$85
with Paint	\$99
Trackman 320DPI Serial/Bus	\$99/\$109
Microsoft Mice	
Serial with Paintbrush	\$109
Serial with Windows	\$139
Bus mouse with Paintbrush	\$105

Novell Networking

4 User ELS Level 1	\$429
8 User ELS Level II	\$939
Advanced NetWare	\$1850
SFT NetWare 286	\$2850
NetWare 386	\$4550

Network Utilities

CC: Mail	
25 User	\$495
Expand	\$445
Cheyenne Software	
Netback	\$189
Monitrox	\$505
Lan Systems	
Lanspace	\$310
Lanspool	\$259
Norton-Lombert	
Close-up Support/ACS	\$179
Close-up Customer/Terminal	\$135
Ontrack	
Disk Manager-N	\$99
Netutils	Call
Taps	
NetPrint 2.0	\$115
Tops 2.1	\$112
Traveling Software	
Desklink 2.2	\$95
Laplink III	\$92

Unix/Xenix Multiuser Products

Digiboard	
Intelligent Serial Cards:	
4/8/16 Port	\$645/795/1295
Wise Terminals	
WY60	\$309
WY150	\$305
WY370 14" Color	Call
(Call on Keyboard options)	
WY50 (with Keyboard)	\$389
WY86 (with Keyboard)	\$409
Santa Cruz Operations	
Xenix 286 CompleteSys	\$995
Xenix 386 CompleteSys	\$1150
Xenix Software	
Foxbase+ 386	\$979
Microsoft Word	\$495
Open Desktop	Call
VP/IX 1/3+ User	\$59/629
Xenix-Net 286/386	\$439/479
Word Perfect 4.2	\$69

Supplies

Sony 5.25" 360K (box)	\$9
Sony 5.25" 1.2M (box)	\$14
Sony 3.5" 720K (box)	\$13
Sony 3.5" 1.44M (box)	\$25
5.25" Diskette Case	\$9
3.5" Diskette Case	\$11
Toner cartridge for HP Deskjet Plus, Laserjet II and IIP	Call
Data Cartridges	
DC2000 (each)	\$19
DC600 (each)	\$27
DC600XL (each)	\$29

*Free Freight in the Continental U.S.

Power Protection Products

Tripplite	
SR5 Spike Bar	\$29
IBc 4 Outlet Isohar	\$45
CC1+ Isohar	\$85
LC1200 Line Conditioner	\$159
BK 325 Battery Back-up	\$279
BK450 Battery Back-up	\$349
OMNI450 or 450LAN Battery Back-up	\$419
BK 750LAN Battery Back-up	\$459
OMNI1200 Battery Back-up	\$795

Software

Aldus Pagemaker	\$499
AMI for Windows	\$129
AMI Professional	\$319
Autosketch Animator	\$179
dbase IV	\$449
Borland Quattro	\$95
Quattro Pro	\$279
Caere OmniPage 386 2.1	\$619
Corel Draw	\$329
Datascram ProComm Plus	\$52
Delrina Perform 2.0	\$159
Delta Technology Direct Access	\$49
Deskview 386	\$115
Fifth Generation Fastback Plus	\$102
Foxbase +	\$189
Generic CADD Level 3	\$155
Harvard Graphics	\$329
IBM Displaywrite IV	\$249
Lotus Freelance Plus	\$329
Lotus 123 r. 2.2	\$359
123 r. 3.0	\$339
Microsim Ribase	\$489
Microsoft Excel 2.1	\$309
Microsoft Windows 386	\$125
Microsoft Word 5.0	\$205
Microsoft Word for Windows	\$325
Microsoft Works	\$99
Northedge Timeslips III	\$159
Norton Utilities Adv.	\$79
Paradox v. 3.0	Call
PC Tools 5.5	\$79
Peachtree Acctg III	\$149
Peachtree Complete III w/ Data Query	\$225
Professional Write	\$145
Quicken	\$39
Symatec Q&A 3.0	\$215
Timeline 3.0	\$379
Timeworks Publish It!	\$125
Word Perfect 5.1	\$249
Wordstar Pro 5.5	\$225
Ventura Publisher 2.0	\$499

Please Call For Other Business Software Titles

Free Freight*
30-Day Money-Back Guarantee
Toll-Free Service & Support
No Credit Card Surcharges

Call for Prices on Other Peripherals

Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Canadian Fax # 412-633-2888 Canadian Voice # 312-226-5200. We are open Mon. thru Fri.: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**





Even This Is More Confining Than Clipper.

Just as the vast expanse of the American West gave its settlers a new perspective on opportunity, Clipper's open architecture lends unprecedented freedom to application development.

Unlike fixed systems, Clipper never forces you to "make do". Its language is fully extensible with user-defined functions and new user-defined commands. You can extend the language with routines written in Clipper itself, or integrate code from other languages like C, Assembler, dBASE® and Pascal. Odds are, you already have knowledge you can use with Clipper!

But if a customizable language isn't enough, there's even more elbow room. Database and I/O drivers can be supplemented or replaced. Even Clipper's linker knocks down barriers by allowing you to develop applications larger than available memory, without defining overlays! And when you're done, Clipper's compiler generates stand-alone, executable files for cost-free, unrestricted distribution.

So, don't let the bounds of fixed systems fence you in. Unleash your imagination in the wide-open spaces of Clipper. To find out more, give us a call today.

Clipper 5.0

The Application Development Standard

213/390-7923

 **nantucket**®

Nantucket Corporation, 12555 West Jefferson Boulevard, Los Angeles, CA 90066. 213/390-7923. FAX: 213/397-5469. TELEX: 650-2574125. Nantucket, the Nantucket logo and Clipper are registered trademarks of Nantucket Corporation. Other brand and product names are used for identification purposes only and may be trademarks or registered trademarks of their respective holders. Entire contents copyright © 1989 Nantucket Corporation.

Circle 200 on Reader Service Card

World Radio History

Reviewer's Notebook

Reviewer's Notebook is a compilation of brief reviews and updates to previously published evaluations. BYTE will publish Reviewer's Notebook each month as space permits.

Dot-Matrix Printers Rise Again



Dot-matrix printers may sound unexciting these days, especially with all those low-cost laser printers hitting the market. But Panasonic's new KX-P1624 24-pin entry is an intriguing, low-priced, full-featured workhorse that fills an important niche.

Panasonic designed the printer for offices that use dot-matrix printers day in and day out for such mundane (albeit necessary) tasks as printing reams of reports, multipart forms, or mailing labels—in short, for jobs where laser printers don't particularly shine.

The KX-P1624 takes forms up to 15 inches wide. It has five built-in letter-quality fonts: Courier, Prestige, Bold PS, Script, and Sans Serif. All are available in 10 different character sizes ranging from 5 to 20 characters per inch. There are also two draft-quality fonts.

Few dot-matrix printers match the KX-P1624's list of standard features. You can feed paper from four different directions (front, back, bottom, or top). A neat flat-belt tractor feed swivels to act as either a push or pull tractor. The push tractor (used with a built-in perforation-

cut feature) is particularly handy for eliminating waste of continuous forms.

You will also find the usual paper-parking feature, which lets you print a single sheet without removing continuous forms. For those worried about software compatibility, the printer emulates the IBM Proprinter XL24E and the Epson LQ-2500. A 12K-byte buffer (expandable to 44K bytes) is standard.

At first glance, I found the printer's "EZ-Set" front panel difficult to understand. You work through several switches (there are no DIP switches) and a panel full of indicator lights to set up the KX-P1624. In the end, I figured out the switches in a short time, and the panel let me set up three macros for my most frequently used combinations.

With a print speed of 160 pica-size characters per second for draft and 53 cps for letter-quality text, the KX-P1624 isn't the fastest 24-pin printer available. But it's speedy enough for all but the most demanding environments. Panasonic could have made it faster, but that would have added to the bottom line, which may be the printer's most surpris-

ing feature: At \$700, the KX-P1624 is hundreds of dollars less expensive than similar printers.

The KX-P1624's output doesn't match what you get from a laser printer, but I wouldn't be shy about sending out a manuscript, letter, or report printed on this printer to my most important readers. The printer does what it's designed to do and does it well. What's more, it's part of an encouraging trend toward feature-packed printers that won't clear out your wallet.—*Stan Miastkowski*

KX-P1624

Panasonic Communications and Systems Co.

Office Automation Group

Two Panasonic Way

Secaucus, NJ 07094

(201) 348-7000

\$699.95

Inquiry 853.

Superbase 4 Windows Outshines GEM Version

In the March 1989 BYTE, I reviewed Precision's Superbase 4, a full-featured database that ran on the GEM graphical user interface but could access only 640K bytes of memory. The program boasted the capability to incorporate graphics and text files as external database fields and had powerful relational capabilities. However, the 640K-byte memory limit and a number of bugs severely hampered the product. In addition, Superbase 4 suffered from inadequate documentation. I concluded that

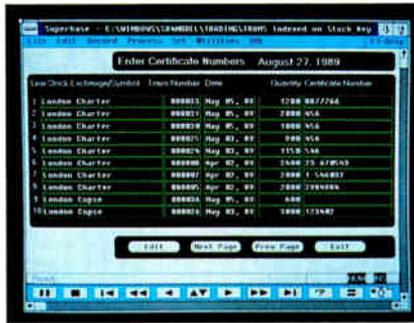
continued

the program had great potential but needed additional memory, the elimination of several bugs, and improved documentation.

Precision seems to have addressed all my complaints in its recently introduced Superbase 4 for Microsoft Windows. Superbase 4 Windows supports both extended and expanded memory, allowing the display of bit-mapped graphics as database fields.

In addition, Superbase 4 Windows includes an external data type that can point to either a bit-mapped graphics file or a text file that can be searched for and queried. The product also includes a comprehensive programming language, a built-in text editor, a telecommunications facility for transferring files, and a powerful Structured Query Language query facility, as well as full-featured forms and report writers.

I checked the program for the bugs that I had found in the earlier GEM version, and all of them had been eliminated. In addition, the documentation has been upgraded and is easier to follow. The communications facility has been



greatly improved, and the VCR-like control panel, which controls the database, works much better than the one in the GEM version. The text-field search feature now works as advertised, and I found it much easier to manage multiple open database files than in the GEM product.

In spite of all these improvements, Superbase 4 Windows is not a product for the casual database user or for the faint of heart. The product has powerful capabilities for database application developers, but you can expect to encounter a steep learning curve before understand-

ing how to really take advantage of those capabilities.

For example, the forms designer presents the user with two rows of more than 30 icons, the functions of which are by no means intuitive and which require a certain amount of effort to learn. The query and file-linking facilities are also complex, and they, too, take some diligence to understand.

Nevertheless, serious database developers for Microsoft Windows should find Precision's Superbase 4 Windows to be an excellent candidate for their development work.—*Nick Baran*

Superbase 4 Windows

Precision, Inc.
 8404 Sterling St., Suite A
 Irving, TX 75063
 (800) 562-9909
 (214) 929-4888
 \$695 with run-time version of Microsoft Windows
 \$995 for five-user LAN extension (total of six users)
 Inquiry 856.

Making Smalltalk with OS/2

Digitaltalk has taken a large stride with Smalltalk/V PM, a version of its Smalltalk/V environment for OS/2's Presentation Manager. This new release holds great promise for those looking to step up to OS/2 from Digitaltalk's 286 version, as well as for developers seeking an easier method for developing PM applications.

Smalltalk/V PM makes it easy for OS/2 developers to build, in hours or days, complete applications that are indistinguishable from those built the hard way—with compilers, linkers, and so forth. Smalltalk/V PM hides the complexity of dealing with windows, input events, and the like until you're ready for them. I produced several applications with Smalltalk/V PM before I knew anything at all about PM. The result was that I could focus on the development problem at hand rather than on the user interface.

Although Smalltalk can be a self-contained, self-sustaining environment, Smalltalk/V PM produces *real* PM programs, with access to all of OS/2's advanced features, including Dynamic Link Libraries and Dynamic Data Exchange. Since any resource available under OS/2 and PM is available to Small-

talk/V PM, integrating V PM programs with those produced in conventional languages is simple.

For those who are already familiar with Smalltalk, Smalltalk/V PM offers some surprises. A new, simpler application model consists only of Models and Windows. A cleaner approach to graphics makes using custom graphics in an application much easier than before.

The changes from previous releases of Smalltalk are significant enough that porting to Smalltalk/V PM could be time-consuming, particularly if your application is graphics-intensive. If the application is loaded with homegrown Panes and Dispatchers that are not simple subclasses of the standard set, you may find it necessary to rebuild large portions of the program.

However, even with all the changes, the environment is still recognizable to users of Smalltalk/V 286 and Smalltalk/V Mac (the 286 and Macintosh versions). All the familiar user interface components remain available, and a few more have been added. Users of other Digitaltalk products will also feel right at home with the programming tools that come with Smalltalk/V PM. The browsers, debugger, and inspector work much

as they did before.

Another key change that Smalltalk/V PM brings to the Smalltalk world is compilation. Instead of keeping track of the classes you define and objects you create in a set of data files, Smalltalk/V PM incrementally produces an .EXE file. This file, together with a single Dynamic Link Library, is all that's needed to run the application on any PM system. The resulting executable file is quite large, but Digitaltalk plans a Developer's Kit to address the problem.

On the whole, Smalltalk/V PM represents a significant new direction in Smalltalk environments. Its close integration with the host system, together with its much-improved application and graphics models, makes this environment far better than what has gone before. The power that it provides to OS/2 developers is valuable. Even if Smalltalk/V PM is used only for rapid prototyping, no OS/2 development team should be without it.—*Eric Smith* ■

Smalltalk/V PM

Digitaltalk, Inc.
 9841 Airport Blvd.
 Los Angeles, CA 90045
 (213) 645-1082
 \$499.95
 Inquiry 855.

Securing your data is as fast as one, two!



When you use DPT's

SmartCache[™]

the caching controller
with disk-mirroring.

Speed and security in one package.

SmartCache with disk-mirroring ensures uninterrupted operation in the event of disk failure by simultaneously writing data to your PC's primary drive and a secondary, "mirror" drive. SmartCache increases system speed and eliminates down time and data loss due to drive failure, thus providing true disk fault tolerance for all PCs.

When we say fast...

Unlike software disk-mirroring that actually slows your PC down, SmartCache dramatically boosts system speed, thanks to its state-of-the-art disk-caching technology. The on-board processor and expandable cache RAM allow the controller to simultaneously manage the primary drive and the mirror drive and still process data at 0.5ms for unprecedented speed and security.

Picture-perfect compatibility.

SmartCache needs no special ROM BIOS or software drivers and is fully compatible with *all* 286/386 PCs and *all* operating systems. Because SmartCache looks exactly like a standard disk controller to your computer, installation is quick and easy.

So smart, it can repair itself.

SmartCache actually repairs all disk errors *automatically*. Even catastrophic drive failures will not cause the system to crash.

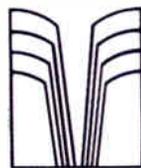
Backed by the best: DPT.

Distributed Processing Technology was the first to develop caching disk controllers for microcomputers and is the recognized leader in the industry. Our products have been at work for over a decade, speeding up minis and mainframes. We offer a 1-year warranty, clear documentation, and outstanding technical support.

Look into SmartCache!

You'll like what you see. Call today and find out how you can add speed and security to your PC system—with SmartCache, from DPT.

132 Candace Drive • Maitland, FL 32751 • (407) 830-5522



DPT
Distributed
Processing
Technology

Circle 96 on Reader Service Card (DEALERS: 97)

Applications Architectures

199 Transparent and Portable
by Mark L. Van Name
and Bill Catchings

205 From TTY to VUI
by Frank Hayes

215 Behind the Scenes
by Howard Eglowstein

225 Bridging Troubled Waters
by Jon Udell

237 Blueprints for the 1990s
by Sheila Osmundsen
An Open Approach
by Herb Osher

248 Building Blocks

Editor's note: *You may notice something different about this section—the name has been changed from In Depth to State of the Art. This new name conveys more precisely the type of information this section contains and highlights the balance between this section of BYTE and the extensive "state of the market" product coverage elsewhere in each issue. While we'll still present information in the usual in-depth manner, it's now clearer than ever that this section is where we discuss the leading-edge technologies that herald the products, tools, and techniques you'll be using in the months and years to come.*

When you plan to construct a house, one of the first things you need is a set of blueprints. Until you have those, you don't know where to begin, how big a hole to dig, or what materials to buy.

In the past, writing applications software has been more like making bricks than building something with them. The developers each made their own bricks, some red, some brown, and some blond, some rectangular, some square, and some hexagonal. The end result has been lots of piles of bricks that don't always fit together the way you'd like them to.

The time has come to step back, make a blueprint of what you want to create, trying to incorporate as many of the pieces you already have as possible, and start construction. One name for this blueprint might be applications architecture, a framework for creating order out of the chaos of applications today.

This first State of the Art section begins with "Transparent and Portable" by Mark L. Van Name and Bill Catchings. In it, they describe the types of applications architectures available that provide a consistent framework across different machines. Currently, the Macintosh is the leader in this area in the personal computer field, but over the next few years, you can expect others to appear. Portable, transparent applications make life easier for all of us who use desktop computers.

Then, in "From TTY to VUI," Frank Hayes discusses user interfaces, their pluses and minuses, and how they compare. Many people today prefer a graphical user interface to the command-line interface, but how do the available GUIs compare with each other? Is it really safe to say "when you've seen one, you've seen them all"?

When you go behind the user interface, you come to the application programming interface. In "Behind the Scenes," Howard Eglowstein explores the next level of detail to consider when you choose a user interface: the capabilities behind it as reflected in the API.

Next, in "Bridging Troubled Waters," Jon Udell describes several cross-platform tools that let you use the same software on different machines. This concept and the products that use it solve the problem of which machine and which operating system to support. An application can be written once and then simply ported to a variety of machines.

In "Blueprints for the 1990s," Sheila Osmundsen provides a comparison of the two major applications architectures available today: IBM's Systems Application Architecture and Digital Equipment's Network Applications Support. More and more companies are exploring the advantages of these consistent frameworks: interoperability and greater portability across dissimilar platforms. New players are entering the field at a growing rate. The text box "An Open Approach" looks at Data General's recent entry, Distributed Applications Architecture.

As these architectures proliferate, will Big Brother be watching? Will you lose your independence? I don't think so. Rather, you will gain the freedom to move from one machine to another and from one operating system to another, without retraining. Knowing an applications architecture will broaden your usefulness and your sales appeal. Individually, you can still march to the beat of a different drummer, but, together, you can harmonize.

—Jane Morrill Tazelaar
Senior Technical Editor
State of the Art



If you need disk performance, PSI's got your number...



50 GigaBytes of Storage

The hyperSTORE supports an incredible 50.4GigaBytes of high performance on-line storage using today's drive technology. And as drive standards and capacities improve, the unique *controller plus Mediadapter™* design protects your investment by allowing you to add new drive interfaces.

28 Hard Disk Drives

The hyperSTORE controls up to 8 MFM, RLL, or ESDI drives, up to 28 SCSI drives, or any combination of drives, each group on an independent interface for improved performance through *true simultaneous operation*. And all drives are cached in the hyperSTORE's on-board cache memory.

20 MegaBytes of Cache

Add as little as 512KBytes of RAM to a zero-K hyperSTORE and enter the fast lane of computing. As your needs increase, simply plug in standard SIMM memory to add to the cache. After filling the 4MByte on-board capacity, our 16MByte expansion card brings the total to 20MBytes.

4 MegaBytes per Second

Data transfer rates of 4MBytes/second burst and over 2.5MBytes/second *sustained* make your disk-intensive applications run amazingly fast. Imagine jobs that used to take an hour, now taking as little as seven minutes. That's the kind of real-world performance the hyperSTORE delivers.

4 Interface Standards

Mediapters allow the hyperSTORE to *concurrently* control MFM, RLL, ESDI, and SCSI drives. So you can mix and match to build the ideal controller for *your* application. And when you add a new drive, you can upgrade to the latest technology without throwing away your old drives.

2 Compatibility Modes

Select WD-1003 mode for 100% compatibility with standard operating systems like Unix, Xenix, and Netware-386. Or switch to native mode and take advantage of the benefits provided by our SSP (Standard Storage Protocol) interface under DOS, PC-MOS, Windows, and Netware-286.

PSI

hyperSTORE-1600™ **Dual-Mode Caching Disk Controller**

Perceptive Solutions, Inc. · 1509 Falcon, Suite 104 · DeSoto, Texas 75115
(800) 343-0903 · (214) 954-1774 · Fax: (214) 953-1774
European Inquiries: ISM · 415-284-9505 · Fax: 415-284-3238

©1989 by PSI. All rights reserved. hyperSTORE, Mediadapter, and the PSI logo are trademarks of Perceptive Solutions, Inc. Other brand and product names are trademarks or registered trademarks of their respective companies. Specifications subject to change. Ad Code: PW9001.

Domestic inquiries: Circle Reader Service No. 217

International inquiries: Circle Reader Service No. 218

Transparent and Portable

*Applications architectures provide compatible access
to incompatible machines*

Mark L. Van Name and Bill Catchings

Sometimes a single solution can remedy several problems. Consider applications software. Users want programs that are easy to use and consistent across different machines. Developers want to produce bug-free software as efficiently as possible for as many machines as possible. And vendors want to provide a broad range of systems to attract as many buyers as possible. Applications architectures can satisfy the needs of all three groups.

An applications architecture is a set of tools for developing applications. By providing a consistent framework on different machines, it lets you get the most out of your equipment and training budgets. It's also a way out of the dilemma that plagues anyone who uses a computer: compromise.

Newer, faster machines promise improved productivity, but often at the cost of learning a whole new way of working. Existing systems let you work in familiar, comfortable ways, but often at the cost of living with less than optimal performance. An applications architecture solves this conflict. It ensures that your new system works the same way as your



current one, or at least close enough so that the cost of learning the new system is bearable.

Such a framework also lets software developers make the most of limited resources. No one has the time or money to support all the interesting and commercially viable systems in use today. Even if you consider just personal computers, you must write software to run under

DOS, Windows, OS/2, and the Mac OS to support the major platforms.

In addition, vendors develop applications architectures to bridge multiple environments. While they may strive for compatibility across product lines, time and changing technologies eventually force vendors to offer systems that are incompatible with previous hardware and operating systems. An architecture allows them to provide users and developers with a smooth migration path from the older to the newer systems.

Laying the Foundation

Most of the benefits of a good architecture stem from two basic features: transparency and portability. Not surprisingly, these terms have slightly different, albeit related, meanings for users and developers.

To a user, transparency is the degree to which a new system resembles the existing one. To put it another way, a new system is transparent if you can't tell the difference between it and your current system.

A transparent system should have the same look and feel as the system you use

continued

now. Its appearance, command structure, and menu structure—in other words, its user interface—should be familiar. Typing the same command, for example, should produce the same result on both systems, as should double-clicking on an icon.

The new system should also offer all the applications you currently use. Basically, if you can walk up to a display attached to a new system and feel as if you're working on the same old system, it is transparent.

To a developer, transparency means that a new system's structure is basically the same as the one on the previous system. The new system must provide a consistent set of abstractions, from the application programming interface (API) to the data, file, database, and network organizations. For example, application programs must be able to call memory-allocation, record-retrieval, and record-locking routines that work the same way on both old and new systems. (For a more-detailed discussion of APIs, see "Behind the Scenes" on page 215.)

Portability, while related to transparency, addresses slightly different concerns. For most users, the crucial part of a system's portability is its ability to handle existing data and procedures. When you walk up to a new system, you want to be able to load your working data—whether on disk, tape, or other media—and get down to business. If you have any automated procedures, which may range from keyboard macros to full-fledged programs, you want to be able to run them, too.

Portability is similar for developers, who need to be able to move current source code and development tools to the new system with as little hassle as possible. To meet this requirement, the new system must provide not only a consistent API, but also a consistent set of such development tools as text editors, compilers, linkers, and debuggers.

A complete applications architecture includes specifications and tools that address all these needs. It runs on several different platforms. It includes development guidelines, a consistent API for every aspect of development, and a complete set of development tools. Its user interface is consistent across systems, and, if it is successful, the resulting applications are also available on all systems.

Arguably, the most successful example of such a structure to date is the one offered by the Macintosh. Applications that follow Apple's user-interface and internal programming guidelines—so-called "well-behaved" applications—

will run on any Mac, from the least to the most powerful, and with any size monitor and any Mac printer. They will also be relatively easy for experienced Mac users to learn, because they will have the familiar Mac look and feel.

Erecting the Framework

The Mac's applications architecture, like any other, consists of tools and specifications that address many issues. While no two approaches are the same, they all have to deal with the same basic problems.

To gain a broad view of the various architectures, we'll construct a framework within which to analyze them. Within this framework, we'll concentrate on the problems that the architectures must help a developer solve. If they solve those problems well, and if they provide a consistent user interface, then they will also meet the needs of the users.

An applications architecture is basically a set of tools with written guidelines for using them. The tools must be powerful enough to let developers build user interfaces that are consistent with the user interfaces of other products that follow the same approach.

The goal of these tools is to free you from having to deal directly with certain external elements. We'll take a look at each of these elements and the tools that these architectures must provide to deal with them.

Insulation Requirements

An applications architecture on any machine must deal effectively with the underlying hardware and system software. This is the area that usually gets the most attention, largely because it is the area where system vendors tend to have the most problems.

Consider, for example, the problems of IBM. This giant firm has customers running such different platforms as its mainframes (with the firm's several different mainframe operating systems), System 38s, System 36s, System 34s, AS/400s, AIX RISC machines, and both DOS and OS/2 PCs. IBM is trying to unite some of these systems with its Systems Application Architecture (SAA), a mammoth task.

To let you work on such different hardware and operating-system combinations, an architecture must insulate you from the complexities of the underlying system. To do this, several key services must be provided.

One is memory management. All applications need to allocate and free memory, a problem that most systems address

differently. The underlying architecture must provide tools for static and dynamic memory allocation, memory freeing, and a consistent way to deal with out-of-memory errors.

Another crucial service is task management. Applications must be able to communicate with one another, exchange data, and, ideally, spawn subtasks. To attain these ends, an architecture must provide good interprocess communication facilities, data-sharing tools (such as a clipboard), and a multitasking/multithreading facility. Sometimes, it must forbid certain facilities on some systems, such as multitasking on PCs, but then you must either write to the lowest-common-denominator system or abandon support for some systems entirely.

Another necessary function is hiding low-level aspects of the system or providing transparent ways to take advantage of those features that are present. Some systems, for example, have floating-point and graphics accelerators, while others do not. Ideally, an applications architecture lets programs automatically take advantage of those accelerators when they are present and remain unchanged on systems without them. Another approach is to provide a set of APIs that either passes calls to the accelerators or, when the system has none, emulates their function in software.

Similarly, as more and more systems begin to offer multiple processors, a good architecture must let applications benefit from them when they are present. At the simplest level, this means only hiding the existence of those processors from the applications. A better answer, however, is to provide tools, such as special compilers, that produce code that can take advantage of multiple processors when they are present.

Finally, such a structure must come with a set of rules for developing applications that distance themselves from the underlying system. These rules range from such simple ones as "Don't call the operating system directly; use the standard toolbox instead," to more complex ones, such as "Don't assume a given byte contains the most significant digit in any word." In essence, the applications architecture must become the underlying system. Writing portable applications means learning to live with the features of this "virtual system."

The Flexible Facade

Moving up a level in hardware, these architectures must let applications work with many different types of monitors.

The problems in this area depend in part on whether the system comes with text or graphics displays.

There are two basic problems with text displays: screen sizes and control codes. Applications must be able to work with different size screens so that text can expand to fill the available space. They also must be able to handle the different control codes demanded by displays from different manufacturers. The latter problem is particularly acute for ASCII display terminals, where a Digital VT220 uses different display codes than a TeleVideo 925, which differs from the next, and so on.

Although these problems are answered in different ways, there are just two basic approaches. One is to provide a template file that contains a set of generic display commands and mappings for those commands for different terminals. This is the approach that Unix typically uses, with its Termcap and Terminfo files. The other approach is to use an insulating software layer. That layer can be anything from a simple receptacle for display drivers, such as those supported by Windows, to a complete set of controlling procedures, such as the Mac's QuickDraw software.

The notion of an insulating layer of software also works for graphics displays, although the problems are more complex. Graphics displays differ in everything from size to resolution to the ways programs must control them. The best solution is to have a set of controlling procedures and an accompanying set of development specifications, such as the Mac's QuickDraw or the X Window System (referred to as X Window for the remainder of this article).

You can, of course, just write drivers for each different graphics standard. This has long been the DOS approach. The differences between the results of this approach and the results of having a layer of graphics software are, however, profound.

Hook a PC up to a high-resolution 21-inch monitor, for example, and most PC applications will still run in 80-column by 25-row mode or 640- by 480-pixel VGA mode, wasting most of the screen's size and resolution. The monitor may come with drivers for certain key applications (typically desktop publishing and CAD/CAM programs), but most programs will run as if they are on a 12-inch display.

Now attach a 21-inch monitor to a Mac. Nearly all Macintosh applications will instantly work with it. At worst, you only have to enlarge their windows. The

screen's size and resolution don't matter, because QuickDraw deals with those features at a level below the applications. In fact, QuickDraw goes so far as to let the Mac work with multiple monitors simultaneously, all with no programming effort other than following the development guidelines.

X Window defines a similar set of insulating functions for Unix graphics workstations. Applications that are designed to use these functions can run on any X Window workstation without the

Hook
a PC up to a
high-resolution
21-inch monitor and
most PC applications
will still run as if
they are on a
12-inch display.

specifics of the different displays causing problems.

X Window can also take advantage of the hardware features of a particular display system. If, for example, the display hardware can draw a filled polygon on the screen, X Window maps that feature to one of its own functions. (X Window itself calculates the pixels to activate for display systems that don't have such a polygon-fill function.) X Window applications look basically the same on different displays, no matter how each screen draws pixels.

Entrances and Exits

Keyboard specifics can also be a problem. The easiest way to handle that problem, of course, is to force every keyboard to emit the same codes. That's essentially the answer for PCs, where keyboards have to be PC-compatible for anyone to buy them.

Another approach is to define a basic set of keycodes for the architecture and a way to provide drivers that map the codes from various keyboards to the basic ones. The coming standard for a Streams-based Unix terminal driver will include

this type of abstraction. This keyboard driver lets keyboards with different national key sets and layouts work with Unix applications.

Printer codes can also cause difficulties. Historically, applications have required special drivers to support the various printers that are popular for a specific machine. This approach, while expensive, at least lets applications take full advantage of the features of different printers.

To minimize development costs, many vendors built their own internal printer-template files. These files mapped the control codes of different printers to a basic set of printer functions. The problem with this approach, of course, is that the basic set has to be very rich in features or it won't be able to take full advantage of some of the printers.

Sometimes printer pseudostandards, such as the Xerox Diablo 630 or the Hewlett-Packard LaserJet, emerge. These pseudostandards typically are the control codes of printers that became so popular that many other printers emulate them.

Today, the trend is toward sophisticated page-definition languages. A PDL provides you with a standardized way to define the appearance of a printed page. A PDL interpreter then turns PDL commands into something that a particular printer can understand. By far the most widely used PDL is PostScript.

Grist for the Mill

The final piece of the external environment of any program is its data. There are several aspects of data that can vary from one system to another, including its machine representation (e.g., which byte in a word contains the most significant bit), file format (e.g., flat or indexed file), and network location. While we won't go into detail on these topics, an applications architecture must nonetheless address them.

Further, as more and more applications rely on databases for their data, the architectures must provide insulating layers for database functions. Apple's CL/1, for example, is a standard toolbox that lets you work with many different types of databases on many different, possibly remote, systems.

Ergonomic Engineering

The sum of all these insulating layers of software is a set of programming abstractions, or tools, for building applications. Programs developed with these tools will work in many external environments. That's a great step forward, but it's not

continued

the end of the journey.

The next step is to ensure that all applications employ the same user-interface style. Key issues here include consistent visual layouts, the way in which you work with the keyboard (and, typically, a mouse), and menu and command structures.

An architecture should do two basic things to help create applications with "acceptable" user interfaces. The first is to provide a set of specifications that defines exactly what "acceptable" means: Developers must have a goal. The other is to provide a set of tools that makes it easy to reach that goal.

The Mac's Toolbox is one example of such tools. A newer and, according to most reports, more powerful answer is the NeXT Interface Builder, which helps build consistent user interfaces quickly.

Early user interfaces were simple command-line interpreters like the one in DOS. These interfaces left you on your own, forcing you to learn many arcane operating-system commands and different working styles for each application.

Then the Mac popularized the graphical user interface (GUI), a system based on graphical icons, pull-down menus, and other devices designed to free you from having to memorize lots of commands. The Mac's interface standards also gave a standard look and feel to Macintosh applications.

Today, GUIs are all the rage. Windows and NewWave are vying for the GUI title on PCs, with such other players as GEM also in the fray. OS/2 has its own GUI, the Presentation Manager.

The Unix world is perhaps the most complicated one currently, with such major GUI contenders as the Open Software Foundation's Motif and Unix International's Open Look, as well as NeXT's NextStep, and others. The goal of all these systems is to free users from the need to learn cryptic Unix commands, so that Unix can become popular with many of the same people that today work happily with Macs. (For further details on GUIs and other user interfaces, see "From TTY to VUI" on page 205.)

Building Overhead

If by now you're thinking that applications architectures sound like a lot of software, you're right. Complete ones include a substantial amount of code and documentation, and they have some costs as well.

Perhaps the most obvious cost is performance overhead. If you want to squeeze the last drop of performance from a system, you write directly to the

hardware, preferably in hand-crafted assembly code designed to take advantage of every feature of the processor and display. These architectures are at the other end of the spectrum: They cover every aspect of the system with a thick, CPU-draining blanket of software.

The standard argument in their favor, however, is that the results justify the performance costs. Besides, ever-faster hardware will handle the CPU requirements easily. We support that argument, but we also think it's important to realize that these architectures have a considerable performance overhead. The more sophisticated the applications architecture that you want to embrace, the more powerful the system you are likely to need.

These architectures can also be complex. The learning time for DOS developers, for example, is far less than the learning time for Mac developers. This is a problem. The best solution to date seems to be using higher-level toolboxes, such as NeXT's Interface Builder, that hide the nitty-gritty under another layer of software.

A final potential cost is in innovation. No architecture can cover everything; when the next great advance in, say, user interfaces comes along, a good one can actually hinder creativity. The only answer here is to design them to grow easily, so that things like user-interface style can evolve to reflect new technologies.

Expansion Plans

Despite the costs, applications architectures are clearly hot. In fact, this is one area where it's easy to make general predictions with confidence.

For one thing, you can expect each of the major vendors to standardize on one applications architecture or, at most, a few. IBM and Digital Equipment Corp. (DEC) are already doing it, and most Unix system vendors are either already standardizing or ready to do so as soon as the Open Software Foundation versus Unix International conflict is resolved.

Another safe bet is that object-oriented programming will play an increasingly important role. Object-oriented systems let you define abstractions that have well-known specifications and are well insulated from the outside world. Objects are the latest and greatest ways to express abstractions in programming, and that's much of what these architectures are all about. The object-oriented approaches of the NeXT system and HP's NewWave are almost certainly just the first of many.

You can also expect to see more high-level cross-system development tools, from large sets of toolboxes built around objects to still-higher-level fourth-generation languages. (For a discussion of some of the various cross-system development tools available, see "Bridging Troubled Waters" on page 225.)

Finally, as the industry learns more about how to build multimedia systems, you can expect to see user interfaces and other aspects of these architectures that take advantage of those systems. Voice and video are likely to become far more common in the future as vendors strive to make computers more accessible.

The Ground Floor

Most of all, you can expect applications architectures to continue to rise in importance. Consistent approaches have proven benefits.

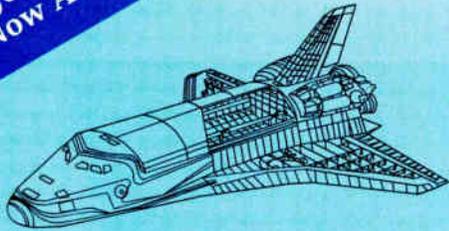
Look, for example, at DEC's success in recent years. While DEC did not have a stated applications architecture a few years ago, it did offer the same basic machine (VAX) and network (DECnet) architecture from its smallest system to its largest. IBM, by contrast, had to support many different system types. The result was a huge increase in DEC's user base, often at IBM's expense.

Even DEC, however, has had to bow to the performance of other machine architectures and now offers workstations based on MIPS Computer's RISC chips. These workstations are not compatible with DEC's VAX products, so now the company is building an applications architecture called Network Applications Support (NAS) to link these two systems and Unix workstations, DOS PCs, and Macs as well. (For a comparison of IBM's and DEC's applications architectures, see "Blueprints for the 1990s" on page 237.)

Over the next few years, you can expect other architectures to join the Mac's as leaders in the personal computer arena. Vendors of other large systems will also strive to offer total architectures on their systems (see the text box "An Open Approach" on page 246). Who will come out ahead is anybody's guess. The only sure thing is that increased portability and transparency will be a plus for everyone who uses desktop computers. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvname" and "wbc3," respectively.

HP LaserJet IIP & IID
Version Now Available!



AutoCAD® Release 10

Plotter
in a Cartridge™

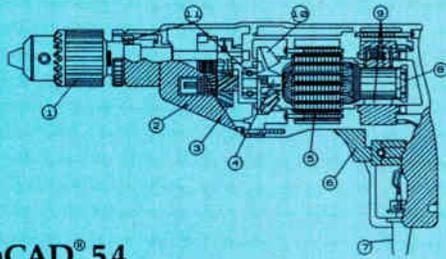
HP 7475A Plotter

Software
Plotter Emulation

15
seconds

3
minutes
17
seconds

1
minute
2
seconds

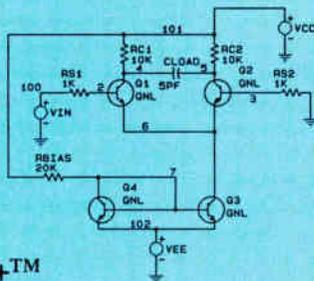


VersaCAD® 5.4

49
seconds

9
minutes
45
seconds

3
minutes
11
seconds



Schema II+™

17
seconds

5
minutes
15
seconds

2
minutes
13
seconds

Compared to Plotter in a Cartridge, everyone else is behind the times.

For fast HPGL output, there really is no comparison. Pacific Data Product's *Plotter in a Cartridge™* is up to 100 times faster than pen plotters or PC-based software emulations.

Simply plug it into your LaserJet Series II or Canon LBP-8II printer and it's ready to print precise, high-quality graphics. And we also have a version for the HP LaserJet IIP and IID printers. *Plotter in a Cartridge™* is compatible with all of the major CAD/CAM, engineering and graphics software packages.

For your nearest authorized dealer, or for more information on our full line of laser printer enhancement products, call Pacific Data Products at (619) 552-0880.

Pacific Data Products—Plug into Power



PACIFIC
DATA PRODUCTS

9125 Rehco Road,
San Diego, California 92121
(619)552-0880, Fax (619)552-0889

Plots run at 8 Mhz with parallel interface. Times quoted reflect PC processing time. *Plotter in a Cartridge* is a trademark of Pacific Data Products, Inc. All other company and product names are trademarks of the company or manufacturer respectively. © 1990 Pacific Data Products, Inc.

Circle 210 on Reader Service Card (DEALERS: 211)

Using 16 Ports Is Easier Than Ever



You told us what you're looking for from your multiuser communication controller. We listened and gave you exactly what you asked for. The ULTRA 16 and ULTRA 8 — designed to make your life easier.

Now you can have...

- ▲ A Powerful 80286 Processor
- ▲ Streams Drivers
- ▲ Field Upgradable From 8 To 16 Ports
- ▲ New "Quick Connect" Cabling
- ▲ A Universal Interface Box and "Dual Lock" Mounting
- ▲ Easy To Install Drivers For SCO XENIX System V, SCO UNIX System V, Interactive 386ix, IBM AIX, Sun OS, IBM OS2 and PC-DOS
- ▲ Transparent Print

- ▲ Multiple Sessions
- ▲ Easy To Use Documentation

When you need a basic multiuser communication controller, give our HOSTESS SERIES a try. Count on our people to give you the support and extra effort you deserve and have come to expect from us since 1982.

**Call Us Toll Free
800-9-COMTROL**



Control Corporation

A Control Systems Company

2675 Patton Road
P.O. Box 64750
St. Paul, Minnesota 55164
(612) 631-7654 • (800) 926-6876

The ULTRA SERIES logo, CONTROL ULTRA SERIES, ULTRA 8, ULTRA 16, Universal Interface Box, CONTROL HOSTESS SERIES, and the CONTROL logo are trademarks of CONTROL CORPORATION. Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies. © CONTROL CORPORATION. All rights reserved.

Circle 71 on Reader Service Card

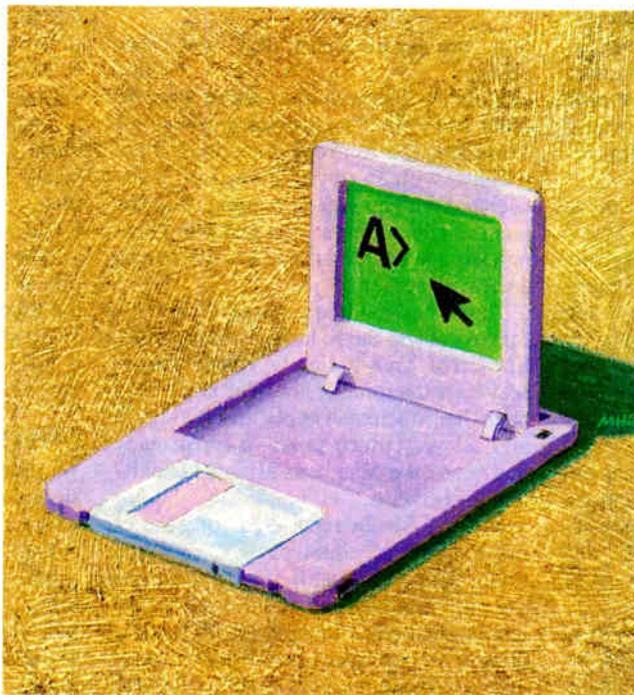
From TTY to VUI

*As computers become more complex,
using them becomes easier and easier*

Frank Hayes

What makes a good user interface? That is not a simple question. Designers have been struggling for decades to create architectures that let you get the most from your software. There are questions of priorities. Should the user interface maximize performance for experts or shorten the learning curve for beginners? Is safeguarding data more crucial than efficiency? And which should take priority: flexibility or throughput?

Not surprisingly, the quality of a user interface depends on the level of technology represented in the underlying hardware. The first interactive computer systems communicated with you through teletypewriters (TTYs)—character-based terminals that could accept only typed input and could print only on paper, one character after another. As technology improved, video display terminals (VDTs) became widely available. These “glass TTYs” could position a character anywhere on the screen. They quickly became the norm in computing. Then came high-resolution graphical displays that could support graphical user interfaces (GUIs), complete with mice.



In the Beginning Was the TTY

The original interactive user interface was the command-line interface. The most familiar CLI today is probably the DOS A> prompt, but the heritage of CLIs goes further back than the IBM PC. They came by way of the TTYs that served as the first terminals for mainframes.

TTYs had a bottleneck problem: Each

command you typed had to be sent to the computer across a relatively slow serial link, and once the command arrived, the computer had to decode it. A typical CLI had to minimize the amount of information making its way from the TTY's keyboard to the mainframe. This is part of the reason why all CLIs have inherited a tendency toward short and cryptic commands. The only way around the bottleneck was to limit the amount of information that had to pass through it. Thus, in those early days, every keystroke counted.

TTYs were limited in what they could print out as well. A TTY printed one character at a time, typewriter style. As the TTY gave way to the VDT, something new was added: the ability to alter the position of the cursor. That made it possible to print information anywhere on the screen. Using special keystrokes and a character-based VDT, software allowed you to move a cursor around the screen. You could go back and correct mistakes and update information. It's hard to grasp today what a profound improvement the electronic VDT was over the paper-based TTY.

continued

It's even harder to grasp that the "glass TTY" still defines the limits of CLIs, even on high-powered PCs. Although desktop computers have all but eliminated the bottleneck between the computer and the screen, character-based PCs behave as though the bottleneck still exists. CLI commands are still short and cryptic, and every single keystroke still counts. With a CLI, one wrong key can wipe out a day's work. However, CLIs remain popular because they work with almost any kind of operating-system architecture that can accept or print one character at a time. But they certainly show their age.

Fortunately, when desktop computers eliminated the CPU-to-display bottleneck, they also made graphics practical, and with them, GUIs.

The Mac Standard

The Macintosh user interface was the first GUI to appear on a popular desktop computer. It became a model for almost all the GUIs to follow. By comparison to the one-character-in, one-character-out simplicity of CLIs, GUIs are immensely difficult to program. The goal, however, is to make life easier and more productive for users. Three standard features distinguish almost any Macintosh screen from a non-GUI screen: a mouse pointer, a menu bar, and one or more windows (see photo 1).

The mouse pointer, which you move around the screen by moving the Mac's one-button mouse, is typically an arrow. A program can change it to one of a number of graphical icons, however, each with its own meaning. For example, to indicate that you're supposed to wait while the computer does its work, the software will typically change the pointer to a watch.

There are several standard mouse actions. Clicking selects an item or an action, double-clicking simultaneously selects an item and starts an action, and dragging moves objects on the screen or selects groups of objects.

The menu bar runs across the top of the screen. Clicking on an item on the menu bar causes the menu to drop down. Each menu item is associated with an action, which you can select by clicking on it. You can also select some menu items by using keyboard equivalents (i.e., using key-based commands instead of the mouse and menu).

Other menu items pull down submenus. A submenu appears to the right of the original menu. The items on the submenu can themselves have submenus, so it's possible to work your way deeper

and deeper into the command structure and see all the menus as you do. Any item, no matter how deep in the menu structure, can have a keyboard equivalent, which would make it unnecessary to go through the entire menu structure to initiate the action.

A window is a rectangle on the screen that lets you work within a program. On a Mac, you may be able to move the window around on the screen, change its size and shape, open it to fill the screen, close it entirely, or change how much of its contents shows. Windows can also con-

The "glass TTY" still defines the limits of CLIs, even on high-powered PCs.

tain buttons, menus, sliders, and other objects.

Outside the window, there can be other icons, such as disk drive icons or a Trashcan. Just as every menu item is associated with an action, every icon is associated with an object, whether that object is a file, a program, a group of files, or a storage device such as a disk drive or a network server.

Apple has made an extraordinary effort to control the Mac GUI, with guidelines that aren't merely suggestions—they have the force of law. The payoff has been that Macintosh applications all look and act very much alike—a consistency that, until the Mac, was almost nonexistent in software.

But the Mac's reputation for ease of use consists of equal parts reality and myth. While almost all Mac applications are similar, they can require extraordinary calisthenics to operate. A mouse-click is used to select *and* deselect items. Some software requires complex user actions, such as triple-clicking or dragging while a key is held down. And with keyboard equivalents, there are often several different ways to accomplish the same thing.

What's wrong with that? It's not consistent—and it's certainly not simple to learn. Jef Raskin, the Apple designer who originally created the Macintosh project and gave the machine its name, argued that every action should always

have the same result, and that every result should have just one action associated with it. For example, there should be only one way of erasing a file.

Raskin's argument is compelling: Efficiency and ease of use come from habit, and if you have one way of erasing a file, you'll become very fast at erasing files that way. The GUI designer's task, Raskin believed, was to find good, easy, efficient ways for you to perform your work. Once those ways have been developed, *all* software should follow them.

Needless to say, Raskin's design changed after he left the project, and the Mac you see today bears little resemblance to his original plan. The result is a plethora of ways to do almost anything on a Mac—which makes it flexible, but much more complex than its reputation implies.

Although the Mac has demonstrated in business settings that it is easier to learn than CLI-based systems, it's still a far cry from a truly easy-to-use system. This is part of the reason that, while Macintosh software was a huge improvement over the software available in 1984, it has not catapulted the Mac into spectacular success.

The Macintosh is certainly not a failure—its consistency across applications is unsurpassed, and Apple's programming guidelines produce software that rarely has trouble coexisting. (By contrast, you often find yourself playing "TSR roulette" when you try to add yet another pop-up program to your collection of DOS utilities and drivers.) And if the Mac hasn't kept the faith of Raskin's original, friendly user-interface design, it still seems like the Holy Grail of interface design compared to DOS.

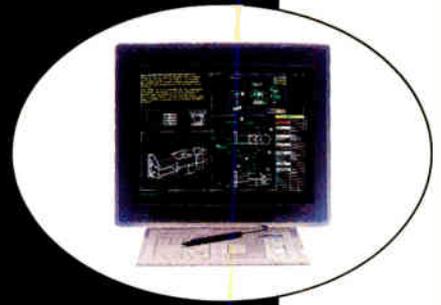
DOS Opens a Window

While the Macintosh was originally designed with a GUI, the PC was designed with CLIs. PCs get their CLI from a file called COMMAND.COM, which is actually a program that runs when no other programs are running. COMMAND.COM provides the A> prompt and executes simple built-in DOS commands such as ERASE, COPY, and DIR. COMMAND.COM also loads and executes applications and batch files.

Early versions of DOS required that the original COMMAND.COM be in place, but more recent versions allow you to replace COMMAND.COM with other command interpreters, including GUIs. However, there's a fundamental problem in adding a GUI to a PC: DOS lacks many of the building blocks of a GUI,

continued

For every PC that has dreamed of becoming a CAD workstation.



© 1990 Hewlett-Packard Company CPE6922

Call for
your **FREE**
HP ME10d
videotape.
1-800-526-
1036.



A workstation CAD package can give you all the functionality you need. But you work on a PC. And you're concerned that it's putting limitations on your designs.

Hewlett-Packard has a better way.

HP ME10d. A mechanical design and drafting system that brings workstation performance to your PC.

Our videotape will show you that it only takes a few steps to complete complex, precise designs. This added efficiency can be yours with a minimum of training. No matter what system you're using today.

HP's ME10d works with ME30 and other industry solutions on IBM, Compaq, and HP Vectra PCs. It can easily accept existing files and designs can be output to

other CAD/CAM applications.

With HP's ME10d you'll get the complete PC CAD solution. And all the assurances that come with the Hewlett-Packard name. Engineering expertise. Commitment to standards. And reliability.

Call **1-800-526-1036**. Get the video. And get more from your PC.

There is a better way.



Circle 136 on Reader Service Card

World Radio History

GUI COMPARISON

These five leading GUIs show their strengths in different areas. The Macintosh is highly consistent across applications; Windows and PM offer SAA compatibility and multitasking; and Open Look and Motif operate through networks but tend to be slow.

GUI	Macintosh	Windows	PM	Open Look	Motif
Operating system	Macintosh	MS-DOS	OS/2	Unix	Unix
Multitasking	No	Yes	Yes	Yes	Yes
Networking GUI	No	No	No	Yes	Yes
File manager	Internal	Internal	Internal	Internal	External
Consistency across applications	Very good	Good	Good	Not available	Not available
Graphics performance	Good	Good	Good	Slow	Slow
Menu style	Pull-down	Drop-down	Drop-down	Pushpin	Drop-down
CLI available	No	Yes	Yes	Yes	Yes
Underlying standards	Macintosh	SAA	SAA	X Window	SAA, X Window
Software base	Large	Moderate	Small	Nonexistent	Nonexistent
Available	Yes	Yes	Yes	No	No

their most recognizable advantage over the standard Macintosh GUI.

But something else sets Windows and PM apart: They are designed to conform to IBM's Systems Application Architecture. SAA is part of IBM's plan to bring a level of standardization to some of its operating systems, from mainframes to PCs. The fundamental idea is to design an architecture in which the same software can be used on a terminal connected to a mainframe, a workstation connected to a minicomputer, and a desktop microcomputer—with only minimal changes to support the wide range of hardware involved.

That task is difficult, because the lowest common denominator, character-based terminals, does not support graphical displays or mice. To allow software to run on both terminals and PCs with GUIs, SAA mandates that every menu item or mouse-based action in an SAA-compliant system must have a keyboard equivalent.

As a result, there will be a certain level of consistency across all SAA applications. Function key F1, for example, is always the help key under SAA (a standard that has been picked up by many non-Windows and non-PM applications). And most Windows applications, for example, generally function like other Windows applications.

However, Microsoft's style guidelines are not nearly as rigorously enforced as Apple's. Given the PC's history of incompatibilities, it's hard to believe that Windows and PM will ever achieve the level of consistency of Mac software.

Windows and PM offer some advantages over the Mac, however, including the ability to minimize a window, but neither Windows nor PM offers a GUI that is as smooth or attractive as the Mac's, or as consistent. Also, Windows and PM, with their mandatory keyboard equivalents, stray even further than the Mac from the principles of ease of use. Ultimately, even more than the Mac does, Windows and PM may suffer from programmers who would rather substitute a windowing system for careful, friendly program design.

X Marks the Spot

Unix poses its own problems for GUIs. Like DOS, Unix was designed as a character-oriented system; any graphical elements must be built on top of the original system. But Unix has another problem: Unlike DOS or OS/2 systems, in which the display is closely tied to the CPU, a Unix system can have a display terminal

continued

such as a windowing system, mouse support, and screen drivers, to handle objects that appear, disappear, change size, and move. Creating a windowing system for DOS requires building all these elements and then piling them atop DOS's command-oriented structure. The result tends to make PC-based GUIs memory-hungry and slow.

Despite the basic problems, there have been several attempts to bring windowing environments to DOS. The most notable have been GEM from Digital Research, Inc. (DRI), Microsoft Windows, and Quarterdeck's DESQview.

GEM was originally designed as a full mouse-and-menus windowing system. It ran into legal trouble with Apple very early, and DRI had to make significant changes to GEM's desktop. Windows was another early contender that ran into trouble with Apple. Microsoft's solution was to sign a license for some of the Apple technology.

But other problems stood in the way of the success of Windows and GEM. Users complained that both systems were slow and required too much memory. In addition, both GEM and Windows require that programs be designed explicitly for them, thus slowing their acceptance. GEM finally found a niche as the shell for Xerox's Ventura Publisher desktop publishing software. It has taken years for Windows to build a significant following.

While DESQview qualifies as a windowing system and supports a mouse, it was not designed primarily as a Mac-competitive GUI. Instead, DESQview was intended to allow several ordinary DOS programs to run simultaneously in separate on-screen windows. As a result, it became the first successful multitasking system for the PC, although it doesn't really fall into the GUI category.

But Windows is a GUI, and a substantial number of programs have now been designed to work with it. Like the Mac's GUI, Windows and its visually similar cousin, OS/2's Presentation Manager (PM), use a mouse pointer, a menu bar, and movable windows. However, some superficial differences quickly become apparent.

For example, menus drop down immediately when the mouse points to an item on the menu bar. (Windows has drop-down menus as opposed to the Mac's pull-down menus.) The windows themselves share only some of the standard features of Mac windows. For example, you can move a Windows or PM window by its title bar, but you can change its shape by dragging any of the other three sides.

Windows and PM also have boxes to *minimize* a window, allowing a program to continue running in the background and remain visible on-screen only as a small icon (see photo 2). That feature—part of their support for multitasking—is



If these images didn't catch your eye,
then why are you reading this ad?

Images that leap out at you, especially in a magazine like this, have to be powerful. And whether you need to present your business information more effectively or you want to expand into multi-media, you need strong visuals. Together with Truevision, you can develop that power for presentations, CAD, training, video production and more. And it's easier than you think. You can bring photo-realism and multi-media to your presentations by using a TARGA board with compatible software and peripherals from over 200 companies.

With a TARGA videographics board and your PC*, XT* or AT*-class machine, you can capture images in real-time from a video source, merge them with other images

or add text and graphs, even create stunning broadcast-quality animations, and then output the result to video, tape, slides or paper prints. That's how to maximize your presentation efforts into multi-media.

Truevision videographics cards are ready for you today. Contact us at **800/858-TRUE** for more information, or visit your local Authorized Truevision Reseller for a demonstration. We'll show you how to visualize your data in a way that no one else can.



TRUEVISION

7340 Shadeland Station, Indianapolis, IN 46256

INTERNATIONAL: Canada 416/499-9400

France 33-952-13-6253

Italy 39-2-242-4551

Switzerland 41-1-825-0949

U.K. 44-1-991-0121

West Germany 49-89-612-0010

Other 617-229-6900

PC, XT and AT are registered trademarks of International Business Machines Corp.

© 1989 Truevision Inc.

Circle 288 on Reader Service Card

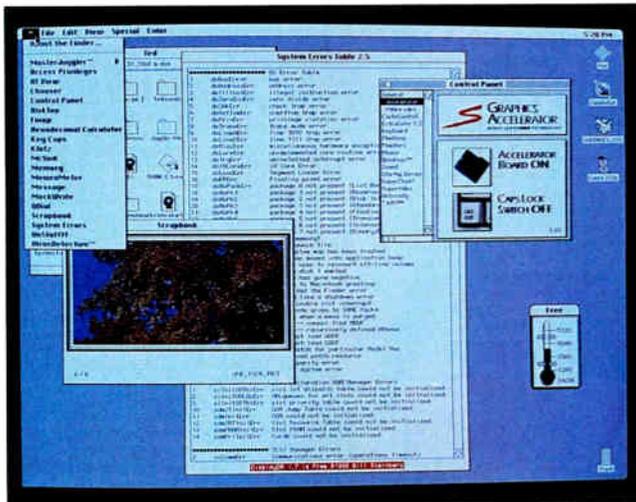


Photo 1: The Macintosh interface contains all the elements of a typical GUI. The pointer (upper left) lets you make selections and position the cursor. Menus supply you with choices among a range of actions. Windows display the output of programs.

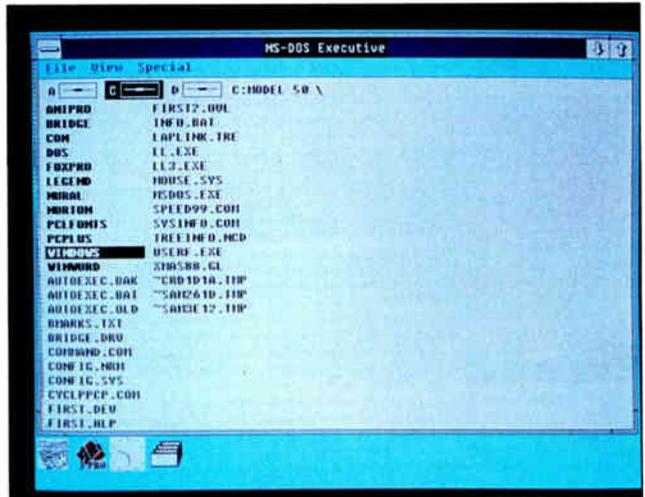


Photo 2: The minimize feature of Windows and PM keeps your display uncluttered while you run multiple applications. Programs running in the background are represented by their icons, rather than by an output window.

that's far from the central computer. It's the bottleneck problem all over again: How can you send large amounts of graphical information through a conventional communications link?

The commonly accepted solution is MIT's X Window System (referred to as X Window for the remainder of this article). X Window is a standard way of describing graphically oriented displays and sending the information from one X Window system to another. X Window also provides the ability to send keystrokes and mouse-movement information, so you can interact fully with the program. X Window doesn't completely solve the bottleneck problem, but it's a great improvement over sending a GUI display to a terminal one pixel at a time.

However, X Window is not a GUI. You might say it's just a graphical communications interface. Several X Window-based GUIs have been built (including proprietary systems, such as DECwindows, which runs only on DEC computers). But the two X Window-based Unix GUIs that promise to become the most widespread are Unix International's Open Look and the Open Software Foundation's (OSF) Motif.

Open Look was designed by Sun in close association with AT&T. In fact, it was originally designed to be the GUI for the new version of Unix (System V release 4), which is scheduled to appear this year. However, Open Look has both technical and political peculiarities. It can use some of the X Window System, but it also depends heavily on Sun's own

operating-system features.

One of the reasons for a hybrid approach was X Window's notorious slowness in updating some screens. This slowness is more than a minor annoyance. It's the most obvious characteristic of many X Window implementations. Users complain that they can move a mouse and wait seconds before the on-screen mouse pointer moves. However, a new version of X Window was recently released, and it's said to be much more responsive.

Another reason may have been Sun's long investment in its own non-X Window GUIs. The Sun alliance with AT&T was directly responsible for the creation of Open Look's main competitor, Motif, which is fully X Window-based.

As you'd expect, Open Look resembles the Mac and PC windowing systems. The usual windows and mouse pointer are there, and, as with Windows and PM, a window can be reduced to an icon while its program continues to run.

But Open Look has some different features as well. You can move a copy of a menu around on-screen, for example, or hold it in position with a pushpin (see photo 3). Even more significant is Open Look's mouse. It has three buttons, each of which has a specific purpose. The left button is for selecting items from menus; the middle button is for moving and resizing windows; and the right button is for pulling up so-called *invisible* windows and menus, which appear separately from any menu bar.

Open Look's unusual use of the mouse

is both its greatest weakness and its greatest strength. If you're accustomed to using other GUIs, the three-button approach is unfamiliar. But it's also much more consistent—a particular mouse button *always* serves the same function. As a result, although the learning curve is somewhat steeper, some users say Open Look is ultimately much more efficient than other GUIs.

OSF/Motif has its own political and technical history. OSF was formed by several Sun competitors who feared that Sun's close relationship with AT&T would produce a version of Unix that would be especially well suited to Sun's workstations—giving Sun a head start in getting products to market. OSF's first project was a competition to design an X Window-based GUI that would compete with Open Look. The result was Motif (see photo 4)—a blend of the look of Hewlett-Packard's NewWave, the feel and behavior of OS/2's PM, and the toolkit from DEC's DECwindows system.

Motif looks very much like Windows or PM, except that it has the characteristic three-dimensional look of NewWave. It works very much like the PC-oriented GUIs and has the ability to minimize a window. However, Motif doesn't come with its own file manager—the portion of the GUI that actually allows you to copy and delete files. Some current implementations of Motif (including The Santa Cruz Operation's Open Desktop) use IXI's X.desktop as the file manager. However, X.desktop can be jarring to some users, since it and Motif don't

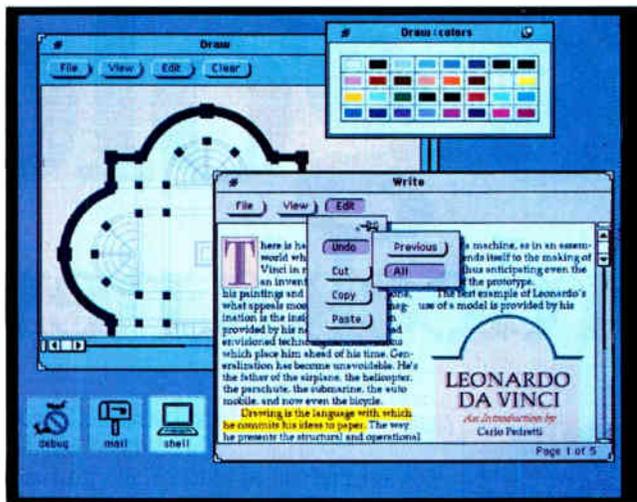


Photo 3: The Open Look pushpin menus let you position a menu wherever you like on the screen.



Photo 4: Motif features a distinctive three-dimensional look, while conforming to the X Window System and IBM's SAA interface standard.

share the same visual style.

Both Open Look and Motif have extensive specifications for conforming to a standard style, but it's too soon to tell whether either system will approach the Mac's consistency across applications. In fact, both GUIs have just been introduced, although several different software vendors have demonstrated their products using early versions of the interfaces. At the moment, Open Look seems almost ready to go. Meanwhile, Motif, with its conventional use of X Window and the mouse, seems to be a more familiar and popular choice, but it isn't yet ready for users.

With either system, it may take a long time before much Unix software makes the jump from a character-based interface to a GUI. However, it does have some things going for it. For example, the more powerful workstations that traditionally run Unix have useful advantages over PCs or Macs. On a Macintosh screen, dragging a window is indicated by a dotted outline; in Motif and Open Look, the entire window moves. But the complexity of X Window and the remaining communications bottleneck will continue to keep it substantially slower than its non-Unix competitors. Still, for communicating across networks with a GUI, X Window is far ahead of its competition (see the table).

Coming Attractions?

If GUIs present a far more complex architecture than CLIs, will the next generation bring still more complexity to

programmers in the search for easier-to-use software? Probably not. The most innovative systems for desktop computers today are racing toward object-oriented programming.

Apple's MultiFinder, a multitasking operating system for the Macintosh, replaces conventional time-sliced preemptive multitasking with event-oriented, cooperative multitasking. This is a step in the direction of the Smalltalk environment that gave birth to modern GUIs. NeXT's NextStep provides tools designed explicitly to speed up programming. NewWave and applications such as ViewLink and Magellan move much of what was once programming into the hands of users.

Meanwhile, hardware is no longer a critical barrier for better user interfaces. While low-speed TTYs once forced you to deal with CLIs, today fiber optics and inexpensive video technology are making an entirely new set of views possible for your desktop windows. In the Knowledge Navigator, the imaginary future computer that Apple president John Sculley likes to describe to his audiences, an animated talking head answers your questions.

But, in the real world, video images are already part of some GUI systems. The images are what might be called semi-interactive video: You can't change the contents of the video, but you can control how to view the images—in what order and at what speed. The combined GUI/video interface even has a name: the video user interface, or VUI.

One use of semi-interactive video, as part of Japan's TRON project, is in software designed for education and running on a modified PC. In one demonstration, you can watch a short video image of the African grassland and then click with a mouse on various animals or plants within the picture to see close-ups, get information, or run a related video. The video images are stored on a videodisk but appear within windows on the computer screen.

Another use of video in a windowed user interface is in networking, particularly in groupware. Researchers at the Xerox Palo Alto Research Center—home of the first GUIs—have experimented with continuous remote video conferencing between the PARC and a facility near Portland, Oregon. With improving video (and networking) technology, the approach could eventually put the faces of every member of your workgroup on your screen—along with a project, document, or spreadsheet the group is working on.

The VUI is an important step in the evolution of user interfaces for desktop computers. Just as the move from CLIs to GUIs made working with a computer less abstract and more "real," VUIs hold the promise of combining graphical, video, and audio information to bring the real world into the computer. ■

Frank Hayes, a former BYTE news editor, is a writer for UnixWorld and lives in Portland, Oregon. You can contact him on BIX as "frankhayes."

There's gold

Now, Quarterdeck's new

Memory is gold.

And like gold, some of it is hidden away inside your computer. For years, we've been working toward putting it all under your control. And now we can.

Now you can make today's more powerful programs run without giving up network and mouse drivers and TSRs.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That's why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It's called Manifest. And it does for memory what PC Tools does for disks. For under \$60.

Quarterdeck's seven years of memory expertise made Manifest

Manifest guides you deep inside your PC.

It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Administering a number of PCs? Manifest's diagnostic and reporting capabilities reduce technical support time. It not only identifies problems but helps to solve them.



Manifest shows you how your memory works. Here's the first megabyte of RAM, showing unused areas.



Your current memory is full of holes. Our tools can fill blocks of unused addresses between 640K and 1024K to free up memory your programs can use.

Manifest shows you the contents of AUTOEXEC.BAT and CONFIG.SYS files. That can be a big help when diagnosing problems. Manifest tells you all about your hardware, too—from your cpu type to what boards you have installed. Manifest even tests memory speed.

And it runs benchmark tests on expanded memory boards so you can make informed buying decisions.

You won't need a PhD to understand what you're doing. Manifest has an interactive 'manual' that tells you how to use the program and what benefits you'll get.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It's a productivity breakthrough from the memory experts at Quarterdeck.



Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your

memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and 'map' memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V. 2.x.

If your PC has 'shadow RAM,' there's even



QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K—freeing it up for your programs to use.

more gold in your PC. QRAM finds the unused parts and puts them under your control.

And if you have an EGA or VGA-equipped PC and don't need graphics at the moment, QRAM will make an additional 96K 'nugget' of memory available! When you need graphics again, QRAM will switch you back to graphics mode! Think how helpful that will be for those big dBASE files.

It can't work miracles, but if there's memory available anywhere, QRAM lets you use it to increase your PC's speed and performance.

QRAM is available bundled with Manifest for just a few dollars more than Manifest alone.

Manifest and QRAM—two more examples of Quarterdeck's commitment to mining the most productivity out of the PC and software you own today.

in your PC. Tools can mine it for you.

Introducing QEMM 50/60 Version 5.0

QEMM (Quarterdeck Expanded Memory Manager) 50/60 is the gold standard in memory management for the IBM PS/2™ series 50 and 60. It works with IBM's Memory Expansion Option, Expanded Memory Adapter/A and compatible memory boards.

It supports all three specifications for expanded memory: EMS 4.0, EMS 3.2 and EEMS memory so you can run all expanded memory programs.

And it also works with Microsoft's XMS specification, in case you want to use Windows.

QEMM lets you use memory locations between 640K and 1024K to run TSRs, mouse and network drivers, DOS resources and MCA adaptors. That means you can gain up to 130K of memory space below 640K for your programs.

Best of all, QEMM is designed to be easy to use—even for those new to the PC. Just install it and type 'optimize,' and it looks at your AUTOEXEC.BAT and CONFIG.SYS files and loads whatever it can in high memory. Automatically.

QEMM 50/60 is priced economically. It's the biggest boost you can give your PS/2 for under \$100.



QEMM and DESQview let you multitask and window with the programs you know and use today.

Introducing QEMM 386 Version 5.0

QEMM 386 can expand the memory of all 386-based computers, including PCs with 80386 upgrade boards. It makes your memory compatible with EMS 4.0, EMS 3.2 and EEMS memory without having to add special hardware. It's compatible with protected-mode programs (like 1-2-3 Release 3, IBM Interleaf and Paradox 386) using DOS extenders compatible with the Quarterdeck/Pharlap VCPI spec.

QEMM also works with Microsoft's XMS spec to extend memory for Windows users.

QEMM gives you maximum control over your memory between 640K-1024K. It can find unused memory nuggets as small as 4K and use them to free up room for programs to use.

QEMM 386 even monitors how your programs use memory while they're running. Then it shows you where there's additional memory you can use. It even measures which parts of your memory are fastest and 'decides' how to use them for better performance. In action, it's easy and fun—almost like having an *artificial intelligence* program to help tune up your PC.

All these capabilities add up to greater performance at a very low cost. And QEMM lets you go for the gold without having to become an expert on the PC memory puzzle.

Like all Quarterdeck products, it works with your current PC and favorite software.

A few words about DESQview

What's the smartest thing to do with all that additional memory? Run DESQview and multitask your favorite programs in windows. Use a mouse or keyboard and you can run graphic and text-based programs side-by-side. All without having to invest in a bigger hard disk or more memory.

From Manifest to QRAM, QEMM and DESQview, Quarterdeck helps you mine the most from the software and PC you have today.



DESQview's recent awards.

System Requirements

Manifest: 8088, 8086, 80286 80386 and i486 PCs & PS/2s

QRAM: 8088, 8086, 80286 PCs. Use of high memory is only available when PC has EMS 4 or EEMS expanded memory or Chips & Technologies shadow RAM.

QEMM 50/60: 80286-based PS/2s and compatibles with IBM PS/2 80286 Memory Expansion Option, IBM PS/2 80286 Expanded Memory Adapter/A or compatible.

QEMM-386: 80386-based PCs and PS/2s and PCs with 80386 add-in boards.

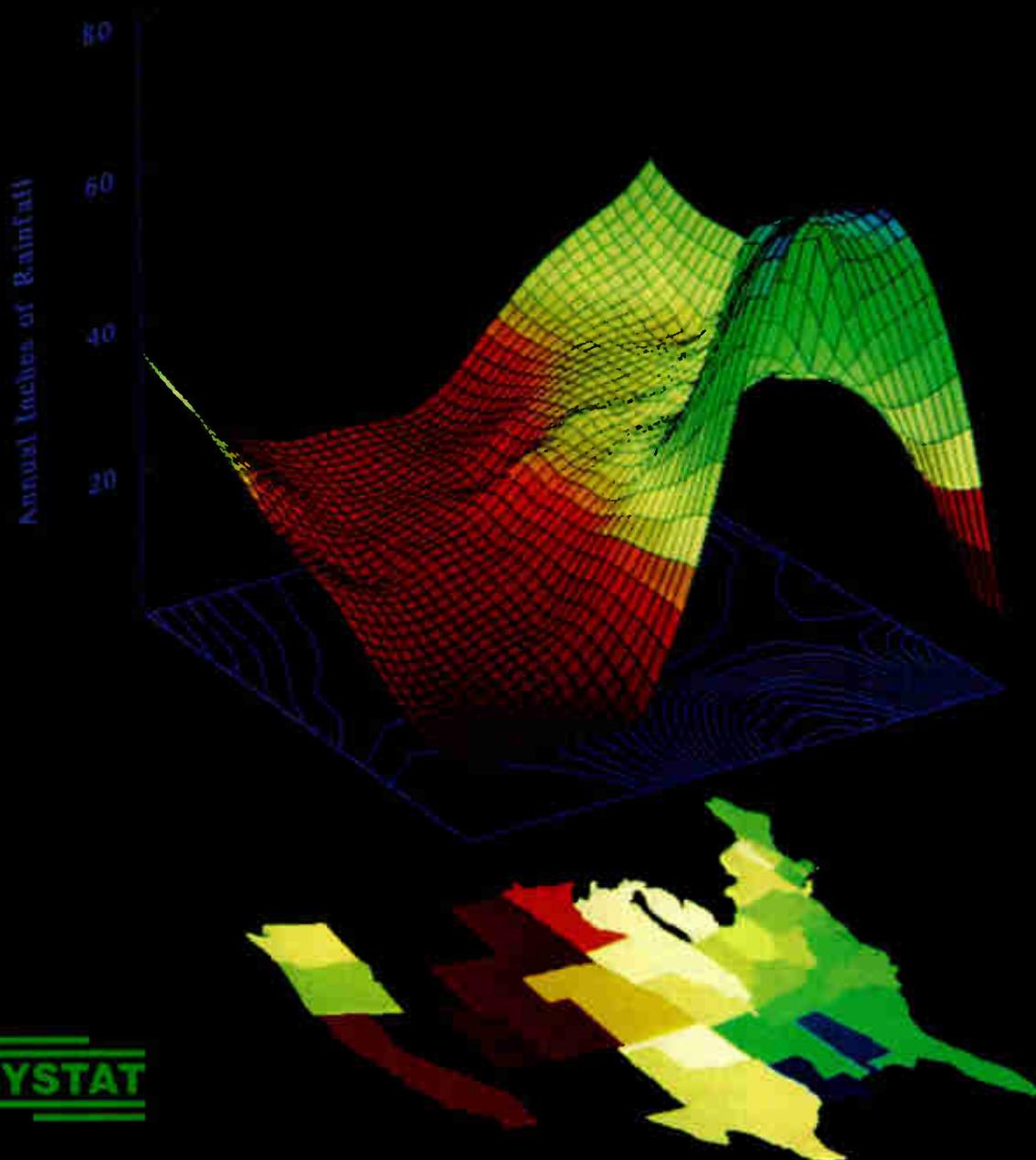
Trademarks: IBM, PS/2: IBM Corporation; PC Tools: Central Point Software; 80386, i486: Intel Corporation, Chips and Technologies: Chips and Technologies



150 Pico Boulevard, Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

Yes! I need increased productivity on my current PC!		Qty	Product	5-1/4	3-1/2	Each	Totals	
Payment <input type="checkbox"/> Visa <input type="checkbox"/> MasterCard			Manifest 1.0			\$59.95		
Expiration _____ / _____			QRAM and Manifest 1.0			\$79.95		
Card # _____			QEMM 50/60 5.0 (with Manifest*)			\$99.95		
Name _____			QEMM 386 5.0 (with Manifest*)			\$99.95		
Address _____		Shipping & Handling \$5 in USA/ \$10 outside USA						
City _____ State _____ Zip _____		California Residents add 6.5%						
							Grand Total	

*introductory offer expires 3/31/90



SYSTAT

The best.

BYTE said it in 1984.

The American Statistician said it in 1985.

InfoWorld said it in 1986, and again in 1988.

PC Magazine said it in 1989.

SYSTAT is the only statistics software to have won both *InfoWorld's* Best in Class award and *PC Magazine's* Editor's Choice award.

SYSTAT is the only statistics package ever to win *InfoWorld's* prestigious Top 100 award.

For five consecutive years, SYSTAT has won every major review in every major publication.

Users agree.

SYSTAT received the top rating in *PC Week's* 1988 user satisfaction poll.

No other statistics company's microcomputer user base rivals the more than 100,000 users of SYSTAT products worldwide.

Find out for yourself why no other company comes close to our record.

MS-DOS,[®] MACINTOSH,[®] UNIX,[®] VMS[®]

For more information and a free poster of this map, call 708 864.5670 or write SYSTAT, Inc. 1800 Sherman Ave., Evanston, Illinois 60201

Systat. Intelligent software for statistics and graphics.

Circle 275 on Reader Service Card

World Radio History

Behind the Scenes

*A good API makes development a piece of cake,
and a bad one can drive you bananas*

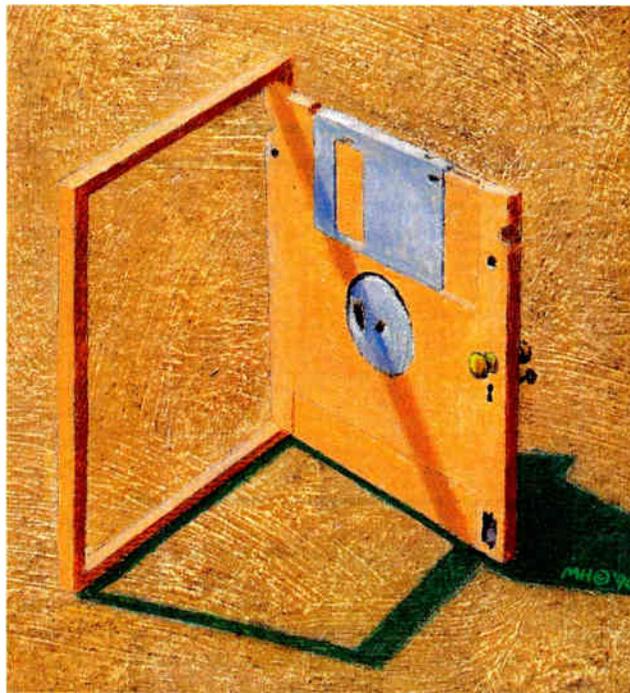
Howard Eglowstein

Providing a user interface that you can learn to use quickly and easily has been a driving force in the computer industry since the Macintosh made "ease of use" a religion in 1984. The major interfaces—DOS and Unix command interpreters, Macintosh Finder, Windows, Presentation Manager, and the X Window System—provide different levels of functionality and comprehensibility.

Deciding which user interface to support in a multiple-machine environment requires more than a simple examination of the different interfaces. It requires an understanding of the programming interface that underlies what you see on your computer screen.

The application programming interface is what gives your program access to the system's resources. A good API will make it easy to concentrate on the task at hand, and a bad one can drive you bananas.

The API lets your program communicate with the operating system, which is responsible for managing all the resources available in the system. At a minimum, this involves managing the keyboard, display, disk drives, and file



system. Most personal computers extend operating-system support to include the management of printer ports, serial I/O ports, and memory.

Giving all programs unrestricted access to all system resources would result in chaos. The operating system needs to be in control to sort out conflicting requests for scarce resources. You need a way to tell the operating system what

your program needs to do. That's what the API is for.

A Bushel of APIs

At the simplest level, the API is just the definition of the raw operating-system calls. CP/M or DOS programmers who work in assembly language use such calls exclusively.

At the next level, a high-level language like BASIC, C, or Pascal incorporates operating-system calls into its own language primitives and standard libraries, making it easier to use the operating system and providing some level of code portability. The high-level-language approach also cuts down radically on learning time; the language designers have programmed the hardest routines for you.

Perhaps the most interesting API is an event-driven windowing environment.

From the outside, a windowing program normally has menu bars and movable windows and uses some sort of pointing device to control a free-roaming cursor. These elements constitute a graphical user interface (GUI). Microsoft Windows and the Mac interface are the most common examples.

A windowing interface combines basic
continued

Listing 1: Programming DOS in assembly language involves manipulating the registers directly and triggering specific interrupts. This code fragment opens a file.

```

Fname db 'FACE.DMG',0
Fhandle dw ?
;
mov DX,offset Fname ; DX register points to the filename
mov AX,3D00h ; AH=the 'open' function (3Dh)
; AL=file mode is open for read (00h)
int 21h ; Software interrupt 21h is the
; standard MS-DOS file system interrupt.
jc Open_error ; When DOS returns, check the Carry bit to see
; if the operation was successful. If it didn't
; work, jump to our error-handling routine.
mov Fhandle,AX ; Since we didn't jump, it must have worked.
; DOS returned the file "handle" in AX. Save it.
; Go on and do more stuff

```

Listing 2: This piece of code demonstrates how to open a DOS file using C. The high-level language shields you from the complexities of the assembly API.

```

#include <stdio.h> /* Standard DOS information, stored in an include
file. */
char name[] = "FACE.DMG"; /* The file we want opened. */
FILE *fp, *fopen(); /* Open the file, store the 'handle' in fp. */
if ((fp = fopen(name,"r") != NULL)) {
/* If we failed, fp = NULL. Punt. */
/* Do some stuff with the file. */
fclose(fp); /* Close the file. */
}
else {
/* We couldn't open the file. */
}

```

Listing 3: Opening the same file from another high-level language, GWBASIC. The same method works under Microsoft QuickBASIC and BASIC 7.0.

```

10 ON ERROR GOTO 200 : ' If the OPEN doesn't work.
20 ' When the file is opened, it will be accessed as channel 1.
30 ' BASIC "channels" are analogous to MS-DOS "handles."
40 OPEN "FACE.DMG" FOR INPUT AS #1
50 ' If FACE.DMG couldn't be opened, we would have jumped
60 ' to line 200.
70 PRINT "File is opened"
80 CLOSE#1
90 STOP
200 ' Error-handling routine.

```

operating-system calls with special libraries that control the graphics display, pointing device, memory allocation, and (if it is supported) multitasking. A high-level language normally ties it all together. However, unlike conventional text-based applications, the event-driven mode of a windowing interface takes control of all user input.

The GUI checks the keyboard and pointing devices and determines which key press or mouse-click is meant for which program. Along with any timer or other interrupts, these input events are placed in a special *event queue*, which the API controls. Instead of checking the input devices, an application asks the

API for any relevant events and processes input by dispatching control to the appropriate *event handler*. Applications that are programmed with an event-driven API have a distinctive look and feel that many people find easier to learn and use. GUIs also provide a more intuitive way of handling a multitasking environment.

Inside the Command Line

DOS and CP/M share a common lineage and thus have similar APIs. In both programming environments, a set of common entry points is set aside for standard operating-system functions. In CP/M (which supports only a 64K-byte program area), the memory at 0005 hexa-

decimal points to the *jump table*, which contains the address of each of the operating-system functions in a specific order. DOS reserves several of the 808x processor's software-interrupt vectors for accessing the operating system.

With both systems, you access an operating-system function by first placing any necessary addresses or data in the appropriate CPU registers and calling the correct interrupt (DOS) or CALL 0005 (CP/M). The operating system takes control, completes the operation, and returns to your program. Your program finds returned data or status information in CPU registers or designated memory buffers.

Both DOS and CP/M function calls are limited to keyboard input, simple screen output, and disk and file system calls. DOS also provides some control over the division of system memory up to 640K bytes. Running DOS on an IBM-compatible machine lets you access the system BIOS as well, enabling you to control the serial and printer ports, graphics screen, and system clock without doing any low-level programming.

APIs Speak Your Language

If assembly programming isn't to your liking, you can program CP/M and DOS machines in a high-level language. BASIC and C are probably the most commonly used high-level languages. They completely shield you from having to manipulate CPU registers directly.

Listing 1 shows an assembly DOS program opening a disk file. Listing 2 contains the same function, written in C. The C compiler handles all the DOS functions and remaps them into a standard ANSI C format. BASIC performs a similar function, except that the standard BASIC implementation on DOS machines is Microsoft's GWBASIC, which is not an ANSI standard. Listing 3 shows how you open a file using GWBASIC.

In these sample listings, note that the filename is designated using the DOS naming conventions. While high-level languages give you some degree of code portability, the operating system always determines the file-naming convention.

Screen control in DOS is not nearly as flexible as file access. DOS uses the system BIOS to give you simple teletypewriter emulation. By outputting characters to a standard file handle, DOS can pass them through the BIOS to the screen. This handle does not support cursor commands, colors, or any display attributes—just characters. (CP/M implementations at least provided some

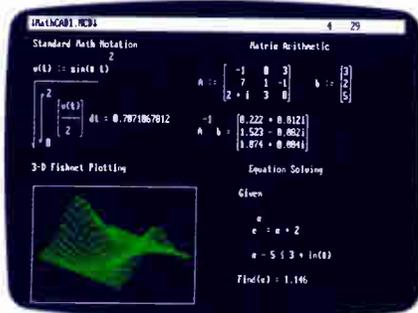
continued

After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell.

Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.

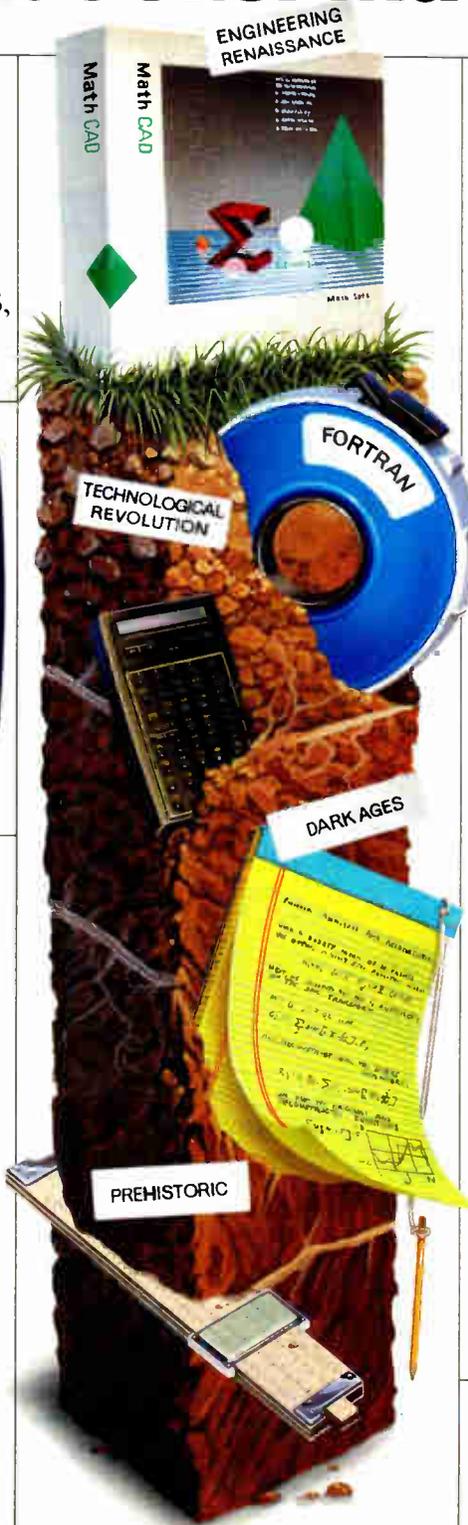


MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

And now we've made the best even better. MathCAD 2.5 is a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, and the ability to import HPGL files from most popular CAD programs, including AutoCAD.* And now you can print on PostScript* compatible printers.

And like before. MathCAD's live document interface™ lets you enter



equations anywhere on the screen, add text to support your work, and graph the results. Then print your analysis in presentation-quality documents.

It has over 120 commonly used functions built right in, for handling equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 60,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists, and economists.

But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."



And for Macintosh* users, we present MathCAD 2.0, rewritten to take full advantage of the Macintosh interface. Entering operators and Greek letters into equations is pure simplicity!

Look for MathCAD 2.5 at your local software dealer, or give us a call. For more information, a free demo disk, or upgrade information, dial 1-800-MATHCAD (in MA, 617-577-1017).

Available for IBM* compatibles and Macintosh computers.

TM and ® signify manufacturer's trademark or manufacturer's registered trademark respectively.

MathCAD®

MathSoft, Inc. One Kendall Square, Cambridge, MA 02139

U.K.: Adept Scientific 0462-480055; France: ISE CEGOS 1-46092768; Germany: Softline 07802-4036; Japan: CRC 03-665-9768.

PE #3

Circle 177 on Reader Service Card

World Radio History

form of terminal emulation, normally with VT52 or similar escape sequences.) However, an IBM-compatible machine gives you control over display attributes, such as cursor location and text colors, through calls to the system BIOS.

In assembly language, you set screen attributes using the INT 10h BIOS interrupt and access the display-file handle through the INT 21h DOS interrupt. GW-BASIC provides its own interface to the BIOS. Sadly, standard C libraries provide only the teletypewriter emulation of DOS—C does not support BIOS calls. To correct that omission, most compilers can be fitted with function libraries that give you full control over the screen. In some cases, these libraries come with the compiler. They are also available from numerous third-party developers.

DOS and Don'ts

DOS is essentially a collection of device-control functions waiting to be called by your application program. Writing for DOS is simply a matter of working in the standard definition of a language, making the appropriate function calls as needed. This limits your program to the functions that DOS defines. (It also restricts your programs to a maximum of 640K bytes of memory.)

Thus, DOS programs tend to be very keyboard-oriented and often have a sparse look about them. Perhaps the most common complaint from DOS users is the lack of a standard user interface. Because DOS handles only basic screen output or keyboard entry, your program is free to use any keystrokes you wish. You can also make the screen look any way you please. However, if you choose to use the DOS API, you should strive to be consistent.

The Nonstandard Standard

Unix has been around much longer than DOS, but it wasn't a practical operating system for desktop equipment until the arrival of fast processors, cheap memory, and high-capacity hard disk drives. Unix is semiportable, and it has been adapted to many different processors and architectures. In the world of Unix, however, there's no such thing as standard hardware, never mind a standard machine-instruction set. If you're going to work with Unix, you have to stay with C or some other high-level language.

C programs written for Unix, like those written for DOS, are based on the standard ANSI C definition. Each Unix manufacturer provides a specific flavor of C compiler designed to generate code compatible with its hardware. All you

have to do is write standard C, compile it on your machine, and you're set. File I/O works through `fopen()`—even the keyboard, since C maps all keyboard input to the `stdin` file pointer.

In theory, any program you write for a DOS machine should compile directly under Unix. There are exceptions, so you can't expect to have portable code if you use direct memory pointers or make assumptions about internal data formats.

The Unix Difference

Unix systems usually have more memory than DOS machines—lots more. Unix

In Unix,
*there's no such thing as
standard hardware,
never mind a standard
machine-instruction set.*

system libraries have built-in support for terminal control and true multitasking.

Preemptive multitasking can make programming a complex system much easier on a Unix machine than it is on a DOS machine. For example, say you're writing the ultimate word processing package and you want it to run under both DOS and Unix. One feature you want to add is background printing, where the software can print one file while editing another.

DOS provides two ways to accomplish this, neither of them terribly elegant. Because a word processor spends most of its time waiting for keystrokes, you can perform limited multitasking within the code by writing a keyboard-sampling routine that prints out a few characters, then samples the keyboard, and then prints a few more characters. Since your program polls the keyboard at regular intervals, this approach works well for a word processor. It is not appropriate for most programs, however.

Another facility available under DOS is the background "multiplex" interrupt, which will perform simple background tasks as a part of DOS's overhead. A standard DOS utility, `PRINT`, uses this interrupt to handle file printing in the background. A number of DOS word processing packages send output to a

temporary file and then have DOS use `PRINT` to output the file. Elegant? No, but it is functional.

On a true multitasking operating system such as Unix, you can spawn a separate task to handle printing. In fact, this task could be a separate copy of the same word processor. The spawned task handles the printing as needed and then destroys itself. The operating system handles task switching and resource conflicts automatically, making the code much simpler.

Terminal Affairs

Screen I/O under Unix isn't much better than it is under DOS. When Unix was developed, bit-mapped graphics screens were an oddity. Until the advent of the microcomputer, all output screens were part of data terminals, some of which featured better functionality than others.

Unix handles a terminal by treating it like a file and using standard file I/O commands to spit characters back and forth. Simply sending ASCII characters wouldn't give you any cursor control, and it's impractical to write support for every possible terminal type into your program. (This is not a problem under DOS, however, because all PCs look alike to DOS.)

To get around this problem, Unix systems provide you with a standard terminal-interface package. A terminal is assumed to support a standard set of functions, driven by escape sequences. A table of all possible terminals is stored in the `Termcap` file, and the system variable `TERM` will tell your program which kind of terminal it's on. It's not nearly as convenient as the single DOS machine type, but it's a good compromise and is one step toward a device-independent interface.

A Sashay Through the Windows

Imagine adding one layer of graphics support between you and the operating system. Further, give this layer complete control over the system memory, keyboard, and file system. Then, have the graphics support offer a wide variety of window types and support any type of screen (within reason). What you wind up with is an API that supports a GUI.

Apple calls its GUI API the `Toolbox` and puts it into the system ROM of every Macintosh it makes. DOS users can buy something similar (in the guise of `Windows/286` or `Windows/386`). Those running `OS/2` have access to similar technology with `Presentation Manager`. In the following discussion, I use Mac terminology

continued



The ARC Proturbo 386/20 Blows The SX Away

It doesn't make sense to buy a 386 SX based personal computer.

They say you can get a 386 SX system at a 286 system price. We'd like to know where!

Realistically, if your applications have outgrown your 286 and you've decided to get a 386, you already know you have to spend more money.

So why compromise performance?

Get an ARC Proturbo 386/20.

It's a true 32-bit 386. It costs the same as many 386 SX systems but blows them all away. If you need 386 power with a painless price tag, don't settle for a wimpy SX.

Get the ARC Proturbo 386/20 and the muscle to handle your growing needs.

Where? At your local ARC dealer.

In California: (213)265-0835

Elsewhere: (800)FIND-ARC

(800)423-3877

ARC
AMERICAN
RESEARCH
CORPORATION

386 is a trademark of Intel Corporation.

Argentina 1-469518
Austria 222-934212
Bahrain 973-531177
Bangladesh 2-44179
Belgium 2-2418784
Denmark 42-951895
England 1-6844144
Finland 52-609100
Hong Kong 3-7420007

Hungary 1-1667688
Iceland 1-687699
Italy 2-2770232
Kuwait 965-2421812
Norway 42-15500
Pakistan 21-521529
Puerto Rico 675-257477
Peru 14-419860

ARC Products are Sold Worldwide



Philippines 2-8189329
Portugal 1-577767
Saudi Arabia 3-8265007
Singapore 65-2967211
Spain 1-3203470
Sri Lanka 1-574980
Sweden 46-31658551
Switzerland 22-7825575
Thailand 2-4984552

Turkey 901-1690230
United Arab Emirates 4-224261
USA 213-2650835
West Germany 40-66051
Yemen Arab Republic 2-207721

Circle 23 on Reader Service Card (DEALERS: 24)

Listing 4: A sample Macintosh event loop. Most of the code has been removed to show the file structure better.

```

{This source is for MPW Pascal}
Program Excellent;
{Program name: Excellent.P}
{Function: This is the main module for this program.}
{History: 1/2/90. Original by Prototyper.}

repeat
  if (theInput <> nil) then
    TEIdle(theInput);
  SystemTask;

  if GetNextEvent(everyEvent, myEvent) then
    begin
      code := FindWindow(myEvent.where, whichWindow);

      case myEvent.what of
        MouseDown :
          begin
            if (code = inMenuBar) then
              begin
                end;
            if (code = InDrag) then
              begin
                end;
            if ((code = inGrow) and (whichWindow <> nil)) then
              begin
                end;
            SystemClick(myEvent, whichWindow);
          end;
        KeyDown,AutoKey:
          begin
            end;
        UpDateEvt :
          begin
            whichWindow := WindowPtr(myEvent.message);
            BeginUpdate(whichWindow);
            EndUpdate(whichWindow);
          end;
      end;
    until doneFlag;
end.

```

nology. Bear in mind, however, that Windows, PM, and the Macintosh are similar and work in much the same way.

In an event-driven environment, the operating system automatically samples the keyboard, mouse, serial ports, and other sources of input. The windowing software directs input events into the proper window's queue. The software then calls the program that controls the window.

When notified of an event, your program looks at the event type and dispatches a routine to handle it. Normally, this event handling takes the form of a case statement in C or Pascal.

Your program would normally provide routines to handle keystrokes, mouse movements, serial I/O (if you're using the serial ports), button clicks, and disk insertions. In addition, the windowing software informs your program when its window is covered up by other windows, when it's uncovered, and when it should be closed.

Listing 4 is a Pascal program (Excellent.P) for the Macintosh that displays a window and waits until you select Quit from the System menu. Most of the meat has been removed to make the structure visible.

GetNextEvent returns the next event

in the queue. The case statement isolates MouseDown and KeyDown events, calls the necessary routines, and then loops until doneFlag is set. In a complete program, doneFlag is set by clicking the close box, selecting Quit from the System menu, or some other action. SystemClick passes a MouseDown event off to activate desk accessories.

Microsoft Windows uses a similar scheme. Listing 5 is an excerpt from SHOBITS, a program in C that displays arbitrary graphics on the screen and wraps text around them. WinMain is the main procedure that displays the graphics window and polls for messages from the event queue. Note the structural similarity between the Windows program and the Macintosh program. In this example, GetMessage serves the same purpose as the Macintosh's GetNextEvent.

Share and Share Alike

Windowing systems are often multitasking, so it's possible that other programs will be vying for the same resources. Thus, the windowing system normally manages memory, as well as screen I/O, which requires special calls to send text to the active window. Keystrokes come in through the event queue. File I/O, on the other hand, is usually handled directly by the operating system.

Multitasking is handled in various ways. Nonpreemptive systems such as the Macintosh use cooperative multitasking, which takes advantage of the fact that programs have to query the system for events. By asking for an event, the program indicates to the event handler that it is waiting for something to do. Another program can then get control of the processor for a while and return control when it is waiting for an event.

If all the programs on such a system are well behaved, then everyone gets a turn. Of course, there are always a few programs that don't play fair and never relinquish control. On the Macintosh or under Windows, there simply is no way for an application to regain control from these ill-behaved ones.

On the other hand, OS/2 is truly a preemptive operating system, and PM can simply take control whenever it wants. Whether you have a preemptive or nonpreemptive environment, it's best to make sure your applications can coexist with other programs in a multitasking system.

A Standard Standard

Windowing interfaces depend on high-resolution graphics displays. In this

continued

If Looks Could Kill...



The ViVa24 Modem knocks 'em dead with style and convenience.



Finally! An affordable, state-of-the-art modem designed to maximize any workstation or desktop and take up minimal space. The new 2400 baud modem from Computer Peripherals, Inc. is a 100% Hayes compatible external modem which boasts more high-tech features than its competition at an unbelievable price tag. 🐸

The compact, distinctively sleek tower design simplifies placement, and it's easily accessible, front panel power switch eliminates fumbling around the back of the unit. The handsome weighted base holds the ViVa24 firmly in place, and sharp LED indicator lights are aligned for comfortable viewing, utilizing international graphic icons that make the ViVa24 simple to understand. 🖨️

The small tower design creates a natural flow of air over the surface of the board, allowing the ViVa24 to run cooler and affording you 24-hour, worry-free operation. The ViVa24 modem provides the user compatibility with IBM PC, XT, AT, IBM PS/2, Apple Macintosh computers and any computer that supports RS-232C. 📠

The ViVa24 modem represents innovation from its footprint up with features such as: use of the Hayes "AT" command set, asynchronous data format, auto-dialing, auto answer, adaptive equalization, non-volatile memory, automatic tone and pulse dialing, remote access while your computer is unattended, self-test and built-in diagnostics. Best, of all, the ViVa24 is fully backed with a five-year limited warranty. 📠

Before investing in an ordinary modem, be sure to investigate the ViVa24. 🐸

Call your nearest dealer or call us for details.

Circle 66 on Reader Service Card (DEALERS: 67)

HIGH FIDELITY™

By Computer Peripherals, Inc.

667 Rancho Conejo Blvd. • Newbury Park, CA 91320
TEL: (805) 499-5751 • Toll Free (800) 854-7600 ext. 22
FAX (805) 498-8848 • TLX: 55299 CPI

Trademarks: IBM, International Business Machines, Corp.; Hayes Microcomputer Products; Apple Macintosh; High Fidelity; Computer Peripherals, Inc.

The Cream.



The Crop.



There are plenty of places to get information in this industry. Too many. But if you want the best quality information, there's only one that rises to the top: **BYTEWEEK**, a weekly newsletter from the same professionals who produce **BYTE Magazine**.

Subscribe now and take advantage of a special subscription rate of \$395 (\$495 outside the U.S. and Canada). *Don't miss this opportunity!*

In the U.S. call **BYTEWEEK's** toll-free number: **1-800-258-5485**. In N.H. and outside the U.S. call **603-924-9281**.

BYTEWEEK offers a money-back guarantee if you are not completely satisfied.

BYTEWEEK 

One Phoenix Mill Lane
Peterborough, NH 03458

Listing 5: A main procedure and event loop from Microsoft Windows.

Listing 5

```

/* The Source file: shobits.c */
#include "windows.h"
#include "shobits.h"          /* There's no bits like SHOBITS */

int PASCAL WinMain( hInstance, hPrevInstance, lpszCmdLine, cmdShow )
{
    msg.wParam = 0;

    if ( hPrevInstance ) {
        /* Copy data from previous instance */
    }
    else {
        /* Call initialization procedure - this is the first instance. */
    }

    if (hWnd = CreateWindow((LPSTR)szAppName,
                           (LPSTR)szMessage,
                           WS_TILEDWINDOW,
                           0, /* x - ignored for tiled windows */
                           0, /* y - ignored for tiled windows */
                           0, /* cx - ignored for tiled windows */
                           0, /* cy - ignored for tiled windows */
                           (HWND)NULL, /* no parent */
                           (HMENU)NULL, /* use class menu */
                           (HANDLE)hInstance, /* handle to window instance */
                           (LPSTR)NULL ) ) { /* no parameters to pass on */

        hInst = hInstance; /* Save instance handle for DialogBox. */

        while ( GetMessage( (LPMSG)&msg, NULL, 0, 0 ) ) {
            /* Polling messages from event queue. */
            TranslateMessage( (LPMSG)&msg );
            DispatchMessage( (LPMSG)&msg );
        }

        return (int)msg.wParam;
    }
}

/* Procedures that make up the window class. */
long FAR PASCAL ShoBitsWndProc( hWnd, message, wParam, lParam )
switch (message)
{
    case WM_SYSCOMMAND:
        switch (wParam)
        {
            case IDSABOUT:
                DialogBox( hInst, MAKEINTRESOURCE(AABOUTBOX), hWnd, lpprocAbout );
                break;
            default:
                return DefWindowProc( hWnd, message, wParam, lParam );
        }
        break;
    case WM_DESTROY: /* Quit was selected from the File menu */
        PostQuitMessage( 0 );
        break;
    case WM_MOUSEMOVE: /* Any time the mouse moves */
        if (bMouseDown) {
            /* Erase old line and draw a new one */
        }
        break;
    case WM_LBUTTONDOWN: /* If either mouse button is pressed */
    case WM_RBUTTONDOWN:
        if (!bMouseDown) {
            /* snag a starting X and Y coord */
        }
        break;
    case WM_LBUTTONUP:
    case WM_RBUTTONUP:
        if (bMouseDown) {
            /* The button was down and has just been released */
        }
        break;
    case WM_PAINT: /* Windows has just asked us to repaint the screen */
        BeginPaint( hWnd, (LPPAINTSTRUCT)&ps );
        if ( PlsAddTxt ) { /* Wrap two columns of text */
            Column1 ( hWnd, GetDC( hWnd ) );
            Column2 ( hWnd, GetDC( hWnd ) );
        }
        PlsAddTxt = FALSE;
        ReadClipboard ( hWnd, GetDC( hWnd ) );
        XORBox ( hWnd, startx, starty, endx, endy );
        EndPaint( hWnd, (LPPAINTSTRUCT)&ps );
        break;
    default: /* Any message we don't have a handler for */
        return DefWindowProc( hWnd, message, wParam, lParam );
        break;
}
return(0L);
}

```

All the power of The Software Link's PC-MOS operating system. All the benefits of both individual and networked PCs.

All in one high-performance, low-cost, multi-tasking system. With no terminals and no additional PCs — unless you want to optionally use your old XT's or AT's.

The UnTerminal™ UnNetwork.™

It's the ideal multiuser system for personal computer users.

UnTerminal monitor-keyboard workstations cost less than terminals. Less than text-only "intelligent I/O" solutions. Less than fiber-optic graphics solutions.

An independently operating UnTerminal workstation outperforms them all. With faster

UnNetwork.

Inexpensive monitor-keyboard workstations replace costly terminals and PCs on the UnTerminal™ UnNetwork.™ Run multiuser and popular PC programs at the same time — with no terminals or PCs — or use any XT's and AT's you happen to have.



The UnTerminal Video Network Adapter™ supports up to 4 Hercules-compatible workstations.

The UnTerminal Video Network Graphics Adapter™ supports up to two color graphics workstations — resolution up to 800 x 600.

The UnTerminal Connect Card makes an XT or AT into a multitasking, multiuser workstation.

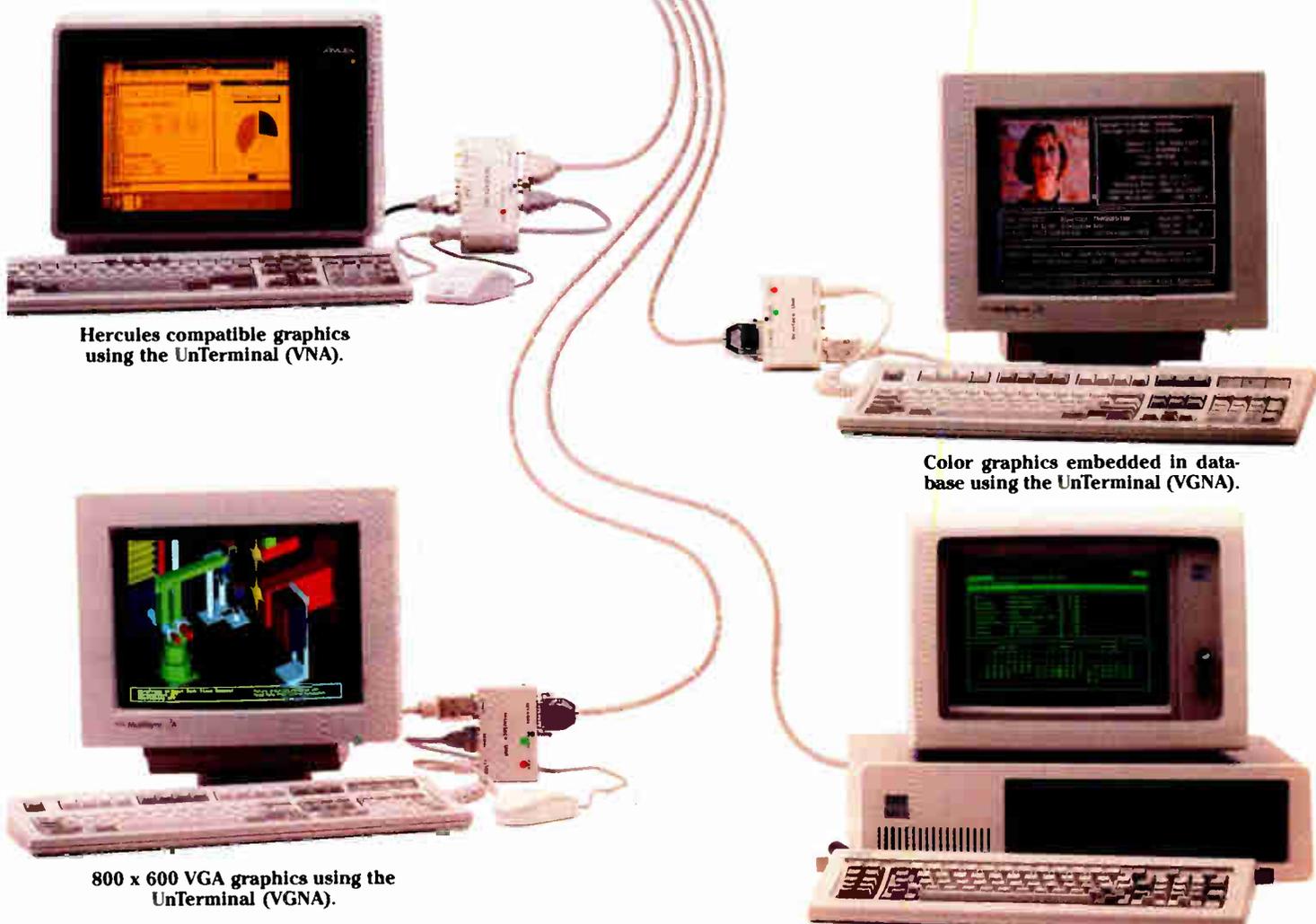
screen refresh — text *and* graphics. Instant switching between single and multiuser screens. Running popular DOS applications. And making every user feel like the only user.

Just add PC-MOS, monitors & keyboards.

The Software Link's PC-MOS multiplies the power of your PC. Why pay extra just to get the boxes? You can run up to eight color or 16 monochrome UnTerminal workstations per system — and save thousands.

*Distributed by
The Software Link, Inc.*

For more information, call: The Software Link, Inc. at (800) 451-LINK or (404) 448-5465.



Hercules compatible graphics using the UnTerminal (VNA).

Color graphics embedded in database using the UnTerminal (VGNA).

800 x 600 VGA graphics using the UnTerminal (VGNA).

Now XT's and AT's can be UnTerminals, too. Hotkey between local and host applications using the UnTerminal (VCCA).



The PC-MOS UnTerminal

PC-MOS MULTIUSER SYSTEMS WITHOUT TERMINALS

The Software Link, Inc., 3577 Parkway Lane, Norcross, GA 30092.
Phone: (800) 451-LINK or (404) 448-5465, FAX: (404) 263-6474, Telex: 4996147 SWLINK.

PC-MOS is a trademark of The Software Link, Inc. UnTerminal, UnNetwork, Video Network Adapter, Video Connect Card Adapter and Video Graphics Network Adapter are trademarks of Advance Micro Research, Inc.

Circle 263 on Reader Service Card (DEALERS: 264)

regard, the Mac Toolbox enjoys the advantage of always running on a Macintosh. There are no problems with non-standard displays. The Toolbox can run any program on any type of display that conforms to Apple's standard. In fact, you can have your program ask the Toolbox about the color and resolution of the display and use this information in your program. Device independence on the Macintosh is excellent.

The PC, however, has few standards, and life with Windows becomes interesting because of it. Microsoft has built in support for the usual screen displays: CGA, EGA, and VGA. Because of the popularity of the monochrome Hercules graphics board, recent versions of Windows now support that card as well. But that's about it. If you want to use one of the new full-page displays with Windows, you will have to make sure that the manufacturer supplies a Windows driver. PM is limited to standard Windows devices.

Cooking Up an Application

APIs are not all sweetness and light. Those who work with Windows or the

Macintosh probably consider the DOS API half-baked. Conversely, the eyes of those involved with DOS tend to glaze over when they first investigate Windows. Happily, the recipe for picking the right API is an easy one.

If you work on the Macintosh, you have no choice. The standard Mac operating system is programmed solely through the Toolbox and event-loop programming. A/UX, the Unix port for the Mac II family, combines the multitasking of Unix with the best of the Toolbox functions.

The X Window System is a standard that is beginning to show up on Unix workstations. However, the GUIs built on top of it are not yet generally available on desktop machines and are incompatible with one another. Until the X Window System-based GUIs make greater inroads into the desktop arena, Unix hackers will have to be content with their true multitasking and Termcap screen control.

If you work on an IBM-compatible machine, you have a few options. Programming conventional DOS applications is easy, and the new crop of DOS extenders

allows access to memory beyond the standard 640K bytes. You can choose between two GUI environments: Windows running under DOS, and PM running under OS/2. All three of these APIs have appeal.

If your applications rely heavily on multitasking, OS/2 is probably the correct choice. However, it may be a long time before OS/2 becomes the standard operating system for IBM compatibles, if it ever does.

If you need to be able to port your application to other machines, straight C under DOS or Unix would be a good choice. If ease of use is a primary concern, then Windows may well be your best choice.

Examining user interfaces is only part of the picture in determining which system to support. Understanding the strengths and weaknesses of each API and matching the right API to the job at hand will make your efforts much more fruitful. ■

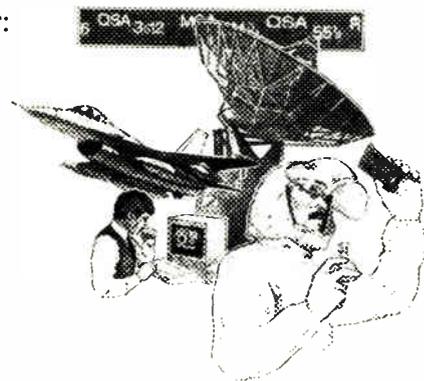
Howard Eglowstein is a testing editor for the BYTE Lab. He can be reached on BIX as "heglowstein."

CAPTURE THE POWER OF QUINTUS PRODUCTS IN YOUR SOFTWARE DEVELOPMENT

Quintus' premier Prolog-based software engineering products provide tools that enhance object-oriented programming, rapid prototyping, debugging, windowing and database interface development.

Quintus proudly offers support for:

- | | |
|--------|--|
| UNIX | Quintus Prolog, Runtime Generator, Runtime Licenses, Quintus ProWINDOWS, Database Interfaces |
| MAC | *MacProlog, MacObject, Prolog ++, Flex |
| MS-DOS | *DOSProlog, Prolog, ++ Flex |



Available across a wide variety of platforms including SUN, Digital VAX/VMS, VAX Ultrix and DECstation, HP, Sony, Apollo Domain, IBM RT/PC (AIX) and IBM PS/2 (AIX), 80386 UNIX, Sequent Symmetry and Intergraph Clipper.

Visit our booth at MACWORLD April 11-13, San Francisco.

The companies and products mentioned are trademarks and registered trademarks of their respective companies. * Registered trademarks of Logic Programming Associates

For more information contact sales:

Quintus Computer Systems Inc.

An Intergraph Company

1310 Villa Street, Mt. View, CA 94041

Phone: (415) 965-7700; 800-AILOGIC

FAX: (415)-965-0551

Quintus 

Train for a High-Paying Career as a Computer Service Technician

Only NRI teaches you to service all computers as you build your own fully AT-compatible micro—now with 1 meg RAM and 20 meg hard drive!



New! Now includes AT-compatible computer system!

Jobs for computer service technicians will almost double in the next 10 years according to Department of Labor projections, making computer service one of the top 10 growth fields in the nation.

Now you can cash in on this opportunity—either as a full-time industry technician or in a computer service business of your own—once you've mastered electronics and computers the NRI way.

Get inside the powerful, fully AT-compatible West Coast computer system

To give you hands-on training with the absolute in state-of-the-art computer technology, NRI includes the powerful new West Coast 1010 ES computer as the centerpiece of your training. You build this 1 meg RAM, fully IBM AT-compatible computer from the keyboard up, plus you now go on to install a 20 megabyte hard disk drive to complete your total computer system.

Understanding you get only through experience

You need no previous background in electronics to succeed with NRI. You start with the basics, rapidly building on the fundamentals of electronics with bite-size lessons. You perform hands-on experiments with your NRI Discovery Lab® and then move on to master such advanced concepts as digital logic, microprocessors, and computer memories.

Learn at home in your spare time

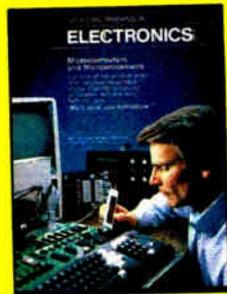
With NRI, you learn at your own convenience in your own home. No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. And all throughout your training you've got the full support of your personal NRI instructor and the entire NRI technical and support staff. They're always ready to answer your questions and help you whenever you need it. Get all the facts from NRI's free 100-page catalog. Send today!

Your incomparable hands-on training includes all this:

NRI's unique Discovery Lab® lets you design and modify circuits, diagnose and repair faults • Hand-held digital multimeter, complete with "talk-you-through" instructions on audio cassette • Digital logic probe lets you visually examine computer circuits • The latest West Coast 1010 ES AT-compatible computer with 101-key, "intelligent" keyboard and 1.2 megabyte, 5¼" floppy disk drive • 20 megabyte hard disk drive you install internally • 64K ROM, 1 meg RAM • MS-DOS, GW-BASIC, and exclusive word processing, database, and spreadsheet software • Reference manuals, programming guidelines, and schematics.

See other side for highlights of NRI "hands-on" computer training →

SEND CARD TODAY FOR FREE NRI CATALOG



COMPUTERS AND MICROPROCESSORS

This training prepares you to service all computers as you build your own fully IBM AT-compatible computer. Total systems training includes 1.2 meg, 5¼" floppy disk drive, 20 meg hard disk drive, monitor, test equipment, software, and the NRI Discovery Lab®.

Check one FREE catalog only.

- Computers and Microprocessors
- TV/Video/Audio Servicing
- Robotics
- Computer Programming
- Security Electronics
- Electronic Music Technology
- Telecommunications Technology
- Basic Electronics

Name _____ (Please print) _____ Age _____

Address _____

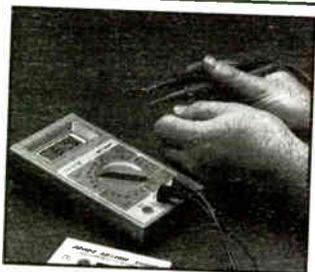
City _____ State _____ Zip _____

For career courses approved under GI Bill check for details.

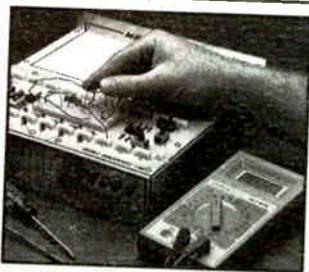
169-040

Accredited by the Accrediting Commission of the National Home Study Council

Get In-Demand Computer Servicing Skills With NRI "Hands-On" Training



Using NRI's unique Action Audio Cassette, you're talked through the operation and practical applications of your hand-held digital multimeter—the basic, indispensable tool for the computer specialist.



You set up and perform electronics experiments and demonstrations using your NRI Discovery Lab[®]. You even interface the lab with your computer to "see" keyboard-generated data.



After you build this digital logic probe, you explore the operation of the West Coast 101-key, detached "intelligent" keyboard and its dedicated microprocessor.

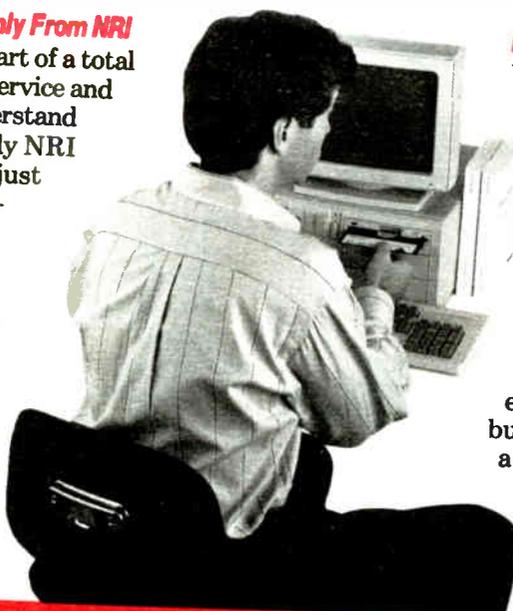


You install the 1.2 meg, 5 1/4" floppy disk drive, learning disk drive operation and adjustment. Later, you improve your data storage capacity dramatically by installing this powerful 20 meg hard drive.

Total Computer Systems Training, Only From NRI

No computer stands alone... it's part of a total system. So if you want to learn to service and repair computers, you have to understand today's computer systems. And only NRI builds meaningful training around just such a powerful computer system—the new West Coast 1010 ES Series Computer, complete with monitor, floppy disk drive, hard disk drive, and valuable software—all yours to train with and keep.

The 1010 ES features full IBM AT compatibility, the breakneck speed of an advanced 80286 CPU, and big-system raw power: 1 meg RAM and full expandability for future system growth.



Mastery Is "Built-In"

You assemble the West Coast 101-key "intelligent" keyboard, install the power supply and 1.2 meg, 5 1/4" floppy disk drive, and attach the high-resolution monitor. You then go on to install a powerful 20 meg hard drive—today's most wanted computer peripheral—now included as part of your NRI hands-on training.

The many demonstrations and experiments you perform as you build your computer system give you a total mastery of computer operation, based on a thorough knowledge of the intricacies of computer theory.

SEND CARD TODAY FOR FREE NRI CATALOG

100-Page Free Catalog Tells More... Send Today!

Send the postage-paid card today for NRI's free 100-page catalog that gives all the facts about NRI computer training, plus career training in robotics, TV/video/audio servicing, electronic music technology, and many other fields. If the card is missing, write to NRI at the address below.

IBM is a registered trademark of International Business Machines Corp.

NRI School of Electronics

McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW
Washington, DC 20008

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 10008 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY ADDRESSEE

NRI School of Electronics
McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW
Washington, DC 20077-3543

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



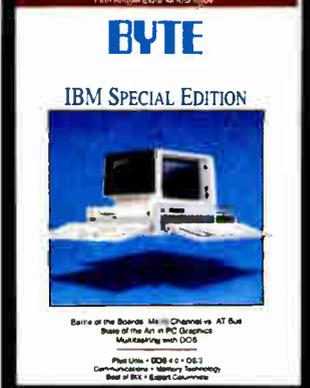
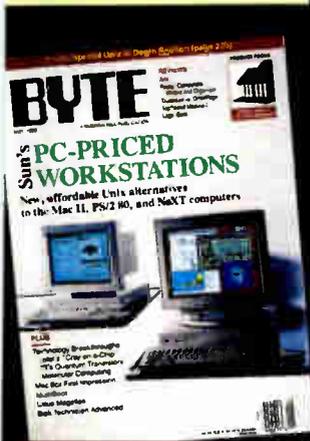
Subscribe to BYTE now and

SAVE up to 52%

PLUS,

get the annual IBM PC Special Issue as an

EXTRA BONUS!



- Stay in the know on all major microcomputer products and innovations
- Save time and money—invest in the best equipment for your needs
- Harness the maximum power of your micro.

Subscribe today and save!

In a hurry? Call Toll-Free 1-800-257-9402 weekdays 9-5 EST. In NJ, call 1-609-426-5535.

Enjoy **MORE SPEED!**

SAVE up to \$66.05

PLUS

get the extra IBM PC Special Issue

Send me BYTE for:

- 1 year (12 issues) for \$24.95 (Save 40% off the newsstand cost)
- 2 years (24 issues) for \$44.95 (Save 46% off the newsstand cost)
- 3 years (36 issues) – \$59.95 SAVE 52% off the newsstand cost (20% off the basic subscription price)

Name _____

Company _____

Address _____

City/State/Zip _____

Payment enclosed Bill me

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it! Single copy \$3.50. The basic annual subscription rate is \$29.95.

IBL5698

Profit from **MORE POWER!**

SAVE up to 52%

PLUS

get the extra IBM PC Special Issue

Send me BYTE for:

- 1 year (12 issues) for \$24.95 (Save 40% off the newsstand cost)
- 2 years (24 issues) for \$44.95 (Save 46% off the newsstand cost)
- 3 years (36 issues) – \$59.95 SAVE 52% off the newsstand cost (20% off the basic subscription price)

Name _____

Company _____

Address _____

City/State/Zip _____

Payment enclosed Bill me

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it! Single copy \$3.50. The basic annual subscription rate is \$29.95.

IBL5698

Gain **MORE APPLICATIONS!**

SAVE up to 52%

PLUS

get the extra IBM PC Special Issue

Send me BYTE for:

- 1 year (12 issues) for \$24.95 (Save 40% off the newsstand cost)
- 2 years (24 issues) for \$44.95 (Save 46% off the newsstand cost)
- 3 years (36 issues) – \$59.95 SAVE 52% off the newsstand cost (20% off the basic subscription price)

Name _____

Company _____

Address _____

City/State/Zip _____

Payment enclosed Bill me

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it! Single copy \$3.50. The basic annual subscription rate is \$29.95.

IBL5698



BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE:

BYTE

Subscription Department
P.O. Box 558
Hightstown, N.J. 08520-9409

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



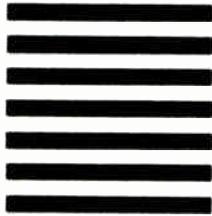
BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE:

BYTE

Subscription Department
P.O. Box 558
Hightstown, N.J. 08520-9409

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 42 HIGHTSTOWN, NJ

POSTAGE WILL BE PAID BY ADDRESSEE:

BYTE

Subscription Department
P.O. Box 558
Hightstown, N.J. 08520-9409

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



Detach and mail card
now to

**SAVE up to
52%**
on BYTE . . .

PLUS,
get the annual IBM
PC Special Issue as
an

**EXTRA
BONUS!**



Order even faster by
phone:

**Call
Toll-Free**

1-800-257-9402
weekdays 9-5 EST.
In NJ, call
1-609-426-5535.

Bridging Troubled Waters

*Cross-platform tools can save time and money
—and perhaps your sanity*

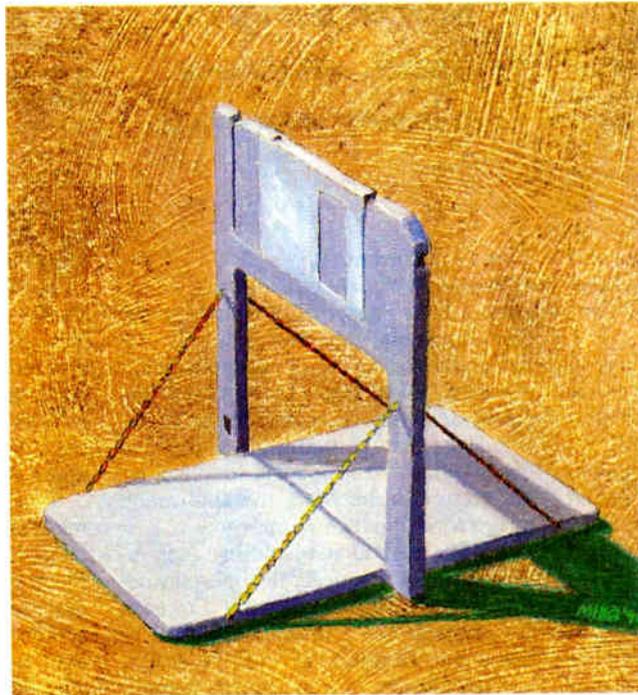
Jon Udell

As desktop computing “standards” proliferate like wildfire, both users and software developers face a similar question: Which machine, and which operating system, should they support? DOS continues to dominate the installed base of microcomputers and thus has the greatest software support, but the Mac has many attractive features, and Unix and OS/2 are coming on strong.

All this results in four operating systems (lumping together the many Unix variations); five major graphical user interfaces—Microsoft Windows, OS/2’s Presentation Manager (PM), the Mac, and the X Window System-based Motif and Open Look; many more minor GUIs; and an uncounted number of different machine architectures.

The choice comes down to limiting your prospects by supporting one machine or facing the daunting prospect of supporting multiple, complex computing environments and application programming interfaces (APIs).

New tools, however, can provide a third alternative. What if you could write an application once to a universal API



and then move it to a variety of popular systems? This would make it easy to support multiple standards and to use the same software on different machines.

I will discuss five toolkits that allow this kind of portability. XVT and Smalltalk/V (both of which are general-purpose toolkits), HOOPS and Design/OA (two graphics libraries), and FoxBase (a DBMS) each provide a common API

across multiple platforms. These toolkits—and others like them—can make it easier for users and programmers to support multiple environments.

Solving a Sticky Problem

XVT (for Extensible Virtual Toolkit) from the Advanced Programming Institute is a set of libraries, one for each graphical environment that it supports. Each library maps a set of common XVT function calls to equivalent system-specific calls. For example, XVT’s `new_window` turns into `NewWindow` on the Mac and `CreateWindow` under Microsoft Windows.

But XVT is more than a Rosetta stone. Although Windows, PM, and the X Window System (referred to as X Window for the remainder of this article) owe much to the event-driven style of programming that the Mac has popularized, they differ from the Mac and from one another in ways that go beyond a one-for-one translation of function names.

For example, each GUI system defines a different set of events. There are 11 Mac events, 24 X Window events, and more than 100 Windows messages. XVT

continued

makes do with 15 events. How does it handle all the complexity of Windows with so few events? It doesn't.

For the sake of portability, XVT sacrifices some of the uniqueness of each of the environments it supports. So you lose, for example, Dynamic Data Exchange, which carries conversations between concurrently executing Windows or PM programs and supports interapplication *hot links*. Since there isn't a DDE analog on the Mac yet, XVT pretends that Windows and PM don't have DDE, either.

Common Cause

Still, XVT handles the basics nicely. Recently, I wrote an XVT program to try out the capabilities of a mixed Mac and PC network. My goal was to build a simple multiuser database that would present an identical user interface to PC and Mac users. Although I'm a relative beginner when it comes to GUI programming, my progress was swift.

Building on the examples provided ("clone first, ask questions later" is my motto), I put together a simple program that displays three flat-file databases, each in its own scrollable window, and provides menu options to add, search for, and delete records. The C source code for the Mac and PC versions was identical. Well, almost identical.

My application needed some network functions (e.g., open a file in share mode, lock a record, unlock a record) that XVT doesn't provide. So I defined my own common interface to these functions and supplied separate Mac- and PC-specific implementations.

The other nonportable part of the project was the resource scripts required to build the program's menus and dialogues. XVT does provide a tool that translates Macintosh RMaker scripts to Windows resource-compiler scripts. And because I used Prototyper 2.0 from SmethersBarnes to build the menus and dialogues interactively, tuning the sizes and locations of dialogue components was easy. Nonetheless, XVT's success in creating a uniform GUI programming environment makes you wish for a uniform resource-tinkering environment, as well.

One result of XVT's least-common-denominator approach is that an XVT program is somewhat simpler than its native counterparts. For example, under Windows, you have to register each window as a member of a window class and provide a filter that can trap messages sent to that window before they go to the default message handler. In XVT, as on

the Macintosh, you can simply create a window.

The Mac in native mode, however, requires more work to make that window behave properly. Say you indicate, by clicking the mouse, your intention to drag a window across the Desktop. The programmer must ask the Toolbox which window received the mouse-click, determine that the click happened in the window's `inDrag` region, and then explicitly call the Toolbox's `DragWindow` function. XVT, like Windows, handles these details automatically.

XVT's
*success in creating
a uniform GUI
programming
environment makes you
wish for a uniform
resource-tinkering
environment, as well.*

Vive la Différence!

Although XVT smooths out the differences among platforms, it doesn't stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application's window to clear space for other applications; on the Mac, the application joined MultiFinder's round-robin.

XVT's method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily system-specific, a portable program can't refer directly to the contents of that menu.

XVT's solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as

"12-point Times Roman."

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for "big," "normal," and "small" sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It's important to understand what XVT isn't, as well as what it is. It isn't intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don't have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Catching Up with Smalltalk

When BYTE dedicated an entire issue to Smalltalk in August 1981, it was the first glimpse many readers had of two intertwining themes—the GUI and object-oriented programming (OOP). At the time, however, Smalltalk was little more than an academic curiosity. The Apple II and CP/M systems of the day couldn't support Smalltalk, and most people could only dream about the Xerox workstations shown in the articles.

Today, the descendants of those exotic workstations roll off assembly lines. The Macintosh, Windows, and PM operating environments embody the GUI and OOP ideas that Smalltalk inspired. Yet Smalltalk itself, designed specifically to help explore and construct complex graphical applications, remains exotic.

Smalltalk may yet have its day. Two main dialects of the language exist, and each spans multiple platforms. ParcPlace Systems' Smalltalk-80, a direct descendant of the original Xerox PARC system, runs on Sun, Apollo, and HP 9000 workstations, as well as Macs and 386 PCs. Digitalk's Smalltalk/V, the one I've worked with, has 286 (non-Microsoft Windows), Macintosh, and PM incarnations.

The two dialects differ considerably. Their underlying class libraries aren't compatible. And in the same way that Smalltalk-80 makes each of its hosts look and feel like a Xerox workstation, Digitalk's latest offerings, Smalltalk/V Mac and Smalltalk/V PM, wear the look

continued

Discover Parallel Processing!

Monoputer/2™

*The World's Most Popular
Transputer Development System*

Since 1986, the MicroWay Monoputer has become the favorite transputer development system, with thousands in use world-wide. Monoputer/2 extends the original design from 2 to 16 megabytes and adds an enhanced DMA powered interface. The board can be used to develop code for transputer networks or can be linked with other Monoputers or Quadputers to build a transputer network. It can be powered by a 20 or 25 MHz T800 and is priced from \$1295.

Parallel Languages

Fortran and C Make Porting a Snap!

MicroWay stocks parallel languages from 3L, Logical Systems and Inmos. These include one Fortran, two Cs, Occam, Pascal, and Ada. We also stock NAG libraries for the T800 and ParaSoft's debugger, profiler, and Express Operating Environment. A single T800 node costs \$2,000, yet has the power of a \$10,000 386/1167 system. Isn't it time you considered porting your Fortran or C application to the transputer? It's easier than you think!

For further information, please call MicroWay's Technical Support staff at (508) 746-7341.

Quadputer™

Mainframe Power For Your PC

MicroWay's Quadputer is the most versatile multiple transputer board on the market today. Each processor can have 1, 4 or 8 megabytes of local memory. In addition, two or more Quadputers can be linked to build large systems. One MicroWay customer reduced an 8 hour mainframe analysis to 15 minutes with five Quadputers, giving him realtime control of his business. Quadputer is priced from \$1995.

COSMOS™/M

Finite Element Analysis Running on the Quadputer

One of the most fruitful areas for parallel processing is finite element analysis. Problems which can be broken into small pieces run naturally on systems built up of many processors. COSMOS/M running on a Quadputer took just 300 seconds to solve a problem which ran in 12,000 seconds on an AT. Even very large mainframe problems run fast on the Quadputer: a system with 12,000 degrees of freedom took just 806 seconds while another that had 23,000 DOF ran in just 40 minutes. Contact MicroWay for information on COSMOS/M.

Attend a MicroWay-sponsored Parallel Processing Seminar: Munich, FRG May 29-30, 1990

Micro Way

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

Listing 1: *Programming the Smalltalk way involves creating methods that interact with objects via messages. Smalltalk is a natural for developing GUI-based applications.*

```
[window file list word]           "declare local variables"
window := TextEditor              "create window"
  windowLabeled: 'Test'
  frame: (0 @ 0 extent: 400 @ 100).
file := File pathName: 'test.txt'. "open file"
list := Bag new.                  "create an empty collection"
[[word := file nextWord:] isNil]  "read words into collection"
  whileFalse: [list add: word].
list asSet asSortedCollection    "eliminate duplicates and sort"
do:
  [:w]                             "get each item"
    window
      nextPutAll: w;                "send it to the window"
      cr].                          "followed by carriage return"
```

that's locally appropriate. Either way, you get a machine-independent programming toolkit.

Digitalk's host-sensitive approach, coupled with the improved performance and packageability that the new Smalltalk/V PM supports, has recently ignited something of a Smalltalk revival. Leading the charge, Microsoft's Bill Gates delivered the ringing endorsement that Smalltalk/V PM is "the right way to develop PM applications."

An Object Lesson

Smalltalk's all-encompassing object orientation takes some getting used to. Listing 1 shows a snippet of Smalltalk/V code—a *method*—to read a text file and write a sorted list of the different words that it contains to a scrollable window.

The short code does quite a bit of work. The TextEditor and File objects respond to the "messages" they receive by asking the host to open a document window and a file, respectively, and by returning Smalltalk objects (assigned to file and window) that can be used to manipulate them. The Bag object answers the message new with an object that can hold a bunch of objects of any kind.

Next, the method sends nextWord to file, assigns the result to word, and sends isNil to word. To the resulting object—a Boolean, since the response to isNil will be true or false—the method sends whileFalse along with a block of code to be evaluated each time a non-nil word appears. That block, in turn, tells list to add word to itself.

Finally, the method sends list the messages asSet (return yourself without duplicates), asSortedCollection (return yourself sorted), and do. The do message iterates over list, picks up each word, and asks window to display it.

I'll agree that the syntax looks strange. But is it really any stranger than the

equivalent Microsoft C or Think C programs, with their event loops and baroque APIs? And the Smalltalk code is *much* smaller than its C counterparts would be.

The Smalltalk Way

Smalltalk encourages an exploratory, cannibalistic style of programming. For example, when I moved the word-cataloging code from the Mac to PM, I decided to add a fancy way to choose the input file. The Smalltalk/V PM environment has a nifty "Browse Disk" menu option. It activates a multipane window that works like PM's own File Manager. The browser is an instance of a Smalltalk class called DiskBrowser. So I created another instance,

```
DB := DiskBrowser new open.
```

I selected a directory and a file and then asked the Smalltalk object inspector to unpack DB. It showed me that two instance variables, selectedDirectory and selectedFile, held the information I needed. Did the DiskBrowser class already define methods to return those items? No, the Class Hierarchy Browser reported, so I used its method editor to create them. Practically for free, my program got a big chunk of the system's user interface. That's the kind of reusability that makes some people religious about Smalltalk.

With all this to offer (and portability, too), why does the language's profile remain low? There are four reasons. Historically, Smalltalk applications didn't adapt to native windowing systems, ran more slowly than did conventional programs, were far more difficult to package and distribute, and required mastering an abstruse class hierarchy.

Smalltalk/V Mac silenced the first objection; Smalltalk/V PM attacks the re-

maining ones. It replaces the traditional interpreted "image" with a true OS/2 executable file, into which methods incrementally compile. That executable file, along with dynamic-link libraries containing necessary run-time support, constitutes a stand-alone PM program—and a pretty fast one at that.

Finally, the traditional scheme for organizing an application's windows, the "model-Pane-Dispatcher" class triad, has evolved into a more natural system based on a new class, ApplicationWindow. The new PM class hierarchy compromises Smalltalk/V's portability to a degree. If you rely on the new classes (although you don't have to), your code won't be guaranteed total transportability to other Smalltalk/V platforms until the new system becomes standard across the product line.

There is no magic bullet. Modern graphical programming is a tricky business, and programming for multiple platforms is even trickier. The results, however, are worth the effort, particularly to the user community. I think that the latest incarnation of Smalltalk/V will spark renewed interest in Smalltalk as an appropriate technology for building portable, user-interface-intensive programs.

There are still more surprises to come. At the 1989 OOPSLA show, an object-oriented database company called Servio Logic showed a Smalltalk application coupled to its GemStone server. What looked to Smalltalk like just an ordinary SortedCollection was, at the other end of a network cable, an industrial-strength database. Now *there's* an architecture for the 1990s.

Jumping Through HOOPS

Now that desktop hardware can do reasonable three-dimensional graphics, there's a large and growing demand for software that can work with 3-D models. The ability to display and manipulate representations of landscapes, machinery, furniture, buildings, and anatomy is revolutionizing a number of engineering and medical disciplines.

One approach to creating portable software for these markets is to build on top of a commercial 3-D CAD package. Most of the leading ones come with tools that you can use to build customized applications. Several, including AutoCAD, MicroStation, and VersaCAD, run on multiple platforms.

Or you could use HOOPS (Hierarchical Object-Oriented Picture System) from Ithaca Software. It's a general-purpose 3-D graphics library, with both C and FORTRAN bindings. It runs on all

the high-end Unix workstations, as well as the Macintosh and (with the help of a DOS extender) 386 PCs (a PM version should be available by the time this article sees print). Several leading PC CAD vendors have incorporated HOOPS into the 386 versions of their products to take advantage of its fast rendering capabilities. So it's clear that HOOPS doesn't trade performance for portability.

I've worked with the 386 and Macintosh versions of HOOPS. Central to its architecture is a database of 3-D geometry—points, lines, and polygons—organized as a hierarchy of named segments.

A typical HOOPS program creates a bunch of segments and inserts geometry into them. Then it sets attributes to control things like the size and location of the display window, the orientation of the model, and the method of rendering (wire-frame or solid). HOOPS automatically makes the screen represent the current state of the database, so there's no redraw function to call.

The hierarchical database means that HOOPS programs can be much more flexible than most CAD programs are. The layers that CAD programs typically use to organize models are nothing more than electronic transparencies. While that approach yields the outputs that architectural and engineering professionals require, a hierarchical scheme can better represent complex structure and interrelationships. For example, because a subordinate segment in a HOOPS database inherits the orientation of its parent, a model is implicitly animatable.

This method of organization is the basis of HOOPS's claim to be object-oriented. The program is mainly declarative: It classifies and describes physical structures and lets HOOPS worry about how to display and render them. It must also contain user-interaction code so you can tell the database things like "Turn the model 30 degrees to the left."

HOOPS and You

HOOPS handles the user interface in a fairly heavy-handed way. It wraps its own event loop around the screen, keyboard, and mouse. When you perform a mouse-click, HOOPS provides the name of the segment you pointed to. You can implement a menu by creating segments with names such as ?picture/menu/file, displaying appropriate text in them (e.g., "File Options"), and setting up the program to react to hits in those segments.

Ithaca Software realizes that it underestimated the GUI juggernaut when it designed HOOPS this way. Although most

commercial graphics and CAD programs create their own user interfaces, people really do want standards. There's no shortage of standards to choose from, but it's reasonable to expect a PM, Mac, or X Window program to obey the local conventions.

So, although it's easier to let HOOPS run the show, you can arrange for it to share screen space and event processing with the host's GUI. Fair warning: This is easier said than done. Nevertheless, HOOPS is a remarkable toolkit. If you want to incorporate 3-D geometry into portable applications, you will want to investigate it.

Design Away with Design/OA

MetaDesign, from Meta Software, is an innovative graphical editor that is avail-

Although
*it's easier to let HOOPS
run the show, you can
arrange for it to share
screen space and
event processing with
the host's GUI.*

able on the Macintosh and under Windows and X Window. The editor helps you to build intelligent diagrams made of nodes and connectors. Nodes automatically maintain their connections when they are moved, making hierarchical networks of nodes easy to create and navigate. In fact, a node hierarchy with attached chunks of text acts like a hypertext document.

These features are often found in computer-aided software engineering tools, and MetaDesign is in fact marketed as a cross between a graphical outline processor and an entry-level CASE tool. But that's really just the tip of the iceberg.

MetaDesign grew out of long-term research into systems analysis. The company's founders, experimenting with a formal technique for analyzing concurrent systems, built the graphical toolkit that they needed to create representations and executable models of such systems. That toolkit has two manifestations:

MetaDesign, a basic graphical editor, and Design/OA, the open-architecture version for building specialized applications on top of the basic editor.

Meta Software has used Design/OA for vertical-market applications that analyze transaction processing in, for example, the banking industry. Other applications include a graphical interface to a relational database, and a hypertext word processor for programmers.

The R Factor

Design/OA thoroughly insulates you from the underlying operating system and its GUI. Working with the toolkit is a lot like working with a programmable text editor. You're given a fully functional program and access to its primitives, which you can deploy to specialize the program.

The Design/OA kernel handles the main event loop and manages the display of the current diagram. An application can intercept and react to menu choices and other events (such as the double-click) and then pass them along to the kernel (or not). With calls to DSmenu-delete and DSmenuadd, the kernel can customize the default menu system, so an application need not look just like MetaDesign.

Two particularly interesting events that an application might want to capture are the node-creation and node-connection operations. The demonstration program that comes with Design/OA captures them to implement an editor that handles a kind of formal diagram called a predicate/transition net.

The modified editor enforces a graphical syntax: It associates types with nodes, requires you to label nodes and connectors, and implements rules like "a transition node can't be connected to another transition node." Dialogues triggered by the creation of a node gather and store information about the node. Syntax-checking routines monitor all requests to connect the node.

With Design/OA, it's pretty straightforward to add interesting and useful extensions to MetaDesign, and easy to move the results from one platform to another. As with any full-blown programming environment, there's a lot to be learned, and the Design/OA documentation (which essentially consists of a couple of sample programs and an alphabetical list of functions) isn't as much help as it should be. But if an application requires intelligent diagramming and has to be portable, Meta Software is a place to look for one.

continued

ZENITH

**TURBOSPORT 386
PORTABLE LAPTOP
COMPUTER**



**386
40 MB
Hard
Drive!**

- 80386 32-bit processor, 12/6 MHz (switchable).
- 40 MB (28ms) hard drive.
- One 3.5" 1.4 MB floppy disk drive.
- 2 MB RAM (expandable to 3 MB).
- MS-DOS 3.21 included. • 100% IBM compatible.
- "Page-White" fluorescent backlit LCD display with 10.5" viewing area.
- Supports: MS OS/2 version 1.0, Xenix, and also Microsoft Windows/386 environments.
- Zero wait state.
- Socket for 80387 numeric co-processor.
- Internal Hayes 2400 Baud modem.
- Serial & parallel printer ports.
- Resolution: 640 x 400 pixels.
- 79-key full function detachable keyboard.
- "Fast" charge NiCad battery pack included.
- Dim.: 13.25"W x 14.75"D x 4.75"H.
- Wt: 14.7 lbs. • One Year Warranty!
- Factory New & Perfect!

* Expansion Slot 1 MB Memory, Carry Case, Battery Pack also available.

Due to a special arrangement, we were able to obtain a large inventory of these laptop computers. As a result, we can now offer them to you at **HUGE SAVINGS!**

Manufacturer's Suggested Retail
\$8,499.00

DAMARK PRICE:

\$ 2999⁹⁹

Item No. B-1961-128686
Insured Ship/Hand.: \$20.00

**FOR FASTEST
SERVICE CALL
TOLL FREE**

1-800-729-9000



DAMARK INTERNATIONAL, INC.
6707 Shingle Creek Parkway, Minneapolis, MN 55430
Customer Service • 612-566-4940

Please rush me: _____ Zenith Laptop Computer(s)
@ \$2999.99 each, plus \$20.00 s/h each.
Item No. B-1961-128686
MN res. add 6% sales tax.

Name _____
Address _____
City, State, Zip _____
 Check/MO VISA Master Card Discover
Card No. _____
Exp. Date _____ Ph. # () _____
Signature _____

DELIVERY TO 48 U.S. STATES ONLY

Mixed-Network Data Management

With all the fanfare surrounding the new generation of server-based database software, it's easy to sneer at the old-fashioned, workstation-based programs. However, for many applications, it's not necessary to locate processing and data in the same box.

Multuser databases that rely on simple file- and byte-range locking to synchronize access to shared data can be quite effective. It is true that a server-based application transmits fewer packets, but how many databases used in typical office situations sustain a transaction intensity that is likely to choke a network?

The reality is that multuser dBASE and dBASE compatibles like FoxBase, though hardly leading-edge, are nonetheless effective toolkits for building applications that manage shared data. When the toolkit spans the PC-to-Macintosh gulf (as FoxBase does), and when you have both PCs and Macs hanging off your network (something that Novell, 3Com, and TOPS all support), things can become pretty interesting.

My XVT project yielded a simple multuser database that ran almost identically on PCs and Macintoshes. The problem was that it was too simple: It had no indexing, keyed-searching, or data-definition capabilities. One solution would have been a portable database library. But the ones I investigated didn't support locking on mixed PC and Macintosh networks. So I looked into FoxBase, which does.

Environmentally Fit

If you've never seen FoxBase on the Macintosh, you'll be amazed at what the Mac interface does for the stodgy "dot prompt" that the PC FoxBase inherits from dBASE. With multiple browse windows, you can view linked databases side by side. Horizontal and vertical scroll bars make browsing easy. To freeze columns (i.e., make them immune to horizontal scrolling), you just drag a divider from the left margin. The view window displays icons for open databases, and arrows for the relational links between databases. You can even set up links by clicking and dragging.

A typical FoxBase application opens databases and index files and then deploys a couple of tools—the browser and the record editor—under program control. In a multuser situation, an application should do an RLOCK (record lock) on your behalf if you ask to edit a record, notify you of the success or failure of the lock request, and take the appropriate ac-

tion in either case.

Fox claims that the code required to do these things ports transparently from the PC to the Macintosh. That's basically true, but I did end up making some adjustments to the application I wrote. The APPEND command on the Macintosh didn't quite work as advertised (although there's an acceptable workaround), and PC-style pop-up menus don't retain their look and feel on the Mac (although you can use the Mac's menu bar instead). Fox's newest PC product, FoxPro, emulates (in character mode) FoxBase/Mac's interface. So the forthcoming multuser FoxPro should work even more smoothly with FoxBase/Mac.

I'd have preferred the simplicity of identical source code, but the changes were minimal and the end result—PC and Mac users sharing a common database—was well worth the trouble. Imagine the convenience. Whether you're using a Mac or a PC, you have access to the exact same data from both machines. No copies, no keeping multiple versions updated.

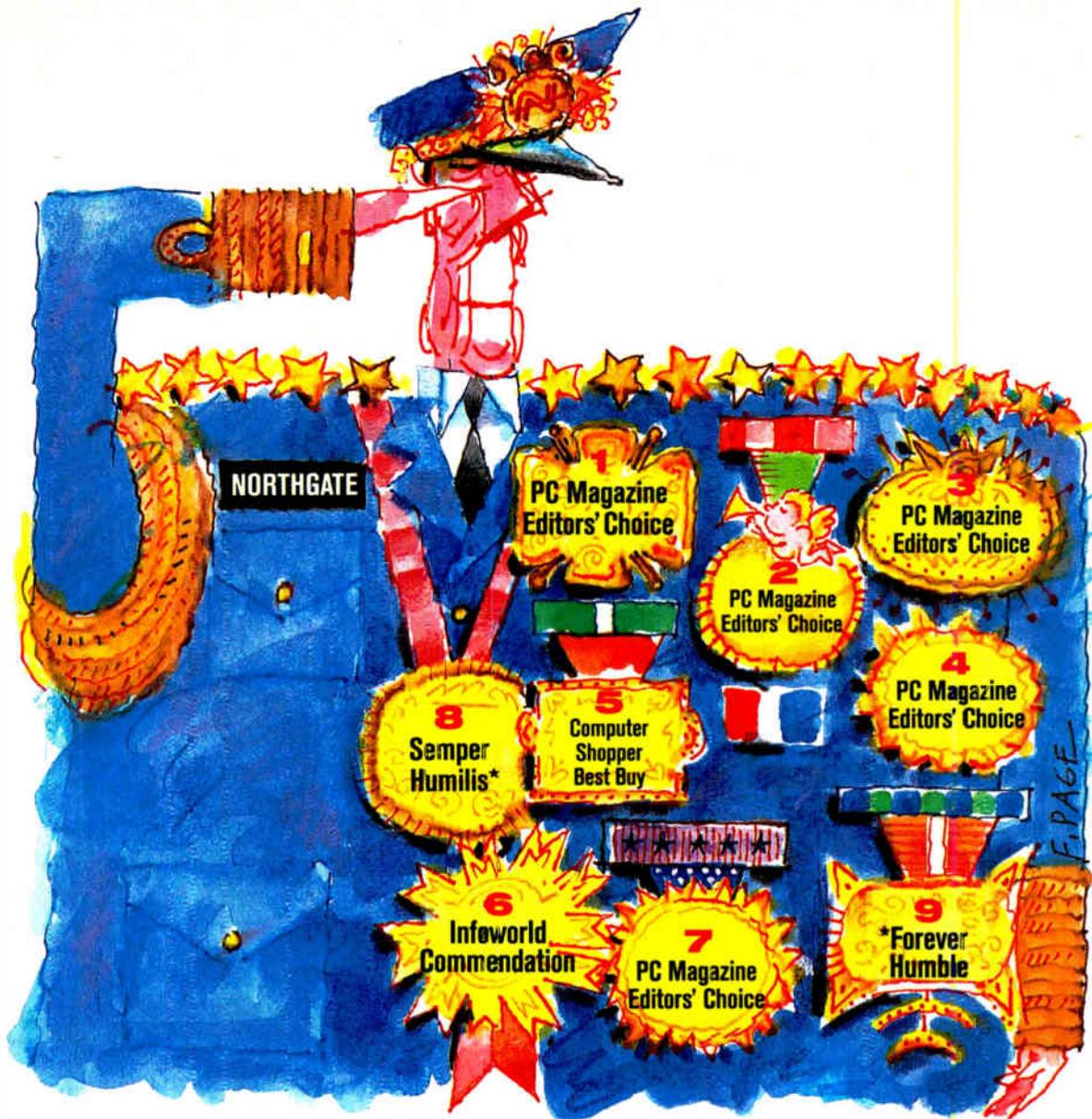
I'm no fan of the dBASE language. And I'll agree that the workstation-based architecture that DOS and Macintosh LANs support will, ultimately, give way to a server-based architecture. But there's much that you can do with these basic technologies. And with FoxBase, you can do it portably.

In Praise of Diversity

Walk into a typical office, and you're likely to find an eclectic mix of computers. The fact is, different machines excel at different things. I use a PC and a Mac and wouldn't want to give up either one. I prefer most Mac applications to their PC counterparts, but for writing and programming I'll take the PC with its fast character mode. When X Window-based applications become common, I'm sure they will have their advantages and disadvantages, too.

Using portable toolkits, developers don't have to target one market at the expense of all others, and users can run similar or identical applications on dissimilar machines. This is important now, and will become more important as networks that encompass diverse machines continue to flourish. It enables you to maintain your choice of hardware while staying fully functional within your work environment. Freedom of choice survives. ■

Jon Udell is a BYTE senior technical editor at large. He can be reached on BIX as "judell."



The Highly Decorated General Northgate

A bit pushy? Not at all. General George Patton would, on occasion, walk around with all of his medals in place. So would Generals Douglas MacArthur and Dwight D. Eisenhower when the spirit grabbed them.

And Samuel F.B. Morse, father of an earlier form of communications, before the world became computerized. (If you think we're making this up, check out Morse's be-medaled photo on the back page of this special Northgate insert.) In the meantime, we could go on and on with the reasons to buy a Northgate system, but we thought the awards said it better than we could.

1. PC Magazine "Editors' Choice" award: 80286 SuperMicro. (PC Magazine, January, 1989)
2. PC Magazine "Editors' Choice" award: 80386 Elegance 20 MHz. (PC Magazine, May, 1989)
3. PC Magazine "Editors' Choice" award: 80386 Elegance 25 MHz. (PC Magazine, May, 1989)
4. PC Magazine "Editors' Choice" award: 80386 Elegance 33 MHz. (PC Magazine, October, 1989)
5. Computer Shopper "Best Buy" awards, three years in a row, based on a vote of the magazine's readers. • Best Buy — complete computer system • Best Buy — overall (all products advertised in the magazine) • Best Buy — Input device: Northgate Omnikey Keyboard.
6. Infoworld. In April of 1989, they saluted Northgate's Elegance 386/25 with the headline: "The Elegance 3000 among the fastest 25-MHz systems" (Infoworld, April 10, 1989). In November, in their review of our Elegance 386/33, they said the following: "Northgate's Elegance 386-33/2000 computer is a top product in most of our scoring categories including value, where it earns just the second excellent mark we've awarded to 33 MHz systems." Overall rating 9.1, their highest ever.
7. PC Magazine "Editors' Choice" award: Northgate's Omnikey Keyboard. 8. "The Northgate Humility award" given to the most modest computer company in Plymouth Minnesota. So there you have it. And the year is still young. Northgate: "Semper Humilis." (Forever Humble).



NORTHGATE COMPUTER SYSTEMS, INC.
 13705 First Avenue North
 Plymouth, Minnesota 55441-41000
 1-800-548-1993

Northgate, OMNIKEY 1112, Omnikey PLUS, and the Northgate "N" logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.

CREATED & PRODUCED BY FREBERG LTD.
 ©Northgate Computer Systems, Inc. 1990 All rights reserved.
 386 IS A TRADEMARK OF INTEL CORPORATION

Circle 206 on Reader Service Card

E l e g a n c e *



PHOTO: HARRY LANGDON

THE NORTHGATE 386 33 MHz ELEGANCE SYSTEM

- *“**1**a. Refinement and grace in movement, appearance or manners.
b. Tasteful opulence in form, decoration or presentation.
2. Something that is elegant.” (American Heritage Dictionary)

You said it.

Since at least three of the medals garnered by General Northgate were for our highly acclaimed Elegance series (triple Editors' Choice awards from PC Magazine, for example), we thought we'd show you what the machine looks like and give you a few specs in case you might be inclined to buy this elegantly designed state-of-the-art computer.

First of all, to photograph an elegant machine . . . you need an elegant photographer. So we went to the most highly respected lensman in Hollywood: Harry Langdon. He normally lights and shoots such famous faces as Linda Evans, Victoria Principal, Cher, Arnold Schwarzenegger and Diana Ross, to name just a few. So shooting a different pretty face like a Northgate Computer is all in a day's work for Harry. For one thing, Northgate doesn't need a hairdresser.

The Elegance series to your left comes in three versions: The 20 and 25 MHz models, and our top of the line/highest performance Elegance: the 33 MHz which earned a 9.1 rating in Infoworld.

The price of the complete 386™ 33 MHz Elegance system pictured: \$5995.00. (Of course, you can buy a fully configured Elegance system starting at \$3395.00.)

The only thing more impressive than the price is the tech support which comes along with our usual 1 year parts and labor warranty. Did we mention that we also ship you replacement parts, should they be needed, overnight at our expense?

And that our tech support people are actually here for you 24 hours a day, every day, every night?

Put us to the test: give us a call some night at midnight. Or 3:00 AM.

Now to the specs:

Technobabble*

**Seemingly endless Technical specifications, without which you aren't about to buy this machine no matter how many awards it's won.*

Not only that . . . would this look like a real computer ad without them? Probably not. Here they are:

STANDARD CONFIGURATION

- ◆ 33 MHz Intel 80386 processor.
- ◆ 150 Mb ESDI Hard Drive 16MS.
- ◆ 4 Mb Ram.
- ◆ 64 K SRam Read-Writeback Cache (Optional 256 K Cache available)
- ◆ Zero wait state performance.
- ◆ 1.2 Mb—5.25" floppy drive (also reads, writes and formats low density diskettes).
- ◆ 1.44 Mb—3.5" floppy drive (also reads, writes and formats low density diskettes).
- ◆ Eight expansion card slots
- ◆ 80387 or Weitek coprocessor support

- ◆ Two serial ports and one parallel port (two with monographics systems)
 - ◆ 14" Multifrequency VGA Color Monitor 1024x768 resolution with 16 bit controller.
 - ◆ Sleek new Elegance 7 drive-bay custom vertical cabinet pictured. (Desktop style optional, save \$150.00.)
 - ◆ Exclusive award winning Omnikey Keyboard.
- 24 Hr 7-days a week tech support: unlimited toll free phone.
Additional Technobabble available upon request



NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North
Plymouth, Minnesota 55441-41000
1-800-548-1993

Northgate, OMNIKEY 102, Omnikey PLUS, and the Northgate "N" logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.

CREATED & PRODUCED BY FREBERG LTD.
© NORTHGATE COMPUTER SYSTEMS, INC. 1990.
ALL RIGHTS RESERVED.

386 IS A TRADEMARK OF INTEL CORPORATION

Northgate Slims Down!



Slimmer. Trimmer. The world's smallest 386, standing not even as tall as America's favorite diet cola. Obviously Northgate has lost a few pounds.

At least in the 386/20 pictured above. But it hasn't lost anything else. How do we pack a 20 MHz real 386 system with a 40 MB hard drive into this space saving, smallest 386 ever introduced?

We do it.

It comes with a VGA monitor and all the usual Northgate guarantees.

Slim price too: \$2,499.00 for the entire system. Let's see the competition match this.

Come to think of it...there is no competition. This is one of a kind. A Northgate original. If you're thinking of slimming down, call **1-800 548 1993**, and we'll tell you more about it.

Of course we still make the bigger 386. It's up to you.

Northgate Computer Systems: regular or diet.



NORTHGATE COMPUTER SYSTEMS, INC.

13705 First Avenue North
Plymouth, Minnesota 55441-41000
1-800 548 1993

"diet Coca-Cola," "diet Coke" and the Dynamic Ribbon device are registered trademarks of The Coca-Cola Company.
©1989 FREBERG LTD./NORTHGATE COMPUTER SYSTEMS, Inc.

D I D W E
M E N T I O N

24

H O U R S / 7 D A Y S A W E E K
T O L L - F R E E T E C H N I C A L S U P P O R T

**NORTHGATE
COMPUTER SYSTEMS, INC.
1 - 8 0 0 - 5 4 8 - 1 9 9 3**

CREATED & PRODUCED BY FREBERG LTD. © NORTHGATE COMPUTER SYSTEMS, INC. 1990. ALL RIGHTS RESERVED.



NORTHGATE COMPUTER
SYSTEMS, INC.
13705 First Avenue North
Plymouth, Minnesota
55441-41000

The Three Greatest Myths:

1. The world is flat.
2. If humans were meant to fly, they'd have wings.
3. All 3780 software is alike.

The fact is,
there's one 3780 PC-to-mainframe solution that stands apart.

It's 3780Plus, from CLEO Communications.

Our 3780Plus software is the leading 2780/3780 PC-to-mainframe connectivity solution for EDI, IRS electronic filing, and other data transfer applications.

Supports MS-DOS, VMS, and UNIX/XENIX operating systems.

Users prefer 3780Plus for one simple reason: *It works.* With over 35,000 worldwide installations, it's guaranteed to connect to any major network.

With 3780Plus, you get

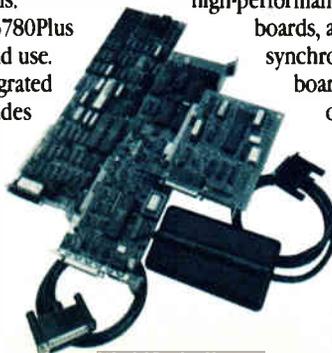
complete IBM 2780/3780 terminal emulation for IBM PCs, PS/2s, and compatibles. It also works with VAX, HP9000, NCR Towers, and lap-top systems, among others. It supports MS-DOS, VMS, and most leading UNIX operating systems.

Users find 3780Plus easy to install and use. In one fully integrated package, it provides forms control, auto dial/auto answer, attended or unattended

operation, and a communications line monitor. You also get our Scripting Command Language (SCL) and Application Program Interface (API).

We offer 3780Plus on high-speed modem boards, high-performance co-processor boards, and economical synchronous interface boards, as well as our intelligent

SYNCcable, which links to your host through your PC's serial port.



Works with VAX, HP9000, and other midrange systems, as well as PCs and PS/2s.

To learn the facts — just the facts — about our unique, proven 3780Plus solutions, call us today at 1-800-233-2536. Or write to us at 3796 Plaza Drive, Ann Arbor, Michigan 48108. FAX: 313/662-1965.

CLEO 
CLEO Communications
A Division of Interface Systems, Inc.

Blueprints for the 1990s

*IBM's SAA and DEC's NAS both provide interoperability
and greater portability across divergent platforms*

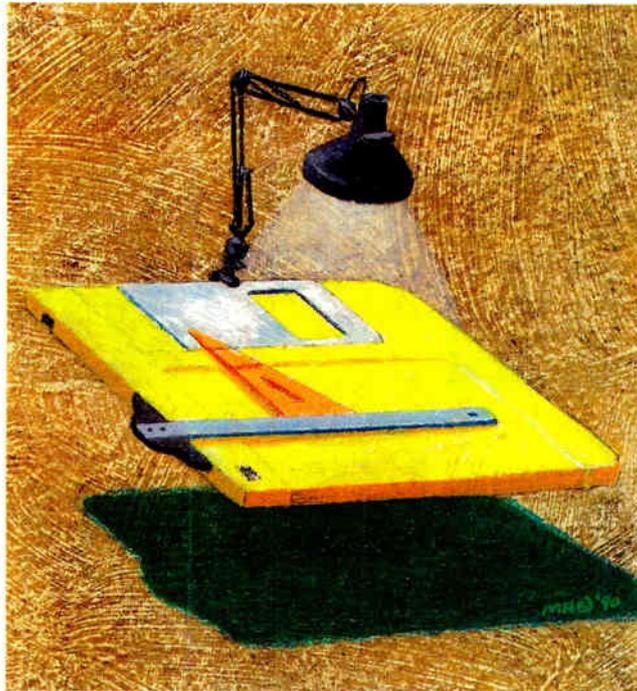
Sheila Osmundsen

Total applications architectures that create a single environment across multiple platforms don't apply to microcomputers—or do they? They do if the choice of such an architecture affects whether or not you can keep your favorite microcomputer. They do if that choice affects what operating systems you can use. And they do if you're trying to create a more productive environment where changing jobs doesn't involve retraining computer skills.

Currently, two total applications architectures are available, one each from IBM and Digital Equipment Corp. A third one is also in the works (see the text box "An Open Approach" on page 246). IBM, with its Systems Application Architecture, and DEC, with its Network Applications Support, are the major players in this arena. The similarities and differences between SAA and NAS are endlessly debated and will continue to be, for they are IBM's and DEC's software blueprints for the 1990s.

Systems Application Architecture

When SAA was introduced in 1987, IBM was suffering from increasing demands



among its customers for compatibility across its divergent platforms. DEC underlined that pressure with its now famous "one operating system" message. DEC could claim a common programming environment across an entire hardware line: the VAX. IBM could not. In addition, the VAX's range of performance was rapidly encroaching on the range that IBM covered with its micro-

computer, minicomputer, and mainframe platforms.

SAA is an attempt to provide common ground for a selection of IBM's platforms with the structure shown in figure 1. The platforms are OS/2 Extended Edition (for microcomputers), OS/400 (for minicomputers), and, within its S/370 (mainframe) hardware architecture, the VM/SP and MVS operating systems (subsystems TSO/E, CMS, CICS, and IMS). CICS and IMS, as transaction-processing monitors, are participating systems; only the relevant elements are supported for these.

SAA is divided into three parts: Common Communications Support (CCS), Common User Access (CUA), and Common Programming Interface (CPI).

CCS identifies the following communications options to be implemented across SAA's platforms: Data streams—3270, Document Content Architecture (now MO:DCA [mixed-object DCA]), Intelligent Printer Data Stream; Applications services—System Network Architecture's distributed service, Document Interchange Architecture office system, SNA Network Management

continued

Architecture; Session services—LU 6.2; Network control—Low-Entry Networking (Type 2.1 nodes); and Data-link controls—Synchronous data-link control, Token Ring network.

The inclusion of IBM's LU 6.2/APPC (advanced program-to-program communications) interface provides SAA's solution for program-to-program connections between IBM computers. This is the major reason IBM people and others sometimes characterize SAA as an extension of SNA.

CUA identifies the elements of the user interface that must be supported across the various platforms, including keyboard, mouse, stream layouts and palettes, applications flow, and user interaction with applications.

CPI provides a common programming

environment for all SAA operating systems. This includes specifying and using an identical set of language implementations. The chosen ones are C, COBOL, and FORTRAN (being implemented in that order), and RPG and PL/I (added to SAA in 1989). In addition, CPI specifies the use of the IBM Cross System Product applications generator and the REXX command-procedures language.

CPI also provides common application programming interfaces (APIs) that specify how to access key services (i.e., programming support), shown in the center of the standard SAA diagram in figure 1. This support includes Presentation Manager (PM), which is the OS/2 Extended Edition implementation toolkit for the Presentation Interface API, and the relational DBMS of each system that

supports the Database Interface.

The system services currently announced are as follows:

- Common Programming Interface (Communications): CPI to LU 6.2/APPC on the various platforms, initially implemented in the CMS subsystem of MVS only.
- Presentation Interface: device-independent APIs for CUA-compliant windowing, keyboard, mouse, fonts, and graphics support based on the S/370 Graphical Data Display Manager (GDDM).
- Dialog Interface: CPI for setting up menus, help functions, data requests, and message selections on user screens.

continued

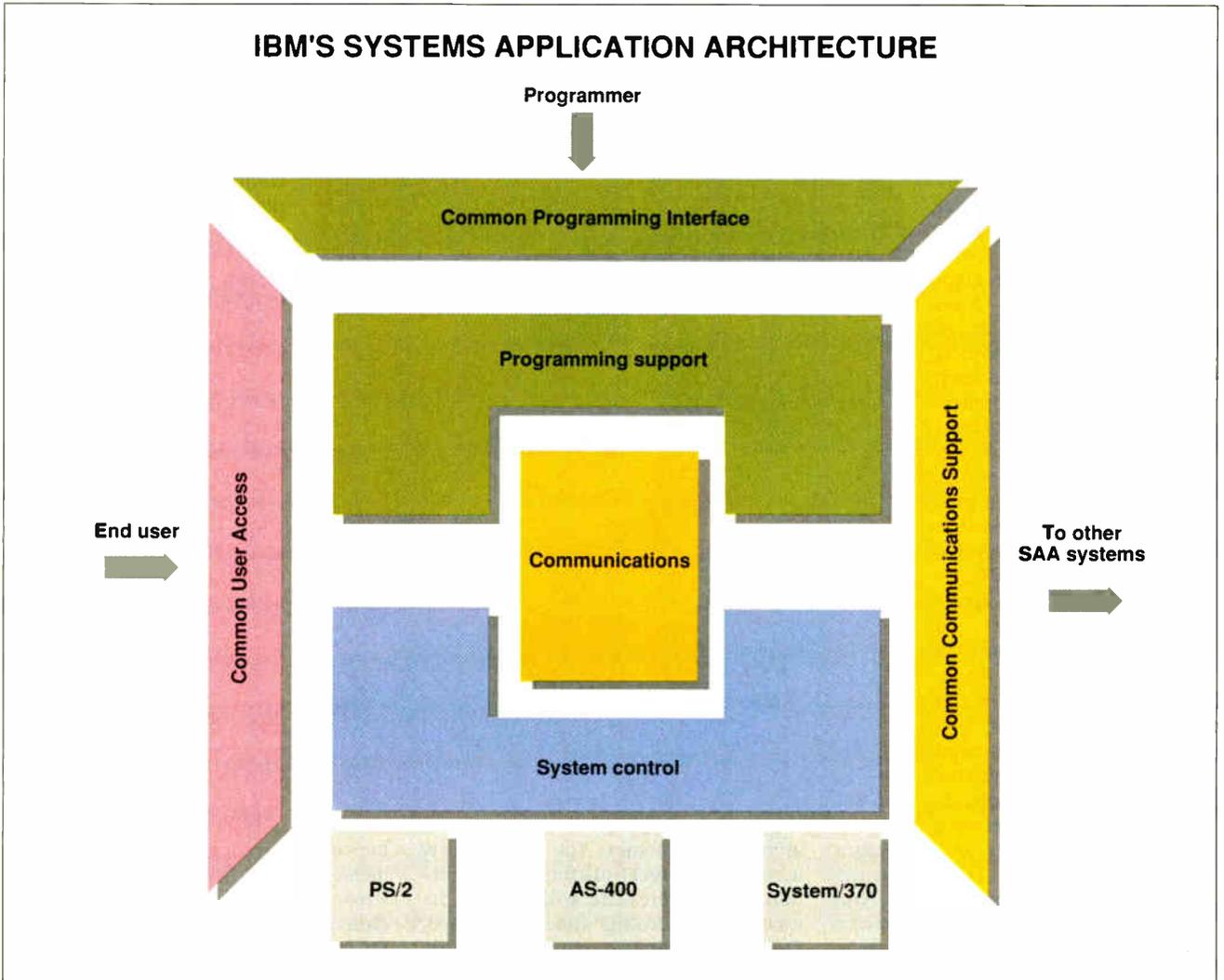
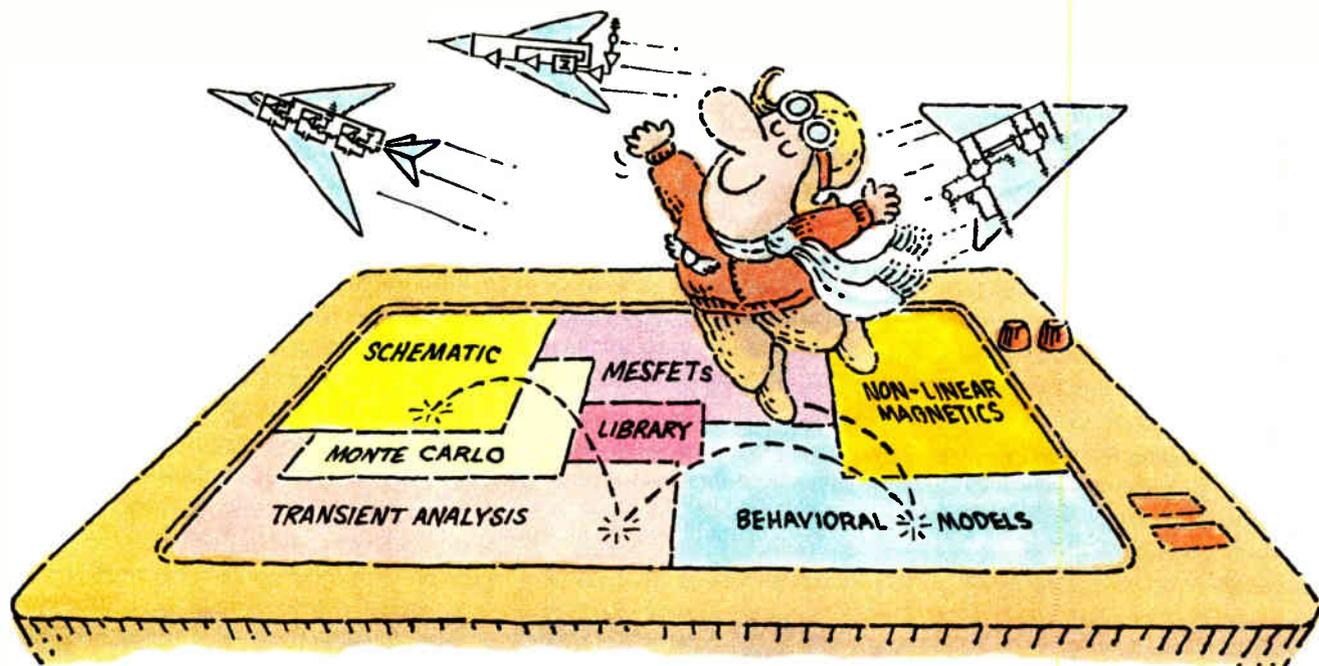


Figure 1: SAA attempts to provide common ground for OS/2 Extended Edition, OS/400, and certain operating systems within IBM's S/370 line. This diagram shows the standard colors for the different layers. These layers are often referred to by their colors: the yellow layer, the blue layer, and so on.



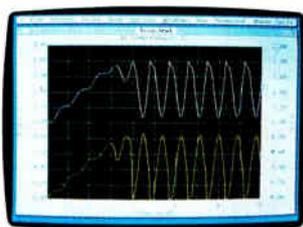
THE NEW MICRO-CAP III.TM SO YOU CAN TEST-FLY EVEN MORE MODELS.

It wasn't easy. But we did it. Made the long-time best-selling IBM® PC-based interactive CAE tool even better.

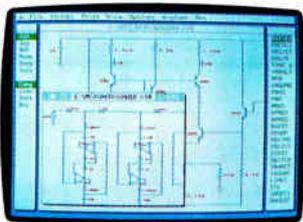
Take modeling power. We've significantly expanded math expression capabilities to permit comprehensive analog behavioral modeling. And, beyond Gummel Poon BJT and Level 3 MOS, you're now ready for nonlinear magnetics modeling. Even MESFET modeling.

Analysis and simulation is faster, too. Because the program's now in "C" and assembly language. That also means more capacity — for simulating even larger circuits.

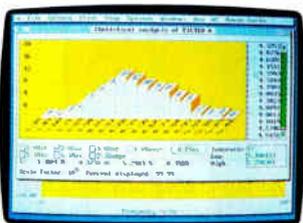
As always, count on fast circuit creation, thanks to window-based operation and a schematic editor. Rapid, right-from-schematics analysis — AC, DC, fourier and transient — via SPICE-like routines. The ability to combine digital/analog circuit simulations using integrated switch



Transient analysis



Schematic editor



Monte Carlo analysis

models and parameterized macros. And stepped component values that streamline multiple-plot generation.

And don't forget MICRO-CAP III's extended routine list — from impedance, Nyquist diagrams and BH plots to Monte Carlo for statistical analysis of production yield. The algebraic formula parsers for plotting virtually any function. The support for Hercules, CGA, MCGA, EGA and VGA displays. Output for plotters and laser printers.

Cost? Still only \$1495. Evaluation versions still only \$150. Brochure and demo disk still free for the asking. Call or write for yours today. And see how easily you can get ideas up and flying.

SPECTRUM

1021 S. Wolfe Road
Sunnyvale, CA 94086
(408) 738-4387

Circle 266 on Reader Service Card

World Radio History

- Database Interface: implemented in Structured Query Language (SQL).
- Query Interface: query and report-writing facilities.
- Repository Interface.
- Distributed Data Management (DDM).

As platform-specific implementations of SAA generally support additional functions, you must use the CPIs with CCS and CUA specifications to ensure applications portability. For example, IBM is redesigning many applications to conform with SAA and may still support some of their original functions as well.

If you use nonconforming functions, your application might not be portable to other SAA platforms.

On the other hand, IBM ensures that source code written to the "ordered subset" of functions that SAA supports in the CPIs will endure, whatever enhancements may be made in the future.

IBM has not yet implemented all the elements of SAA: Internal guidelines state that SAA support on one platform must be followed with support on all the other platforms within two years. But SAA is not static. Repository Interface was announced in September 1989, and IBM is planning its first implementation on the MVS operating system for June.

Network Applications Support

While IBM is providing applications integration for its own systems, DEC is going ahead with integrating Unix and providing interoperability with popular desktop platforms—VMS, its proprietary operating system, and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. SAA does not address this mission at all.

As IBM's development of its Unix environment (AIX) has been on a separate track for the first three years of SAA's existence, DEC's Unix support may be an advantage that will stand for some time. But then, strong in technical computing where Unix has its bedrock, DEC

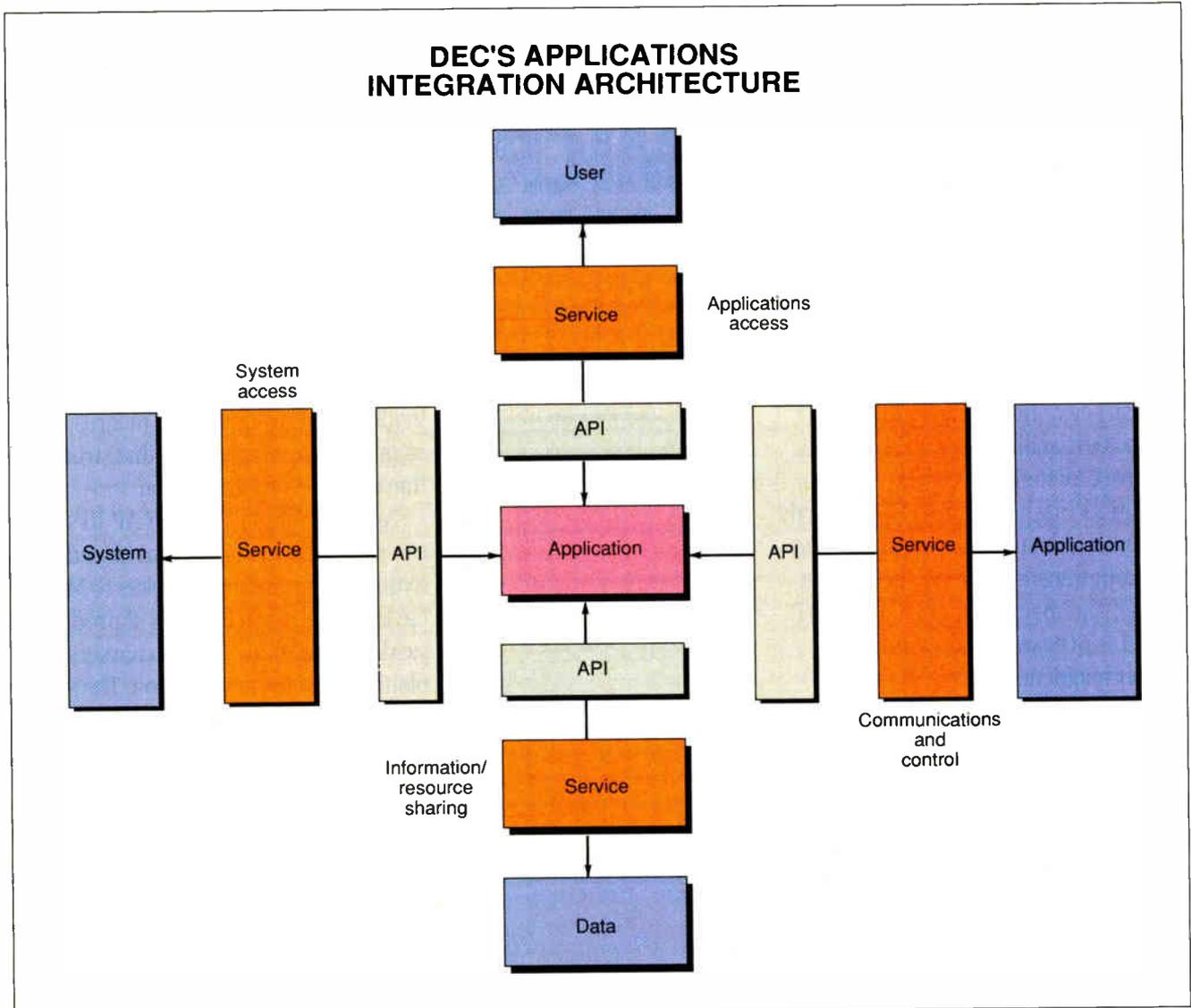


Figure 2: AIA provides the architectural categories for NAS. NAS attempts to integrate Unix and provide interoperability with VMS and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. The colors used group like elements together but do not have the significance of the colors in figure 1.

has had more reason to focus on Unix.

The NAS scheme provides applications on the five platforms mentioned with access to common services that run under VMS and Ultrix. Those services may exist on larger machines or on the VMS or Ultrix workstations. (VMS and Ultrix workstations can perform as servers as well as clients. The other three desktop computers are clients only, although a server role may be in the future for OS/2.)

In addition, DEC claims greater openness for NAS because it is based on de facto and de jure industry standards. SAA's ingredients may or may not adhere to standards: It's not in the charter. However, many of them do, and whatever IBM does is often so widely implemented that it becomes a de facto standard, anyway. Both companies are trying to drive relevant standards in their respective strategies, especially in integrating new technologies for which standards are just emerging.

DEC uses the label Applications Integration Architecture (AIA) to describe NAS architecturally, according to the structure shown in figure 2. However, NAS is the overall term used. The NAS implementations deliver that architecture and map directly to it. The table on page 242 contains the generic designation that AIA supplies for the various pieces of the environment followed by the current names of NAS implementations. Due to NAS's basis in standards, the pieces often match up with various standardization efforts.

Like SAA, NAS reflects much intention as well as reality. For example, DEC's electronic document interchange (EDI) services, although they have been outlined, will not show up until late this year. The slot for Repository services is filled by DEC's Common Data Dictionary/Plus for VMS. Last spring, DEC announced that it will support an API for CDD/Plus based on a draft standard jointly developed with Atherton Technology. The proposed standard is now before standards-review committees.

The API, an Ultrix version of CDD/Plus, and client support for DOS and OS/2 are forthcoming, probably beginning later this year. LiveLinks and Builder in the NAS list are data-link technologies currently offered by DEC in compound-document-architecture (CDA) based applications; DEC plans to make them generic services for NAS.

The System access category also requires explanation. POSIX provides an interface to System services in contrast to the high-level services in the other cate-

gories. DEC now supports it in Ultrix, with VMS support to come. This will provide a common portable development environment. The use of POSIX is a possible route to further integration of OS/2 into the NAS scheme, since Microsoft has stated that OS/2 will support POSIX.

Finally, with the sole exception of POSIX, NAS's base in standards does not mean that standard functionality is synonymous with the NAS service functionality. Standardized function is a variably important component of full-function NAS services, depending on how far a standard has progressed. For example, DECwindows was developed on an X Window System (referred to as X Window for the remainder of this article) base and incorporates a look and feel that is slated to migrate to conformance with the Open Software Foundation's Motif, both fully fleshed-out standards.

On the other hand, DEC's CDA implementation incorporates existing open document architecture/open document interchange format standards, as does IBM's MO:DCA, in fact. But those standards are minimal so far. DEC hopes its work in the relevant standards processes will lead to incorporating its technology for tabular data handling and live links, for example, into the standard.

Adherence to industry standards creates an additional dimension to portability and interoperability under NAS that can be significant. The X Window underpinnings of DECwindows, for example, allow a DECwindows user to run a program that supports X Window even if it was written for another system with a different user interface. In addition, the X Window base is portable.

Similarities

SAA and NAS share some generic characteristics. Both provide APIs that address heterogeneous collections of computing resources. These APIs allow applications to access the various services that different operating systems deliver. They provide interoperability and greater portability across dissimilar platforms.

In addition, both SAA and NAS are emerging concurrently with new technologies—graphical interfaces, repositories, compound document architectures, and distributed databases. The architectures are important elements in their companies' respective development efforts around new technologies as well as in rewriting programs to bring existing products into line.

Each is a Chinese puzzle of components in various states of conformance.

Neither SAA nor NAS is static. New elements are continually being added. The results are often strikingly similar, especially when you consider how far apart IBM's and DEC's recipes for computing were just five years ago.

Differences

Nevertheless, tracking SAA and NAS requires understanding the differences between them. These differences show up in purpose, in structure, and in delivery, partly owing to the unwritten maxim that competing vendors don't completely match capabilities. You don't catch up, you leapfrog and differentiate.

You can summarize the major differences in the following ways.

IBM's SAA provides

- a common applications environment for those IBM operating systems chosen for SAA support; and
- an extension of IBM's SNA to provide a new degree of peer-to-peer communications among those systems.

DEC's NAS uses the company's peer-to-peer networking strength (DECnet/OSI and the Unix-oriented TCP/IP protocols) to provide

- common services to applications running on a variety of desktop platforms, including its own VMS and Ultrix (Unix) workstations, DOS PCs, OS/2 PCs, and Macintoshes;
- a common applications development environment between DEC's VMS operating system and its Ultrix platform; and
- an environment that is based on industry standards.

When comparing the breakdowns of NAS and SAA structures, a difference and possible source of confusion is that DEC names the implementation in which an API is contained. The implementation and the API are separate in IBM's definition of SAA. Like SAA, however, NAS also makes strict distinctions; the API in each instance is inviolate.

For example, in SAA, CUA specifies the graphical user interface, and Presentation Interface is the API for interfacing to PM, IBM's version of CUA for OS/2 Extended Edition. DECwindows, by contrast, is a complete toolkit for graphical interface, akin to PM and incorporating the necessary APIs.

Further, DEC has used various means to implement NAS goals. For example, MS-DOS Display Facility (in table 1) is a

continued

Computers for the Blind

Talking computers give blind and visually impaired people access to electronic information. The question is how and how much?

The answers can be found in *The Second Beginner's Guide to Personal Computers for the Blind and Visually Impaired*, published by the National Braille Press.

This comprehensive book contains reviews, written by blind users, of software that works with speech.

Send orders to:

National Braille Press Inc.
88 St. Stephen Street
Boston, MA 02115
(617) 266-6160

\$12.95 for braille or cassette
\$14.95 for print

NBP is a nonprofit braille printing and publishing house

NAS FUNCTIONALITY LIST

The Applications Integration Architecture describes Network Applications Support architecturally. The NAS implementations deliver that architecture. Notice that the pieces of the environment are the same as the services shown in figure 2.

Pieces of environment	Generic AIA designations	Current NAS implementations
Applications access	Windowing services	DECwindows (for VMS, Ultrix) MS-DOS Display Facility
	Forms services	DECforms
	Terminal services	Terminal emulators (all platforms)
	Graphics services	DEC GKS DEC PHIGS
	Application control services	LiveLink Builder
Communications and control	Messaging services EDI services	Mailbus VAX/EDI
Information/resource sharing	Compound document services	CDA Toolkit CDA Viewers CDA Converter Library DECimage Applications Services
	Data access services	SQL Services
	Repository/dictionary services	CDD/Plus
	File-sharing services	VMS Services for PCs NFS for Ultrix VMS/Ultrix Connection
	Print services	DECprint
System access	System services	POSIX interface

separate implementation that allows the DOS desktop to use a DECwindows application, even though its lack of multi-tasking prevents it from running as a true DECwindows workstation.

When comparing the lists of functions as definitions of an applications environment, some other differences pop up. SAA's specification of many protocols for communications has no parallel in the NAS list. DEC has provided all NAS platforms with support for DECnet and TCP/IP protocols, and applications built on top of NAS services are network-independent. Also, communications functions in the NAS list are built on the underlying network mechanisms.

Apples, Oranges, and Sequels

At this stage in their development, even when equivalent NAS and SAA functions have been implemented, a 1-to-1 comparison is elusive and difficult to generalize from. A close look at one case offered in both frameworks, however—SQL database access—illustrates some of the differences between them. It also

shows how similar SAA and NAS can be when they both conform to the same standard.

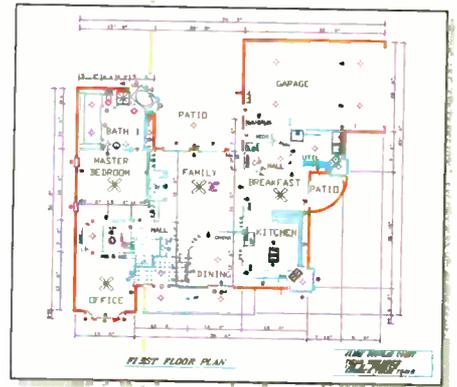
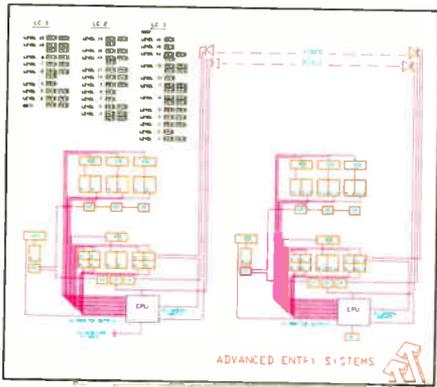
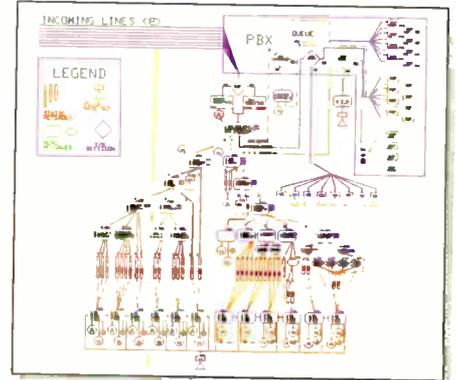
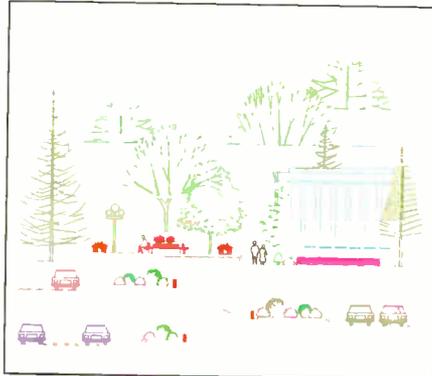
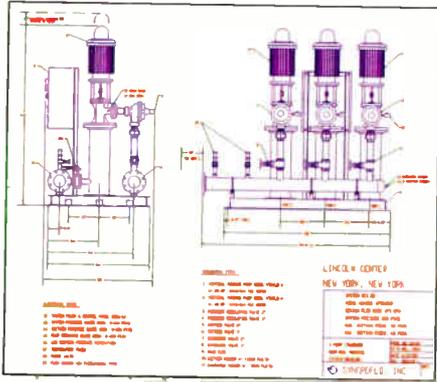
Two comparisons are relevant for clarity. The first addresses DEC's evolving integration of VMS and Ultrix under the NAS umbrella, comparing the current VAX SQL interface for VMS's relational database to SAA's SQL CPI.

The VAX SQL interface is slated to present a common API to the relational DBMS for Ultrix, which DEC is expected to release this year, based on technology licensed from Ingres. As such, VAX SQL is the strict apples-to-apples comparison to SAA's SQL CPI. Listings 1 and 2 show the almost identical steps required to retrieve payroll information in a C application using the VAX SQL and SAA SQL interfaces.

Notably, IBM has been talking about extending the SAA SQL CPI umbrella to embrace its relational DBMS for AIX, for which it initially licensed technology from Oracle. Although this extension would entail communications issues,

continued

FOR SALE: DRAWING BOARD, T-SQUARE, DRAFTING PENS...BARELY USED.



It's time to consider computer-aided design and drafting (CADD). Join over 200,000 users who create better drawings faster with Generic CADD. From simple floor plans to detailed engineering drawings, there's a Generic CADD solution to all your drawing needs.

Generic CADD.
A better way to draw.

Get started quick with The CADD Starter Kit. Computerized drawing is easier than you think. Create your own drawings and designs in just hours using the Starter Kit's step-by-step tutorials, sample drawings and pre-drawn design symbols.

Draw like a pro with CADD Level 3. Draw blueprints, floor plans and schematics just once...

then revisions are just a "stretch," "move" or "copy" away. You can enhance your image while saving time with this precision drawing tool.

Powerful PC CADD starts at under \$200. Order either Generic Software program now and you'll receive FREE a copy of the book, "Converting to

CADD—A Beginner's Guide to Computer-Aided Design." Just note on your registration card that you saw this offer.*

It's a real bargain. See your local software dealer to buy the right Generic CADD product for you. Or call us at **800-228-3601, ext. 703** (U.S. and Canada) for the dealer nearest you.

©1990 Generic Software, Inc. Generic Software is a Trademark of Generic Software, Inc.* Offer good through May 31, 1990 in the U.S. and Canada only.

Generic
SOFTWARE
AN AUTODESK COMPANY

11911 North Creek Parkway South
Bothell, WA 98011
800-228-3601 ext. 703
FAX 206-483-6969

Circle 126 on Reader Service Card (DEALERS: 127)

Listing 1: *This C code shows the programming required for NAS's SQL Services to access data in DEC's Rdb relational database. Compare this to listing 2. Both programs are in dynamic SQL but use quoted strings to replace user input.*

1. To set up program for SQL communications

```
#include <sqlsrvda.h>
#include <sqlsrvca.h>
#include <sqlsrv.h>
```

2. To declare SQL variables

```
char *assoc_id, *stmt_id;
struct SQLDA *sel_list;
char name[20],ssn[10];
int hours_worked
```

3. To prepare select statement

```
sqlsrv_prepare(assoc_id,0,
              "SELECT * FROM PAYROLL WHERE PAY = 0",
              stmt_id,0,&sel_list);
```

4. To open cursor

```
sqlsrv_open_cursor(assoc_id,"C1",stmt_id,0);
```

5. To fetch

```
sel_list->SQLVARARY[0].SQLDATA = &name;
sel_list->SQLVARARY[1].SQLDATA = &ssn;
sel_list->SQLVARARY[2].SQLDATA = &hours_worked;
sqlsrv_fetch(assoc_id,"C1",0,0,sel_list);
```

Listing 2: *This C code uses SAA's CPI to access a relational database. It differs from the VAX SQL in the stmt.len statement, which reformats the input string from C to COBOL format in the IBM case.*

1. To set up program for SQL communications

```
EXEC SQL INCLUDE SQLCA;
```

2. To declare SQL variables

```
EXEC SQL BEGIN DECLARE SECTION;
char name[20],ssn[10];
int hours_worked;
struct {short len;
       char stg[36];
       }stmt;
EXEC SQL END DECLARE SECTION;
```

3. To prepare select statement

```
stmt.len = 35;
strncpy(stmt.stg,"SELECT FROM PAYROLL WHERE PAY = 0",35);
EXEC SQL PREPARE SELECT1 FROM :stmt;
```

4. To open cursor

```
EXEC SQL DECLARE C1 CURSOR FOR SELECT1;
EXEC SQL OPEN C1;
```

5. To fetch

```
EXEC SQL FETCH C1 INTO :name, :ssn, :hours_worked;
```

necessitating an interface for LU 6.2 and TCP/IP, it may be one of the first steps IBM takes to merge the separate path of AIX development with SAA.

NAS provides database access from the desktop platforms via SQL Services as client/server software. The emphasis is on relieving the client of as much processing as possible due to the memory and processing limitations of DOS.

As the primary results, NAS's SQL Services omits the use of precompilers and supports only dynamic SQL (rather than dynamic and static SQL, as in both VAX SQL and SAA). Dynamic SQL software analyzes statements at run time, the function that permits ad hoc queries. The server can perform this analysis in the NAS scheme, so you don't have to run a precompiler locally.

Programming for OS/2 Extended Edition queries under SAA is somewhat simpler than programming for DOS using NAS's SQL Services. Still, SAA does not support DOS. In addition, code written to the NAS API for DOS is portable to other supported NAS platforms. So far, DEC supports SQL Services for VMS, Ultrix, and DOS clients.

However, the DOS deficiencies arbitrate unnecessary restrictions on the other two platforms. When DEC provides a common SQL for Ultrix and VMS relational DBMSes, it will probably introduce an unrestricted optional version of SQL Services for those systems as clients. They will remain clients, however. The other ingredient of SQL Services is establishing a session between the desktop and the remote host that has the database.

In SAA, the remote connection is established transparently. IBM plans to incorporate LU 6.2 communications capabilities into its relational DBMSes on all SAA platforms; that is, into Database Manager on OS/2 Extended Edition, into the integral relational DBMS of OS/400, into SQL/DS for VM, and into DB2 for MVS. A catalog and optimizer in each system determine where remote data is located.

In this transparent distributed database-access scheme, a query goes to the local database, which determines the location of the remote database being accessed. At the present time, transparent access is supported only between like systems. From an OS/2 Extended Edition system, the program in listing 2 could retrieve data from a database on another OS/2 Extended Edition system, but not from DB2.

DEC plans to provide a SQL Services API for OS/2 this year. In addition, DEC

and Apple are jointly developing Mac support for NAS. Last May, Apple announced that a SQL Services product supplying a VMS server and an API for the Macintosh will be forthcoming.

Both IBM and DEC support the ISO/ANSI X3.135 standard for SQL, each with its own extensions. However, NAS supports some 54 functions compared to 19 in the SAA CPI.

Current Directions

This year, DEC is likely to move a remote procedure call into its lineup. Program-to-program applications have been held back in the past because DEC never provided an easy-to-use API for the sophisticated bidirectional communications services in DECnet. As IBM backs up its new LU 6.2 CPI with more support, such applications will become more attractive, and DEC is expected to jump ahead to incorporate the RPC as a service in NAS.

As the flow of DECwindows and PM implementations from third-party sources increases to more than a trickle, it will be interesting to see if IBM comes out with high-level communications support. This would allow applications on remote systems to open windows on the PS/2s, fulfilling one of IBM's aims: to off-load mainframes from having to do screen management.

It will also be interesting to see how open IBM's protocols will be. Right now, DECwindows, with the X Window base providing that capability across a network, is far more attractive. While SAA leaves you on your own for high-level support, DECwindows allows you a variety of options. In addition to building DECwindows applications, you can build compatible workstations, alternative network services, and applications with a look and feel suited to custom environments.

Keeping Score

How do NAS and SAA stack up in the microcomputer arena? Clearly, at this time and for plans currently in place, DEC has the edge. NAS supports DOS; SAA does not. NAS supports the Macintosh; SAA does not. NAS supports Unix; SAA does not. The tally is not entirely one-sided, however. Both NAS and SAA support versions of OS/2, and both support forms of SQL.

In addition, both IBM and DEC claim adherence to standards, although DEC seems to be more serious about it. IBM is accustomed to being able to influence the setting of standards by brute force: If IBM does it, then it will probably be-

come a de facto standard. DEC is also trying to influence standards in its favor: DEC is intensifying its participation in the industry processes for standards setting.

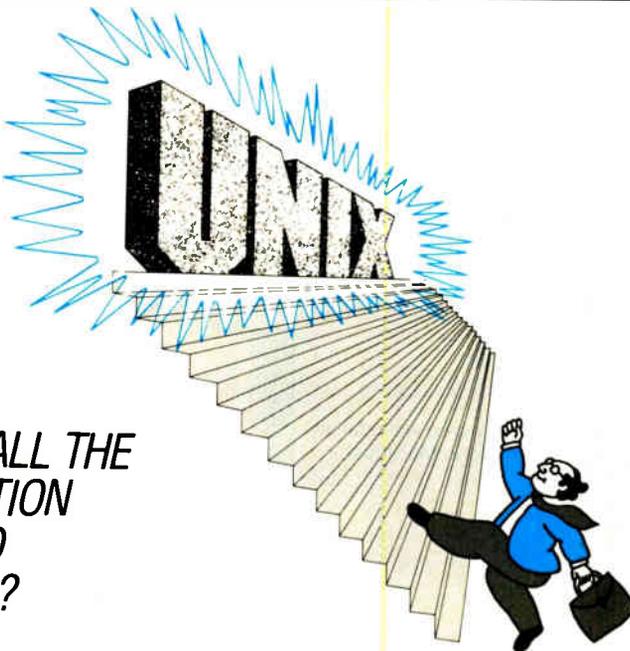
NAS and SAA show transformations in DEC's and IBM's approaches to the 1990s as the two vendors who most loudly claim the ability to mastermind enterprise-wide computing. They are only just beginning to make their marks. New players are entering the field, and IBM

and DEC are still jockeying for position. Keep your scorecards handy. ■

ACKNOWLEDGMENT

Thanks to Harold Lockhart, senior consultant at Technology Concepts, Inc. (Sudbury, MA), for writing the listings.

Sheila Osmundsen is an industry analyst in Boston, Massachusetts, who specializes in tracking DEC and IBM. She can be reached on BIX c/o "editors."



**HAVING
TROUBLE
FINDING ALL THE
INFORMATION
YOU NEED
ON UNIX®?**

**TAKE THE FIRST STEP . . .
CALL DATAPRO TODAY!**

If you're looking for detailed analysis of the critical issues surrounding UNIX . . . if you need timely information on the products and key players in the industry . . . then turn to Datapro Reports on UNIX Systems & Software.

Updated monthly, this unique new information service is designed to help you discover the opportunities UNIX offers . . . decide how UNIX fits in your organization . . . optimize results while minimizing risk.

UNIX® is a registered trademark of AT&T.

datapro®

Each month, Datapro Reports on UNIX Systems & Software brings you in-depth analyses of everything new and noteworthy in the UNIX market. You receive the most up-to-date, thoroughly researched information available. Information you can put to use in planning your own UNIX strategies.

Find out how much of a difference Datapro can make to your decision-making: call us today at **1-800-DATAPRO** (1-800-328-2776) or use the reader service card.



An Open Approach

Herb Osher

In today's multivendor environments, it is difficult, if not impossible, to completely integrate information artifacts—a Macintosh desktop, a Unix mail message, a Lotus 1-2-3 spreadsheet—without trade-offs.

A technical writer, for example, may value the Mac's user-friendly interface, but struggle when accessing data on DOS-based PCs over a Token Ring LAN. A CAD/CAM expert may prize a high-performance Unix workstation for mathematical analysis, but hit a brick wall when trying to include data residing on an IBM mainframe. Although there are many ways to share data in mixed environments, little progress has been made in integrating applications across proprietary systems.

Major innovations in the microcomputer world of the 1990s will most likely come from the development of distributed architectures based on industry standards. In recent years, Data General has been creating such an architecture that targets open systems: Distributed Applications Architecture (DAA).

The Architecture

DAA is a set of written specifications and software products that allows you to integrate distributed applications across mixed environments. It gives you a consistent view of data, applications, and services no matter what machine or operating system you use. DAA is based on the client/server computing model. It's not limited to one hardware or soft-

ware environment. Clients are portable to a range of operating systems, and servers to new hardware architectures that support Unix V release 3.

The architecture provides an integrated environment for those who write applications to a variety of standards. It also integrates popular shrink-wrapped applications. The standard environments that DAA supports include DOS, OS/2, Unix, POSIX, and the Motorola 88000 Binary Compatibility Standard.

Data General began announcing products based on DAA in 1989. In February, it launched the AViiON family of computers—servers and workstations based on the 88000 RISC chip—and a version of Unix called DG/UX. The AViiON systems comply with the

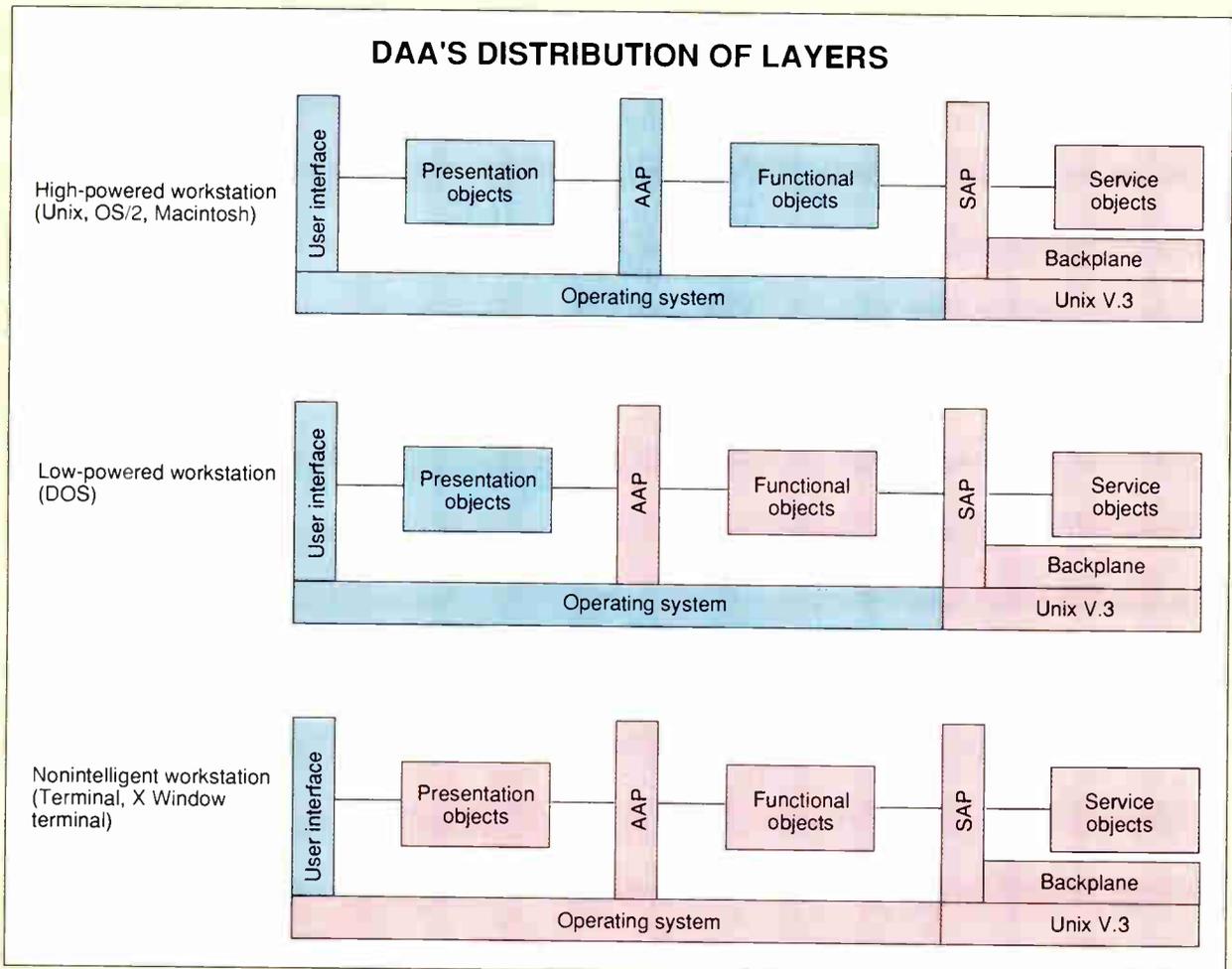


Figure A: The applications-access point (AAP) and service-access point (SAP) are industry-standard remote procedure calls that allow you to configure DAA for different workstations. Notice how the distribution of layers depends on the sophistication of the workstation used. (The red shows the portion residing on the server; the blue shows that on the clients.)

88open Binary Compatibility Standard, which ensures applications portability on all 88000-based products.

Built on these RISC and Unix technologies is the most critical component of the design: an open client/server platform that's based on an object-oriented model. DAA's object-oriented facilities support the object-action paradigm, which allows you to select objects and then apply actions to them.

DAA lets you choose your own workstations, network protocols, and database software. The design, from the beginning, centered around distributed object management. Object orientation has been integrated into the client, network, and database components, and object-management services are provided at the presentation, function, and data management levels.

In addition, DAA is a complete implementation of a distributed architecture. This encompasses a backplane of software services (e.g., object database, communications link, name, authentication, notification, and systems management services). Similar to a hardware backplane design, DAA's software backplane allows you to plug in services such as mail, calendar, and print, and to expand to other services when necessary. DAA also provides a set of application programming interfaces (APIs) based on remote procedure calls (RPCs) used to integrate distributed applications across networks.

The Clients

The DAA platform is organized into user communities. It connects clients across LANs and wide-area networks to geographically dispersed servers. This environment can consist of various heterogeneous computing components using a mix of operating systems such as Unix, DOS, OS/2, and the Mac OS.

Clients are *logical workstations* that can run on RISC-based Unix workstations, Macs, PS/2s, PCs, and ANSI and X Window System terminals. The DAA platform provides you with a common user environment across workstation clients using any of the following: Microsoft Windows and Hewlett-Packard's NewWave for PCs; Open Software Foundation's Motif for Unix workstations; Presentation Manager for PS/2s; and text-based menu interfaces for ANSI and X Window terminals. A Mac implementation will preserve the traditional Mac look and feel.

Based on an object-oriented paradigm, the logical workstation includes *functional objects*, such as an in-box object and related methods like read, re-

ply, and forward. Functional objects provide functionality at the applications level and interact with *presentation objects*, which provide a view of the functional objects. In addition, clients can integrate popular shrink-wrapped software as applications-level objects to run on PCs and workstations. A *local object manager* manages these objects.

The client also has access to two powerful mechanisms that leverage functions and services scattered across multiple clients and servers (see figure A). An applications-access point (AAP) allows presentation objects to transparently invoke functional objects that may reside on a client or server. The service-access point (SAP) interface connects the functional objects on the logical workstation with service objects in the object database. The SAP defines the point where the functional objects plug into a DAA server backplane. You can build custom-integrated applications using the SAP interface.

The Servers

The DAA servers consist of communications links, service-providing shared computers, and their peripherals. The server is composed of a service backplane with service objects built on it. It can span more than one physical computer.

At the heart of the object-oriented computing platform is the object database. A component of the service backplane, this database stores all objects, including services. Objects are self-contained units that encapsulate the data and the methods that manipulate it. Object orientation enables DAA to define its objects using high-level abstractions. The database is based on an extension of the SQL model and operates with a range of SQL relational database systems, such as Informix, Oracle, Ingres, and Sybase.

The API available to clients, the SAP, makes RPCs to methods in objects in the database. The DAA platform provides a library of basic objects. It also provides a library of presentation objects that supports a common user interface based on a HyperCard-like model.

The service backplane also houses additional services. An X.500-based name service keeps track of all user names, workstations, and services. Communications links, to allow workstations and services to communicate transparently, are based on industry-standard RPCs, like NetWise. An authentication service enables client and server to authenticate themselves and guarantee secure sessions. A notifica-

tion service notifies you of changes in status, like new mail. The backplane also houses systems management services for distributing software and managing networks, users, and objects.

The Networks

Users, clients, servers, and the objects associated with them are organized geographically into groups called *domains* and *communities*. Domains and communities provide a home, or address, for these entities and an organization that is the basis for system management.

A domain is a group of users, a list of clients and servers, and all the objects that these clients and servers own. The system can authenticate, register, and centrally manage all users and services within it. A community is a collection of interconnected domains. No central authority controls its members. Rather, a loose federation of domains exists.

As an open architecture based on industry standards, DAA can communicate with other environments. For example, it embraces Data General's Systems Application Architecture communications strategy, which is aimed at compliance with SAA protocols. This architecture allows a meaningful subset of SAA applications to execute in DAA client/server environments. It also provides extensive support for cooperative processing and data distribution between SAA and DAA applications.

At the transport level, the platform is based on Data General's Open LAN architecture, which allows integration over TCP/IP, Novell NetWare, LAN Manager, Token Ring, Open Systems Interconnection, and AppleTalk networks. OSI standards are used as the basis for DAA's naming and management services.

A Single-System Image

DAA presents an open approach to computing in the 1990s. The architecture significantly reduces the trade-offs commonly experienced when you integrate popular operating systems, workstations, interfaces, and applications in today's multivendor environments.

DAA provides much information-processing power, with network-based applications distributed optimally throughout the system. It creates a unified single-system image among heterogeneous computing environments.

Herb Osher is division director of the Office Systems and Distributed Computing Group at Data General Corp. (Westborough, MA). He can be reached on BIX c/o "editors."

Building Blocks

The future course of applications software depends on the interplay of diverse concepts, standards, products, and market forces. For more information on the elements discussed in this section, contact the organizations listed below.

ANSI X3.135 (SQL)
American National Standards
Institute (ANSI)
1430 Broadway
New York, NY 10018
(212) 354-3300
Inquiry 1051.

CL/1
Finder
MultiFinder
QuickDraw
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 1052.

DECnet
DECwindows
Network Applications
Support (NAS)
Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(508) 493-5111
Inquiry 1053.

Design/OA
MetaDesign
Meta Software
150 Cambridge Park Dr.
Cambridge, MA 02140
(617) 576-6920
Inquiry 1054.

DESQview
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9851
Inquiry 1055.

Distributed Applications
Architecture (DAA)
Data General Corp.
4400 Computer Dr.
Westborough, MA 01580
(508) 366-8911
Inquiry 1056.

88open Binary Compatibility
Standard
88open Consortium, Ltd.
8560 Southwest Salish Lane,
Suite 500
Wilsonville, OR 97070
(503) 682-5703
Inquiry 1057.

FoxBASE+
FoxBASE+ /Mac
Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162
Inquiry 1058.

GEM
Digital Research, Inc.
Box DRI, 70 Garden Court
Monterey, CA 93940
(408) 649-3896
Inquiry 1059.

GemStone
Servio Logic Development Corp.
1420 Harbor Bay Pkwy., Suite 100
Alameda, CA 94501
(415) 748-6200
Inquiry 1060.

HOOPS
Ithaca Software
902 West Seneca St.
Ithaca, NY 14850
(607) 273-3690
Inquiry 1061.

Interface Builder
NextStep
NeXT, Inc.
900 Chesapeake Dr.
Redwood City, CA 94063
(415) 366-0900
Inquiry 1062.

LU6.2/APPC
OS/2 Extended Edition
Presentation Manager
Systems Application
Architecture (SAA)
IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 1063.

MS-DOS
OS/2
Presentation Manager
Windows
Windows/286
Windows/386
Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
Inquiry 1064.

NewWave
Hewlett-Packard Co.
3000 Hanover St.
Palo Alto, CA 94304
(415) 857-1501
Inquiry 1065.

Open Look
Unix International, Inc.
Waterview Corporate Centre
20 Waterview Blvd.
Parsippany, NJ 07054
(201) 263-8400
Inquiry 1066.

OSF/Motif
Open Software Foundation
11 Cambridge Center
Cambridge, MA 02142
(617) 621-8700
Inquiry 1067.

Prototyper
SmethersBarnes
520 Southwest Harrison St.,
Suite 435
Portland, OR 97201
(503) 274-2800
Inquiry 1068.

Smalltalk-80
ParcPlace Systems, Inc.
1550 Plymouth St.
Mountain View, CA 94043
(800) 882-7880
(415) 691-6700
Inquiry 1069.

Smalltalk/V Mac
Smalltalk/V PM
Digitalk, Inc.
9841 Airport Blvd., Suite 604
Los Angeles, CA 90045
(800) 922-8255
(213) 645-1082
Inquiry 1070.

TRON
TRON Association
Tomoe-cho Annex 2
5F, 8-27, Toranomon 3 Chome
Minato-ku, Tokyo 105
Japan
81-3-433-6741
Inquiry 1181.

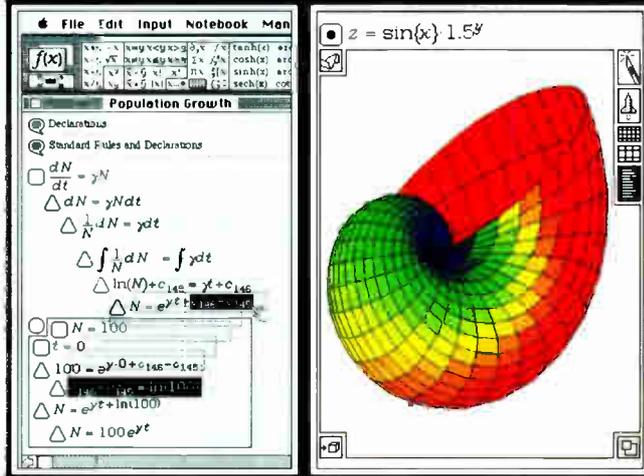
X.desktop
IXI, Ltd.
62-74 Burleigh St.
Cambridge CB1 1OJ
England
44-0223-462131
Inquiry 1182.

XVT
Advanced Programming
Institute, Ltd.
Box 17665
Boulder, CO 80308
(303) 443-4223
Inquiry 1183.

X Window System
MIT Software Distribution Center
Technology Licensing Office
Room E32-300
77 Massachusetts Ave.
Cambridge, MA 02139
(617) 258-8330
Inquiry 1184.

This resource guide lists information sources for the major concepts and products listed in the section. 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 of the guide.

Intuitive Mathematics and Equations Made Easy



Theorist's equation outlining and manipulation process, and one of many customizable graphs.

Have you ever wished for a symbolic algebra program that was easy to use and powerful, but only required 1 MB of memory? A program where you didn't have to learn how to program, memorize syntax rules, or read a large manual? A program that solves equations the way you normally do, symbolically and numerically - step by step. How about using those solved equations, answers, and graphs and placing them into your word processing and page layout documents, with typeset quality results! What about graphs? How about 2-D graphs, 3-D solids, contour plots, animation, and more, all saved as PICT, PICS, or Encapsulated PostScript for quality output. Well if this is what you want, than please give us a *call*, or *write* for some detailed information and how to order **Theorist** and **Expressionist**. Theorist will solve and graph your equations. Expressionist produces typeset quality equations for your documents! And best of all, the programs can work together importing and exporting equations back and forth. Both are simple enough for the student, yet powerful enough for the professional educator, scientist and engineer. Prescience (pronounced PRE-shens) brings you the complete mathematical solution for the Macintosh. Our programs enable you to concentrate your time investigating and presenting your work, not learning how to!



Expressionist™ \$129.95
Typeset Quality Equation Editor



Theorist™ \$379.95
Symbolic Algebra & Graphing

Prescience Corporation
814 Castro Street #111
San Francisco, CA 94114
(415) 282-5864

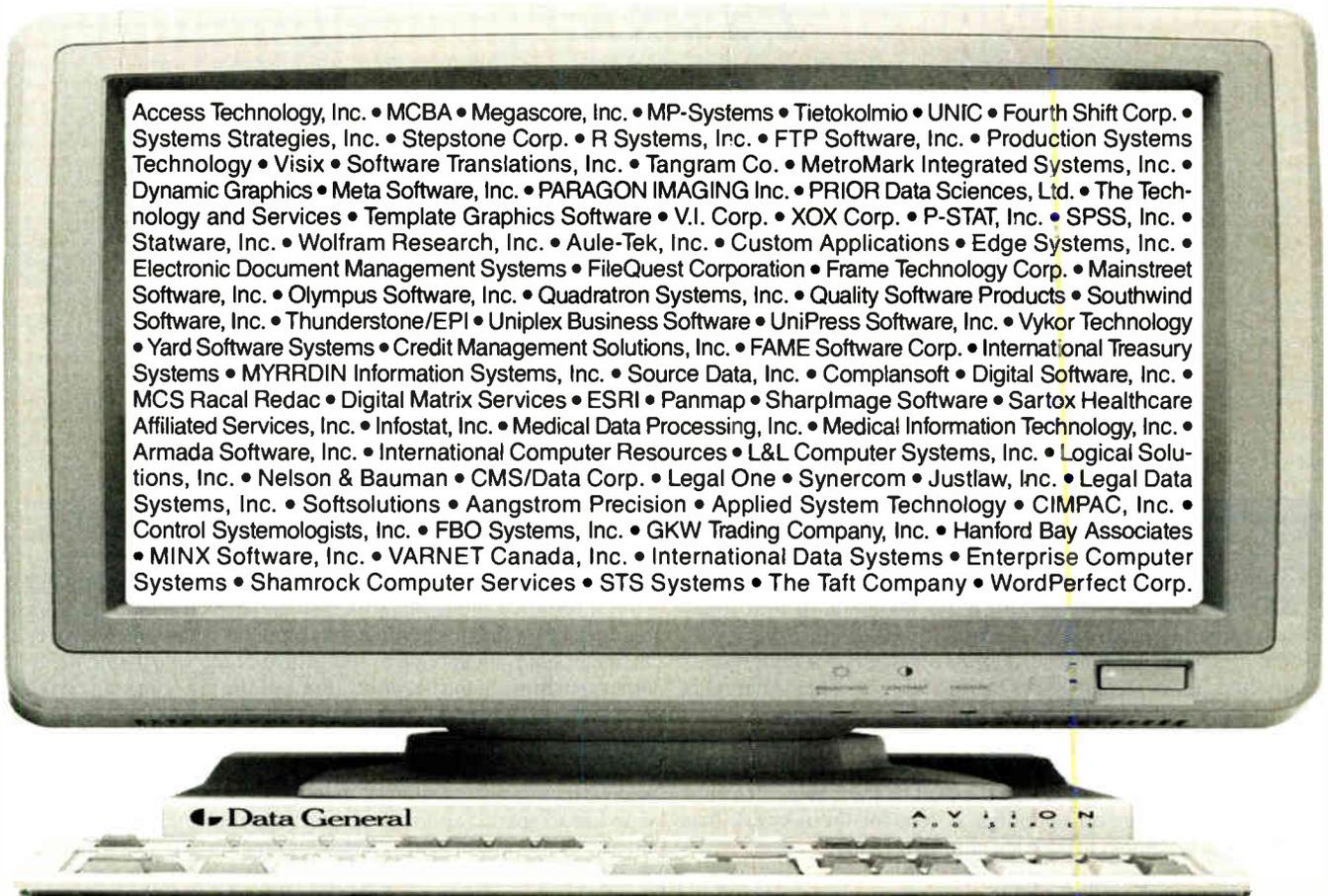
Prescience 
Intuitive Tools For Mathematics

DEPTH &

Oracle Corporation • Micro Focus Ltd. •
Absoft Corp. • Accel8 Technology Corp.
• ACCUCOBOL • Applied Logic Systems,
Inc. • B32 Software Ltd. • Basis Inter-
national • BASIX Development Group •
Boston Business Computing • Datavision
Ltd. • Diab Data, Inc. • Digital Information
Systems • Egan Systems, Inc. • Franz, Inc.
• Gensym Corp. • Green Hills Software,
Inc. • HCR Corp. • Ibuki, Inc. • Inference
Corp. • Interactive Software Engineering,
Inc. • InterSystems Corp. • Jyacc, Inc. •
Language Processors Inc. • Megascor,
Inc. • Micronetics Design Corp. • NKR
Research, Inc. • Oasys Software Corp.
• Quantitative Technology Corp. •
Programmed Intelligence Corp. • SINC,
Inc. • Software Systems Design, Inc. •
Subject, Wills & Company • Tadpole Tech-
nology, Inc. • TeleLOGIC • Tele-Soft •
Transoft Limited • UNITECH Software Inc.
• Verdex Corp. • Visible Systems Corp.
• Wild Hare Computer Systems Inc. •
Emerge Systems, Inc. • Industrial Pro-
gramming, Inc. • JMI Software Consul-
tants, Inc. • Lynx Real-Time Systems,
Inc. • FTP Software Inc. • Ready
Systems • VMARK Software, Inc. •
Cognos, Inc. • Cybertek Software Inc.
• Empress Software, Inc. • Progress
Software Corp. • INGRES Corp. • Sybase,
Inc. • Thoroughbred Division • Unify
Corp. • Zortec, Inc. • Novell, Inc. • SAS
Institute, Inc. • Technology Concepts, Inc.
• Phoenix Technologies Ltd. • Informix
Software, Inc. • Ryan-McFarland Corp.



BREADTH



Data General's AViiON lets you run both.

When you're looking for solutions, choose the UNIX® system-based RISC platform that scores of industry leading software vendors have already chosen: Data General's AViiON™ Family!

There's a deep set of proven utilities, databases, and 4GLs that make developing or porting your own programs as easy as can be. And there's a broad range of applications for industries like banking, insurance, hospital management, accounting and more.

Data General supports the 88open BCS, the industry's only binary standard for multivendor interoperability. That means AViiON is open to the most important networking, communications, and software standards.

Call 1-800-DATAGEN and we'll send you a brochure listing hundreds of third-party software programs available for Data General's AViiON Family.

Name _____

Company _____

Address _____ Phone _____

City _____ State _____ Zip Code _____

 **Data General**

3400 Computer Drive, Westboro, MA 01580

AViiON is a trademark of Data General. UNIX is a registered trademark of AT&T. © 1990 Data General Corporation.

Circle 81 on Reader Service Card

World Radio History

TIME AND MONEY

*In a distributed operating system called Spawn,
computers buy and sell time to balance the workload*

Peter Wayner

In the world of mainframe computers, time is quite often money. The system administrators often allocate the company computer's time by charging the users more for using the machine in the hours of high demand and less at times when demand is low (like in the middle of the night). Most personal computer users are hardly familiar with this concept because they never have to share their machines. This situation is changing, though, as networks connect many machines.

People with overloaded computers will soon realize that there might be an idle computer on the network that could handle some of the work and lessen the load on their own. The only problem is building an operating system for the network that makes it easy, quick, and efficient to share time.

In the Beginning...

At Xerox's Palo Alto Research Center (PARC), one team of researchers is borrowing the metaphor from the old mainframe system and putting a price on computer time. Their new network, called Spawn, is not just a collection of wires for transferring files; it is a miniature auction economy where machines trade time for a computerized version of cash.

The one big difference between these new networks and the mainframes is the structure of the "economy." The mainframes sell computer time to users at fixed prices and guess how the pricing will control demand. This new system for managing a distributed system of computers is a pure market filled with many buyers and sellers who set prices by bidding for computer time. The result seems to be an ideal way to allocate resources and also, incidentally, to study how markets work.

The basic Spawn system operates on a network of Unix computers running Sun Microsystems' protocols for Remote Procedure Calls (RPC) and accessing a Network File System (NFS). The designers chose Unix and C because they make up the core of an almost universal operating system that can handle multitasking and network computing. They also chose this combination in spite of the fact that much of Unix's power wasn't neces-

sary and a smaller, finely tuned distributed operating system would be more efficient. But they gained ease of implementation and universality in the trade-off.

The structure of Spawn is easy to understand. Each computer runs a resource-managing process that keeps track of the work being done on the machine. If the computer is idle, the resource manager holds an auction to sell a slice of the spare time to another machine on the network. If one of the jobs running on the machine needs more computer time, the resource manager watches for auction announcements and bids at the auctions until it finds the necessary computer cycles. The manager also keeps track of the amount of electronic "cash" that each process has to spend, although the current implementation makes no attempt to guard against fraud or counterfeiting. (Other researchers are developing secure cash systems relying on clever cryptography, but these ideas are outside the scope of this article.)

Finding the Parallelism

Under Spawn, each application must call up the resource manager when it has a task that could be spun off to run on another machine. The programmer must build the intelligence into the application itself so the application can know when it has a bit of computation that can be "spawned" and executed in parallel.

The process is not automatic. Once the application makes the decision, it hands off the procedure to Spawn, which finds another machine to do the work. The program must know how to integrate the information when it comes back.

For example, ray tracing is an application suited for parallel processing (see "The Art of Ray Tracing," February BYTE). The programmer might set up a program, break it up into 100 different sections, hand those 100 different sections to Spawn, and ask it to bid for time on 100 different machines. If 100 different machines are free, the information will come back very quickly. If fewer machines are free, the resource manager will bid on the available time and continue looking until all 100 jobs

continued



are finished. (Note that even if there are 100 free machines holding auctions for their free time, the whole job will not get done 100 times faster. The overhead of communication and bidding prevents perfect efficiency. Preliminary test results show overhead has ranged from 7 percent to 10 percent.) The ray-tracing program then reassembles the data into final results.

The jobs Spawn sets up on different machines can vary in intelligence. The simplest subapplications act like black boxes and only report their results after they've finished their work. The more sophisticated ones send information regarding their partial progress to their manager, which examines all their reports and will often send back instructions to the subapplications regarding the best way to proceed.

Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

This interaction is especially useful for solving problems such as the traveling salesman problem—finding the fastest, shortest route to many locations. Different processes could search different routes and, through the manager, keep track of the current best solution.

The subapplications can also recursively create their own subapplications by splitting their part of the problem into small sections. The entire structure of applications and subapplications can form a big tree-like structure in the network. These subapplications get the money to bid for new time from the process, this managing process in turn obtains money from the process above it, and so on. The manager of the top application is responsible for passing enough currency down to the entire tree so that subapplications can buy enough time to finish their tasks.

The strategies used by the top applications to guide their subapplications can be simple or complex. Equal funding is easy to implement, but it's only efficient if all subapplications are performing an equivalent amount of work. The top application, for example, might create several different applications that would each explore a different approach to the same problem. More funding, though, could be allocated to the solution that is more likely to succeed. A better but more complex heuristic for allocating the currency would reward the more successful subprocesses with more cash to spend on more computer cycles. Of course, this method relies on the existence of some measure of relative progress and success.

Bad Code in the Node?

A major advantage of the economic model is its ability to survive disasters such as other computers crashing on the network. A centralized allocation scheme not only must devote a large amount of time maintaining an active list of machines but must not fail itself. If it stopped, every job would be lost. Some other complex distributed systems have provisions for electing a new central processor in the event of a crash. These protocols are complex and time-consuming because the new central processor must either discover the status of the jobs or restart them.

In the Spawn environment, the resource manager does not need to know the operating status of all the machines. When it wants to buy time, it just watches for announcements of new auctions. However, the application itself must watch for trouble. If a machine running a subprocess crashes in the middle of the job, the top process must notice that no results were returned and restart the subprocess by buying time at the next auction. Fault tolerance can be built in by starting subapplications simultaneously on different machines and accepting the results of the first successful subtask. Obviously, if the top manager halts, the entire job will crash as well. The rest of the network, though, will not be affected.

The Auctions

Spawn conducts closed auctions that are clever combinations of open auctions and sealed-bid auctions. Open auctions aren't efficient on a computer network because they can run indefinitely and flood the network with message after message. Spawn requests sealed bids and sells the computer time to the top bidder, but at the price offered by the *second-place* bidder.

Using sealed bids reduces the network load, since they consist of only one message. Setting the price at the second-place bid results in almost exactly the same price as if there were an open auction. (The difference between taking the first and the second price is important. A normal sealed-bid auction charges the winner just what the time is worth to the top bidder alone. Consequently, the price paid is always the largest amount the top bidder is willing to spend—not the equilibrium price obtained when supply balances demand. The second-place bid is the price at which the second-place bidder would have dropped out of an open auction.) Interestingly enough, if there is only one bidder, the slice of computer time is given away gratis because the effective second-place bid is 0.

Each process must use some strategy to decide what to bid. Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. In the meantime, they received a constant trickle of money from their manager. The effect of this system is simple and fair. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

How Spawn Performs

The best measure of the system, of course, is its performance. The team at the Xerox PARC has tested Spawn with a number of different experiments. These tests have revealed a great deal about the fairness, adaptability, and chaotic behavior of the system.

Some experiments parceled out parts of a Monte Carlo simulation to the various machines. (A Monte Carlo process is a testing method for analyzing large, complex simulations by generating random initial conditions and checking the results. For example, a Monte Carlo simulation of a craps game would roll the dice enough to show that the house has a distinct advantage.)

continued

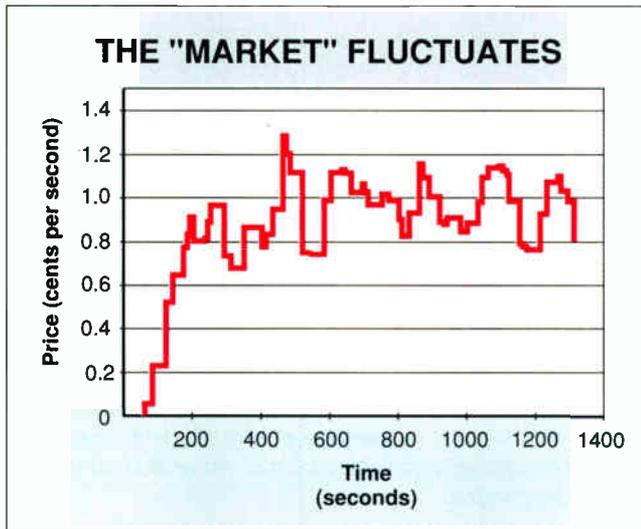


Figure 1: This graph shows how the price of computer time on the Spawn network fluctuates. Six Sun workstations ran three tasks that were given 30, 20, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs began, the price quickly increased, eventually oscillating at around 1 cent per second. Such chaotic behavior is typical of the economic marketplace on which Spawn is modeled.

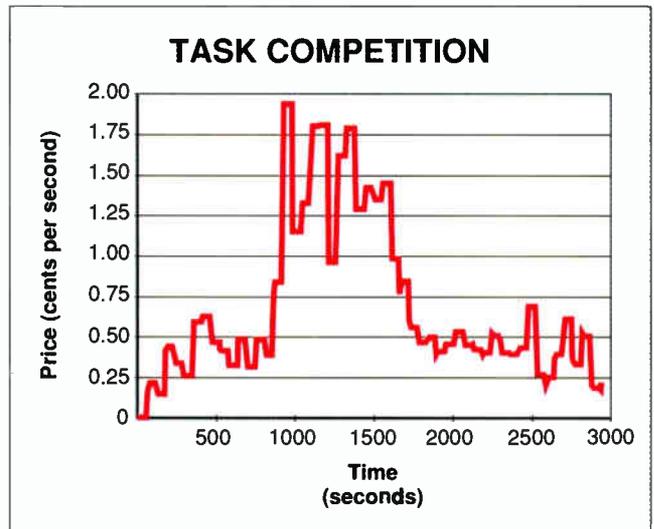


Figure 2: In this graph, you can see how the price of computing time soars when a high-priority job with plenty of funding enters the market. Two processes with 1 and 2 cents per second to spend begin to lose most of the auctions (at around the 900-second mark) to a process that has 7 cents per second to spend. The price returns to normal when the later process is finished.

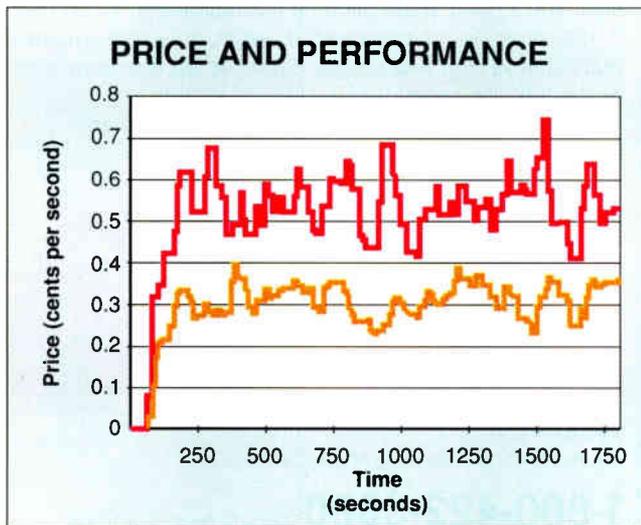


Figure 3: The price of computing time on different machines is different if the machines have different capabilities. The dark line shows the price of time (established by auction) on the faster and consequentially more valuable Sun-4/260. The gray line is the price of computation on a Sun-4/100.

The simulations are very easy to split into many sections and run in parallel.

The researchers experimented with various funding strategies. Figure 1 shows the results of connecting six Sun workstations and running three tasks that are given 30 cents, 20 cents, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs begin, the price quickly increases until it oscillates around an equilibrium price of 1 cent per second.

Because there are six machines, and therefore six auctions conducted, the total money spent per second is, on average, equal to the money flowing to the processes. The fluctuations in the prices shown in the figure are just the first evidence of the random nature of the system. If the same set of programs is restarted, the price graph will be different. The average price will remain the same, but the shape of the price oscillating randomly around this average will be different. The chaos enters the system because the bidding is not linear: Each auction is priced at the value of the second-largest bid.

Team members Bernardo Huberman and Tad Hogg studied a similar system of equations that are easier to analyze theoretically. They discovered that the chaos was often unavoidable when there were delays in communication between computers and each computer's knowledge about the status of the others was incomplete.

The noisy, erratic behavior of the price should be familiar to anyone who plays the stock market. The process is fair, at least to those who subscribe to free-market doctrines, which form the axioms at the foundation of the system. The processes that receive the highest priority are the ones with the most money. In the simulation shown in figure 1, where the ratio of capitalization was 3 to 2 to 1, the allocation of computer cycles was roughly 2.79 to 2.00 to 1.00. The chaotic behavior is probably the cause of the discrepancy between the two ratios.

High-Priority Jobs

The effects of high-priority jobs are easy to see in figure 2. The system begins and ends with two processes (with 1 cent and 2 cents to spend per second). In the middle of the graph, a process starts with 7 cents per second. It quickly begins winning about 60 percent to 80 percent of the auctions, and the price soars. When the job finishes, the price quickly returns to normal. This effect should be familiar to people who watch real markets perform in the same way. (The price of homes in the

continued

Up to date. Down to earth.

Changing the world. 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.

The information you need. 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 world's

biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help you and your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

The whole UNIX-verse.

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 the strategies that are changing your world. And *UNIXWORLD* consistently offers the freshest, most down-to-earth writing you'll find in any computer publication.

Subscribe and Save. Subscribe today, and receive the next 12 issues of *UNIXWORLD* for just 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.*

1 year \$18.00 (save 50%)
2 years \$32.00 (save 55%)
3 years \$42.00 (save 60%)

Subscribe now! Call toll-free:

1-800-341-1522

UNIXWORLD

If you're into UNIX, you need *UNIXWORLD* MAGAZINE.

UNIX® is a registered trademark of AT&T. UNIX WORLD is not affiliated with AT&T.

*UNIXWORLD's no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.

A McGraw-Hill publication

World Radio History

San Francisco Bay area, for instance, soared over the last 20 years as the computer industry brought more and more spending money into the area. The price of homes in Houston, on the other hand, collapsed after the price of oil dropped, cutting the flow of money into the region.)

If there are two different machines in the network with different capabilities, different prices will develop. Figure 3 shows the prices of the auctions run on a network of three Sun-4/260s (top line) and six Sun-4/110s (bottom line). The 4/260 is roughly 40 percent faster than the 4/110, and the average prices are quite different. The 4/260 gets more work done, so it is more valuable.

The most important part of the economic model is its support of an easily scalable, very diverse system. A large network will almost certainly not be made up of equivalent machines. Some will be faster than others. Some will have access to special data, and others may have numerical processors suited only for special problems. The value of these systems to all the users will change as they run different programs. If everyone is interested in inverting matrices, then the price of time on the systolic array will be high. On another day, with users running different applications, the time might be free. Dynamic pricing strategies ensure that the network will adapt.

Tying It Up

The chaotic nature of Spawn may seem a bit disconcerting, but, unfortunately, theoretical analysis seems to imply that the chaos is unavoidable. A system with built-in delays and imperfect knowledge seems to lead to chaos. This noise makes it dif-

ficult to predict exactly what the network will do. Spawn, though, always seems to behave as intuition might predict. The difficult problem is finding a strategy for bidding that can attempt to watch auction prices and plan intelligently.

Other systems for trading cycles between machines and balancing the network load often behave quite similarly when the Spawn applications bid naively. These other systems are often just economies that use terms like *priority quotient* instead of economic terms. The difference is usually largely semantic.

Setting up a distributed network of computers to share their cycles is a difficult problem that must be solved as networks become more prevalent. The free-market metaphor is not only easy for the mind to understand, but truly useful. Spawn effectively and flexibly allocates computer cycles with a small amount of interaction.

For further reading on the subject, try *The Ecology of Computation* (edited by B. A. Huberman, Elsevier Science Publishing, 1988). This book contains articles about distributed networks, including a piece about a system built at MIT called the Enterprise. In this system, instead of bidding money, the computers bid estimated finishing time. ■

ACKNOWLEDGMENTS

My thanks to Carl Waldspurger, Bernardo Huberman, Jeffery Kephart, Tad Hogg, and Scott Stornetta, members of the Spawn team at the Xerox PARC, for providing background material.

Peter Wayner is reading toward a Ph.D. in computer science at Cornell University. He can be reached on BIX c/o "pwayner."

THE FIRST NAME IN TRUE OEM COMPATIBILITY

NATIONWIDE
1-800-292-6272

FAX MARYLAND LOCAL
1-301-561-4659 1-301-561-0200

Hours: Monday - Friday
8:00 a.m. - 6:00 p.m. EST



WE ACCEPT PURCHASE ORDERS & CHECKS

Use of Equipment manufacturer's names is for identification only. NCRC is in no way affiliated with the OEMs listed.

NATIONAL COMPUTER RIBBONS®

9566 Deereco Road • Timonium, Maryland 21093

90 DAY NCRC GUARANTEE

We have always believed that no sale is complete until the customer has received total satisfaction from our products. We will never, knowingly, disappoint you. If for any reason your purchase does not give you complete satisfaction, the full purchase price will be cheerfully refunded upon return of the merchandise.

Philip E. Boringen, President

By buying from the manufacturer you are guaranteed the freshest ribbons, highest quality and fastest service.

We manufacture our products with the blackest matrix inks, premium high density nylon, precision engineered plastics and "Rem" air refrigerated loading equipment.

Minimum Order 6 Ribbons

COLORS
BLUE - GREEN - PURPLE - RED
Nylon Only

CARTRIDGE RIBBONS (NYLON)		
No.	Description	Price Ea. (Black)
180	Apple Imagewriter II 4/C	9.75
114	Apple Imagewriter	3.75
127	Brother M 1509/1709	6.65
104	Canan A-1200	5.65
109	Centronics 350/351/352/353	10.75
118	Citizen LSP 1200/1800	5.65
169	Citizen MSP 10/20	3.15
170	Citizen MSP 15/25	4.45
123	Comrex 420	8.65
131D	Data Products B-300/600	6.25
140	Epson DFX 5000	22.85
280	Epson EX 800/1000	5.35
165	Epson FX/MX/RX 70/80/85	3.15
167	Epson FX/MX/RX 100/185/186	4.45
288	Epson Lq500/Lq800/Lq850 H.D.	4.45
209	Epson Lq 1000 H.D./Lq 1050	5.65
163	Epson Lq 1500	3.75
281	Epson Lq 2500 H.D.	5.65
283	Epson Lq 2550	5.65
283C	Epson Lq 2550 4 color	23.00
287	Epson Lq 950	5.25

No.	Description	Price Ea. (Black)
175	Epson LX 80/90	3.15
145	Hewlett Packard 2631A	13.85
181	IBM 3287/3615 SD Loop	2.25
195	IBM 3287/3619 SD Cart	3.15
188	IBM 4201 ProPrinter II	4.75
176	IBM 4202 ProPrinter XL	5.65
177	IBM 4207 ProPrinter X24	5.65
211	IBM 4208 ProPrinter XL24	7.35
184	IBM 4224	12.95
875	IBM 4234	26.35
286	Mannesmann Tally 85	5.05
285	Mannesmann Tally 86	5.65
204	Mannesmann Tally 120/160	3.85
205	Mannesmann Tally 140/80	4.45
660	NEC Pinwriter P1/P2/P6	4.55
661	NEC Pinwriter P3/P7	5.05
662	NEC Pinwriter P5/P9	5.05
663	NEC P2200 H.D.	6.95
210	NEC 5200/5300 Nylon	6.85
210M	NEC 5200/5300 M/S	11.75
210C	NEC 5200/5300 4 color	23.00
209	Okidata 182/183/192/193/320/321	4.55

No.	Description	Price Ea. (Black)
206	Okidata 292	6.15
208	Okidata 293/294	7.05
212	Okidata 393	14.95
215	Panasonic KXP 1124	5.65
217	Panasonic KXP 1080/1091	4.55
216	Panasonic KXP 1180	7.95
220	Panasonic KXP 1524	9.15
221	Panasonic KXP 1624	10.25
226	Radio Shack DMP 400/LPV1	3.75
282	Radio Shack /DMP 130	4.75
282	Seikosha SP800/1000	4.75
261	Star Micronics NB/NL/NP/NX 10	4.55
264	Star Micronics NL/NP/NX 15	6.65
266	Star Micronics NX 1000	4.25
266C	Star NX 1000 4 color	9.85
267	Star Micronics NX 2400	5.45
262	Star Micronics Radix 10/SR10	4.55
263	Star Micronics Radix 15/SR15	5.25
245	Toshiba P321/P351	3.95
245	Toshiba P1340/P1350/P1351	3.95
246	Toshiba P321SL/P341SL	5.85
247	Toshiba P351SX	6.55

No.	Description	Price Ea. (Black)
135	Tritel	3.25

CARTRIDGE RIBBONS (FILM)

(correctable / multi-strike)

307	Brother EM200 HR15/M/S	4.75
158	Diablo Hytype II M/S	3.75
202	NEC 3500/8800 M/S Flip	6.75
170	IBM Selectric II H.Y. Corr	2.05
321	IBM Actionwriter Corr	4.50
334B	Olivetti ET 121/351 M/S	5.55
227	Ricoh 1300/1600 M/S	3.75

TWIN SPOOL (NYLON)

454	Decision Data 6807/6711/6814	9.15
456	Dec writer LA 30/36	3.35
462	IBM 3262/5262	6.55
465	IBM 3525 T/S	4.05
464	IBM 5225/5250/5280	19.15
470	Okidata 80, 82, 92, 93	1.65
467	Printonix 150/300/600	6.55
470	Star Micronics Gemini 10/10X	1.65

"CALL US FOR VOLUME DISCOUNT PRICING"

*This is only a partial list of our products. *Prices subject to change without notice. *\$5.00 shipping and handling charge on all orders under \$50.00. Over \$50.00 actual freight is charged.

Try our products and see why 100,000+ customers are now using National Computer RIBBONS brand products.

SAVE 50% or more with our National Computer RIBBONS brand products.

CAD



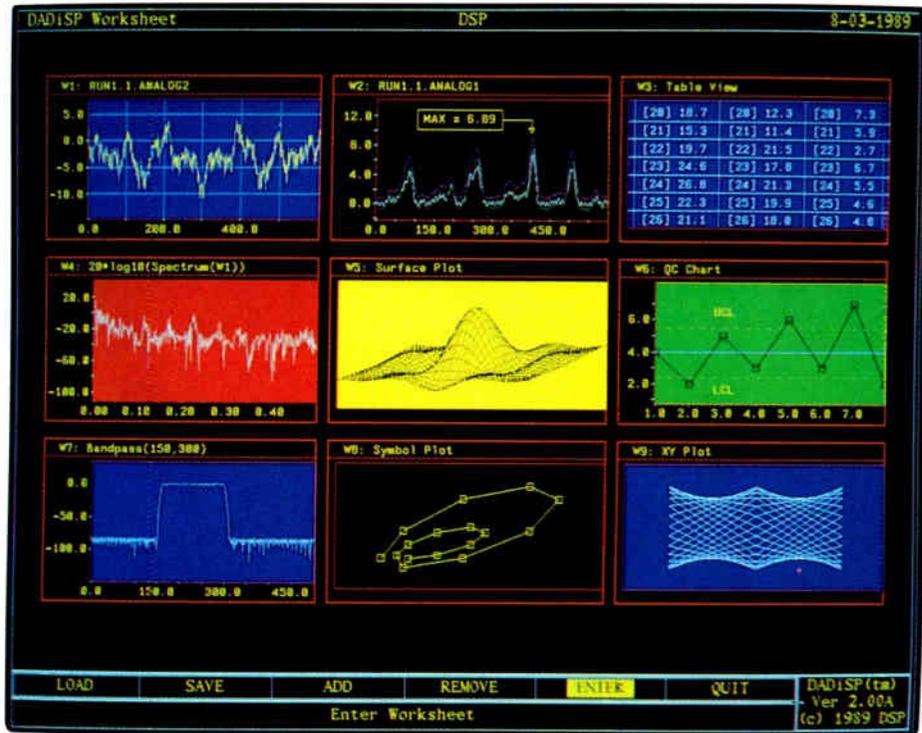
RAD

Introducing software that thinks. There has never been personal computer design and drafting software this powerful, this fast or this intuitive. Vellum thinks. Its radical new technology automatically pinpoints and aligns geometry as you draw. Built-in intelligence allows you to draw virtually freehand, yet set precise dimensions at any time. Finally, the days of complex commands and weeks of training are gone. Vellum has made industrial-strength design click on the Macintosh. For a demonstration see your Ashlar dealer or call (408) 746-3900.



Circle 30 on Reader Service Card

Introducing DADiSP 2.0



DADiSP. The Big Picture in Data Analysis

DADiSP — interactive graphics and data analysis software for scientists and engineers. DADiSP 2.0 delivers unprecedented power, through easy-to-use menus. Choose from hundreds of analysis functions and graphic views — from tables to 3-D. Simultaneously display multiple windows, each with different data or analyses, for unlimited perspective on your toughest data analysis problems.

Build your own analysis worksheets — build and display an entire data analysis worksheet, *without programming*. And DADiSP's powerful graphic spreadsheet automatically recalculates and updates the entire worksheet if you change your data or an analysis step.

Do serious signal processing... the way you always pictured it! FFTs, digital filter design, convolutions, waterfall plots, and more — all at the press of a key.

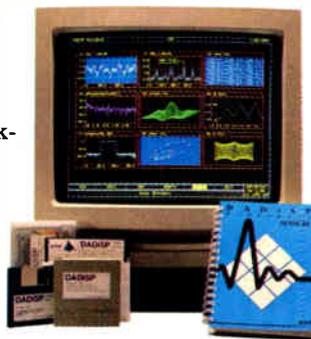
Let your instruments do the talking — use DADiSP-488 to bring data from your instruments directly into a DADiSP window for immediate viewing and analysis.

Flexible, expandable, customizable — annotate your graphs and send them to printers, plotters, or publishing packages. Create your own macros, automate routine tasks, and run any program written in any language from within DADiSP. *DADiSP even lets you build your own menus.*

A proven standard — already used by thousands of engineers and scientists worldwide, in a whole range of applications like medical research, signal processing, chemistry, vibration analysis, communications, manufacturing quality control, test & measurement, and more. DADiSP supports the IBM PC and PS/2, SUN, DEC VAX, HP 9000 and Concurrent families of personal computers and workstations.

**GET THE PICTURE!
CALL TODAY 617-577-1133**

Ask for our Evaluation Disk. For more information, write to DSP Development Corporation, One Kendall Square, Cambridge, MA 02139, or FAX: 617-577-8211.



Australia-Interworld Electronics, 03 521-2952; England-Adept Scientific, (0462) 480055; Biosoft (0223) 68622; France-SM2I, (1) 34810178; Sacasa, 69077802; West Germany-Datalog, (02166) 46082; Stemmer Elektronik, 089-809 02-0; Israel-Racom Electronics, 03-491-922; Italy-BPS Computers, (02) 61290221; Japan-Astrodesign, 044-751-1011; Netherlands-Computer Engineering Roosendaal, 01650-57417; New Zealand-GTS Engineering, (09) 392 464; Sweden-Systek, 013 110140; Switzerland-Urech & Harr AG, 61 611325; Taiwan-Advantech, 2-351-2117

NEW OBJECTS FOR OLD STRUCTURES

Converting existing applications to object-oriented applications is possible and often very advantageous

Jeff Duntemann and Chris Marinacci



When you forge ahead to apply new language technology to new projects, existing applications usually get left behind. Writing new applications is fun; converting old ones is just drudgery. Besides, existing applications work already. If they're not broken, why spend the time to fix them?

This last question is actually another question in disguise. Is the benefit to be gained from new language technology worth the risk in "lifting the hood" on a completed application? The answer, of course, is that it all depends on the value of the technology.

Ring out the Old; Ring in the OOP

New technology shows up with great regularity in the programming tools business. Still, it's been a long time since anything has generated the excitement that's been created by object-oriented programming (OOP) systems—probably not since the appearance of structured methods in the 1960s. (See "Object-Oriented Programming," February BYTE.)

Is OOP worth the bother?

The answer is almost certainly yes, and the same reasons that apply to new applications also apply to converting old applications:

- **Maintainability**—OOP programs are more easily read and understood (and hence

changed) than traditional structured programs. OOP techniques provide a highly effective means of controlling program complexity by imposing a functional hierarchy on program details and hiding whatever details the programmer doesn't have to face at any given time.

- **Reusability**—It is possible for programmers to write objects so loosely coupled that they can be considered "black boxes" that can be dropped into programs with little disruption of unrelated code. If they design them well, programmers can use these same black boxes as standard software parts in future applications, and often with no changes whatsoever.

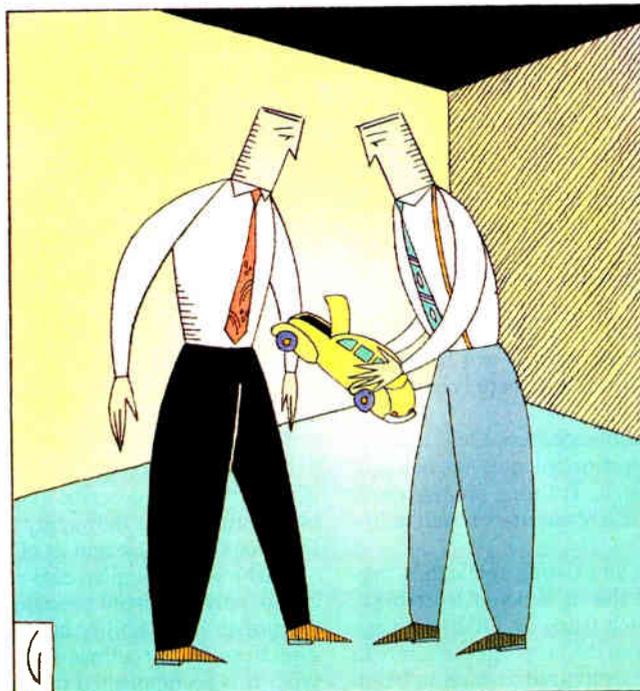
applications, and often with no changes whatsoever.

- **Extensibility**—One benefit of OOP's inheritance concept is that objects can be easily extended with new features without any unnecessary duplication of code. A child object is declared that inherits everything its parent object has and defines only those things that differ from (or must be added to) the parent object.

Weigh Costs and Benefits

Converting an application involves several important decisions regarding the shape of not only that application, but of applications that will be written or converted in the future. Actually, before developers convert any old applications to object-oriented applications, they should put a

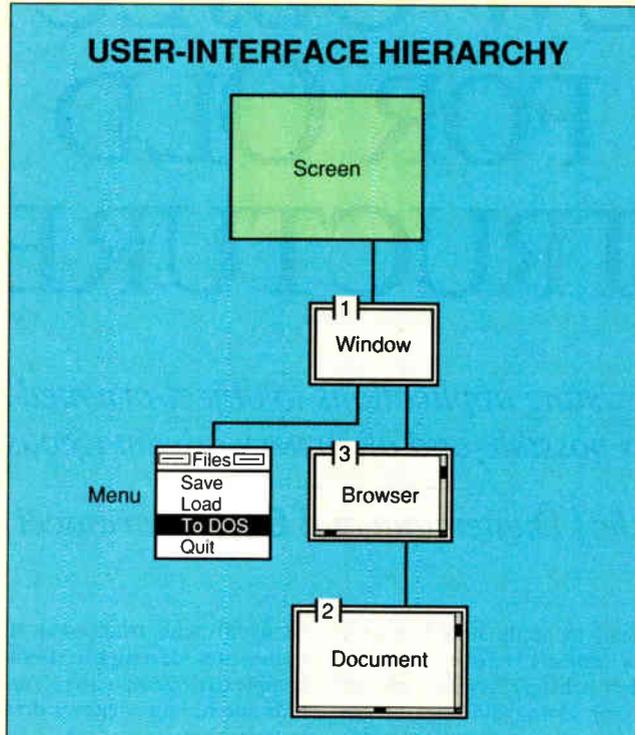
continued



An Object's Heritage

The Screen object type contains all the methods that manipulate the display controller directly. It models the full screen only. The Window object type subdivides the screen with methods to allow sizing, dragging, and border control.

Other screen subsets, including menus and browsers, are children of the Window type. The browser models a read-only editor. It contains methods to manage vertical and horizontal scrolling. The Browser object is an abstract object, meaning that it exists to be inherited from. Its child objects implement specific methods to handle the display of particular types of data—that is, a text browser, a hexadecimal dump browser for memory or files, and so forth.



The Document object inherits the ability to display data to the screen from the Browser type and adds the additional methods needed to edit, search, load, and save text. Note that because the Document object inherits its "frame" from the user-interface hierarchy (see the figure), changing the user-interface objects propagates the changes to the document without any changes to the Document object itself.

Making the application's central object a descendant of the user interface ensures that the application will be consistent with the user interface to the very highest level—that of the application proper.

strategy in place for designing object orientation into future applications. This way, they can spread costs between future development projects and current applications. Developers should, in fact, be thoroughly familiar with these costs before they begin any conversion project. The main costs involve time, tools, talent, and inconvertible applications.

Viable big-picture planning is time-consuming, difficult, and expensive. Without a well-designed hierarchy, there's no way to take advantage of the powers of late binding and polymorphism. But designing the hierarchy isn't easy and can require a level of coordination of efforts among individuals that has never been achieved. The application's architects and support personnel need to be part of the process. Object-oriented conversion is not a small matter to be left to the programmers in the trenches who have been maintaining the code.

In addition, existing development tools may be incompatible with OOP techniques. Older code libraries may not link with new object-oriented modules. Debuggers may not be able to trace object-oriented code, especially where there is heavy use of late binding.

In this early stage of OOP's acceptance, too, OOP talent is still fairly hard to come by, and object-oriented design and programming skills may be a little rough. Training programmers is costly, and staff turnover may greatly retard—or even halt—an important conversion project.

Finally, it's always possible that an existing application may require so much effort to convert that it is better to rethink, redesign, and recode it from scratch using an OOP language that may be completely different from the language currently in use. Applications not written in a structured fashion to begin

with, for example, are nearly impossible to recode along OOP lines without a total rewrite.

In general, the higher the coupling between application components—modules, procedures, or whatever—the harder it will be to recode for OOP. Also, code that takes full advantage of system-level resources such as interrupts is hard to meld with true object-oriented code. Some applications convert more easily than others. It's a good idea to know which ones are easier to convert before you begin the conversion process.

Structured Pascal vs. Object-Oriented Pascal

People long assumed that OOP would require new and radically different languages, such as Smalltalk. But over the last few years, major object-oriented extensions to both Pascal and C have shown this concept to be false. Apple published its Object Pascal specification in the mid-1980s. Soon after, Bjarne Stroustrup defined the C++ object-oriented extension to the C language. Since then, effective and efficient object-oriented extensions to structured languages—most notably Objective C, used in the NeXT workstation—have appeared on the scene.

In mid-1989, Borland International extended its Turbo Pascal implementation of Pascal to incorporate objects. The techniques that we'll describe assume the use of Turbo Pascal 5.5, but in broad terms they apply to any language bridge between a traditional language and its object-oriented extensions.

Turbo Pascal implements all three key object-oriented concepts: polymorphism, encapsulation, and inheritance. Polymorphism is the ability of objects to respond appropriately to directives from routines that do not know the objects' exact type. It is accomplished through late binding, which is the de-

termination of call destination addresses at run time rather than at compile time.

Encapsulation is the melding of code and data into a single structure. It is embodied in the object structure, which is defined very much like a record:

```
type
  Point = object
    X, Y : Integer;
    Visible : Boolean;
    procedure MoveTo(NewX, NewY : Integer);
    procedure WhereIs(VAR PosX, PosY : Integer);
    function IsVisible : Boolean;
    procedure Show; procedure Hide;
  end;
```

In an object, data fields like *X* and *Y* and methods like *IsVisible* and *Show* are defined (encapsulated) together. You can freely access the data fields from outside the record or use the in-place methods that perform all useful manipulations on the data fields.

Inheritance allows a child object to make use of all data and methods belonging to its parent object, while adding or changing only what it must to implement its new features:

```
Circle = object(Point) { Inherits from Point }
  Radius : Integer;
  procedure Grow(GrowBy : Integer);
  procedure Shrink(ShrinkBy : Integer);
end;
```

A circle differs from a point only in that a circle has a radius. The *Grow* and *Shrink* methods are provided to change the radius without directly accessing the *Radius* data field. All of *Point*'s definitions are directly accessible from *Circle* as though *Circle* had defined them itself. In other words, given an instance of *Circle* named *ACircle*, the inherited *Show* method is called by the statement *ACircle.Show*.

Turbo Pascal objects can override inherited methods simply by redefining them. The compiler knows that an identifier has been redefined when it parses an identifier's second definition; Object Pascal's *OVERRIDE* reserved word is therefore redundant and unnecessary.

Late binding is implemented by declaring a method as virtual using the new reserved word *VIRTUAL*. Objects that are descended from one another in an object hierarchy can all share a single virtual method name (like *Show*), but each can implement that method differently as its individual needs require. Which implementation is actually executed for a given invocation of a virtual method is not decided until run time—hence the term *late binding*. Traditional Pascal procedure calls are *bound* (i.e., the calling logic is given the address of the procedure) at compile time.

Late binding in Turbo Pascal 5.5 makes possible polymorphism (from the Greek for “many shapes”). A single virtual method call can have many shapes, depending on which object type is being called at the moment.

Can You Convert This Application?

Before we discuss how to do a conversion, it's worthwhile to consider which applications may be difficult or impossible to move toward object orientation. You should ask several important questions of any conversion prospect.

Is it structured to begin with? Unstructured applications should be left as they are or totally rewritten. Unstructured Pas-

cal applications make little use of procedures and data structures. Data is scattered across dozens or hundreds of global variables. The main program is large, and loops are often implemented with *GOTOs* and labels. Many line-for-line ports from older versions of *BASIC* and *FORTRAN* end up looking like this, and they tend to be as flexible as concrete.

Object orientation is in one sense a structure of structures. If fundamental program structures such as procedures and records are missing, making it object-oriented might as well be considered a complete rewrite from scratch. Even the specifications may have to be rewritten, as an unstructured spec will be more hindrance than help in writing object-oriented code.

A lesser but related question should be asked of any application. Does anyone in-house really understand it? Old, rarely used, and poorly commented applications should be left alone, or else respecified and rewritten by someone who has never even seen the old application.

The second question is less plain and more troublesome. Does the application or any major part of it depend on non-object-oriented tools? Screen generators that create Pascal code for data-entry modules fall into this category, as do toolbox products consisting of many interrelated procedures and functions that must be linked into the program code. These products are “object-ignorant” and require the application to perform procedure calls and set up data structures in certain ways.

While you can, to a degree, make applications that use such tools object-oriented, the tools will eventually become a source of considerable frustration and will limit the evolution of the object-oriented application along natural object-oriented lines. Furthermore, reusability and extensibility of modules that incorporate non-object-oriented tools will be severely limited or rendered impossible.

First Steps Toward Conversion

Unlike with totally object-oriented languages such as *Smalltalk*, *Turbo Pascal* programmers have a lot of choice regarding to what degree an application will be object-oriented. Furthermore, you can convert a traditional Pascal application incrementally without degrading the performance of the application.

The first steps are easy. Remove conflicts with reserved words and predefined identifiers. Turbo Pascal 5.5 adds only four new reserved words to the language: *OBJECT*, *VIRTUAL*, *CONSTRUCTOR*, and *DESTRUCTOR*. If the application contains any use of any of these words, you must choose new identifiers. There are only two new predefined identifiers that, if at all possible, you should not redefine: *Self* and *Fail*. Note that there is nothing in Turbo Pascal's overlay scheme that hinders object orientation. Objects can exist in overlays without modification or special considerations.

Looking for Near-Objects in Old Applications

Programmers are often surprised at how easily they can recast certain portions of an application in object form. The surprise comes from the fact that they sometimes unwittingly create libraries of procedures and functions along object-oriented lines without thinking of them as object-oriented. Often, then, by this time, they have performed everything but encapsulation.

Such “near-objects” usually consist of a data structure or family of data structures and several procedures and functions that act on those data structures. The whole is often defined within a unit, which reduces coupling with other program code and further facilitates “objectification.”

One common example of a near-object is a unit that defines a calendar date record and several routines for manipulating

continued

Listing 1: A long string object type definition produced by encapsulation.

```

const
  MaxLStringLength = 65521; { The maximum amount that can be
                             allocated to a pointer }

type
  LStringRange = 0..MaxLStringLength;
  LStringData = array [1..MaxLStringLength] of Char;
  LStringDataPtr = ^LStringData;
  LStringPtr = ^LString;
  LString = object
    Len : LStringRange;      { Current length }
    MaxLen : LStringRange;   { Length that has been
                             allocated. This is always
                             allocated in blocks of 16
                             bytes so that the long
                             string's data doesn't have
                             to be reallocated every time
                             the long string grows. }

    Data : LStringDataPtr;
  constructor Init;
  destructor Done;
  function SetValue(NewLen : LStringRange; NewData :
    Pointer) : Boolean;
  function FromString(S : String) : Boolean;
  function ToString : String;
  function Length : LStringRange;
  function Copy(Start, Amt : LStringRange) : String;
  function Insert(S : String; Start : LStringRange) :
    Boolean;
  procedure Delete(Start, Amt : LStringRange);
  function Append(S : String) : Boolean;
  procedure Change(Ch : Char; Start : LStringRange);
  function Assign(LS : LString) : Boolean;
  function FromStream(var S : DosStream) : Boolean;
  procedure ToStream(var S : DosStream);
end;

```

dates. The date record generally contains the date expressed as a month, day, and year value:

```

type
  Date =
    record
      Month, Day, Year : Integer;
    end;

```

Other expressions of the date, such as the DOS time stamp, a slash-delimited string form such as "6/29/89," or a fully spelled-out string form such as "June 29, 1989," are usually calculated and returned by routines defined in the unit. Other useful routines might include a procedure to set a date variable to the current date in the system clock, or to calculate the days between two date values.

```

interface
  procedure SetToToday(When : Date);
  function AsDOSStamp(When : Date) : Word;
  function AsShortString(When : Date) : String;
  function AsLongString(When : Date) : String;
  function AsJulian(When : Date) : LongInt;
  function DayOfTheWeek(When : Date) : Integer;
  function DaysBetween(Date1, Date2 : Date) : LongInt;

```

All these routines can become methods in a date object if you remove the unnecessary parameters (it is assumed that the methods will act on the object's own date data) and place their headers within an object type definition.

```

type
  Date =

```

```

object
  Month, Day, Year : Integer;
  procedure SetToToday;
  function AsDOSStamp : Word;
  function AsShortString : String;
  function AsLongString : String;
  function AsJulian : LongInt;
  function DayOfTheWeek : Integer;
  function DaysBetween(Date2 : Date) : LongInt;
END;

```

The DaysBetween method retains one parameter and returns the number of days between its own date value and the value of the Date2 object passed as a parameter.

Long Strings as Objects

One of Borland's ongoing research projects during the development of Turbo Pascal's object extensions was the creation of the TurboCalc spreadsheet program. One near-object identified during the specification process was the long string type (capable of storing up to 64K-byte characters) used by the spreadsheet.

In a way similar to the date example presented earlier, a long string was originally implemented as a record containing the string length and a pointer to an array of characters containing the string data. A suite of functions and procedures performed the necessary manipulations on the string record: insert, append, copy, return length, and so on. Encapsulating the data from the original record with the procedure definitions of the routines that acted on the data produced the long string object type definition shown in listing 1.

Recasting utility libraries as objects provides some immediate benefits. In almost all cases, the resulting objects are more loosely coupled than the original library. This reduction in coupling allows their reuse in other applications that are either being converted or under development. Creating objects from utility libraries confers future benefits, as well. Long after their creation, objects can be easily and efficiently extended by creating child objects from these objects. Inheritance confers all the parent's code and data on the child object while allowing the child object to change only that code and data that differ from the parent type.

Identifying the Central Object Within an Application

At the core of most applications of any consequence is a large and often complex data structure representing the work that the application does. For a word processor, this is the document that is often created as a linked list of text lines on the heap. For a database, it may be a binary tree or some other system of records and indexes tied together through pointers. For a spreadsheet, it is usually some kind of sparse array held together with pointers.

This data structure is the essence of what goes on in a program, and all the rest of the code in the program serves it in some way. However the data structure is represented, it should become an object during conversion. The trick here is knowing what code belongs to this central object and what code belongs elsewhere in the program. The identification process is one of "drawing a line around the object," including the code that works with the data structure directly and excluding the code that performs other tasks.

This process sounds simpler than it is, especially when you consider that large objects can (and should) manage their own complexity by containing other smaller and simpler objects. A word processor document is a good example. Most word pro-

NEW OBJECTS FOR OLD STRUCTURES

processors express a document as a linked list of text lines. Each line is a string, and strings are excellent candidates for objectification. The string object should contain the methods for managing string data within the string. The document object should leave manipulation of data within the strings to the string objects themselves and concentrate on managing the relationships of the strings to one another. These relationships include data that flows among strings, say, during the reformatting of a paragraph.

Obviously, drawing this line becomes a lot easier when you have some plan for an object hierarchy in mind. One of the knottiest problems is that of drawing the line between the data structure and the user interface. In order to achieve speed in displaying data to the screen, the central data structure is often very tightly coupled to the display routines. This tight coupling makes isolating the user-interface objects as a separate (and easily reusable) hierarchy much more difficult.

One way around this problem is to make the central data structure a child object of the user-interface hierarchy (see the text box "An Object's Heritage" on page 262). The browser object would presumably have a redraw method, which could be overridden by the data structure object with a method that displays the data structure to the screen or window. Don't be afraid to make the central object of the application a descendant of the user interface: The object inherits the ability to present itself to the user according to the rules you have established for your applications.

There are nonobvious benefits to this procedure, as well. If you have a windowing system in which you can create and display a new window at will, making the document or spreadsheet object a descendant of the window object means that splitting the screen into as many documents or spreadsheets as you need is as easy as instantiating a second document or spreadsheet object. The screen-splitting code is right there, inherited from the parent user-interface object.

Incremental Conversion

As you develop object-oriented subsystems for new applications, try grafting them onto old applications under conversion. The tremendous advantage of an object-oriented subsystem is that it is completely decoupled from the application itself. Assuming it doesn't conflict with any existing subsystems within the application, you can add a proven object-oriented subsystem as easily as linking it in and calling its methods.

The hardest part of such a graft might in fact be stubbing out or removing procedures and functions made obsolete by the new subsystem. Watch out for any and all unexpected side effects. Coupling is a snake with an infinite number of heads.

The Application as Object

As you work with OOP, you might get used to thinking of applications as containers for objects. But why not design applications that *are* objects? The entire application then becomes reusable as a component part of larger systems.

Such an application-object might have only two methods: Activate, which initializes and executes the application, and Deactivate, which "cleans up" any resources used by the application and returns control to the execution platform, which might be a DOS shell. Additional methods to export data to a clipboard for exchange with other applications would be right in line with the object philosophy.

Paradoxically, this forward-thinking conversion strategy is one that you might apply to old applications that are too unstructured or too poorly understood to be converted any other

continued

• Video Textbook Training • Video Textbook Training •

The Ultimate Training Solution

40 to 60 hours of in-depth training per course. Lessons consist of objectives, lectures, examples with detailed explanations, exercises with the presentation of multiple solutions per problem and lesson reviews. Developed by professionals that have taught these courses to thousands of students. Courses currently available include:

- The UNIX Operating System, Utilities and Bourne Shell Programming
- The UNIX Operating System, Utilities and C Shell Programming
- The ANSI C Programming Language and Libraries
- Programming with QUICK C
- Programming with TURBO C
- INFORMIX/SQL Applications Development
- INFORMIX/4GL Applications Development
- Programming with ADA
- Programming with C-scape

Designed to be your personal video textbook, the price of each course is an affordable \$150, plus applicable sales tax. Check, VISA and MasterCard accepted.

Video Textbook Training

200 Lakeside Drive, Building A4
Morgantown, WV 26505
(304) 292-0917 FAX (304) 296-4032

UNIX is a registered trademark of AT&T.
INFORMIX/SQL and 4GL are registered trademarks of INFORMIX Software, Inc.
QUICK C is a registered trademark of Microsoft Corporation.
TURBO C is a registered trademark of Borland International.
C-scape is a registered trademark of Oakland Group, Inc.

• Video Textbook Training • Video Textbook Training •

FontS

on - the - fly

Vector™ TeX

The most complete micro typesetting system available today. Scalable fonts, font effects, TeX standard and powerful new features. Saves more than 80% of storage as compared to other TeX's. Supports all major printers. Leaves other TeX's in the dust. Only \$249.

NewFase™ for WordPerfect

The instant font generator for WP 5.0/5.1. Create high-quality fonts as you need them. Use 90% less storage than with BitStream. Get camera-ready output on most lasers and dot-matrix printers. Comes with not 1 but 10 scalable fonts. Special symbols, foreign characters, and more. Optional Greek, Cyrillic, APL, astrological fonts. From \$149.

Fonts a-la-carte

LaserJet softfonts generated in seconds! Much faster than BitStream. Much higher quality than Glyphix. Save time, \$\$s, space. From \$25.

Vector TeX and NewFase are trademarks of MicroPress.

MICRO



PRESS

Call today for the latest catalog.

(718) 575-1816

67-30 Clyde Street, #2N Forest Hills, NY 11375

way. Putting an object "wrapper" around the entire application might be considerably easier than attempting to convert its tangled innards.

If you use this scheme, a word processor becomes a document object, and an accounting application becomes a ledger object. A hidden benefit of this scheme is that the ledger object could become a field in a database, as could a spreadsheet object or document object. Similarly, a document might become a cell in an object-oriented spreadsheet, subject to formulas that might return the document's size or time stamp or even a Boolean flag indicating whether the document contains certain patterns.

Guidelines for Conversion

Converting a traditional application into an object-oriented one is not an all-or-nothing proposition. You can convert incrementally and go as far as time and energy—and the design of the original application—allow. Here is a simple strategy for conversion:

- Find the near-objects in the application and make them objects, ideally set off in a separate module. These near-objects would include string objects, time and date objects, and so on. Performing this procedure is a good way to learn object-oriented techniques when starting from scratch.
- Establish an object-oriented hierarchy plan for future applications. This process involves high-level planning of a user interface, a help system, on-line tutorials, and other relatively application-independent and reusable subsystems.
- With the hierarchy in mind, return to the application being converted and identify the central data structure. Recast the data structure as an object, separating it as much as possible from the other subsystems, such as the user interface and help system.
- As you develop other object-oriented subsystems for future applications, try to add them to the application being converted. This step may involve a lot of rewriting if the original application is object-unfriendly. The amount of programming time you can reasonably allow for the project will dictate the amount of rewriting that takes place.

Watch out for some pitfalls. First, don't get overzealous and try to turn simple data types into objects. Leave characters, enumerations, numeric types, and Booleans as they are. Simple types are treated specially by the language in numerous ways, most of which are lost when the simple types are surrounded by an object framework. The benefits gained by turning simple types into objects are not worth the complication and loss of flexibility.

Don't use virtual methods unless late binding is necessary. Static method calls are identical in speed and overhead to ordinary procedure calls. Moreover, Turbo Pascal's smart linker will strip out any static methods that are never called within an application, reducing the application's code size. Because calls to virtual methods are not known to the compiler at compile and link time, they cannot be stripped out.

Don't design an object hierarchy to accommodate the quirks of a non-object-oriented application. Reusing such a hierarchy in future development will carry those quirks into all your future applications. Instead, wipe the slate clean and design your hierarchy for the future, and then put as many resources as you can afford to into rewriting the old application to adhere to the principles of a fully object-oriented design.

Keep in mind that change for the sake of change isn't the goal. You make an application object-oriented to obtain certain benefits, but the process involves trade-offs. After taking a good hard look at your existing application, you may correctly decide that the benefits aren't worth the costs. The danger here is that you may base your decision on too little information and have too little experience in OOP.

Write at least one fully object-oriented application before you attempt to convert an existing application. Give the conversion process a chance. The compelling benefits of object-oriented techniques turn up in surprising places. ■

Jeff Duntemann is the former editor of Turbo Technix, the Borland language journal. Currently, he is a freelance writer focusing on the programming industry. Chris Marinacci is development coordinator for Turbo Debugger and Turbo Assembler at Borland International. They can be reached on BIX c/o "editors."

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.

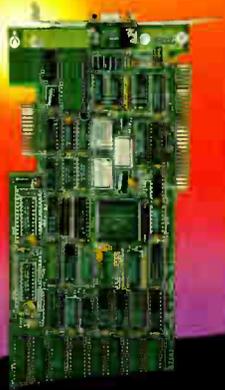
BYTE MAGAZINE

ATTN: SUBSCRIBER SERVICE
P.O. Box 555
HIGHTSTOWN, NJ 08520



Aurora 1024™

GRAPHICS BOARD

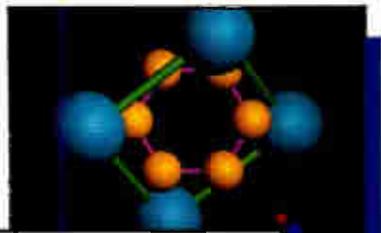


THE DAWN OF A NEW GRAPHICS AGE

**TI 34010 COPROCESSOR
8514/A COMPATIBLE BOARD
1024 x 768 with 256 COLORS!**



The Aurora 1024™ brings the graphics user into the new age of graphics processing. By adding the Aurora 1024 high resolution graphics card to your XT or AT, you will have unparalleled processing power with 100% IBM 8514/A compatibility. The Aurora 1024 is a full-featured TI 34010-based board that runs at resolutions up to 1024 x 768 x 256 colors.



HIGH SPEED

WIDE COMPATIBILITY

AFFORDABLE PRICE

The Aurora 1024 is fast! It runs 20-50 times faster than VGA and 10-50% faster than IBM's 8514/A. But that's not all! With the specially designed ADI driver, you will see AutoCAD re-draw 20 times faster than IBM's 8514/A and other industry-leading boards (as shown below).

With the Aurora 1024, you also get industry-wide software compatibility. That's because IBM's new graphic standard, the Adapter Interface (AI) used for the 8514/A, is included with every board. And for AutoCAD users, we also include our specially designed ADI driver—as well as the hottest performing Windows and VENTURA driver available. These interfaces give ready access to a wide range of important non-CAD application programs, such as Lotus 1-2-3®, Wordperfect®, Quattro®, PS/RIO®, PS/TOPAS®, EXCEL®, EnerGraphics™ and Pagemaker® ... plus hundreds of other titles.

The Aurora 1024 sets a new standard of value and performance at about half the price of most comparable high-resolution graphic boards. You simply won't find a better price anywhere! **\$995**



ORDER TODAY
CALL TOLL FREE
1 (800) 325-0174

ENERTRONICS
Innovator in Graphic Solutions

Compuclassics

Spring Has Sprung... And So Have Our Deals!



Monthly Specials in Green.
Prices good while supplies last

ACCOUNTING & PERSONAL FINANCE

Dac Bonus Pack 4.0	\$175.00
Peachtree III w/ Data Query	\$229.00
Quicken 3.0	\$39.00
Ronstadt's Financials	\$115.00
Turbo Tax Personal	\$45.00
Turbo Tax Professional	\$229.00

CAD

Autosketch 2.0	\$95.00
Design Cad 3D 2.2	\$205.00
Design Cad 4.0	\$155.00
Genenc Cadd Level 3	\$165.00

COMMUNICATIONS

Carbon Copy Plus 5.2	\$115.00
Close Up Support 3.0	\$165.00
PC Anywhere III	\$69.00
Procomm Plus	\$52.00
Smarterm 240 3.0	\$199.00

DATABASE

Clanion Professional Developer	\$399.00
Database 4.2	\$485.00
Foxpro Single User	\$479.00
PFS Professional File 2.01	\$209.00
R & R Code Generator	\$109.00
R & R Relational Report Writer	\$115.00
RBase For DOS	\$465.00

DESKTOP PUBLISHING

Bitsream Fonts (each)	\$95.00
Flowcharting II Plus	\$135.00
Freedom Of Press	\$259.00
Go Script Plus Ver 3	\$199.00
Go Script Ver 3	\$99.00
Gostyles - Laserjo	\$149.00
Interactive Easyflow	\$109.00
Per-FORM 2.0	\$169.00
PFS 1st Publisher	\$89.00
Power Up! Express Publisher	\$89.00
The New Print Shop	\$39.00
Ultrascrip PC 2.0	\$119.00
Ultrascrip PC Plus 2.0	\$269.00
Ventura Publisher	\$549.00

EDUCATION & ENTERTAINMENT

ATI Teach Yourself Series	\$59.00
F19 Stealth Fighter	\$45.00
Flight Simulator 4.0	\$45.00
Individual Training Series	\$40.00
King's Quest (each)	\$35.00
Leisure Suit Larry III	\$39.00
Simcity	\$35.00
Tetris	\$22.00
Vette!	\$32.00
Where... is Carmen San Diego	\$30.00

GRAPHICS

Autodesk Animator	\$189.00
Deluxe Paint II Enhanced	\$89.00
Freelance Plus 3.01	\$349.00
Graphwriter II	\$309.00
Harvard Graphics 2.13	\$319.00
Inset Plus (w/HuJaak)	\$139.00
PC Paintbrush IV	\$65.00
PC Paintbrush IV Plus	\$119.00
Puzzazz Plus 1.3	\$69.00
Show Partner FX 3.5	\$229.00

HARDWARE & PERIPHERALS

Copy II Option Board Deluxe	\$115.00
Intel Above Board Plus 512K	\$435.00
Logitech Bus Mouse C9	\$85.00
Logitech Scan ManPlus	\$185.00
Logitech Serial Mouse C9	\$65.00
Logitech Trackman Serial or Bus	\$89.00
Masterpiece	\$89.00
Masterpiece Plus	\$105.00
Microsoft Mouse w/Paint	\$109.00
Orchid Prodesigner Plus 512K	\$349.00
Pacific Data 25-in-one	\$289.00
Pacific Data Pacific Page	\$509.00
Paradise VGA 1024-512	\$305.00
Polaroid Palette Plus (EGA)	\$2,399.00
Prac Periph 2400 Ext w/MNP	\$209.00
Prac Periph 2400 Int w/MNP	\$179.00
Sola 286i Accelerator	\$259.00
Sola 386i Accelerator	\$399.00
Super Cartridge 1-1Q Engineering	\$275.00
Super Cartridge 2-1Q Engineering	\$449.00

Worldport 2400 Modem	\$249.00
Worldport 2400 Modem w/ MNP	\$345.00
Worldport 2496 Fax Modem	\$485.00

INFORMATION MANAGEMENT

Agenda	\$275.00
askSam	\$175.00
Grandview	\$199.00
Tornado W/Library	\$79.00

INTEGRATED

Alphaworks	\$115.00
Smartware II with Spell Checker	\$469.00
MS Works 2.0	\$95.00
Q & A 3.0 (Networkable)	\$245.00
Symphony Plus	\$475.00

LANGUAGE & PROGRAMMING

Brief	\$159.00
Btneve	\$159.00
C Asynch	\$119.00
Macro Assembler	\$99.00
Matrx Layout 2.0	\$135.00
MS C 5.1	\$299.00
MS Fortran	\$299.00
MS Quick C w/ Quick Assembler 2.01	\$135.00
Object Professional	\$109.00
Obase	\$149.00
Quick C	\$67.00
Quickbasic	\$67.00
Smalltalk V286	\$129.00
Sourceur w/Bos	\$109.00
SPF/PC	\$159.00
Turbo Asynch +	\$119.00
Turbo B Tree Filer S/U	\$79.00
Turbo C Pro Pack	\$175.00
Turbo C Tools	\$92.00
Turbo Pascal 5.5	\$105.00
Turbo Pascal Pro Pack	\$165.00
Turbo Power Tools Plus	\$92.00
Turbo Professional	\$79.00
Zortech C ++ 2.0	\$149.00

NETWORKING

Lantashc Starter Kit 2MBPS	\$409.00
NE 1000 Ethernet Card	\$169.00
NE2000 16 Bt Ethernet Card	\$205.00
Novell ELS Level II 1-8 User	\$1,175.00
Novell SFT V.2.15	\$3,099.00
Western Digital Ethercard Plus	\$189.00

OPERATING ENVIRONMENT

Desqview	\$79.00
Desqview 386 1.1	\$125.00
IBM DOS 3.3	\$95.00
IBM DOS 4.01	\$119.00
MS Windows 286	\$67.00
MS Windows 386	\$129.00
OS/2 Standard Edition 1.2	\$269.00

OS/2

Excel for OS/2	\$335.00
Logitech Multiscope	\$185.00
MS OS/2 Presentation Mngtr Toolkit	\$329.00
Wordperfect for OS/2	\$319.00

PROJECT MANAGEMENT

Adv. Project Manager Workbench 3.05	\$845.00
Harvard Project III	\$465.00
Sotor Project Scheduler IV	\$429.00
Timeline 3.0	\$409.00

SCIENTIFIC / STAT

Brammaker	\$149.00
Derive	\$130.00



Digital's Smalltalk/V PM combines the power of the industry's leading object-oriented programming with the richness of OS/2 Presentation Manager. Fully compiled, giving a PM application developer an extremely responsive environment. Contains a manual which is consistently reviewed as the best introduction to object-oriented programming available. Source code compatibility with Digital's other Smalltalk products.

Smalltalk/V PM

\$295.00

Mathcad 2.5	\$305.00
Mathematica 386 w/387 Support	\$845.00
Statgraphics	\$579.00
Systat w/ Graphics	\$509.00

SPREADSHEET

Lotus 1-2-3 Ver 2.2	\$349.00
Lotus 1-2-3 Ver 3.0	\$419.00
Quattro Pro	\$269.00
Sideways 3.2	\$42.00
The Baler	\$359.00

UTILITIES

1 Dir Plus 3.0	\$49.00
386 To The Max Pro	\$79.00
Above Disk 3.1	\$65.00
Automenu	\$39.00
Brooklyn Bridge 3.0	\$75.00
Check It	\$89.00
Copy II PC 5.0	\$25.00
Copywrite/zerodisk w/Rescue	\$55.00
Direct Access	\$52.00
Desk Technician Advanced	\$99.00
Fastback Plus	\$109.00
Headroom	\$79.00
Lap Link Release III	\$92.00
Magellan	\$139.00
Norton Commander	\$79.00
Norton Utilities Advanced	\$79.00
PC Tools Deluxe 5.5	\$77.00
Pop Drop Plus	\$59.00
Print Cache (Laserport)	\$99.00
Print Q 4.0	\$89.00
Q-Dos II	\$39.00
Software Bridge 4.0	\$85.00

Speedstor	\$35.00
Sprinkle II	\$69.00
Super PC-Kwik Powerpak	\$79.00
XTree Pro Gold	\$75.00

WINDOWS

Adobe Illustrator Windows	\$295.00
AMI Professional	\$319.00
Corel Draw Windows 1.1	\$329.00
Crosstalk For Windows	\$125.00
DB Fast/Windows	\$169.00
Excel	\$319.00
nDC Windows Express	\$45.00
Hyperpad 1.0	\$89.00
IBM Current	\$295.00
Microgate Designer	\$469.00
Pagemaker 3.0	\$529.00
Pubtext File Organizer	\$159.00
Superbase 4 for Windows	\$439.00
Word for Windows	\$329.00

WORD PROCESSING

Displaywrite IV	\$255.00
Grammatik IV	\$52.00
Multimate 4.0	\$295.00
Rightwriter	\$52.00
Word 5.0	\$219.00
Word Perfect 5.1	\$249.00
Wordstar 5.5	\$185.00

XENIX/UNIX

SCO Forbase + 386	\$675.00
SCO Unix Dev. System 386	\$675.00
SCO Unix Operating System 386	\$605.00
SCO Xenix Complete System 386	\$1,079.00
Wordperfect for SCO Xenix 386	\$519.00



HiJaak is a graphics capture/conversion utility. Capture provides screen and LaserJet capture capability. Most popular screens are supported for graphics and text screen capture. Convert provides image interchangeability between various graphics file formats. HiJaak brings images into DTP packages from many sources. HiJaak also supports 13 Group-3-Fax cards.

HiJaak

\$95.00

WE WELCOME CORPORATE ACCOUNTS AND INTERNATIONAL ORDERS.

Circle 62 on Reader Service Card

INTERNATIONAL ORDERS
818.347.2444
FAX YOUR ORDER
818.347.9977
PHONE YOUR ORDER
800.733.3888

Immediate shipment on purchase orders from government and state agencies, cities, counties, school and universities. ● Prices subject to change with out notice and while stocks last. ● We ship the latest versions. ● We accept Visa, Master Card, and American Express. ● 2% surcharge on American Express. ● 15% restocking fee for all non-defective items returned. ● Please call (818) 347-9400 for an authorization number on defective goods or your return will not be accepted. ● Due to copyright laws we cannot take back any software where the seal has been broken. ● \$5.50 minimum shipping per item, less on bulk orders. ● \$10 Blue Label shipping. ● \$4.50 C.O.D. charge. ● Heavier items are charged accordingly. ● We do not guarantee compatibility. ● Call for prices for any software item not included in this ad. ● Order desk open 7 A.M. to 5 P.M. Monday to Friday (PST), Saturday 10 A.M. to 2 P.M. P.O. Box 10598, Canoga Park CA 91309. Showroom: 7959 Deering Ave., Canoga Park California 91304.

WHO OWNS THE COPYRIGHTS?

All those involved in creating a computer program should make sure to determine their copyright interests

William T. McGrath



With the proliferation of computer usage in the business world, the importance of copyright ownership in computer programs can no longer be overlooked. A copyright owner obtains an array of valuable rights, including the exclusive right to sell copies of an original work and to sell new works based on or derived from the original work.

As a general rule, the author of a work is the owner of the copyright. However, if the author is an employee of a corporation or other business entity, and the work is created within the scope of employment, then the employer is the owner of the copyright.

More difficult questions arise if the author of the work is an independent contractor. In a typical situation, a company contracts with a freelance programmer to create software for a particular business application. The program is successful, and the company starts marketing the software commercially. The programmer also begins marketing the software or a modification of it.

Litigation is bound to follow—each party claiming that it has the exclusive right to sell the software. Much hangs in the balance, since the copyright owner not only can prevent the other party from selling the software but may also recover an award of damages, including any profits the in-

fringer made from marketing the program.

The ownership question has been veiled in confusion for several years. The problem arose from conflicting interpretations given by courts to the “work-made-for-hire” rule of the Copyright Act.

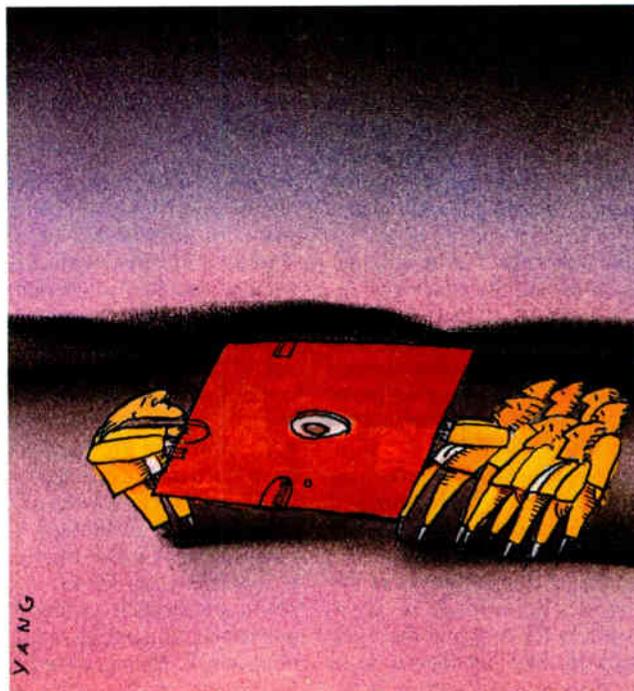
Supreme Court Ruling

A recent decision by the U.S. Supreme Court, *Community for Creative Non-Violence v. Reid*, will eliminate much of the confusion. In the *Reid* case, involving ownership of a copyright to a sculpture, the Court for the first time addressed the issue of who owns the copyright to works created by independent contractors. The Court resolved the conflicting interpretations of the lower courts in a decision that greatly expands the rights of independent contractors.

For independent contractors, the decision is a boon. For hiring parties, the decision is a clear indication that certain contractual measures should be taken if the party wants to obtain ownership of a program’s copyright.

The decision is a departure from the way the ownership issue has been analyzed in the past. It should cause computer professionals to reexamine the status of copyright ownership in the programs they have created or commissioned

continued



WHO OWNS THE COPYRIGHTS?

CATEGORIES OF WORK-MADE-FOR-HIRE

Works-made-for-hire by independent contractors must fall into one of these categories. In addition, there must also be a written agreement between the parties.

Contribution to a collective work, such as a magazine or anthology*

Audiovisual works

Translations*

Supplementary works, including work published as an adjunct to a work by another author*

Compilations*

Instructional texts

Tests

Answer material for tests

Atlases

* These are the categories that, if broadly construed by the courts, a computer program could arguably fall into.

others to create. As a result of the Supreme Court's ruling, freelance programmers may own the copyrights to past works without realizing it.

The work-made-for-hire doctrine has two parts. The first part says that if a work is created by an employee within the scope of his or her employment, then the copyright is automatically owned by the employer. No written agreement is required, and it does not matter what kind of work is involved. This aspect of the Copyright Act is fairly straightforward and easy to apply.

The second part deals with "specially ordered or commissioned works" and provides that the commissioning party owns the copyright if the work is a work-made-for-hire. The Act provides that a commissioned work can be a work-made-for-hire if there is a signed agreement to that effect and the work falls into one of nine specifically identified categories of works (see the table). If these requirements are met, the commissioning party owns the copyright.

This seemingly clear dichotomy between works by employees and works on commission became hopelessly clouded when some lower courts held that commissioned works could be works-made-for-hire even though there was no signed agreement. The courts reasoned that if the hiring party exercised "supervision and control," the creator of the work could be considered an employee even though he was by most standards an independent contractor.

Since the independent contractor was viewed as an employee, the courts said that the employer owned the copyright, regardless of the type of work or whether there was a signed agreement. Several court cases applied this analysis and ruled that computer programs were owned by the commissioning party. The courts gave little guidance as to the type or degree of supervision and control necessary to give copyright ownership to the hiring party rather than the creator.

The *Reid* case has entirely changed the analysis for determining copyright ownership. The Supreme Court has eliminated the fiction that an independent contractor can be considered an employee merely as a result of supervision by the hiring party.

The Court ruled that an independent contractor owns the copyright to any work he or she creates unless there is an express signed agreement that the work is for hire and the work falls into one of the nine categories specifically identified in the Copyright Act. If there is no written agreement or if the

work is not one of the types mentioned in the Act, the independent contractor retains ownership of the copyright.

In *Reid*, the Court ruled that the artist was an independent contractor, not an employee. Since there was no written agreement and sculpture did not fall into one of the nine categories, the artist owned the copyright.

Who Is an "Employee?"

The Court ruled that the determination of whether a hired party is an employee or independent contractor should be made according to traditional principles of agency law.

Under common law agency principles, several factors distinguish independent contractors from employees. In order to determine which is which, courts look at the skill the job requires, who owns the instruments and tools used in the job, the location of the work, the duration of the relationship between the parties, whether the hiring party has the right to assign additional projects to the hired party, and the extent of the hired party's discretion over when and how long to work.

The courts take into consideration additional factors, such as the method of payment, the hired party's role in retaining and paying assistants, whether the work is part of the regular business of the hiring party, whether the hiring party is in business, the provision of employee benefits, and the tax treatment of the hired party. No one of these factors is determinative.

What Qualifies as Work-Made-for-Hire?

As previously noted, a work by an independent contractor can only become a work-made-for-hire if it falls into one of nine categories of works listed in the Copyright Act. These categories are an odd conglomeration of different types of works. They are the result of lobbying efforts and compromises made during the legislative process.

Computer programs are not specifically identified. However, some of the categories are arguably broad enough to encompass programs under some circumstances. The scope of these categories is unclear, and they are sure to become the next battlefield in litigation over copyright ownership.

Courts have thus far provided no guidance as to whether they will be construed broadly or narrowly. If the courts interpret these categories broadly, a computer program could arguably fall into one of the following categories: contribution to a collective work, translations, supplementary works, and compilations.

- *Collective works:* A collective work is a work in which a number of contributions, constituting separate and independent works in themselves, are assembled into a collective whole. Typical collective works are periodicals, anthologies, and encyclopedias. It is not uncommon, however, for separate and independent software modules to be assembled into a collective whole. A recent court case involved a software system consisting of 236 separate programs. These independent modules could arguably be considered contributions to a collective work.

- *Translations:* Programmers often translate a program from a form written for one type of computer to a form suitable for another. A program can also be translated from one programming language to another. These arguably could be considered "translations" under the statute.

- *Supplementary works:* A supplementary work is a work prepared as a secondary adjunct to a work by another author for the purpose of illustrating, explaining, or assisting in the use of the other work. Examples are forewords, afterwords, pictorial illustrations, charts, tables, and indexes. In the computer indus-

It is not likely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire.



try, the user documentation and manuals accompanying the programs will often constitute supplementary works.

- **Compilations:** A compilation is a work formed by a collection of preexisting materials or data, arranged and selected so as to constitute an original work. Typical examples include telephone books, directories, and catalogs. But some computer programs could arguably be considered compilations, as in cases, for example, where subroutines from different programs are combined into a new program.

It is unlikely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire, and it remains to be seen how the courts will treat software in connection with these categories.

Joint Authorship of Computer Programs

Since the concept of "supervision and control" alone is not enough to create a work-made-for-hire, commissioning parties sometimes claim copyright ownership by virtue of being joint authors of the software.

The Copyright Act defines a joint work in true lawyer-like language as "a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole." To be a joint work, it is essential that at the time the work is created, the authors intend that their respective contributions will be merged into an integrated unit.

An author of a joint work is a co-owner of the work's copyright and is entitled to modify, reproduce, or distribute copies of the work. A joint author's protection extends to the entire work, not just the portion he or she contributed. Each author has the independent right to sell or license the joint work but has a duty to account to the co-owners for any profits earned.

Several cases have recently addressed the question of requirements to qualify as a joint author in the development of software. It is clear from these cases that a commissioning party who merely describes to the programmer what the software should do or look like is not a joint author.

In *Whelan v. Jaslow Dental Laboratory*, a case decided by the federal appeals court in Philadelphia, a dental laboratory owner commissioned the creation of software for use in his business. The owner gave the programmer a detailed description of the operation of the business, dictated the functions to be performed by the computer, and even helped design the language and format of some of the screens that would appear on

the computer's visual displays.

The court nonetheless found that the programmer was the sole author of the software. The court's principal focus was on the creation of the source and object codes. The owner's general assistance and contributions to the fund of knowledge of the author did not make him a creator of any original work. The court made an analogy to an owner explaining to an architect the type and functions of a building the architect is to design. The owner is not a coauthor of the architectural drawings no matter how detailed the ideas or instructions he or she provides.

Obtaining Copyright by an Assignment

The Supreme Court's work-made-for-hire decision does not leave commissioning parties entirely out in the cold, however. A party can still obtain ownership of a copyright by a written agreement transferring the copyright. The ownership of the copyright simply becomes a matter of contract negotiation.

There are some pitfalls, though. To be valid, the transfer of copyright ownership must be in writing and signed by the copyright owner. Further, the Copyright Act provides that after 35 years, the copyright ownership will revert to the original author. While most software would be obsolete long before the reversion, it is conceivable that some systems could have a life that long.

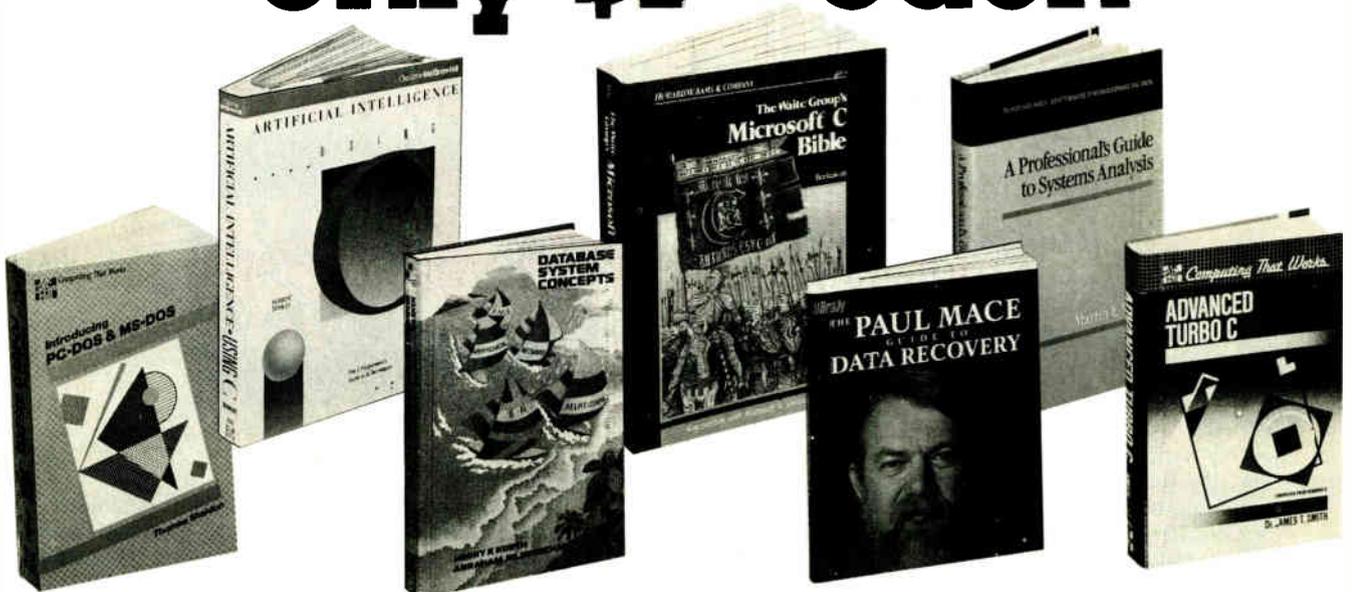
Copyright Importance to Programmers

The importance of copyright ownership cannot be overstated. The copyright owner controls reproduction, modification, and sale or licensing of a computer program. The financial benefits of ownership, too, are very real, especially where the software is unique or has high marketability.

The Supreme Court's decision resolves some issues, but it leaves many questions unanswered. Consequently, all parties involved in a computer program (even those programs that are already implemented) should exercise care in determining their copyright interest. As for future transactions, programmers should negotiate up front the matter of copyright ownership, and hiring parties should obtain a written assignment if they want to be sure they own the copyright to programs created by freelancers. ■

William T. McGrath is a partner at the law firm of Burke, Wilson, and McIlvaine Ltd., Chicago, Illinois. He practices primarily in the areas of copyrights, trademarks, and computer-related matters. He can be reached on BIX c/o "editors."

Take any 3 books for only \$1⁰⁰ each



when you join BYTE Book Club[®] VALUES UP TO \$141.45!

OS/2 PROGRAMMER'S GUIDE. By E. Iacobucci. 1100 pp., illus., softbound. "Byte" magazine called it "a necessity." This giant reference explains all the basic functions you'll need, with emphasis on such new or different functions as multitasking and memory management. 881300-X Pub. Pr., \$29.95

INTRODUCING PC-DOS & MS-DOS, Second Ed. By T. Sheldon. 403 pp., illus., softbound. This Second Edition covers all releases through 4.0, as well as Microsoft Windows and DOS-SHELL. Features the same hands-on tutorial format of the First Edition, with expanded coverage of batch file techniques that can dramatically increase your computing speed. 565/651 Pub. Pr., \$27.95

LOCAL AREA NETWORKS: Architectures and Implementations. By J. Martin, with K. K. Chapman. 353 pp., illus. An indispensable reference for all who buy, install, maintain, or manage LAN services. Provides complete coverage of the concepts, architectures, and implementations of LAN technology. 584900-3 Pub. Pr., \$40.00

A PROFESSIONAL'S GUIDE TO SYSTEMS ANALYSIS. By M.E. Modell. 307 pp., illus. Detailed coverage of what you need to know—what questions to ask, how to conduct a cost-benefit analysis, how to document and validate your findings—to design the best systems for your user's needs. 426/325 Pub. Pr., \$34.95

ADVANCED GRAPHICS IN C: Programming and Techniques. By N. Johnson. 430 pp., illus., softbound. Now C programmers can write crisp graphics programs for the IBM-PC using the IBM EGA (Enhanced Graphics Adaptor) or the AT&T Image Capture Board (ICB). Includes GRAPHIQ, a complete C graphics toolkit. 881257-7 Pub. Pr., \$22.95

- Your one source for computer books from over 100 different publishers
- the latest and best information in your field
- discounts of up to 40% off publishers' list prices

ADVANCED TURBO C. By J. T. Smith. 256 pp., illus., softcover. Mastering Turbo C has never been easier. Crystal-clear answers to all your questions are supplemented by fully-documented programming examples. Coverage includes string processing, screen handling with *Turbo C Tools*, keyboard input, file handling, memory management, interrupt services, and much more. 587/078 Pub. Pr., \$24.95

THE WAITE GROUP'S MICROSOFT C BIBLE. By N. Barkakati. 787 pp., illus., softbound. The complete guide to all 370 functions, with purpose, syntax, example call, includes, common uses, returns, comments, cautions, and "see also" references for each function. Also features two handy tutorials on C basics and the C 5.1 compiler, as well as compatibility checks for all other C compilers. 584830-9 Pub. Pr., \$24.95

THE PAUL MACE GUIDE TO DATA RECOVERY. By P. Mace. 352 pp., illus., softbound. An indispensable guide to restoring vanished files and coping with virtually every type of data loss emergency. You get clear, step-by-step instructions for restoring deleted files or directories, recovering lost or damaged Lotus 1-2-3 files, what to do when your disk won't boot, and much, much more. 584926-7 Pub. Pr., \$21.95

THE NEW DOS 4.0. By K. W. Christopher, Jr., B. A. Feigenbaum, and S. O. Saliga. 535 pp., illus., softbound. Practical advice from IBM's own DOS 4.0 developers to help you harness more PC power and versatility. Covers SELECT, the DOS Command Prompt, batch filing, Command Line Redirection, the EDLIN Line Editor, and much more. 584889-9 Pub. Pr., \$22.95

EGA/VGA: A Programmer's Reference Guide. By B.D. Kiewer. 269 pp., illus., softbound. All the practical guidelines are right here for learning the ins and outs of the Enhanced Graphics Adaptor—one of the most popular PC add-on boards available—and its PS/2 counterpart, the Video Graphics Array. It's filled with innovative programming techniques... tips for working around the bugs in the BIOS... and EGA/VGA BIOS calls not available elsewhere. 350/892 Pub. Pr., \$29.95

DATABASE SYSTEM CONCEPTS. By H. F. Korth and A. Silberschatz. 546 pp., illus. From fundamental concepts to advanced problem solving, this book provides a clear understanding of the design and use of database systems. Also demonstrates the best ways to protect data from unauthorized access and malicious or accidental alteration or destruction. 447/527 Pub. Pr., \$46.95

ARTIFICIAL INTELLIGENCE USING C: The C Programmer's Guide to AI Techniques. By H. Schildt. 412 pp., 37 illus., softbound. This hands-on guide shows you how to create your own AI applications and systems using C. After an introductory overview it provides coverage of expert systems, logic, natural language processing, machine learning, pattern recognition, and more, with ready-to-run programs illustrating each topic. 881255-0 Pub. Pr., \$21.95

PROGRAMMING USING THE C LANGUAGE. By R.C. Hutchison and S.B. Just. 579 pp., illus. Whether you want to understand programs in C written by others, or write better C programs of your own, this practical, authoritative book gives you the tools and guidance you need. Coverage includes program organization, sorting algorithms, recursion, linked lists, and more — with many sample programs. 315/418 Pub. Pr., \$29.95

LIFE WITH UNIX: A Guide for Everyone. By D. Libes and S. Ressler. 346 pp., illus., softbound. A practical, readable sourcebook that gives you the information you need to use UNIX effectively. Provides a thorough examination of its advantages and disadvantages... analyses from the viewpoints of users, programmers, and administrators... and a complete guide to UNIX books, periodicals, users' groups, and share-ware. 585017-6 Pub. Pr., \$29.95

SECURITY IN COMPUTING. By C. P. Pfleeger. 538 pp., illus. Here are the best ways to maintain the confidentiality and integrity of your computer system. This insightful guide helps you evaluate the security risks inherent in the computer tasks you perform and shows you exactly what you must do to make your operations secure. 584941-0 Pub. Pr., \$44.00



PROGRAMMING WITH TURBO PASCAL. By D. Carroll.
852908-5 Pub. Pr., \$39.95

HIGH-SPEED ANIMATION & SIMULATION FOR MICROCOMPUTERS. By L. Adams.
583855-9 Pub. Pr., \$20.95

TURBO LANGUAGE ESSENTIALS: A Programmer's Reference. By K. Weiskamp, N. Shamma, and R. Pronk.
584905-4 Pub. Pr., \$24.95

HARD DISK MANAGEMENT WITH MS-DOS AND PC-DOS. By D. Gookin and A. Townsend.
583954-7 Pub. Pr., \$28.95

UNDERSTANDING & USING dBASE III® PLUS. By R. Krumm.
583940-7 Pub. Pr., \$22.95

32-BIT MICROPROCESSORS. Edited by H. J. Mitchell.
425/85X Pub. Pr., \$48.50

ADVANCED 80386 PROGRAMMING TECHNIQUES. By J. L. Turley.
881342-5 Pub. Pr., \$22.95

NETWORKING SOFTWARE. By C. B. Ungaro.
606969-9 Pub. Pr., \$39.95

THE DATABASE EXPERT'S GUIDE TO SQL. By F. Lusardi.
390/029 Pub. Pr., \$24.95

PRINCIPLES OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS DEVELOPMENT. By D. W. Rolston.
536/147 Pub. Pr., \$44.95

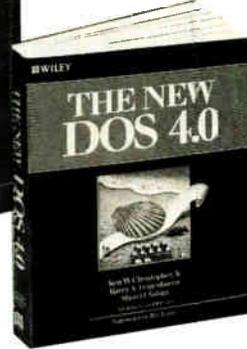
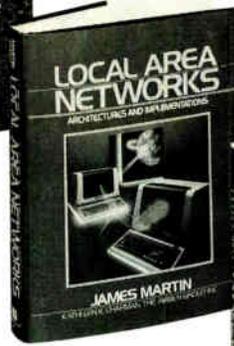
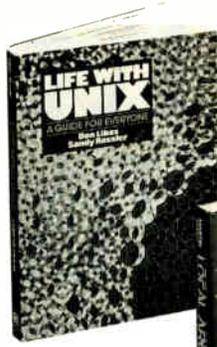
APPLYING TURBO PASCAL LIBRARY UNITS. By N. Shamma.
584791-4 Pub. Pr., \$22.95

DATA STRUCTURES USING PASCAL, 2nd Ed. By A. M. Tenenbaum & M. J. Augenstein.
583738-2 Pub. Pr., \$46.00

MICROCOMPUTER LANS: Network Design and Implementation. By M. F. Hordeski.
584580-6 Pub. Pr., \$32.95

OPERATING SYSTEMS. By M. Milenkovic.
419/205 Pub. Pr., \$44.95

IBM PS/2: A Reference Guide. By T. J. Byers.
095/272 Pub. Pr., \$39.95



Any 3 books for \$1.00 each... if you join now and agree to purchase two more books—at handsome discounts—during your first year of membership.

MASTERING TURBO PASCAL 4.0, 2nd Ed. By T. Swan.
584762-0 Pub. Pr., \$22.95

DESIGNING USER INTERFACES FOR SOFTWARE. By J.S. Dumas.
584641-1 Pub. Pr., \$31.00

68000 ASSEMBLY LANGUAGE PROGRAMMING, 2nd Ed. By L. Leventhal; D. Hawkins; G. Kane & W. Cramer.
583817-6 Pub. Pr., \$28.95

C CHEST AND OTHER C TREASURES FROM DR. DOBB'S JOURNAL. Edited by A. Holub.
584807-4 Pub. Pr., \$24.95

CICS FOR MICROCOMPUTERS. By J. L. LeBert.
369/682 Pub. Pr., \$29.95

FILE ORGANIZATION FOR DATABASE DESIGN. By G. Wiederhold.
701/334 Pub. Pr., \$44.95

STRETCHING TURBO C. By K. Porter.
584967-4 Pub. Pr., \$24.95

1-2-3 RELEASE 3: The Complete Reference. By M. Campbell.
881318-2 Pub. Pr., \$28.95

PROGRAMMING IN C, Revised Ed. By S.G. Kochan.
584701-9 Pub. Pr., \$24.95

MASTERING ORACLE: Featuring Oracle's SQL Standard. By D. J. Cronin.
585034-6 Pub. Pr., \$24.95

STRUCTURED PROGRAMMING IN ASSEMBLY LANGUAGE FOR THE IBM PC. By W. C. Runion.
584827-9 Pub. Pr., \$43.25

PORTABILITY AND THE C LANGUAGE. By R. Jaeschke.
584966-6 Pub. Pr., \$34.95

DATA TYPES AND DATA STRUCTURES. By J. J. Martin.
583689-0 Pub. Pr., \$45.00

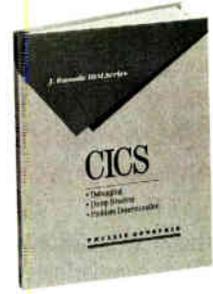
WORDPERFECT®: THE COMPLETE REFERENCE. By K. Acerson.
881312-3 Pub. Pr., \$27.95

TROUBLESHOOTING AND REPAIRING THE NEW PERSONAL COMPUTERS. By A. Margolis.
583871-0 Pub. Pr., \$18.95

New! BYTE LARGE SYSTEMS Books



MVS: Concepts and Facilities. By R. H. Johnson. 613 pp., illus. This comprehensive overview of IBM's mainframe operating system provides you with a crucial edge in MVS programming, management, and systems development. Covers processor complexes, MVS/XA and MVS/ESA, DASDs, the I/O subsystem, and much more.
326/738 Pub. Pr., \$39.95



CICS: Debugging, Dump Reading, Problem Determination. By P. Donofrio. 176 pp., illus. A long-needed, step-by-step troubleshooting guide for CICS programmers. Provides invaluable information on problem determination, interactive debugging, terminal autoinstall, service strategies, the new dump formatting routine, and dump reading procedures that will have you clearing up failures in no time.
176/06X Pub. Pr., \$39.95

Here's how BYTE Book Club® works to serve you:

- **Important information . . . we make it easy to get!** Today, professionals who perform best are those who are best informed. For reliable, hands-on information, turn to the Byte Book Club. Every 3 or 4 weeks (12-15 times a year), members receive the Club Bulletin offering more than 30 books – the best, newest, most important books from all publishers.
- **Dependable service . . . we're here to help!** Whether you want information about a book or have a question about your membership, just call us toll-free or drop us a line. To get only the books you want, make your choice on the Reply Card and return it by the date specified. If you want the Main Selection, do nothing – it will be sent to you automatically. (A small shipping and handling charge is added to each shipment.)
- **Club convenience . . . we do the work!** You get a wide choice of books that

simply cannot be matched by any bookstore. And all your books are conveniently delivered right to your door. You also get 10 full days to decide whether you want the Main Selection. (If the Club Bulletin ever comes late and you receive a Main Selection you don't want, return it for credit at our expense.)

- **Substantial savings . . . and a bonus program too!** You enjoy substantial discounts—up to 40%!—on every book you buy. Plus, you're automatically eligible for our Bonus Book Plan which allows you savings up to 70% on a wide selection of books.
- **Easy membership terms . . . it's worthwhile to belong!** Your only obligation is to purchase 2 more books – at handsome discounts – during the next 12 months, after which you enjoy the benefits of membership with no further obligation. You or the Club may cancel membership anytime thereafter.

Fill out the card and mail today! If the card is missing, write to:

BYTE Book Club,® P.O. Box 582, Hightstown, New Jersey 08520-9959
For faster service in enrolling, call 1-800-2-MCGRAW

Now There's a Periscope Board for Your IBM PS/2®

With the new Periscope® Model I/MC, you now have the same robust Periscope Model I debugging capabilities using a PS/2 with Micro Channel® architecture that you already have using a PC, XT, AT, or AT-compatible 80386 machine.

Just like the current Periscope Model I, Periscope Model I/MC has a 32K footprint in system memory, above 640K but in the first megabyte. The board stores the Periscope software and all debugging information (symbols, etc.) in its write-protected RAM.

Designed for use in machines with the IBM Micro Channel bus architecture, the board allows you to add chips to extend the 512K of write-protected RAM to a full two megabytes, if need be. (Most developers find 512K to be quite enough, however.)

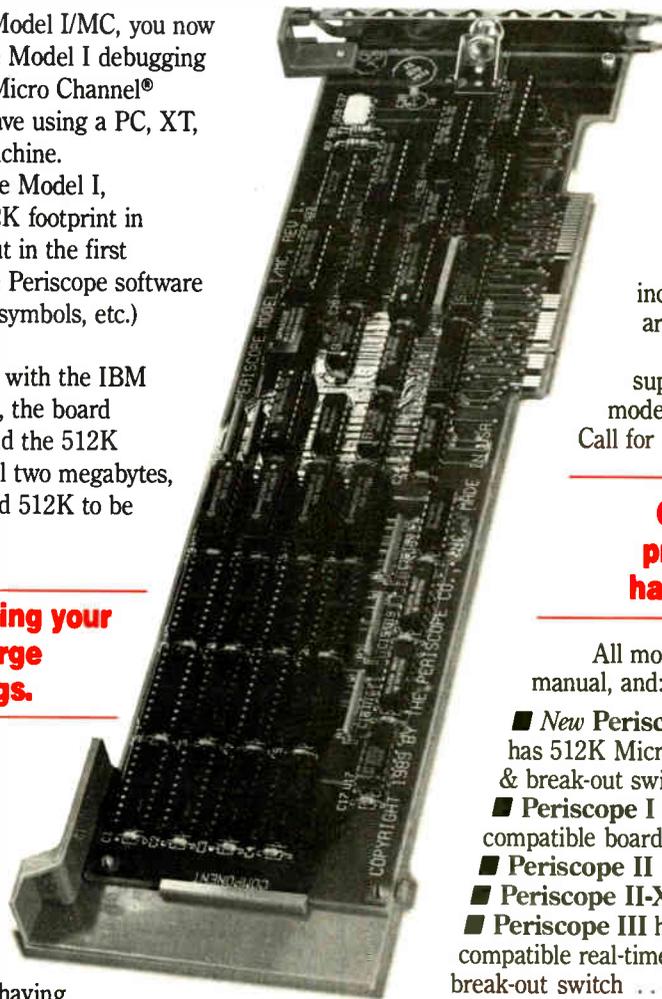
Don't worry about trashing your debugger, debugging large programs, or erratic bugs.

With this new board in your IBM PS/2 or compatible, Periscope uses zero memory in the lower 640K. So you don't have to worry about things like a runaway program trashing your debugger, or not being able to debug a very large program, or having bugs appear or disappear when you load your debugger.

Use the break-out switch, which plugs into the board, to break in to your system safely any time. It keeps you from having to power down and back up when your system hangs. You can just press the little red "panic" button to find out exactly what is going on.

Periscope Model I for PCs, XTs, ATs, and AT-compatible 80386s. The manual, disk, and quick-reference card shown come with all models of Periscope.

Circle 219 on Reader Service Card
(DEALERS: 220)



Real-time hardware-assisted debugging of programs running on PS/2s is now possible! The

remote feature of the new Version 4.3 Periscope software enables Periscope IV to support real-time debugging of programs running on DOS-based machines, including those with Micro Channel architecture. The open architecture remote debugging feature will support OS/2® and other protected-mode environments in the near future. Call for details.

Choose from a full line of professional software and hardware-assisted models.

All models include Version 4.3 software, manual, and:

- **New Periscope I/MC** (MC Board for short) has 512K Micro Channel-compatible board & break-out switch \$745.
- **Periscope I** has 512K PC- and AT-compatible board & break-out switch \$595.
- **Periscope II** has break-out switch \$175.
- **Periscope II-X** has no hardware \$145.
- **Periscope III** has PC- and AT-compatible real-time board (to 10MHz) & break-out switch \$1395.
- **Periscope IV** has 80286 and 80386 AT-compatible real-time hardware (to 25MHz) & breakout switch \$2195-\$2995.
- **PLUS** board is Model I board (no software), optional with Models III & IV \$500.

Call Toll-Free Today For More Information 800-722-7006

MAJOR CREDIT CARDS AND QUALIFIED COMPANY PURCHASE ORDERS ACCEPTED

IBM, PS/2, OS/2, and Micro Channel are registered trademarks of the IBM Corporation.



1197 PEACHTREE ST. • PLAZA LEVEL • ATLANTA, GA 30361
404/875-8080 FAX 404-872-1973

The
Periscope
Company, Inc.

MANAGING THE WELL-TEMPERED LAN

Network management can be a daunting task, but new tools and emerging standards can help

William Stallings

A recent survey of Fortune 500 companies by a market research firm, Infonetics (Santa Clara, CA) revealed that these firms are suffering an average of two local network outages per month, with an average outage time of 5 hours. About 5 percent of the companies averaged more than two such outages per week. Company executives estimate the average annual costs per firm at \$3.5 million in lost productivity and over \$600,000 in lost revenue.

These are Fortune 500 companies with the budget and technical staff to handle local network installations, so how can this be? The answer is their lack of effective network management. Networks have grown in many ways—physical extent, number of users, amount and diversity of traffic, and complexity of supporting communications software. In addition, in too many companies, network management tools and procedures have not kept pace with these factors.

One University's Experience

LAN administrators who follow the industry's product offerings are aware that software tools can help to keep a LAN or set of LANs running smoothly. For example, a large university (which, for security reasons, will remain nameless) has developed an

effective networking strategy based solely on Ethernet products. It began with a very simple architecture based on the use of a central backbone Ethernet. Attached to this central backbone were repeaters to 35 of the 110 on-campus buildings. Each remote site, designated a *minihub*, serviced equipment in a single building or a cluster of buildings. Thus, the architecture was a star arrangement, with a central backbone network and a number of minihub networks attached to the backbone.

With the use of repeaters, the entire system functioned as a single Ethernet providing a total capacity of 10 megabits per second. With growth in the number of users and in the amount of time average users utilize the network, however, this capacity soon became insufficient.

As the load on the network increased, the university was able to keep pace by splitting the backbone into two backbones connected by an Ethernet bridge. Effective use of this configuration requires thoughtful load balancing to minimize the traffic through the bridge and avoid a bottleneck. With the aid of a traffic-monitoring package, the university was able to observe the traffic between pairs of stations and make an effective split.

At present, this architecture is sufficient to serve the needs of the main campus. However, there are also five

continued



C for the 8051 Compare:

Benchmark Results — Sample program: Eratosthenese sieve
Program from BYTE (1/83) expanded with I/O and interrupt handling.

	Archimedes		
	ICC51 v2.20A	MCC51 v1.2	FRANKLIN C51 v2.1
Compilation time	12 sec ✓	18 sec	17 sec
Linkage time	29 sec	9 sec	6 sec ✓
Execution time	11.45 sec	9.00 sec	0.88 sec ✓
Total code size	5318 bytes	3798	1726 ✓
Sieve module size	736	1021	541 ✓

Call now for your free DEMO disk.



FRANKLIN

SOFTWARE, INC.

888 Saratoga Ave. #2 • San Jose, CA 95129
(408) 296-8051 • FAX (408) 296-8061

Europe A: (0222) 25 36 26 B: (010) 22 34 55 CH: (032) 41 01 11 D: KEIL (089) 46 50 57 DK: (02) 65 82 00 F: (1) 64 07 85 64 GB: (0962) 73 31 40 NL: (01858) 16133 S: (040) 92 24 25 Far East: Aust: (61) 02 65 41 873 R.O.C.: (02) 76 40 2156 N.Z. (64) 04 694 129 (fax).

AUDIO F/X

STEREO SOUND For PC's and Compatibles

FEATURES INCLUDE:

- Digital recording and playback (greater than 44.1 KHz).
- Unlimited recording and playback time.
- Built in stereo music synthesizers.
- On board amplifiers for direct cabling to stereo speakers.
- DMA and Interrupt driven for background operation.

Used in applications such as:

- Advertising, Presentations, Training, Education, Multimedia Products, Games, Etc..

Packaged complete with:

- SONATA, a full featured MIDI compatible music editor.
- Digital recording and playback utilities.
- Show Partner F/X drivers.
- Recording patch cable.
- PISCES, DRUM, and DEMO, sound and music files.

Also available:

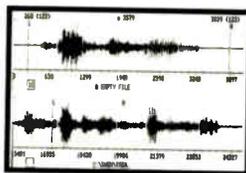
- The Sound Editor, a powerful digital sound editor.
- DJFX - Digital reel - reel.
- Spelling Voice - Teach spelling.
- Annotator - Voice comment text.

Coming soon:

- SIERRA games compatibility.

\$349.95* Retail
30 Day Money Back
Guarantee.

Trademarks: SIERRA - Sierra On-line Inc.
Show Partner F/X - Brightbill-Roberts Ltd.



FORTE

72 Karenlee Dr.
Rochester, NY 14618
Phone (716) 427-8595
*REV 3.0

regional campuses located in a 90-mile radius around the main campus. Each of these sites requires a network for on-campus communications, as well as links to the other regional campuses and the main campus. In keeping with their main-campus configuration, the university has developed an architecture that is simple, uniform, and compatible with the central campus architecture and that provides communications both within each

Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture.

regional campus and among all the campuses.

Each regional campus is served by a minihub. Each minihub is connected to the main campus by means of a pair of remote bridges. At installation, each pair of remote bridges is connected by a 56,000-bps link provided by a university-owned private microwave system.

For emergency backup, an alternative path via 9600-bps modems using dial-up telephone lines is in place. Thus, if the microwave system fails, by using the public telephone network, the university still has a limited amount of connectivity. If the single 56,000-bps link becomes saturated, it is possible to install an additional 56,000-bps link between the same two bridges. The bridges use multiple links simultaneously, load-balancing between them automatically.

This scheme extends the transparent, seamless interconnection of devices to the regional campuses. In effect, the regional networks and the central system perform as a single Ethernet.

Every station on the expanded network has a unique address, and any station can address any other station with no knowledge of its physical location. The consistent use of repeaters and bridges guarantees this transparency. Furthermore, the regional campuses are poised for expansion with no disruption or re-configuration of the overall network. Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture. Indeed, any of the regional campuses can establish a two-segment backbone in the same manner as the central campus. The same seamless interconnection exists no matter how much the remote network expands.

Automated Tools Help

The network management group uses several software control tools. These tools support the institution's ability to configure devices remotely, to diagnose problems, and to reboot terminal servers. The university uses utilities for automating password changes, collecting server usage statistics, and reviewing server-PROM revision levels.

The university also uses network management software to

MANAGING THE WELL-TEMPERED LAN

produce audit trails for all connections, disconnections, occurrences of queues, network faults, and other network events of significance. The audit trail helps determine future needs for additional host computer connections, identify common client mistakes, and study other usage trends.

Also obtainable is a LAN-monitoring package that provides cumulative information on overall Ethernet traffic. Reports, available in real time, supply information regarding peak throughput and long-term utilization trends. The information helps determine expansion requirements, assists in deciding how to load-balance the two halves of the core network, and generally provides a good picture of overall use and performance of the Ethernet.

The software is deficient in one area, however: fault isolation. Initially, the university mixed Ethernet components from two different vendors. Each of these products had strong points. However, this mix created chronic problems. Each manufacturer, of course, credited the other manufacturer's equipment as the source of the intermittent (but severe) network disruptions. Finally, for the sake of standardization, the university eliminated all LAN equipment except that of a single vendor. The improvement in network reliability was dramatic.

Prior to the standardization, there was an average of three user-perceivable Ethernet disruptions per day. After standardization, the rate settled down to fewer than one disruption per month. This improvement resulted not because the remaining vendor was the only reliable one, but because there was a single point of responsibility for errors.

Configuration Assistance Welcome

As another example, consider the difficulties of a government research center that was relying on a broadband LAN to tie together mainframes, minicomputers, personal computers, and terminals located in over 100 buildings spread across a 350-acre site. As the traffic on the LAN grew, it became impossible to accommodate all the equipment on a single 5-Mbps, 6-MHz channel. As a result, the center opened up five channels on the LAN with channel-to-channel bridges to allow any device to talk to any other device.

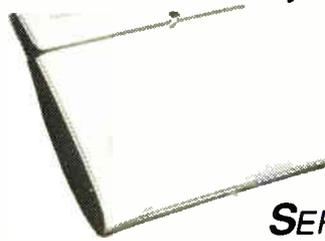
The center tried to cluster groups of users on the same channel, but, even so, users occasionally reported slow responses. Also, there were instances when connections seemed to lock up and require cancellation. To manage the network properly and plan for growth, the center installed performance-monitoring software that provided a profile of connections across bridges versus connections on the same channel, traffic per connection, traffic per bridge, and other useful statistics. Thus, the center was able to continually adjust channel assignments to maintain proper load balancing.

This software, however, was insufficient to diagnose a new problem that cropped up. At random times, a surge of traffic would drastically reduce response time. This situation would occur without any noticeable change in the number of connections or active users. The center decided to add software that could count the number of retransmissions of packets by source and by channel. As a result of the installation, a clue emerged. The slow response time coincided with high retransmissions on two particular channels involving a terminal cluster on one channel and a large minicomputer on the other.

The monitoring software was set to generate an alarm when this condition occurred. When the alarm sounded, a network administrator checked the jobs running on the minicomputer and eventually traced the problem to a high-volume graphics job that would dump large volumes of data onto the LAN. After

continued

*Want to save Time, Money,
& Headaches?*



**GET SUPERSOFT'S
SERVICE DIAGNOSTICS**

All the software, alignment diskette, parallel/serial wrap-around plugs, ROM POSTs and extensive, professional documentation to provide the most comprehensive testing available for IBM PCs, XT, ATs and *all compatibles* under DOS or Stand Alone. No other diagnostics offers such in-depth testing on as many different types of equipment by isolating problems to the board and chip level.

NEW: SuperSoft's **ROM POST** performs the most advanced **Power-on-Self-Test** available for system boards that are compatible with the IBM ROM BIOS. It works even in circumstances when the Service Diagnostics diskette cannot be loaded.

NEW: 386 diagnostics for hybrids and **PS/2s!**

For over nine years, major manufacturers have been relying on SuperSoft's diagnostics software to help them and their customers repair microcomputers. End users have been relying on SuperSoft's Diagnostics II for the most thorough hardware error isolation available. Now versions of Service Diagnostics are available to save everyone (including every serious repair technician) time, money, and headaches in fixing their computers, even non-IBM equipment.

- | | |
|--|--|
| All CPUs & Numeric Co-processors | All Color Graphics & Monochrome Monitors |
| System Expansion & Extended Memory | Parallel & Serial Ports |
| Floppy, Fixed & Non-standard Disk Drives | Mono, CGA, Hercules & EGA |
| Standard & Non-standard Printers | Adapters |
| System Board: DMA, Timers, Interrupt, Real-time Clock & CMOS config. RAM | All Keyboards & the 8042 Controller |

NEW: Manufacturer's burn-in diagnostics now available for IBM and compatible PC, XT, AT, 386, 486 and PS 2 systems.

Service Diagnostics for PC, PC/XT, and compatibles only	.....\$169
Alignment Diskette for PC, PC/XT and compatibles (48 tpi drives)	.....\$ 50
Wrap-around Plug for PC, PC/XT and compatibles (parallel and serial)	.....\$ 30
Service Diagnostics for AT and compatibles only	.....\$169
Alignment Diskette for AT and compatibles (96 tpi drives)	.....\$ 50
Wrap-around Plug for AT (serial)	.....\$ 15
ROM POST for PC, PC/XT and compatibles only	.....\$245
ROM POST for AT and compatibles only	.....\$245
Service Diagnostics: The KIT (includes all of the above—save \$502).	\$495
Service Diagnostics for PS/2 models 25/30 50/60 or 70/80 and compatibles (please specify)	.....\$195
Service Diagnostics for 386 or V2, V30, or Harris, etc. (please specify)	.....\$195
Diagnostics II is the solution to the service problems of users of all CP/M-80, CP/M-86 and MS-DOS computers	.....\$125
Alignment Diskette for PS/2 and compatibles (3.5 inch)	.....\$ 50

To order, call 800-678-3600 or 408-745-0234
FAX 408-745-0231, or write SuperSoft.

your microcomputer repair solution

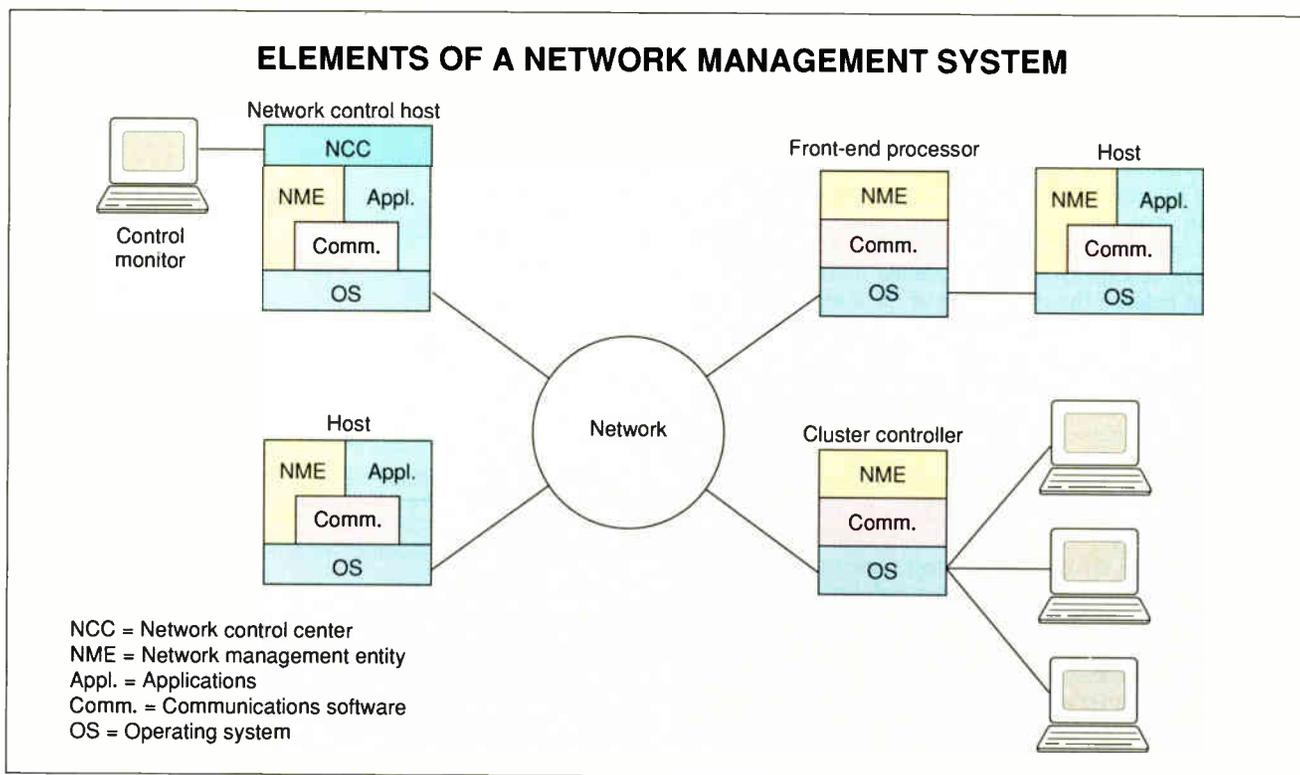
SuperSoft

FIRST IN SOFTWARE TECHNOLOGY P.O. Box 611328, San Jose, CA 95161-1328 (408) 745-0234 Telex 270385

SUPERSOFT is a registered trademark of SuperSoft, Inc.; CDC of Control Data Corp.; IBM PC, AT & XT of International Business Machines Corp.; MS-DOS of MicroSoft Corp.; NEC of NEC Information Systems, Inc.; PRIME of PRIME INC.; Sony of Sony Corp.

Circle 272 on Reader Service Card

APRIL 1990 • B Y T E 277



Each system includes a network management entity package that performs local functions. It can communicate with a network control center that has the same software as other nodes, plus network control software that provides a user interface for managing the entire network.

this diagnosis, it was possible to reconfigure the network to solve the problem.

The use of monitoring software to diagnose and resolve performance problems is perhaps an obvious tactic that most LAN customers will employ. There are other areas that may seem more mundane but that nevertheless can save much time and energy. Any software that will help in the configuration process becomes valuable when an organization grows from a small user population on one LAN to a large population on a number of LANs spread throughout several sites.

Network Management Systems

Most personnel responsible for network management appreciate the value of network management software. But two problems confront the manager. First, the variety of tools needed can lead to the procurement and use of a number of packages with different user interfaces and different hardware platform requirements. Second, if the facility includes equipment from a number of vendors, it is difficult to find software that works effectively across all vendor brands.

From the user's point of view, the best approach would be to obtain a set of tools for network management that provides several features. It would contain a single-operator interface with a powerful but user-friendly set of commands for performing most or all network management tasks. It would require a minimal amount of separate equipment. That is, most of the hardware and software required for network management would be incorporated into the existing user equipment.

A system that supplies this type of integration is generally referred to as a network management system. It consists of incremental hardware and software additions implemented

among existing network components. The software used in accomplishing the network management tasks resides in the host computers and communications processors (e.g., front-end processors and network interface units). A network management system is designed to view the entire network as a unified architecture, with addresses and labels assigned to each point and the specific attributes of each element and link known to the system. The active elements of the network provide regular feedback of status information to the network control center.

The figure illustrates the architecture of a generic network management system. Each network node contains a collection of software devoted to the network management task, referred to in the diagram as a network management entity. Each NME collects statistics on communications and network-related activities and stores statistics locally. Each NME also responds to commands from the network control center, including those that transmit collected statistics to the network control center, change a parameter (e.g., a timer used in a transport protocol), provide status information (e.g., parameter values and active links), and generate artificial traffic to perform a test.

At least one host in the network is designated as the network control host. In addition to the NME software, the network control host includes a collection of software called the network control center. The NCC includes an operator interface to allow an authorized user to manage the network. The NCC responds to user commands by displaying information and/or by issuing commands to NMEs throughout the network. This communication is carried out using an application-level network management protocol that uses the communications architecture in the same way as any other distributed application.

continued



The Book is dead. Long live the CD-ROM.

An exaggeration? Remember what the automobile did to horse drawn carriages. OK, books aren't buggy whips, but CD-ROM will forever change the way we store, distribute and access information.

CD-ROM NEWS

You've probably read a lot about this exciting technology recently. At Compact Disk Products we were early believers in the benefits of CD-ROM and formed an entire company to promote its use. Look to this column each month for CD-ROM news and new product information. Then look for our special offers of the most popular CD-ROM hardware and software. This month we've joined with two CD-ROM industry heavyweights, Microsoft and Hitachi, to offer packages that will convince you to join the information revolution now.

HITACHI CDR-3600 EXTERNAL AVAILABLE

Since its September, 1989 debut, the third generation CDR-3600 has become the leading internal CD-ROM drive. Many owners of earlier drives are upgrading to the CDR-3600 with its look ahead cache, linear pickup head motor and compact design. Now CDP is pleased to offer the CDR-3600's superior speed and reliability to users who need an external model (available for either domestic or international voltages).

Dealer Inquiries Welcome

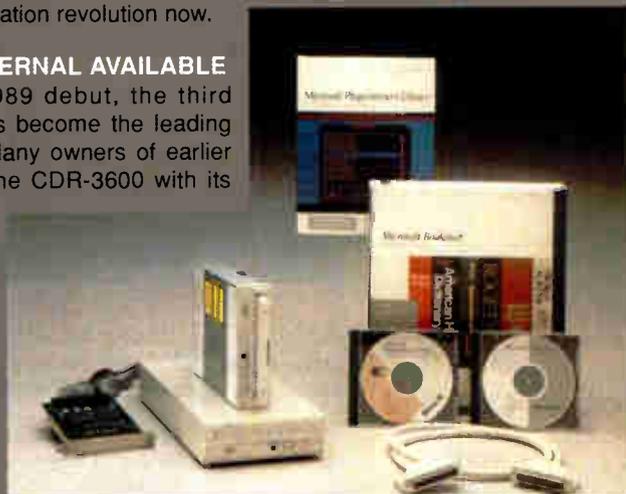


photo. Doug Kilpatrick

Compact Disk Products
223 East 85th Street
New York, NY 10028

Inquiries (212) 737-8400
Fax (212) 737-8289
Compuserve 75530,214



ORDERS
(800)-MEGABYTE (634-2298)

CDP SPECIAL OFFERS

PACKAGE A - \$899 (\$1290 value)

Microsoft Bookshelf and HITACHI CDR-3600 INTERNAL drive kit (complete)! Make your writing more precise and more interesting with this indispensable collection of references. Includes *The World Almanac and Book of Facts*, *Chicago Manual of Style*, *Bartlett's Familiar Quotations*, *Roget's II: Electronic Thesaurus*, *American Heritage Dictionary*, *Forms and Letters*. RAM resident. Search a complete reference work from within your document. Powerful cut and paste features for use with popular word processing and spreadsheet programs.

PACKAGE B - \$999 (\$1390 value)

Microsoft Programmer's Library and HITACHI CDR-3600-INTERNAL drive kit (complete)! "...a masterpiece of simplicity and function." -PC World, May, '89. The most comprehensive, authoritative and valuable collection of programming documentation available. Instant access to Microsoft's Technical Reference Manuals and Microsoft Press books for OS/2, Windows, C, FORTRAN, MASM and more. Over 3,000 files of source code.

OTHER PACKAGES AVAILABLE

BONUS OFFER: Until April 30, order package A or B and buy any of the following for only \$49 each.

- **CD-PLAY:** Give your CD-ROM drive more features than top-of-the-line home audio CD-Players. Ram resident.
- **Food Analyst CD-ROM:** The complete nutritional analysis software.
- **Programmer's ROM:** Useful source code in Pascal, Assembler, Modula 2, OS/2 and 8 other languages.
- **Sherlock Holmes on Disk:** The complete unabridged works with graphic woodcuts.

UNCONDITIONAL GUARANTEE

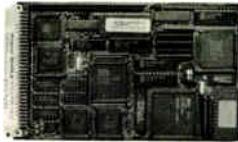
If for ANY REASON you are unhappy with your purchase, return it within 30 days for a FULL REFUND of your purchase price (not shipping and handling).

PC Compatible Single Board Computers for the OEM

DR DOS® Now Available

Quark®/PC +

- NEC V-40® Processor
- Video/LCD Controller
- 8 or 10 MHz Frequency
- Up to 768K Memory



4" x 6"

Quark®/PC II

- 80386 SX based
- EGA® Video/Color LCD Controller
- SCSI Hard Disk Control
- Floppy Disk Control
- Up to 4 Mbytes Memory



4" x 6"

To order or enquire call us today.

Megatel Computer Corporation
(416) 245-2953 FAX (416) 245-6505

125 Wendell Ave., Weston, Ontario M9N 3K9

REPS: Italy 39 331 256 524

W. Germany 49 6074 98031

U.K. 44 959 71011

Netherlands 31 838 541 301

Australia 61 03 568 0988

France 1 47 46 94 52

Austria 43 222 587 6475

Finland 358 0757 1711

Sweden 46 4097 1090

Norway 47 986 9970

Denmark 45 244 0488

Trademarks: Quark - F. + K. Manufacturing Co.
DRDOS - Digital Research Ltd. EGA - IBM Corp. V-40 - NEC Corp.

megatel



You've heard all about those
"Super-Big-Number-One" cartridges.

We've heard all about you
wanting Solutions, not numbers.

Introducing the Solution II™
series of font cartridges,
featuring the quality, hand-
tuned fonts, most requested
by demanding laser printer
users.

For those special needs, the
Custom Solution II™ cartridge
is custom engineered for your
unique requirements. Your
Custom Solution II™ cartridge
will include fonts, logos, signa-
tures or other graphic images.



Mitchell Pacific

Suite 1050, 10303 Jasper Avenue

Edmonton, Alberta Canada T5J 3N6

Phone (403) 425-0100 Fax (403) 420-0900

MANAGING THE WELL-TEMPERED LAN

DIVISIONS OF NETWORK MANAGEMENT

Table 1: ISO is developing standards for network management within a framework consisting of five main functional areas.

Fault management	The facilities that enable the detection, isolation, and correction of abnormal operation of the OSI environment.
Accounting management	The facilities that enable charges to be established for the use of managed objects and costs to be identified for the use of those managed objects.
Configuration and name management	The facilities that exercise management control over, identify, collect data from, and provide data to managed objects. They assist in providing for continuous operation of interconnection services.
Performance management	The facilities needed to evaluate the behavior of managed objects and the effectiveness of communications activities.
Security management	The facilities that address those aspects of OSI security essential to operate OSI network management correctly and to protect managed objects.

NETWORK MANAGEMENT STANDARDS

Table 2: So far, ISO has issued five standards that relate to network management. The overall management framework is part of the OSI model specification.

ISO 7498-2	Open Systems Interconnection—Basic Reference Model Part 4: Management Framework
DIS 9595	Common Management Information Service (CMIS) definition
DIS 9596	Common Management Information Protocol (CMP) specification
DP 10040	Systems Management Overview
DP 10164	Structure of Management Information

Several observations are in order. Since the network management software relies on both the host operating system and the communications architecture, most offerings to date are designed for use on a single vendor's equipment. In the case of a network of personal computers, there are a number of LAN network management packages that will tie together personal computers from a number of vendors. Standards in this area are still immature, but in the next few years, there should emerge standardized network management systems designed to manage a multiple-vendor network.

MANAGING THE WELL-TEMPERED LAN

As depicted in the figure, the NCC communicates with and controls what are essentially software monitors in other systems. The architecture can be extended to include technical control hardware and specialized performance-monitoring hardware as well.

To maintain high availability of the network management function, it makes sense to use two or more NCCs. In normal operation, one of the centers idles or simply collects statistics while the other performs control functions. If the primary NCC fails, the backup system should still function.

Network Management Standards

As LANs for personal computers expand to become networks of LANs, the need for network management becomes increasingly important. Until now, LAN users have had to rely on a simple network control facility provided by the LAN hardware vendor, or a set of proprietary software, such as IBM's Net-View or the Novell software. These approaches will ultimately be inadequate for several reasons.

Users want the freedom to mix equipment from different vendors and yet retain a unified network management architecture with a single interface. Also, tools developed to deal with single-LAN management are inadequate for dealing with an internet consisting of multiple LANs and wide-area networks.

What is needed is a standard for network management that would function as the basis for multivendor and multinet network management tools. The International Standards Organization (ISO) has developed a standard for network management referred to as the Open Systems Interconnection (OSI) management framework. It specifies the functions to be performed by a network management system and defines protocols for the exchange of commands, responses, and measurement data.

This standard is relatively new, and no products are yet available. However, it is serving as the basis for network management systems being developed by computer and LAN vendors and, as such, will assume increasing importance in the marketplace.

Functional Areas

The ISO document divides the network management task into five functional areas (see table 1). These areas provide a useful checklist for assessing any network management offering.

Fault management facilities allow network managers to detect problems in the communications network and the OSI environment. These facilities include mechanisms for the detection, isolation, and correction of abnormal operation in any network component or any of the OSI layers.

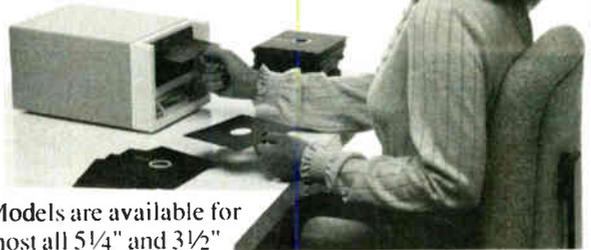
Fault management facilities detect and report the occurrence of faults. These procedures allow a managed system to notify its manager of the detection of a fault, using a standardized event-reporting protocol. Other facilities log the received event report. This log can then be examined and processed. In addition, there are fault management procedures that schedule and execute diagnostic tests, trace faults, and initiate correction of faults. These procedures can be invoked as a result of analyzing the event log.

Accounting management facilities allow a network manager to determine and allocate costs and charges for the use of network resources. They provide procedures that inform users of costs incurred, using event reporting and data manipulation software, and enable accounting limits to be set for the use of managed resources. They also enable costs to be combined where multiple resources are used to achieve needed communication.

continued

ALF's Quick Copy is your Disk Copying Solution

The **Quick Copy** stand-alone duplicators copy disks quickly and reliably. No computer or computer knowledge is required. There are no complicated commands to learn, no keyboard to search, and no thick manual to read. To view step-by-step instructions on the built-in display, just press the "Explain" button at any time. Anyone who's ever used a toaster can make perfect copies with **Quick Copy**.



Models are available for most all 5¼" and 3½" disks. Prices start at just \$1495. Call for details.

Call 1-800-321-4668 today!

(Hours 8-5 MST, M-F. Inside Colorado call 303-423-0371.)

ALF

ALF Products Inc.
3940 Youngfield St.
Wheat Ridge, CO 80033

Protects while you type!



- **Remains In Place** while you use your computer.
- **Avoids Costly Repairs.** Protects delicate electronics from dust, spills, smoke, ashes, staples.
- **Soft, Flexible,** retains normal keyboard feel.
- **Washable, Durable High-Tech Polymer** lasts years.
- **Hundreds of Models.** SafeSkin is available for most PCs, laptops, workstations and clone keyboards.
- **Office • Home • Factory • Classroom • Laboratory**

List Price \$29.95. Please call or write for free color brochure. Dealer inquiries encouraged.

SafeSkin™
KEYBOARD PROTECTOR

Merritt Computer Products, Inc. 5565 Red Bird Center Drive
Suite 150, Dallas, Texas 75234/(214) 339-0753 • FAX (214) 339-1313
In Canada call 1-800-663-1061

New!

Monitor & Control The World FROM YOUR PC



SOLUS, an integrated system, includes monitor, data-log and control software which features "Programming By Selection." You can create applications easily, with no prior programming experience.

ONLY \$895
Hardware Only
VISA/MC/AmEx

The all new SOLUS™ Personal Control Computer™ lets you monitor and datalog just about any condition in the real world. Then, based on these monitored conditions, SOLUS lets you control a wide variety of electrical devices.

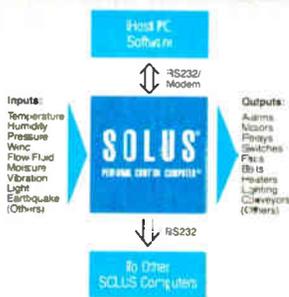
SOLUS makes it possible for any PC user to create powerful monitor and control applications. Quickly. Easily. Inexpensively. And with no prior programming experience.

SOLUS comes with a 30-day satisfaction guarantee.

Call toll free now:
800-247-5712

Discover SOLUS today.
And control the world
around you!

282 BYTE • APRIL 1990



36 digital/analog input/output channels are compatible with standard sensors and output devices. SOLUS can be located on site, or remotely via modem.

Solus Systems, Inc.

4000 Kruse Way Place, 2 • 285
Lake Oswego, OR 97035 U.S.A.
Phone: 503 • 635 • 3966
Fax: 503 • 635 • 3004

© 1989 Solus Systems, Inc. SOLUS™ and Personal Control Computer™ are trademarks of Solus Systems, Inc.

Circle 304 on Reader Service Card

Configuration and name management facilities allow network managers to exercise control over the configuration of the network components and OSI layer entities. Configurations can be changed to alleviate congestion, isolate faults, or meet changing user needs. Configuration management provides procedures to collect and disseminate data concerning the current state of resources. Locally initiated changes or changes due to unpredicted occurrences are communicated to management facilities by means of standardized protocols.

These facilities also provide procedures that set and modify parameters related to network components and OSI layer software, as well as initialize and close down managed objects. They also change the configuration and associate names with objects and sets of objects.

Performance management facilities enable the network manager to monitor and evaluate the performance of network and layer entities. Performance management provides procedures to collect and disseminate data concerning the current level of performance of resources, and maintain and examine performance logs for purposes such as planning and analysis.

Security management facilities allow a network manager to manage those services that provide access protection for communications resources. Security management provides support for the management of authorization facilities, access control, encryption and key management, authentication, and security logs.

OSI Management Architecture

The key elements of the architectural model of an OSI system are as follows:

- **Network management application.** This application provides the mechanism for the network manager, a human, to read or alter data, control the network, and access reports. Residing in the NCC, this application could be a very simple command interpreter or an expert system requiring very little interaction with the network manager.
- **System management application process (SMAP).** This application is the local software within a system responsible for executing the network management functions on a single system (e.g., host and front-end processor). It has access to an overall view of system parameters and capabilities and can, therefore, manage all aspects of the system and coordinate with the network management application and SMAPs on other systems.
- **System management application entity (SMAE).** This application is responsible for communication with other nodes, especially with the network management application in the NCC host. Standardized application-level protocols are used for this purpose.
- **Layer management entity (LME).** Software is embedded into each layer of the OSI architecture to provide network management functions specific to that layer.
- **Management information base (MIB).** This is a collection of information at each node pertaining to network management.

By defining these five items, ISO has created a structure within which developers can create standards relating to network management.

Related ISO Standards

The OSI management framework document (ISO 7498-4) is part of the overall specification of the OSI architecture. It supplies a general structure for network management. In addition, ISO is developing specific standards for various aspects of network management (see table 2).

These ISO standards are important to the user who is planning a future network management strategy. Although the standards have not been finalized, several vendors are positioning themselves to provide ISO-compliant network management products. Furthermore, the products being developed will operate not only on the OSI architecture, as you would expect, but also on the TCP/IP protocol suite.

This latter communications architecture, developed as a set of military standards, is widely used in LAN products. Thus, whether your installation uses TCP/IP or OSI-based products, the ISO standards offer the means for developing a vendor-independent network management capability.

The ISO standards are based on three key concepts: the management information base (MIB), the Common Management Information Protocol (CMIP), and the Common Management Information Service (CMIS).

The MIB is a list of items that can be managed by the network management system. The network management specifications developed for TCP/IP make use of the same formats and include a subset of the objects defined in the ISO standard.

The CMIP is the protocol by which various management entities communicate. The use of the term *common* refers to the fact that the protocol is used to support work in all five functional areas of OSI network management (those listed in table 1). This application-level protocol is part of the OSI protocol suite and is intended to work with systems that implement the OSI architecture.

In the TCP/IP community, the current draft version of CMIP is used in CMOT (for CMIP over TCP/IP). This is the same protocol; the difference is that the protocol is specified to run over TCP/IP rather than the OSI protocols. A number of TCP/IP vendors are working on CMOT implementations. In the meantime, the TCP/IP community is relying on the Simple Network Management Protocol (SNMP), which provides a rudimentary network management capability that can be used in the near term. SNMP and CMOT share the same management information base, which will make migration easier.

Finally, the CMIS defines the services that can be supported by CMIP.

Network Management Solutions

The need for network management grows with the complexity and scale of the networks to be managed. Although it is possible to acquire software and hardware tools that address specific areas individually (e.g., fault detection and security), a full-fledged integrated network management system is the most effective way to satisfy the spectrum of network management requirements.

As in other aspects of computer communications, proprietary approaches to network management create difficulties in the areas of flexibility and vendor independence. Accordingly, the ISO network management framework and evolving standards offer hope for resolution of the network management problems facing those with substantial network installations. Both TCP/IP and OSI-based products that conform to this set of standards are beginning to appear. Now is the time to plan for the use of this effective network management system. ■

Editor's note: *This article is based on material in the author's new book, Business Data Communications (Macmillan, 1990).*

William Stallings is president of Comp-Comm Consulting in Prides Crossing, Massachusetts, and the author of 14 books on data communications and computer systems. He can be reached on BIX c/o "editors."

SAVE 000's OF DOLLARS BUYING COMPUTER EQUIPMENT

WE HAVE BEEN SOURCING COMPUTER EQUIPMENT FOR MANY COMPANIES WORLDWIDE FOR OVER SIX YEARS. WE ARE NOW MAKING OUR DATABASE AVAILABLE TO ALL;

YOU RECEIVE A DATABASE CONTAINING

- 500 Suppliers, Taiwan, Hong Kong, Japan etc;
- Over 4000 individual priced computers, components and peripherals in detail.
- Contact Names, Telephone/Fax Numbers.Terms.
- Integrated Management Software and Report generator (3.5" & 5.25") 'Design your own system?'
- Buyers Guide, Shipping details, Terms of Trading and Documentation guides.

■ THE ULTIMATE BUYERS GUIDE! ■

For only \$95

Updates available Quarterly

L&A

56 RETFORD DRIVE - MANOR PARK - WALMLEY
WEST MIDLANDS - B76 8FE ENGLAND
TELEPHONE/FAX - 44 21 378 5580 (24 HOURS)

P&P \$3.50 WORLDWIDE

NUMBER OF UNITS:

80486 40Mb Mono Complete - \$3500
80386 20Mb Mono Complete - \$1000

MATHPAK 87 v3.0 Now supports MS QuickBASIC also!

Over 180 assembler coded routines which are designed to take full advantage of 80x87 math coprocessors.

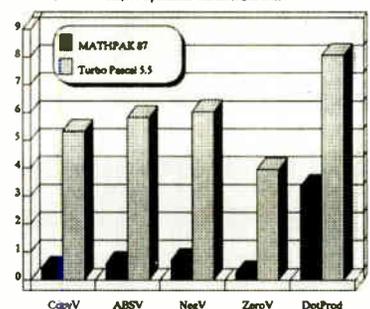
Designed for Speed

Up to 20 X faster than high level language!

1 K complex FFT on a 386/20 takes 0.25s; real 0.12s (2.0s & 1.1s on an IBM XT); dot product (length 10,000) in 0.08s (0.49s on XT).

MATHPAK 87 provides you with the fastest, most convenient and comprehensive set of tools available.

Timings (COMPAQ 286, 12MHz)
100,000 Operations with an 80x87 80287



MATHPAK 87 v3.0 includes: real & complex vector/scalar routines; matrix manipulation routines; complex number routines; LU decomposition/back-solving routines for real & complex systems; gaussian elimination, matrix inversion, tridiagonal system routines; EISPACK type eigenvalue/vector routines; statistical routines; singular value decomposition; FFTs (1-D, 2-D, complex, real, convolution,...); spectral analysis routines; routines for solving systems of non-linear equations, optimization, non-linear least squares, numerical integration, differential equations; missing functions for Modula-2 & Pascal (tan, log10, power, sinh, ...); & more.

Widely used in signal & image processing, simulation, spectral analysis, etc.

Order Today!

30-day money back guarantee
Precision Plus Software
1239 Sir David Drive
Oakville, Ontario
Canada L6J 6Y9
Tel: 416-829-1511
Fax: 416-829-1742

Users like MATHPAK 87 & take the time to tell us!

\$129US Available for Turbo Pascal, Fortran (MS or F77L), C (MS, Turbo or Lattice), Modula-2 (Logitech or ITC) and MS QuickBASIC.
Add \$69US for complete source code. Add \$5 for shipping. Specify compiler.

International Dealers: West Germany: SOS Software, tel: 0821/57 1081, fax: 0821/57 7659; U.K.: Grey Matter, tel: 0364 53499; Netherlands: Lemax Co. BV, tel: 02968 94 210.

BIX CALENDAR

APRIL

Display this month's
BIX activities

A P

L

Interactive Games Exchange offers two new conferences.

If you've ever felt you were in a time warp, join sca (Society for Creative Anachronisms) and swap stories with other people who know the feeling. Right now, SCA is exploring the medieval experiences of contemporary people.

And if you have children under age 14, introduce them to BIXing. It's fun for kids, encourages social interaction, and promotes computer literacy. (join bix.kids)

For other information about IGX, see below.

Exchange Updates

Real-time on the Interactive Games Exchange—The IGX continues to offer real-time fun — such as role-playing game techniques in the ff conference and on-line backgammon and trivia in the fun.n.games conference. If your idea of fun is a serious debate on social issues, you'll want to join the gazebo conference every Monday night. If you want to meet with BIX management and talk about whatever is on your mind, join the gazebo conference on Thursdays. For free-form role-playing games that take you back to the Middle Ages — and sometimes far into the future — check into the Meade & Mirth Inn every night at 9 PM EST. (join mnm/inn)

IBM Exchange—In concert with the April BYTE's focus on GUIs and 80386 motherboards, this month's IBM Exchange will feature discussions on both Microsoft Windows and OS/2 Presentation Manager GUIs. The topics will be explored from the perspectives of both the user and the programmer. We'll also discuss the ways in which other companies, such as Lattice and Borland (both of which have vendor conferences on BIX) support Windows and PM programming. (join micro-soft and ibm.os2)

If you're considering replacing an 80386 motherboard, you'll want to join either the ibm.at or ibm.pc conference. We'll discuss what you should look out for when buying one, prices, speed/performance, compatibility with Unix and OS/2, and how to fit them into XT/AT cases. We'll even drop a few names of suppliers and their prices, and invite other conference attendees to describe their experiences with motherboard replacements.

Mac Exchange—This month, the Mac Exchange will provide coverage of the MacExpo in San Francisco, with several reports from the floor on what to see, what's hot, and what's on the way. If you plan to attend the show, we'll help you plan your time wisely. If you're not coming, the Mac Exchange promises to be the next best thing.

Other offerings in the Mac Exchange during April include our continuing on-line C tutorial, product critiques, and question-and-answer sessions about every facet of the Macintosh world.

BIX Conference News The Oakland Group, makers of the C-scape object-oriented interface management system for DOS, Unix and Look&Feel (a screen design tool), has joined the BIX vendor Support Exchange. (join oakland.group)

Video Associates Labs (VAL) has opened a conference to support users of its Microkey Mark 10 video overlay (genlock) hardware. (join val)

Hot and cold fusion, interstellar travel, and electronic gadgets are some of the discussion topics in the new Technology Conference. (join technology)

The 7th Annual Contact Conference, where anthropologists, physicists, science-fiction writers, sociologists, and xenobiologists explore their common ground, was held during March in Phoenix, Arizona. BIXen prepared for this annual meeting and will continue its spirit of cooperation all year long in the Contact Conference. (join contact)

Circle 450 on Reader Service Card

Finally. An on-line service that doesn't nickel and dime you.

It's BIX's flat-fee service

BIX is short for BYTE Information Exchange. The on-line information service that's yours for an unheard-of flat fee of just \$39 for three months*—an amount you could easily waste in just two to four hours with an *hourly rate*, on-line service. (Not to mention the fact that you'd be nickel-and-dimed for its monthly minimums.)

And here's another distinction: BIX is strictly for microcomputer pros; it contains no "fluff." As a subscriber, here's what you've got coming to you:

- All the information and ideas exchanged in more than 150 microcomputer-related conferences—a give-and-take in which you can participate.

- Microbytes Daily*—up-to-the-minute industry news and new product information.
- Plus support from hardware vendors and software publishers, access to extensive software libraries, and the use of our electronic mail service—which allows *binary attachments*.

Subscribe to BIX right now— using your computer and modem

Set your telecommunications program for full duplex, 7 bits, even parity, 1 stop bit. Call BIX directly on our special registration-only number: 800-225-4129 (in Massachusetts, call 617-861-9767). Then hit the return key, and respond as follows:

Prompt:	You Enter:
login (enter "bix");	bix
Name?	bix.flatfee

You can charge your BIX subscription to major credit cards, or have it billed to your company.

You may also purchase unlimited off-peak access via Tymnet for just \$20 per month, or \$3 per off-peak hour, in the continental US.** For more information, and your local Tymnet access number, call 800-227-2983 (in NH and outside the US, call 603-924-7681).

**Based on a \$156 annual fee, billed quarterly. You may cancel at any time. If you prefer, you may subscribe for a 3-month trial at just \$59. Fee does not include Tymnet connect charges.*

***No extra charge for 2400-baud access. Tymnet prices are subject to change. International networks access BIX at NUI 310690157800.*

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983. In NH 603-924-7681.



Extended-DOS

640K DOS



Go Beyond 640K DOS.

Build multi-megabyte programs with Phar Lap's 386|DOS-Extender.[™]

If the DOS 640K limit is driving you nuts, get all the memory you want with 386|DOS-Extender from Phar Lap.[®]

Large-scale benefits. By turning DOS into a true 32-bit operating system, 386|DOS-Extender shatters the 640K barrier. It lets you create protected mode applications that use all the memory in the machine – up to 4 gigabytes. You work within a flat, 32-bit address space. No more suffering with overlays, bank-switched EMS, or segmentation.

With full 32-bit memory and power, you can finally build workstation-class applications for the PC. Your Extended-DOS programs will run considerably faster, have room for more features, and be more responsive than those in 16-bit DOS.

And if that's not enough, add Phar Lap's 386|VMM[™] virtual memory manager. With true demand-paging, 386|VMM enables your application to grow bigger than available RAM. Both code and data are automatically swapped to disk as needed.

Total compatibility. Because 386|DOS-Extender is embedded into your program, it is invisible to the end-user. Your program looks exactly like any other DOS application. There's no new operating environment for your end-users to buy or learn.

Every 80386 PC that can run MS-DOS or PC-DOS can run 386|DOS-Extender. It is completely compatible with all DOS-based software, including TSRs and network managers.

386|DOS-Extender is backed by a full complement of 32-bit languages. Choose your favorite from among C, Fortran, Pascal, Ada, Assembler, and others. And with

Phar Lap, you'll be using the finest, most widely used 386 software development tools in the world.

Proven success. AutoCAD 386, IBM Interleaf Publisher, and Paradox 386 are just a few of the hundreds of Extended-DOS applications already being shipped with 386|DOS-Extender. Utilizing this exciting new technology, industry leaders are keeping their competitive edge by delivering the speed and power that 386 users have been waiting for.

So if DOS is looking smaller than ever, call Phar Lap today.

And see what it's like beyond 640K.

Phar Lap 386|DOS-Extender.

We open a world of memory.



Phar Lap Software, Inc.
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

Trademark holders: 386|DOS-Extender[™] and 386|VMM[™] – Phar Lap Software, Inc.; Interleaf Publisher[™] – Interleaf, Inc.; Paradox[™] – Borland International. Registered trademark holders: Phar Lap[®] – Phar Lap Software, Inc.; Ada[®] – U.S. Dept. of Defense; MS-DOS[®] – Microsoft Corp.; AutoCAD[®] – Autodesk, Inc.; IBM[®] – IBM Corporation. © 1989 Phar Lap Software, Inc.

Circle 221 on Reader Service Card

World Radio History

GATEWAYS TO PROTECTED MODE

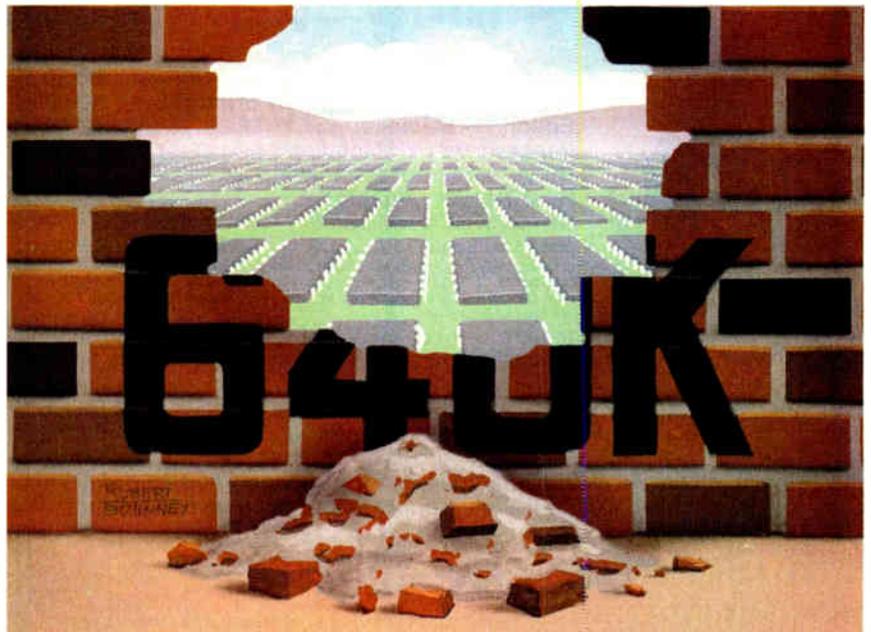
DOS extenders offer the best of two worlds: DOS compatibility and access to protected mode

For programmers and users of Intel-based microcomputers, the architectural legacy of the IBM PC is a blessing and a curse. No other industry-standard architecture enjoys as wide a variety of polished pre-packaged software, useful utilities, and high-powered development tools.

However, few architectures have as many restrictions and limitations. The most hobbling of these are the formidable 640K-byte barrier, which prevents programs, data, and DOS from using more than 640K bytes of directly accessible memory, and the 64K-byte limit on memory segment size, which requires programs to perform special gymnastics to manipulate large data objects.

Both limitations arise from the design of the original PC and its CPU, the Intel 8088. The 8088's address space contains only 1 megabyte, and only 640K bytes of this was made available for programs and data on the PC. Despite the introduction of the 286, which can address up to 16 MB of RAM, and the 386, which can perform 32-bit arithmetic and address up to 4 gigabytes in a single segment, the need for downward compatibility and lack of a standard operating environment that supports the new features force most users to run these microprocessors as fast 8088s, in what is called real mode.

Seeking to extract more performance from today's faster clones, clever engineers have come up with numerous ways to circumvent these two limitations. Among these are EMS, add-on program switchers and multitaskers, completely new operating systems, and DOS extend-



ers. Each has advantages and disadvantages vis-à-vis features, compatibility, performance, development techniques, and hardware requirements. In this installment of *Under the Hood*, I'll discuss how DOS extenders work and how they compare to other methods of getting around the PC's limitations.

Why a DOS Extender?

A DOS extender lets a program run in the protected mode of the 286 or 386, while maintaining access to DOS, DOS device drivers, TSR programs, and the IBM PC BIOS. DOS-extender programs can use all the memory in the machine, including extended memory (i.e., the region above the 1-MB address reach of the original 8088). Protected mode costs some speed, typically 5 percent to 10 percent for the enhanced security of "sanity checking" on accesses to memory and I/O devices, but large memory and—on the 386—full 32-bit addressing and arithmetic usually offset that perfor-

mance hit by a wide margin.

The user of a DOS-extender program starts it from the DOS prompt the same way he or she would run any other program. There's no new environment to learn, and the user need not even be aware that the extender is at work. DOS-extender makers have gone out of their way to ensure that an ordinary DOS application must be modified only in very minor ways to work with the extender; it might even take just a recompilation.

The downside of DOS extenders is that they run only on systems that use 286, 386, and i486 microprocessors. Users of 8088- and 8086-based machines are left out in the cold. And because the machine must switch back to real mode to handle many system interrupts (including timer ticks and keystrokes), some operations are actually slower, especially on the 286. It's possible, in fact, to drop incoming characters when doing serial I/O at 9600 bps. Fortunately, this problem can

continued

be circumvented with special programming techniques.

What are the other options for getting around the PC's limitations, and how do they compare? While a complete discussion of this topic could fill an entire column by itself, I'll now summarize the key methods.

Other Possibilities

Expanded memory is a bank-switching scheme that switches memory in and out

of the PC's address space in 16K-byte blocks. Its key advantage is that it's available on most PC compatibles, including those with 8-bit CPUs.

Expanded-memory emulator programs are available to turn the extended memory on an AT clone into expanded memory, and memory managers (e.g., CEMM, QEMM-386, and 386Max) can use the 386 paging unit to do the bank switching.

Expanded memory's main disadvan-

tages are lack of speed (it takes time to switch banks) and the awkwardness of dealing with RAM that's been broken up into 16K-byte chunks. Expanded memory does not provide access to protected mode or the enhanced addressing and math facilities of the 386 chip.

386 operand and address size overrides let a program running on the 386 in real mode use 32-bit arithmetic and enhanced addressing modes. This simple but little-known feature of the 386 can be used to speed up key parts of a computation. I've seen one program that uses operand size overrides to compute the Mandelbrot set five times faster than it could otherwise.

However, this technique may cause compatibility problems with some OEMs' versions of OS/2, specifically those that don't preserve the full 386 registers during a task switch.

Address size overrides let real-mode programs use powerful array-addressing modes with 32-bit offsets and built-in "shift and add" operations. They can also be used to address segments larger than 64K bytes and memory above 1 MB. However, the techniques for doing so are undocumented (and hence unsupported) by Intel; they may disappear in later chips. And, of course, the 286 supports none of these features.

Other operating environments—notably Unix, OS/2, Concurrent DOS, PC-MOS, and QNX—have been developed to support the enhanced architectural features of the newer chips, but users have been loath to migrate to them. Why? Because they're expensive, require large investments in RAM and hard disk space, and lack DOS's phenomenal software base. Rewriting your own code to run under these new environments can be expensive and incredibly time-consuming.

Fortunately, many of these systems have facilities to run DOS programs—or even several at once—as tasks, but they often do it slowly and with limited compatibility. And the DOS programs they do run are still limited to 640K bytes within their individual "virtual machines" or "compatibility boxes."

Add-on multitaskers (e.g., DESQview and VM/386) let multiple DOS applications run simultaneously and offer good DOS compatibility, but they don't offer a full-up enhanced operating-system environment. And the individual programs they run are still subject to the same limitations they'd encounter under DOS. Note, though, that many of these environments now support DOS-extender

continued

Never buy another ribbon!

Over 125,000 sold

Shipping \$4.50



Universal Cartridge (includes one adapter)	68.50
Multicolor Adapter (specify printer)	40.00
Epson only Maclnker mod. 271EP	42.00
Imagewriter only Maclnker™ mod. 234IM	42.00
Universal Spool Maclnker	68.50
Heat Transfer Adapter	25.00
Extra Ink Bottle, black	3.00
Colored Ink Bottle	4.00
extra reservoir	5.00
Extra Ink Bottle, black	3.00
Colored Ink Bottle	4.00
extra reservoir	5.00

All models delivered complete with bottle of ink, ink meter, reservoir, reservoir cover
Go color !! Single & multicolor, standard and heat transfer cartridges available; red, green, blue, brown, purple, yellow, orange, white, silver and gold. Indelible and OCR ink cartridges available.

The Universal Cartridge Maclnker re-inks most cartridges with appropriate adapter. Universal Spool unit re-inks all spools. - Operation is very simple and automatic. Average cartridge can be re-inked 60-100 times at 5 cents/re-inking. - Extra dark, lubricated ink cools, lubricates and extend printhead life. Multicolor Adapters for multiband cartridges (Rainbow, Imagewriter, Epson, NEC, Fujitsu, Okidata etc.). - Dedicated Maclnkers available for special cartridges and for Band Printers. Customers vary from individuals to Fortune 500 corporations, thousands of schools/colleges. Users have reported documented savings of \$30,000.00/year with Maclnker.

LightSpeed 9624E 9600 baud modem



Shipping \$7.00

\$799.00

- True 9600 bps modem, V.32, full duplex. 9600/4800/2400/1200 bps
- MNP class 5 error correction & data compression for data flow up to 19.2 kbps
- Fully CCITT V.32/V.22bis/V.22, Bell 212A/103J compliant
- Auto speed selection
- Non volatile memory storage
- Synchronous & asynchronous modes
- Cable and software included (specify PC or MAC)

LightFax 9624 superior fax/modem



Shipping \$7.00

\$499.00

- 9600 baud fax, compatible with all Group 3 fax machines
- 2400 baud modem, 100% Hayes™ compatible.
- Excellent picture quality, superior to standard fax
- Fax from application or from flexible text/graphics editor
- Full status light in fax & modem mode
- Powerful software for scheduled sending, broadcasting, file queuing etc.
- Cable and software included (specify PC or MAC)



NEW! BothWay Automatic Data Switches. Use them to share one printer between two computers or two computers with one printer. Compact, velcro-mount on computer or printer.

BothWay Parallel89.00 BothWay Serial99.00

Computer Friends, Inc.
14250 NW Science Park Dr.
Portland OR 97229

Satisfaction or 30 day
refund. Immediate
shipment. Major credit
cards. PO's from
National Accounts

Order Toll Free 1-800-547-3303

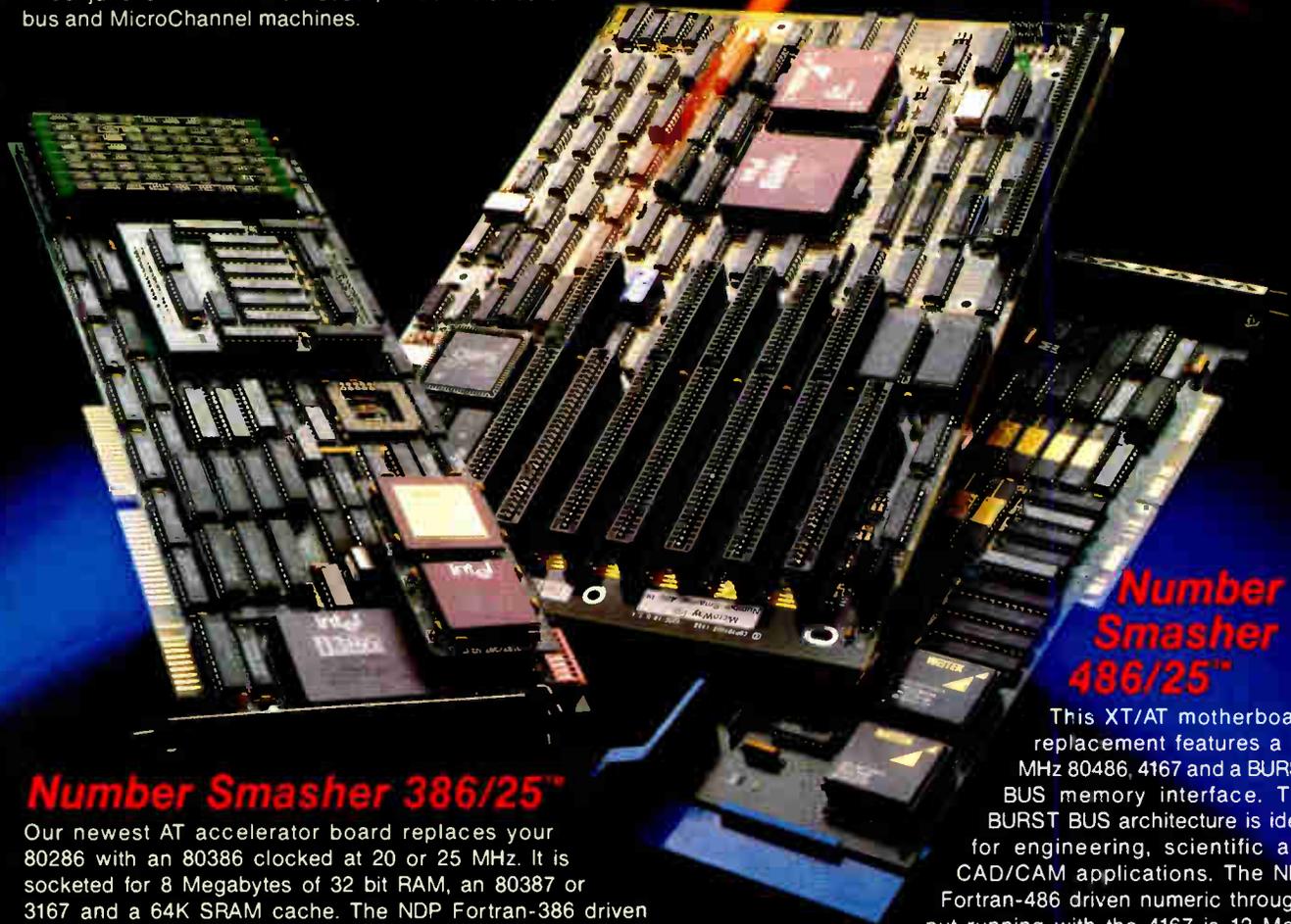
In Oregon (503)626-2291

fax (503)643-5379

telex 4949559 CF

Weitek Your 386/486!

The new 4167 delivers up to 10 Megaflops when driven by NDP Fortran-486 and is supported by dozens of scientific, engineering and CAD applications. MicroWay provided the tools to develop many of these applications and supplies the interface cards required to use Weitek coprocessors in conjunction with with an 80387, in both standard AT bus and MicroChannel machines.



Number Smasher 386/25™

Our newest AT accelerator board replaces your 80286 with an 80386 clocked at 20 or 25 MHz. It is socketed for 8 Megabytes of 32 bit RAM, an 80387 or 3167 and a 64K SRAM cache. The NDP Fortran-386 driven 3167 throughput at 25 MHz is 5.5 Megawhetstones.

Number Smasher 486/25™

This XT/AT motherboard replacement features a 25 MHz 80486, 4167 and a BURST BUS memory interface. The BURST BUS architecture is ideal for engineering, scientific and CAD/CAM applications. The NDP Fortran-486 driven numeric throughput running with the 4167 is 12 Megawhetstones and 10 Megawhetscales (see BYTE 1989 IBM issue).

mW3167/387

This popular daughterboard (shown on the Number Smasher 386/25) lets you plug a 3167 and an 80387 into a 386 system that has a single EMC socket.

mW3167/MCA

Our MCA Weitek card runs in the IBM Model 70 and 80. At 20 MHz, its performance is 2 to 3 times that of an 80387.

3167/4167 Numeric Performance

	3167/MCA	NS 386/25	NS/486/25
Megawhetstones	3.4	5.5	12.2
Megawhetscales	1.6	3.1	9.9

NDP Fortran-486 and C-486 are globally optimized main-frame compilers that have been fine tuned for the 80486 and 4176.



Weitek 3167 and 4167 are trademarks of Weitek Corp. MicroWay and Number Smasher are registered trademarks of MicroWay, Inc. 80386, 80387, 80486 are trademarks of Intel Corp.

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
 32 High St., Kingston-Upon-Thames, UK., 01-541-5466
 USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

WorldRadioHistory

applications, thanks to VCPI (see "Stretching DOS to the Limit," *IBM Special Edition*, Fall 1989).

Microsoft Windows provides a graphical user interface as well as some multitasking, but it's hungry for RAM and sucks the wind out of a slow CPU. Applications must be extensively rewritten to take advantage of the GUI, and Windows/386 (at least in its current incarnation) won't coexist with some TSR programs or with DOS extenders.

Inside a DOS Extender

A DOS extender's job is a tricky one. DOS and the BIOS run in real mode. Thus, they perform operations that are illegal in a protected-mode system. The DOS extender filters requests from the application program to the system, as well as any information that comes back. The result: DOS and the BIOS "look" like protected-mode system software to the application, and it looks like a real-mode application to them.

The figure shows, schematically, where the DOS extender fits into the scheme of things. The DOS extender manages and filters communications between the program and other system software. It also performs mode switches as necessary and sets up the descriptor tables (i.e., GDT, LDT, and IDT) that control how memory is used.

Care and Feeding of DOS and the BIOS

To make the BIOS and DOS useful to a protected-mode program, the DOS extender must run the system software in real mode and make it think it's dealing with an ordinary real-mode program. This can require a good deal of work.

For one thing, DOS and the BIOS don't know how to handle protected-mode addresses. If a DOS or BIOS call requires a pointer to a parameter (as is often the case with disk functions), the protected-mode address furnished by the application (which contains an abstract segment selector and an offset) must be converted to a real-mode address (which contains a physical segment number and an offset).

What's more, since DOS and the BIOS can't access memory above F000:FFFF hexadecimal (the 1-MB limit), any parameters passed in high memory must be either copied down into the lower part of RAM or mapped into it with the 386's paging unit. Likewise, results must often be copied back up to high memory after a call.

Not all DOS extenders have a full repertoire of DOS and BIOS calls, however. For instance, Phar Lap Software's 386/DOS-Extender does not support DOS functions that use file-control blocks, and none automatically supports NetBIOS (although Rational Systems supplies sample source code that can be used to make NetBIOS calls from the DOS extender). Eclipse Computer Solutions' DOS extenders do buffer copying, but they limit it to 16K bytes on many calls.

A DOS extender must handle interrupts in both real and protected modes. Interrupts can arise from three sources: software interrupts (like the ones used to call DOS and the BIOS), hardware interrupts (usually generated by peripherals), and processor exceptions (usually caused by errors in the application). Furthermore, because the IBM PC BIOS disregards Intel's recommendations and uses some "reserved" interrupt vectors for BIOS functions, the extender must also figure out the cause of each interrupt and call the proper routine.

continued

Microcomputer News On-line

In this fast paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MSDOS machines, Macintosh, Unix workstations, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

See our ad on pages 284, 285 of this issue.

Call now and subscribe today.

BIX

One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983 ♦ In NH (603) 924-7681

**12 Mhz
286 VGA
COMBO KIT**

- 80286-12 CPU
- 1 Meg RAM
- 1.2 Meg Floppy Drive
- 1.44 Meg Floppy Drive
- 40 Meg 28 ms Hard Drive
- 16 bit VGA Board
- 14" VGA color Monitor
- 2S/1P/1G ports
- 101-key Keyboard
- Genius Mouse
- M/S DOS 4.01
- Panasonic 1180 printer
- Surge Protector

\$1850

**16 Mhz
386SX
VGA**

- 80386-16SX CPU
- 1 Meg RAM
- 1.2 Meg Floppy Drive
- 1.44 Meg Floppy Drive
- 66 Meg 25 ms Hard Drive
- 16 bit VGA Board
- 14" VGA color Monitor
- 2S/1P/1G ports
- 101-key Keyboard
- Genius Mouse
- M/S DOS 4.01

\$1995

**20 Mhz
386
VGA**

- 80386-20 CPU
- 2 Meg RAM
- 1.2 Meg Floppy Drive
- 1.44 Meg Floppy Drive
- 66 Meg 25 ms Hard Drive
- 16 bit VGA Board
- 14" VGA color Monitor
- 2S/1P/1G ports
- 101-key Keyboard
- Genius Mouse
- M/S DOS 4.01

\$2395

**25 Mhz
386
VGA**

- 80386-25 CPU
- 2 Meg RAM
- 1.2 Meg Floppy Drive
- 1.44 Meg Floppy Drive
- 66 Meg 25 ms Hard Drive
- 16 bit VGA Board
- 14" VGA color Monitor
- 2S/1P/1G ports
- 101-key Keyboard
- Genius Mouse
- M/S DOS 4.01

\$2495

**25 Mhz
CACHE
386 VGA**

- 80386-25 CPU
- 32K 25ns Cache Memory
- 4 Meg RAM
- 1.2 Meg Floppy Drive
- 1.44 Meg Floppy Drive
- 150 Meg 18 ms ESDI Drive
- 32K Fast Cache ESDI Controller
- 16 bit VGA Board
- 14" VGA color Monitor
- 2S/1P/1G ports
- 101-key Keyboard
- Genius Mouse
- M/S DOS 4.01

\$3595

**33 Mhz
CACHE
386 VGA**

- 80386-33 CPU
- 32K 25ns Cache Memory
- 4 Meg RAM
- 1.2 Meg Floppy Drive
- 1.44 Meg Floppy Drive
- 150 Meg 18 ms ESDI Drive
- 32K Fast Cache ESDI Controller
- 16 bit VGA Board
- 14" VGA color Monitor
- 2S/1P/1G ports
- 101-key Keyboard
- Genius Mouse
- M/S DOS 4.01

\$3995



"ALTEC Zip 386s are solid machines featuring brand-names parts. A good buy, they are clearly affordable." PC Magazine May 30, 1989"

Fast Release
We do same day shipping.

The ALTEC-286 turned in some of the best performance times of all the machines tested." PC Magazine Feb. 14, 1988

Free 4 Months On-Site Service

The Altec Collection- Pillars of Success



Policy:

- Same day shipments with standard configurations for order before 3:00 pm E.S.T.
- Shipping and handling extra. Personal and company checks require 10 days to clear. Prices are subject to change and all items are subject to availability. All returns must be shipped prepaid, insured, in original condition and complete with documentation. All returns must have RMA #



1-800-255-9971

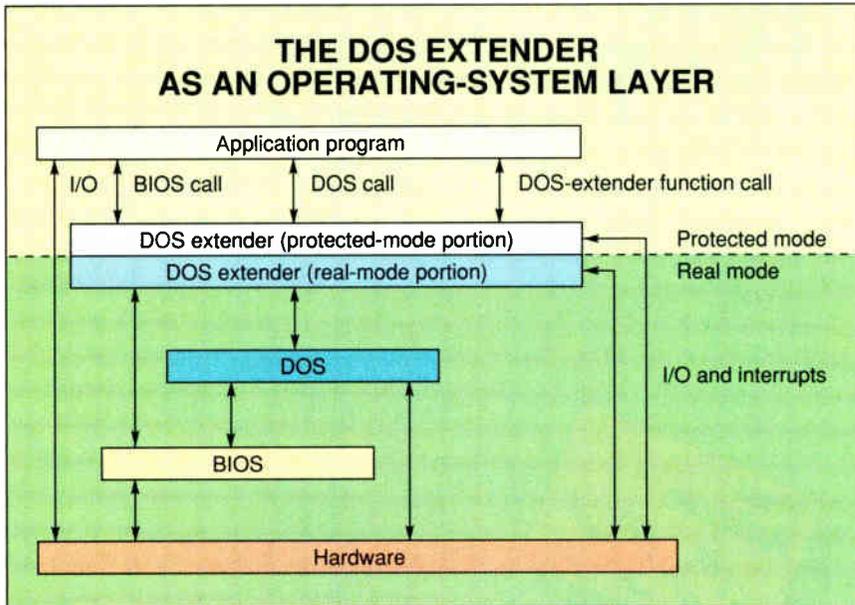
- Altec's Another Standout-Service**
- 30 Day Money Back Guarantee
 - 1 Year Warranty for Parts and Labor
 - Free 4 Months On-Site Service
 - Lifetime Toll-Free Technical Support

18555 East Gale Ave.
Industry, CA 91748
Tel: 818/912-8688
FAX: 818/912-8048



Circle 18 on Reader Service Card

World Radio History



A DOS extender accepts DOS and BIOS calls from a protected-mode application, processes the parameters, and reissues the request in real mode. It also fields interrupts in protected mode (and some in real mode as well), performing mode switches and reissuing interrupt requests as necessary. A DOS-extender application can also have a portion that runs in real mode (not shown), usually for the purpose of handling interrupts without a mode switch.

Turning Off the Engine

One problem that the DOS extender must overcome in each machine is that of switching quickly and nondestructively between real and protected modes. The technique varies with the microprocessor involved. The 286 can be switched from real mode to protected mode in a few instructions. Unfortunately, Intel, in its zeal to make sure that the protection mechanisms on the 286 were secure, provided no way to switch it back! The only way to do so is to reset the microprocessor via a hardware reset line or a particularly nasty sequence of erroneous instructions.

When IBM designed the AT, it noted this problem and provided a hardware workaround for it. An output from the keyboard controller was connected to the main CPU's reset line. The CPU could "commit suicide" by ordering the keyboard controller to toggle the line. The keyboard controller could also be ordered to mask or unmask the 286's A20 address line to simulate the 8088's behavior in real mode.

Some compatibles—including many Compaq machines, systems that use application-specific IC chip sets, and the PS/2s—provide more direct ways of forcing resets and toggling A20. The 386 can be returned to real mode quickly without a reset, and the i486 even provides a pin

to notify the internal cache controller that A20 is masked, so that the address used by the cache corresponds to the physical address that appears on the machine's data bus. The bottom line: The time to switch back to real mode can be as short as 30 microseconds on a fast 386 or as long as half a millisecond on a 6-MHz 286.

Protected-Mode Constraints

While the DOS extender is doing its job, the application program must cooperate with it by following the architectural guidelines for protected mode.

As I mentioned in the December 1989 *Under the Hood*, the most important of these restrictions have to do with memory addresses. A program can access only the memory for which it has a segment selector, and then only in a way that corresponds to the type of the segment. You cannot write to a code segment or execute a data segment (although it is possible to create an *alias*—a writable data segment that overlaps a code segment—if you must).

You can only perform an intersegment jump or call to a "safe" entry point through a call gate. You can't read or write beyond the end of a segment. And you can't trash the operating system by mistake—unless, of course, it chooses to let you do so. If you try to do any of these

things, you will get a GP (General Protection) fault, and your program will stop running.

Generally speaking, protection is a good idea. It tends to catch program bugs like wild pointers and out-of-bounds array indexes. Different DOS extenders provide different degrees of protection, however, as you'll see shortly when I look at some actual products.

Virtual Memory

Another advantage of protected mode is the possibility of virtual memory. If you like writing programs that use 64 MB of RAM, and you don't happen to have that much handy, a DOS extender can help. Virtual memory in the 286 must be implemented by swapping whole segments, up to 64K bytes at a time. On the 386, however, the paging unit works with 4K-byte pages.

In either case, a simple least-recently used algorithm is usually sufficient to keep the system from thrashing. All the manufacturers of DOS extenders I've seen either have virtual memory or plan to have it in the near future.

Four DOS Extenders

To gain experience with DOS extenders, I obtained copies of four products: two for the 286 and two for the 386. These included Rational Systems' DOS/16M (the DOS extender that Lotus picked for 1-2-3), Eclipse Computer Solutions' OS/286 and OS/386, and Phar Lap Software's 386/DOS-Extender. To familiarize myself with the development process for each one, I wrote a simple program—the ever-popular "hello world"—in assembly language. It made only two DOS calls: one to function 9 (Write String), and another to function 4C hexadecimal (Terminate Program).

I then built and executed each program, using my own AT clone for the 286 extenders and a 20-MHz 386 system lent to me by Arche Technologies for the 386 extenders. All the programs generated by the 286 extenders also ran on the 386 with no changes, as you might expect.

Although the source code used with both of the 286 extenders was the same, DOS/16M required me to assemble and link an additional module into my code. The purpose of this module was to set up a series of segments for descriptor tables and video screens and to make sure the segments were in the right order.

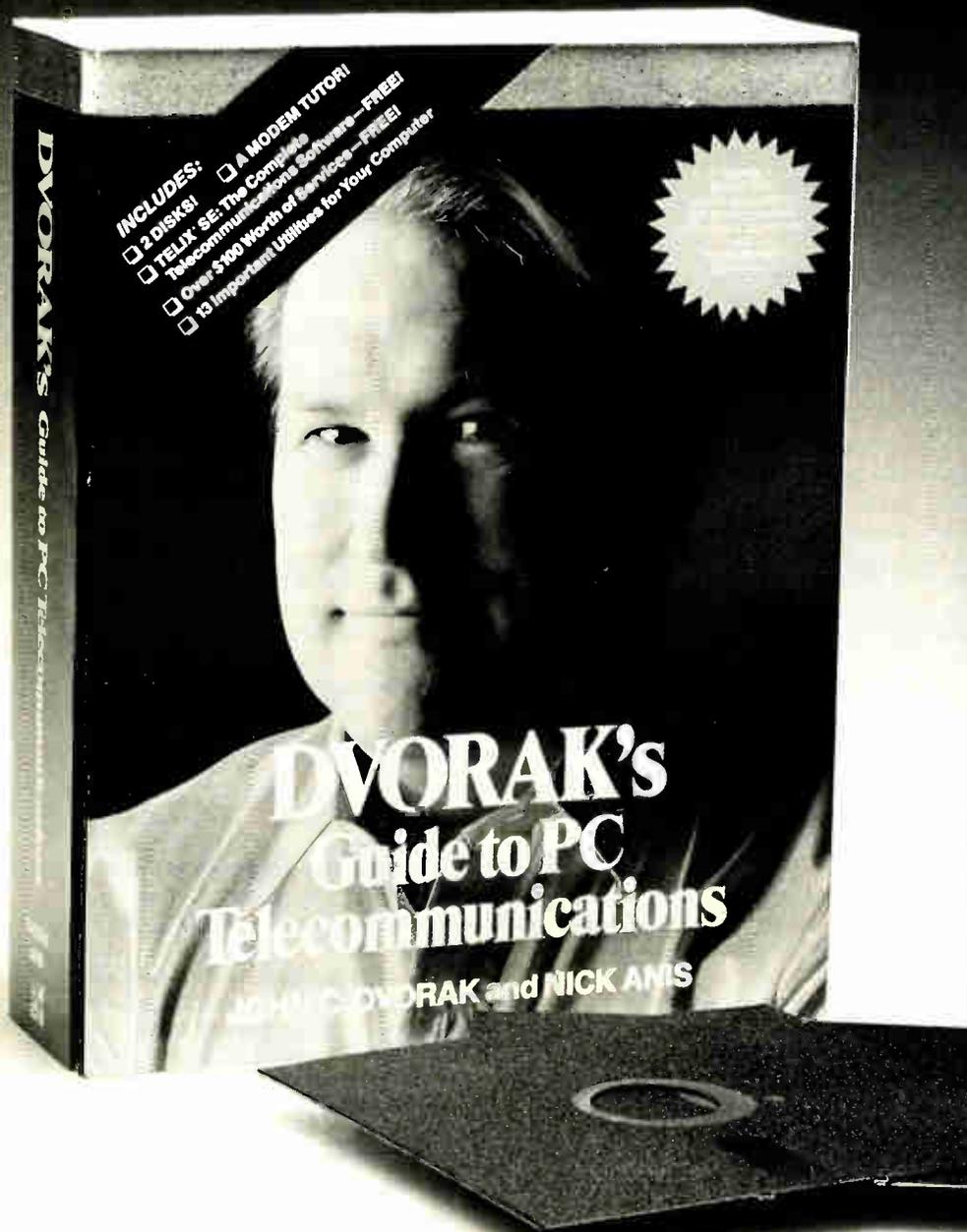
Building a DOS-Extender Program

For each 286 DOS extender, I used the Microsoft Macro Assembler (MASM)

continued

Wise Guide.

Dvorak's Guide to PC Telecommunications



by John C. Dvorak and Nick Anis • Foreword by Peter Norton

"Dvorak's style and humor make this a refreshing and accessible sourcebook with an incredible breadth of coverage." Peter Norton

TELECOMMUNICATIONS JUST GOT SIMPLE—

Plug into the world of electronic databases, bulletin boards, and on-line services. All you need is your computer, a modem, and this outstanding book and disk package by internationally acclaimed columnist John C. Dvorak and programming wiz Nick Anis.

With this book and software package you can:

- Send and receive electronic mail, memos, and reports to and from your office, hotel room, beach resort, or home.
- Set up an efficient home-office.
- Schedule airline reservations electronically.
- Download over 10,000 software programs right into your computer over regular phone lines.
- Get instantaneous stock quotes.
- Tap into most major newspapers and newsletters electronically.

For **Only \$49.95** you get a comprehensive, easy-to-read guide on everything you ever wanted to know about telecommunications plus TWO diskettes loaded with outstanding free programs. This book is written for experts and novices alike.

INCLUDES:

- Two 5-1/4" Disks
- A Modem Tutor
- TELIX/SE—The complete Telecommunications Software - FREE!
- Over \$1500 in Discounts and Services
- 13 Important Utilities for Your Computer - FREE!

\$49.95, ISBN: 0-07-881551-7, 750 pp. Quality Paperback, 2 5-1/4" Disks (IBM PC/Compatible).

(3-1/2" Disks available through a coupon offer.)

Available Now at Book Stores and Computer Stores

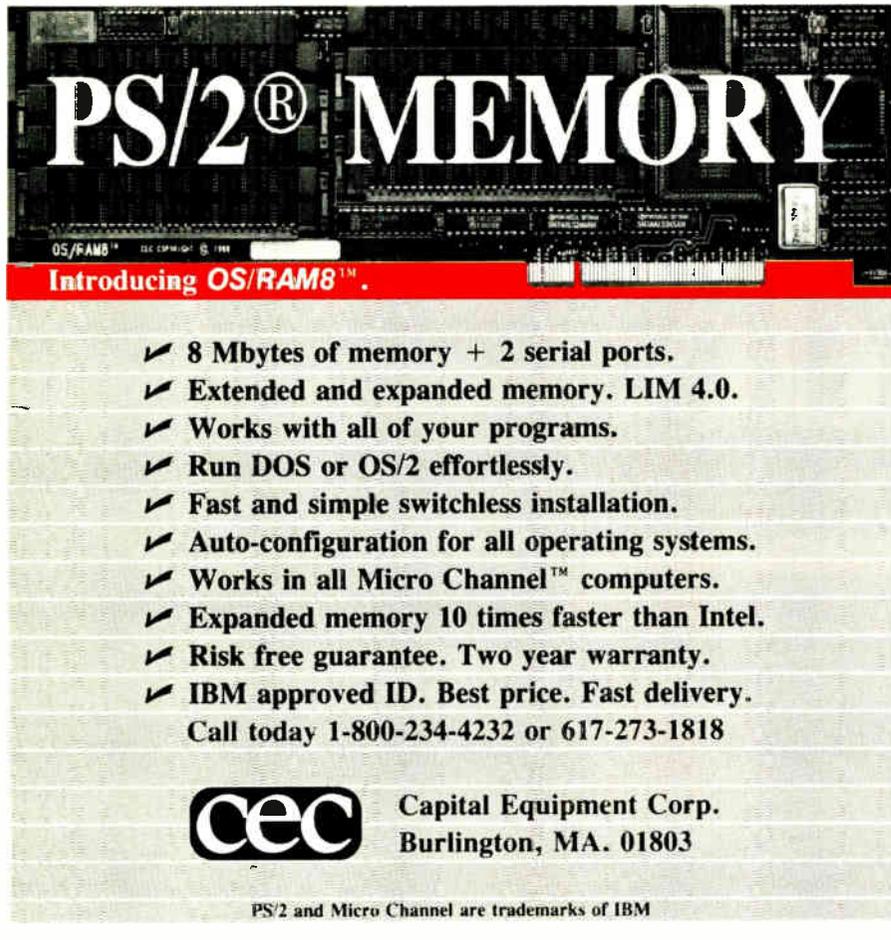
ORDER TODAY!
CALL TOLL-FREE
1-800-262-4729



Osborne McGraw-Hill
2600 Tenth Street
Berkeley, CA 94710

(Available in Canada through McGraw-Hill Ryerson, Ltd. Phone: 416-293-1911)

1989 © McGraw-Hill, Inc.



PS/2[®] MEMORY

Introducing OS/RAMB[™].

- ✓ 8 Mbytes of memory + 2 serial ports.
- ✓ Extended and expanded memory. LIM 4.0.
- ✓ Works with all of your programs.
- ✓ Run DOS or OS/2 effortlessly.
- ✓ Fast and simple switchless installation.
- ✓ Auto-configuration for all operating systems.
- ✓ Works in all Micro Channel[™] computers.
- ✓ Expanded memory 10 times faster than Intel.
- ✓ Risk free guarantee. Two year warranty.
- ✓ IBM approved ID. Best price. Fast delivery.

Call today 1-800-234-4232 or 617-273-1818

cec Capital Equipment Corp.
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

5.10 and the Microsoft Overlay Linker 3.65 to generate the initial .EXE files and associated .MAP files. (The .MAP files are very important, because they let the postprocessors set up call gates for intrasegment calls.) Both .EXE files ran as ordinary real-mode programs from the DOS prompt. I then passed each through a postprocessor (.EXPress for OS/286 and MAKEPM for DOS/16M), which converted them to a protected-mode format.

To execute the OS/286 program, I loaded the OS/286 kernel as a TSR program by simply typing OS286 at the DOS prompt; I could then execute the "hello world" program by typing UP HELLO. DOS/16M didn't require a resident kernel; I was able to run that version by typing LOADER HELLO.

I assembled the 386 examples with MASM, but I linked each with a 32-bit linker provided by the manufacturer of the DOS extender. I did the version for OS/386 first, and it assembled, linked, and ran on the first try. However, the Phar Lap linker rejected the code with a complaint about a *segment fixup* in the object module. (A segment fixup is used in large-model programs to let the loader insert segment selectors into the code just before it runs.) Phar Lap uses a small—or "flat"—memory model. The

one segment used for code, data, and the stack covers all of memory. Its linker and loader therefore don't need to handle the concept of fixups.

I solved the problem by removing a reference to SEG DATA in the source code. The program then linked and ran without a hitch. OS/386, like OS/286, loads the kernel as a TSR program. You use the UP command to run programs. (OS/386 will also run 16-bit protected-mode programs created for OS/286, so you can keep one kernel loaded for both.) Phar Lap provides a loader that's called RUN386 to run its programs. All three DOS extenders came with debuggers. None was of the quality of CodeView or Turbo Debugger, but they all seemed adequate for simple debugging jobs.

Run-Time Environments

Each of the DOS extenders I used presented a slightly different run-time environment to the program. Phar Lap's is the simplest: The code, data, and stack are all mapped into a single large program segment. This segment is normally aliased so that all the segment registers point to it. (Unfortunately, this means that it's very easy for a buggy program to clobber its own code.)

The other three extenders allow multiple segments. The Phar Lap and Rational

Systems extenders run all protected-mode code at PL 0, but the Eclipse extenders run the kernel at PL 0 and the user program at PL 3. The latter seems to me to be a wise decision; it's a good idea to take as much advantage as possible of the facilities of protected mode.

High-Level Languages and DOS Extenders

All the DOS extenders I tested came with lists of high-level-language compilers that they supported. (There's no room here to list them all; contact the manufacturers for the most current lists.) Some compiler manufacturers (e.g., MetaWare) work with the DOS-extender manufacturers to make their products compatible; others (e.g., Microsoft) aren't as cooperative and are supported via third-party patches to the run-time libraries. Almost all the patches are workarounds for areas where the run-time libraries access absolute addresses directly, create self-modifying code, or do segment-address arithmetic.

To see what it was like to work with a high-level language under a DOS extender, I tried Meridian Software Systems' AdaVantage Ada compiler and environment, which work with OS/286. Once I got the system installed, I could hardly tell the difference between developing for real and protected modes. The environment "knew" about the DOS extender and behaved appropriately. I was able to get some simple Ada programs running in about an hour.

I tried one more experiment. Eclipse claimed in its manual that the .EXPress program would convert many real-mode programs to run in protected mode, as long as there was no segment arithmetic and the program was reasonably well behaved. I decided to test this by writing a simple Turbo Pascal "hello world" program, generating a .MAP file, and then running the output through .EXPress.

That didn't work, as .EXPress complained that it couldn't find a "Publics by Name" section in the .MAP file (there wasn't one) and quit without producing any output. Daringly, I used a text editor to add the required heading to the .MAP file and tried again. This time—lo and behold!—the conversion worked, and the program ran in protected mode.

Eclipse says that it will soon support Turbo Pascal with a patched run-time library that allows the heap and overlays to work completely.

Compatibility Problems

DOS extenders work hard to make your hardware perform unusual stunts—and

COMPANY INFORMATION

Eclipse Computer Solutions, Inc.
1 Intercontinental Way
Peabody, MA 01960
(508) 535-7510
Inquiry 982.

Phar Lap Software, Inc.
60 Aberdeen Ave.
Cambridge, MA 02138
(617) 661-1510
Inquiry 983.

Rational Systems, Inc.
220 North Main St.
Natick, MA 01760
(508) 653-6006
Inquiry 984.

sometimes the hardware doesn't cooperate. Before you can run Eclipse's OS/286 kernel, you must run a program called Tune, which checks the characteristics of your machine and sets the kernel up to work with it. The documentation warns that Tune may crash the machine a few times as it works, so when this happened on my trusty 8-MHz 286 clone, I calmly rebooted and tried again.

Alas, Tune hung the machine more than 20 times before I stopped trying. It couldn't figure out how things needed to be configured. I therefore called Eclipse, and its technical-support people were very helpful. They gave me a command that forced Tune to configure the kernel as if my machine were a standard AT. The resulting kernel ran with no problems.

What Price Speed?

Each of the DOS extenders I tested lets you "bind" the extender to the loader program to create an .EXE file that can be run directly from the DOS prompt. However, only Rational Systems' package actually included such a utility. The other vendors required you to buy a license before you could use it.

Suppose you're now sold on the idea of using a DOS extender in your application. How much can you expect to pay in royalties? If you have a successful product, you will probably pay a great deal, regardless of which vendor you choose.

Phar Lap charges \$1995 for the first 1000 copies and 2 percent of the list price of your program for each copy thereafter.

Rational Systems' DOS/16M, which has a \$5000 price tag to start with, comes with a license that lets you distribute 200 copies of your programs. After that, you

PS/2® MEMORY

Introducing **OS/RAM32™**

- ✓ 8 Mbytes of fast 32 bit memory.
- ✓ Works in all Micro Channel™ computers.
- ✓ Fast LIM 4.0 driver included.
- ✓ Provides extended and expanded memory.
- ✓ Easy switchless installation.
- ✓ Automatic configuration for DOS, OS/2 or UNIX.
- ✓ Risk free guarantee. Two year warranty.
- ✓ IBM approved ID. Fast delivery.
- ✓ From \$299 to \$1249 with 8 Megabytes.
- ✓ PC Magazine "Hot Prospect" 1/16/90.

Call today 617-273-1818 or 1-800-234-4CEC

cec Capital Equipment Corp.
Burlington, MA. 01803

PS/2 and Micro Channel are trademarks of IBM

pay \$30 per copy up to the 999th copy and \$15 per copy thereafter. If you wish to prepay for some larger number of copies or buy a blanket license, you need to negotiate directly with the company.

Eclipse lets you distribute 2500 copies of your application(s) for a single \$10 registration fee, but after that you must pay more, up to a maximum of \$15,000.

These prices may be sufficiently daunting to developers that they are inspired to roll their own DOS extenders. While this is a tricky business, it's certainly possible—and even likely—that some will do so. And compiler developers, eager to cash in on the DOS-extender market, may develop extenders exclusively for their own products.

I asked each vendor if its agreement made provisions for distribution of products as shareware; so far, none had. Unfortunately, without special terms for this mode of distribution, it's unlikely that we'll see protected-mode programs written with these DOS extenders in the shareware arena.

The Right Choice?

With OS/2, Windows, Unix, DESQview, DOS extenders, and DOS replacements all competing for pieces of the operating-environment marketplace, DOS extenders have two key advantages.

First, they don't require you to run out and buy an expensive piece of software (and possibly hardware to match); second, they provide better performance than most (perhaps all) of the other environments. The 386 DOS extenders run consistently ahead of Unix and OS/2 on virtually all benchmark tests, probably because they eliminate the overhead of a multitasking kernel and scheduler.

I plan to experiment further with DOS extenders as a way of getting more out of my systems and honing my protected-mode programming skills. While vanilla DOS and real mode will surely be around for a long time to come, it's clear that protected-mode programming will play an important role in the future of the Intel-based world. ■

ACKNOWLEDGMENT

Many thanks to Arche Technologies for the loan of a 386 system for use with the 386 DOS extenders.

L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

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

Unleash Your 80386 & 80486!

If you own or are about to buy a 386, 386SX, or 486-based system, you are losing 50% or more of your system's speed if you are still running 16-bit code or have not installed a coprocessor. To date, hundreds of mainframe applications have been ported to the 386 that take advantage of the real power of the 386. Many of these new applications were compiled with MicroWay NDP Fortran and C. Our compilers break the 640K barrier wide open, making it possible to run programs up to 4 gigabytes in size. They also run in virtual memory under DOS, UNIX or XENIX, generating mainframe quality, globally optimized code capable of driving every coprocessor on the market, including the latest high performance devices from Weitek and Cyrix. If you have a question about coprocessor performance, call for a free copy of an article by Stephen Fried, "The State of PC Numerics in 1990"

For Model 70 and 80 owners, we offer a Weitek Micro Channel card that runs 200% faster than an 80387. For Compaq Deskpro owners, our Weitek daughterboard takes a 3167 and Cyrix CX83D87. We also offer RAMPak one and four megabyte Deskpro RAM upgrades.

NDP Fortran-386 is as close to VMS FORTRAN as you can get in a non-VAX environment, while our C conforms to both the UNIX System V and ANSI standards and includes MicroWay and Microsoft extensions. If you plan to mix FORTRAN with C or Pascal, our languages are the only choice. Our compilers include GREX, a library of 135 character and pixel oriented graphics routines that automatically detect and support CGA, Monochrome, Hercules, EGA and VGA. We complement our compilers with a complete line of 386 tools listed below.

Please call (508) 746-7341 for more information.

486 Your PC!

Number Smasher-486™ is a 25 MHz replacement motherboard for ATs and 80386s. This motherboard supports an optional Weitek 4167 numeric coprocessor and up to 16 megabytes of 32-bit page mode memory. The Number Smasher-486 has been designed with Cache Shadow RAM for BIOS and video, and a 32-bit BURST memory bus which takes advantage of the enhanced features of the 486. It is ideal for applications such as CAD/CAE workstations, statistical analysis, linear programming, and multi-tasking operating environments, such as UNIX, XENIX, and OS/2. It supports the Phoenix, AML, or Award BIOS. The Number Smasher-486 with 0K is priced at \$3995.

NDP Fortran-486™, NDPC-486™, and NDP Pascal-486™ compilers were released in March, 1990 at \$1195 each.

386 Compilers and Tools

NDP Fortran-386™, NDP C-386™, and NDP Pascal-386™ compilers generate globally optimized, mainframe quality code that runs on the 386 or 486 in protected mode under UNIX, XENIX, or Phar Lap extended DOS. The compilers address 4 gigabytes of memory while supporting the 80287, 80387, Weitek and Cyrix coprocessors. Applications can mix code from all three compilers and assembly language. The DOS versions allow the user to write his own numeric error handlers and interface 386 real mode programs from protected mode. The VM versions use Phar Lap's Virtual Memory Manager to run programs which exceed the size of your system memory. **NDP Fortran-386** is a full FORTRAN 77 with FORTRAN 66, BSD 4.2, DOD, and VMS extensions. **NDP C-386** is a full K&R C with both MS and ANSI extensions. It is 100% compatible with UNIX C and is substantially faster than the C which comes with UNIX. **NDP Pascal-386** is a full ANSI/IEEE Pascal, with extensions from C and BSD 4.2 Pascal.

DOS versions (require Phar Lap Tools) \$595
 VM versions (require VMM and Tools) \$695
 UNIX/XENIX versions \$795
 Phar Lap Development Tools \$495
 Phar Lap Memory Manager (VMM) \$295
NDP Windows™ Library \$125, C Source \$250
NDPHOOPS™ \$795
NDP Plot™ \$325
NDP/FFT™ NDP or 80x87 version ea \$250
NDP to HALO '88 Graphics Interface \$100
NDP NAG™ — The NAG Workstation library is a subset of the NAG mainframe libraries. It contains a library of 172 routines designed to solve differential equations and eigenvalue problems, perform matrix operations, fit curves, do statistics and regression analysis, generate random numbers, and compute special functions and integrals. \$795, Weitek version \$995

NEW! C++

NDP C++ is a MicroWay port of the UNIX C++ preprocessor version 1.2. It runs in protected mode under DOS, UNIX, or XENIX, and is ideal for writing numerics and graphics applications. The product comes with an example of how to support complex numbers in C++ \$295

Parallel Processing

MicroWay's IBM compatible Monoputer, Quadputer, Videoputer, and Linkputer boards work together using Inmos transputers to provide expandable, plug-in mainframe performance for your desktop PC.

Monoputer™ — Includes one T800 and up to 16 meg of RAM for parallel code development. The 4 MWhetstones T800 makes it the ideal FORTRAN engine for cost-effective execution of your mainframe programs. from \$1295

Quadputer™ — This board for the AT or 386 can be purchased with 1 to 4 transputers and 1 or 4 meg of memory per transputer. Two or more Quadputers can be linked together to build networks of up to 100 or more transputers providing mainframe power. from \$1995

Videoputer™ — The highest performance graphics card on the market. Uses a T800 and TI 34010 in conjunction with an 80 MHz Brook Tree DAC. With one meg \$4495

Linkputer™ — Links up to 8 boards to provide dynamic transputer topologies. \$1500

Transputer Compilers and Utilities

These parallel languages are designed for use with the Monoputer, Quadputer and Videoputer.
Logical Systems Parallel C \$595
3L Parallel C, FORTRAN, or Pascal \$895
TBUG — debugger for 3L \$330
Parsec Parallel C/static \$895

ParaSoft EXPRESS Package — Includes transputer communications libraries, parallel code development library, C source level debugger, and system performance monitor. \$1500
Helios PC/s \$1250

Nexis Windows File Server — Lets you run parallel applications under the Microsoft Windows environment. \$495

T800/NAG™ — Port of the complete NAG mainframe library. Contains 268 functions. \$2750

387BASIC™ — Our 16-bit MS compatible compiler introduces numeric register variables to produce the fastest 80x87 code on the market. For "floating-point and other complicated mathematical calculations, you'll appreciate the extraordinary speed with which 387BASIC handles these processes". PC Magazine 10/31/89. \$250

NEW! Cyrix FasMath™

Cyrix CX83D87 FasMath™ — Fastest 80 bit Intel compatible coprocessor. Performs transcendental up to 3 times faster than the 80387. 20 MHz: \$499 25 MHz: \$649 33 MHz: \$799

Weitek-Based Coprocessor Boards

mW1167™ and **mW3167™** coprocessor boards are built at MicroWay using Weitek components. Each includes an 80387 socket.

mW1167-16 \$595
mW1167-20 \$795
mW1167 Micro Channel-16/20 from \$995
mW3167 Micro Channel-25/33 from \$1495
3167-20 \$795
3167-25 \$995
3167-33 \$1295
mW3167/80387 Board \$200

Intel Coprocessors and RAM

8087	\$84	8087-2	\$120
80287-8	\$195	80287-10	\$220
80387-16	\$330	80387-16SX	\$310
80387-20	\$375	80387-25	\$460
80C287A	\$280	80387-33	\$550

287Turbo-20™ This coprocessor board runs a specially qualified Intel CMOS 80287 at 20 MHz regardless of the main CPU speed. \$450
RAMPak™ — one or four meg 32-bit memory expansion module for Compaq Deskpro 386 20/25. One meg \$240. Four meg \$700

386 Your AT!

NUMBER SMASHER-386™ — A full sized card that replaces the 80286 microprocessor on your IBM AT or compatible motherboard with an 80386 that runs at 20 or 25 MHz. It runs numerically intensive applications up to a factor of 60 times faster, while maintaining full hardware and software compatibility when running all 386 applications. Includes sockets to optionally add up to 8 megabytes of 32-bit memory, an Intel 80387, Weitek, or Cyrix numeric coprocessor, and 64K or 256K of high speed cache memory. from \$895

12 MHz PC Accelerators

SuperCACHE-286 12 MHz \$399
FastCACHE-286 12 MHz \$299

MicroWay

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
 32 High St., Kingston-Upon-Thames, UK., 01-541-5466
 USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023



When in Finland,
do as the Finnish do;
when in assembly,
try the same

In *The Mythical Man-Month*, Frederick P. Brooks Jr. estimates that replacing 1 percent to 5 percent of high-level-language code with machine language is the best fix for any speed problem. For many hackers, that's been the most tantalizing of statements. True, a number of high-level languages, notably the ones in Borland's Turbo family, do provide machine language interfaces; but wasn't your reason for mastering one of those languages precisely that you'd be spared a byte-by-byte coping with assembly? If so, then (like me) you may have no grasp of assembly at all, and the luscious fruit Brooks dangles is just out of reach.

All need not be lost. Although I'll not be denying that the more you know the better, I'll offer a case history of how enlightened ignorance can sometimes lead to useful work. A Turbo Pascal program I'd written got speeded by a factor of six when I replaced two short procedures with assembly equivalents. One of them, yes, I copied from a book, but the other I devised on the principle by which a non-speaker of Finnish might manage to order breakfast in rural Finland: Observe the natives and imitate their ways.

Ignorance can be enlightened by two things: by the fact that all computer languages have structural analogies that the very nature of the computer enforces, and by the fact that once you find a skeleton to flesh out, a few hints from a good book may suffice.

A Dark and Stormy Night

It all started when I needed a program that would locate text strings (words and

phrases) in large text files and then tell me where and how often it had found them. Well, don't the MS-DOS utilities offer FIND.EXE? Yes, yes; but FIND doesn't tell you how often it found its quarry; it can tell you on how many distinct lines, which may be quite a different number. Also, for my purposes, FIND has at least two trouble areas.

The first is awkwardness. Each and every search requires a complex command line, where you specify the file to be searched, the string to be sought, refinements like "Ignore letter case" and "Display line numbers," instructions about where the output should go (disk? printer?): in short, much finicky key-pushing per search. And I envisaged perhaps dozens of searches per session.

The other trouble with FIND is that you can't make it disregard punctuation. That can cause no end of trouble. Say you want all instances of the word *up* in a file that contains, among other items, the following:

1. go up to
2. Up there
3. puppy
4. Get up!
5. Upset

The instances you want are 1, 2, and 4. FIND's search will locate 1, 3, and 4, overlooking "Up" and including an unwanted "puppy." The same search with the /I switch set (to ignore case distinctions) will locate not only the three items you do want, but also two you don't—items 3 and 5. By prefixing a space to the search string, you could exclude "puppy," and spaces both before and after would exclude "Upset" too; but then the trailing space would make the search miss "Get up!" So can't you somehow suppress punctuation as well as case?

Not, so far as I can see, with the DOS version of FIND. So my next step was to write a Turbo Pascal program, called SEEK, with the following specifications:

1. Just once, at the start, you name the file you plan to search.
2. The program asks you where you want the output: Printer? Disk file? Screen?
3. After that, it asks you for something to find (the Quarry), and each time you supply a Quarry it offers you two options:
Ignore case distinctions? <y/n>
Ignore punctuation? <y/n>
4. Output consists of numbered lines containing the Quarry.

If the Quarry appears twice on a line, the line is shown twice. At the end, the program tells you that the Quarry was found *n* times, or else it tells you, "I didn't find [Quarry]." It then asks you for a new Quarry; by answering "-" you can exit to DOS.

Like most no-fuss programs, SEEK devotes much code to getting filenames, error-checking, and other such house-keeping. But once under way, it spends most of its time as follows:

1. Read the next line of text to a string;
2. On a working copy of the string, (a) attach a leading and a trailing space; (b) swamp case differences if required; (c) kill punctuation if required;
3. Search the modified CopyString for Quarry; (a) If found, write the original line (numbered) to Outfile. (b) Search further along the string for a recurrence. (c) Found another? Back to 3a. No more? Back to 1.

The Game Is Afoot

I didn't need to write a search algorithm; Turbo Pascal has a very fast POS function to return an integer designating the first appearance of your Quarry in a line. A zero means "not found," so only when

```
POS (Quarry, CopyString) <> 0
```

continued

do you have to do anything more. (What you do is print `LineNumber` and `Line`, then behead `CopyString` right up to the end of the Quarry you've found, and then search what's left anew, just in case your Quarry is present more than once.)

That worked—not as fast as `FIND` but agreeably fast—so long as I didn't request it to "Ignore case differences" or "Ignore punctuation." In particular, the latter mired `SEEK`'s feet in molasses.

The obvious way to "Ignore case differences" was to put both the Quarry and the working copy of each input line into uppercase. That meant, for each of perhaps many hundred input lines, a `FOR` loop that ran from 1 to the length of the line, uppercasing characters as necessary. Turbo's `UPCASE` function made that go a lot faster than it might have; the procedure increased `SEEK`'s run times by some 30 percent, ascribable mostly to loop overhead. Without `UPCASE`—well, read on.

And the obvious way to "Ignore punctuation" meant a similar `FOR` loop, to ask each character in the line if it's contained in the set {0..9, a..z, A..Z} and replace it by a space if it isn't. (Quarry also gets a space appended if it hasn't one already; thus, a search for "up" with both options set becomes a search for "UP," and lo, you find "Get Up!" because it's been transformed into "GET UP "; meanwhile, the space guards us against distraction by "PUPPY.") Neat, yes. But you've no built-in Turbo function to help you, and that loop increases run time by an intolerable 650 percent.

I've since replaced the search function itself with an assembly version derived from Robert Jourdain's book *Turbo Pascal Express*. As published, it had a bug, which Dan Mick fixed for me via `BIX`. Moreover, so efficient is the Turbo Pascal `POS` that the speed gain proved unspectacular. Still, it was there.

Closing In on the Quarry

So back to *The Mythical Man-Month*'s rule of thumb: When a program spends most of its time doing one thing over and over, then optimize that routine and watch the sparks fly. Obvious candidates for optimization were perhaps the `LineUppercaser` and certainly the `Punctuation Killer`. To optimize a Turbo Pascal routine, you'd rewrite it in assembly language. But I didn't know assembly.

I did, though, chance to remember a detail from the Turbo Pascal 3.0 manual. To illustrate Turbo's in-line assembly code, it offered a sample procedure that did just what "Ignore case" wanted: converted entire strings to uppercase. So

I replaced my Pascal Procedure `UpperCase` with a careful copy of what the manual listed. The assembly version ran so fast that for files of, say, 25K bytes, the difference between ignoring case differences and not ignoring them was nearly unmeasurable. *The Mythical Man-Month* was right; I was on to something.

But could I also deal with punctuation in assembly? How long would it take to learn what I'd need? Weeks, likely, with luck. The payoff, savings measured in seconds, seemed insufficient.

But then two things dawned on me in rapid succession. First, when you need code in a language you don't know, best get it from a book, which was what I'd just done with `ProcedureUpperCase`. Second, if you can't find it in a book, look for something structurally similar and work out just the modifications. And that is the secret of flirting with assembly (or any other) language. Let a wizard handle the grunt work. Save your own attention for the details you need.

Something structurally similar? Well, I needed to read in a string, check it character by character, and replace anything that wasn't a numeral or letter with a space. And what does `ProcedureUpperCase` do? It reads in a string, checks it character by character, and replaces any lowercase characters with uppercase. That seemed close enough to be promising. Possibly, just by retouching `ProcedureUpperCase`, I could come up with machine code for a `ProcedureDePunct`. I finally did, and here's a play-by-play.

All Is Revealed

The first step was to gain some understanding of how `ProcedureUpperCase` worked. It is listed in full in listing 1. I'll be scrutinizing those mysterious assembly statements toward the right. Any reader fluent in MS-DOS assembly can either look away or relive the struggle.

First to catch the eye is that pair of labels, `L1:` and `L2:`. And since assembly items are supposed to jog human memories, an instruction beginning with `J` is probably a jump. (Yes, a book confirmed that.) Examining the code more closely, you find three jumps up to `L1:` and one jump clear out to `L2:`. Coming right after a counter has decremented, that `JZ` likely means "jump if zero" and jumps you to the exit point. Yes, `L2:`, at the very bottom, does look like an exit. If so, then the business part of the procedure, its repeated looping and testing, is confined to `L1:` and below. So the lines down to `L1:` are doing setup, and you can likely take them over as they stand. (All that turned out to be true.)

Now, how does the testing work? It looks as though the range `a` through `z` is being tested, since a character within that range wants uppercasing. A way to uppercase is to subtract decimal 32 (20 hexadecimal) from the character's ASCII value, and that must be what's happening in the second-to-last line of code, which begins with `SUB` and ends with `20H`. Thereafter, a `JMP` takes us back up to `L1:`, which must be where a new character starts getting fetched.

Another detail: Our character is evidently not being checked against all 26 of the letters `a` through `z`. The routine is just looking at boundary conditions. An assembly manual confirms the guess that `JA` means "jump if above" and `JB` means "jump if below." "Above" and "below" confused me for a little while. "Below" means "lower in value"—that is, nearer the top of the ASCII table. So if the character's ASCII value is less than hexadecimal 61 (`a`), or if it's higher than hexadecimal 7A (`z`), it's not a lowercase letter, and the jump takes us back to `L1:` to fetch the next candidate.

You can see how this is getting promising: Checking for membership in a range seems quick. Now recall the coarse structure of the ASCII table, where the alphanumeric characters come in just three blocks: decimal 48–57 (the numerals 0 through 9), 65–90 (the uppercased `A` through `Z`), and 97–122 (the lowercased `a` through `z`). You might check your character for membership in each block; keep it if it qualifies or have a space quash it otherwise.

So envisage a label `SP:` where that space gets substituted, and (as before) label `L1:` where you get the next character. An automatic jump to `L1:` should follow `SP:`. Using "below" the way assembly jargon uses it—to mean "nearer the top of the ASCII table"—pseudocode might look like this:

Initialize.

`L1:` Get a character.

Below 0? Jump to `SP:`, then to `L1:`.

Below or equal to 9? Jump to `L1:`.

Below `A`? Jump to `SP:`, then to `L1:`.

Below or equal to `Z`? Jump to `L1:`.

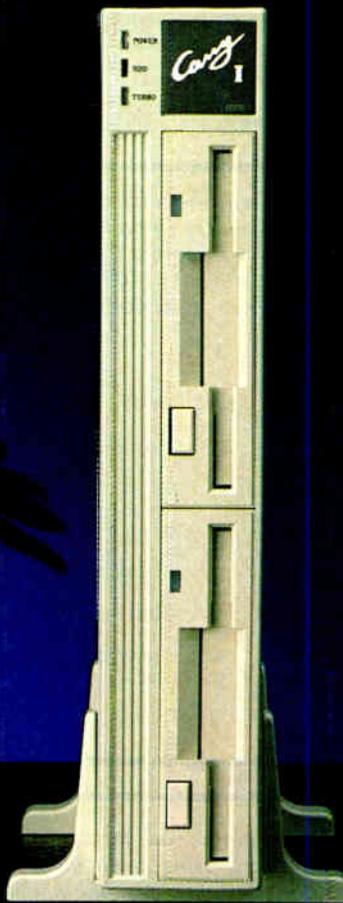
Below `a`? Jump to `SP:`, then to `L1:`.

Below or equal to `z`? Jump to `L1:`.

Notice that when you've descended as far as `A`, you've already eliminated the numerals, leaving it safe to exclude anything above `A`. Likewise, when you've reached `a`, you've eliminated all capitals as well as all numerals. And the place to put `SP:` is under the `z` test. That's because

continued

**A Refreshing Idea....
A New Standard....
Computing Goes Better With CARRY-I**



CARRY-I

**The Book Size Computer
The Book you'll read over and over again**

CARRY-I 8088

10MHZ XT/AMI BIOS /256K RAM expandable to 640k/One to two 720KB 3.5" FDD/
Serial/Parallel/Game/CGA/MGA/Standard keyboard connector/16Watt Power adapter
Dimension: 240mm x 185mm x 45mm Weight: 1.9kg-2.4kg

CARRY-I 80286

12MHZ, 0 Wait State AT/AMI BIOS with Diagnostic/1MB RAM/20MB Hard Disk
Drive optional/One to two 1.44MB 3.5" FDD/2 Serial/1 Parallel/CGA/MGA/Standard
keyboard connector/30Watt Power adapter
Dimension: 240mm x 185mm x 45mm Weight: 2.1kg-2.8kg

CARRY-I KEYBOARD

82 Key/XT-AT Autoswitch
Dimension: 310mm x 145mm x 27mm

*It's priced lower than you'd expect for a PC with this kind of power and portability.
But don't take our word for it. Call us today for more information.*



FLYTECH TECHNOLOGY CO., LTD.

HEAD OFFICE:

2 FL., NO. 8, LANE 50, SEC. 3,
NAN-KANG RD., TAIPEI, TAIWAN, R.O.C.
TEL: (02)785-2556 FAX: (02)785-2371
TELEX: 22233 FLTCO

U.S.A.:

3008 SCOTT BLVD., SANTA CLARA, CA 95054 U.S.A.
TEL: (408)727-7373, 727-7374 FAX: (408)727-7375

WEST GERMANY:

MENDELSSOHNSTRASSE 53,
6000 FRANKFURT AM MAIN 1, WEST GERMANY
TEL: (069)746-081, 746-453 FAX: (069)749-375

HONG KONG:

B12, B FL., BLOCK B, TONIC INDUSTRIAL CENTRE,
19 LAMHING ST., KOWLOON BAY, KOWLOON,
HONG KONG
TEL: 305-1268 FAX: 796-8427

COCA-COLA is a registered trademark of COCA-COLA Company

PC/XT/AT, are registered trademarks of International Business Machines Corp.

Circle 117 on Reader Service Card



Listing 1: *The compiler sees only the column at the left, where slashes separate binary instructions and \$ is Turbo Pascal's marker for a hexadecimal number; thus, \$C4 says what C4h would say in C, and either of them represents decimal 196, or binary 1100 0100. To the right of each statement, between curly brackets, is its assembly equivalent, meant solely for human consumption.*

```

PROCEDURE UpperCase (VAR Strg : 'lineStr');
  {From Turbo Pascal 3.0 manual, p. 113} BEGIN
  INLINE (
    $C4 / $BE / Strg /      { LES DI,Strg[BP] }
    $26 / $8A / $0D /      { MOV CL,ES[DI] }
    $FE / $C1 /            { INC CL }
    $FE / $C9 /            {L1: DEC CL }
    $74 / $13 /            { JZ L2 }
    $47 /                  { INC DI }
    $26 / $80 / $3D / $61   { CMP ES:BYTE PTR [DI], 'a' }
    $72 / $F5 /            { JB L1 }
    $26 / $80 / $3D / $7A / { CMP ES:BYTE PTR [DI], 'z' }
    $77 / $EF /            { JA L1 }
    $26 / $80 / $2D / $20 / { SUB ES:BYTE PTR [DI], 20H }
    $EB / $E9              { JMP SHORT L1 }
  ) {L2:
END; {Procedure UpperCase}

```

Listing 2: *The Turbo Pascal in-line code for a procedure that strips all but alphanumeric characters from a string, replacing suppressed characters by spaces. Jumps are represented by their decimal (not hexadecimal) equivalents; backward (negative) jumps are in two's-complement notation (256 plus the negative value).*

```

PROCEDURE DePunct (VAR Strg : 'lineStr'); BEGIN
  INLINE (
    $C4 / $BE / Strg /      { LES DI,Strg[BP] }
    $26 / $8A / $0D /      { MOV CL,ES[DI] }
    $FE / $C1 /            { INC CL }
    $FE / $C9 /            {L1: DEC CL }
    $74 / 44 /              { JZ L2 (+44) }
    $47 /                  { INC DI }
    $26 / $80 / $3D / 48 /  { CMP ES:BYTE PTR [DI], '0' }
    $72 / 30 /              { JB SP (+30) }
    $26 / $80 / $3D / 57 /  { CMP ES:BYTE PTR [DI], '9' }
    $76 / 239 /             { JBE L1 (-17) }
    $26 / $80 / $3D / 65 /  { CMP ES:BYTE PTR [DI], 'A' }
    $72 / 18 /              { JB SP (+18) }
    $26 / $80 / $3D / 90 /  { CMP ES:BYTE PTR [DI], 'Z' }
    $76 / 227 /             { JBE L1 (-29) }
    $26 / $80 / $3D / 97 /  { CMP ES:BYTE PTR [DI], 'a' }
    $72 / 06 /              { JB SP (+6) }
    $26 / $80 / $3D / 122 / { CMP ES:BYTE PTR [DI], 'z' }
    $76 / 215 /             { JBE L1 (-41) }
    $26 / $C6 / $05 / $20 / {SP: MOV ES:BYTE PTR [DI], ' ' }
    $EB / 209              { JMP SHORT L1 (-47) }
  ) {L2:
  ) END; {Procedure DePunct}

```

tive steps, supplied in two's-complement format. For short jumps, that means just subtracting the number of backward steps from decimal 256, although Duntemann offers a handy hexadecimal table.

The sole thing he doesn't stress sufficiently is that Turbo Pascal in-line code does not demand hexadecimal. Converting a decimal count to hexadecimal (or worse, trying to count in hexadecimal) is one more thing that's likely to bollix nonexperts. But it needn't be done. Instead of, say, \$2C (Turboese for 2CH), you can just insert plain decimal 44. Blessedly, the compiler won't care. (And how might you obtain decimal 44? As I'll be explaining in a moment, you simply count, kindergarten-style.)

Counting the Steps

Now look at listing 2, which is what I arrived at after some hours. The top five lines are copied straight from Procedure UpperCase in the Turbo 3.0 manual. Next, you'll easily spot the checks for the three ranges: 0 through 9, A through Z, and a through z. Once more, their syntax is lifted from the parent program; all I did was supply decimal numbers to mark where the ranges begin and end.

When the character's ASCII number is smaller than the number at the start of the range, then you jump (JB) down to SP:, where a MOV instruction substitutes a space. If you've taken that jump, you're done with this character, and you head back up to L1: to fetch another. If you haven't, you next try a match with the number at the end of the range. This time, if it's equal or smaller, you're within the range, and a jump-if-below-or-equal (JBE) takes you back up to L1:, where you pull in the next candidate from your string, or else you exit to L2: if no more string is left. And if both of those tests have failed, you move to the next range and repeat the process.

It all works perfectly. And fast! An unencumbered search clear through the 42,000 characters in a 750-line text file takes about 10 seconds. Depunctuating every line the Pascal way adds 55 seconds more. But depunctuating by this assembly procedure adds exactly 1 second: a stunning 55-to-1 improvement.

The Final Clue

Now for a few last details. Where did I get the code for JBE, which is not to be found in that parent program? I looked it up in Jeff Duntemann's "Eyeball Assembler," which spells out the hexadecimal codes for every useful assembly combination. That's also where I got the

continued

unwanted characters still lurk below z, and a descent that gets as far down as those can safely fall through to SP: without further testing.

A Necessary Confrontation

And now it's time to confront the need to write that Turbo Pascal in-line code in hexadecimal. Help is needed here, and the most suave and savvy help around is Jeff Duntemann's *Turbo Pascal Solutions* (Scott Foresman, 1988). After

Duntemann has done everything he can to discourage you from even attempting Turbo Pascal in-line code, he offers ample hints, backed up by an invaluable 70-page "Eyeball Assembler."

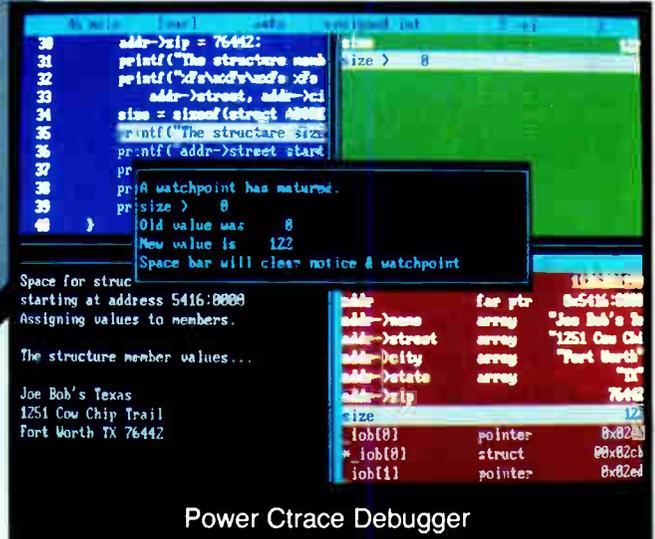
His most salient hint is this: Unlike real assembly, Turbo Pascal in-line code cannot just jump to a label. It must supply the number of steps in the jump, and "if you miss it by even a single byte, you could be reaching for the power switch." Moreover, backward jumps mean nega-

Power

Incredible Value!



Don't take our word for it, take theirs...



"Do you know what the underground bargain C compiler of this year is? It's the Mix Power C compiler. For under \$25 with shipping, it is one heck of a good compiler."

Victor Schneider
Dr. Dobb's Journal, June 88 (Letter to the editor)

"Overall, Power C's performance is remarkable for the price. Quite compatible with the Microsoft C and Turbo C "standards", Power C is a heavyweight contender in the educational, hobbyist, and perhaps even the professional market — at a bantamweight price."

Stephen Davis
PC Magazine, September 13, 88 (Review)

"Power C is an unbelievable product for \$19.95, and is very competitive with Turbo C, Microsoft C, and Microsoft's new Quick C in both features and performance. It is excellent for the beginner who wants to learn C, or for the experienced programmer who wants to develop professional applications. The manual alone is worth the price of this package, and the generous library source code and assembler offer adds to the value of it. If you have any desire to program in C, or want a more powerful C compiler, get a copy of Power C!"

Michael Cortese
Computer Shopper, August 88 (Review)

"The Ctrace debugger is where Mix really shines. It is magnificent. It's not only better than the stripped down debugger Microsoft includes with Quick C, it's better than the full debugger Microsoft provides with its high-end compiler (Codeview)."

David Weinberger
Computer Shopper, November 88 (Review)

Technical Specifications

Power C includes: Power C compiler with integrated Make, Power C Linker, Power C Libraries (450 functions), the Power C book (680 pages), and support for...

- ✓ ANSI standard
- ✓ IEEE floating point
- ✓ 8087/80287 coprocessor
- ✓ auto-sensing of 8087/80287
- ✓ automatic register variables
- ✓ unlimited program size
- ✓ mixed model (near & far pointers)
- ✓ graphics on CGA, EGA, VGA, & Hercules

Optional Products:

- ✓ Power Ctrace debugger
- ✓ Library source code
- ✓ BCD business math

Order now by calling our toll free number or mail the coupon to Mix Software, 1132 Commerce Drive, Richardson, TX 75081.

1-800-333-0330

For technical support call: 1-214-783-6001
 Minimum System Requirements:
 DOS 2.0 or later, 320K memory, 2 floppy drives or hard drive.
 Runs on IBM PC XT, AT, PS/2 and compatibles.

60 day money back guarantee

Name _____
 Street _____
 City _____
 State _____ Zip _____
 Telephone _____

Pay by: Money Order Check
 Visa MC AX Discover

Card # _____
 Card Expiration Date _____
 Computer Name _____ Disk Size 5 1/4" 3 1/2"

Product(s) (Not Copy Protected)

<input type="checkbox"/> Power C compiler (\$19.95)	\$ _____
<input type="checkbox"/> Power Ctrace debugger (\$19.95)	\$ _____
<input type="checkbox"/> Library Source Code (\$10.00)	\$ _____
(includes assembler & library manager)	
<input type="checkbox"/> BGD Business Math (\$10.00)	\$ _____
Add Shipping (\$5 USA - \$20 Foreign)	\$ _____
Texas Residents add 8% Sales Tax	\$ _____
Total amount of your order	\$ _____

B



Circle 194 on Reader Service Card

SOME ASSEMBLY REQUIRED

code for the key command

```
MOV ES:BYTE PTR [DI], ' '
```

which moves a space into the slot in memory that some unwanted character is occupying. (And no, I did not know that assembly command. I hunted through Duntemann's long list of MOV commands for one that looked like the SUB command I was replacing. You see what I meant about imitating the natives.)

And what about the lengths of all those jumps? The length is inserted as the last element in each jump instruction, and for forward jumps you just count how many elements are to be jumped over. Thus, the code for the last JB SP: ends with a 6, because to get to the start of SP: you must jump over the six machine-code elements in the next two lines. As I mentioned earlier, Turbo Pascal's compiler understands decimal numbers, although purists would prefer that you convert to hexadecimal.

The backward jumps to L1: are a little trickier. Examine the JBE L1:, just after the comparison with 9. Count the jump counter itself as 1, and count backward along each line of machine code until you reach the first instruction (\$FE) for L1:, and you'll get 17. Subtract that from 256 to get its two's-complement value, 239. That's your jump counter.

Assembly, My Dear Watson

So, lo, without any real grasp of MS-DOS assembly, you've acquired in-line machine code for a fast DePunct procedure. Let me repeat that I'm making no claims for ignorance. I'm certainly prepared to learn that a better assembly version of DePunct is possible. But I'm still asserting that a little patience, a little luck, a little analytic effort, and one good book can take you further with an unfamiliar language than you may have imagined you could go. ■

Editor's note: *The Turbo Pascal source code and a compiled version of SEEK are available in a variety of formats. See page 5.*

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times and Harper's. His recent books include A Sinking Island and Mazes. He can be contacted on BIX as "hkenner."

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

People are talking about us.

F77L-EM/32

Port 4GB mainframe programs to 80386s with this 32-bit DOS compiler. Winner of *PC Magazine's* 1988 Technical Excellence Award. \$895*

F77L

The compiler of choice among reviewers and professionals. New Version 4.0 includes an Editor, Profiler, Linker, Make Utility, Weitek and 386 Real-Mode Support, Graphics. \$595

F77L-EM/16

Address up to 15MB on 80286s with this award winning extended-memory compiler. \$695*

Lahey Personal FORTRAN 77

Full ANSI77, Microsoft C and Borland C interfaces, Debugger, at an unbeatable price. \$95

* Requires DOS Extender (\$195)

Lahey Available for Concurrent DOS & FlexOS 386.



When people talk about FORTRAN the name mentioned most often is



Contact us to discuss our products and your needs. (800) 548-4778
Lahey Computer Systems, Inc. P.O. Box 6091, Incline Village, NV 89450
Tel: (702) 831-2500 FAX: (702) 831-8123 Tlx: 9102401256

FORTRAN IS OUR FORTE

FAST SCSI STORAGE

Compatible with 286/386, Sun, Microsystem, Macintosh, Apple II, Tandy, Atari, Amiga

A-Hive - Enclosure for SCSI Drives

- Room for 2-HH or 1-FH drive 30 Watts \$119.
- Incl. all internal cables 65 Watts \$169.



Hermit Crab-Portable Hard Drive (2.8"x5.5"x7.5")

32MB to 200MB 28ms to 12ms \$429

Hermit Crab Shell \$89

SCSI Hard Drive 32MB to 760MB \$309

SCSI Tape Drive 50MB to 155MB \$389

2HD/4Floppy 286/386 Controller

1:1 16MHz MFM/RLI

XT/AT/286/386 SCSI/ESDI/MCA Controller

TULIN CORPORATION Tel:408-432-9025
2156H O'Toole Ave, San Jose,CA95131 Fax:408-943-0782

BYTE

PRODUCT SHOWCASE

- BUYER'S MART
- BYTE BITS
- PRODUCT SPOTS
- MICRO PRODUCT CENTER



THE BUYER'S MART

BAR CODE

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM

Add bar codes and big graphics characters to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39. Epson, Oki, IBM dot matrix text up to 1/2", LaserJet up to 2". Font cartridges not required. \$179-\$239. 30-day \$\$ back.

Worthington Data Solutions

417A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

BAR CODE READERS

Keyboard emulation for PC/XT/AT & PS/2's, all clones and any RS-232 Terminal. Transparent to your operating system. Available with Steel wands, Lasers, Slot & Magstripe Readers. Same day shipping, 30-day money-back guarantee. One-year warranty. Reseller discounts available.

AMERICAN MICROSYSTEMS

(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

Inquiry 588.

BAR CODE PRINTING SOFTWARE

- MS/PC DOS SYSTEMS
- 9 & 24 PIN DOT MATRIX
- H-P LASER JET/PLUS/SERIES II
- MENU-DRIVEN or MEMORY RESIDENT
- CODE 39, 1 2/5, UPC A/E, EAN 8/13
- BIG TEXT & BAR CODE SOFTFONTS

AMERICAN MICROSYSTEMS

(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

Inquiry 589.

PRINTING SOURCE CODE

Portable C source code program prints Code 39 and UPC bar codes. Label printing program for HP, Oki, and EPSON printers, can be used by itself or added to any custom application. Documentation shows how to add drivers and bar code patterns. Introductory price of \$59.95. No Royalties. Specify UNIX V/386 or MSDOS. 5.25" or 3.5" formats.

Infinity Computer Services, Inc.

P.O. Box 269, Coopersburg, PA 18036
215-965-7699

Inquiry 590.

BAR CODE SOFTWARE SOLUTIONS

ISD has software solutions that allow you to use bar codes for most anything. Like identifying products. Labeling packages. Or even managing assets and paperwork. You'll be able to speed and simplify data collection. Track products dock-to-stock. Streamline inventory control. And more.

Integrated Software Design, Inc.

171 Forbes Blvd., Mansfield, MA 02048
TEL: (508) 339-4928 FAX: (508) 339-2257
© 1989 Integrated Software Design, Inc.

Inquiry 591.

PC-Wand Bar Code Solutions

Bar codes are easy with a FULL line of readers & printers. They plug & play with your existing systems, most all makes of CPU/printer/terminal/software in your office, store, truck, factory or warehouse. Our bar code DOS programs print on matrix or laser printers. 30 day refund, 1 year warranty.

International Technologies & Systems Corp.

655-K North Berry St., Brea, CA 92621
TEL: (714) 990-1880 FAX: (714) 990-2503

BAR CODE

BAR CODE READERS Only \$285

- Complete Bar Code Systems Available
- Acts like a 2nd Keyboard for IBM XT/AT, PS/2 and Clones, Macintoshes and any RS-232C Terminal
- Wand/Laser scanner/Slot reader/Magnetic card reader connectivity
- POS Special Keyboard with Bar Code/Magnetic Card Readers
- No software or hardware modification needed
- 30-day Money-back Guarantee

KASCO TECHNOLOGY, INC.

486 Casita Way, Los Altos, CA 94022
Tel: (415) 949-0969 FAX: (415) 949-3814

Inquiry 592.

5-YR. WARRANTY AT PERCON

PERCON decoders are now covered by a five-year limited warranty. That means you won't spend one cent replacing your PERCON bar code decoder for five full years. That's reliability you can count on!

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399
See our ad on page 317

Inquiry 593.

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data! Choose from stainless steel wand or laser interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems

15127 N.E. 24th, Suite 333, Redmond, WA 98052
206-451-8966

Inquiry 594.

BAR CODE READERS

Among the best and most widely used bar code decoders. Reads all major codes (39, 1 2/5, S 2/5, UPC/EAN/JAN, CODABAR, MSI). Connects between keyboard and system. IBM, PS/2, MAC, DEC-VT compatible. OS & software independent. Same day ship. 2 Year Warranty (pen incl).

Large Reseller Discounts

Solutions Engineering

4705 Langdrum Lane, Bethesda, MD 20815
(800) 635-6533 (301) 652-2738

Inquiry 595.

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 596.

VARIANT MICROSYSTEMS BAR CODE READERS DELIVER

- WAND/LASER/MAGNETIC CARD CONNECTIVITY
- Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS/2 and portables.
- RS232C 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

3140 De La Cruz Blvd., Suite 200/Santa Clara, CA 95054/(408) 980-1880
FAX: (415) 623-1372

Inquiry 597.

BUSINESS OPPORTUNITY

Turn your computer into a family wage earner

Learn how some people are making over \$3000/wk with their computer. Every month receive a new and fascinating method of making money with your computer — each opportunity completely detailed — subscribe to ComputerProfits™ Reg. \$44/yr — now ONLY \$22/yr. VISA/MC call (603) 880-3991 or send to

ComputerProfits™

41 Carlene Dr., Nashua, NH 03062
(satisfaction guaranteed)

Inquiry 598.

CABLES AND ACCESSORIES

Parallel Printer Cables \$3.59 and Up
Serial Cables \$4.95 and Up
Switchboxes \$11.95 and Up
We can supply ALL your cabling needs. Master-Card & Visa Accepted. Dealer pricing available. Corporate & Government accounts welcomed.

CONNECT-IT

P.O. Box 14337, Arlington, Texas 76094
(817) 461-9400 M-F 9-6 p.m. cst

Inquiry 599.

CAD/CAM

POSTPLOT

The professional PostScript translator for HP-GL plotfiles supports the HP7475- and HP75XX-Instruction set. Plotfiles can easily be translated and/or printed on every PostScript-Printer. The compiler-like functions with the integrated editor allow modifications for * Orientation * Zoom * Character set * Pens * Paper size etc. \$465 plus \$20 shipping.

ds-datasections

Hauptstrasse 146a - D-8752 Glatzbach - W. Germany
FAX (49) 602146303

Inquiry 600.

VIEWER Professional

The ultimate solution for plotter users supports HP-GL plot-file previewing saving costs and time for unnecessary plots. Viewer works with the 75XX instruction set on most of the graphics cards allowing zoom function and additional instructions on Paper sizes up to A0 and E. \$465 plus \$20 shipping.

ds-datasections

Hauptstrasse 146a - D-8752 Glatzbach - W. Germany
FAX (49) 602146303

Inquiry 601.

CASE

FINITE STATE PROGRAM COMPILERS

State programs develop quicker, run faster and use less memory than sequential programs. A few keystrokes can replace hundreds of instructions. The Compeditor, a CASE software development tool, forms source state programs in: Ada, BASIC, C, FORTRAN and Pascal. FOR IBM DOS.

Price \$200 per lang. (With Primer and Debugger)
Sampler \$50.00 (With all manuals & credit)

AYECO 5025 Nassau Circle, Orlando
INCORPORATED FL 32808 (407) 295-0930

Inquiry 602.

CD-ROM

ALDE CORPORATION

CD ROM players as low as \$499 plus selected disc. Choose from many titles. Alde does consulting, joint venture and/or royalty projects for qualified parties. Write, call or fax for complete information. New Ada release.

Box 1086, Glen Lake, MN 55346
1-800-727-9724 FAX: 1-612-934-2824

Inquiry 603.

APRIL 1990 • B Y T E 305

THE BUYER'S MART

CD-ROM

Largest Selection and Best Price
Microsoft Programmers Library & Drive \$949.
Computer Library \$695 • Public Domain S/W \$49.
NEC PC or Mac Drive Kit \$749 • Bookshelf-Best Price!

Drives from \$499. Hundreds of titles from \$29.
MC/VISA/AMEX/COD, Money-back Guarantee.
Call or write for free 120-page catalog.

Bureau of Electronic Publishing

141 New Road, Parsippany, NJ 07054
800-828-4766

THE SOURCE FOR CD-ROM

Inquiry 604.

A COMPACT DISC SALES AND CONSULTING FIRM AT SPECIAL

CD-ROM Drive, 286 16mbz, 42MB hard drive, 101 keyboard, high resolution monochrome, DOS 4.01 with DOS Extension Software & 3 titles. **\$2,495**
NEC CDR 35 Portable for IBM. **\$599**
Hitachi internal **\$439** External **\$479**
Retails at \$679 Sale **\$499**
Post DM 3200 **\$349**
Toshiba XM \$120 for MAC or IBM **\$349**
Toshiba XM 3201 for MAC or IBM **\$549**

Title special of the month **\$249**

Free Catalog/VISA/AMEX/COD

CD ROM, INC.

1667 Cole Blvd., Suite 400, Garden, CO 80401

TEL: 303-231-9372 FAX: 303-231-9581 CIS: 72007544

Inquiry 605.

CD-ROM/WORM/ERASABLES WE BEAT ANY PRICE

CALL FOR LOW, LOW MONTHLY SPECIALS
CD-ROM Drives: HITACHI • NEC • SONY • TOSHIBA • PHILLIPS • DENON • CHINON

Worm Drives: MAXTOR • PANASONIC • PIONEER • TOSHIBA

Erasable Drives: MAXTOR • CANON • SONY

ENDLESS STOCK OF CD-ROM discs, unmatched anywhere!
AMEX/MC/VISA/COD/PO's Welcome

CD-ROM SHOPPER (201) 866-1666

1168 Elm Terrace 24-hr auto order line
Rahway, NJ 07065 Fax (201) 866-8048
7 days a week

Inquiry 606.

CD-ROM Publishing Services

Complete CD-ROM publishing services including custom software interface. Reasonable rates, fast turnaround. Call for quote.

Titles published: Food/Analyst, Econ/Stats, Consu/Stats, Agri/Stats.

Hopkins Technology

CD-ROM Publisher

421 Hazel Lane

Hopkins, MN 55343-7117

(612) 931-9376 CIS 74017,614

Inquiry 607.

CD-ROM Developer's Lab

Multimedia production resource for Mac & PC developers & managers. Proven design, management, data prep, programming, pre-mastering, and manufacturing techniques & specs from 18 leading companies. Demos of off-the-shelf tools for imaging, audio, animation (Mac). Real applications using Media—Mixer source tools. CD-ROM XA, PC or Mac \$795, Transportable \$845. Visa or MasterCard.

Software Mart, Inc.

4131 Spicewood Springs Road I-3, Austin, TX 78759

512-346-7887

Inquiry 608.

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 Brian Higgins for more information

603-924-3754

or

Fax: 603-924-2683

Inquiry 609.

306 BY T E • APRIL 1990

COMMUNICATIONS

PC SDLC SUPPORT

Use Sangoma hardware and software to provide a cost effective, robust and easy to use SDLC link from MS-DOS, XENIX, AIX, PICK, PC-MOS, etc.

All real time communication functions performed by intelligent co-processor card.

X.25 support also available.

Sangoma Technologies Inc.
(416) 474-1990

7170 Warden Avenue #2, Markham, Ontario, Canada L3R 8B2

Inquiry 610.

COMPUTER INSURANCE

INSURES YOUR COMPUTER

SAFEWARE provides full replacement of hardware, media and purchased software. As little as \$49 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am-10 pm ET. (Sat. 9 to 5)

TOLL FREE 1-800-848-3469

(Local 614-262-0559)

SAFEWARE, The Insurance Agency Inc.

Inquiry 611.

COMPUTER UPGRADE

THE COMPLETE XT UPGRADE

The K-311 Upgrade Kit converts your XT to full 32-bit, 20MHz 80386 CPU and high speed disk performance. The K-311 Kit Includes 20MHz 80386 w/1Mb RAM, 16-bit Adaptec 1:1 controller, 63Mb 28Ms Mitsubishi disk drive, choice of 1.2 or 1.4Mb diskette drive, Key Tronic 101 Plus keyboard, 200 W PS, new drive cables. Matches or exceeds the performance of a new system but at far less cost. Top quality, easy installation, 1 year warranty, \$1,795

5G Corporation

4131 Spicewood Springs Road A-4, Austin TX 78759
800-333-4131 512-345-9843 Fax 512-345-9575

Inquiry 612.

\$799 FOR 386-20

\$599 FOR 386SX \$399 FOR 286-12

Upgrade your computer at a fraction of the cost. Send your computer in, we will do the work. Order now, we will send you a box for mailing your computer. Your old parts will be exchanged for labor charge. We will put in new parts & charge wholesale prices for any parts which do not fit the new system. Prices shown are for motherboard and 1MB RAM. New system available at low prices.

ABTECH Inc.

1431 Potrero Ave., S. El Monte, CA 91733
(800) 992-1978 in Calif. (818) 575-0007

Inquiry 613.

CROSS ASSEMBLERS

CROSS ASSEMBLERS

Universal Linker, Librarian

Targets for 36 Microprocessors

Hosts: PC/MS-DOS, micro VAX, VAX 8000

ENERTEC, INC.

BOX 1312, 811 W. Fifth St.

Lansdale, PA 19446

Tel: 215-362-0966 Fax: 215-362-2404

Inquiry 614.

CROSS ASSEMBLERS/SIMULATORS

Brand new full-function simulator for the 8096 controller, supporting ALL MODES of interrupts plus the HSI, HSO, A/D, and Serial features, with full disassembler, just \$300! Our superb simulators for the 8048, 8051, and 8085 sell for \$200, and those for the 8052 and Z80 for \$250 each.

Our line of cross assemblers for all above target CPUs are also full PC compatible and sell for \$100 each. We offer discounts for simulator plus assembler packages.

Lear Com Company

2440 Kipling St./Ste. 206, Lakewood, CO 80215

303-232-2226

Inquiry 615.

CROSS ASSEMBLERS

MACINTOSH CROSS ASSEMBLERS

µASM™—New Version 3.0! Integrated text editor, assembler, and terminal package. S or Hex output downloads to most EPROM programmers. Macros, cond'l ass'y, local & auto labels, symbol table cross-ref. \$149.95 each plus S/H. MC/V/AE. Tech. bulletin avail. Most 8-bit MPUs.
30 day money back guarantee.

MICRO DIALECTS, INC., Dept B

P.O. Box 30014, Cincinnati, OH 45230

(513) 271-9100

Inquiry 616.

CROSS ASSEMBLERS

Relocatable

Macros

PC Compatible

GUARANTEED, SUPPORTED

DEBUG SIMULATORS • DISASSEMBLERS

EPROM PROGRAMMERS

MICRO COMPUTER TOOLS CO.

Phone Toll Free (800) 443-0779

In CA (415) 825-4200

912 Hastings Dr., Concord, CA 94518

Inquiry 617.

6800-Family Development Software

Our C Compilers for the 6800, 6801, 6809, & 68HC11 feature a complete implementation (excluding bit fields) of C as described by K&R and yielding 30-70% less code than other compilers. Our Assemblers feature macros and conditional assembly. Linker & Terminal Emulator included.

Wintek Corporation

1801 South St., Lafayette, IN 47904

(800) 742-6809 or (317) 742-8428

Inquiry 618.

CROSS COMPILERS

68000 C Compiler

Available under MS-DOS, UNIX and VMS
CrossCode C generates ROMable code for all members of the Motorola 68000 family. It comes with an optimizing compiler, Motorola-compatible assembler, linker, librarian, symbol lister, and universal downloader. For more info, see our display ad on page 105.

Call today: 1-800-448-7733

Software Development Systems, Inc.

4248 Belle Aire Lane, Downers Grove, Illinois 60515 USA

Outside USA dial 1-708-971-8170. FAX: 1-708-971-8513

Inquiry 619.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION

More than just a straight dump or ASCII transfer!
Word Processing, DBMS, and Spreadsheet data on Disks or Tapes transferred directly into applications running on Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters, and Electronic Publishing systems.

IBM PS/2 & Macintosh supported

#1 in the translation industry!

CompuData Translators, Inc.

3325 Wilshire Blvd., Suite 1202, Los Angeles, CA 90010

(213) 387-4477 1-800-825-8251

Inquiry 619.

DBMS/COPY

CONVERTS YOUR DATA INTO INFORMATION
Now your favorite stat package can access any database. DBMS/COPY can directly convert any database or spreadsheet file (ORACLE, PARADOX, dBASE, LOTUS etc.) into any stat package file (SAS, SPSS, SYSTAT, etc.) and vice versa. The PLUS version allows sorts, selections, and recalculations. \$195. 30-day guarantee. VISA/MC/AMEX/PO/COD. Call for free limited version.

CONCEPTUAL SOFTWARE INC.

P.O. Box 56627, Houston, TX 77256

(713) 667-4222 FAX: (713) 667-3FAX

1-800-STATWOW

Inquiry 620.

THE BUYER'S MART

DATA SECURITY

"We all sincerely believed that when we punched delete, it was gone forever. Wow, were we wrong!"
—Lt. Col. Oliver North, July 7, 1987

DELETE IS NOT COMPLETE!

Use **DATA SHREDDER** - The ultimate security blanket.
From **CORPWARE** - Software that means Business.

CORPWARE, LTD. 800/562-3475
All elements of ad are tm, sm and/or © 1989 CORPWARE, LTD

Inquiry 621.

DATA/DISK CONVERSION

DISK CONVERSIONS

Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Micom, NBI, CT, Exxon, WRDPLEX also WP, WS, MSWRD, DW4, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.

FREE TEST CONVERSION CONVERSION SPECIALISTS

531 Main St., Ste. 835, El Segundo, CA 90245
(213) 545-6551 (213) 322-6319

Inquiry 622.

FROM MACs TO MAINFRAMES. . .

Our 12 conversion systems support over 1000 formats

DISK INTERCHANGE SERVICE COMPANY

2 Park Drive • Westford, MA 01886
(508) 692-0050

Inquiry 623.

BUY YOUR OWN CONVERSION SYSTEM!

With nearly a decade of experience in data conversion, you can work with the industry leader in 9-track tape, cartridge tape and diskette conversion systems. Enjoy the convenience of your own conversion system. Call today to discuss your application!

Flagstaff Engineering

1120 Kaibab Lane, Flagstaff, AZ 86001

(602) 779-3341

MasterCard - Visa - American Express Accepted

Inquiry 624.

THE #1 CHOICE In disk & tape conversion

for many leading corporations, government agencies, law firms, and companies in every industry—world-wide.

Free test • Satisfaction guaranteed

Graphics Unlimited Inc.

3000 Second St. North, Minneapolis, MN 55411

(612) 588-7571 or (612) 520-2345

FAX: (612) 588-8783

Inquiry 625.

QUALITY CONVERSIONS

to or from virtually

ANY TAPE OR DISK FORMAT!

Horan Data Services converts over 2000 formats incl. 9-track tape and 8", 5 1/4" or 3 1/2" diskettes. All densities & most operating systems supported. Formats include EB/CDC, ASCII, databases, spreadsheets, and dedicated or PC word processors.

Call 1-800-677-8885

Hours 8:00AM to 5:30PM Eastern Time
817 Main Street, Third Floor, Cincinnati OH 45202

Inquiry 626.

DATA/DISK CONVERSION

*** We RENT conversion systems or DO the conversion for you!***

Conversion Capabilities: 9 Track Tape, 8" Disk, 1/4" Cartridge, Word Processors, Optical Disk, 2.3 Gigabyte Backup, Fax Workstations

WE WILL SOLVE YOUR DATA CONVERSION PROBLEMS!

LIONSGATE DATA SERVICES

CALL: (818) 704-5867 OR FAX: (818) 716-5647

Inquiry 627.

IBM PC ◀ TO ▶ HP FILE COPY FASTER EASIER TO USE

Update version uses windows: Call for free demo! IBM PC <to> HP File Copy allows IBM PCs, PS/2, compatibles to interchange files with Hewlett-Packard Series 70, 80, 200, 300, 1000, 9000s.

Oswego Software

Box 310 708/554-3567
Oswego, IL 60543 FAX 708/554-3573

Inquiry 628.

CONVERSION SERVICES

Convert any 9-track magnetic tape to or from over 2000 formats including 3 1/2", 5 1/4", 8" disk formats & word processors. Disk-to-disk conversions also available. Call for more info. Introducing OCR Scanning Services.

Pivar Computing Services, Inc.

165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 (800) Hi-Pivar

Inquiry 629.

DATABASE MGMT SYSTEMS

dBASE file access from C

Code Base 4 is a library of C routines which gives complete dBASE or Clipper functionality and file compatibility. Use DOS, Unix, OS/2 or MS Windows.

\$295 with Source! FREE DEMO

Sequiter Software Inc.

Call (403) 439-8171 Fax (403) 433-7460

Inquiry 630.

DEMOS/TUTORIALS

INSTANT REPLAY III

Build Demos, Tutorials, Prototypes, Presentations, Music, Timed Keyboard Macros, and Menu Systems. Includes Screen Maker, Keystroke/Time Editor, Program Memorizer, and Animator. Rec'd Great Reviews! Simply the BEST. Not copy protected. No royalties. 60-day satisfaction money-back guar. IBM and Compat. \$149.95 U.S. Chk/Cr. Crd. Demo Diskette \$50.00.

NOSTRADAMUS, INC.

P.O. Box 9252

Salt Lake City, Utah 84109 (801) 272-0671

Inquiry 631.

DISASSEMBLERS

80x86 .EXE/.COM to .ASM

- Accurately reconstruct, study & modify [64K+] programs with a minimum of input or editing of output.
- Assembly language output is MASM 5.x-compatible
- Exhaustive flow-trace distinguishes code from data.
- Best formats for each. Commented BIOS calls/DOS functions. SEGMENT/PROC/other vital pseudo-ops

PC-DISnData (5 1/4" disk & manual) \$165

PRO/AM SOFTWARE

220 Cardigan Road, Centerville, OH 45459
(513) 435-4480 (9 A.M. - 5 P.M. EST M-F)

Inquiry 632.

DISASSEMBLERS

SOFT-X-PLORE

See "BYTE's May '88 issue pg. 78." Disassemble 500 kb (*) program at 10,000/min. (*) in any file, ROM/RAM memory up to 80386 instruction set (!) **SOFT-X-plore:**
* is for MS/DOS 2.0+ systems
* uses 20 algorithms and seven passes (*)
* only \$99.95 plus S&H w/30-day guarantee.
To order call (800) 446-4656 or info (203) 953-0236

Or write: **RJSWANTEK INC.**
178 Brookside Rd., Newington, CT 06111
* best on the market MCVISA accepted

Inquiry 633.

DISK DRIVES

PS/2 DRIVES FOR PCs ATs

Compat:KiU/PC \$279
Compat:KiU/AT \$219

Built-in floppy controllers—no problem.

Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes *plus more!* Call for further information or to place an order.

VISA/MC/COD/CHECK.

Micro Solutions Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115 815/756-3411
See our ad on page 100.

Inquiry 634.

DISK DUPLICATION

SOFTWARE PRODUCTION

- Disk duplication
- All formats
- EVERLOCK copy protection
- Label/sleeve printing
- Full packaging services
- Warehousing
- Drop shipping
- Fulfillment
- 48-hour delivery
- Consultation & guidance

Star-Byte, Inc.

2880 Bergey Rd., Hatfield, PA 19440

215-997-2470 800-243-1515

Inquiry 635.

EDUCATION

B.Sc. & 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. BSC subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. MS program includes subjects in Software Engineering and Artificial Intelligence.

AMERICAN INST. FOR COMPUTER SCIENCES

1704-BY 11th Ave. So., Birmingham, AL 35205
205-933-0339

Inquiry 636.

Urgently Required

Be a highly paid computer consultant. We offer a comprehensive training program. Upon successful completion of the program, we will offer you a license to operate your own business and introduce your business worldwide through our worldwide network.

As we have limited openings, write us today! Send your resume and evaluation fee of \$50. USD payable to:

Worldwide Canadian Management Consultant Inc.

P.O.B. 639, Pickering, Canada L1V 3T3

Inquiry 637.

ENTERTAINMENT

CROSSWORD PUZZLE PROGRAM \$95

Wordsmith automatically constructs symmetrical crossword puzzles from 40,000 words in user modifiable lists. IBM/Compatible, 640K memory. Hard drive recommended. 5-1/4" or 3-1/2" disks. 30-day money-back guarantee.

COLLINS SOFTWARE

J.L. Collins, Box 110, 875A Island Dr., Alameda, CA 94501

Inquiry 638.

THE BUYER'S MART

ENTERTAINMENT

NEMESIS™ Go Master®

Go, a game of strategic elegance, has been a way of life in the Orient for over four thousand years. Many consider Go to be the secret of the Japanese businessman's success. "While chess is a game of war, Go is a game of market share" [President of Nikko Hotels]. "If you are interested in Go, buy this program."

Game of the Month J. Pournelle BYTE 7/87
Toyogo, Inc. The Leader in Computer Go.
 76 Bedford St. #34Y, Lexington, MA 02173, (617) 861-0488
 1-800-4-TOYOGO

Inquiry 639.

FLOW CHARTS

Flow Charting II+

For IBM and compatibles. It will amaze you with its speed, power and simplicity. 26 standard shapes with over 120 sizes — 10 text fonts — 4 line styles. Place text, lines and shapes anywhere on your chart. For only \$229 you'll never draw another chart by hand.

Patton & Patton

81 Great Oaks Blvd., San Jose, CA 95119
 1-800-525-0082 Ext. 42 (Outside CA)
 408-629-5376 Ext. 42 (CA/Int'l)

Inquiry 640.

WINDOWS FLOWCHARTER \$79

RFFlow is a professional drawing tool for flowcharts & org charts (requires Microsoft® Windows). 75 shapes automatically adjust in size. Move, copy, delete groups of objects. 7 levels of zoom. Move flowcharts to other applications via the Clipboard. Supports Windows printers, plotters, and cartridge or soft fonts. Call for free trial disk.

RFF ELECTRONICS

1053 Banyan Court, Loveland, CO 80538
 Phone: (303) 663-5767 FAX: (303) 669-4889

Inquiry 641.

STRUCTURED FLOW CHART

NSChart creates Nassi-Shneiderman (structured) flowcharts from a simple PDL. Key words define structures & text strings appear in the chart. Easy to create, even easier to revise! Automatic chart sizing, text centering. Translators from many languages available. For Mac and IBM PC.

SILTRONIX, INC.

P.O. Box 82544, San Diego, CA 92138
 1-800-637-4888

Inquiry 642.

FREE COMPUTER MAGAZINES

FREE SUBSCRIPTIONS To More Than 200 Magazines

Don't spend a fortune on computer, communications or business magazines. The SeaBird Directory lists over 200 titles you can get free and runs on any IBM PC.

For more info, and **FREE DEMO DISK**, call:

1-800-782-0194
 or fax to: 617-863-8684

Inquiry 643.

GRAPHICS

EGAD Screen Print

Prints contents of VGA, EGA, CGA displays on variety of dot-matrix and laser printers. Prints in gray tones or color. Crop box lets you print any region of the screen. Enlarge graphics 1 to 4 times (reduction too). Setup program for picking printer colors, etc. \$25.00 Postpaid. Call or write for free catalog.

LINDLEY SYSTEMS

4257 Berwick Place, Woodbridge, VA 22192-5119
 (703) 590-8890

Inquiry 644.

308 B Y T E • APRIL 1990

GRAPHICS

IMAGE CAPTURE BOARD

Capture images from any VCR or Cam-Corder. Resolution: up to 512 x 480 pixels: 256 Colors or 256 shades of grey. Images may be saved in GIF, PCX, TIFF formats and more. VGA Required. Available for PC/XT/AT and PS/2: \$749.00
 JLasers. Increase laser printer resolution to 4800 x 300 dpi w/256 grey scale. PS/2: \$599.00
 PC/XT/AT: \$399.00

PEGASYSTEMS (614) 885-1007

P.O. Box 713, Westerville, OH 43081

Inquiry 645.

HANDHELD COMPUTER

TURNKEY HANDHELD SYSTEMS

HARDWARE and Customized SOFTWARE to give you Solutions, not hassles. Solve your portable computer problems with a system designed for your needs. Our systems approach has aided companies in Banking, Insurance and other fields needing a customized approach.

EXTECH 150 Bear Hill Road
 INSTRUMENTS Waltham, MA 02154
 (617) 890-7440

Inquiry 646.

HARD DRIVE REPAIR

HARD DRIVE REPAIR

WE WILL REPAIR YOUR HARD DRIVE AT A FRACTION OF THE COST OF REPLACING IT. FAST TURNAROUND!!! CALL FOR DETAILS.

H & W micro, Inc.

528-C FOREST PARKWAY
 FOREST PARK, GA 30050
 (404) 366-1600

Inquiry 647.

DISK DRIVE REPAIR DATA RECOVERY

SALES of new, remanufactured and removable disk drives

FULL TECHNICAL SUPPORT

ROTATING MEMORY SERVICE

1506 Dell Avenue, Campbell, CA 95008
 (408) 370-3113

We buy used drives good or bad

Inquiry 648.

HARDWARE

CHIP CHECKER

- 74/54 TTL + CMOS
- 8000 Nat. + Semiconductors
- 14/4000 CMOS
- 9000 TTL
- 14-24 Pin Chips
- 3" + 6" IC widths

Tests/identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM-compatible version \$259. C128 + C64 version \$159.

DUNE SYSTEMS

2603 Willa Dr., St. Joseph, MI 49085
 (616) 983-2352

Inquiry 649.

OUTDATED BIOS?

An AWARD ROM BIOS will Update your IBM XT, AT, Clone. Supports:

- ☆ Enhanced (101/102) Keyboards
- ☆ 1.44Mb 3.5" Floppies
- ☆ Expanded Hard Drive Table

1 800-423-3400 or (412) 782-0384

KOMPUTERWERK, INC.

851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 650.

HARDWARE

Macintosh® Parts & Repairs

Programs for the corporate, government, dealer and educational buyer. Call for kit.

Save up to 55% on Mac II CPU

800-274-5343 / 617-891-6851

Pre-Owned Electronics, Inc.

30 Clematis Ave • Waltham, MA 02154
 Macintosh is a registered trademark of Apple Computer, Inc.

Inquiry 651.

HARDWARE/ADD-ONS

Call Today

for DRAMATIC Low Pricing

on New Slims™ Memory Modules

1, 2, 4 and 8 Megabyte 72-pin modules available

TermoTrol Corp.

1888 Century Park East, Suite 1900, L.A., CA 90067
 213-284-3242 800-365-0045

Inquiry 652.

HARDWARE/CONTROLLERS

EMBEDDED SYSTEMS CONTROLLERS

SC/FOX™PCS (Parallel Coprocessor System) and PCS32 are PC/XT/AT plug-in boards. 16 and 32 bit. 15 MIPS average, 50 MIPS burst. PCS uses the Harris RTX 2000™ 16-bit Forth CPU with 1-cycle multiplier, 14 prioritized interrupts, 3 timer/counters, 8-channel I/O bus. PCS32 uses the new SC32 32-bit Forth CPU. SC/FOX SBC (Single Board Computer) is an 18 MIPS average, 60 MIPS burst, Eurocard-size RTX 2000 stand-alone computer. SC/FOX SCSI I/O Plug-on board for PCS or SBC with SCSI, floppy, 56K-baud serial, 16-bit parallel ports, and software drivers. Forth development software included. Ideal for embedded realtime control, data acquisition, robotics, and signal processing.

SILICON COMPOSERS INC. (415) 322-8763
 208 California Avenue, Palo Alto, CA 94306

Inquiry 653.

HARDWARE/COPROCESSOR

DIGITAL SIGNAL PROCESSOR

DSP products for the IBM PC/XT/AT based on the TI TMS32010 and TMS320C25 up to 12 MIPS operation. Designed for applications in communications, instrumentation, speech, and numeric processing. Offered with 12 bit 110 KHz A/D and D/A and continuous-to-disk data acquisition & playback option. From \$650.

DALANCO SPRY

89 Westland Ave., Rochester, NY 14618
 (716) 473-3610

Inquiry 654.

HOME AUTOMATION

COMPUTERIZE YOUR HOUSE!

FREE CATALOG! Do-it-yourself home automation systems bring computerized security, entertainment, convenience and state of the art technology to your home now. Unique X-10, radio, computer interfaces, software, computerized telephones, voice, talking security, lighting, TV, A/V, video observation, and lots more. Easy to install
 Call or write for free catalog!

Home Automation Laboratories

3277 Roswell Road, Suite 300-B, Atlanta, GA 30305
 (404) 319-6000 ext. 2# (24 hrs.)

Inquiry 655.

INVENTORY MANAGEMENT

STOCK-MASTER 4.0

Commercial grade inventory management software at micro prices.

- Supports all 12 transaction types
- Trend Analysis
- Quality Control
- Multiple Locations
- Purchase Order Tracking
- Open Order Reporting
- Serial/Lot # Tracking
- Stock Status Reporting
- Activity History Analysis
- Bill of Materials
- Purchase Order Writing
- Order Entry
- Material Requirements
- On Line Inquiry

Applied Micro Business Systems, Inc.

177-F Riverside Ave., Newport Beach, CA 92663 714-759-0582

Inquiry 656.

THE BUYER'S MART

INVENTORY MANAGEMENT

dFELLER Inventory

Business inventory programs written in modifiable dBASE source code.

dFELLER Inventory \$150.00

Requires dBASE II or III, PC-DOS/CPM

dFELLER Plus \$200.00

with History and Purchase Orders

Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates

550 CR PPA, Route 3, Ishpeming, MI 49849

(906) 486-6024

Inquiry 657.

LANS

The \$25 Network

Try the 1st truly low-cost LAN

- Connect 2 or 3 PCs, XT's, AT's
- Uses serial ports and 5-wire cable
- Runs at 115K baud
- Runs in background, totally transparent
- Share any device, any file, any time
- Needs only 14K of RAM

Skeptical? We make believers!

Information Modes

P.O. Drawer F, Denton, TX 76202

817-387-3339

Orders 800-628-7992

Inquiry 658.

LAPTOP COMPUTERS

Laptop Savings

Laptops: Toshiba • Zenith • NEC • Sharp

• Epson • Mitsubishi • Compaq

Also Laptop Accessories: Modems, Fax Modems, External Drives, Portable Printers, Memory, Key Pads, Hard Drives, Batteries, and Auto Adapters.

Computer Options Unlimited

12 Maiden Lane, Bound Brook, NJ 08805

Phone: 201-469-7678 (Fax: 201-469-7544)

Hours: 9am/10pm 7 days Worldwide sales

Inquiry 659.

LAPTOP BLOWOUT SALE!!!

MITSUBISHI • SHARP • PANASONIC • TOSHIBA

Laptops are now at their lowest prices ever. We buy direct from the factory, unlike our competition. We guarantee the lowest net prices in the entire country and stock every item specific to laptops. We ship in 24 hours. We also stock over \$1 million in laptops alone! Always buy from a factory-direct dealer. For your protection we check for stolen credit cards & ship only to your billing address. No COD's Please.

TOTE-A-LAP

1501 El Camino Real, Belmont CA 94002

(415) 591-1663 ext. 603

Inquiry 660.

LAPTOP PERIPHERALS

LAPTOP BACKLIGHTS

Factory Installed • 90-Day Warranty

Toshiba, Amstrad, Sanyo, DG,

Kaypro, IBM, HP, etc. \$295

The Portable Peripherals People

Axonix Corporation

(801) 466-9797

Inquiry 661

TOSHIBA LAPTOP ENHANCEMENTS

FAK/MODEMS: 9600/2400 bps, software, acoustic port

MODEMS, INTERNAL: 2400 bps, acoustic or serial port

MODEM, DEDICATED: 2400 bps (T1200, T1600, T3200SX)

SERIAL IO CARDS: RS232, RS422, SCSI, HPIL, Barcode

BATTERY PACKS: 12V external battery + vehicle adapter

Contact us for more information:

PRODUCT R&D Corporation (Call)

800/234-5584, Fax: 805/546-9716

Inquiry 662.

LAPTOP PERIPHERALS

Atari Portfolio™

- System Memory expansion
- Hi-Capacity Ram cards
- Modem—Serial-parallel
- Rechargeable Battery Power
- Money Back Guarantee

Worell

109 South Water Street

Northfield, MN 55057

(507) 645-8315

Inquiry 663.

MEMORY CHIPS

FREE FREE FREE

- Need memory for IBM or MAC?
- Want to pay the lowest possible price?
- Want superior service?
- Want free advice?
- Wholesale source! Shipping worldwide!
- International FAX: country code+402-691-8548 24 hrs. 7 days
- International Direct: country code+402-691-8248 24 hrs. 7 days
- Free call! Free info!

McDonald and Associates

1-800-338-1531 24 HRS 7 DAYS (U.S.)

1-800-242-5751 FAX LINE 24 HRS 7 DAYS (U.S.)

Inquiry 664.

MONITOR INTERFACE

COMPUTER VIDEO GENERATOR

Test EGA, VGA, Multisync & Data Projectors with handheld monitor tester. From 15.7 KHz to 64.0 KHz, battery powered, 4 patterns, all plug-in with no adapter cables.

NETWORK TECHNOLOGIES INC.

800-RG8-TECH

In OH: 216-543-1646

UK: 0244-880478

Paris: 01331-476-32789

Inquiry 665.

NETWORKS

Network 2 to 4 Personal Computers

to share printers, exchange files, and on-screen chat, using **PC-InterLink**. Installs in minutes without opening the PC, by connecting to the parallel printer port. Requires no additional power. Supports up to four computers and twelve printers. A two-user **PC-InterLink** starter kit retails for only \$199.95. Add-on port adapters are available for \$49.95.

SoftWorx, Inc. (214) 480-8278

801 E. Campbell Road, Suite 355, Richardson, TX 75081

Inquiry 666.

NEURAL NETWORKS

BrainMaker:

"The most fascinating computer software I've ever seen... learn about this stuff." *John Dvorak, PC Mag.* Predicts stocks, bonds, sales, inventories. Comprehensive documentation. Menus. Only \$195!

Free Brochure: 818/355-1094

California Scientific Software

Inquiry 667.

MacBrain™ 2.0

MacBrain 2.0 Neural Network Simulation Software for the Macintosh (includes HyperBrain™): Graphical, interactive, menu-driven. Full Range of ready-to-use paradigms. Completely modifiable using HyperBrain. Expert Systems, predictive modelling, combinatorial optimization and more. Plus, SE and II family, HDI-Chorus parallel processing version available. \$995/\$795, educational.

NEURIX

1 Kendall Sq. Suite 2200 Cambridge, MA 02139

(617) 577-1202

FAX: (617) 577-1209

Inquiry 668.

PROGRAMMERS TOOLS

HYPERINTERFACE™

Menu Creator™ — A program generator for menu-driven user interface. Excellent for complex menu systems. \$99.95. **Advanced Library** — Extended capability for data entry and advanced text-display control from your programs. \$99.95. **FORTRAN, Pascal, C, BASIC supported. HYPERMATH™** — An application of Menu Creator™ and the Advanced Library. FREE

Avanpro Corp.

P.O. Box 969, Pacific Palisades, CA 90272

(213) 454-3866

Inquiry 669.

TLIB™ 4.12 Version Control

"TLIB™ is a great system" — *PC Tech Journal 3/88*. Full-featured configuration mgmt for software professionals. All versions of your code instantly available. Very compact, only changes are stored. Check-in/out locks, revision merge, branching, more. Mainframe deltas for **Panasonic, ADR, IBM, Unisys**. Only \$99.95 + S&H, or 5-station LAN \$299.95 + S&H. MS-DOS VISA/MC

BURTON SYSTEMS SOFTWARE

P.O. Box 4158, Cary, NC 27519 (919) 856-0475

Inquiry 670.

For QuickBasic programmers

SMART^{menu}™ Cuts your development time by more than 60% by giving you an integrated user interface that easily configures to your applications. Dialogue boxes, pop-up & pull-down menus, as well as "fill the form" type entries. For QB 4.0 or later. Library, tools & manual are \$69 + S&H.

KALTEK

P.O. Box 2166, Martinez, CA 94553

(415) 370-1920

Inquiry 671.

TURBO PLUS \$149.95

Programming tools for use with Turbo Pascal 5.0 & 5.5.

Screen Painter, Code Generator, I/O Fields, Dynamic

Menus, Programming Unit Libraries, OOP Support, and

Sample Programs included. All routines work in both text

and graphics modes! 60-day money-back guarantee!

Demo Disk avail. For IBM and compatibles.

NOSTRADAMUS, INC.

P.O. Box 9252, Salt Lake City, UT 84109-0252

(801) 272-0671

Inquiry 672.

Get INSIDE!

The best PC software performance tool is now better than ever with source line timing, caller timing and arbitrary event timing—all with microsecond accuracy and without source modification. The expanded DOS analysis mode identifies I/O bottlenecks. \$125

Call today for a free brochure and the latest list of supported

compilers. 30-day guarantee. VISA/MC/COD

Paradigm Systems

P.O. Box 152, Milford, MA 01757

(800) 537-5043

In MA: (508) 478-0499

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 Brian Higgins for more information

603-924-3754

Fax: 603-924-2683

Inquiry 673.

THE BUYER'S MART

PROGRAMMERS TOOLS

FREE BUYER'S GUIDE

Programmer's Connection is an independent dealer representing more than 440 manufacturers with over 1200 software products for IBM and Macintosh personal computers. We have serviced the professional programmer since 1984 by offering sound advice and low prices. Call or write today to receive your FREE comprehensive Buyer's Guide.

Programmer's Connection US 800-336-1166
7249 Whipple Ave. NW Canada 800-225-1166
North Canton, OH 44720 International 216-494-3781

Inquiry 674.

SPEED FORTRAN DEVELOPMENT AND CUT MAINTENANCE COSTS

FORWARN—Finds common programming errors such as mismatched parameter lists and common blocks, and uninitialized variables. Prints detailed cross-references and call-tree diagrams. \$329

FORTRAN DEVELOPMENT TOOLS—includes Pretty (indents, renumbers, changes GOTOs to IF-THEN-ELSEs, etc.) and 6 more tools. \$129. For IBM PC. Also for UNIX—ask for details.

Quibus Enterprises, Inc.
106 N. Draper Avenue, Champaign, IL 61821
(217) 356-8876

Inquiry 675.

Pascal PrettyPrint

Standardize your Pascal source code with this powerful, full featured reformatting and pagination system. This fully customizable program for all PC Pascals (+OOP):

- Adjusts indent, font and case to show program structure
- Adjusts case by maintaining a standard identifier database
- Provides menu and command line interfaces; on-line help
- Saves time and improves readability

\$29.95 + \$5 S&H Visa/MC/Check/MO (717) 383-1188

Qwikware
P.O. Box 222, Pockville, PA 18452

Inquiry 676.

'C' DOCUMENTATION TOOLS

- C-CALL \$59 Creates graphic-tree of caller/called structures, and files-vs-procedure table-of-contents
- C-HDR \$59 Creates/inserts/updates headers for each procedure showing caller/called and identifiers
- C-LIST \$39 List, action-diagram, reformat programs
- C-REF \$49 Local/global/parameter cross reference
- SPECIAL \$149 All 4 plus integrated C-DOC version

SOFTWARE BLACKSMITHS INC.
6064 St. Ives Way, Mississauga, ONT Canada L5N-4M1
(416) 858-4466

Inquiry 677.

SIMPLE TOOLKIT FOR X-WINDOW

For any X-Window programmer. Simple, but well-thought-through toolkit provides power and flexibility. Little space-time overhead. Library of popular widgets incl. Great for adding X-Window interface to existing C programs. \$54.99 + \$3.49 S&H, logarithmic (base 2) pricing for multiuser license. We ship portable C source on DOS disk. You upload to X-Window Unix platform and "make" binaries. Specify 3.5" or 5.25" disk. We fully support what we sell.

Strom Systems, Inc.
9009 Avondale NE H-215, Redmond, WA 98052
206-881-0855

Inquiry 678.

Auto Function Tester A Structured TESTING TOOL for C • Statement & Branch Test Case Coverage • Timing • Self Documenting • Regression Testing MUCH MORE requires MSC v5+, TC v2+ \$199
Source Code Catalog A DATABASE for YOUR functions • Language Independent • 30k TSR • Find Functions by CATEGORY, XREF, DESC • PASTE function call • Import/Export • Use Category DICTIONARY and/or FREE FORM entry • AUTO ADD functions from C or dbase SOURCE • AUTO ADD functions from MSC compatible LIBS, requires DOS 2.x, 3.x—\$99 NETWORK VERS—\$199, add \$5 s/h + CA res. 6.25% tax

Talls Computer Service Inc.
P.O. Box 1539, Nevada City, CA 95959
(916) 265-5777

Inquiry 679.

310 BYTE • APRIL 1990

PROGRAMMERS TOOLS

FAST TITLE SCREENS

Fully automatic, professional title screen generator creates magic with line-drawing characters, fast. Quick Titles 2.0 saves for DBase, QuickBasic, C, WordPerfect, Batch files, BBS, etc. Multiple font, border, sizes and styles. No fussing. \$59 U.S. funds.

The Logic Factory
Box 9627
Edmonton, AB, CANADA T6E 5X3

Inquiry 680.

PROTOTYPING

Frustrated with Demo II? You'll Love

PROTOSCREENS

Powerful Rapid Prototyping Software
Easy to Learn and Use • No Programming
Simulate mainframe, mini, and PC systems
Training available on rapid prototyping

BAILEY & BAILEY Software Corporation
859 East 2850 North Ogdun UT 84414
(801) 782-2345 Credit Cards Overnight Del.

Inquiry 681.

PUBLIC DOMAIN

\$3.00 SOFTWARE FOR IBM PC

Hundreds to choose from, word processors, databases, spreadsheets, games, lotto, communications, business, music, bible, art, education, language and useful utilities for making your computer easier to learn. Most programs have documentation on the disk.

Free 125-page catalog.

BEST BITS & BYTES
P.O. Box 8245, Dept. B, Van Nuys, CA 91409
In CA: (818) 764-9503 800-245-BYTE

Inquiry 682.

\$1 per DISK Sale

20 TOP IBM PC PD/SW DISKS (360K) ONLY \$20 + \$3 S&H

QubeCalc, EDRAW, AutoMenu, Math Tutor, PC-DOS Help, Baker's Dozen, Languages, EZ-Form, PC-Style, PackDisk, PC-Stock, KidGames, Best Games, Home Inventory, PC-Outline, Form Letters, ImagePrint, SideWriter, PC-Prompt, Best Utilities.

BRIGHT FUTURES INCORPORATED
P.O. Box 1030, East Windsor, CT 06088
FREE CATALOG (\$1.50 per disk)

Inquiry 683.

FREE CATALOG

\$1 IBM SOFTWARE

For your free 32-page Master Edition catalog featuring the best of IBM Shareware from just \$1 each, call or write today!

1-800-338-2118

SOFSOURCE

Box 828, East Lansing, MI 48826

Inquiry 684.

FREE SOFTWARE CATALOG

Low as \$1.20/disk
Over 1000 quality IBM software
On 5.25" and 3.5" format
From outside U.S.A., except Canada, please send US \$2.00 refundable with order.
For fast service, write to

SOFTSHOPE
P.O. BOX 3678, Ann Arbor, MI 48106-3678
313-761-7638

Inquiry 685.

PUBLIC DOMAIN

FREE SOFTWARE FOR IBM® PC's

TRY US! Get 15 disks full of our best selling software—FREE! Great graphics, programmers utilities, desktop publishing, finance, games, education, plus our 1600 disk catalog. Pay only \$5.00 for shipping/handling — VISA/MC/AMEX

INTERNATIONAL SOFTWARE LIBRARY
511-104 Encinitas Blvd. • Encinitas CA 92024
CALL TODAY (619) 942-9998

Inquiry 686.

16 and 32 BIT MICROS

EDUCATIONAL TRAINING SYSTEMS in a notebook with power supply—for the Motorola 68000/68020/68881, TMS32010 DSP, Intel 8086/8087, A/D-D/A Converters, cross assemblers, serial interfaces with software, complete systems, documentation, schematic, operating system, cables. Starting Prices—\$230.00.

Phone URDA, Inc.

1-800-338-0517 or (412) 683-8732

Inquiry 687.

REVIEWS

Find "Hands-on" Reviews in Seconds!

PC Reviews is an easy to use on-line database for NOVICES and PROS who need to locate and read "hands-on" reviews. BYTE, Data Based Advisor, PC Today, PC Magazine, Computer Language, Info World and 35 more included. Natural language front-end helps define search terms. A perfect use for a modem. "Wonderful!", say users.

Compatible Technologies Group, Inc.
88 Fulton St. #2400, New York, NY 10038
(212) 463-8989 (201) 653-7688 8-N-1 for FREE DEMO

Inquiry 688.

SECURITY

FIGHT PIRACY!

Since 1986, companies worldwide have been choosing Az-Tech security products. If you demand the strongest protection available, why not choose one of these "proven leaders":

- EVERLOCK Copy Protection
- EVERTRAK Software Security
- EVERKEY Hardware "Key" Software Security

For IBM and Compatibles: 30 day money back guarantee. Free info and demo disk available.

Az-Tech Software, Inc.
305 East Franklin, Richmond, MO 64085

(800) 227-0644 (816) 776-2700
Fax: (816) 776-8398

Inquiry 689.

THE ULTIMATE COPY PROTECTION

- Completely Menu Driven
- Defeats all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk Support
- Unlimited Metering
- FREE Demo Disk

STOPVIEW™ STOPCOPY PLUS™
BBI COMPUTER SYSTEMS® (301) 871-1094
14105 Heritage Ln., Silver Spring, MD 20906 FAX: (301) 460-7545

Inquiry 690.

COP's Copylock II

- Protects on standard diskettes
- Cannot be copied by any device incl. Option Board
- Fully hard disk installable
- Normal back-up of protected programs
- LAN-support
- Creates safe demo version of your software

Standard Version \$975, Automatic Version \$1950

DANCOTEC Computer

In US: 2835 Sierra Rd. San Jose, CA 95132 408-729-8182 or 1-800-344-2545
Int'l: 2850 Bagvedvej, Denmark Phone: +45-444-0322 Fax: +444-0722

Inquiry 691.

THE BUYER'S MART

SECURITY

RID YOUR SYSTEM OF VIRUSES FOR EVER VIRUSAFE™

The most effective anti-virus system available.
 ■ Recognizes over 70 viruses—regularly updated. ■ Protection against existing and future viruses. ■ Seeks, identifies and removes known viruses resident in memory and programs. ■ Checks integrity of specified programs for virus related changes. ■ Boot operated memory resident program constantly on guard against new virus attacks.

Price \$80 Visa/MC. 30-day money-back guarantee.
EllaShim Microcomputers Inc.
 520 W. Hwy 436, Suite #1180-30, Altamonte Springs, FL 32714
 TEL: (407) 682-1587 FAX: (407) 869-1409
 See us at PC New York Expo, Booth 2565

Inquiry 692.

BIT-LOCK® SECURITY

Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port-transparent security device. PARALLEL or SERIAL port. Complemented by economical KEYLOK™ and multifaceted COMPUTE-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac)

MICROCOMPUTER APPLICATIONS
 3167 E. Otero Circle, Littleton, CO 80122
 (303) 770-1917

Inquiry 693.

1st Defense ANTI-VIRAL software

Protect your investment by removing that virus before it strikes.

\$59.95

1st Defense Anti-Viral Systems

ModaLogic Incorporated

10474 Broadview Rd., Broadview Hts, OH 44127

(216) 838-5238

MS-DOS 2.11+ • Ohio Residents Add \$4.20

Specify either 3 1/2" or 5 1/4" disk

Inquiry 694.

PC Security "Password"

With All the Computer Security Talk, **PASSWORD** is the Perfect Security Lock.

Password is a software program providing security for your PC. Password is Easy to understand and Simple to install, requires no reformatting. The boot limit option secures your hard disk. Password provides for up to 100 users with the supervisor controlling access to protected directories. Password is menu-driven with pop-up windows and help screens. The program provides an audit trail of users, and a screen blanking feature.

PASSWORD \$99.00 US Visa, MC, Amex

Nasdec International Inc.

2704-85 Garry Street, Winnipeg MB Canada R3C 4J5

PH: (204) 956-2798 FAX (204) 943-3702

Inquiry 695.

COPY PROTECTION

The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.

• Hard disk support • No source code changes

• Customized versions • LAN support

• New upgrades available

(408) 773-9680

SOFTGUARD SYSTEMS, INC.

710 Lakeway, Suite 200, Sunnyvale, CA 94086

FAX (408) 773-1405

Inquiry 696.

HANDS OFF THE PROGRAM® OPERATING SYSTEM SECURITY

Secures subdirectories, files, printers and floppies
 Keyboard lock — automatic or manual
 Log PC boot, program exec, file opens, login/logouts
 Prevents DOS FORMAT and most viruses
 Drive A: Boot Protection / Hard Disk Lock
 IBM PC or 100% comp. — DOS V3.0+ — \$89.95 + \$3.75 S/H

SYSTEMS CONSULTING INC.

PO BOX 111209, Pittsburgh, PA 15238

(412) 781-5280

Inquiry 697.

SECURITY

HANDS OFF THE BOARD® 1/2 SIZE SECURITY BOARD

Stop floppy boot — Require password to boot PC
 Real-time disk encrypt — prevent boot sector virus
 Prevent DOS FORMAT/DISK and low-level formats
 Set hard disk READ ONLY or turn ON/OFF
 Turn floppies, printers and COM ports ON/OFF
 IBM XT, AT Bus — DOS V3.0+ — \$149.95 + \$5.00 S/H

SYSTEMS CONSULTING INC.

PO BOX 111209, Pittsburgh, PA 15238

(412) 781-5280

Inquiry 698.

SOFTWARE/ACCOUNTING

PC TIME CLOCK

AutoTime is an Employee Management System that allows you to turn any PC into an Electronic Time Clock. AutoTime provides Time & Attendance, Job Costing, Payroll Interface, and Labor Distribution reporting. Network compatible. Prices start at \$495. Other Business Products: Network FAX, Absence Call-In, db-EDI.

Chase Technologies

1617 Kingman Ave., San Jose, CA 95128

(408) 998-2917

Inquiry 699.

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORD/INVENTORY
- ACCOUNTS RECEIVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

\$99 ea. + S&H

DATAMAR SYSTEMS Cred. Card-Check-COD

4876-B Santa Monica Ave.

San Diego, CA 92107

(619) 223-3344

Inquiry 700.

AUTO-POST

It's here! A totally integrated business management system for \$495. Invoices, statements, payroll, inventory general ledger, proposal, job cost and payables. It runs compiled with dBASE III compatible files. A 100-pg. users manual is included. Demo \$9.95 with manual \$29.95.

New Serv

1615 Gelthor Dr., Suite 34, Fairfield, OH 45014

Phone: (513) 829-1585

Inquiry 701.

SOFTWARE/BASIC

QuickBASIC 4.5 TOOLS!

Our FREE CATALOG features:

NEW, UPDATED FINALLY! Library with over 400 routines for QB 4.5; XGRAF, the complete graphics package for QB 4.5; Other top-line products from all major vendors.

Call 1-800-423-3400 or (412) 782-0384

KOMPUTERWERK, INC.

851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 702.

SOFTWARE/BUSINESS

DATA ENTRY SOFTWARE

Full-featured, heads-down data entry with two-pass verification, edit language, operator stats, much more! Designed for the PS/2®, PC, XT, AT or compatibles. Standalone \$395 LAN version available.

FREE 30-day trial

Computer Keyes Tel: 206/776-6443

21929 Makah Rd. Fax: 206/776-7210

Woodway, WA 98020 USA: 800/356-0203

Inquiry 697.

SOFTWARE/BUSINESS

BLP88—LP w/BOUNDED VARIABLES

A general-purpose system similar to LP88 for solving linear programs with up to 1000 constraints and 5000 bounded or unbounded variables. Build BLP88 into your own programs with compiled Turbo Pascal units. BLP88 reads/writes LOTUS worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Many other features including interactive and batch operation, spreadsheet LP display and editing, equation processor, problem/basis storage, primal/dual conversion, file I/O, Simplex restart, report generator, sensitivity analysis. \$149 with manual and 8087 support. \$299 with Turbo Pascal units

Eastern Software Products, Inc.

PO. Box 15328, Alexandria, VA 22309

(703) 360-7600

Inquiry 703.

DATA ENTRY

KeyEntry III®, a complete Data Entry System that provides all the capabilities for designing data entry applications, controlling data flow, & monitoring/reporting operator activity & performance. Supports LAN and stand-alone environments. Evaluation copy (all programs & documentation) available. Call today for information!

Southern Computer Systems, Inc.

2732 Seventh Avenue South

Birmingham, AL 35233

(800) 533-6879/(205) 251-2985

Inquiry 704.

SOFTWARE/EDUCATION

EASE GRADING BLUES!

Now in its 6th year, GRADEBOOK II can: rank students, easy edit, calculate student and class averages, add/drop, excuse absences, assign letter grades, calculate course grades (plus 10 more functions). You can print 8 report types with 86 options. You get: software, support, and manual for only \$49.50 ppd. MC/VISA. Specify IBM PC or Apple II. Order now!

WREN SOFTWARE, INC.

P.O. BOX 1138, Dept. B, Castle Rock, CO 80104

303/660-0049

Inquiry 705.

SOFTWARE/ENGINEERING

Boolean Logic Simulator

- LOGICSIM—a designer's assistant
- Make your logic equation waveforms visible
- Graphic waveform stimulus editor
- Single, multiple, simple & complex devices
- Multiple clocks for registered eqn's
- For IBM & clones, XT & up, CGA, EGA, VGA
- \$89.95 includes 1 yr upgrade support
- \$1500 demo
- VISA, PO, MO, CHK

ARCTOS SYSTEMS CORP.

20 Sandwell Cr., Kanata, Ontario, Canada K2K 1V3

(613) 592-0947

Inquiry 706.

SCADA SYSTEM DESIGN

IBM PC or compatible

Supervisory Control And Data Acquisition modular design software includes interactive screens for sizing RTU parameters, modem speed, etc., extensive tutorial, provision for engineering analysis modules, addressing stability & control and alternative technologies for communications subsystems. \$450 Engineering modules priced individually, and described in free catalog.

AURASTAR INFORMATION SYSTEMS, INC.

Suite 620, 12001 N. Central Expressway, Dallas, Texas 75243

(214) 770-1950 Fax (214) 770-1954

Inquiry 707.

Affordable Engineering Software

FREE APPLICATION GUIDE & CATALOG

Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Engineering Graphics • Signal Processing • Active/Passive Filter Design • Transfer Function/FFT Analysis • Logic Simulation • Microstrip Design • PC/MS-DOS • Macintosh • VISA/MC

BV Engineering Professional Software

2023 Chicago Ave., Suite B-13, Riverside, CA 92507

(714) 781-0252

Inquiry 708.

THE BUYER'S MART

SOFTWARE/ENGINEERING

MASS & VOLUME CALCULATOR WITH MATERIALS DATABASE
Calculate the volume of dozens of shapes easily with **Mass2**. Weights are calculated for over 700 materials. Differential and proportional comparisons made automatically. Flexible input system accepts Decimal, Fractional, and Exponential notation. For IBM PCs and Compatibles with 384K. \$69

DEMPSEY'S FORGE, Software Division
Rt 2 Box 407, Gladys, VA 24554
Let us FAX you a flier. CALL 804-283-4602

Inquiry 709.

The new approach to logistics TAYLOR, THE DYNAMIC ANALYST
Taylor is the fully menu-driven factory simulation package that combines ease of use with great flexibility. Taylor offers interactive graphical modeling, numerous modeling options, animation, in-depth result analysis and the Taylor Language Interface (TLI). Version 4.0 of the easiest-to-use personal simulation package on the market is available now.

F&H, Logistics and Automation BV
Spoorlaan 424, 5038 CG Tilburg, The Netherlands
Phone: +31 13 366344 Fax: +31 13 427516

Inquiry 710.

Analog Circuit Simulation

- Schematic Entry
- SPICE Simulator
- Model Libraries
- Monte Carlo Analysis
- Parameter Sweeps
- Plotting/Graphics Output

Intusoft has a complete PC-based system including everything from schematic entry through SPICE simulation using extended memory to comprehensive interactive post processing. Starting at \$95 for ISpice, the complete system sells for just \$790.

Intusoft
The leader in low cost, full featured CAE software

PO Box 6607, San Pedro, CA 90734
(213) 833-0710 FAX (213) 831-3956

Inquiry 711.

Personal Software for "What if" Engineering
Cedar fuses mathematics and intelligent geometric modeling and works with geometrics the same way a spreadsheet works with numbers. Now you can have the power of a smart drawing system integrated with a scientific calculator and formula solver within one easy-to-use software package. Requires Microsoft Windows \$895

MCAE Technologies Inc.
Tel: 408-748-0334 Fax: 408-748-1915

Inquiry 712.

MIDNIGHT ENGINEERING™
A new publication for entrepreneurial hardware and software engineers that will encourage and challenge you to personally develop and market your own products.

- PRACTICAL ARTICLES
- INSIGHTFUL INTERVIEWS
- DETAILED PRODUCT REVIEWS

call or write for a FREE copy of the premiere issue of *Midnight Engineering*.

Midnight Engineering
111 E. Drake Rd., Suite 7041, Fort Collins, CO 80525
303-491-9092

Inquiry 713.

SIMULATION WITH GPSS/PC™
GPSS/PC™ is an MS-DOS compatible version of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your models. If you are contemplating the creation or modification of a complex system you need GPSS/PC to help you predict its behavior. Call now.

MINUTEMAN Software
P.O. Box 1717Y, Stow, Massachusetts, U.S.A.
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 714.

SOFTWARE/ENGINEERING

Circuit Analysis — SPICE
Non-linear DC & Transient; Linear AC.
* Version 3B1 with BSIM, GaAs, JFET, MOSFET, BJT, diode, etc. models, screen graphics, improved speed and convergence.
* PC Version 2G6 available at \$95.
Call, write, or check inquiry # for more info.

Northern Valley Software
28327 Rothrock Dr., Rancho Palos Verdes, CA 90274
(213) 541-3677

Inquiry 715.

FREE ENGINEERING MAGAZINE
Personal Engineering is a monthly magazine sent free of charge (USA only) to scientists/engineers who use PCs for technical applications. Topics each month include Instrumentation • Data Acq/Control • Design Automation. To receive a free sample issue and qualification form either circle below or send request on letterhead to:

Personal Engineering Communications
Box 300, Brookline, MA 02146

Inquiry 716.

SIMPLE_1 for SIMULATION
SIMPLE_1 MS-DOS discrete/continuous simulation with visual and interactive features, integrated editor and on-line documentation. Particularly suited for JIT, logistics and health care situations. Whether you're modeling current or proposed systems you can benefit from **SIMPLE_1's** flexible and unparalleled modeling capabilities today! Check It out!

Sierra Simulations & Software
RR #2 Box 918B, Canaan, New Hampshire 03741
(800) 446-3697 (603) 523-9645

Inquiry 717.

SAUNA:
3D Thermal Analysis Made Easy!

- All heat transfer modes: convection, radiation, conduction.
- Interactive menu-driven
- Powerful edit features
- Easy to learn and use
- Models: enclosures, heat sinks, circuit boards, plates
- Integrated color graphics
- 3D thermal analysis
- Thermal parameters library
- IBM PC & Macintosh II.

Tatum Labs Inc.
3917 Research Park Dr. B-1, Ann Arbor, MI 48108
313-663-8810

Inquiry 718.

FORTRAN for Macintosh
Language Systems FORTRAN 2.0 is a full-featured, optimizing compiler integrated in MPW. Full ANSI FORTRAN 77 plus VAX-compatible extensions including COMPLEX*16 and NAMELIST. Arrays greater than 32K. 68000/20/30 and 68881/2 object code. Fast execution, high accuracy. Any Macintosh with 1-2 megabytes, HD required.

Language Systems Corp.
441 Carlisle Drive, Herndon, VA 22070
(703) 478-0181

Inquiry 719.

SOFTWARE/FORTRAN

GEOLOGICAL CATALOG
Geological software for log plotting, gridding/con-touring, hydrology, digitizing, 3-D solid modelling, synthetic seismogram, fracture analysis, image processing, scout ticket manager, over 50 programs in catalog. Macintosh too! Please call, or write, for Free Catalog!

RockWare, Inc.
4251 Kipling St., Suite 595, Wheat Ridge, CO 80033 USA
(303) 423-5645 Fax (303) 423-6171

Inquiry 720.

SOFTWARE/GEOLOGICAL

GRAPHICS SOFTWARE
Michael F. Barnsley

The Desktop **Fractal Design System** will be an indispensable educational and scientific tool for students, engineers, and all scientists. The software (which runs on IBM and compatible PCs with an enhanced graphics board [EGA and VGA] and 640K memory) helps to connect theoretical concepts with on-screen geometric modeling.

1989, \$39.95/ISBN: 0-12-079063-7
Includes Desktop **Fractal Design Handbook** and one floppy disk.

Academic Press
ATTN: Book Marketing Dept. #09040
1250 Sixth Ave., San Diego, CA 92101

Inquiry 721.

SOFTWARE/GRAPHICS

CAD/CAM Developers!
You save hundreds of hours of programming and debugging time (and the thousands of dollars this time costs!) when you use the CAD/CAM math and DXF routines in the

QuickGeometry Library

All the routines you need for any type of CAD/CAM/CAE program! 250 ready-to-use routines that construct, intersect and offset lines, arcs, circles, ellipses and even splines!

\$199 includes C source code and telephone support.
Call (617) 628-5217 today for information or to order!

Building Block Software, PO Box 1373, Somerville, MA 02144

Inquiry 722.

The Ultimate CAD/CAM Engine
TurboGeometry Library 3.0. The most complete tool box of 2D & 3D routines available today! Over 300 routines. Surfacing, Solids, Hidden line, Volumes, Areas, Transforms, Perspectives, Decom, Clipping, Tangents & more. 30 day guar., \$199.95 w/source S&H Incl. Foreign \$225.00. MS/PC DOS 2.0+. Turbo Pascal, Turbo C, MSC, MIX C, Zortec C+-. VISA/MC, PO, Chk, USA funds only.

Disk Software, Inc.
2116 E. Arapaho Rd., #487, Richardson, TX 75081
(214) 423-7288, (800) 635-7760, FAX (214) 423-4465

Inquiry 723.

RAINDROP™
FAST, compact PrtScr Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 12 video graphic standards. Scale, rotate, colorize and more. "CALL" from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library \$39.95 + \$3 s/h.

ECLECTIC SYSTEMS
8106 St. David Ct., Springfield, VA 22153
(703) 440-0064

Inquiry 724.

SEGS 2.0
Scientific Engineering Graphics System

- Logarithmic, Time/Date & Linear Axes.
- Easy Curve Fitting and Data Smoothing.
- 1-2-3 Interface & Numeric Spreadsheet.
- Supports all Video & Device Standards.
- 10 Curves with up to 8000 points each.

Edmond Software, Inc.
5900 Mosteller Dr. #1124 405-842-0558
Oklahoma City, OK 73112 800-284-3381

Inquiry 725.

PEN PLOTTER EMULATOR
FPLOT turns your dot matrix or laser printer into an HP pen plotter. Fast hi-res output. No jagged lines. Vary line width, color. Works with Autocad, Drafrix, etc. Supports NEC P5/P6, IBM Proprinter, Epson LQ/FX, Toshiba, HP Laserjet, Okidata 29x/39x, Hercules/CGA/EGA/VGA. \$64 check/m.o./VISA/MC

Fplot Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11030
718-545-3505

Inquiry 725.

THE BUYER'S MART

SOFTWARE/GRAPHICS

DoDOT for Microsoft Windows

With DoDOT, you can:

- Capture screens, windows, dialog boxes, and pull-down menus.
- Convert between various file formats: TIFF, Postscript, PCX, IMG, GIF, MAC, PIC, PCL, MSP, Clipboard, Bitmap, and more.
- View and edit image with full color support.
- Print images to wide range of printers: LaserJet, Postscript, and more.

With each purchase, you receive free upgrade and support. Only \$129 + \$5 SH!

Halcyon Software 10297 Cold Harbor Ave.
Cupertino, CA 95014 tel: (408) 257-0612 fax: (408) 257-2012

Inquiry 726.

POPULAR HGRAPH

SCIENTIFIC 2D & 3D graphic routines for IBM PC, VAX, SUN and Macintosh. Powerful, easy to use. Multiple fonts, device and machine independent. Uses max resolution. Links with FORTRAN, Pascal, C, Modula-2 and QuickBasic. \$119.00

Custom software development.
UGraph—the graphics editor available now!
HeartLand Software, Inc.
234 S. Franklin, Ames, IA 50010
(515) 292-8216

Inquiry 727.

GRAPHICS PRINTER SUPPORT

AT LAST! Use the PrtSc key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer (incl. Postscript) in up to 64 shades of gray or 256 colors. GRAFPLUS supports all versions of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards. Linkable/OEM versions available. \$49.95

Jewell Technologies, Inc.
4740 - 44th Ave. SW, Seattle, WA 98116
(800) 359-9000 x527 (206) 937-1081

Inquiry 728.

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program.

GRAFATIC: screen routines \$135.
PLOTATIC: plotter driver 135
PRINTATIC: printer driver 135

For the IBM PC, XT, AT & compatibles. We support a variety of compilers, graphics bds., plotters and printers.

MICROCOMPATIBLES

301 Prelude Dr., Dept. B, Silver Spring, MD 20901 USA
(301) 593-0683

Inquiry 729.

GRAPHIC TOOLS LIBRARY

XGLIB: Blazing Fast. User coord., Thick lines & arcs. Polygon Engine. Figure drawing. Splines. Text scale, rotate. Keyb, Mouse. Plots, charts and presentation graphics. Screen print. \$99.

PC VDI: Display and Printed graphics. Outline font factory. Pan, Scroll. Includes XGLIB NO ROYALTIES. Take NOVA PRINVIEW test. \$395. ANSI comp. "C", PASCAL, FORT, MS QBASIC & BASIC.

NOVA INC.

2500 W. Higgins Road, #1144 CALL 708-882-4111
Hoffman Estates, IL 60195 FAX 708-882-4173

Inquiry 730.

IMAGE TOOLS LIBRARY

SCANPRO: Fast Image Graphics. Image Capture. Animation, Bitbit, Scale up-down, Rotate, Mirror, Tile fill, Scroll. Data base. Text & Line draw. Pop-ups. Scaled Printplot, EMS support and 149 funcs. A better package for PCX file handling. \$149. ANSI Comp. Most "C", PASCAL, FORT, MS BASIC. PCXIO: Source Library avail. in "C"/Assembler for read/write & display of .PCX files. \$295.

NOVA INC.

2500 W. Higgins Road, #1144 CALL 708-882-4111
Hoffman Estates, IL 60195 FAX 708-882-4173

Inquiry 731.

SOFTWARE/GRAPHICS

VGA ColorWorks™ V2.2

The most advanced image creation and manipulation package available for the VGA. Import/export TIFF, PCX, TARGA images Edit with over 250,000 colors in multiple hardware resolutions (switchable on-the-fly). Complete set of geometrics and patterns. Special effects include tint, shade, blend, mask, fountains, cut/paste, hardware zoom emulation, ... much more (over 150 drawing controls). Incl. 44 fonts, drivers for PostScript, HP-LaserJet, HP-PrintJet, Epson LQ/FX. Producing up to 64 gray levels or 4096 colors. \$59. Call for our free fully operational demo.

SPG Inc.

PO Box 171008 Hialeah, FL 33017
(305) 362-6602

Inquiry 732.

PC SOFTWARE FOR WORK OR PLAY \$3.00 / DISK

Written by some of the best programmers in the world and delivered to you. From DOS enhancement utilities to adult only, desk top publishing, business/investment, database, word processing, games, etc., etc. Our FREE CATALOG contains hundreds of the best software programs on the market. Your complete satisfaction is guaranteed when ordering from:

SILICON VALLEY FREWARE

P.O. Box 70397, Sunnyvale, CA 94086
(415) 965-9700

Inquiry 733.

GRAPHICS LIBRARIES for C, FORTRAN, PASCAL & QuickBASIC

- Supports VIDEO, PRINTERS & PLOTTERS.
- Linear, log, polar, smith, bar & pie charts.
- Scalable fonts, line types, markers.
- Multiple plots on a page.
- Over 100 routines with full source code.
- 240 page manual. No royalties.

\$295.00 **Sutrasoft** (713) 491-2088

10506 Permian Dr. • Sugar Land, TX 77478

Inquiry 734.

PRINTED GRAPHICS

The GraphLink™ Printer Graphics Toolkit lets your Turbo Pascal programs build and print graphics at the printer's resolution! 80+ routines emulate Borland Graphics Interface. Supports the most popular laser and dot matrix printers. Only \$125 (\$250 for Professional version)! Soon for TC, MS-C, Quick C.

VISITECH SOFTWARE.

DS 3807 Ridgewood Ct., Pittsburgh, PA 15239
(412) 733-4775

SOFTWARE/INVESTMENT

Compare 1,500 "Equity" and/or "Fixed Income" Mutual Funds on IBM or compatible PC. Simple menu commands search and sort 25 into fields. Contains 10 years' activity, updated monthly/quarterly. Data transports to Lotus 1-2-3.

One year quarterly subscription to either "Equity" or "Fixed Income" Funds diskettes only \$199; both for \$299 plus \$3 H&P per diskette. Single diskette @ \$69.95 plus \$3 H&P. Call 1-800-553-3575 to order or for Free Brochure, or write to:

Business Week Diskettes
Dept. BY190, P.O. 1597, Fort Lee, N.J. 07024

Inquiry 735.

SOFTWARE/LANGUAGES

DRUMA FORTH-83

Break the 64K barrier without speed/space penalty. Powerful, attractively priced. '83 Standard.

- 1Mb+ automated memory management
- Full OS interface, extensive utilities
- On-line documentation, ASCII/block files
- Other products: windows, modules, profiler
- IBM PC/XT/AT & all compatibles

FREE learn/utility disks offered: INQUIRE

DRUMA INC.

6448 Hwy. 290 East E103, Austin, TX 78723
Orders: 512-323-0403 BBoard: 512-323-2402

Inquiry 736.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^2 = \sum_{k=0}^{\infty} [x_k^{2n}(\eta)] + \left(\frac{1}{\sqrt{\alpha \pm \beta x}} \right)$$

- MathEdit constructs math equations to be inserted into WordPerfect, Word, WordStar, and others.
- WYSIWYG interface—no codes need to be learned.
- MathEdit—\$199

K-TALK

COMMUNICATIONS

30 West First Avenue, Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 737.

SOFTWARE/MEDICAL

PC HOLTER/ECG SOFTWARE

Provides automated ECG data acquisition, analysis, and report generation. FDA approved for medical applications. Complete report review, edit, and print features. Includes beat superimposition and laser printer support. Utilizes tape cassette or solid-state memory data collection devices. Custom versions for OEMs, VARs and dealers.

Diagnostic Medical Instruments, Inc.

6724 Thompson Road, Syracuse, NY 13211
(800) 544-5500 Ext. 20 FAX: (315) 437-2005

Inquiry 738.

Medical Systems with ECS

PPM offers a complete line of medical software ranging from simple insurance claims processing to comprehensive A/R management. PC CLAIM PLUS: claims processing with ECS to over 100 major insurance carriers—30-day money-back guarantee. THRESHOLD—complete A/R, patient billing, comprehensive practice management statistics. CLAIM NET—Nationwide electronic claims clearinghouse transmits claims to over 160 insurance carriers. Dealer inquiries welcome. Software prices start at \$459.00.

Physicians Practice Management

350 E. New York, Indianapolis, IN 46204
800-428-3515 317-634-8080

Inquiry 739.

SOFTWARE/PACKAGING

HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS

Cloth binders & slipcases like IBM's. Vinyl binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity imprinting. Bulk disks. Everything you need to bring your software to market. Disk and binder mailers. Much more! Low Prices! Fast service! Call or write for a FREE CATALOG.

Anthropomorphic Systems, Limited

376-B E. Saint Charles Rd., Lombard, IL 60148
1-800-DEAL-NOW 312-629-5160

Inquiry 740.

SAVE SAVE SAVE SAVE LET'S TALK PACKAGING

From Disk Labels to Manuals to Shipping Boxes—We are a complete packaging service. Everything you need to market your software. Call for our free catalog.

SOFCOM Printing and Packaging

10305 Reading Rd., Cincinnati, OH 45241
513-563-7136

Inquiry 741.

SOFTWARE/SCANNERS

Optical Character Recognition

Stop retyping: PC-OCR™ software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Panasonic and most other scanners. Supplied with 18 popular fonts. User trainable: you can teach PC-OCR™ to read virtually any typestyle incl. foreign fonts. Proportional text, matrix printer output, Xerox copies OK. \$385. Check/MSA/MC/AmExp/COD

Essex Publishing Co.

P.O. Box 391, Cedar Grove, NJ 07009
(201) 783-6940

Inquiry 742.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

Chaos/Nonlinear Dynamics

ODYNAMICAL SOFTWARE I and II \$250 / \$350
Ordinary and Delay Differential Equation Solvers • Bifurcation Diagrams • Basin Boundaries • 2- and 3-D Plotting • Poincaré Sections • Return Maps • Spectral Analysis, Fractal Dimensions, Lyapunov Exponents

CHAOS IN THE CLASSROOM Instructional Programs
Maps and Bifurcations \$49.95 Fractals and Julia Sets \$59.95

DYNAMICAL SYSTEMS, INC.

P.O. Box 35241, Tucson, AZ 85740, (602) 292-1962

Inquiry 743.

free catalog!
800-942-MATH
Micro Math Scientific Software

Inquiry 744.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including Btrieve and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS \$149. OS/2, XENIX, UNIX \$249.

(702) 588-3737

Opt-Tech Data Processing

P.O. Box 678 — Zephyr Cove, NV 89448

Inquiry 745.

If you can find better
sort/merge/select software, buy it!
Sortex
Ultimate in performance and reliability
30-Day Money-Back Guarantee
Only \$149.95
Systemat Corporation
231 N. Deerfield Drive, Walnut, CA 91789
PHONE: 714 594 9567 FAX: 714 594 7984

Inquiry 746.

SOFTWARE/UTILITIES

EZ-COPY PLUS™

- Diskette Duplicator
 - 2X+ faster than DOS' DISKCOPY
 - All 5.25" and 3.5" formats supported.
- Only \$129+ s/h. ©

EZX Publ., 917 Oakgrove, Ste 101, Houston, TX 77058
Orders (V/MC/AX) & Brochures: 1-800 • USEASYX, xB490
INFO: 1-713-280-9900; BBS: 280-8180; FAX: 280-0525

Inquiry 747.

SOFTWARE/VOICE

MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development Toolkit for Turbo Pascal to access all the features of the WATSON or DIALOGIC Speech Boards. It is also a high level library of procedures to build MULTI-LINE VOICE RESPONSE systems in minutes. A powerful TELEPHONE ANSWERING program is given as an example with source code.

DIALOGIC 599\$, WATSON 99\$, Visa/MC

ITI Logiciel

1705 St. Joseph E, Suite 4, Montreal, PQ, Can. H2J 1N1
(514) 861-5988

We can also write your Voice Response application programs.

Inquiry 748.

314 BYTE • APRIL 1990

SPEECH SYNTHESIS

SPEECH SYNTHESIS CHIP

Want the most advanced phoneme synthesis chip available? One flexible enough to generate speech, music and sound effects... yet low cost and remarkably easy to use? The ARTIC-263 is all of this and more... a versatile, high-quality, phoneme-based, speech synthesizer circuit contained in a single, monolithic, 24-pin, CMOS integrated circuit.

Artic Technologies

55 Park Street, Troy, Michigan 48063
Phone: (313) 588-7370 FAX: (313) 588-2650

Inquiry 749.

STATISTICS

The BASS System™

Why use up 8 meg and 640K just to run a data step on your PC? Now you can run your data step code and statistical procs with a system that takes only 1 meg and 400K (and costs only \$399)! Free information:

BASS Institute, Inc.

P.O. Box 349, Chapel Hill, NC 27514
(919) 933-7096 or BB: (919) 968-6755 (N,8,1)

Inquiry 750.

SOLO 3.0 from BMDP

Popular statistics and excellent graphics for the PC. Quick and easy to use. For business professionals, researchers, or students. From the leader in statistical software for over 25 years. Top-notch support. Satisfaction guaranteed! \$199 complete with graphics. Call today, VISA or MC.

BMDP Statistical Software, Inc.

1440 Sepulveda Blvd., Suite 316, Los Angeles, CA 90025
(213) 479-7799

Inquiry 751.

Cover all the bases of design...

with Methodologist's Toolchest! a comprehensive package of five programs to aid in research design and analysis. Specifically, these programs offer assistance in sampling, data collection procedures, statistical analyses, experimental design, and measurement and scaling. \$499.95 + s/h. VISA, MC, AMEX. PO, Checks accepted.

The Idea Works, Inc.

100 West Briarwood, Columbia, MO 65203
1-800-537-4866 FAX 314-445-4589
Outside USA 314-445-4554

Inquiry 752.

Know where you're going?

You will—by using Statistical Navigator™, an expert system that helps you select the best statistic for a problem. Statistical Navigator suggests appropriate analyses and explains how each fits your needs. Version 1.1—\$99.95 + s/h. VISA, MC, AMEX, PO, Checks accepted.

The Idea Works, Inc.

100 West Briarwood, Columbia, MO 65203
1-800-537-4866 FAX 314-445-4589
Outside USA 314-445-4554

Inquiry 753.

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

865 East 400 North, Kaysville, UT 84037
Phone: 801-546-0445 Fax: 801-546-3907

Inquiry 754.

SYSTEM SOFTWARE

PC Compatible File System

All 'C'; very portable, rommable. Add floppy & Winchester support to embedded systems, or transfer data to/from pc floppies or partitions from your OS. Full, high quality implementation.

High quality CD-ROM interface software available too.

etc bin systems

20 Higley St., Groton, MA 01450
(508) 448-9340

Inquiry 755.

UNINTERRUPTABLE POWER

HOW TO PROTECT YOUR COMPUTER And Make It Last Longer

FREE money-saving literature. What you need to know about UPS—uninterruptible power supply. How to get complete protection from power line problems. 350VA through 15KVA models from the world's largest manufacturer of single-phase UPS.

Best Power Technology, Inc.

P.O. Box 280, Necedah, WI 54646
(608) 565-7200 ext. 3853

TOLL FREE (800) 356-5794 ext. 3853

See our Ad on page 335

Inquiry 756.

UTILITIES

ACCUBACK—BACKUP SYSTEM

Program features (all DOS Systems):
• 100% byte by byte read verification
• Supports absolute file matching
• Purges to DOD standards
• DOS RESTORE
• Creates active archives that are directly accessible
The most accurate backup system available. Special introductory price: \$79.95 plus \$4.00 shipping/handling.

AMER TECHNOLOGY SYSTEMS, INC.

DEPT D, 8700 SW 26th, Suite E, Portland Oregon 97219
(503) 245-2948 FAX (503) 245-0846 VISA/MC

Inquiry 757.

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 Brian Higgins for more information
603-924-3754

or

Fax: 603-924-2683

Inquiry 758.

COPY AT TO PC—BRIDGE-IT 3.5

"COPYAT2PC" RELIABLY writes 360KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape back-up. Only \$79.00 + SH
"BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 3 1/2" 720KB/1.44MB drives for PC/XT/AT without upgrading DOS/BIOS. Only \$39.00 + SH
BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT \$129.00 + SH VISA/MC/CODD UPS BR

MICROBRIDGE COMPUTERS

655 Sky Way Suite 220, San Carlos, CA 94070
1-415-593-8777(CA) 1-415-593-7675 (FAX)
1-514-845-0818 (CANADA) 1-800-523-8777
0908-260-188 (UK)

Inquiry 759.

DELTA, the better text file comparison tool. Scrollable windowed presentations of file or directory comparisons, with a built-in editor window. Ideal for programmers! Requires DOS 2.0 or higher with at least 384K RAM. A hard disk is recommended. Order now. \$79.

DEMO available on our BBS

OPENetwork

POWER TOOLS FOR POWER USERS

215 Berkeley Pl. (B-1), Brooklyn, NY 11217
718-638-2240 BBS: 718-638-2239

Inquiry 760.

UTILITIES

Recover deleted files fast!

Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk; view, change or create formats, change a file's status, change data in any sector. MS-DOS \$75 U.S. Check/Credit card welcome.

QUAD SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

COPYWRITE

CopyWrite
Removes
Copy Protection
No more diskettes,
manuals or
codewheels.
1000's of products copied.

US \$75

QUAD SOFTWARE LIMITED
45 Charles St. E. 3rd Fl. Dept B.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243 Fax (416) 961-6448

Remove Hardware Locks

Software utility allows for the removal of hardware locks. Don't wait for your lock or key device to fail or be stolen. Following packages available:

CADKEY	\$99.00	PCAD	\$199.00
Microstation	\$99.00	Personal Designer	\$199.00
MicroCadam	\$99.00	SmartCam	\$99.00

Call for other products. Visa/MC Welcome

(204) 669-4639

SafeSoft Systems Inc.

191 Kirlystone Way, Winnipeg, MB, Canada, R2G 3B6

Inquiry 761.

AppleWorks ↔ IBM

CROSS-WORKS 2.0 transfers both ways between Apple IIe/IIc/IIgs and IBM PC/XT/AT/PS-2 & compatibles. Exchange AppleWorks with Microsoft Works, WordPerfect, Lotus 1-2-3, and dBase III/IV! Included cable plugs in serial ports for 19,200 baud transfers. Easy menu operation. \$99.95 (+ shipping).

Phone (919) 870-5694 for free info packet.
SoftSpoken Co., PO Box 18343, Raleigh, NC 27619

Inquiry 762.

Why You Want BATCOM!

BATCOM is a batch file compiler that transforms your .bat files to .exe files to make them faster. BATCOM extends DOS with many new commands so you can read keyboard input, use subroutines, and much more. In addition, BATCOM protects your source code. No royalties! Only \$59.95. Order today!

Wenham Software Company
5 Burley St., Wenham, MA 01984
(508) 774-7036

Inquiry 763.

Boot From Drive B:

YWSOFT's B:Boot! will boot a PC/XT/AT, PS/2 or compatible from drive B: If you have a 3.5" and a 5.25" drive, you can now boot from disks of both sizes. Also works for external drives. Works for DOS and non-DOS disks. \$19.90 + 2.00 S&H.

YWSOFT Co.

P.O. Box 2231, Bloomington, IN 47402
Tel: (812) 857-4772

Inquiry 764.

WORD PROCESSING

We can read 130 languages from Armenian to Zulu

Use SPOT OCR Software with an image scanner and your PC to read 130 foreign languages, typed pages, typeset material, magazines and books into standard text files. Flagstaff Engineering can provide any OCR solution. Call today to discuss your application!

Flagstaff Engineering

1120 Kaibab Lane, Flagstaff, AZ 86001
(602) 779-3341
MasterCard—Visa—American Express Accepted

Inquiry 766.

FARSI / GREEK / ARABIC / RUSSIAN

Hebrew, all European, Scandinavian, plus either Hindi, Punjabi, Bengali, Gujarati, Tamil, Thai, Korean, Viet, or IPA. Full-featured multi-language word processor supports on-screen foreign characters and NLO printing with no hardware modifications. Includes Font Editor. \$355 dot matrix; \$150 add'l for laser; \$19 demo. S/H in U.S. incl'd. Req. PC, 640K, graphics. 30-day Guarantee. MC/VISA/AMEX

GAMMA PRODUCTIONS, INC.

710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401
213/394-8622 Tlx: 5106008273 Gamma Pro SNM

Inquiry 767.

DuangJan

Bilingual word processor for English and: Armenian, Bengali, Burmese, Euro/Latin/African, Greek, Gujarati, Hindi, Khmer, Lao, Punjabi, Russian, Sinhalese, Tamil, Telugu, Thai, Ukrainian, Viet, ... Only \$109+\$5 s/h (foreign) + \$12 s/h. Font editor included. For any IBM compatibles with dot-matrix & LaserJet printer. Demo \$9+\$1 s/h. Visa/MC

MegaChomp Company

3438 Cottman Ave., Philadelphia, PA 19149-1606
(215) 331-2748 FAX: (215) 331-4188

Inquiry 768.

THE BUYER'S MART

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

To help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

603-924-3754

or

Fax:

603-924-2683

Inquiry 769.

THE BOOKS PASCAL PROGRAMMERS ARE ASKING FOR

Turbo Pascal® DiskTutor by Werner Feibel
(Includes 1 Book and 3 Disks)



"...The ideal tool for learning Turbo Pascal and object-oriented programming."

- Philippe Kahn,

Borland CEO

This package contains 2 disks providing the essentials of Borland's popular compiler, 1 disk of programming examples, and an easy-to-follow book that guides you step-by-step to mastering Turbo Pascal and object-oriented programming.

\$39.95. ISBN: 0-07-881575-4, 500 pp.

Borland•Osborne/McGraw-Hill Programming Series

Turbo Pascal® 5.5: The Complete Reference

by Stephen K. O'Brien
The most complete single resource ever published for all Turbo Pascal 5.0 and 5.5 programmers. Covers every Turbo Pascal command, feature, and programming technique.

\$26.95. ISBN: 0-07-881501-0, 900 pp.

Borland•Osborne/McGraw-Hill Programming Series



Using QuickPascal®

by Steven Nameroff
A practical get-up-and-go guide to Microsoft's Pascal with object-oriented programming. Covers beginning concepts to intermediate-level techniques and even some advanced topics.

\$24.95. ISBN: 0-07-881520-7, 500 pp



AVAILABLE IN FINE BOOK STORES
AND COMPUTER STORES EVERYWHERE

or Call Toll-Free

1-800-262-4729

Mon. - Fri. 8:30 - 4:30 P.M.T.

(Available in Canada through McGraw-Hill Ryerson, Ltd. ph: 416-293-1911)



Osborne McGraw-Hill
2600 Tenth Street
Berkeley, CA 94710

APRIL 1990 • B Y T E 315



VOICE MASTER KEY® SYSTEM II
 VOICE RECOGNITION & SPEECH RESPONSE
 FOR IBM PC/XT/AT/386, PS/2, LAPTOPS, COMPATIBLES

FOR PRODUCTIVITY, PRESENTATIONS, SOFTWARE DESIGN, ENTERTAINMENT, LANGUAGE TRAINING, EDUCATION, MORE...

SPEECH/SOUND RECORDING AND PLAYBACK. Desktop Audio sound editing allows you to create custom sound applications. Variable sample rate (to 20 KHz) and compression levels. A four-voice music synthesizer is included, also!

VOICE RECOGNITION TSR utility allows you to add voice command keyboard macros to your CAD, desktop publishing, word processing, spread sheet, or entertainment programs. Up to 64 voice commands in RAM at once—more from disk.

HARDWARE SYSTEM contains built-in speaker with separate volume and tone controls, external speaker and headphone jacks. Enclosure made of sturdy vinyl-clad steel. Attaches to parallel printer port without affecting normal printer operation (U.S. Patent 4,812,847). Headset microphone, printer cable, 9 volt AC adapter (110 volt UL/CSA listed), and comprehensive user manual included.

QUALITY THROUGHOUT. MADE IN USA. ONLY \$219.95

ORDER HOTLINE: (503) 342-1271 Mon-Fri, 8 AM to 5 PM PST

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Specify computer type when ordering. Add \$5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C&F/CIF quotes. OEM configurations available.

30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED.

CALL OR WRITE FOR FREE PRODUCT CATALOG



COVOX INC.
 675 Conger Street
 Eugene, Oregon 97402

TEL (503) 342-1271
 FAX (503) 342-1283
 BBS (503) 342-4135

dBASE Data Entry



The TransTerm 5 is a work station data entry/display terminal for on-line shop floor data collection into PC/AT based systems. The unit is one of a family of such terminals which feature LC displays for operator prompting and data entry via a membrane keyboard or an optional barcode wand (Code 39). A multi-terminal polling controller (up to 250 stations) and a dBASE III+ compatible software package are also available. System costs below \$300.00 per station. Call for info.

Options—backlighting for display, RS-422 I/O, 20 Ma current loop I/O. dBASE is a registered trademark of Ashton Tate, Inc.

COMPUTERWISE, INC.

302 N. Winchester • Olathe, KS 66062 • 913-829-0600 • Fax 913-829-0810

BIOS SOURCE CODE

The AT BiosKit gives you a complete Bios with source code you can modify for your own applications! The BiosKit includes a Bios on diskette ready for programming an Eprom, and includes the utilities you need to Rom the source code. The Bios also has a Rom Monitor/Debug and Setup. At last you have control over the core of your system. Over 380 pages, with diskette, \$199. The XT BiosKit is only \$99, or get both for \$279. The Intel Wildcard Supplement for the XT BiosKit is \$49.

FREE We'll include a free copy of the pocket-sized XT-AT Handbook by Cholsser and Foster with each BiosKit if you mention this ad when you order. Of course, this \$9.95 value is also available by itself. Or buy five or more for only \$5.00 each.



800-462-1042
 In California 619-271-9526

Annabooks

12145 Alta Carmel Ct Suite 250-262
 San Diego, California 92128

Money-back guarantee

DISC DRIVE REPAIR SPECIAL

Formatted Cap.	Flat Rate	SPECIAL
10-19 mb	\$99	89.10
20-29 mb	\$125	112.50
30-39 mb	\$150	135.00
40-49 mb	\$175	157.50
50-85 mb	\$210	189.00
86-120 mb	\$275	247.50
121-150 mb	\$325	325.00
151-275 mb	\$425	425.00
276-380 mb	\$495	495.00
TEST & EVALUATION \$25		

SHIPPING YOUR DRIVE FOR REPAIR
 Pack your drive carefully and well protected in a sturdy shipping box. Include with the shipment a note with your name, address, daytime telephone number and a brief description of the problem with the drive. If prepaying, allow \$9 for shipping and insurance costs.

**WE DO DATA RECOVERY
 CALL FOR QUOTE
 FLOPPY DRIVE REPAIRS**

5.25" & 3.5" • \$45 8" • \$135
 VALID THROUGH 4/30/90

DISC DRIVE SALES

XT/AT FLOPPY DRIVES		XT/AT HARD DRIVES	
3.5" .....720K .....new .....\$105		10 mb .....unnu .....\$75	
3.5" .....1.44mb .....new .....115		20 mb .....ref .....89	
5.25" .....360K .....ref .....49		30 mb .....ref .....159	
5.25" .....720K .....ref .....49		42 mb .....unnu .....239	
5.25" .....1.2mb .....ref .....89		72 mb .....ref .....295	
KITS FOR IBM AT & COMPATIBLES		MACINTOSH SCSI SUBSYSTEMS	
85MB .....SCSI .....\$995		HD/SCSI .....20 mb .....\$295	
147 MB .....ESDI/SCSI .....1395		HD/SCSI .....30 mb .....395	
230 MB .....ESDI/SCSI .....1895		HD SCSI .....40 mb .....495	
320 MB .....ESDI/SCSI .....1995		HD SCSI .....80 mb .....895	
		HD SCSI .....156 mb .....1,195	
HARD CARDS		NOVELL SUBSYSTEMS	
10MB 85MS .....\$185		150 MB .....\$1975	
20MB 65MS .....225		320 MB .....2795	
30MB/65MS .....295		650 MB .....4295	
40MB 65MS .....345			
48MB 36MS .....395			

THOUSANDS OF DISC DRIVES IN STOCK
 We Feature Technical Support for Everything We Sell
 We Specialize in Disc Drives — Ask for Our Brochure

jb TECHNOLOGIES, INC.

5105 Maureen Lane Moorpark, CA 93021

TEL 805 • 529-0908
 FAX 805 • 529-7712

9600bps MODEM



OR **FAX** **\$299**

300-9600bps MODEM \$299
\$95-2400bps ALL PRODUCTS...30 DAY FREE TRIAL

The **SPEEDMODEM™** is a knock out for value and performance. It features **DYNAMIC IMPEDANCE STABILIZATION™**, **DIS™**, (patent pending). **DIS** improves signal quality, assuring maximum speed and data integrity. **DIS** is renowned for superior performance where other modems fail. All products are internal IBM cards, made in USA, 5 year warranty. *If you aren't totally satisfied, return within thirty days for full refund!* **DISisIT**

	with DIS	no DIS
• SPEEDMODEM 300-9600-bps	\$299	
• SPEEDMODEM + FAX -9600	\$399	
• FAX-9600 full featured high speed fax card	\$299	
• 2400-4800-bps MNP-5 MODEM	\$193	\$169
• 2400-bps MODEM with SEND ONLY FAX	\$159	
• 2400-bps MODEM	\$119	\$95
• FREE \$69 EASYCOM™ SOFTWARE with modem		

CompuCom Corporation March '89 p102 **BYTE MAGAZINE***
"Real deal...worked fine...quite a bargain!"
 CALL (408) 732-4500 (800) 228-6648

Protect Your Copies of **BYTE**

NOW AVAILABLE: Custom-designed library files or binders in elegant blue simulated leather stamped in gold leaf.

Binders—Holds 6 issues, opens flat for easy reading.
 \$9.95 each, two for \$18.95, or four for \$35.95.



Files—Holds 6 issues.
 \$7.95 each, two for \$14.95, or four for \$27.95.



Order Now!

Mail to: Jesse Jones Industries, Dept. BY, 499 East Erie Ave., Philadelphia, PA 19134
 CALL TOLL FREE (24 hours): 1-800-972-5858

Please send _____ files; _____ binders for BYTE magazine.
 Enclosed is \$ _____
 Add \$1 per file/binder for postage and handling. Outside U.S.A. add \$2.50 per file/binder (U.S. funds only please).
 Charge my: minimum \$15
 _____ American Express
 _____ Visa _____ MasterCard
 _____ Diners Club
 Card # _____
 Exp. Date _____
 Signature _____

Name: _____
 Address: _____
No Post Office Box
 City: _____
 State: _____ Zip: _____

Satisfaction guaranteed. Pennsylvania residents add 6% sales tax. Allow 3-6 weeks delivery in the U.S.



Only your imagination limits how you benefit from PERCON® keyless data collection.



Checking out books or checking in employees—input data quickly and accurately using bar codes or magnetic stripes. PERCON has proven bar code solutions for IBM®, DEC™, and Apple Macintosh®. Call 1-800-8-PERCON.

PERCON

2190 W. 11th Avenue, Eugene, Oregon 97402-3503
 (503)344-1189 FAX(503)344-1399

© 1990 Percon, Inc. PERCON, IBM, DEC and Apple Macintosh are trademarks.

REEL 9-TRACK GENIUS

OVERLAND DATA will bring out the *genius in you* when it comes to connecting your PC to the mini/mainframe world. We were the first company to connect 9-track to PCs, and we are still the leaders with the largest installed base worldwide! Call the experts... **ODI!**

- Up to 15 MB per minute
- PC/XT/AT/386/PS2 & Compat.
- DOS, XENIX, UNIX, NOVELL
- 800, 1600, 3200, & 6250 BPI
- Outstanding customer support
- 24-hour delivery available
- Cipher, Anritsu, Qualstar & M4



Overland Data
 "Experience Makes The Difference"

1-800-PC-9TRAK

5600 Kearny Mesa Road • San Diego, CA 92111
 TEL: 619/571-5555 • FAX: 619/571-0982 • 800/729-8725

SIP & SIMM MODULES

Part No.	Function	Price
512KIT	IBM PS2 100ns 256K x 9 SIMM (2 each)	99.95
2MEGKIT	IBM PS2 100ns 1MEG x 9 SIMM (2 each)	369.95
41256A9A 10	262 144x9 100ns 256K x 9 SIMM (Has Leads)	44.95
41256A9B 80	262 144x9 80ns 256K x 9 SIMM	49.95
42100A8B 10	1.048 576x8 100ns 1MEG x 8 SIMM	109.95
42100A9A 80	1.048 576x9 80ns 1MEG x 9 SIP (Has Leads)	124.95
42100A9B 80	1.048 576x9 80ns 1MEG x 9 SIMM	119.95

Upgrade for Models 30, 50Z and 60

7400

Part No.	1-9	10+	Part No.	1-9	10+
7400	29	19	7474	39	29
7402	29	19	7475	49	39
7404	29	19	7476	45	35
7405	35	25	7483	59	49
7406	39	29	7485	65	55
7407	39	29	7486	45	35
7408	35	25	7489	225	215
7410	29	19	7490	49	39
7411	35	25	7493	45	35
7414	49	39	7495	59	49
7416	35	25	74107	29	19
7417	35	25	74121	39	29
7420	29	19	74123	49	39
7427	29	19	74125	49	39
7430	29	19	74147	199	189
7432	39	29	74150	135	125
7438	39	29	74151	39	29
7442	49	39	74154	135	125
7445	75	65	74161	69	59
7446	89	79	74174	59	49
7447	89	79	74185	59	49
7473	39	29	74193	79	69

74LS

Part No.	26	16	74LS139	49	39
74LS00	26 <td>16</td> <td>74LS139</td> <td>49 <td>39</td> </td>	16	74LS139	49 <td>39</td>	39
74LS02	28	18	74LS151	49 <td>39</td>	39
74LS03	28	18	74LS153	49 <td>39</td>	39
74LS04	28	18	74LS154	129	119
74LS05	28	18	74LS157	45	35
74LS06	59	49	74LS161	49	39
74LS07	59	49	74LS163	49	39
74LS08	28	18	74LS164	59	49
74LS09	28	18	74LS165	75	65
74LS10	26	16	74LS166	89	79
74LS11	29	19	74LS173	45	35
74LS14	49	39	74LS174	39	29
74LS20	29	19	74LS175	39	29
74LS21	29	19	74LS191	59	49
74LS27	35	25	74LS192	69	59
74LS30	28	18	74LS193	69	59
74LS32	28	18	74LS194	69	59
74LS38	35	25	74LS221	69	59
74LS42	49	39	74LS240	59	49
74LS47	85	75	74LS241	59	49
74LS73	39	29	74LS244	59	49
74LS74	35	25	74LS245	79	69
74LS75	39	29	74LS257	49	39
74LS76	39	29	74LS259	99	89
74LS83	45	35	74LS273	89	79
74LS85	55	45	74LS279	89	79
74LS86	29	19	74LS367	49	39
74LS90	49	39	74LS373	79	69
74LS93	49	39	74LS374	79	69
74LS123	49	39	74LS393	89	79
74LS125	49	39	74LS394	119	109
74LS132	49	39	74LS399	5.95	5.85
74LS138	49	39	74LS688	2.39	2.29

74S/PROMS*

Part No.	25	74S188*	1.49
74S00	25	74S188*	1.49
74S04	25	74S189	1.49
74S32	25	74S240	1.39
74S74	25	74S244	.99
74S12	25	74S273	1.49
74S124	25	74S288*	1.49
74S138	15	74S377*	.99
74S153	.49	74S374	.99
74S163	.75	74S387*	1.29
74S174	.15	74S472*	2.95
74S175	.39	74S571*	2.49

CD-CMOS

Part No.	19	CD4051	59
CD4001	19	CD4051	59
CD4002	19	CD4052	59
CD4007	19	CD4053	59
CD4011	19	CD4060	65
CD4012	25	CD4061	29
CD4013	29	CD4069	25
CD4015	29	CD4070	29
CD4016	29	CD4071	19
CD4017	19	CD4072	19
CD4018	19	CD4073	19
CD4020	59	CD4081	19
CD4021	49	CD4093	.35
CD4024	45	CD4094	.89
CD4027	35	CD4503	.35
CD4028	49	CD4504	.59
CD4029	35	CD4518	.75
CD4030	65	CD4520	69
CD4042	49	CD4522	.75
CD4043	59	CD4528	69
CD4046	65	CD4538	.79
CD4047	65	CD4543	.79
CD4049	29	CD4584	.49
CD4050	29	CD4585	69

NEC V20 & V30 CHIPS

Replace the 8086 or 8088 in Your IBM PC and Increase Its Speed by up to 30% Price

Part No.	Function	Price
UPD70108-5	(5MHz) V20 Chip	5.25
UPD70108-8	(8MHz) V20 Chip	6.95
UPD70108-10	(10MHz) V20 Chip	10.95
UPD70116-8	(8MHz) V30 Chip	7.95
UPD70116-10	(10MHz) V30 Chip	13.49

MICROPROCESSOR COMPONENTS

Z80, Z80A, Z80B, SERIOS		8000 SERIES Continued		8000 SERIES Continued	
Part No.	Price	Part No.	Price	Part No.	Price
Z80	1.25	8155-2	3.75	8286	2.29
Z80A	1.25	8155	4.25	8741	9.49
Z80A CTC	1.65	8205	9.95	8742	14.95
Z80A DART	4.95	82C11	6.95	8748 (25V)	7.95
Z80A PIO	1.89	8212	1.99	8748H (HMOS)(21V)	9.95
Z80A SIO/C	3.95	8216	1.39	8749	9.95
Z80B	2.75	8224	1.49	8751H (3.5 12MHz)	34.95
Z80B CTC	3.95	8228	1.49	8755	13.49
Z80B PIO	3.95	8237-5	4.25	80286 10 (10MHz) LCC	29.95
Z8400HB1 CPU-8MHz	1.95	8243	1.95	80287 3 (5MHz)	109.95
		8250A	4.95	80287 8 (8MHz)	209.95
		8250B (For IBM)	5.95	80287 10 (10MHz)	239.95
8031	3.95	8251 A	1.95	80386 16 PGA	249.95
80C31	8.95	8252	1.89	80387 16 (16MHz)	349.95
8035	1.25	8253 5	1.95	80387 20 (20MHz)	399.95
8039	1.59	82C53 5	3.95	80387 25 (25MHz)	499.95
8052AHBASIC	24.95	8254	3.95	82284 (8MHz)	5.49
8080A	1.95	8255A 5	2.95	82288 (8MHz)	6.95
8085A 2	3.59	8256	11.95		
8086	3.95	8259 5	2.25		
8088 (5MHz)	89.95	8272	3.49		
8087 (10MHz)	139.95	8274	4.75		
8087 2 (8MHz)	129.95	8279-5	2.95		
8088 (5MHz)	4.95	8282	2.95		
8088 2 (8MHz)	6.95	8284A	1.95		
8155	2.49				

STATIC RAMS

Part No.	Function	Price
2016 12	2048x8 120ns	2.95
2102	1024x1 350ns	.89
2114N	256x4 450ns MOS	2.49
2114N 2L	1024x4 450ns	2.49
21C14	1024x4 200ns (CMOS) Low Power	.49
5101	256x4 450ns (CMOS)	1.95
6116P 1	2048x8 100ns (16K) CMOS	3.19
6116P 2	2048x8 150ns (16K) CMOS	2.79
6116P 1P	2048x8 100ns (16K) LP CMOS	3.55
6116P 3	2048x8 150ns (16K) LP CMOS	3.09
6264P 10	8192x8 100ns (64K) CMOS	6.75
6264P 15	8192x8 100ns (64K) CMOS	4.95
6264LP 10	8192x8 100ns (64K) LP CMOS	6.95
6264LP 12	8192x8 120ns (64K) LP CMOS	6.49
6264LP 15	8192x8 150ns (64K) LP CMOS	4.95
6514	1024x4 350ns CMOS	3.25
43256 10L	32.768x8 100ns (256K) Low Power	10.95
43256 15L	32.768x8 150ns (256K) Low Power	9.95
62256LP 10	32.768x8 100ns (256K) LP CMOS	11.95
62256LP 12	32.768x8 120ns (256K) LP CMOS	11.25
62256LP 15	32.768x8 150ns (256K) LP CMOS	10.95

DYNAMIC RAMS

Part No.	Function	Price
TMS4416 12	16.384x4 120ns	3.95
TMS4416 15	16.384x4 150ns	3.75
4116 15	16.384x1 150ns (MM5290N 2)	1.49
4128 15	131.072x1 150ns (Piggyback)	4.09
4168 100	65.536x1 100ns	2.19
4164 120	65.536x1 120ns	2.39
4164 150	65.536x1 150ns	2.15
41256 60	262.144x1 60ns	5.25
41256 80	262.144x1 80ns	3.75
41256 100	262.144x1 100ns	3.15
41256 120	262.144x1 120ns	3.25
41256 150	262.144x1 150ns	2.95
41264 12	64Kx4 120ns Video RAM	10.95
41464 80	65.536x4 80ns	5.95
41464 12	65.536x4 120ns	3.95
41464 15	65.536x4 150ns	3.59
51258 10	262.144x1 100ns Static Column	8.95
511000P 80	1.048 576x1 80ns (1 Meg)	12.95
511000P 10	1.048 576x1 100ns (1 Meg)	8.25
514256P 10	262.144x4 100ns (1 Meg)	12.95
514258 10	262.144x4 100ns Static Column	26.95

EPROMS

Part No.	Function	Price
TMS2516	2048x8 450ns (25V)	4.95
TMS2532	4096x8 450ns (5V)	5.95
TMS2532A	4096x8 450ns (12.5V)	5.25
TMS2564	8192x8 450ns (25V)	6.95
TMS2716	2048x8 450ns (5V, +5V, +12V)	6.49
1702A	256x8 2K (1µs)	3.25
2708	1024x8 450ns	6.95
2716	2048x8 450ns (25V)	3.49
2716 1	2048x8 350ns (25V)	3.95
2732	2048x8 450ns (25V) CMOS	4.25
2732 1	2048x8 450ns (25V) CMOS	3.95
2732A 20	4096x8 200ns (21V)	3.35
2732C	4096x8 450ns (25V) CMOS	4.25
2764 25	8192x8 250ns (21V)	3.95
2764A 20	8192x8 200ns (12.5V)	4.19
2764A 25	8192x8 250ns (12.5V)	3.49
2764 15	8192x8 150ns (12.5V) CMOS	4.95
27128 20	16.384x8 200ns (21V)	5.95
27128 25	16.384x8 250ns (21V)	5.25
27128A 15	16.384x8 150ns (12.5V)	4.75
27128A 20	16.384x8 200ns (12.5V)	4.75
27C128 25	16.384x8 250ns (21	

Now Available...Jameco's NEW Flyer 142 with 48 pages of Computer Peripherals & More!

Sony 3.5" 720Kb Disk Drive

• IBM PC/XT/AT Compatible
• Double-sided, double-density
• Documentation included

MPF11 Disk Drive.....\$49.95
SMK 5.25" Installation Kit for MPF11...\$14.95

Logitech ScanMan Plus Scanner and Mice

Scanner only:
• IBM PC/XT/AT Compatible
• 4" Scanning Window
• Ideal for DTP and Graphics Programs
• 400DPI

SCANP Scanner.....\$219.95
MSER Serial Mouse.....\$79.95
MBUS Mouse w/Bus.....\$89.95
MPS2 PS/2 Mouse.....\$74.95

Prometheus 9600 Baud Modem

9600E External 9600 Baud.....\$699.95
1200B Internal 1200 Baud.....\$49.95
2400B Internal 2400 Baud.....\$99.95

Jameco Digitizer Tablet

• AutoCAD 10 template and four-button cursor
• Resolution: up to 1016 lines per inch
• Accuracy: ±.025"
• Emulates three of the world's most popular formats
• EEPROM allows custom configuration

JCAD Digitizer Tablet..\$199.95
Stylus Two Button Stylus.....\$39.95

MOTHERBOARDS

20MHz 386 Only \$629.95!
• All w/ OK RAM

JE3520 Pictured

JE1001 Jameco 4.77/8MHz 8088 (PC/XT)....\$89.95
JE3005 Jameco Baby 8/12MHz 80286 (AT) \$199.95
JE3010 Jameco Baby 8/16MHz 80286 (AT) \$299.95
JE3011 Jameco Baby 8/20MHz 80286 (AT) \$389.95
JE3025 AMI Baby 20MHz 80386.....\$1199.95
JE3026 AMI Full-Size 25MHz 80386.....\$1899.95
JE3028 AMI Full-Size 33MHz 80386.....\$2299.95
JE3520 Jameco Baby 20MHz 80386.....\$629.95
JE3525 Jameco Baby 25MHz 80386.....\$1199.95
JE3533 Jameco Baby 33MHz 80386.....\$1699.95

Jameco 20MHz 80386 Desktop Computer Kit

• Fully IBM Compatible
• Free! Concurrent 386 Disk Operating System Software Included
• Free! QAPLUS Diagnostic Software Included!
• Free! WORDSTAR EASY Word Processing Software Included!
• 1Mb RAM Included, Expandable to 8Mb onboard, 16Mb with optional expansion board
• 8/16/20MHz Keyboard Switchable Operation
• AMI BIOS ROMs Included
• Floptop Case w/ 200 Watt Power Supply
• MiniScribe 3.5" 40Mb RLL Hard Disk Drive
• 1.2Mb Floppy DSHD Disk Drive
• 22.0 Norton SI Rating
• 101-Key (Enhanced) Keyboard

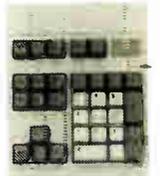
JE3550 20MHz 80386 Compatible Kit.....\$1599.95



Shown with VGA Option (not included)
JE2060 VGA Monitor and VGA Card.....\$529.95
(See Below)

Jameco 32-Key Keypad for IBM PC/XT/AT & Compatibles

Ideal for use with Laptops!



• Great for use with laptop computers as well as original IBM AT layout keyboards
• 12 function keys • Separate cursor keys • Tactile touch keyswitches • Software and manual included

JE2018.....\$59.95

IBM Compatible Cases and Power Supplies

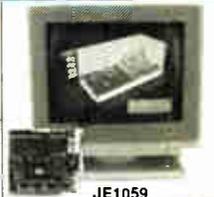
JE1030

JE1010 Flip-Top Standard PC/XT Case.....\$39.95
JE1011 Side Standard PC/XT Case.....\$39.95
JE1030 150 watt PC/XT Power Supply.....\$59.95
JE1032 200 watt Baby AT Power Supply.....\$89.95
JE1035 300 watt AT Power Supply.....\$139.95
JE2011 Vertical Case w/300W Pwr Supply.....\$249.95
JE2012 Mini-Vertical Case w/200W Pwr Supply.....\$149.95
JE2014 Flip-Top Baby XT Turbo Case.....\$69.95
JE2019 Flip-Top Baby AT Case.....\$69.95

EGA & Multiscan Monitor Packages

Casper 14" EGA monitor and EGA card package (720 x 350 max. resolution)
JE1059 EGA Monitor & EGA Card.....\$459.95

Relisys 14" Multiscan monitor and EGA card package (800 x 600 max. resolution)
JE2057 Multiscan Monitor & EGA Card.....\$559.95



JAMECO IBM PC/XT/AT COMPATIBLE CARDS

JE1043 360K/720K/1.2Mb/1.44Mb Floppy Disk Controller Card (PC/XT/AT).....\$49.95
JE1050 Monochrome Graphics Card w/Parallel Printer Port (PC/XT/AT).....\$49.95
JE1052 Color Graphics Card w/ Parallel Printer Port (PC/XT/AT).....\$49.95
JE1055 EGA Card w/ 256K Video RAM (PC/XT/AT).....\$139.95
GC1500 Orchid 8 Bit VGA Card w/256K Video RAM (PC/XT/AT).....\$169.95
JE1057 8/16 Bit VGA Card w/256K Video RAM (PC/XT/AT).....\$199.95
JE1060 I/O Card w/ Serial, Game, Printer Port & Real Time Clock (PC/XT).....\$59.95
JE1062 RS232 Serial Half Card (PC/XT/AT).....\$29.95
JE1065 I/O Card w/ Serial, Game and Parallel Printer Port (AT).....\$59.95
JE1071 Multi I/O Card w/ Controller & Monochrome Graphics (PC/XT).....\$119.95
JE1077 Multi I/O Card w/ 360K/720K/1.2Mb/1.44Mb Floppy Controller (AT).....\$74.95
JE1081 2Mb Expanded or Extended Memory Card (zero-K on board)(AT).....\$109.95



IBM PC/XT/AT Compatible Keyboards

JE2017

JE2015 84-Key Standard AT Style Layout.....\$59.95
FKB4700 101-Key Enhanced Layout with 12 Function Keys.....\$69.95
JE2016 111-Key Enhanced with Solar Powered Calculator.....\$79.95
JE2017 104-Key Enhanced with Trackball (Microsoft Compatible).....\$99.95

Floppy Disk Drives & Diskettes

Mitsubishi

MF353B 3.5" 720Kb Internal Drive ..\$99.95

Toshiba

356KU 3.5" 1.44Mb Internal Drive \$109.95

TEAC

FD55B 5.25" 360Kb Half Ht.\$89.95
FD55G 5.25" 1.2Mb Half Ht.\$99.95

3.5" & 5.25" Diskettes (10 per box)

DSDD 5.25" DSDD (360Kb).....\$6.95
DSHD 5.25" DSHD (1.2Mb).....\$13.95
3DS 3.5" DSDD (720Kb).....\$16.95
3HD 3.5" DSHD (1.44Mb).....\$34.95

MiniScribe Hard Drives & CMS Tape Back-Ups

Part No.	Capacity	Style	Average Speed	Format	Drive Alone	W/8-Bit (XT) Controller	W/16-Bit (AT) Controller
M8425	20Mb	3.5"HH	68ms	MFM	\$224.95	-----	-----
M8425XT	20Mb	3.5"HH	68ms	MFM	-----	\$269.95	-----
M8425AT	20Mb	3.5"HH	68ms	MFM	-----	-----	\$339.95
M8425F	20Mb	3.5"HH	40ms	MFM	\$249.95	-----	-----
M8438	30Mb	3.5"HH	68ms	RLL	\$249.95	-----	-----
M8438XT	30Mb	3.5"HH	68ms	RLL	-----	\$299.95	-----
M8438AT	30Mb	3.5"HH	68ms	RLL	-----	-----	\$389.95
M8450	40Mb	3.5"HH	46ms	RLL	\$329.95	-----	-----
M8450XT	40Mb	3.5"HH	46ms	RLL	-----	\$369.95	-----
M8450AT	40Mb	3.5"HH	46ms	RLL	-----	-----	\$429.95
M3085	70Mb	5.25"HH	20ms	MFM	\$599.95	-----	-----
M3085AT	70Mb	5.25"HH	20ms	MFM	-----	-----	\$699.95
M3180E	150Mb	5.25"HH	17ms	ESDI	\$1199.95	-----	-----
M9380E	330Mb	5.25"FH	16ms	ESDI	\$1699.95	-----	-----
DJ10	40Mb	Tape Drive with up to 120Mb capability (includes one TB40 Tape).....					\$299.95
QFA500	150Mb	Tape Drive with up to 500Mb capability (includes one TC150 tape).....					\$1049.95

Hard & Hard/Floppy Disk Controller Cards

Computer Type	MEM Hard		RLL Hard		MEM Hard/Floppy		RLL Hard/Floppy	
	Part No. / Price							
8088 (PC/XT) @ 3:1 Interleave	XTGEM\$79.95	1004A27X\$89.95	JE1044\$109.95	-----	-----	-----	-----	
80286 (AT)/386 @ 2:1 Interleave	1003VMM1\$129.95	1003VSR1\$149.95	1003VMM2\$149.95	1003VSR2\$169.95	-----	-----	-----	
80286 (AT)/386 @ 1:1 Interleave	1006VMM1\$149.95	1006VSR1\$169.95	1006VMM2\$169.95	1006VSR2\$189.95	-----	-----	-----	

1355 Shoreway Road
Belmont, CA 94002
24 Hour Order Hotline (415) 592-8097
FAX's (415) 592-2503 or (415) 595-2564
Telex 176043 - Ans. Back: Jameco Bmt
Data Sheets - 50c each
Send \$2.00 Postage for a FREE 80-Page Catalog
©1990 Jameco Electronics 4/90
IBM is a registered trademark of International Business Machines



\$50.00 Minimum Order - U.S. Funds Only
CA Residents Add 6.25%, 6.75% or 7.25% Sales Tax
Shipping - Add 5% plus \$1.50 Insurance
(May vary according to weight and shipping method)
Terms: Prices subject to change without notice
We are not responsible for typographical errors
Items subject to availability and prior sale
Product: pictured may only be representative
Complete list of terms/warranties is available upon request.

24-Hour Order Hotline (415) 592-8097 • The Following Services Are Also Available Through (415) 592-8097 From 7AM - 5PM P.S.T.:
• Customer Service • Technical Assistance • Credit Department • All Other Inquiries

Scottsdale Systems

—Since 1980—

1-800-777-2369

COMPUTERS		PLOTTERS		PRINTERS		LASER PRINTERS			
SAVE WYSE 386 25 MHz \$3920 WYSE 286 2214 \$1351 SAMSUNG WYSE 386 25 MHz \$2795 WYSE 286 2214 \$1249		IOLINE Roland DESKTOP PLOTTERS DXP 1100 1 Year Warranty \$914 DXP 1100 2 Year Warranty 1339 DXP 1100 3 Year Warranty 1759		HOUSTON INSTRUMENTS Roland DRAFTING PLOTTERS GRX 360 A D Size \$3579 GRX 360 A L Size 4589		Alps Allegro \$345 Alps 324E 735 Canon B1 30E 725 Panasonic 119 237 Panasonic 118S 185 CANON LPB 8111 \$1795 LPB 4 9559		PACIFIC DATA 25 in 1 \$265 Plotter in a Cartridge 239 IOMEGA 315 Barmoull Box 305 B 120 1.1 4 MB Internal 5895 B 120 1.44 MB Internal 1095 Prices do not include interface	
TERMINALS/MONITORS WYSE TERMINALS \$299 MONITORS \$499 649 WY 386 A w Keyboard 377 WY 286 A w Keyboard 405 WY 386 A w Keyboard 468 WY 286 A w Keyboard 367 WY 386 A w Keyboard 1489 WY 286 A w Keyboard 95		ENTER CALCOMP \$599 C \$3859 L \$3329 L \$3329		ROLAND FLATBED PLOTTERS 1 Year Warranty \$1989 2 Year Warranty 2439 3 Year Warranty 2941		VIDEO 7 Video 7 V Ram \$475 Video 7 V Ram 355 Video 7 V Ram 225			
MATH CO-PROCESSORS CALL		HEWLETT PACKARD CALL		BOARDS Video 7 V Ram \$475 Video 7 V Ram 355 Video 7 V Ram 225		TAPE BACKUPS Emerald Systems \$1069 Genoa \$1069 Irwin \$1069			
SOFTWARE CAD SOFTWARE \$510 MULTI USER \$310 IMACGRAPH 1 Year Warranty \$510 (H 516 & L 41) \$220 L 2 & AD 139 TORIBO CAT 69		OPTICAL SCANNER & SOFTWARE CALL		MIRUS Desktop Digital \$299 Desktop Digital \$299 Desktop Digital \$299		HARD DRIVES CDC IMPRIMS \$112 72 MB thru 600 MB \$360 Pranam \$215			
LEASING AVAILABLE Call for pricing on larger digitizers INTERNATIONAL ORDERS WELCOME		DIGITIZERS KURTA \$439 CALCOMP \$629 CALCOMP \$365 CALCOMP \$365		TIARA ETHERNET \$112 \$360 \$215		CALL SERVICE FOR REPAIRS ON PRINTERS, TERMINALS, MONITORS, COMPUTERS.			

Scottsdale Systems • 1555 W. University Dr., Tempe, AZ 85281
 602-966-8609 SERVICES (Mon - Fri) 602-731-4742 FAX 602-966-8634

TOSHIBA LAPTOPS

Call for low lease prices

T1600-286/12Mhz * 20MB hard disk * 1.44MB 3 1/2" floppy * EGA backlit display * Battery/AC * 11.16lbs. \$2749 T1600 - 40MB \$2999	T3100-286/12Mhz same as T 1600 with: * HiRes CGA gas plasma display (no battery) \$2399 T3100 - 40MB \$2645 T3 100SX \$CALL
--	--

T1000 smallest laptop
 6.4 lbs \$595
 * 2 720K floppy
 * 1Mb RAM
 * LCD backlit
 * Battery
\$1335

LASER PRINTER
 Page laser 6 \$1195

800-383-3199

orders only
 714-898-8626
 customer service/foreign orders
 FAX: 714-891-1202

T3200- 286/12Mhz * 40MB hard drive * 2 expansion slots * EGA gas plasma * 1MB RAM * 1.44MB 3 1/2" floppy * 100/220v (no battery) \$3199	T5100-386/16Mhz * 2MB RAM * EGA gas plasma * 110/220v T5100 40MB \$3895 T5100 100MB \$4599
--	--

T5200-386/20Mhz
 * 2MB RAM
 * 2 expansion slots
 * VGA gas plasma
 * 1.44MB 3 1/2" floppy
 With 40MB \$4549
 With 100MB \$4945

PRINTERS
 EXP writer 301 laptop printer \$335
 * 4lbs * 24 pin
 * 2KB RAM * Battery
 EXP writer 311 24 pin \$379

T.P.C. TELEPHONE PRODUCT CENTER

FAX \$299

EPSON FAX (lowest\$) w/cutter F1000 \$635 F2000/F3000 \$695/765	SANYO SF2U/SF200 \$625/\$799 SF 515 \$1145
--	---

RICOH
 RICOH RF850 \$598
 RICOH RF900 \$648
 RF200 \$928
 RICOH Fax 15 \$1029
 RICOH Fax 25 \$1199
 RICOH Fax 35 \$1395
 RICOH Fax 65 \$1425

PANASONIC
 KXP 80 \$548
 KXF 120 \$754
 KXF 220 \$1058
 PANAFAX UF 140 \$699
 PANAFAX UF 150 \$695
 PANAFAX UF 250 \$1159
 PANAFAX UF 260 \$1299

SHARP
 SHARP FO 230 \$639
 SHARP FO 300 \$658
 SHARP FO 330 \$735
 SHARP FO 550 \$1195
 SHARP FO 510 \$950
 SHARP UX 110 \$499
 SHARP UX 350 \$998

LAPTOPS

FREE 2400 MODEM/CARRYING CASE

ZENITH LAPTOPS Minisport 2MB RAM \$CALL Supersport 184 \$1299 Supersport 184-2 \$1899 Supersport 286 20MB \$2499 Supersport 286 40MB \$2699 386SX 40MB \$CALL	COMPAQ LAPTOPS SLT 286 20MB \$3689 SLT 286 40MB \$3999
--	---

EPSON LAPTOPS
 Equity LT 20MB \$1595
 Equity LT 286E \$CALL

SHARP LAPTOPS
 PC 4602 2 FD \$1195
 PC 4641 1 FD, 40MB \$1695
 PC 5541 286 40MB \$2395
 MZ 100 2 FD \$998

MITSUBISHI

MP 286-210 2 FD \$1295	MP 286-220 1 FD, 20MB \$1695
MP 286-240 1 FD, 40MB \$2098	

HYUNDAI
 Super LT3-286-20 \$1695
 Super 386S \$CALL

TEXAS INSTR.
 Model 12 286 20MB \$2599
 Model 25 286 20MB \$3099
 Model 45 286 40MB \$3399

MORE LAPTOPS
 Samsung \$2399
 Peaot \$CALL
 Atari portfolio list \$399 \$CALL
 PSION \$CALL
 Bondwell 8200 2 floppys \$795
 AD 300

MURATA

Murata 1400 \$635	Murata 900 \$489
Murata F30 \$1349	Guis 110/220v \$498
Nissei 303 \$299	

TOSHIBA
 TOSHIBA 3200 \$598
 T3600 \$745
 T3750 \$855

FAX CARDS
 Quadram JT 9600 \$399
 Quadram JT Fax-PORTABLE \$329
 Complete PC
 Fax board 9600 \$399

SCANNERS
 Complete PC \$499
 Full Page \$595
 Mitsubishi SP MU215AF \$595
 Chinon with OCR \$CALL
 Genie Scan w/OCR \$599

T.P.C. 12603 Hoover St., Garden Grove, CA 92641

FIRST SOURCE INTERNATIONAL

WE ACCEPT INTERNATIONAL ORDERS

First Source International, Inc.
 4000 Barranca Parkway, Suite 250
 Irvine, California 92714
 Phone: (714) 262-3226 FAX: (714) 262-9145



OUTSIDE CA 1-800-535-5892

IBM PS/2

MEMORY MODULES

Models 30-286,50,50Z,60	
512K Kit 30F5348	\$89.00
2MB Kit 30F5360	\$299.00
Models 70-E61/121	
1MB 6450603	\$169.00
Models 70-E61/121,50Z,55SX	
2MB 6450604	\$325.00
Model 70-A21	
2MB 6450608	\$329.00

MEMORY BOARDS

Model 80-141	
1MB 6450375	\$349.00
Models 80-111/311	
2MB 6450379	\$575.00
All Models 70 and 80	
0-8MB with 2MB 6450605	\$1250.00

LASER PRINTERS

FOR APPLE AND HEWLETT-PACKARD

Apple Laserwriter II/NTX	
1MB Kit M6005	\$279.00
4MB Kit M6006	\$769.00
Hewlett-Packard LaserJet II & IID	
1MB 33443B	\$225.00
2MB 33444B	\$339.00
4MB 33445B	\$555.00
Hewlett-Packard LaserJet IIP	
1MB 33474A	\$189.00
2MB 33475A	\$325.00
4MB 33477A	\$529.00

COMPAQ

MEMORY MODULES

Deskpro 286	
512K Kit 113012-001	\$85.00
Deskpro 286-E,386-20 20E/25,Portable 3	
1MB 113131-001	\$249.00
4MB 113132-001	\$549.00
Portable 386	
1MB Kit 107651-001	\$325.00
Deskpro 386-16	
1MB Kit 108071-001	\$289.00
4MB Kit 108072-001	\$869.00
Deskpro 386S	
1MB 113646-001	\$249.00
4MB 112534-001	\$549.00
Deskpro 386-33	
2MB 115144-001	\$489.00

MEMORY BOARDS

SLT-286	
1MB 110235-001	\$465.00
Portable 386	
4MB 107653-001	\$1245.00
Deskpro 386-16	
1MB 108069-001	\$475.00
2MB 108069/71-001	\$625.00
4MB 108070-001	\$1399.00
8MB 108070/72-001	\$2499.00
Deskpro 386-20E	
1MB 113644-001	\$395.00
4MB 113645-001	\$1145.00
Deskpro 386S	
1MB 113633-001	\$349.00
4MB 113634-001	\$995.00

AST

Premium 286	
512K Kit 500510-001	\$79.00
Bravo-286,Workstation	
512K Kit 500510-010	\$89.00
2MB Kit 500510-002	\$269.00
Premium 386-16/20C	
1MB Kit 500510-007	\$129.00
4MB Kit 500510-008	\$379.00
Premium 386-20	
1MB Kit 500510-003	\$129.00
4MB Kit 500510-004	\$379.00
Bravo 386-SX	
2MB Kit 500510-002	\$269.00
4MB Kit 500510-008	\$379.00
Premium 386-SX/25	
1MB 500718-001	\$175.00
Premium 386-33,486-25	
1MB 500718-002	\$179.00

APPLE

Models Plus,SE,SE-30,II,IICX	
1MB Kit MO218	\$109.00
4MB Kit MO2707	\$339.00
Models Plus,SE	
2MB Kit MO219	\$169.00
Model IICi	
4MB Kit MO292LL-A	\$385.00

WE CARRY A FULL LINE OF MEMORY PRODUCTS FOR HEWLETT-PACKARD TOSHIBA, ZENITH, AND MANY OTHERS

SIMMS

IBM TYPE

ADD \$10.00 FOR SIPPS	
4Mx9 80	\$949.00
1Mx9 12	\$85.00
1Mx9 10	\$90.00
1Mx9 80	\$95.00
1Mx9 70	\$105.00
1Mx9 60	\$CALL
256x4-10	\$11.50
256x4-80	\$12.00
256x1-10	\$2.50
256x1-80	\$2.75
256x9-80	\$3.95
256x9-60	\$4.50
FOR EVEREX, DELL, AT&T, SUN MICROSYSTEMS WESTERN DIGITAL AND MANY MORE.	
64Kx4-10	\$3.75
64Kx4-80	\$4.50
64Kx1-12	\$1.55
64Kx1-10	\$1.85

DRAM

DIP,ZIP,OR SOJ

1Mx1-10	\$9.00
1Mx1-80	\$9.50
1Mx1-70	\$10.00
1Mx1-60	\$CALL

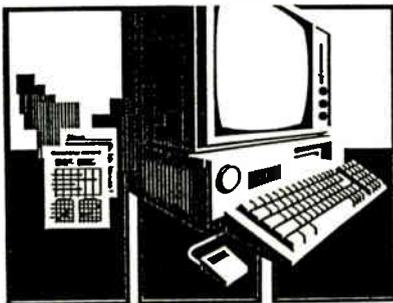
WE ACCEPT PURCHASE ORDERS FROM GOVERNMENT AGENCIES, UNIVERSITIES, AND QUALIFIED FIRMS.

TERMS AND CONDITIONS

NO SURCHARGE ON MASTERCARD / VISA.
 1 YEAR WARRANTY ON ALL PRODUCTS.
 20% RESTOCKING FEE ON ALL NON-DEFECTIVE RETURNS, RMA# REQUIRED.
 ALL PRICES SUBJECT TO CHANGE

Microcomputer News On-Line

In this fast paced industry, can you afford to wait a week or a month for information that may affect you today?



MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

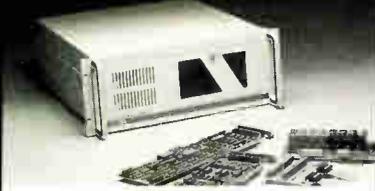
Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX One Phoenix Mill Lane, Peterborough, NH 03458
 1-800-227-2983

PC-LabCard



19" Rack Mountable Industrial PC

IPC-600

- 19" Rack mountable chassis
- 12 Slot passive backplane
- Supports 80286 or 80386 CPU card
- Cooling fan with removable air filter
- Special hold-down clamp to protect plug-in cards against vibration
- Shock mounted disk drive housing supports 2 half height drives

For Your Catalog Call
408-293-6786



Circle 20 on Reader Service Card

PC-LabCard



Industrial PC Card Cage with 8 Slot Backplane

IPC-6010

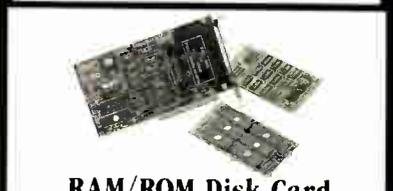
- Open-style framework for flexible installation in custom enclosure
- 8 Slot industrial backplane
- 4 Layer PCB with dedicated power & ground planes
- Supports both standard PC power connection and industrial screw terminal connection
- Special hold-down clamp to protect plug-in cards against vibration

For Your Catalog Call
408-293-6786



Circle 20 on Reader Service Card

PC-LabCard



RAM/ROM Disk Card for "Diskless" PC

PCI-790

- Replaces mechanical disk drive by solid-state disk
- Interchangeable SRAM or EPROM memory module
- Supports up to 4 cards in a single PC with power-on autoboot capability
- Ideal for high speed, heavy duty access and high reliability applications

ADVANTECH

USA & Canada: contact San Jose, CA

Tel: 408-293-6786 Fax: 408-293-4697

Europe & Asia: contact Taipei, Taiwan

Tel: 886-2-9184567 Fax: 886-2-9184566



Circle 20 on Reader Service Card

ALL NEW !!!
9 TRACK TAPE SUBSYSTEM
for IBM PC/AT/386
complete for only
\$2,595.00
1 YEAR WARRANTY



- IBM/ANSI compatible at 800*/1600/3200 bpi
- Controller, cables and software included
- Interfaces for PS/2*, Xenix* and DEC*
- SCSI*, AT or MCA* Bus I/O at 25/50/100 ips

* optional

AKSystems Inc
20741 Marilla St. Chatsworth CA 91311
TEL:818/709-8100 FAX: 818/407-5889

Circle 14 on Reader Service Card

UNIVERSAL PROGRAMMER

\$585 including:
S/W cable, interface
card, 1 yr. warranty,
30 day money back
guarantee.

Programs:

- E(P)ROMs upto 2Mbits & 16 bit wide.
- PALs from AMD, MMI, TI, NS, CYPRESS etc.
- 22 V10 from AMD, ATMEL, TI, SAMSUNG & CYPRESS
- EPLDs from ALTEGA, INTEL, TI
- GALs from LATTICE, SGS & NS
- FPLs from SIGNETICS
- PEELs from ICT, HYUNDAI & GOULD
- BIPOAR PROMs
- SINGLE CHIPS (8748, 8751 & 87C51 series).

Supports:

- 32-Bit WORDSPLIT with 4 GANG adaptor.
- PALASM2 CPU:ABEL, TANGO/OCAD JEDEC files.
- PAL VERIFICATION using TEST VECTOR
- GAL electronic signature recognition
- 32-Bit WORDSPLIT with 4 GANG adaptor
- 87C451, 63701X/Y/V & 63705V with adaptor.
- Test ICs (TTL, CMOS) & D/S Memories, ICs with user definable test patterns

High speed, parallel interface & S/W upgradable for new parts.

XELTEK

473 SAPIENA CT. #26
SANTA CLARA,
CA 95054

1-800-541-1975 (Toll Free Order)

TEL: (408) 727-6995

FAX: (408) 727-6996

COD,VISA,MC,AMEX

Circle 299 on Reader Service Card

33 MHz 80386 Motherboard

Faster than the Everex Step™
8.3 MIPS! \$2,099 (Ok) Qty 1



Features:

- 64K/256K Write Back Cache
- Dual Read/Write Cache
- 100% Faster DMA Throughput than Standard AT
- Transparent Refresh
- True 32-Bit Memory Exp. to 16MB
- Support 80387/Wentek
- UNIX, OS/2 & Novell Compatible
- 1 Year Full Warranty
- Complete Documentation

	MIPS	Cache	Ok	4M
386/33	8.3	256K	2499	2949
386/33	8.3	64K	2099	2549
386/25	6.2	64K	1399	1799
386/20	4.9	64K	1199	1599

Technology Power Enterprise, Inc.
46560 Fremont Blvd #118, Fremont CA 94538
Tel (415) 623-9162 FAX (415) 623-9462

Circle 148 on Reader Service Card

8051 68HC11 EMULATORS



For info call:

Australia	(02) 654 1873
Austria	(0222) 38 76 38
Benelux	+31 1858-16133
Denmark	(02) 65 81 11
Finland	90-452 1255
France	(01) 69 412 801
Great Britain	0962-73 3140
Israel	(03) 484832
Italy	(011) 7710010
Korea	(02) 784 7841
New Zealand	(09) 392464
Portugal	(01) 83 56 70
Scandinavia	+46 40922425
Singapore	065 743-2086
Spain	(93) 217 2340
Switzerland	(01) 740 41 05
Taiwan	(02) 7640215
Thailand	(02) 281-9596
West Germany	08131-1687
U.S.A. FAX	(408) 378-7869

NOHAU CORPORATION

51 E. Campbell Ave. • Campbell, CA 95008

(408) 866-1820

Circle 205 on Reader Service Card

FREE CATALOG

RS-232C INTERFACE & MONITORING EQUIPMENT CATALOG

WRITE or CALL for YOUR FREE COMPREHENSIVE B & B ELECTRONICS CATALOG TODAY! Pages and pages of photographs and illustrated, descriptive text for B&B's complete line of RS-232C converters, RS-422 converters, current loop converters, adapters, break-out boxes, data switches, data splitters, short haul modems, surge protectors, and much, much more. Most products meet FCC Part 15. Your RS-232 needs for quality, service and competitive prices will be more than met by B&B ELECTRONICS. Manufacturer to you, no middleman! Money-back guarantee! Same day shipment! One-year warranty on products! Technical support is available.



Order direct from manufacturer TODAY & SAVE!

Write For Your FREE Catalog Today!

B&B electronics
MANUFACTURING COMPANY

4002D Baker Road, P.O. Box 1040 • Ottawa, IL 61350

Phone: 815-434-0846

Circle 37 on Reader Service Card

DYNAMIC RAMS

SIMM	Capacity	Access Time	Price
1MBIT	80/100	100ns	\$ 7.95
514256	100ns		\$ 8.50
41464	150ns		\$ 2.65
41256	100ns		\$ 2.55
41256	120ns		\$ 2.40
51258	80ns		\$ 3.75
4164	120ns		\$ 2.10

MATH COPROCESSORS	Price	E PROMS	Price
80387-33 33MHz	\$550.00	27C101 250ns	\$ 17.00
80387-25 25MHz	\$445.00	27C512 200ns	\$ 9.75
80387-20 20MHz	\$355.00	27S12 250ns	\$ 7.75
80387-16 16MHz	\$305.00	27C256 250ns	\$ 5.25
80387SX 16MHz	\$290.00	27V56 250ns	\$ 4.25
80C237A 12MHz	\$265.00	27128A 250ns	\$ 4.00
80287-10 10MHz	\$208.00	27C64A 200ns	\$ 4.25
80287-B 8MHz	\$185.00	27S4 250ns	\$ 3.50
8087-1 10MHz	\$160.00		
8087-2 8MHz	\$125.00		

I.C. EXPRESS

15140 Valley Blvd. City of Industry, CA 91744
Tel: (818) 908-8888 Fax: (818) 309-1236
ORDER: (800) 877-8188 (Mon-Fri. 8-5 PST)
CALL FOR CURRENT PRICES & VOLUME DISCOUNTS
Minimum order \$10.00. Shipping & Handling. UPS Ground by 09:00 AM PT (00:00) & ALL MECHANISMS 100% GUARANTEED WITH PROMPT DELIVERY

Circle 148 on Reader Service Card

HELP THE AMERICAN FOUNDATION FOR THE BLIND HELP YOU!

The American Foundation for the Blind's National Technology Center (NTC) maintains a Job Index/User Network which features information from over 1,100 blind and visually impaired people who use adaptive equipment in a variety of jobs.

The NTC is looking for additional participants. Blind and visually impaired individuals of all ages who have hands-on experience with computers, low vision aids, talking products, or other adaptive devices are needed as resource people and/or evaluators.

As a resource person, other users may contact you to share your knowledge and experience. As an evaluator, you may be asked to evaluate both existing and newly developed or adapted devices. Evaluations are published in the "Random Access" section of the *Journal of Visual Impairment & Blindness*.

If you are interested, please fill out the form below or call our hotline, 1-800-232-5463 (New York residents call 212-620-2147). Tell the operator you wish to be part of the Job Index/User Network.

Your response will be followed by a brief, confidential telephone survey. The information you provide will be used for NTC purposes only and will include the equipment you use, your experience with it, training and employment.

Your assistance will enable the Job Index/User Network to continue as a major information and support system for blind and visually impaired people nationwide.

Mail to: American Foundation for the Blind, National Technology Center, 15 West 16th Street, New York, NY 10011, Attn: A. Hypolite

Name _____

Address _____

City _____ State _____ Zip _____

Best time to contact _____ Telephone _____

KNAPCO

YES !!! For 1990 KNAPCO DELIVERS THE POWER OF

EMERSON UPS



* Also below the AccuCard

A low cost alternative to the use of standard 300 Va To 500 Va UPS systems.



PRICED AT \$249.

EMERSON MODELS WATTAGE LIST NOW

UPS 200	\$412	\$249.
UPS 600	\$798.	\$559.
UPS 800	\$998.	\$565.
UPS 1250	\$1398.	\$899.
UPS 1500	\$1798.	\$1195.
SW 1000	\$698.	\$439.

TRUE ON LINE MODELS

PC ET	\$798.	\$479.
AP 15KVA	\$3217.	\$2299.
AP 3KVA	\$5550.	\$4199.
AP 5KVA	\$9499.	\$6999.

EMERSON UPS

\$479
retail \$798

\$439
retail \$698

true SINEWAVE or ONLINE
KNAPCO DELIVERS THE BEST PRICES !!!!

APRIL SPECIALS
POWER CONDITIONERS
1250 WATTS ONLY \$199.
DATA TRANSFER BOXES
A/B SERIAL BOX \$14.95
MITSUBISHI LAPTOPS
MP 286 - 220 \$2199.

800-541-8126
FAX 813-449-0701 A-22
813-449-0019

KNAPCO

QUALITY DISTRIBUTION FOR 45 YEARS
1201 HAMLET AVE.
CLEARWATER FL. 34616

EZ-WRITER™

(E)EPROM Multiprogrammer
Best Portable (E)EPROM
Programmer Money Can Buy.



Models from \$495.

★ 100% USA Made

- Stand-alone
- Remote Control
- 40-pin Micro Option
- All models with 40 char. LCD
- GANG/SET (E)EPROM Option
- RAM expandable to 16 Megabit
- Model KF with Parallel Port for fast Up/Download
- Universal (E)EPROM Support including Megabit devices
- Model K3/C3, easy 3 key Operation
- Data I/O* Compatibility features



1-800-523-1565
In Florida (407) 994-3520
Fax: (407) 994-3615
CA (408) 437-2414

* Data I/O is a registered trademark of DATA I/O Corporation

Circle 55 on Reader Service Card

NEW FREE 384 PAGE DATA ACQUISITION & CONTROL HANDBOOK FOR IBM PC/XT/AT, PS/2 AND COMPATIBLE COMPUTERS



NEW 1990 HANDBOOK

- A/D BOARDS
- SIGNAL CONDITIONING
- COMMUNICATION
- INDUSTRIAL CONTROL
- PC INSTRUMENTS
- IMAGE ACQUISITION

*SEND TODAY FOR YOUR FREE 384 PAGE METRABYTE DATA ACQUISITION & CONTROL HANDBOOK

KEITHLEY METRABYTE

440 Myles Standish Blvd., Taunton, MA 02780
(508) 880-3000 TLX: 503989 FAX: (508) 880-0179

Circle 154 on Reader Service Card

DATA ACQUISITION

ALL needs ! ANY computer !

- PC Software Included
- Serial, Modem, & Bus
- Stand Alone Ability
- Laptop & Handheld
- PC & MAC Cards
- Inexpensive
- OEM & VAR
- RTU's



Call for FREE DEMO DISK !

Specialists in portable and battery backed up as well as PC compatible modular systems.



Call for applications info: (201) 299-1615
P.O. Box 246; Morris Plains, NJ 07950

MEASUREMENT TO GO

ELEXOR

Circle 104 on Reader Service Card

Real Time Waveform Display.

Only CODAS waveform recording systems offer true real time waveform display.

- For IBM AT, PS/2 Micro Channel*, and compatibles.
- Record up to 16 waveforms to disk in real time at up to 50,000 samples per second for instant playback, analysis, and manipulation.
- Includes all necessary hardware and software for fast, turnkey startup.
- Includes Microsoft C-compatible library of function calls for customization.

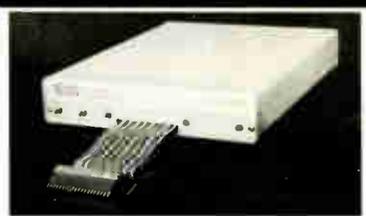
For a FREE Evaluation Package, call: 1-800-553-9006. In Ohio, 1-216-434-4284.

DATAQ INSTRUMENTS, INC.

825 Sweitzer Ave., Akron, OH 44311

*IBM, AT, PS/2, and Micro Channel are trademarks or registered trademarks of IBM Corp. Microsoft C is a trademark of Microsoft Corp.

Circle 85 on Reader Service Card



68HC05 In-Circuit Emulator

The TECICE-HC05 is a low cost real time emulator for the Motorola 68HC05 family of single chip microcomputers. Any host computer with serial port and terminal emulation software can be used with TECICE-HC05. Base price is \$1195.00. Complete development system software is available for MS-DOS computers including the Byte Craft Limited C6805 Code Development System which includes a 8085 C compiler with Integrated Development Environment.

TECI THE ENGINEERS COLLABORATIVE, INC.

RR#3, BOX 8C Barton, Vermont 05822
Phone (802) 525-3458 FAX (802) 525-3451

Circle 108 on Reader Service Card

9-Track Tape Subsystem for the IBM PC/XT/AT



Now you can exchange data files between your IBM PC and any mainframe or mini-computer using IBM compatible 1600 or 6250 BPI 9-Track tape. System can also be used for disk backup. Transfer rate is up to 4 megabytes per minute on PCs and compatibles. Subsystems include 7" or 10 1/2" streaming tape drive, tape coupler card and DOS compatible software. For more information, call us today!

QUALSTAR®

9621 Irontdale Ave., Chatsworth, CA 91311
Telephone: (818) 882-5822

Circle 237 on Reader Service Card



COMPUTER DISCOUNT WAREHOUSE™



CD-ROM



HITACHI 3600/3650	\$589.77
NEC External	559.10
NEC Internal	499.55
NEC XT / AT / PS/2	138.93
TOSHIBA CD-ROM External	799.29
TOSHIBA CD-ROM PS/2 External	1069.12

IRWIN 145C 40MB Internal	\$339.94
IRWIN 2080 80MB Internal PS/2	442.70
IRWIN 445 AT 40MB External	472.27
IRWIN 745SP 40MB External	499.98
IRWIN 785SP 80MB External	567.25
IRWIN 485A 80MB External AT	538.64
IRWIN 6451E 250MB External	1077.86
IRWIN 787SP 120MB Internal	592.77



WHY PAY RETAIL?

CDW™ Sells For Less

AND SERVICES YOU BETTER



INTEL BOARDS & CO-PROCESSORS

INTEL Above Board Plus	\$399.68
INTEL Inboard 386 PC	569.53
INTEL Visual Edge	448.39
INTEL Connection Co-processor	495.67

SPEED UP YOUR PC UP TO 500%!

INTEL MATH COPROCESSORS

INTEL 80287-8	\$206.55
INTEL 80287-10	223.55
INTEL 80387-16	337.60
INTEL 80387-20	390.65
INTEL 80387-25	478.92
INTEL 80387-SX	299.82
INTEL 80387-33	575.20
INTEL 80C287-A	268.50



HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

COMPUTERS

SAMSUNG

S-3000VE, 4.77/10 MHz	\$499.11
S-550 AT Comp., 8/12 MHz	885.64
S-550, 20 Meg	1198.80
SD700SX	CALL
SAMSUNG PC Terminal/286	635.60
S-630 - 286	693.50

PACKARD BELL

PB 686, 12 MHz	\$717.80
PB 286, 20 Meg Laptop / 40 Meg Laptop	1937.55 / 2134.37
PB 386/25	2519.20
FORCE 386SX, 16 MHz	1273.70
FORCE 386SX, 40 Meg	1595.13

TOSHIBA

T-1000SE	CALL	T5200, 40 Meg	TOSHIBA
T1600	CDW	T3100e	PRICES!
T1200, 2 Drive	FOR	T5200, 100 Meg	ALL
T5100	THE	T3100SX	MODELS
T1200, 20 Meg	LATEST	T3200SX	AVAILABLE

WYSE

MDL 3216	\$998.17	MDL 2116	\$1138.20
MDL 3225	3476.22		

IBM PS/2

30286, 30 Meg	1845.55	MDL 555X, 80 Meg	3178.39
MDL 70, 60 Meg	3747.20	MDL 555X, 40 Meg	2289.59
MDL 30286, 1 Dr.	1412.10	MDL 30286, 20 M.	1710.50
MDL 7361 Port.	5449.75	MDL 80, 70 Meg	5069.37

COMPAQ

286, MDL 1	\$1549.95	386S84	\$3280.40
286E, MDL 1	1899.50	MDL 555X, 40 Meg	2817.99
386-20E, 100 Meg	2524.49	MDL 486, 42MB	4298.12
386S, MDL 1	2524.49	LTE Laptops	CALL

HEADSTART

Headstart III LX CD Unit	NEW MODEL
Headstart III CD Unit	TOO LONG
Headstart XT Explorer	TO ADVERTISE

HP & CPQ COMP. MEMORY

1MB Module CPQ - 386, 386S, 20E	\$189.66
4MB Module CPQ - 386, 386S, 20E	593.50
1MB Exp. Bd. - 386S, 20E	198.86
4MB Exp. Bd. - 386S, 20E	638.70
2MB Upgrade LaserJet II / IID	317.36
2MB Upgrade LaserJet IIP	346.13
4MB Upgrade LaserJet II / IID	546.87
4MB Upgrade LaserJet IIP	219.65

WYSE TERMINALS

WYSE 50/60 Amber or Green	\$373.40 / 300.16
WYSE 85 / 30 Amber	375.90 / 294.10
WYSE 99GT / WYSE 150	394.82 / 272.45

PLOTTERS, DIGITIZERS & SCANNERS

CalComp

1023	\$3498.40	12 x 12	\$358.12
1043DM	5825.15	12 x 18	719.10
1025	4544.06	36 x 48	3236.15

HURTA

121251	\$349.06	36 x 48	\$2891.53
12 x 17	499.65	4 Button Cursor	75.00

LOGITECH

Scanman PC / Scanman PS/2	\$177.89 / \$214.50
Trackman	93.00

Summagraphics

Summa II 12 x 12	\$267.40
Summa II 12 x 18	\$599.50

HEWLETT PACKARD

HP7440A	\$968.30
HP7475A	1389.89
HP7550	CALL
HP750 - LOWEST PRICE	CALL
HP7575-EXL	CALL
HP SCANJET +	1049.66

HOUSTON INSTRUMENT	
HI DMP-52	
DMP-52MP	
HI DMP-61DL	
DMP62DL	
Image Maker/Jetpro	

PRINTERS

EPSON

LX810	CALL	LO510	ALL EPSON
LO850	CDW	LO550	MODELS
FX850	FOR BEST	LO1050	READY
FX1050	PRICE	LO2550	TO SHIP
LO1010	EVER	CALL FOR ACCESSORIES	

CDW™ stocks all out of stock feeders and ribbons.

NEC

P2200XE	\$344.65	P5300	\$685.63
P5200	509.12	P9600L	1039.24

DICOMINIX by KODAK

150P/300	\$309.17 / 418.17
----------	-------------------

TOSHIBA

Expresswriter 311	CDW	321SL	MODELS
Expresswriter 301	CDW	341SL	IN STOCK
351SX	ALL TOSHIBA	CALL FOR PRICES	

brother

M-1809	\$363.63	M-1909	\$457.10
M-1824L	482.95	M-1924L	599.65

OKIDATA

ML 182 Turbo	\$234.48	ML 321	\$479.28
ML 172	199.95	ML 390	475.96
ML 380	357.95	ML 391	639.48
LASER 400	930.00	ML 393	995.90
ML320	329.68	ML 393 Color	1067.60

Panasonic

1124	\$292.75	1592	\$409.44
1895	CALL	1191	232.12
1180	193.85	1624	445.32

LASER PRINTERS

BROTHER HL-8e / Postscript	\$1799.90 / 3277.20
H-P LaserJet Model 2 / IID	1575.95 / 2744.95
H-P Deskjet Plus/H-P Laserjet IIP	679.33 / 1034.07
H-P LaserJet III	CALL
H-P Deskwriter	819.22
NEC LC890	3095.60
PACIFIC DATA 25 in 1 Cartridge	272.86
PACIFIC DATA Postscript Cartridge	478.60
PACIFIC DATA Plotter in a Cartridge	247.50
PACIFIC DATA 1 Meg Upgrade	229.39
PACIFIC DATA 1 Meg for 2P	252.94
PACIFIC DATA Headliner	268.28
TOSHIBA Page Laser 12	CALL



- Sales
- Services/Support
- Product Knowledge
- On Time Delivery
- Frequent Buyers Program

DRIVES, TAPES & CARDS

CONNOR 40 Meg / 110 Meg	\$409.29 / 627.29
OMEGA 20-20 External B	1658.92
OMEGA B1441/B144X	998.65 / 1299.10
OMEGA B244X/B120X	1990.25 / 992.80
OMEGA B200X External 5.25"	1619.40
MOUNTAIN 40 Meg Int. / Ext.	385.80 / 557.75
MOUNTAIN 150M Filesafe	1398.39
MOUNTAIN 300 Meg External	2538.80
MOUNTAIN 100 Meg External	445.30
PLUS Passport 40 / 70 System Kit	489.75 / 579.88
PLUS PS/2 MC System Kit	585.58
PLUS DEVELOPMENT 20 Meg 40 Meg	\$498.44 / 567.80
STORAGE DIMENSION ALL MODELS	CALL
SYSGEN 5.25" External Floppy	225.25
WELTEC 5.25" External Floppy	207.77

Seagate

SEAGATE 20 Meg	\$299.58	SEAGATE 4096 80	599.95
SEAGATE 30 Meg	269.32	SEAGATE ST 251 1	325.23
ST4383E 293 MB	1588.10	ST4766E 676 MB	2452.40
ST4182E 160 MB	1098.44	ST1126A 111 MB	710.68
ST1162A 143 MB	919.44	ST2383A 338 MB	1864.40

MICROPOLIS

1335 70 Meg	\$565.40	1355 142 Meg	\$1050.40
1375 153 Meg	1469.85	1558 338 Meg	1512.52

NOVELL NETWORKING

SOFTWARE STARTER KITS

Entry-Level 286 Starter Kit, 4 Users	CALL
Entry-Level 286 Starter Kit, 8 Users	FOR BEST
NOVELL Netware 386	NOVELL
NOVELL 286 Advanced Netware V. 2.15	PRICING
NOVELL SFT Netware V. 2.15	AUTHORIZED
NOVELL Netware Assurance	SALES & SERVICE

INTERFACE CARDS

3COM ETHERLINK	\$375.45
ARCNET PC110 LANboard PS/2	343.75
ARCNET PC130 LANboard	164.27
ARCNET PC130E LANboard	198.50
ARCNET SMC 16-Bit File Server Board	393.50
ARCNET SMC 16-Bit Workstation Board	276.15
ETHERNET Interface Connector (NE1000)	156.25
G-NET Interface Card w/Cable	298.52
NOVELL NE2000	209.40
THOMAS CONRAD 16 Port Hub	699.25
THOMAS CONRAD 8 Port Hub	378.65

MODEMS & COMMUNICATIONS

INTEL 2400 Internal/External	149.75/176.94
INTEL 2400B MNP 2400 Ext. MNP	191.22/224.11

PRACTICAL PERIPHERALS

2400MNP Int.	\$169.11	2400 Int.	\$128.88
2400SA MNP	197.72	2400SA	172.97

HAYES

1200 External	\$278.60	2400B Internal	\$224.45
1200B Internal	163.20	2400 PS/2	345.40
2400 External	338.84		

Robotics

Courier 1200	\$189.60	1200 External	\$129.10
Courier 2400	279.60	2400B	199.70
1200B	108.45	14 400 HST	586.75
Dual 14 400 HST	952.65		

MH & MEGAHERTZ CORPORATION

2400 for ZENITH	\$167.10	1200 for COMPAQ SLT	\$259.80
2400 for NEC	225.88	2400 for TOSHIBA	183.74

BATTERY BACKUP & SURGE

AME-1200VX	\$911.45	AME-520ES	\$377.48
AME-330XT	257.72	AME-800RT	699.19
AME-450AT	321.82		

DataShield

500 Watt	\$555.05	SS700+	\$687.90
800 Watt	628.56	1200 Watt	962.75
S100	59.55	6 Outlet Surge	27.85

Durant Technologies, Inc.

BPS-300	\$314.00	BPS-550	\$474.11
BPS-500	465.88	BPS-1200	698.82
BPS-800	648.30		

BC-450

BC-450	\$349.50	4 Outlet	\$44.25
BC-1200	649.55	LC-1200	158.85
BC-2000	1179.80	LC-1800	196.80

MISC & ACCESSORIES

A-B Switching Box (ABX Box)	\$39.95 / 44.95
BASF 5 Pack of 10 DS/DD w/Case	29.00
INTELLICOM Long Link	129.70
KENSINGTON Masterpiece Plus	99.99 / 123.40
KEYTRONICS 5151 IBM or AT&T	133.95
KEYTRONICS 101	94.95
5TH GEN Logical Connection 256K / 512K	447.72 / 514.36
Electronic 4-Way Switchbox	99.85
XT Power Supply 150 Watt	59.00

FAX MACHINES AND BOARDS

Complete Fax 9600	\$369.50	SHARP FO330	\$665.00
JT-Fax 9600	527.65	Oki Fax Machines	CALL

SOFTWARE

WORDPERFECT 5.1 5.25" or 3.5"	\$246.39
ASHTON TATE dBase III+ / dBase IV	424.00 / 476.10
ASHTON TATE Multimate Advantage II	288.12
LOTUS 1-2-3 5.25" / 3.5" V2.2	339.95
LOTUS 1-2-3 V.3 LOTUS Networker	337.00 / 1892.20
BORLAND Paradox 3.0	439.17
BORLAND Quattro / Quattro Pro	94.52 / NEW
BORLAND Sidekick Plus	131.25
MICROSOFT Excel / Windows 386	299.04 / 129.05
LAN SPOOL / LAN Space	265.10 / 319.00
MERIDIAN Carbon Copy	119.37
SYMANTEC Q&A	217.40
SOFTWARE PUB. Harvard Graphics	274.71
XEROX Ventura Software Version 2.0	489.00

MONO MONITORS & CARDS

CDW Color / Mono Cards w/P	\$84.00 / 79.00
HERCULES™ Color / Mono Cards w/P	146.14 / 179.84
AMDEK A10A / 1280	149.95 / 579.78
COMPAQ Mono VGA Mono	167.00 / 209.95
IBM PS2 8503	209.95
SAMSUNG Monitor	84.10
PACKARD BELL 1472 Amber	

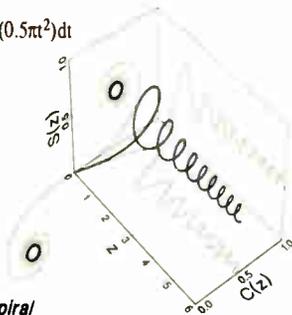
GraphicTM

"gives you all the C language routines you need to write an impressive scientific graphing program of your own. Highly recommended."*
— PC Magazine

Fresnel Integrals

$$C(z) = \int_0^z \cos(0.5\pi t^2) dt$$

$$S(z) = \int_0^z \sin(0.5\pi t^2) dt$$



Cornu's Spiral

IBM[®] PC (with source code) \$395

Circle 256 on Reader Service Card

Macintosh[®] (no source code) \$295

Circle 257 on Reader Service Card

Licensed for personal use only

VTEKTM 4.3

DEC[®] VT100/102/52
& Tektronix[®]
4010/4014/4105
Terminal Emulator
for IBM[®] PCs

"its ease of use, high resolution graphics, emulation, and price make it a more attractive purchase than the other products."*

— MINI-MICRO Systems
\$195

Circle 258 on Reader Service Card

*Full reprints on request
Scientific Endeavors
508 North Kentucky Street
Kingston, TN 37763 USA
(615) 376-4146 FAX:(615) 376-1571

Joystick Adapter for PS/2

Qua Tech GPA-1000 works with IBM Micro Channel for PS/2 Models 50, 60, 70, and 80. Connect two joysticks or four paddles. Also compatible with IBM Game Control Adapter for PC-XT and AT.

Call our toll free order line:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

IBM, Micro Channel, PS/2, PC-XT, AT, and Game Control Adapter are trademarks or registered trademarks of IBM Corp.

Circle 233 on Reader Service Card

Synchronous Communication Boards for AT

Qua Tech synchronous/asynchronous serial boards for PC-AT and compatibles support RS-232, RS-422, and RS-485 communication.

Call for our free
PC Interface Handbook:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

PC-AT and PC are registered trademarks of IBM Corp.

Circle 235 on Reader Service Card

5218 Printer Interface for PS/2 and AT

Qua Tech interface cards connect IBM 5218 DisplayWriter printer to PS/2 and AT*. Available now. Hundreds installed.

For order info, call:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

IBM, DisplayWriter, PS/2, and AT are trademarks of IBM Corp.

Circle 314 on Reader Service Card

RS-422/RS-485 Boards for AT, Micro Channel

RS-422/RS-485 asynchronous serial communication boards from Qua Tech available in 1 to 4 ports for PC-AT and compatibles and 1 to 4 ports for PS/2 Micro Channel.

Call for our free
PC Interface Handbook:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

PC-AT, Micro Channel, and PS/2 are trademarks or registered trademarks of IBM Corp.

Circle 234 on Reader Service Card

Digital I/O Board

Single-slot Qua Tech PXB-721 for PC-AT has 72 digital I/O lines. Connect three choices of data acquisition modules. Supports Labtech Notebook[™]

Call for our free
PC Interface Handbook:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

LabTech Notebook is a trademark of Laboratories Technologies Corp.

Circle 236 on Reader Service Card

Intelligent multiport, supports RS-422

SmartLynx AT[™] intelligent 4-port serial adapter for PC-AT and compatibles supports RS-422 and most multi-user operating systems. On-board processor takes burden off CPU.

For order info, call:
1-800-553-1170

QUA TECH

QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

PC-AT is a trademark of IBM Corporation.

Circle 315 on Reader Service Card

**90 KHZ 4-CHANNEL
SIMULTANEOUS
SAMPLE / HOLD WITH
12-BIT RESOLUTION**

SINGLE PIECE PRICE \$995

- For IBM PC/XT/AT® and compatibles
- 32K data buffer
- Pre-trigger or post-trigger data or any combination of both
- Stream data to disk
- Two 4-bit optically isolated output ports
- Event marker and auxiliary inputs
- Flexible and expandable

LAWSON LABS, INC.

5700 Raibe Road
Columbia Falls, MT 59912
406-387-5355
800-321-5355



Circle 165 on Reader Service Card

almost UNIVERSAL PROGRAMMER

**PAL
GAL
EPROM
EEPROM
PROM
87xxx...**



\$475

LATTICE-MMI-CYPRESS-INTEL-TI-AMD-ALTERA-NS...

200/100 MHz Logic Analyzer



\$1299-LA27100(100 MHz) Price is complete Pads and Software included
\$1899-LA27200(200 MHz)

• FREE software updates on BBS

Call - (201) 994-6669

Link Computer Graphics, Inc.

4 Sparrow Dr., Livingston, NJ 07039
FAX:(201)994-0730

Circle 166 on Reader Service Card

**ULTRA:BASE
COMPLETELY USER FRIENDLY**

BRANDYWARE presents ULTRA:BASE

Finally a database you can use without timely manuals, and have fun doing it! Features include, Help windows, Mailing labels, Calculator, Memo pad & alarm, Faskyes, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to the printer, Global update and delete, Auto-date, Grand totals, Running totals, List of matching records, Auto fill-in of all deleted records, and records the last time the folder was used.

Plus all the standard features like searching, updating, sorting, dos shell, printing records to the printer or screen, printing results of amortization to printer or screen, rename fields or folders, delete folders, All this and NO manual required. All the help you need is provided for you, at the time you need it, with on screen help and pop-up help windows. Guaranteed to be the easiest database (with power) to use, or your money back.

requires CGA, EGA, VGA, Hard drive
Send check or money order to:

BRANDYWARE

24 North Hibbert suite 6
Mesa, Arizona 85201
602-644-1067

ONLY
\$79.95

C.O.D.
OK

Circle 52 on Reader Service Card

Remote POWER ON/OFF

- LC-80 POWEROFF \$189
- LC-90 POWEROFF \$210
- LC-91 POWERON/OFF \$279 plus \$6.00 shipping and handling

PHONE CONTROL

The perfect compliment to your external modem and PC; providing everything you need to access your computer from any remote site, even if it isn't on. Also included at the low price of \$279 is "pcAnywhere", the award winning communications software. So there is nothing else to buy, making the LC-91 a truly outstanding value. All models allow you to **POWEROFF** your system under keyboard or software command, or after any number of unattended applications.

*** MAKING PRODUCTIVITY CONVENIENT ***

**30 DAY MONEY BACK GUARANTEE
FULL (2) YEAR WARRANTY**
(Made in USA, Patent Pending)

LTech

9205 South Keating
Oak Lawn, IL 60453
FAX: (708) 423-5369

CALL: 1-800-342-5196

Circle 173 on Reader Service Card
(DEALERS: 174)

**8031
In-Circuit
Emulation
\$199**

Our emulator provides most of the features of an 8031 In-Circuit-Emulator at a significantly lower price. It assists in integration, debug, and test phases of development. Commands include: disassembly, trace, breakpoint, alter register/memory, and load Intel Hex file.



HiTech Equipment Corp
9400 Activity Road
San Diego, CA 92126
(619) 566-1892

Circle 138 on Reader Service Card

ICs PROMPT DELIVERY!!!
SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN FOR FEB. 18, 1990

OUTSIDE OKLAHOMA. NO SALES TAX

DYNAMIC RAM		
1MB MEM DeskPro 386/20		\$295.00
SIMM 1Mx9	80 ns	225.00
SIMM 256Kx9	100 ns	35.00
1Mbit 1Mx1	80 ns	8.75
41256 256Kx1	60 ns	4.15
41256 256Kx1	80 ns	2.50
41256 256Kx1	100 ns	2.20
41256 256Kx1	120 ns	1.95
4464 64Kx4	120 ns	2.50
41264* 64Kx4	100 ns	7.50
EPROM		
27C1000 128Kx8	200 ns	\$18.00
27512 64Kx8	200 ns	7.80
27256 32Kx8	150 ns	6.50
27128 16Kx8	250 ns	3.75
STATIC RAM		
62256P-10 32Kx8	100 ns	\$10.00
6264P-12 8Kx8	120 ns	4.50
6116AP-12 2Kx8	120 ns	4.25

OPEN 6 DAYS, 7:30 AM-10 PM, SHIP VIA FED-EX ON SAT.

SAT DELIVERY INCLUDED ON MICROPROCESSORS UNLIMITED, INC. 24,000 S. Peoria Ave. BEGGS, OK 74421 (918) 267-4961
No minimum order. Please note prices subject to change! Shipping insurance extra, up to \$1 for packing materials

Circle 187 on Reader Service Card

Circle 94 on Reader Service Card (DEALERS: 95)

3M DISKETTES

DS-DD	Quantity Discounts Available	DS-HD
5.39	5.25" 3M Brand Diskettes	10.95
9.59	3.50" 3M Brand Diskettes	19.95
17.95	8.00" 3M Brand Diskettes	20.75

3M DATA CARTRIDGES

DC-2000	14.49	DC-600A	19.99
DC-300XLP	17.99	DC-6150XTD	21.49

3M COMPUTER TAPES

1200' w/tape seal	8.95	DEC TK-50	25.95
2400' w/tape seal	11.95	DEC TK-52/TK-70	39.95
3600' w/taoe seal	18.95	IBM-3480	4.95

3M HIGHLAND DISKETTES

3.79	5.25" 3M Brand Diskettes	6.89
------	--------------------------	------

3M ACCESSORIES

5/4-Head clean kit	3.95	3M Flip'N'File-5/4	3.95
3 1/2-Head clean kit	10.95	3M Flip'N'File-3 1/2	2.95
Plotter Pens/pk 5	5.95	3M Diskcover/50-5/4	7.95
3480 Cleaning Cart	15.95	3M DataSaver-5/4	3.95



DS-DD	Quantity Discounts Available	DS-HD
4.49	5.25" BASF Brand Diskettes	7.79
7.99	3.50" BASF Brand Diskettes	17.95

.32	BASF 5.25" DS-DD No-Logo Bulk with Tyvek sleeves, labels & W/P tabs		
2400' w/tape seal	10.95	600' w/tape seal	6.95
1200' w/tape seal	7.95	300' w/tape seal	5.45

maxell *Free 11th Disk with Game

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
5.95*	10.95*	9.69	19.95

Verbatim DataLifePlus (Teflon/Preformatted)

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
5.95*	10.95	9.69	19.95

Dysan 100% BETTER

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
6.09	10.95	9.69	19.95

KAO Color Diskettes

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.38*	.68*	.69	1.49

*WITH SLEEVES, LABELS AND W/P TABS

No-Logo Bulk Diskettes

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.25*	.49*	.49	1.49*

*WITH SLEEVES, LABELS AND W/P TABS

PRINTER RIBBONS STORAGE BOXES

Apple Imagewriter	2.95	Disk File/60-5/4	5.95
Brother HR/15/25	4.95	Disk File/50-3/2	5.95
Citizen LSP 120D	3.95	MP-10-5/4	1.50
Diablo HyType II	3.25	MP-10-3/2	1.50
Epson MX/FX/RX100	3.55	White Box/10-5/4	.29
IBM Proprinter	3.95	White Box/10-3/2	.29

Call for other ribbons Call for other storage boxes

TERMS: No surcharge on VISA, Mastercard or AMEX Order packaging and processing = \$2.95 per order. COD orders add \$3.95
SHIPPING: \$1.95/5 cartridges, \$0.95/50 diskettes. PD's accepted from recognized institutions on Net 30. Bank Draft, T/T or L/C acceptable. Price quoted for case (100 disks or 10 cartridges). For quantities less than 1 case add 5%.

Toll Free Order Line: 1-800-523-9681
Information Line: 1-801-255-0080
TLX-9102404712 FAX-801-572-3327

R DISK COTECH
DISKCO TECHNOLOGIES, INC.
213 Cottage Avenue
P.O. Box 1339 Sandy, Utah 84091

APRIL 1990 • B Y T E 327

UNICORN-YOUR I.C. SOURCE

COLLIMATOR PEN



A low power collimator pen containing a MOVPE grown gain guided GaAlAs laser. This collimator pen delivers a maximum CW output power of 2.5 mW at 25 °C.

These collimated laser sources are designed for industrial applications such as data retrieval,

telemetry, alignment etc.

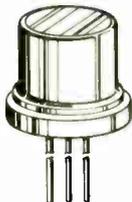
The non-hermetic stainless steel encapsulation of the pen is specifically designed for easy alignment in an optical read or write system, and consists of a lens and a laser device. The lens system collimates the diverging laser light. The waferfront quality is diffraction limited.

The housing is circular and precision manufactured with a diameter of 11.0 mm and an accuracy between + and - 11 μm.

LIST PRICE ~~\$180.00~~ PRICE **\$39.99**

Quality Components — Low Prices Since 1983

LASER DIODE



Designed for general industrial low power applications such as reading optical discs, optical memories, bar code scanners, security systems, alignment etc.

The gain guided laser is constructed on a n-type gallium arsenide substrate with a Metal

Organic Vapor Phase Epitaxial process (MOVPE).

The device is mounted in an hermetic SOT148D (diameter 9.0 mm) encapsulation.

The SB1053 is standard equipped with a monitor diode, isolated from the case and optically coupled to the rear emitting facet of the laser. This fast responding monitor diode can be used as a sensor to control the laser optical output level.

LIST PRICE ~~\$38.00~~ PRICE **\$9.99**

We Carry A Full Line of Components

CALL FOR FREE CATALOG

EPROMS

STOCK #	PINS	DESCRIPTION	1-24	25-99	100+
1702	24	256 x 4 Tris	3.99	3.79	3.41
2708	24	1024 x 8 450ns	5.79	5.50	4.95
2758	24	1024 x 8 450ns	3.99	3.79	3.41
2716	24	2048 x 8 450ns (25v)	3.19	3.03	2.73
2716-1	24	2048 x 8 350ns (25v)	3.39	3.22	2.90
TMS2716	24	2048 x 8 450ns	6.29	5.98	5.38
27C16	24	2048 x 8 450ns (25v-CMOS)	3.59	3.41	3.07
2732	24	4096 x 8 450ns (25v)	3.79	3.60	3.24
2732A-2	24	4096 x 8 200ns (21v)	3.79	3.60	3.24
2732A	24	4096 x 8 250ns (21v)	3.69	3.51	3.16
2732A-4	24	4096 x 8 450ns (21v)	3.09	2.94	2.65
TMS2532	24	4096 x 8 450ns (25v)	5.79	5.50	4.95
27C32	24	4096 x 8 450ns (25v-CMOS)	4.19	3.98	3.58
2764-20	28	8192 x 8 200ns (21v)	3.99	3.79	3.41
2764	28	8192 x 8 250ns (21v)	3.59	3.41	3.07
2764A-20	28	8192 x 8 200ns (12.5v)	3.99	3.79	3.41
2764A	28	8192 x 8 250ns (12.5v)	3.59	3.41	3.07
TMS2564	28	8192 x 8 250ns (12.5v)	6.79	6.45	5.81
27128-20	28	16,384 x 8 200ns (21v)	5.79	5.50	4.95
27128	28	16,384 x 8 250ns (21v)	4.79	4.55	4.10
27C128	28	16,384 x 8 250ns (21v)	5.39	5.12	4.61
27256-20	28	32,768 x 8 200ns (12.5v)	5.99	5.69	5.12
27256	28	32,768 x 8 250ns (12.5v)	4.99	4.74	4.27
27C256	28	32,768 x 8 250ns (12.5v-CMOS)	5.99	5.69	5.12
27512-20	28	65,536 x 8 200ns (12.5v)	10.49	9.97	8.97
27512	28	65,536 x 8 250ns (12.5v)	9.49	9.02	8.12
27C512	28	65,536 x 8 250ns (12.5v-CMOS)	9.99	9.49	8.54
27C1024	32	131,072 x 8 200ns (12.5v-CMOS)	27.99	26.59	23.93
68764	24	8192 x 8 450ns	18.99	18.04	16.24
68766	24	8192 x 8 450ns	15.99	15.19	13.67

UNICORN ELECTRONICS

10011 Canoga Ave., Unit B-8
Chatsworth, CA 91311

ORDER BY PHONE (TOLL FREE)

(800) 824-3432 (OUTSIDE CALIFORNIA)

IN CALIFORNIA (818) 341-8833

ORDER BY FAX (818) 998-7975

REAL-TIME MULTITASKING KERNEL

8086/88, 80x86/88 80386 68000/10/20 Z80, 64180, 8080/85

- Fast, reliable operation
- Compact and ROMable
- PC peripheral support
- DOS file access
- C language support
- Preemptive scheduler
- Time slicing available
- Configuration Builder
- Full documentation
- InSight™ Debugging Tool
- Interrupt messages
- Message exchanges
- Dynamic operations
 - task create/delete
 - task priorities
 - memory allocation
- Event Manager
- Semaphore Manager
- List Manager

No Royalties
Source Code Included

Demo Disk \$25 US
Manual only \$75 US
AMX 86 \$3000 US
(Shipping/handling extra)

Call for prices for other processors

AMX, AMX 86, InSight are trademarks
KADAK Products Ltd
Z80 is a trademark of Zilog Inc.

KADAK Products Ltd.
206-1847 West Broadway
Vancouver, B.C. Canada
V6J 1Y5
Telephone (604) 734-2796
Fax (604) 734-8114

Circle 152 on Reader Service Card

Professional
8086 ROM Development
with C thru ROM and ROM-DOS

C thru ROM works with Microsoft C or Turbo-C to comprise a complete ROM development package: comprehensive debugger, remote debugging, startup code, full 80x86 locator, ROMable library, etc.

C thru ROM, \$495

ROM-DOS, a ROMable operating system, provides functionality of DOS 3.2 less networking. Runs PC programs and EXE files. Supports AUTOEXEC and CONFIG.SYS. Uses only 29K ROM and little as 6K RAM. \$6 each in quantity.

ROM-DOS Developer's Kit, \$495

Call for info and demo disk
1-800-221-6630
Datelight, 17505 - 68th Ave NE, Bothell WA, 98011
(206) 486-8086, fax: (206) 486-0253

Circle 84 on Reader Service Card

Intelligent Solutions
NetWare, DOS, OS/2 & Xenix

SCSI CONTROLLERS FOR ISA & MCA

Novell tested under NetWare 286

Use with NetWare 286 or 386

Use any size SCSI disk drive

Handle large SCSI hard drives and erasable opticals

NOVELL LABS AUTHORIZED
TESTED AND APPROVED
NetWare Compatible

PROCOMP

Phone: (216) 234-6387
FAX: (216) 234-2233

The SCSI Professionals
6801 ENGLE ROAD, CLEVELAND, OH 44130

Circle 224 on Reader Service Card

WELCOME TO THE 16 BIT WORLD
Turn your Turtle into a Rabbit for only

\$189.00 OKB INSTALLED

You do not need to buy a new computer!!!
Trade in your slow XT mainboard for a new AT 80286, which includes:

- Microprocessor Intel 80286 CPU, socket for 80287.
- 12 MHz speed, selectable between 6 and 12 MHz.
- 0/1 Wait state, clock calendar, reset button.
- 512KB, 1MB, 2MB, 4MB mem. Upgrade.
- 640/384 mapping.
- Six 16-bit slots & two 8-bit slots, 16 level IRQ.
- Fits in the XT and AT cases.

with 512 KB. **\$245.00**
with 1024 KB. **\$299.00**

ICROCHIP TECHNOLOGY

2900 N.W. 72 Ave., Miami, FL 33122
(305) 592-5739 • FAX (305) 592-5738

Circle 185 on Reader Service Card

LOW-LOW-LOW

hp Laser Printers/Scanjet Plus Interface/Plotters — Call

Memory for Hard Drives, Tape Backup for above and Sun & DEC Systems

IBM COMPAQ Apple ALR
EVEREX AST & other

XT/AT Compatibles & 386 Computers
CALL FOR LOW PRICES

Gov't, Corporate, Schools, Dealers, & Export INQUIRIES WELCOME.

SURAK inc.

44912 Osgood Road, Fremont, CA 94539
Ph: (415) 651-5101 Fax: (415) 651-5241
1-800-543-1001
VISA, Master Card accepted. w/sc

Circle 274 on Reader Service Card

Cross-Assemblers as low as \$50.00
Simulators as low as \$100.00
Cross-Disassemblers as low as \$100.00
Developer Packages
as low as \$200.00 (a \$50.00 Savings)

A New Project
Our line of macro Cross-assemblers are easy to use and full featured, including conditional assembly and unlimited include files.

Get It To Market—FAST
Don't wait until the hardware is finished to debug your software. Our Simulators can test your program logic before the hardware is built.

No Source!
A minor glitch has shown up in the firmware, and you can't find the original source program. Our line of disassemblers can help you re-create the original assembly language source.

Set To Go
Buy our developer package and the next time your boss says "Get to work," you'll be ready for anything.

Quality Solutions
PseudoCorp has been providing quality solutions for microprocessor problems since 1985.

BROAD RANGE OF SUPPORT
• Currently we support the following microprocessor families (with more in development):
Intel 80486, RCA 1802/05, Intel 8051, Intel 8096
Motorola 6800, Motorola 6801, Motorola 68HC11, Motorola 6805
Hitachi 6301, MOS Tech 6502, WDC 65C02
Rockwell 65C02, Intel 8080/85, Zilog Z80, NSC 800
Hitachi HD64180, Motorola 68000/8, Motorola 68010, Intel 80C196
• All products require an IBM PC or compatible.

So What Are You Waiting For? Call us:
PseudoCorp
Professional Development Products Group
716 Thimble Shoals Blvd., Suite 17
Newport News, VA 23606
(804) 873-1947 FAX: (804) 873-2154

Circle 232 on Reader Service Card

BACK ISSUES FOR SALE

BYTE

Limited Quantities — Order Now!

	1987	1988	1989	1990
January	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
February	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
March	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
April	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
May	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
June	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
July	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
August	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
September	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
October	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
November	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
December	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inside the IBM PCs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Available Issues

Rates (postage and handling included):

1987-'90 BYTE Issues	\$6.00*
BYTE '83-'84 Index	\$4.00
BYTE 1985 Index	\$4.00
BYTE 1988 Index	\$4.00
1985 Inside the IBM PCs	\$4.00
1986 Inside the IBM PCs	\$5.00
1988 Inside the IBM PCs	\$6.00
1989 Inside the IBM PCs	\$6.00

*June 1988 (Benchmarks) \$3.00

*December 1988 \$3.00

The above prices include postage in the U.S. Please add \$.50 per copy for Canada and Mexico; and \$2.00 per copy to foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

Please indicate which issues you would like by checking (✓) the boxes.

Send requests with payments to:

BYTE Back Issues
One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281

Check enclosed. Payments from foreign countries must be made in U.S. funds payable at a U.S. bank.

Name _____

Address _____

City _____ State _____ Zip _____

Charge: VISA MasterCard

Card # _____

Exp. Date _____

Signature _____

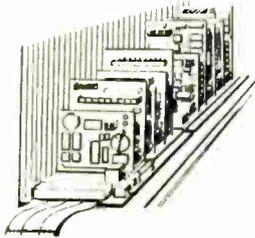
All orders must be prepaid. Please allow four weeks for delivery.

A-BUS™

Data Acquisition and Control

Low Cost A/D, Motion Control, Relays, D/A, Digital I/O...

Sample applications: - Read sensors, voltages, light levels, temperatures, keypads, touch-tones; - Switch electrical devices; - Automate experiments; - Test equipment.



A-BUS Cards

- Analog Input: 8 inputs, 8 bit, 7500 conversions/second. AD-142: \$142
- 12 BIT A to D: 1 input, bipolar, integrating 130ms conversion AN-146: \$153
- High-Speed 12-bit A/D converter: 8 inputs, 10µs conversion. FA-154: \$179
- NEW Relay Card: 8 relays (3A at 120VAC contacts, SPST). RE-140: \$142
- Reed Relay Card: 8 relays (20mA at 60VDC, SPST). RE-156: \$109
- D/A Converter: Four 8 bit. DA-147: \$149
- 24 line TTL I/O: 24 input and/or output signals. TTL 0/5V levels. DG-148: \$72
- Digital Input: 8 opto-isolated. Voltage levels or switch closures. IN-141: \$65
- Digital Output Driver: 8 lines, 250mA at 12V. For relays, solenoids... ST-143: \$78
- Clock with Alarm: CL-144: \$98
- Touch Tone Decoder: PH-145: \$87
- Prototyping card: 4x4.5" PR-152: \$16
- Counter Timer: Three 16 bit counter/timers. CT-150: \$132
- Smart Quad Stepper Controller: On board microprocessor controls four motors simultaneously. SC-149: \$299
- Options: Power Driver PD-123: \$49
- Remote keypad RC-121: \$54

A-BUS Parallel Adapters for:

- IBM PC/XT/AT & compatibles. Uses one short or long slot. AR-133: \$69
- Others available: Apple II, Commodore 64, 128, TRS-80.
- A-BUS Cable: Parallel adapter to card or motherboard. 3 ft. CA-163: \$24
- Cable for two A-BUS cards CA-162: \$34
- Serial Adapter: Connect A-BUS to any RS-232 port. SA-129: \$149
- Serial Processor: A-BUS Single Board Computer with BASIC. SP-127: \$189
- Motherboard: Up to 5 cards in a metal frame with card guides. MB-120: \$108
- Metal Cover for A-BUS
- NEW Motherboard MC-108: \$45
- Acrylic Cover AC-109: \$49
- Power Supply: 1A, 12VDC. PS-126: \$12

Call for new 1990 catalog:
(203) 656-1806

Mon-Fri 9-5 EST (or Fax 203 656-0756)



242-B West Avenue, Darien, CT 06820

BLAST Your Message Thru!

Voice Messaging • Call Processing
Audiotex • Telemarketing
Order Processing • Call Distribution

Powerline transforms your personal computer (PC/XT/AT/386) into a multi-line voice processing command center capable of controlling 16 telephone lines. Intelligently process your sales, inquiries and messages in the background. Give your computer some PUNCH!

Blast your message through with Powerline! Package includes hardware, software, cables, speaker, 2 year warranty. Single Line \$295.00 Multi-line \$895.00

Developed by OEM specialists VISA, MC, AMEX, COO
For Information or Sales Call
(415) 652-9800
FAX (415) 652-5311

TALKING TECHNOLOGY, INC.
4383 PIEDMONT AVE., OAKLAND, CA 94611

Circle 276 on Reader Service Card

Free Diskettes

3.5" DSDD Bulk	*.47	ea.
3.5" DSDD White Box	*.57	ea.
3.5" DSHD Bulk	*1.39	ea.
3.5" DSHD White Box	*1.49	ea.
5.25" DSDD Bulk	*.20	ea.
5.25" DSDD White Box	*.27	ea.
5.25" DSHD Bulk	*.27	ea.
5.25" DSHD White Box	*.49	ea.

*Includes Sleeves, Tabs and Labels (3.5" Labels only)
USER LABELS \$3.00 FOR 50 ea. SLEEVES 2 ea ea.
All disks 100% error free - Money back guarantee.
Buy 5,000 disks mix and match and get 100 disks...

Absolutely Free

Government and Fortune 500 PO's acceptable
MC/VISA/Prepaid/C O D (Standard UPS charge for COD)
Add 2.9% for credit card orders
No Handling Charge
Free Freight on orders of \$200 or more
Orders less than \$200 are 3.5" 50c ea per 25ea
5.25" 50c ea per 50ea PA residents add 6% sales tax

Toll Free 1-800-5FLOPPY

IQ BUSINESS PRODUCTS INC.

Circle 147 on Reader Service Card

EZ-ROUTE VERSION II

SCHEMATIC TO P LAYOUT \$500 INCLUDES AUTO ROUTER

EZ-ROUTE Version II from AMS for IBM PC, PS/2 and Compatibles is an integrated CAE System which supports 256 layers. Trace width from 0.001 inch to 0.255 inch, flexible grid, SMD components and outputs on Penplotters as well as Photo plotters and printers

Schematic Capture \$100, PCB Layout \$250, Auto Router \$250.
FREE EVALUATION PACKAGE
30 DAYS MONEY BACK GUARANTEE
1-800-972-3733 or (305) 975-9515

ADVANCED MICROCOMPUTER SYSTEMS, INC.
1321 N.W. 65 Place - Ft. Lauderdale, FL 33309

Circle 36 on Reader Service Card

IMAGING CARD

- Dual camera inputs
- Composite video in/out
- 256 x 240 resolution
- Digitize/display at frame speed
- 16 Meg. color palette out (DV-02)
- External trigger input option
- PC/XT/AT compatible
- Complete with software & library

DV-02 8-bit 256 gray levels. \$849
DV-03 6-bit 64 gray levels. \$549
VISA/MC Demo disk available

Control Vision

PO Box 596 Pittsburg KS 66762
800/292-1160 316/231-6647

Circle 74 on Reader Service Card

THE GENERAL STORE RETAIL OPERATIONS SYSTEM

The premier system for retail store management. Supports cash drawers, barcode readers, receipt printers, customer displays, digital scales and complete online credit card authorization. Controls all types of retail stores both hardgoods and apparel with complete size/color matrix management and reporting. Easy to install and use. Field proven for speed and reliability. Provides all the features needed for today's retail merchant at a price far below comparable systems. Demo system available.

Accounts Receivable
Point of Sale
Inventory Control
Accounts Payable
General Ledger
Mailing List
...Multiuser/Network Ready...

\$995 Complete system
Dealer inquires invited.

Crichlow Data Sciences, Inc.
(804) 471-0500
P.O. Box 6420 - Virginia Beach, VA 23456

Circle 77 on Reader Service Card

E/EPROM & MICRO PROGRAMMER

\$895

■ EP-1140 includes: software, cable, user's manual, 2 free software update coupons, toll-free technical support, one-year warranty & a unconditional 30-day money back guarantee

■ Programs 24-, 28-, 32- & 40-pin E/EPROMs

■ Supports 874X & 875X series microcontrollers

■ Connects to a standard parallel port

■ 32-pin model, EP-1132, available for \$695

The Engineer's Programmer™

CALL TODAY 800-225-2102

BP MICROSYSTEMS
10681 Haddington, #190, Houston, TX 77043
713/461-9430 FAX 713/461-7413

Circle 51 on Reader Service Card



PS/2 model 30/286	1895
PS/2 model 50/30 meg	2395
PS/2 model 70/60 meg	3695
PS/2 model 80/40 meg	4395
PS/2 model 70/120 meg	5595
PS/2 model 80/115 meg	Call

Call for other models



386 S 40 meg	Call
386 20E - 40 meg	4195
286E 40 meg	2275
386 110 meg/25 MHz	7295
386 60 meg/25 MHz	5895
Portable III 40 meg/12 MHz	3995

CARD & MONITOR EXTRA

Call for other models

Macintosh

Mac IICX/80 Meg, 40 Meg RAM	5095
Mac-II/40 Meg	4095
Mac-SE 30/40 Meg	3595
Call for 60 and 100 Meg	
Lazer NT	3495
Lazer NTX	4795

LOW PRICE LEADER

SINCE 1983

LAP-TOP

Compaq SLT 286-20/40	3795/Call
Toshiba T1000	659
T1000SE	Call
T1200HB	Call
T1600-40 Meg	Call
T3100E-40 Meg	Call
T3200-40 Meg/SX40	Call
T5100-40/100	Call
T5200-40/100	Call
T3100SX	Call
Zenith 286-20/40 Meg	Call
Mitsubishi 286-20/40	2395/Call

DISKS

DYSAN 5 1/4 HD / 3 1/2 HD	12/25
MAXELL 5 1/4 HD / 3 1/2 HD	11/24
Min. 10 Boxes Order	

Everex

Step 286 - 12 & 16 MHz & 20 MHz
1 Meg RAM
Set up utility in ROM
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call! for your configuration

Everex

Step 386-20 MHz & 16 MHz & 25 MHz & 33 MHz
Up to 256K cache of very high speed RAM
2 Meg RAM, expandable to 16 Meg
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call!



AST 486	Call
AST 286 model 70	1249
AST 386 model 300c	2695
AST 386 40 Meg	3095

CARD & MONITOR EXTRA
CALL FOR OTHER MODELS

WE STOCK

CITIZEN
OKIDATA
EVEREX
GOLD STAR

TOSHIBA
NEC
WYSE
HITACHI

PRINCETON GRAPHICS
SONY
ACER
HOUSTON INSTRUMENTS

AMDEK
HAYES
SAMSUNG
CALCOMP

PC MOUSE
MICROSOFT MICE
LOGITECH
MITSUBISHI

IRWIN & ARCHIVE
TAPE BACK
TAXAN
MAGNOVOX

BOARDS

Paradise VGA +	219
Vega VRAM	409
ATI VGA Wonder	259
Everex EGA	149
Tatung 16 bit	239

SOFTWARE SPECIALS

dBase IV	455
Wordperfect 5.1	260
Aldus Pagemaker	445*
Ventura Publisher	495
Clipper	435
WordStar 5.5	150
EasyExtra	40



NOVELL
Authorized Dealer

Intel Coprocessors

8087-3	105
8087-2	145
80287-8	225
80287-10	249
80387-16	395
80387-20	425
80387-25	495
80387-33	599

PRINTERS

EPSON	
LX-810/LQ-510	199/339
LQ-850/1050	545/749
FX-850/1050	359/479
OKIDATA	
320/321	359/490
390/391	490/649

TOSHIBA	
321-SL/341-SL	399/595
351-SX 350 CPS	929

PANASONIC	
1524/1624	Call
1124	319

Call for others

LASER PRINTERS

HP Laser II	1595
HP Desk Jet+	675
HP Laser 2P	995
Panasonic 4450	1395
Brother HL-8-E	1895
Nec LC 890	3195
Toshiba Laser	Call

MODEMS

Everex 1200 Int	79
Everex 2400 Int	149
Hayes 2400 B	299
More in Stock	Call

ALL QUOTED PRICES ARE CASH PRICES ONLY.
Visa and MasterCard 3% higher, American Express 5% higher

EXPORTS Available

COMPUTERLANE

HOURS:
M-S 9-6

1-800-526-3482 (Outside CA)
(818) 884-8644 (In CA)
(818) 884-8253 (FAX)

22107 ROSCOE BLVD.
CANOGA PARK
1/2 BLOCK W. OF TOPANGA
CA 91304

CORPORATE ACCOUNTS WELCOME
CALL FOR VOLUME DISCOUNTS
CONSULTANTS CALL FOR PRICING

Prices subject to change without notice
* Quantities are limited

Compaq is a Registered Trademark of Compaq
IBM is a Registered Trademark of International Business Machines

NEVADA HAS NEVER BEEN SO CHEAP

MEMORIES...

COMPAQ

Description	Equiv. Compaq Part #	For Model #	Your Low Price
1MB Add-on Module	113131-001	386/20/25/20E/286E	249 ⁰⁰
1MB Add-on Module	113646-001	Deskpro 386S	249 ⁰⁰
4MB Add-on Module	113132-001	386/20/25/20E/286E	549⁰⁰
4MB Add-on Module	112534-001	Deskpro 386S	549 ⁰⁰
1MB Memory Exp Bd	113644-001	Deskpro 386/20e	469 ⁰⁰
1MB Memory Exp Bd	113633-001	Deskpro 386S	469 ⁰⁰
4MB Memory Exp Bd	113645-001	Deskpro 386/20e	1149 ⁰⁰
4MB Memory Exp Bd	113634-001	Deskpro 386S	1149 ⁰⁰
1MB Memory Exp Bd	117428-001	286E	469 ⁰⁰
4MB Memory Exp Bd	117429-001	286E	1299 ⁰⁰
1MB Upgrade Bd	110235-001	SLT/286	469 ⁰⁰
4MB Upgrade Bd	108070-001	386/16	1299 ⁰⁰



HEWLETT PACKARD LASER JET II, IID & IIP

1Meg	199 ⁰⁰	2Meg	299 ⁰⁰	4Meg	429 ⁰⁰
HP LASER JET II 1699 ⁰⁰					

EVEREX

RAM 3000 DELUXE Up to 3 Meg. Selectable memory addresses. Expanded Memory Specifications (EMS) 4.0 DS/2. Can be used to back up base memory up to 640K and the rest as either Expanded or Extended or both. Uses 256K D-RAM.	9400
RAM 10000 Up to 10 MB capacity supports base, extended or expanded memory in any combination. Compatible with Lotus/MS-DOS/2. 4.0 Operates with no additional w.r.t. state. Uses 1 MB D-RAM.	16900
MINI-MAGIC (EV138) Up to 576K. For PC. Uses 256K & 64K.	4900

STANDARD SIPP/SIMM MODULES

Description	150NS	120NS	100NS	80NS	70NS
64 x 9 IBM	19 ⁰⁰	29 ⁰⁰	34 ⁰⁰	39 ⁰⁰	—
256 x 8 Apple	19 ⁰⁰	24 ⁰⁰	29 ⁰⁰	39 ⁰⁰	—
256 x 9 IBM	14 ⁰⁰	19 ⁰⁰	29 ⁰⁰	33 ⁰⁰	48 ⁰⁰
1Meg x 8 Apple	—	75 ⁰⁰	85 ⁰⁰	89 ⁰⁰	—
1Meg x 9 IBM	—	85 ⁰⁰	89 ⁰⁰	94 ⁰⁰	109 ⁰⁰
4Meg x 9 IBM	—	—	—	799 ⁰⁰	849 ⁰⁰

intel COPROCESSORS

Description	8 Bit	32 Bit	
8087 5MHz or less	88 ⁰⁰	80807-16 16MHz	309 ⁰⁰
8087-2 8MHz	119 ⁰⁰	80387-20 20MHz	359 ⁰⁰
8087-1 10MHz or less	169 ⁰⁰	80387-25 25MHz	459 ⁰⁰
		80387-33 33MHz	559 ⁰⁰
80287 6MHz	129 ⁰⁰	80387-SX	299 ⁰⁰
80287-8 8MHz	189 ⁰⁰		
80287-10 10MHz	218 ⁰⁰		
80C287-12 Laptop	289 ⁰⁰		

BOCA

BOCORAM 30 Expanded memory for IBM PS2 models, 25, 30. Uses 256K RAM chips and up to 2 Meg of expanded memory.	15900
BOCARAM 50Z 2MB. 0 wait state expanded or extended memory for IBM PS2 Models 50, 50Z, 60 Uses 1MB, D-RAM.	15900
BOCARAM 50/60 Up to 4MB for model 50/60. 0 wait state extended, expanded and base memory. Uses 1MB D-RAM.	15900
BOCARAMAT PLUS Expanded or extended memory for the IBM AT Uses 120NS 1 Meg RAM chips OK up to 8 Meg.	12900

IBM PS2 (BOARDS & MODULES)

Description	Equiv. IBMPS2 Part #	For Model #	Your Low Price
512K Upgrade	30F 5348	30/286	399 ⁰⁰
2MB Upgrade	30F 5360	30/286	1699 ⁰⁰
1MB Module	6450603	70 E61 & 121	299 ⁰⁰
2MB Module	6450604	70 E61 & 121	299⁰⁰
2MB Mem. Board	6450608	70-A21	319 ⁰⁰
1MB Mem. Board	6450375	80-041	369 ⁰⁰
2MB Mem. Board	6450379	80-111 & 311	569 ⁰⁰
2MB Exp. 8MB	6450605	70/80	1249 ⁰⁰

D-RAM CHIPS

Description	150NS	120NS	100NS	80NS	70NS
64 x 1	.99	1.41	2.16	—	—
64 x 4	2.15	3.45	3.85	3.45	3.85
256 x 1	1.11	2.45	2.85	3.45	3.85
256 x 4	—	11.45	11.85	12.45	12.85
1 Meg x 1	—	8.45	8.85	9.45	9.85

ORCHID

TWIN TURBO 12 • Turn your PC, XT & Compatibles into 80286-12MHz. • 8K of static cache memory • Socket for 80287 Co-Processor • Speeds disk access up to 10 times • Software, Ram Disk - disk caching - print spool - clock calendar. List price was 795 ⁰⁰ .	Your Price 199 ⁰⁰
RAMQUEST II • Memory card for PS/2 models 50 & 60 • Comes with 1 Meg of Ram expandable to 2 Megs (uses 256K's) • EMS 4.0 compatible & DS/2 • Ram disks, disk caching & print spooling software included. List price was 795 ⁰⁰ .	Your Price 149 ⁰⁰
The Real Thing ORIGINAL BOARDS • 512K memory expansion board for IBM AT • Model 6450203 IBM. List price 395 ⁰⁰ .	Your Price 79 ⁰⁰
• 512K expandable to 2 Megs for IBM AT • Model 6450343. List price 495 ⁰⁰ .	Your Price 119 ⁰⁰

SYSTEMS

CAT 386-20MHZ BASE SYSTEM	CAT 286-10MHZ AT BASE SYSTEM
• 101 Key Keyboard	• 512K Exp. to 1 MEG
• 200 Watt/AT Case	• 200 Watt Power Supply
• 1 2 Meg Floppy Drive	• AT Style Keyboard
• 1 Meg of Memory	• Western Digital Controller
• Parallel, Serial & Clock	• 1.2 Meg Floppy
\$1299⁰⁰	\$599⁰⁰

CAT 386SX BASE SYSTEM	CAT 10MHZ XT BASE SYSTEM
849⁰⁰	• 256K (Dpt. 640K)
	• 150 Watt Power Supply
	• AT Style Keyboard & Case
	• 8087 Socket • 360K Floppy
	\$349⁰⁰

Seagate HARD DRIVES

	AT KIT	XT KIT	
ST125-0	20MB 40msec 3.5"	\$249	\$299
ST125-1	20MB 28msec 3.5"	\$269	\$319
ST138-0	30MB 40msec 3.5"	\$289	\$339
ST138-1	30MB 28msec 3.5"	\$309	\$359
ST225	20MB 65msec	\$199	\$249
ST238R (RL)	30MB 65msec	\$219	\$279
ST251-1	42MB 28msec	\$339	\$389
ST277R-1 (RL)	65MB 28msec	\$379	\$429
ST4096	80MB 28msec	\$579	\$629
ST4144 (RL)	120MB 28msec	\$649	\$699

XT kits include cables, software (over 32MB) controller
AT kits include cables, rails, software (over 32MB)

EVEREX TAPE BACKUPS

40MB Mini Cartridge, 3.6MB/min AT (DC 2000)	299 ⁰⁰
60MB Streaming Cassette, 5MB/min w/cont (CT600)	649 ⁰⁰
60MB Streaming 600A, 5MB/min w/cont (DC600)	849 ⁰⁰
125MB Streaming Cartridge, 5MB/min w/cont	1119 ⁰⁰
OC2000 19 ⁰⁰ External Add 195 ⁰⁰	OC600 24 ⁰⁰

POWER SUPPLIES

150 WATT XT Compatible • UL Approved • 110/220V Input 4 Connector 49 ⁰⁰	FULL SIZE AT CASE \$59 00
200 WATT FOR 286/386 AT Compatible • UL Approved • 110/220V Input 4 Connector 69 ⁰⁰	

WESTERN DIGITAL

WX1	8 bit	MFM	Hard Only	\$ 49
27X	8 bit	RL	Hard Only	\$ 59
MM 1	16 bit	MFM	Hard Only	\$ 99
MM 2	16 bit	MFM	Hard/Floppy	\$109
SR 1	16 bit	RL	Hard Only	\$119

Everex 16 Bit MFM Hard/Floppy, 1 • 1 Interleave

Cable Set for Hard Drive \$ 5
XTFC for 2-360K floppy 14⁰⁰
XT-FDC high density, 1 2 or 1 4 59⁰⁰

Seagate

10 MEG HARDDRIVE

- Full HT • 60 day warranty
- 10 Meg St412 • Refurbished
- Qty 1 88⁰⁰
- Controller & Cables Add 5⁰⁰

Buy LOTUS 1 2 3 & Get Always FREE

Version 2.01 5/4 199⁰⁰
Lotus Metro 1 0 List 85⁰⁰ Your Price 29⁰⁰

FLAT BED IMAGE SCANNER

• 300 DPI • 16 Secs per page • 32 Level Gray Scale • 6 Mo Warranty • Ready to go Interface card and cable included. List \$1595 Your Price *799⁰⁰

OPTIONS: Automatic Document Feed	299 ⁰⁰	
DCR	199 ⁰⁰ PC Paint	79 ⁰⁰

HIGH SPEED SCANNER



by Princeton Graphics
Ready to go for IBM - Type Machine
Desktop LS300 Scanner
List Price 1095⁰⁰ Your Price: 399⁰⁰

STANDARD FEATURES

- 300 DPI - Allows for the creation of high resolution graphics/text
- Automatic Sheet Feeder - Efficient document handling.
- Image Input - Sheet or card (up to 5 sheets can be set with the built-in Automatic Document Feeder)
- Scanning Speed - 12 seconds/page (at 300 dot/inch) 6 seconds/page (at 150 dot/inch)
- Gray Scale - 32 shades either pattern or 2 shades

PC Paint By Z Soft 165	79 ⁰⁰	DCR Software	249 ⁰⁰	199 ⁰⁰
Super Fax by Calculus				

LETTER QUALITY PRINTER

By C. ITOH
DAISYWHEEL PRINTER MANUFACTURED
Why pay \$1149 for a C.Itoh

STARWRITER™ F-10

When our 40 cps letter quality daisywheel printer from the same manufacturer is only \$399⁰⁰ ea.

OPTIONS

• 6 ft. Serial Cable	\$ 19 ⁰⁰
• Bidirectional Tractor	99 ⁰⁰
• Serial to Parallel Converter	99 ⁰⁰

ORDERS ONLY

800-654-7762

TECHNICAL / CUSTOMER SERVICE / ORDER STATUS:
702-294-0204
FAX 702-294-1168

Trademarks are Registered with their respective Co's Prices Subject to Change
All Products 90 Day Warranty unless stated otherwise

SE HABLA ESPANOL

• WE ACCEPT INTERNATIONAL ORDERS

• WE ALSO PURCHASE EXCESS INVENTORY. FAX OR CALL

• MEMORY PRICES ARE FLUCTUATING AGAIN. CALL FOR CURRENT PRICES

• NO SOFTWARE RETURNS

NO SURCHARGE FOR MC/VISA

TERMS:

MC • VISA • CDD CASH • NET
Purchase Orders from Qualified Firms
Personal Checks • AE add 4% • CDD add \$5.00
20% Restocking Fee May Apply
No Refunds After 30 Days



Formerly Mead Computer



1000 Nevada Hwy. • Unit 101
Boulder City, NV 89005

SHIPPING: (min 6⁰⁰) UPS

IEEE 488

Please see our ad p. 149
**Easiest to use,
GUARANTEED!**

- IBM PC, PS/2, Macintosh, HP, Sun, DEC
- IEEE device drivers for DOS, UNIX, Lotus 1 2 3, VMS, XENIX & Macintosh
- Menu or icon driven acquisition software
- IEEE analyzers, expanders, extenders, buffers
- Analog I/O, digital I/O, RS-232, RS-422, SCSI, modem & Centronics converters to IEEE 488

Free Catalog & Demo Disks
(216) 439-4091

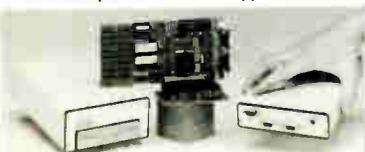
IOtech

25971 Cannon Rd. - Cleveland, OH 44146

Circle 146 on Reader Service Card

Complete PC Systems

For Complex Stand-Alone Applications



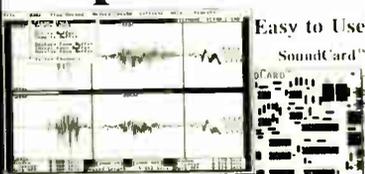
- Now Available! Systems that are functionally equivalent to large PCs's, in compact packages. Our systems are based on single board CPU's and include all hardware, software, and support needed to run your special applications.
- Run DOS applications without a disk using our BIOS. Store DOS and user programs in EPROM's.
- Debug Monitor, BIOS for disk capability, utilities, and source code are available.
- Compatible with PC systems. Run 8088 code and DOS applications. Use standard PC/AT cards in passive backplanes for expansion.
- Our CPU cards use V40/V50 micros and drive PC/AT bus. Options: 1meg RAM, 256K ROM, 5 serial ports, SCSI, CMOS, floppy, printer, graphics.

CPU Cards \$249 (q25)
Systems \$499 (q1)
Customization available
(303)444-7737

655 Hawthorne Ave. Boulder, CO 80304 FAX (303) 786-9983

Killa

SuperSound



Easy to Use!
SoundCard™

SoundFX™ Editor
DISCOVER THE POWER OF SOUND in
YOUR IBM-PC/AT from \$19.95!

Best Digital Audio Software/Hardware.
Developers: Add TurboSound™ to any PC
30 Day Money-Back Guarantee if not Satisfied

- SuperSound - Stereo, SoundFX™, Graphics Editor and SoundCard™ \$310
- SuperSound - Mono version software and hardware \$230
- SuperSound - Single version special hardware software for IBM-PC \$420
- SoundFX™ - Full track editor, waveform generator w/ SoundBytes™ \$39.95
- SoundFX™ - Playback printer port hardware module w/ SoundBytes \$39.95
- TurboSound™ - add real voice, sound effects, etc. to PC - no added hardware!
- For Business - Training, Point of Sale Shows - Works with Graph, Office, &
- For Fun - Create Your Own Mix like those on Synths, Alter Your Voice...
- Write or Call for FREE PRODUCE CATALOG of IBM-PC sound products.

Tech: (408)-446-4521 by **Silicon Shack** FAX: (408)-374-4412
5120 Campbell Ave #112, San Jose, CA 95136

Orders: 800 - 969 - 4411 VISA - MasterCard
*SuperSound, SoundFX, SoundFX Jr, SoundFX, SoundCard, SoundBytes, and TurboSound are trademarks of Silicon Shack, Ltd. Other product names are trademarks of their manufacturers.

Circle 260 on Reader Service Card

EFFORTLESS EDITING

between files —
across applications —

Vq2™

If you work with
more than one file,
you need Vq2
— the editor for
multi-file processing.

OS/2 & DOS versions... both for \$150
1-800-284-3269



GOLDEN BOW SYSTEMS
2665 ARIANE DRIVE, #207
SAN DIEGO, CA 92117
(619) 483-0901

Circle 129 on Reader Service Card

Item	M/C Visa AMEX	COD	Prepay
5.25 DSDD	.19	.18	.17
5.25 DSHD	.38	.36	.32
3.5 DSDD	.55	.48	.41
3.5 DSHD	1.10	.89	.85

Diskette Emporium

Box 402, 110 East Hotchkiss
Hotchkiss, CO 81419

Orders only: 1-800-322-5254 (24 hrs, 7 days)
Inquiries: 1-303-753-3306

Add .01 ea for shipping on 5.25 disks and .02 ea
for 3.5 disks. \$1 handling charge. COD orders
add \$2.75.

Circle 93 on Reader Service Card

TurboSound™



Easy to Use!
SoundCard™

SoundFX - III™ Editor
SOFTWARE DEVELOPERS:
PUT THE POWER OF NATURAL,
CLEAR VOICES and SOUNDS in
YOUR IBM-PC APPLICATIONS with
NO ADDED USER HARDWARE!!!

PC Digital Audio Desktop Workstation
Software / Hardware *\$640.
30 Day Money-Back Limited Guarantee

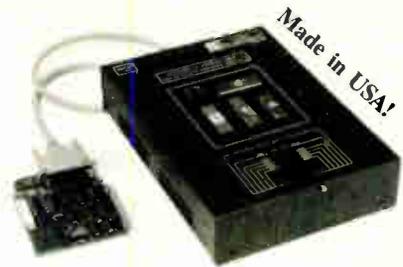
- SoundFX - III - Professional Sound Editor for platform sound integration
- AM radio quality sound - You get clear, rich voices, and polyphonic music.
- Works with any IBM-PC - Correct pitch for any type and speed of computer
- Wide range of volume control for PC's internal speaker by software only
- You have total control over creative content - No outside services required
- Plus One-Touch, No-Menu, Low-Cost - Fee starting at \$10 for 2,500 copies.

Tech: (408)-446-4521 by **Silicon Shack** FAX: (408)-374-4412
5120 Campbell Ave #112, San Jose, CA 95136

*SuperSound, SoundFX, SoundFX Jr, SoundFX, SoundCard, SoundBytes, and TurboSound are trademarks of Silicon Shack, Ltd. Other product names are trademarks of their manufacturers.

Circle 261 on Reader Service Card

Circle 38 on Reader Service Card



PC BASED UNIVERSAL DEVICE PROGRAMMER \$695/895

- Programs EEPROMs, MICROS, BIPOLARS, PALs, GALs, EPROMs, PEELs. (current libraries support over 900 devices by over 35 manufacturers).
- Software driven pin drivers. INA generated programming voltages (8 bit DAC's used to generate voltages from 5-25V with 0.1V resolution for all pins).
- Fast device programming/verify/read via dedicated parallel interface.
- Upgradeable for virtually any future programmable devices up to 40 pins.
- Self-sustinent operation. No additional modules or plug-in adapters required.
- Includes user friendly MEMORY BUFFER FULL SCREEN EDITOR. (Commands include: Fill, Move, Insert, Delete, Search. Data entry can be done in ASCII or HEX form. FUSEMAP EDITOR for Logic devices).
- Friendly Menu-Driven interface. Device selection by PIN and Manufacturer.
- Supports 816/52 bit data word formats.
- Programming algorithms: Normal, Intelligent I & II, Quick Pulse Programming. Automatic selection of fastest algorithm for any given part.
- Verify operation performed at normal & worst case operating voltage.
- Functional test: JEDEC standard functional testing for logic devices.
- TTL Logic functional test for 74xx/54xx series devices and memory devices. Test library can be updated by the user. User definable test pattern generation.
- File formats accepted: .EDEC (full), JEDEC (kernel), Binary, MOS Technology, Motorola Hex, Intel Hex, Tektronix Hex.
- Base price (\$695) includes Interface card, cable, Memory + Micro + Bipolar library, TTL CMOS MEMORY device test capability, one year free updates.
- Complete price (\$895) includes all of the above plus Logic Device Library.
- Library updates can be received via floppy or B&C Customer Support BBS.
- Full 1 year warranty. Customer support via voice line, Fax & dedicated BBS.

UNIVERSAL RS-232 PROGRAMMER \$345/495

- Programs EE/EPROMs, ZPRams, Intel Micros, Memory Cards.
- Stand-Alone Mode for EE/EPROM and Memory Card Duplication / Verify.
- All 24/28/32 pin EE/EPROMs to 4 Mbits (upgradeable to 32 megabits).
- Micros: 8741A, 2A, 4, 8, 9, 51, C81, C81A/B, 52, 53, 55, C521, C541, 9761.
- Model U P100 (\$345). Model UP200 (\$495) accepts dedicated modules.
- Memory Cards Programming Module (Seiko Epson, Fujitsu) - \$145
- Four socket GANG Programming Module - \$145
- On-Board Programming capability. Custom interface modules available.
- User friendly Menu-Driven Interface Program for IBM-PC and Macintosh.
- Can be operated with any computer containing an RS-232 serial port.
- Optional built-in Eraser/Timer module (\$50); Top cover conductive foam pad.
- OLM open board programmer configurations available (from \$245).
- Free one year software updates and Customer Support.
- Customer support via voice line, dedicated BBS or fax. Full 1 year warranty.



INTELLIGENT ROM EMULATOR \$395

- Emulates 2716 through 27512 EPROMs (2k to 64k bytes) with a single unit.
- Connects to the standard parallel printer port. Uses standard printer cable.
- Intelligent "In-Circuit-Emulator" type features include: Address Compare, Address Snapshot, Trigger Input, Halt Output, Programmable Reset Output.
- Powerful Memory buffer editor. Selectable wordizes.
- User friendly software. Command set includes: Load, Write, Display, Run, Type, Edit, Fill, Run-Command-File, Monitor, Print, Reset, Help, Calculator.
- FAST data loading via parallel printer port (64k bytes in less than 10 seconds).
- Cascadable to 8 units. Includes target cable with Trigger, Halt & Reset clips.
- CMOS model with NiCAD rechargeable 9V battery backup - \$495.
- Built in battery recharging circuitry. After code downloading from the host computer this model can be disconnected and used in stand-alone mode.
- File formats accepted: Binary, Intel Hex, Motorola S.

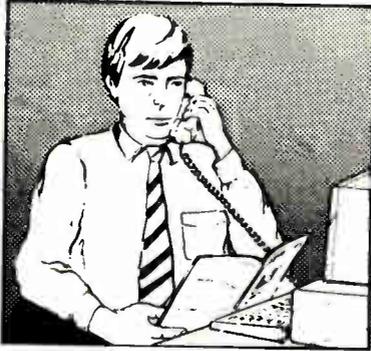
MC / VISA / AMEX Call today for datasheets!

Circle 39 on Reader Service Card

B&C MICROSYSTEMS INC.
355 WEST OLIVE AVE., SUNNYVALE, CA 94086 USA
TEL: (408)730-5511 FAX: (408)730-5521 BBS: (408)730-2317

Buy with

Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- How long has the company been in business?
- Does the company offer technical assistance?
- Is there a service facility?
- Are manufacturer's warranties handled through the company?
- Does the seller have formal return and refund policies?
- Is there an additional charge for use of credit cards?
- Are credit card charges held until time of shipment?
- What are shipping costs for items ordered?

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

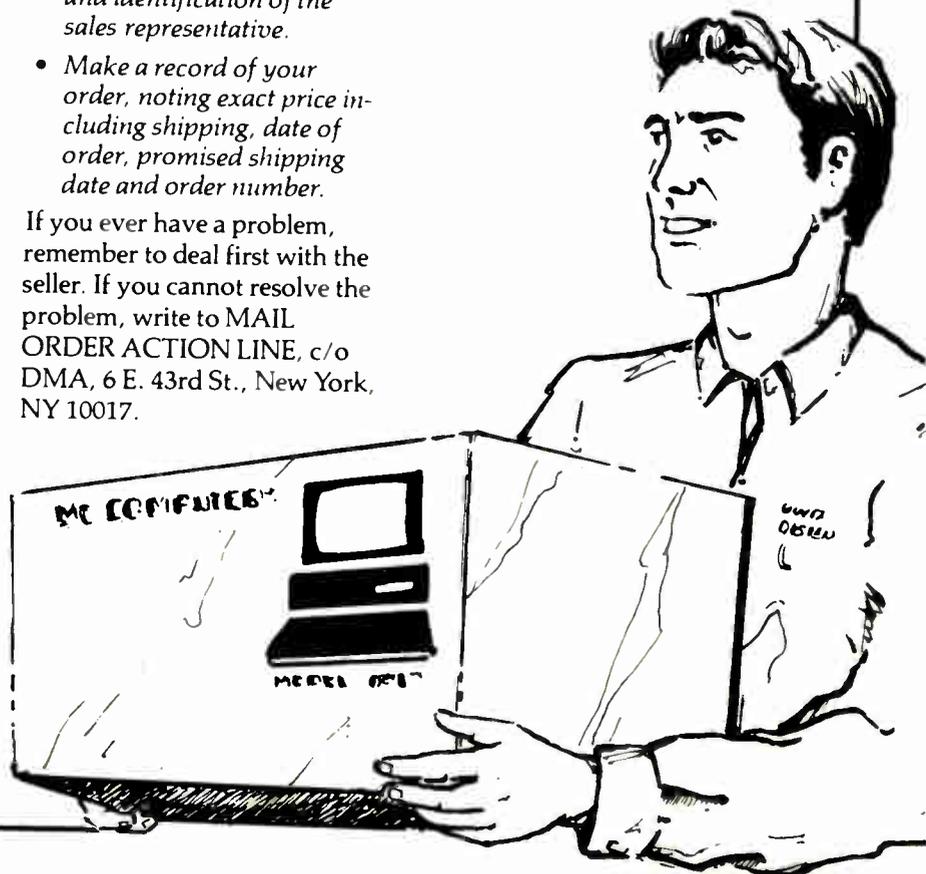
- State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.
- Establish that the item is in stock and confirm shipping date.
- Confirm that the price is as advertised.
- Obtain an order number and identification of the sales representative.
- Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing
Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association, Inc.



LOW COST, RELIABLE EPROM PROGRAMMER

1 Year
Warranty



Operates stand-alone or PC based. Shooter™, an intelligent EPROM programmer, uses serial port for communications. No modules to buy. Now includes 512K buffer; \$395 price includes cable, software and manual.

**LOGICAL
DEVICES, INC.**

1201 N.W. 65th Place
Ft. Lauderdale, FL 33309
FAX: (305) 974-8531
1-800-331-7766

Circle 167 on Reader Service Card
(DEALERS: 168)

SAME DAY SHIPPING

R & R Electronics

6050-X, McDonough Drive, Norcross, GA 30093
(404) 368-1777 • Fax (404) 368-9659

Prices subject to change without notice

SIMMs add \$2 for SIPP

1Mx9-80	\$90	256Kx9-80	\$30
1Mx9-100	\$85	256Kx9-100	\$26
1Mx8-80	\$80	PS/2	Call
1Mx8-100	\$75	1Mx9-70	\$99

D-RAMS

256K-70	\$3.50	64x1-10	\$ 1.75
256K-80	\$2.50	64x4-100	\$ 4.00
256K-100	\$2.25	256x4-80	\$10.00
256K-120	\$2.10	1Mx1-100	\$ 8.25
256K-150	\$2.00	1Mx1-80	\$ 8.50

MATH CO-PROCESSORS

8087	\$ 90	80387-SX	\$335
8087-2	\$115	80387-16	\$310
8087-1	\$165	80387-20	\$355
80287-8	\$185	80387-25	\$450
80287-10	\$210	80387-33	\$550

800-736-3644

Circle 248 on Reader Service Card

How to Protect Your Computer



And Make It Last Longer

FREE money-making literature. What you need to know about UPS — uninterruptible power systems. How to get complete protection from power line problems. 350 VA to 15 KVA models from the world's largest manufacturer of single-phase UPS.

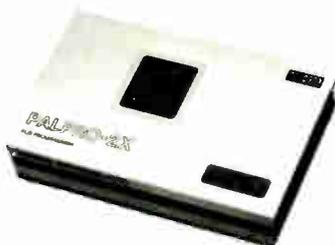
Best Power Technology, Inc.
P.O. Box 280, Necedah, WI 54646

Toll-Free (800) 356-5794, ext. 3864
(608) 565-7200, ext. 3864

Circle 45 on Reader Service Card

STAND-ALONE UNIVERSAL PLD PROGRAMMER

Costs Less, Performs More



Palpro-2x™ is an intelligent programmer supporting PLDs from a wide variety of sources. Works with any PC or computer using a serial port. FREE one year device update and warranty. Price \$995.

**LOGICAL
DEVICES, INC.**

1201 N.W. 65th Place
Ft. Lauderdale, FL 33309
FAX: (305) 974-8531
1-800-331-7766

Circle 169 on Reader Service Card
(DEALERS: 170)

MARYMAC



of discounting
Tandy® computers,
Fax and Radio
Shack® products

Radio Shack® SCO Tandy®

We will meet or beat...
GUARANTEED LOWEST PRICES

MARYMAC INDUSTRIES INC.

22511 Katy Fwy.

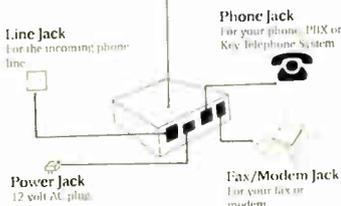
Katy (Houston), TX 77450

1-713-392-0747 FAX (713) 574-4567

Toll Free 800-231-3680

Circle 176 on Reader Service Card

FAX / Phone Switch II



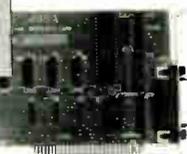
- Connects your fax and phone to a single line.
- Works with all telephones, PBXs, Key Systems, Modems, Answering Machines or Fax Machines.
- Fully Automatic.

To hear a demo, call:
(415) 547-2902

ESS
1900 Powell Street, Suite 205
Emeryville, CA 94608
Telephone: (415) 547-2755

Circle 109 on Reader Service Card

LOW COST INTERFACE CARDS FOR PC/XT/AT



RS-485/422 Card [PC485] \$95/125

- Serial Async. Communication up to 4,000ft.; 2 or 4 wires, NS16450 UART.
- Can be configured as COM1-COM4; Maximum Baud Rate 56Kb.
- Flexible configuration options: RTS or DTR control of transmission direction
- Full/half duplex operation. Supports hardware handshaking (RTS/CTS)
- Dual drivers/receivers; handles 64 devices; Compatible with most comm. software
- High speed version available (supports baud rates up to 256K B) - \$165

Dual-Port RS-485/422 [PCL743] \$175

- Two independent channels /UARTs; 2 or 4 wire operation. Max. Baud 56Kb
- Dipswitch configurable as COM1-4 (IRQ2-7). On board terminator resistor.

IEEE-488 Card [PC488A] \$145

- Includes INSTALLABLE DOS DEVICE DRIVERS and support for BASIC
- Additional Support for ASSEMBLY, C, Pascal and FORTRAN - \$ 50.
- IRQ (1-6), DMA channel 1 or 2. Up to 4 boards per computer.
- Compatible with most IEEE-488 Software packages for IBM PC (e.g. ASYS, TANT-GPIB, Lotus Measure). Compatible with NI's GPIB-PC/HA

IEEE-488 Card [PC488B] With Built-In Bus Analyzer \$345

- Software Support for BASIC, QuickBASIC and GWBASIC
- Additional libraries for C, Pascal, FORTRAN, Assembly - \$50 (all)
- Full range of Talker, Listener, Controller, Serial/Parallel Poll, SRQ, etc...
- Powerful menu-driven BUS ANALYZER can be run in the background while 488 programs or commands are executed; Features Program Stepping, Break points, Real Time Bus Data Capture (4K buffer), Instant Screen Toggling.
- Complete Controller / Talker / Listener capability. Based on TI's TMS-9914.
- Memory-resident Printer Port Emulation Utility included. (1-11-3)
- NEC-7210 based card (compatible with NI's GPIB-PC/HA) - \$445.

DIGITAL I/O Card [PCL720] \$175

- Input: 32 TTL compatible channels; Input load is 0.2 mA at 0.4V.
- Output: 32 TTL compatible channels; Sinks 24mA(0.5V), Sources 15mA(2.0V)
- Counter/Timer: DC to 1.6MHz; 3 channels; 16 bit counters; 6 counting modes.
- Breadboard area for prototyping. Dipswitch I/O port selection (200-388 hex).

LOW COST DATA ACQUISITION & CONTROL CARDS FOR PC/XT/AT



12 BIT A/D & D/A [PCL711s] \$295

- A/D converter: 8 single-ended channels; Device: AD574; Conversion time less than 25µsec; Input range: ±5V; Software Trigger. Model only.
- D/A converter: 1 channel; 12 bit resolution; 0 to +5V/10V Output Range.
- Digital I/O: 16 Input / 16 Output channels; All I/Os TTL compatible.
- External Wiring Terminal Board with mounting accessories included.
- Software: Utility software for BASIC and QuickBASIC included. Includes Routines and Demo/Sample Programs for BASIC and Quick-BASIC.

12 BIT A/D & D/A [PCL812] \$395

- A/D converter: 16 single ended inputs; Device: AD574; Conversion time less than 25µsec; Built-in programmable pacer; Input ranges: ±10V, ±5V, ±1V.
- D/A converter: 2 channels; 12 bit resolution; Output Range optional.
- Digital I/O: 16 Input / 16 Output channels; All I/Os TTL compatible.
- Counter: 1 channel programmable interval counter/timer; Uses Intel 8254.
- DMA and interrupt capability. Utility software for Basic included.

FAST 12BIT A/D/A [PCL718] \$795

- A/D converter: 16 single ended or 8 differential channels; 12 bit resolution; Programmable scan rate; Built-in Interrupt and DMA control circuitry; Conversion speed 60,200 samples/sec (standard), 100,000 samples/sec (optional).
- Input ranges: Bipolar ±10V, ±5V, ±2.5V, ±1V, ±0.5V; Unipolar 10.5, 2.1V.
- D/A converter: 2 channels; Resolution: 12 bits res; Settling time: 5µsec; ±5V.
- Digital I/O: 16 OUT, 16 IN; TTL compatible; All I/Os TTL compatible.
- Counter: 16 bit prog. interval counter/timer; Uses Intel 8254; Pacer clock.
- Software: Utility software for BASIC and QuickBASIC included. Supported by LabDAS (\$195/495), ASYST, LABTECH, UnkelScope

6 Channel 12 bit D/A [PCL726] \$495

- Output Ranges: 0 to +5V, 0 to +10V, ±5V, ±10V or sink 4-20mA.
- Settling time: 70µs. Linearity: ±1/2bit. Voltage output driving capacity: ±5mA
- Digital I/O: 16 digital inputs and 16 digital outputs; TTL compatible.

STEPPER MOTOR CARD \$395

- Capable of independent and simultaneous control of up to 3 stepper motors.
- Speed: Programmable from 3.3 PPS to 3410 PPS; Built-in acceleration control.
- Output Mode: One clock (Pulse, Direction) or two clock (CW, CCW pulses)
- Step position Read-back; Opto-isolated outputs; Crystal based timing.
- Includes 8 bit digital input/output port. Order P/N [PCL-738B]

MC / VISA / AMEX

Call today for datasheets!

Circle 40 on Reader Service Card

B&C MICROSYSTEMS INC.

355 WEST OLIVE AVE., SUNNYVALE, CA 94086 USA
TEL: (408) 730-5511 FAX: (408) 730-5521 BBS: (408) 730-2317



Dynamic C

... is a real breakthrough for programming embedded microprocessor systems in the C language. Dynamic C is a complete menu-driven, PC-based compiler, editor, and source debugger. It compiles and downloads to your target at 25,000 lines per minute. Includes multi-tasking kernel. With Dynamic C you get the advantages of the C language without the problems. Only Z-World has Dynamic C.

Ask for our free demo disk.

Z180 / HD64180



Single Board Computer

The SBC100 single board computer has serial and parallel ports, iSBX ports, battery-backed RAM, EPROM, a battery-backed time-date clock, power fail detection, watchdog timer and LED display. Power supply included. A prototyping area lets you add up to 20 IC's. Single board computer only \$395. Dynamic C programming system, including PC interface card, only \$695.

Z80 / Z180 / HD64180



In-Circuit Emulator C Development system

The ic180 is a total development system including in-circuit emulator. Dynamic C and all supporting software. Only \$3,495 including pod for Z80, Z180/HD64180 or HD647180.

RS-232/485



Communications Coprocessor

The Z485 communications coprocessor for PC has 2 asynchronous, full duplex channels. 57k baud. Dynamic C available. Only \$295. OEM discounts.

Z-World Engineering

1340 Covell Blvd., Davis, CA 95616

(916) 753-3722

Fax: (916) 753-5141

New EPROM Programmer



At \$495, Wintek's Universal EPROM Programmer is a low-cost and versatile tool for programming most industry-standard EPROMs (2716-27256). Since it can operate with an IBM PC, as well as stand-alone, the Programmer is ideal for use with PC-based microcomputer development software. Credit cards are welcome.

Wintek Corporation

1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428

Circle 298 on Reader Service Card

Powerful, Easy Printer Sharing



DPI PrintDirector 6/10/16

- share printers, plotters, modems
- variety of serial/parallel configurations
- buffer options from 250K to 4M
- easy installation software

From **\$495**

1 800 243-2333



DIGITAL PRODUCTS, INC.
the sub-LAN™ company

Circle 90 on Reader Service Card



Sure it's insured?

SAFEWARE® Insurance provides full replacement of hardware, media and purchased software. As little as \$49/yr. covers:

- Fire • Theft • Power Surges
- Water Damage • Auto Accident

For information or immediate coverage call:

1-800-848-3469

Local 1-614-262-0559

On CompuServe, "GO SAF"
On GENIE, "SAFEWARE"



SAFEWARE, The Insurance Agency Inc.
2929 N. High St., P.O. Box 02211
Columbus, OH 43202

Circle 249 on Reader Service Card

MOTHERBOARD

FAST!
6 mips
L.M. = 43.5 MHz

\$1095



FEATURES:

- 80386-25 cpu • 64K (25ns) SRAM Cache • 256K Cache Option • Expandable to 16MB on Board w/o memory card • 80387 Weitek socket • User selectable bus speed • Dallas hybrid clock chip • 100% AT compatible • 1 yr. part/labor warranty

16 bit VGA
(1024 x 768)
\$123

M.B. w/1 Meg	\$1220
M.B. w/4 Meg	1495
M.B. w/8 Meg	1995
Mono comp. sys., 1M	1745
VGA comp. sys., 1M	2095
256K cache, HD option, 80387	Call

Dealer Inquiries Welcome

Schwab Computer

730 E. El Camino Real, Sunnyvale, CA 94087
Tel: (408) 245-6666 Fax: (408) 245-3103

Circle 313 on Reader Service Card

SAVE ON 9 TRACK TAPE SYSTEM

FOR IBM PC/XT/AT & PS-2



- Mainframe to PC Data Transfer
- High Speed Backup
- All Software, Complete System
- Service and Support, easy Installation

call (818) 343-6505 or write to:

CONTECH Computer Corp.
P.O. Box 153 Tarrytown, CA 91356

CONTECH

Circle 73 on Reader Service Card

Terminal Emulation

TEK 4105/4010

- Tektronix 4105
- Tektronix 4010/4014
- VT220, VT102
- Picture files
- VGA and EGA support
- High resolution hardcopy

VT220

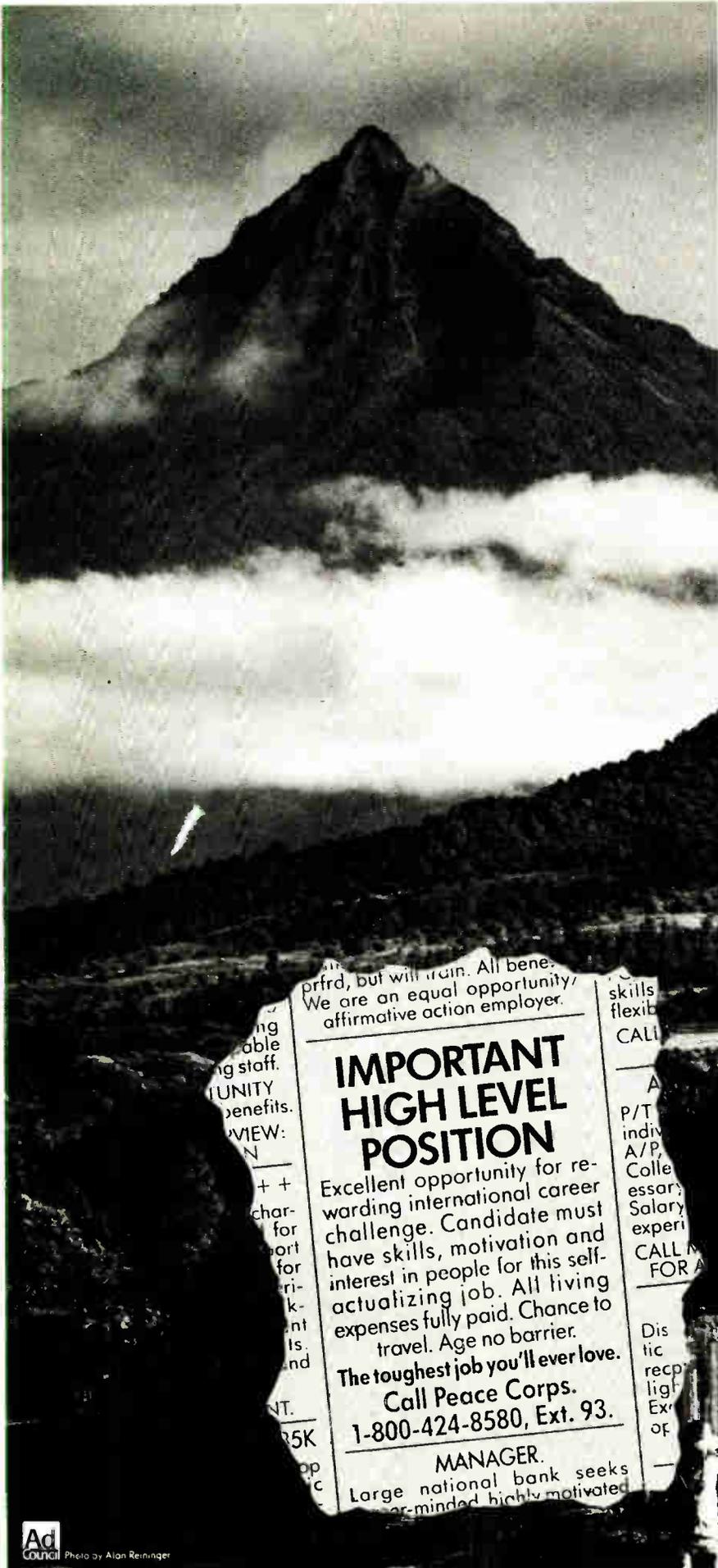
- VT220, VT102 emulation
- File transfer
- 132 column modes
- Color support
- Hot key

■ ■ ■ Diversified Computer Systems, Inc.

3775 Iris Avenue, Suite 1B
Boulder, CO 80301 (303) 447-9251
FAX 303 447-1406

Backmark: VT102 VT220 DEC Tektronix Tektronix, Inc.

Circle 98 on Reader Service Card



prfrd, but will train. All bene.
We are an equal opportunity/
affirmative action employer.

IMPORTANT HIGH LEVEL POSITION

Excellent opportunity for re-
warding international career
challenge. Candidate must
have skills, motivation and
interest in people for this self-
actualizing job. All living
expenses fully paid. Chance to
travel. Age no barrier.

The toughest job you'll ever love.
Call Peace Corps.
1-800-424-8580, Ext. 93.

MANAGER.
Large national bank seeks
experienced, highly motivated

skills
flexib
CALL
A
P/T
indiv
A/P
Colle
essary
Salary
experi
CALL
FOR A
Dis
tic
recep
light
Exp
of

ng
able
ng staff.
UNITY
benefits.
VIEW:
N
+ +
char-
for
port
for
ri-
k-
nt
is.
nd
NT.
75K
pp
C

Ad Council Photo by Alan Reininger

SONY

<p>3 1/2" DS 8⁹⁵ PER BOX</p>	<p>3 1/2" HD 17⁹⁵ PER BOX</p>
--	---

Bulk Diskettes

PER EA
Min. 50

3.5" DS - **.49**

3.5" HD - **1.49**

3M

Authorized Distributor Magnetic Media Division

<p>5 1/4" DD 5⁹⁵ PER BOX</p>	<p>5 1/4" HD 10⁹⁵ PER BOX</p>
<p>3 1/2" DS 8⁹⁵ PER BOX</p>	<p>3 1/2" HD 17⁹⁵ PER BOX</p>

maxell

<p>5 1/4" DS 5⁹⁵ PER BOX</p>	<p>5 1/4" HD 10⁹⁵ PER BOX</p>
<p>3.5" DS 8⁹⁵ PER BOX</p>	<p>3.5" HD 17⁹⁵ PER BOX</p>

Old Reliable

Diskette Connection

<p>NORTHWEST</p> <p>PO BOX 10247, WILMINGTON, DE. 19880</p>	<p>1-800-451-1849</p>
<p>SOUTHEAST</p> <p>PO BOX 4183, DEERFIELD BEACH, FL 33442</p>	<p>1-800-940-4600</p>
<p>MIDWEST</p> <p>PO BOX 1874, BETHANY, OK. 73008</p>	<p>1-800-654-4058</p>
<p>WEST</p> <p>PO BOX 12396, LAS VEGAS, NV. 89112</p>	<p>1-800-621-6221</p>

Minimum Order \$20.00 NO SURCHARGE on VISA / MC
COD orders add \$3.00 UPS Surface shipping add \$4.00
per each 100 Disks (First Class US Mail delivery extra)
(Prices are subject to change without notice)

FAX

(405) 495-4598

Industrial Control Systems
LAN Terminals
Diskless Systems

ROMDISK™

For the IBM PC, XT,
AT PC DOS* or MS DOS*

SOLID STATE DISK AND DRIVE EMULATORS

- Make PC/XT/AT and compatibles diskless terminals with local DOS and program storage.
- Single or dual disk emulation of 5¼" or 3½" diskettes up to 1.2MB, read/write up to 770K.
- On-board EPROM programmer—simply copy a diskette to program the EPROMs or Flash EEPROMs.
- Flash EEPROMs remotely programmable on LANs.
- Two Autoboot modes, a File (read) and a Programming mode—automatic disk drive designation set-up during booting.
- Flash EEPROM models are electrically erasable. SRAM models are battery backed. EPROM models are ultraviolet erasable.
- Programming utilities included with programmable models.
- List prices with memory ICs from \$295. OEM prices and models available DEM with or without memory ICs.

CURTIS, INC.
2837 North Fairview Ave. • St. Paul, MN 55113
612/631-9512 • Fax 612/631-9508

IBM PC XT AT PS2 and PC DOS are trademarks of IBM. MS DOS is a trademark of Microsoft.

Circle 80 on Reader Service Card

Turn your old XT/AT
into a **WARPSPEED/386**

386SX MotherBoard
\$ 299

- Intel 16 Mhz 80386 SX CPU
- Socket for Intel 80387 SX Coprocessor
- Shadow RAM Support
- 8 Expansion Slots 6 16 bits, 2 8 bits
- I/O Speed at 8 Mhz to use existing cards
- Interleave w/1Mb RAM
- Fully AT Compatible

SYSTEMS/MEMORY...Call
386SX-ALL-IN-ONE..\$399
386/33(32K Cache)..\$1249

HomeSmart Computing
ORDER LINE: (800) 627-6998
Limited time offer. Prices subject to change.

Circle 139 on Reader Service Card

96 LINE I/O BOARD

- For IBM PC/XT/AT
- 96 input/output/bidirectional lines
- 8 interrupts shareable and selectable
- Dipswitch addressing

(214) 559-7175

CENTRUM RESEARCH

4514 Cole Avenue, Suite 600
Dallas TX 75205
Fax: (214) 528-4638

Circle 59 on Reader Service Card

BIOS Development • Embedded &
Control Systems • ROM Development

ROM
EEROM
SRAM

The Kolod Research R³OM™ Card

- 4 28-pin JEDEC sockets (up to 256K of ROM, 128K of RAM, or any combination)
- Each socket can be configured independently with respect to address, size and type of chip (SRAM, ROM, or SRAM as ROM)
- Battery backup available for all of the sockets
- Variable wait state generation
- Flexible port decoding
- Software or hardware controlled write-protect
- Unique Fly-by DMA circuit test
- Support upto 8 boards in one system
- PC/XT/AT/386/486 support

Designed and Produced by:
Kolod Research, Inc.
1898 Techny Court
Northbrook, Illinois
U.S.A. 60062-5474
(708) 291-1586

\$285.00
(US)

Circle 159 on Reader Service Card
(DEALERS: 160)

Put Your Phone, Fax & Modem on One Phone Line

New microprocessor-based Phone Line Manager will operate 3 units on 1 line, automatically deciding the correct device for the incoming or outgoing transmission.

- Prices starting from \$295
- 5 Year Warranty

In Canada or the USA, call toll-free
1-800-848-8731

Programmer's Odyssey

120 Hudson St., Northborough, MA 01532 USA
phone: (508) 393-5560 fax: (508) 393-1456

Circle 225 on Reader Service Card

CORTEX CORPORATION MASTER CONTROL

For Industrial Control and Multiple
File Server Applications: Control up
to 16 CPU's with a single Monitor
and Keyboard!

- Units to Control from 2 to 16 CPU's
- Enclosed Keyboard Drawer and Monitor (5 inch screen)
- 16 Gauge Steel Rack - mount construction, Double-plated
- Black Anodized Aluminum Faceplate

CORTEX CORPORATION
(612) 894-3354 • Fax (612) 894-2414
12274 Nicollet Ave. S. • Burnsville, MN 55337

Circle 75 on Reader Service Card

SOFTWARE DEVELOPERS: Are Your Products Too Hard To Install?

INSTALL 3.00 is an automatic installation program you can distribute—royalty free—with your product.

Features: File compression • Up to 4.3 Gigabyte file sizes • Elegant user interface • Full C Source • CRC Disk integrity verification • Handles all installation errors (open disk drive doors, unformatted and full disks, etc.) • Free tech support • NEW: Can intelligently modify CONFIG.SYS and AUTOEXEC.BAT files • 30-day money-back guarantee.

INSTALL offers over 3 years of proven reliability that is being used to install some of the most prestigious products in the industry. We would like to add your name to that list. **No programming needed!**

KNOWLEDGE DYNAMICS CORP.
HC4 Box 185-H, Canyon Lake, TX 78133
1-800-331-2783 MC/VISA/COD/PO
1-512-964-3994 (International)
1-512-964-3958 (24-hr FAX) **\$249.95**

Circle 157 on Reader Service Card

Q-TEK

PH: 818-407-0303 FX: 818-407-0262

SIMMS/SIPPS

1x9-80.....\$79	256x9-80.....\$24
1x9-100.....\$77	256x9-100.....\$23
1x8-80.....\$75	IBM PS2.....CALL

DRAMS

41256-80.....\$2.00	1MB-80.....\$7.65
41256-100.....\$1.85	1MB-100.....\$7.45
41256-120.....\$1.75	4164-100.....\$1.40
44256-100.....\$8.60	4464-80.....\$2.90
44256-80.....\$8.75	4464-100.....\$2.75

CPU/COPROS.

80386-20.....\$300	80387-16.....\$325
80386-25.....\$400	80387-20.....\$345
80287-10.....\$205	80387-25.....\$445

VGA CARD

1024x768 HI RES
With 256K exp to 512K 16-BIT.....\$97

Circle 241 on Reader Service Card

VT240 Keyboard for your PC

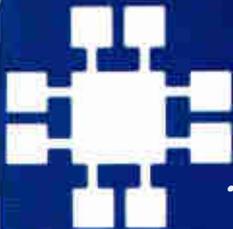
Turn your PC into a VAX
workstation with the
PowerStation™

- an exact VT200/VT300 layout keyboard to plug into your PC, and
- ZSTEM 240 or 220 terminal emulation software

3738 North Fraser Way, Unit 101
Burnaby, B.C., Canada V5J 5G1
Tel: 604-431-0727 Fax: 604-431-0818
Toll Free Order Desk: 800-876-6089

ZSTEM and PowerStation are trademarks of KEA Systems Ltd.

Circle 153 on Reader Service Card



JDR Microdevices

MMC
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association Inc.

• 30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

DYNAMIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
4116-150	16384x1	150ns	16	1.49
4164-150	65536x1	150ns	16	2.49
4164-120	65536x1	120ns	16	2.89
4164-100	65536x1	100ns	16	3.39
TMS4464-12	65536x4	120ns	16	3.95
41256-150	262144x1	150ns	16	2.59
41256-120	262144x1	120ns	16	2.95
41256-100	262144x1	100ns	16	3.15
41256-80	262144x1	80ns	16	3.75
414256-100	262144x4	100ns	20	12.95
414256-80	262144x4	80ns	20	13.45
1 MB-120	1048576x1	120ns	18	11.95
1 MB-100	1048576x1	100ns	18	12.35
1 MB-80	1048576x1	80ns	18	13.95

SIMM/SIP MODULES

PART#	SIZE	SPEED	FOR	PRICE
41256A9B-12	256K x 9	120ns	SIMM/PC	36.95
41256A9B-80	256K x 9	80ns	SIMM/PC	49.95
42100A8B-10	1MB x 8	100ns	SIMM/MAC	109.95
42100A9B-10	1MB x 9	100ns	SIMM/PC	113.95
42100A9B-80	1MB x 9	80ns	SIMM/PC	119.95
256K9SIP-80	256K x 9	80ns	SIP/PC	54.95
256K9SIP-60	256K x 9	60ns	SIP/PC	64.95
1MBx9SIP-80	1MB x 9	80ns	SIP/PC	124.95

MATH COPROCESSORS

8-BIT COPROCESSORS

8087	5 MHz	89.95
8087-2	8 MHz	129.95
8087-1	10 MHz	169.95

16-BIT COPROCESSORS

80267	6 MHz	139.95
80267-8	8 MHz	209.95
80267-10	10 MHz	239.95
80C827	12MHz	299.95

32-BIT COPROCESSORS

80387-16	16 MHz	359.95
80387-SX	16 MHz	319.95
80387-20	20 MHz	399.95
80387-25	25 MHz	499.95
80387-33	33MHz	649.00



INCLUDES MANUAL & SOFTWARE GUIDE

Littlefoot™ CASE

- ACCOMMODATES ALL MOTHERBOARD SIZES
- INCLUDES 250 WATT POWER SUPPLY
- MOUNTS FOR 3 FLOPPY & 4 HARD DRIVES
- TURBO AND RESET SWITCHES
- SPEED DISPLAY, POWER, DISK LEDS
- MOUNTING HARDWARE, FACEPLATES AND SPEAKER INCLUDED

CASE-100

CASE-200	"SUPERFOOT"-HOLDS 11 DRIVES	\$499.95
CASE-120	"MINIFOOT"-W/200 WATT PS	\$199.95



STANDARD CASES

CASE-70	FULL SIZE SLIDE CASE	\$89.95
CASE-50	FOR 8088 OR MINI-86 MOTHERBOARDS	\$59.95
CASE-FLIP	FLIP-TOP XT-STYLE CASE	\$39.95
CASE-SLIDE	SLIDE TYPE XT-STYLE CASE	\$39.95
CASE-JR		\$149.95
WITH 150W POWER SUPPLY. FOR 8088 OR MINI-286 BOARDS.		
CASE-JR-200		\$189.95
WITH 200W POWER SUPPLY. FOR 8088 OR MINI-286 BOARDS.		

UL APPROVED POWER SUPPLIES

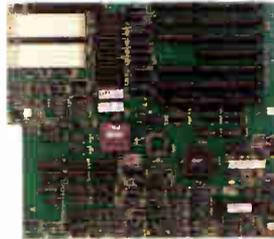
PS-135	135 WATT FOR 8088	\$59.95
PS-155	150 WATT FOR 8088	\$69.95
PS-200X	200 WATT FOR 8088	\$89.95
PS-200	200 WATT FOR 286/386	\$89.95
PS-250	250 WATT FOR 286/386	\$129.95

JDR MICRODEVICES 2233 BRANHAM LANE, SAN JOSE, CA 95124 (408) 559-1200 FAX (408) 559-0250 TELEX 171-110

RETAIL STORE: 1256 S. BASCOM AVE., SAN JOSE, CA (408) 947-8881 HOURS: M-F 9-7, SAT. 9-5, SUN. 12-4

COPYRIGHT 1990 JDR MICRODEVICES

YOUR MOTHERBOARD CONNECTION!



"OUR FASTEST" 33MHZ CACHE 386 \$1495

• **NORTON SI 45.9 • LANDMARK AT SPEED 50.8**

• 35MHZ 80386 MPU • 64K ZERO WAIT STATIC RAM CACHE

• 1/2/4MB ON BOARD RAM USING 80NS 512MS (OKB INSTALLED) • 1/2MB USING 4/8 256K SIMMS OR 4/8MB USING 4/8 1MB SIMMS • CHIPS & TECHNOLOGY 82C206 DMA INTERRUPT CONTROLLER • SOCKETED FOR 80387-33 MATH CO PROCESSOR • EIGHT EXPANSION SLOTS (ONE 32-BIT, SIX 16-BIT, ONE 8-BIT) • AMI BIOS ASSURES IBM COMPATIBILITY • 8/33MHZ KEYBOARD ADJUSTABLE SPEEDS

MCT-386MBC-33 \$1495.00

25MHZ 386 \$999

• **NORTON SI 29.7 • LANDMARK AT SPEED 32.5**

• 25MHZ 80386 MPU • 10MHZ/25MHZ KEYBOARD SELECTABLE SPEEDS • 16MB ON BOARD RAM CAPACITY USING SIPS (OKB INSTALLED) • 1/2MB USING 36/72 256KX1 DRAMS OR 4/8 256K SIPS; 4/8MB USING 36/72 1MBX1 DRAMS OR 4/8 1MB SIPS; 16MB USING 72 1MBX1 DRAMS AND 8 1MB SIPS • SHADOW RAM FOR BIOS & VIDEO • SOCKETED FOR WEITEK 3167 COPROCESSOR • EIGHT EXPANSION SLOTS (FIVE 16-BIT, THREE 8-BIT) • AMI BIOS ADJUSTABLE BUS SPEEDS • INTERLEAVED MEMORY • NEAR 0 WAIT STATE

MCT-386MB25S \$799

20MHZ 386 \$799

MCT-386MB20S • **NORTON SI 23.0 • LANDMARK AT 25.8**

MINI 25MHZ CACHE 386

• **NORTON SI 30.5 • LANDMARK AT SPEED 40.7**

• 25MHZ 80386 • REQUIRES ONE OF THE RAM CARDS LISTED BELOW • SHADOW RAM FOR ROM BIOS • USES MEMORY CACHING FOR SUPERIOR PERFORMANCE • MEMORY INTERLEAVING FOR NEAR 0 WAIT STATE OPERATION (8 BANKS OF MEMORY REQUIRED) • SOCKETED FOR 80387 OR WEITEK 3167 COPROCESSORS

MCT-C386-25 \$1199.00

1/2/4MB USING 8/16/32 256KX4 DRAMS & 4/8/16 256KX1 DRAMS (OK INSTALLED) \$99.95

MCT-C386-M4 \$99.95

1/2MB USING 36/72 256KX1 DRAMS OR 4/8MB USING 36/72 1MBX1 DRAMS (OK INST) \$99.95

MCT-C386-M8 \$99.95

1/2/4MB USING 4/8/16 256K SIMMS, 4/8/16MB USING 4/8/16 1MB SIMMS OR 10 MB USING 36/72 256K SIPS AND 8 256K SIPS (OK INSTALLED) \$99.95

MCT-C386-M16 \$99.95

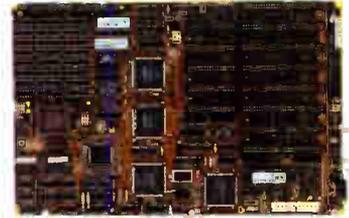
MINI 20MHZ 386 \$629

• **NORTON SI 23.0 • LANDMARK AT SPEED 26.1**

• MEMORY INTERLEAVING FOR NEAR ZERO WAIT STATES • SOCKETED FOR 80387 COPROCESSOR • USES 80NS OR 100NS, 256K OR 1MB SIP/DIP RAMS • 16MB RAM CAPACITY: 8MB ON BOARD, 8MB USING OPTIONAL RAM CARD (OKB INSTALLED) • ON-BOARD RAM: 1/2MB USING 4/8 256K SIPS OR 4/8MB USING 4/8 1MB SIPS • FIVE 16-BIT SLOTS, TWO 8-BIT SLOTS, ONE 32 BIT SLOT FOR PROPRIETARY RAM CARD • STANDARD XT HOLE SPACING • AMI BIOS • SIZE: 8.5" X 13"

MCT-M386-20 20MHZ VERSION \$629.00

MCT-M386-25 25MHZ VERSION \$799.00

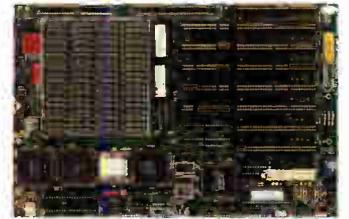


16MHZ MINI 386-SX \$399.95

• **NORTON SI 15.3 • LANDMARK AT SPEED 20.8**

• USES 16MHZ INTEL 80386SX CPU • EXPANDABLE TO 8MB ON BOARD • 512K/1MB USING 18/36 256KX1 DRAMS OR 2/4 256K SIPS OR 4/8 256KX4 AND 2/4 256KX1 DRAMS; 2/4MB USING 18/36 1MBX1 DRAMS OR 2/4 1MB SIPS; 6/8MB USING 36 1MBX1 DRAMS AND 2/4 1MB SIPS • AMI BIOS • CHOOSE FAST 0 WAIT STATE OR 1 WAIT STATE FOR ECONOMIC USE OF SLOWER RAM • FIVE 16-BIT & THREE 8 BIT EXPANSION SLOTS • CHIPS & TECHNOLOGY NEW ENHANCED ADVANCED TECHNOLOGY (NEAT) CHIPSET • SOCKET FOR 80387SX-16 COPROCESSOR • 8.5" X 13" SIZE FITS IN MINI-AT AND FULL-SIZE AT CASES

MCT-386SX \$399.95



20MHZ 286 \$389.95

• **NORTON SI 20.3 • LANDMARK AT SPEED 26.3**

• NEAT CHIPSET HAS POWER TO COMPETE WITH 386 SYSTEMS • EXPANDABLE FROM 512K TO 8MB 512K/1MB USING 18/36 256KX1 DRAMS OR 2/4 256K SIPS; 2/4MB USING 18/36 1MBX1 DRAMS OR 2/4 1MB SIPS; 6/8MB USING 36 1MBX1 DRAMS AND 2/4 1MB SIPS • 20 10MHz KEYBOARD SELECTABLE SPEEDS • AMI BIOS • SHADOW RAM AND PAGE INTERLEAVED MEMORY • FAST 0 WAIT STATE OR 1 WAIT STATE FOR SLOWER RAM • 8.5" X 13" FITS MOST XT, MINI-AT & FULL SIZE AT CASES • FIVE 16 BIT & THREE 8 BIT SLOTS • SOCKET FOR 80287-12 MATH CO-PROCESSOR

MCT-M286-20N \$289.95

16MHZ 286 W/NEAT CHIPSET \$289.95

MCT-M286-16N NORTON SI 16.2 / LANDMARK AT 21.1

12MHZ 286 W/NEAT CHIPSET \$269.95

MCT-M286-12N NORTON SI 12.0 / LANDMARK AT 15.5

12.5MHZ 286 \$199.95

• **NORTON SI 14.3 • LANDMARK AT SPEED 16.5**

• AT COMPATIBLE • 6/11.5MHZ KEYBOARD SELECTABLE SPEEDS • EXPANDABLE TO 4MB ON BOARD, 512K/1MB USING 18/36 256KX1 DRAMS; 2/4MB USING 18/36 1MBX1 DRAMS (OKB INSTALLED) • MEMORY SPEED: 120NS FOR 1 WAIT, 100NS FOR 0 WAIT

MCT-M286-12 \$199.95

MCT-M286-10 6/10MHZ VERSION \$189.95

10MHZ 8088 NORTON SI 2.1 \$99.95

• NOW USES LOW-COST 256K X 4 1MB DRAMS • XT COMPATIBLE OPERATES AT 4.77/10MHZ • KEYBOARD SELECTABLE CLOCK SPEEDS • SOCKET FOR 8087-1 COPROCESSOR OR 8 SLOTS • MCT BIOS • 640K RAM CAPACITY (OKB INSTALLED)

MCT-TURBO-10 \$99.95

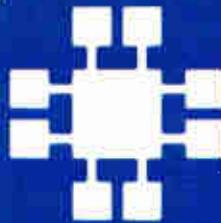
MCT-TURBO 8MHz VERSION \$89.95

ORDER TOLL-FREE 800-538-5000

CUSTOMER SERVICE 800-538-5001 TECH SUPPORT 800-538-5002

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)





JDR Microdevices®

• 30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

MONITORS

VGA PACKAGE
\$499.95

VGA COLOR AND CLARITY AT AN EGA PRICE! • 8-BIT VGA CARD IS FULLY COMPATIBLE WITH IBM VGA • 720 X 540 MAXIMUM RESOLUTION, 640 X 480 IN 16 COLORS • 528 X 480 IN 256 COLORS • HIGH RESOLUTION ANA. OG MONITOR • EGA, CGA, MONO AND HERCULES COMPATIBLE • DRIVERS FOR WINDOW., GEM, 1-2-3, SYMPHONY, AUTOCAD & VENTURA
VGA-PKG
MONO-VGA PAPERWHT VGA MONITOR \$139.95
NEC-MULTI-3D NEC MULTI 3D MULTI:YNC \$649.00
CM-1440 SEIKO DUAL FIXED FREQUENCY \$599.00



RELISYS MULTISYNCH \$429.95

• 14" NON-GLARE SCREEN • 800 X 560 MAX RESOLUTION
• CGA/EGA/VGA COMPATIBLE • TT/ANA. OG MODE
JDR-MULTI

RELYSIS VGA MONITOR \$359.95

• 14" ANALOG VGA MONITOR • GLARE RESISTANT SCREEN
• 720 X 480 MAXIMUM RESOLUTION • TILT/SWIVEL BASE
VGA-MONITOR

EGA MONITOR \$339.95

• 14" NON-GLARE SCREEN WITH 640 X 350 MAXIMUM RESOLUTION • DISPLAY 16 COLORS SIMULTANEOUSLY
EGA-MONITOR

TAXAN DUAL PAGE MONITOR \$1499

• GLARE RESISTANT 15" MONOCHROME SCREEN
• INCLUDES DISPLAY CARD • 1180 X 960 NON-INTERLACED
TAXAN-P

14" SCREEN MONO \$139.95

• GLARE RESISTANT 14" SCREEN WITH AMBER DISPLAY
• 720 X 350 RESOLUTION • TILT SWIVEL BASE
GM-1489

MONO-SAMSUNG SAMSUNG 12" FLAT SCREEN \$129.95
JDR-MONO 12" MONO WITH GREEN SCREEN \$69.95



ENHANCED KEYBOARD WITH CALCULATOR \$74.95

• NUMERIC KEYPAD DOUBLES AS A MULTI-FUNCTION BUSINESS CALCULATOR WITH MEMORY FUNCTIONS • 101 KEYS • 12 FUNCTION KEYS • XT AT & PS/2 COMPATIBLE (PS/2 REQUIRE: ADAPTOR GENDER 5-6 \$1.95)
FC-3001

ENHANCED KEYBOARDS

BTC-5339 101 KEY WITH 12 FUNCTION KEYS \$69.95
BTC-5339R COMPACT 101-KEY, 30% SMALLER \$79.95
MAX-5339 101-KEY MAXI SWITCH (286 ONLY) \$84.95
K103-A ALDIBLE "CLICK" 101-KEY KEYBOARD \$84.95

STANDARD KEYBOARDS

BTC-5060 84-KEY WITH 10 FUNCTION KEYS \$59.95
MAX-5060 MAXI-SWITCH 84-KEY (86 ONLY) \$64.95

GENISCAN SCANNER \$199.95

• UP TO 400 DPI • 32 LEVELS OF GRAY SCALE • SPEED OVERRUN WARNING LIGHT
• AUTO MERGE FOR LARGE IMAGES
• INCLUDES INTERFACE CARD
• INCLUDES SCANEEDIT II, & DR. GENIUS SOFTWARE
GS-4500
PRODIGY-OCR OCR SOFTWARE \$49.95



FASTTRAP 3-AXIS TRACKBALL \$109.95

• 2 & 3 AXIS POINTING CAPABILITY
• HIGH RESOLUTION 200 PULSE INCH
• HARDWARE VARIABLE RESOLUTION
• STANDARD RS 232C SERIAL INTERFACE
FAST-TRAP
PC-TRAC 2-AXIS TRACKBALL \$89.95



CABLES AND GENDER CHANGERS

MOLDED; GOLD-PLATED CONTACTS; 100% SHIELDED

CBL-PRINTER 5 FT. PC PRINTER CABLE 9.95
CBL-PRNTR-25 25 FT. PC PRINTER CABLE 15.95
CBL-PRNTR-RA RIGHT ANGLE PRINTER CABLE 15.95
CBL-DB25-MM DB25 MALE-DB25 MALE 6 FT. 9.95
CBL-DB25-MM DB25 MALE-DB25 FEMALE 6 FT. 9.95
CBL-9-SERIAL DB9 FEMALE-DB25 MALE 6 FT. 6.95
CBL-KBD-EXT 5 FT. KEYBOARD EXTENSION 7.95
CBL-CNT-MM 36-PIN CENTRONICS-MM 14.95
CBL-FDC-EXT 37-PIN EXT. FLOPPY CABLE 9.95
CBL-MNT-9 9-PIN MONITOR EXTENSION 6.95
CBL-MNT-15 15-PIN MONITOR EXTENSION ON CABLE 9.95
CBL-MODEM MODEM-DB25 DB25 FEMALE 6.95
GENDER-VGA DEG-DB15 ADAPTOR 4.95

RAM CARD FOR HP LASERJET \$89.95

• FOR LASERJET SERIES II PRINTERS
• USER EXPANDABLE TO 1, 2 OR 4MB
(OK INSTALLED - USE 256K 150NS OR 1MB 120NS DRAMS)
MCT-RAMJET



RAM CARD FOR LASERJET IIP \$299.95

• ADDS 1MB TO 4MB RAM (1MB INSTALLED)
IIP-RAM

JETFONT SUPERSET -150 FONTS! \$299.95

2 CARTRIDGES CONTAIN THE EQUIVALENT OF 18 SEPARATE HF CARTRIDGES WITHOUT DOWN-LOADING! • FOR HP LASERJET, LASERJET II AND LASERJET II • DRIVERS FOR WORDPERFECT WORD-STAR 2000, IBM DISPLAY WRITE 4, MS WORD, WINDOWS, 1-2-3, DBASE II AND MORE!
SUPERSET

LOGITECH MICE

• THREE-BUTTON SERIES 9
• 320 DPI RESOLUTION
• SERIAL PS/2 COMPATIBLE
LOGITECH
LOGC9 SERIAL MOUSE \$96.95
LOGC9-C SERIAL MOUSE (NOT PS/2 COMPATIBLE) \$79.95
LOGC9-P SERIAL MOUSE WITH PAINTSHOW \$109.95
LOGC9-PC SERIAL MOUSE WITH PAINT.CAD \$154.95
LOGB9 BUS MOUSE \$89.95
LOGB9-P BUS MOUSE WITH PAINTSHOW \$104.95
LOGB9-PC BUS MOUSE WITH PAINT.CAD \$149.95



DEVELOPERS' WORLD

JDR caters to the developer with a full line of prototyping and programming products. Here are just a few examples, Request our catalog for our complete line!



PROTOTYPE CARDS
JDR-PR1 16-BIT WITH +5V AND GROUND PLANE 27.95
JDR-PR2 ABOVE WITH I/O DECODING LAYOUT 29.95
JDR-PR2-PK PARTS KIT FOR JDR-PR2 ABOVE 8.95
JDR-PR10 16-BIT WITH I/O DECODING LAYOUT 34.95
JDR-PR10-PK PARTS KIT FOR JDR-PR10 ABOVE 15.95

EPROMS

PART#	SIZE	SPEED	Vpp	PINS	PRICE
2716-1	2048x8	350ns	25V	24	3.95
2732A	4096x8	250ns	21V	24	3.95
2764	8192x8	450ns	12.5V	28	3.49
2764-250	8192x8	250ns	12.5V	28	3.99
2764-200	8192x8	200ns	12.5V	28	4.25
27128	16384x8	250ns	12.5V	28	4.25
27128A-200	16384x8	200ns	12.5V	28	5.95
27256	32768x8	250ns	12.5V	28	4.95
27C256	32768x8	250ns	12.5V	28	5.95
27512	65536x8	250ns	12.5V	28	7.95
27C101-20	131072x8	200ns	12.5V	32	24.95

EPROM PROGRAMMER \$129.95

• PROGRAMS 27XX AND 27XXX EPROMS UP TO 27512 • SPLIT OR COMBINE CONTENTS OF SEVERAL DIFFERENT SIZED EPROMS (VARIOUS FORMATS AND VOLTAGES) • READ, WRITE, COPY, BLANK CHECK AND VERIFY • HEX AND INTEL HEX FORMATS SOFTWARE
MOD-EPROM

DATASE II EPROM ERASER \$39.95

• SMALL SIZE! • ERASES ALL SIZE EPROMS UP TO 4 AT A TIME - MOST IN 3 MINUTES • WALL PLUG POWER SUPPLY
DATASE II



MODULAR PROGRAMMING SYSTEM

EACH MODULE IN THIS SYSTEM USES A COMMON HOST ADAPTOR CARD, SO YOU CAN USE JUST ONE SLOT TO PROGRAM EPROMS, PROMS, PALS & MORE!

COMMON HOST ADAPTOR CARD \$29.95

• UNIVERSAL INTERFACE FOR ALL THE PROGRAMMING MODULES!
• SELECTABLE ADDRESSES
PREVENTS CONFLICTS
• MOLDED CABLE
MOD-MAC

UNIVERSAL MODULE \$499.95

• PROGRAMS EPROMS, EEPROMS, PALS, BI-POLAR PROMS, 8748 & 8751 SERIES DEMIC'S; 15V6 AND 20V8 GALS (GENERIC ARRAY LOGIC) FROM LATTICE, NS, SGS • TESTS TTL, CMOS, DYNAMIC & STATIC RAMS
• LOAD DISK, SAVE DISK, EDIT, BLANK CHECK, PROGRAM, AUTO, READ MASTER, VERIFY AND COMPARE • TEXT TOOL SOCKET FOR 3" TO 6" WIDE C'S (8-40 PINS)
MOD-MUP

MOD-MUP-EA 4-UNIT ADAPTOR \$99.95

EPROM MODULE \$119.95

• PROGRAMS 24-32 PIN EPROMS, CMOS EPROMS & EEPROMS FROM 16K TO 1024K • HEX TO OBJ CONVERTER • AUTO BLANK CHECK/PROGRAM/VERIFY • VPP 5, 12.5, 12.75, 13, 21 & 25 VOLTS • NORMAL, INTELLIGENT, INTERACTIVE & QUICK PULSE PROGRAMMING ALGORITHMS
MOD-MEP
MOD-MEP-4 4-EPROM PROGRAMMER \$169.95
MOD-MEP-8 8-EPROM PROGRAMMER \$259.95
MOD-MEP-16 16-EPROM PROGRAMMER \$499.95

PAL MODULE \$249.95

• PROGRAMS MM, NS, T120 & T124 PIN DEVICES • BLANK CHECK, PROGRAM, AUTO, READ MASTER, VERIFY & SECURITY FUSE BLOW
MOD-MPL

OTHER MODULES

MOD-MMP MICROPROCESSOR PROGRAMMER \$179.95
MOD-MIC D-GITAL IC & MEMORY TESTER \$259.95
MOD-MBP BI-POLAR PROM PROGRAMMER \$499.95

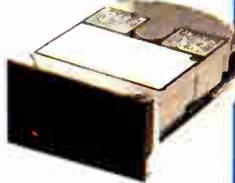
PAL DEVELOPMENT SOFTWARE \$99.95

ENTRY-LEVEL PAL DEVELOPMENT FROM CHPL FULL SUPPORT FOR 16L8, 16R4, 16R8, 16R8, 20L3, 20R4, 20R8 AND 20X8
MOD-MPL-SOFT

MICROPOLIS

HIGH SPEED HARD DRIVES

KITS INCLUDE:
FAST FLOPPY/HARD
CONTROLLER CABLES,
INSTALLATION GUIDE &
NOVELL NETWARE-286
SOFTWARE



SIZE	MODEL	AVG. SPEED	INTER FACE	DRIVE PRICE	KIT PRICE
157.5MB	1355	23MS	ESDI	\$949	\$1049
157.5MB	1375	23MS	SCSI	\$999	\$1099
338.1MB	1558	18MS	ESDI	\$1619	\$1799
338.1MB	1578	18MS	SCSI	\$1619	\$1799
676.8MB	1568	16MS	ESDI	\$2499	-
676.8MB	1588	16MS	SCSI	\$2499	-

\$99⁹⁵

1.44MB 3-1/2" DRIVE

- 80 TRACKS • 135 TPI • ULTRA HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- INCLUDES ALL NECESSARY MOUNTING HARDWARE

FDD-1.44X BLACK FACEPLATE	
FDD-1.44A BEIGE FACEPLATE	
FDD-1.44SOFT SOFTWARE DRIVER	\$19.95
MF355A 3-1/2" MITSUBISHI 1.44MB, BEIGE	\$129.95
MF355X 3-1/2" MITSUBISHI 1.44MB, BLACK	\$129.95
FDD-360 5-1/4" DOUBLE-SIDED DD 360K	\$69.95
FD-55B 5-1/4" TEAC DOUBLE-SIDED DD 360K	\$99.95
FDD-1.2 5-1/4" DOUBLE-SIDED HD 1.2M	\$95.95
FD-55G 5-1/4" TEAC DOUBLE-SIDED HD 1.2M	\$129.95

"...because I'm so happy, I have decided to make you my computer vendor for life!"

—John Erwin, San Jose CA



PROMETHEUS

9600 BAUD V.32 MODEM \$699

- 9600/4800/2400/1200 BPS • FULL DUPLEX • ASYNCHRONOUS/SYNCHRONOUS • MNIP-5 FOR 100% ERROR FREE TRANSMISSIONS • CCIT V.32, V.22/BIS/V.22, BELL/212A COMPATIBLE • DATA COMPRESSION ALLOWS 19.2K BAUD

PRO-96E

EXTERNAL 2400 BAUD \$149⁹⁵

- 2400/1200/300 BPS • REQUIRES SERIAL PORT & CABLE

PRO-24E

PRO-24I 2400 BAUD INTERNAL MODEM 1/2 CARD \$99.95

MODULAR CIRCUIT TECHNOLOGY

4800/2400 BPS

FAX MODEM

\$149⁹⁵

- 4800 BAUD GROUP III FAX TRANSMISSION ONLY • 2400 BPS DATA MODEM • MENU DRIVEN PROFAX SOFTWARE • SENDS DOS TEXT, PCX & TIFF FILES TO FAX TRANS.

MCT-FAXM

MCT-24I INTERNAL 2400 BAUD DATA MODEM \$89.95

MCT-12I INTERNAL 1200 BAUD DATA MODEM \$69.95

VIVA 2400 BAUD \$139⁹⁵

- STATE-OF-ART DESIGN AND PERFORMANCE • 2400/1200/300 BAUD OPERATION • FULLY HAYES AT COMMAND SET COMPATIBLE • EXTENDED S REGISTER PROGRAMMING • 8 INTERNATIONAL ICON STATUS LIGHTS • BUILT-IN SPEAKER
- 2ND PHONE JACK FOR VOICE • AUTO WAIT FOR DIAL TONE & AUTO REDIAL
- STANDARD RS-232C INTERFACE
- "GRANITE LOOK" BASE

new!



TERMS: Minimum order: \$10.00. For shipping and handling include \$3.50 for UPS Ground and \$4.50 for Air. Orders over 1 lb and foreign orders may require additional shipping charges. Contact the sales department for the amount. CA residents must include applicable sales tax. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities & to substitute manufacturer. All merchandise subject to prior sale. A full copy of our terms is available upon request. Items shown may only be representative.

HARD DISKS

21.4MB	\$199	65.5MB	\$389
32.7MB	\$219	80.2MB	\$569
42.8MB	\$339	84.9MB	\$499

DRIVE KITS

21.4MB	\$249
32.7MB	\$279

Seagate



KITS INCLUDE HARD DRIVE, DRIVE CONTROLLER, CABLES AND JDR'S DETAILED INSTRUCTION MANUAL

SIZE	MODEL	AVG. SPEED	FORM FACTOR	DRIVE ONLY	XT KIT	AT F/W KIT
21.4MB	ST-225	65MS	5-1/4"	\$199	\$249	\$309
32.7MB RLL	ST-238	65MS	5-1/4"	\$219	\$279	\$379
42.8MB	ST-251-1	28MS	5-1/4"	\$339	\$389	\$449
43.1MB SCSI	ST-251N	40MS	5-1/4"	\$419	-	-
65.5MB RLL	ST-277-1	28MS	5-1/4"	\$389	\$449	\$549
80.2MB	ST-4096	28MS	5-1/4"	\$569	-	\$679
84.9MB SCSI	ST-296N	28MS	5-1/4"	\$499	-	-
122.7MB RLL	ST-4144R	28MS	5-1/4"	\$699	\$759	\$859
21.4MB	ST-125	40MS	3-1/2"	\$259	\$299	\$373
32.1MB RLL	ST-138R	40MS	3-1/2"	\$289	\$339	\$429

MODULAR CIRCUIT TECHNOLOGY INTERFACE CARDS

DRIVE CONTROLLERS

1.44MB FLOPPY \$49⁹⁵



- XT OR AT COMPATIBLE • SUPPORTS 2 FLOPPY DRIVES (360K, 720K, 1.2MB & 1.44MB) • USER SELECTABLE AS A PRIMARY OR SECONDARY (3RD OR 4TH) FLOPPY DRIVE

MCT-FDC-HD

HIGH DENSITY 4-FLOPPY CARD \$59.95

- INTERFACES UP TO 4 FLOPPY DRIVES • CABLES FOR 4 INTERNAL DRIVES • BIOS SUPPORTS ANY COMBINATION OF DRIVES (360K/720K/1.2MB/1.44MB)

MCT-FDC-H4

FLOPPY DISK \$29.95

- INTERFACES UP TO 4 FLOPPY DRIVES TO IBM PC OR COMPATIBLE • DS/DD AND DS/OD COMPATIBLE

MCT-FDC

HARD DISK \$79.95

- SUPPORTS 16 DRIVE SIZES INCLUDING 10, 20, 30 AND 40MB • CAN DIVIDE 1 LARGE DRIVE INTO 2 LOGICAL DRIVES

MCT-HDC

MCT-RLL RLL CARD SUPPORTS 2 RLL DRIVES \$89.95

286/386 FLOPPY/HARD \$149.95

- FLOPPY/HARD DISK CONTROL IN AN AT DESIGN • FOR UP TO 2 FLOPPIES (360K/720K/1.2MB/1.44MB) & 2 HARD DRIVES

MCT-AFH

286/386 1:1 INTERLEAVE \$169.95

- CONTROLS 2 HARD & 2 FLOPPY DRIVES (360K/720K/1.2MB/1.44MB) • CONCURRENTLY USE HARD & FLOPPY DRIVES

MCT-FAFH

MEMORY CARDS

576K RAM CARD \$49.95

- USER SELECTABLE CONFIGURATION TO 576K • USES 64K AND 256K DRAMS (OK INSTALLED)

MCT-RAM

286/386 EXPANDED MEMORY \$129.95

- USER EXPANDABLE TO 2MB USING 1MB DRAMS • CONFORMS FULLY TO LIM EMS 3.2 • RAM DISK SOFTWARE

MCT-AEMS

MCT-EMS XT COMPATIBLE EMS CARD \$99.95

FAX SWITCHER \$109⁹⁵

CONNECT ONE PHONE LINE TO YOUR PHONE, FAX, MODEM AND ANSWERING MACHINE - THIS DEVICE ROUTES THE CALLS! • OPERATES ON SINGLE OR MULTI-LINE SYSTEMS • AUX PORT FOR MODEM, CORDLESS PHONE, ALARM, POS TERMINAL, ETC.



FAXM-SWITCH

DFI ETHERNET CARD \$199⁹⁵

- 100% HARDWARE COMPATIBLE WITH NOVELL NE-1000 ETHERNET CARD
- FOR THICK OR THIN ETHERNET
- 15 PIN ETHERNET CONNECTOR
- BNC CONNECTOR FOR THIN ETHERNET



DFINET-300 8-BIT VERSION \$199.95
DFINET-400 16-BIT VERSION \$239.95

JIM'S BARGAIN HUNTERS CORNER



Jim Wharton
JDR's VP Sales

\$999

25MHZ CACHE 386 MOTHERBOARD

REGULAR LIST \$1099.00 - 25MHZ 80386 MPU - 64K ZERO WAIT STATE STATIC RAM CACHE - 1/2/4/8MB ON-BOARD RAM USING 80 NS SIMMS (OKB INSTALLED) • CHIPS & TECHNOLOGY 82C206 DMA INTERRUPT CONTROLLER • SOCKETED FCR 80387-25 MATH COPROCESSOR • EIGHT EXPANSION SLOTS (ONE 32-BIT, SIX 16-BIT & ONE 8-BIT) • AMI BIOS ASSURES IBM COMPATIBILITY - 8/25MHZ KEYBOARD SELECTABLE SPEEDS
MCT-386MBC-25 EXPIRES 4/30/90

ORDER TOLL-FREE 800-538-5000

CUSTOMER SERVICE 800-538-5001 TECH SUPPORT 800-538-5002

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)



New, Improved!

8051/8052 BASIC COMPILER!

Now with integer, byte and bit extensions. Fully compatible with MCS BASIC 52. Runs on IBM-PC or compatible.

\$295.00

Call Now! 603-469-3232



Binary Technology, Inc.
Main Street • Box 65 • Meriden, CT 06450

Circle 46 on Reader Service Card

Infra-Red Remote Control

OCTACOMM®/IR

Change TV channels from your PC. Control DOS programs from a hand-held remote. Use a PC to send and receive the infra-red signals used by hand-held remote controllers like those used with TVs, VCRs and other devices. Maintains a database of IR signals learned from your own hand-held remote controller. Hardware attaches to the serial port of the IBM-PC. Software for DOS 2.0 and greater.

Price: \$395.00

Houston Computer Services, Inc.
11331 Richmond Avenue / Suite 101 / Houston, Texas 77082
(713)493-9900
M/C • Visa • Discover • AmEx • COD

OCTACOMM is a registered trademark of Houston Computer Services, Inc.

Circle 140 on Reader Service Card

AVPROM™ \$295



For IBM-PC's & compatibles, menu-driven AVPROM programs EPROMs up to 8x faster than serially-connected units (20 sec. for 2764).

- Programs 2716 thru 27512A.
- 4- and 10 socket gang versions too. Call for prices.

For complete specs, free 32 pg. development tool catalog, call

800-448-8500.
or 207-236-9055

AVOCET SYSTEMS, INC.

120 Union St., Rockport, ME 04856

Circle 34 on Reader Service Card

VIDEO FRAME GRABBERS




MODEL	RESOLUTION	
HRT 256-4	256 x 256 x 4	495
HRT 256-8	256 x 256 x 8	795
HRT 512-8	512 x 512 x 8	995
HRT 512-24	512 x 512 x 24	1995

- IBM PC/XT/AT COMPATIBLE
- DIGITALIZE IN REAL TIME
- COMPOSITE VIDEO IN
- 24 BIT RGB OUT except model HRT 256-4
- 16 level gray scale out
- SOFTWARE LIBRARY OF IMAGE ANALYSIS ROUTINES
- FREE SOFTWARE UPGRADES TO REGISTERED OWNERS
- FULL CREDIT ON UPGRADE PURCHASE IN FIRST YEAR
- RETURN OLD BOARD AND JUST PAY DIFFERENCE



HIGH RES TECHNOLOGIES
P.O. BOX 76
LEWISTON, N.Y. 14092
PHONE 416-497-6493 FAX 416-497-1988

Circle 137 on Reader Service Card

Save Can You Buy Direct?

Have You Got Our Prices? Will You Pay Too Much?
Copyright 1989 AATLS

Save At Least \$440.00

SEND NO MONEY NOW

Get UPS - Freight Free - 48 States

Prices include 3% pre-payment discount

- Intel® 80286 Microprocessor Gives You Extraordinary Speed and Processing Power
- 640K RAM and 3 1/2" Disk Drive Are Standard
- New SmartDrive™ Technology Provides Low-Cost Hard Disk Expansion (Get FREE Installation)

Visit www.aatls.com Add \$20.00 Sales Tax
ASK ABOUT OUR 30 DAYS BUY-BACK POLICY

For fastest service, Call Toll-Free
800-433-SAVE

FORT WORTH COMPUTERS
377 Plaza Granbury, TX 76040
Customer Service Desk (817) 573-4111

Circle 82 on Reader Service Card

REWITABLE/ERASABLE OPTICAL DISK DRIVE SYSTEM



WRITE/ERASE/STORE and DIRECTLY ACCESS vast amounts of information on a REMOVABLE disk!

- "REWITABLE/ERASABLE" allows user to read & write over and over up to a million times. Direct or random access at speeds comparable to a hard disk
- CAPACITY: 650 megabytes (1024 bytes/sector) or 594 megabytes (512 bytes/sector) of recordable data
- High track density-15,000 tpi
- DATA LIFE: 10 to 25 years with no degradation
- Immune to EMI or RFI emissions

Applications: IBM PC or Compatibles / Novell (LAN) / Wang VS
Coming Soon: HP / NCR / DEC / Apple MAC 2/ Jukebox

Only \$5500
Includes software, disk drive and all cables. *Optical disks - \$290/ea. Extended warranties available

ADC APPLIED DATA COMMUNICATIONS
14272 Chambers Road, Tustin, CA 92680
Outside CA: 1-800-221-5486 TEL: (714) 731-9000
Inside CA: 1-800-334-5486 FAX: (714) 838-7172

Circle 29 on Reader Service Card

Magnetic Tape/Diskette Conversion

Transfer data between 1600/3200/6250 9 track magnetic tapes and 5.25" or 3.5" diskettes. We specialize in Telephone Billing Tapes and other mainframe/mini to PC Data File Transfers. Low Costs.

Advanced Management Technologies, Inc.

691 South Irolo Street, Suite 1702
Los Angeles, CA 90005
213/389-7445

Circle 27 on Reader Service Card



QUARTERHORSE

High Capacity Tape Subsystems

for Disk Backup, Data Acquisition, and Archiving
on IBM PC/XT/AT & PS/2

Everything you need in a single high quality package: Drive, SCSI Host Adapter, Enclosure, and DSI's Backup Software.

- 150 Mb 1/4" CT.....\$1,395.
- 320 Mb 1/4" CT.....\$1,495.
- 1.2 Gb 4mm DAT.....\$3,195.
- 2.3 Gb 8mm HS.....\$3,695.

Optional Application Interface Library (in "C") available. Full Support.

DATA STRATEGIES INTERNATIONAL, INC.
9020 Capital of Tx. Hwy. Suite 570
Austin, Tx. 78759
(512) 338-4745 FAX (512) 345-1328

Circle 82 on Reader Service Card

JLaser 5 . . . \$399

Laser Printer Controller



Thinking of buying a

- LaserMaster
- Intel Visual Edge™
- Kofax board

JLaser 5 gives you the functions of all three boards combined into one, plus EMS:

- Fast laser printing
- Half-tones on a laser printer
- Group 4 file printing and display

TALL TREE SYSTEMS
2585 E. Bayshore Rd. ■ Palo Alto, CA 94303
(415) 493-1980 ■ FAX (415) 493-7639

Versions available for HP Series II and Canon LBP-4 laser printers. All products are trademarks of their respective companies. Artwork for this ad created with JLaser 5 and included software.

Circle 277 on Reader Service Card

EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

INQUIRY #	COMPANY	PAGE	INQUIRY #	COMPANY	PAGE	INQUIRY #	COMPANY	PAGE
1121	ACMA	36	887	HEWLETT-PACKARD	85, 102, 171,	1000	PALINDROME	53
986	ADOBE SYSTEMS	102	985		199, 205, 237, 248	853	PANASONIC	193
1083	ADVANCED PROGRAMMING INSTITUTE	248	1065			1069	PARCPLACE SYSTEMS	248
1051	AMERICAN NATIONAL STANDARDS	248	890	IBM	85, 124, 145, 193, 199, 237,	1133	PERSTOR SYSTEMS	36
888	APPLE COMPUTER	53, 81, 102,	1063		248, 275, 287, 353	983	PHAR LAP SOFTWARE	287
995		111, 179, 199, 205, 248, 353		INFONETICS	275	1088	PIONEER COMPUTER	130
1052			1078	INTEL	85, 130	1132	PLUS DEVELOPMENT	36
1090			1122	INTELLIGENCE TECHNOLOGY	36	856	PRECISION	193
994	ARC SOFTWARE	53	1138	INTERNATIONAL MACHINE CONTROL SYSTEMS	36	1002	PREMIER INNOVATIONS	53
	ASHTON-TATE	163		INTERNATIONAL STANDARDS ORGANIZATION	275	1055	QUARTERDECK OFFICE SYSTEMS	248
	AT&T	179, 205	1061	ITHACA SOFTWARE	248	1127	RADIUS	36
1074	ATRONICS	130	1082	IXI	248	984	RATIONAL SYSTEMS	287
1006	BORLAND INTERNATIONAL	53, 102, 145, 261, 297	1104	JAEGER + WALDMANN GMBH	77		ROYAL	119
1071	BRIGHTWORK DEVELOPMENT	97	1079	JAMECO ELECTRONICS	130	881	SAMNA	157
1075	C ² MICRO SYSTEMS	130	1080	JC INFORMATION SYSTEMS	130		SAMSUNG	97
1076	CACHE COMPUTERS	130	1081	JDR MICRODEVICES	130	1089	SEATTLE TELECOMM AND DATA	130
1105	CHADWICK-HEALEY	77	1131	KEY TRONIC	36	1003	SEIKOSHA AMERICA	53
	CHIPS & TECHNOLOGIES	145	886	LOTUS DEVELOPMENT	102	1060	SERVIO LOGIC DEVELOPMENT	248
998	CLARY	53	991	MAXIMUM STORAGE	53	851	SHARP ELECTRONICS	152
	COMPAQ COMPUTER	287	1054	META SOFTWARE	248	1068	SMETHERSBARNES	248
1140	COVOX	36	1082	MICRONICS COMPUTERS	130	1130	SOFTWARE HORIZONS	36
1072	CUBIX	97	988	MICRORIM	102	1101	SONY	77
1056	DATA GENERAL	237, 248	883	MICROSOFT	53, 119, 145, 157,	1005	STRATEGIC SIMULATIONS	53
1137	DAVINCI GRAPHICS	36	996		193, 205, 225, 248	889	SUN MICROSYSTEMS	205, 252
1102	DAY-TIMERS	77	1064	MIT	252		SYMANTEC	179
	DELL COMPUTER	145		MIT SOFTWARE DISTRIBUTION CENTER	248		TEXAS INSTRUMENTS	85
1053	DIGITAL EQUIPMENT	199, 205, 237, 248	1184			981	TGS SYSTEMS	81
1059	DIGITAL RESEARCH	248	1083	MONOLITHIC SYSTEMS	130	992	THE SOFTWARE TOOLWORKS	53
855	DIGITALK	193, 225, 248	1084	MOTOROLA	237		3COM	225
1070			1084	MYLEX	130	1106	TIME-SPACE RESEARCH	77
1077	DTK COMPUTER	130	1085	NASCENT TECHNOLOGY	130		TOPS	225
982	ECLIPSE COMPUTER SOLUTIONS	287		NATIONAL COMPUTER	145	987	TOSHIBA	102
1057	88OPEN CONSORTIUM	248	882	NBI	157	997	TOYOGO	53
1120	EMERSON COMPUTER	36	852	NEC TECHNOLOGIES	145	1081	TRILLIAN COMPUTER	85
1129	EPSON	36, 193	1135	NEW MEDIA GRAPHICS	36		TRON	248
1073	FARALLON COMPUTING	97	1062	NEXT	199, 248	1103	UNIVERSAL MEDIA DIVISION	77
1128	FINLUX	36		NOVELL	171, 225, 237	1066	UNIX INTERNATIONAL	248
886	FOX SOFTWARE	163, 248	1086	OEM	130	993	USROBOTICS	53
1058			1067	OPEN SOFTWARE FOUNDATION	248		XEROX	199, 205, 225, 252
1004	GADGETS BY SMALL	53		OPEN SYSTEMS INTERCONNECTION	275		ZSOFT	85
1001	GOLDSTAR TECHNOLOGY	53	1087	ORCHID TECHNOLOGY	130			

The
BYTE On-Going Utility in Space
(BOGUS) tests: APRIL FOOL

READER SERVICE

Advertising Supplement included with this issue:
Jade Computer (U.S. and Canada Subscribers)
Circle 316 on Reader Service Card
*Correspond directly with company.

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
* SOFTLINE CORP	E&W-43	509 GALACTICOMM	MW-4	539 MICRO DATABASE SYSTEMS	NE-11	496 ORANGE MICRO	PC-17
322 SOFTWARE DMI	E&W-66	* MICROCOMPUTING MKTG.CNCL	MW-14	540 MICRO DATABASE SYSTEMS	NE-11	497 ORANGE MICRO	PC-17
321 SOLUTION SYSTEMS	E&W-61	510 MICRO IMAGE INTERNATIONAL	MW-2	541 MICRO IMAGE INTERNATIONAL	NE-10	498 PAO-KU INTERNATIONAL LTD	PC-7
334 SPECTRA PUBLISHING	E&W-81	511 MICRO IMAGE INTERNATIONAL	MW-2	542 MICRO IMAGE INTERNATIONAL	NE-10	499 PAO-KU INTERNATIONAL LTD	PC-7
323 SYSTEMSTAR LTD	E&W-53	512 OMEGA SYSTEMS	MW-13	543 PAO-KU INTERNATIONAL LTD	NE-5	500 RESOURCE CONCEPTS,INC	PC-19
* TOPS	E&W-31	513 OMEGA SYSTEMS	MW-13	544 PAO-KU INTERNATIONAL LTD	NE-5	501 RESOURCE CONCEPTS,INC	PC-19
324 TP ENTERPRISE LTD	E&W-60	514 PAO-KU INTERNATIONAL LTD	MW-3	545 PC LINK CORPORATION	NE-17	502 SIA	PC-20
406 TREND MICRO DEVICES,INC	E&W-47	515 PAO-KU INTERNATIONAL LTD	MW-3	546 REASON TECHNOLOGY	NE-16	503 SIA	PC-20
407 TREND MICRO DEVICES,INC	E&W-47	516 PERSONAL COMPUTER ENTERPRISE	MW-7	547 RESOURCE CONCEPTS,INC	NE-13	504 TOP LINK COMPUTER	PC-14
325 TRIANGLE DIGITAL SERVICES	E&W-70	517 PERSONAL COMPUTER ENTERPRISE	MW-7	548 RESOURCE CONCEPTS,INC	NE-13	505 UNITED INNOVATIONS	PC-3
326 TRIGEM COMPUTER	E&W-2	518 REASON TECHNOLOGY	MW-11	549 SAGE/POLYTRON	NE-6,7	506 ZERICON,INC	PC-13
332 TWINHEAD INT'L CORP	E&W-83	519 RESOURCE CONCEPTS,INC	MW-5	550 SIA	NE-14		
327 USA SOFTWARE	E&W-33	520 RESOURCE CONCEPTS,INC	MW-5	551 SIA	NE-14		
328 VASCO SONG CHEER	E&W-50	521 SHEBRO COMPUTERS,INC	MW-9	552 TRIPP LITE	NE-10		
329 VIKING SOFTWARE SERV	E&W-32	522 SHEBRO COMPUTERS,INC	MW-9	553 TRIPP LITE	NE-10		
330 WISEMANN & THEIS GMBH	E&W-62	523 SIA	MW-16				
		524 SIA	MW-16				
E&W DIRECT RESPONSE POSTCARDS		Northeast 52 NE1-24		Pacific Coast 52 PC1-20		South 52 SO1-16	
* BYTEWEEK/NEWSLETTER	E&W	* BIX	NE-22	476 COMPUTER AIDED TECH	PC-18	554 BOFFIN LTD	SO-7
* COMPUTER BUYERS GUIDE/VULCAN	E&W	525 BOFFIN LTD	NE-23	477 COMPUTER AIDED TECH	PC-18	555 BOFFIN LTD	SO-7
* GATEWAY 2000	E&W	526 BOFFIN LTD	NE-23	478 COMPUTERS FOR THE BLIND	PC-11	556 BROAD MARKETING ASSOC	SO-8
* METRABYTE	E&W	527 CDC,INC	NE-21	479 CONWEX RESOURCES	PC-9	557 BROAD MARKETING ASSOC	SO-8
* PROGRAMMERS JOURNAL	E&W	528 CDC,INC	NE-21	480 DP-TEK	PC-14	558 CRAZY NANCY'S	SO-5
* REASONABLE SOLUTIONS	E&W	529 COMDEK	NE-22	481 DST	PC-6	559 CRAZY NANCY'S	SO-5
		530 EDWIN SYSTEMS CORP	NE-19	482 EKM	PC-18	590 GALACTICOMM	SO-4
		531 EDWIN SYSTEMS CORP	NE-19	483 EKM	PC-18	* MICROCOMPUTING MKTG.CNCL	SO-12
		532 GALACTICOMM	NE-2	484 HANZON DATA,INC	PC-5	561 OMEGA SYSTEMS	SO-14
		533 HARMONY COMPUTERS	NE-3	485 HANZON DATA,INC	PC-5	562 OMEGA SYSTEMS	SO-14
		534 HARMONY COMPUTERS	NE-3	486 HANZON DATA,INC	PC-6	563 PAO-KU INTERNATIONAL LTD	SO-9
		535 LAPTOPS,ETC	NE-4	487 HANZON DATA,INC	PC-6	564 PAO-KU INTERNATIONAL LTD	SO-9
		536 MANCHESTER EQUIPMENT	NE-24	488 HANZON DATA,INC	PC-6	565 RESOURCE CONCEPTS,INC	SO-15
		537 MANCHESTER EQUIPMENT	NE-24-B	490 HANZON DATA,INC	PC-6	566 RESOURCE CONCEPTS,INC	SO-15
		538 MASCOT COMPUTER CORP	NE-9	491 METAWARE	PC-15	567 SHEBRO COMPUTERS,INC	SO-3
		* MICROCOMPUTING MKTG.CNCL	NE-20	* MICROCOMPUTING MKTG.CNCL	PC-10	568 SHEBRO COMPUTERS,INC	SO-3
				492 MICRO IMAGE INTERNATIONAL	PC-2	569 SIA	SO-16
				493 MICRO IMAGE INTERNATIONAL	PC-2	570 SIA	SO-16
						571 SOFTMORE	SO-11
						572 TRIPP LITE	SO-2
						573 TRIPP LITE	SO-2
						574 ZERICON,INC	SO-13

BYTE ADVERTISING SALES STAFF:

Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281
Arthur Kossack, Eastern Regional Sales Manager, 645 North Michigan Ave., Chicago, IL 60611, tel. (312) 751-3700
Jennifer L. Bartel, Western Regional Sales Manager, 8111 LBJ Freeway, Suite 1350, Dallas, Tx 75251, tel. (214) 644-1111
Liz Coyman, Inside Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO
CANADA & EASTERN CANADA
Dan Savage (617) 262-1160
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116
FAX: (617) 262-6430

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Kim Norris (212) 512-2645
McGraw-Hill Publications
1221 Avenue of the Americas—
28th Floor
New York, NY 10020
FAX: (212) 512-3520

EAST
PA, NJ (SOUTH),
MD, W. VA, DE, D.C.
Thomas J. Brun (215) 496-3833
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102
FAX: (215) 496-3828

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA,
MS, AR, LA
John Y. Schilin (404) 252-0626
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 520
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN,
KY, OH, WI, NB, IN, MI
Kurt Kelley (312) 751-3740
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611
FAX: (312) 751-3767

**SOUTHWEST,
ROCKY MOUNTAIN**
CO, OK, TX,
Alison Keenan (214) 644-1111
McGraw-Hill Publications
8111 LBJ Freeway, Suite 1350
Dallas, TX 75251
FAX: (214) 480 8517

NORTH PACIFIC: San Francisco, CA
NORTHERN CA, OR, ID, MT,
WY, NORTHERN NV
Roy J. Kops (415) 954-9728
Leslie Hupp (415) 362-4600
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111
FAX: (415) 954-9786

NORTH PACIFIC: Campbell, CA
SILICON VALLEY, HI, WA, AK,
W. CANADA
Bill McAfee (408) 879-0371
McGraw-Hill Publications
1999 South Bascom Ave.
Suite #210
Campbell, CA 95008
FAX: (408) 879-9067

SOUTH PACIFIC: Los Angeles, CA
LOS ANGELES COUNTY, AZ,
NM, NORTHERN NEVADA
Andrew B. Uphoff (213) 480-5243
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

SOUTH PACIFIC: Costa Mesa, CA
ORANGE COUNTY,
SAN DIEGO COUNTY, UT
Ron Cordek (714) 557-6292
McGraw-Hill Publications
3001 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626
FAX: (714) 557-2219

BYTE BITS (2x3)
Mark Stone (603) 924-6830
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart (1x2)
Brian Higgins (603) 924-3754
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Regional Advertising
James Bail (603) 924-2533
Barry Echavarría (603) 924-2574
Larry Levine (603) 924-2637
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

National Sales
Mary Ann Goulding
(603) 924-2664
Patricia Payne (603) 924-2654
Jonathan Sawyer (603) 924-2665
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Outsert Sales Program
Scott Gagnon (603) 924-2651
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck Mailings
Ed Ware (603) 924-6166
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Computing for Engineers Deck
Ellen Perham (603) 924-2598
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Peterborough, NH Office
Inside Sales FAX: 603-924-2683
Advertising FAX: 603-924-7507

International Advertising Sales Staff:

UNITED KINGDOM
Ros Weyman
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 4BR
England 01 493 1451
FAX: 01 493 9896

FRANCE, ITALY
Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
4 Ashmount Road, Hornsey Lane
Highgate, London N19 3BH
England 44 1 281 4116
FAX: 44 1 281 8224

GERMANY, BENELUX
Frank Tanis
Batenburg 103
3437 AB Nieuwegein
The Netherlands
31 34 02 49496
FAX: 31 34 02 37944

ISRAEL
Dan Ehrlich
Ehrlich Communication International
P.O. Box 11297
Tel Aviv 61112
Israel
(972) 3-449823
FAX: (972) 3-5468168

SPAIN
Mrs. Maria Sarmiento
Pedro Teixeira 8, Off. 320
Iberia Mart I
Madrid 4, Spain
1 45 52 891

JAPAN
Masaki Mori
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
3 581 9811
FAX: 81-3-581-4018

HONG KONG
Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 5-260149
Telex: 60904 SEVEX HX
FAX: 852 810 1283

SINGAPORE
Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 734-9790
Telex: RS5539 SEAVEX
FAX: 65 732 5129

TAIWAN
Nancy Yin
Thirdwave Publishing Corp.
977 Min Shen E. Road, 1-4 Flr.
Taipei 10581 Taiwan ROC
Tel: 886 2 763 0052

BRAZIL
Mr. Ernest McCrary
Empresa Internacional de
Comunicacoes Ltda.
Rua da Consolacao, 222
Conjuntio 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Index to Advertisers by Product Category

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
HARDWARE							
800	ADD INS	140	HOUSTON COMPUTER SERVICES 342	135	HEWLETT-PACKARD PERIPH 116,117	513	OMEGA SYSTEMS MW-13
15	ALPHA PRODUCTS 330	153	KEA SYSTEMS LTD 338	141	HOUSTON INSTRUMENTS 165	561	OMEGA SYSTEMS SO-14
20	AMERICAN ADVANTECH 322	188	MICROSPEED, INC 61	310	IOLINE 100	562	OMEGA SYSTEMS SO-14
57	CAPITAL EQUIPMENT 294	189	MICROSPEED, INC 61	311	IOLINE 100	498	PAO-KU INTERNATIONAL LTD PC-7
58	CAPITAL EQUIPMENT 295	464	OYSTER TERMINALS E&W-49	208	OUTPUT TECHNOLOGY CORP 49	499	PAO-KU INTERNATIONAL LTD PC-7
59	CENTRUM RESEARCH 338		PERCON 317	274	SURAH, INC 328	514	PAO-KU INTERNATIONAL LTD PC-7
74	CONTROL VISION 330	806	MASS STORAGE	505	UNITED INNOVATIONS PC-3	543	PAO-KU INTERNATIONAL LTD NE-5
96	DISTRIBUTED PROCESSING TECH 195	14	AK SYSTEMS 322	330	WIESEMANN & THEIS GMBH E&W-62	544	PAO-KU INTERNATIONAL LTD NE-5
97	DISTRIBUTED PROCESSING TECH 195	42	BASF 167	506	ZERICON, INC PC-13	583	PAO-KU INTERNATIONAL LTD SO-9
530	EDWIN SYSTEMS CORP NE-19	73	CONTECH COMP CORP 336	574	ZERICON, INC SO-13	584	PAO-KU INTERNATIONAL LTD SO-9
531	EDWIN SYSTEMS CORP NE-19	82	DATA STRATEGIES INT'L, INC 342			215	PC BRAND 185
107	ENERTRONICS RESEARCH, INC 267	116	FLAGSTAFF ENGINEERING 154	840	PRINTER RIBBONS		PC BRAND 186-191
120	FORTE 276	209	OVERLAND DATA 317	201	NATIONAL COMPUTER RIBBONS 258	545	PC LINK CORPORATION NE-17
133	HERCULES 161	222	PINNACLE MICRO 69	812	SCANNERS/IMAGE PROCESSORS	517	PERSONAL COMPUTER ENTERPRISE MW-7
137	HIGH RES TECHNOLOGIES 342	237	QUALSTAR CORPORATION 324	333	ACCEL CO, LTD E&W-46	242	RADIO SHACK CIV
138	HITECH EQUIPMENT CORP 327		SEAGATE 83	476	COMPUTER AIDED TECH PC-18	546	REASON TECHNOLOGY NE-16
146	IO TECH 333	270	STORAGE DIMENSIONS 55	477	COMPUTER AIDED TECH PC-18	520	RESOURCE CONCEPTS, INC MW-5
447	JC INFORMATION SYSTEMS E&W-27	271	STORAGE DIMENSIONS 55		DATA TRANSLATION 128A-B	254	SANG COMPUTER SYSTEMS GMBH 155
159	KOLOD RESEARCH 338	289	TULIN CORPORATION 302	83	DATA TRANSLATION 129	313	SCHWAB COMPUTER 336
160	KOLOD RESEARCH 338	290	TULIN CORPORATION 302	813	SOFTWARE SECURITY	473	SHEBRO COMPUTERS, INC E&W-41
458	MICROMINT, INC E&W-24	807	MISCELLANEOUS	403	ALADDIN KNOWLEDGE SYS E&W-20	474	SHEBRO COMPUTERS, INC E&W-41
	MICROWAY 143	20	AMERICAN ADVANTECH 322	420	CONTROL TELEMETRY E&W-64	521	SHEBRO COMPUTERS, INC MW-9
	MICROWAY 227	76	AMERICAN ADVANTECH 322	432	FAST ELECTRONIC GMBH E&W-59	522	SHEBRO COMPUTERS, INC MW-9
	MICROWAY 289	312	DATAPRO 245	128	GLENCO ENGINEERING 72	567	SHEBRO COMPUTERS, INC SO-3
205	NOHAU CORP 322	428	DIETRICH GMBH E&W-86	230	PROTECH MARKETING, INC 107	568	SHEBRO COMPUTERS, INC SO-3
331	OSBORNE/MCGRAW-HILL E&W-80	481	DST PC-6	231	PROTECH MARKETING, INC 107	523	SIA MW-16
217	PERCEPTIVE SOLUTIONS, INC 198	108	ENGINEERS COLLABORATIVE, INC 324	245	RAINBOW TECHNOLOGIES 162	524	SIA MW-16
218	PERCEPTIVE SOLUTIONS, INC 198	489	HANZON DATA, INC PC-6	246	RAINBOW TECHNOLOGIES 162	550	SIA NE-14
219	PERISCOPE 274	490	HANZON DATA, INC PC-6	247	ROSE ELECTRONICS 101	551	SIA NE-14
220	PERISCOPE 274	143	INTEGRAND 176	265	SOFTWARE SECURITY, INC 175	502	SIA PC-20
224	PROCOPM USA 328	448	KNAPCO E&W-58	814	SYSTEMS	503	SIA PC-20
233	QUA TECH, INC 326	449	KNAPCO E&W-58	11	ACMA COMPUTERS, INC 170	589	SIA SO-16
234	QUA TECH, INC 326	173	L-TECH 327	402	AGC TECH CORP E&W-55	570	SIA SO-16
235	QUA TECH, INC 326	174	L-TECH 327	16	ALR 2,3	504	TOP LINK COMPUTER PC-14
236	QUA TECH, INC 326	182	MERRITT COMP. PROD 281	17	ALR 2,3	282	TOSHIBA 30,31
314	QUA TECH, INC 326	216	PC POWER & COOLING, INC 84	18	ALTEC TECHNOLOGY CORP 291	283	TOSHIBA 30,31
315	QUA TECH, INC 326	261	SILICON SHACK LTD III	23	AMERICAN RESEARCH CORP 219	324	TP ENTERPRISE LTD E&W-60
325	TRIANGLE DIGITAL SERVICES E&W-70	328	VASCO SONG CHEER E&W-50	24	AMERICAN RESEARCH CORP 219	326	TRIGEM COMPUTER E&W-2
288	TRUEVISION 209	808	MODEMS/MULTIPLEXORS	405	ASI EUROPE E&W-63	332	TWINHEAD INT'L CORP E&W-83
296	VIDEO SEVEN 108,109	43	BAY TECH 183	408	AURORA TECH CORP E&W-69	301	ZENITH DATA SYSTEMS 33
303	Z-WORLD ENGINEERING 336	44	BAY TECH 183	409	BEHAVIOR TECH. COMP CORP E&W-52	303	Z-WORLD ENGINEERING 336
801	DRIVES	66	COMPUTER PERIPHERALS, INC 221	47	BLACKSHIP COMPUTER SYS 128	815	TERMINALS
29	APPLIED DATA COMMUNICATIONS 342	67	COMPUTER PERIPHERALS, INC 221	525	BOFFIN LTD NE-23	69	COMPUTERWISE 316
184	MICRO SOLUTIONS COMP. PROD 100	456	MEGADATA COMP. CORP E&W-76	526	BOFFIN LTD NE-23	816	UPS
802	FACSIMILE	457	MEGADATA COMP. CORP E&W-76	554	BOFFIN LTD SO-7	45	BEST POWER TECHNOLOGY 335
63	COMPUCOM CORPORATION 317	284	TOUCHBASE SYSTEMS 54	555	BOFFIN LTD SO-7	105	EMERSON ELECTRIC 153
443	INTERQUAD E&W-5	809	MONITORS	60	CHEETAH 169	106	EMERSON ELECTRIC 153
155	KNAPCO 324	529	COMDEK NE-22	78	CSS LABORATORIES, INC 139	155	KNAPCO 324
156	KNAPCO 324	444	INTERQUAD E&W-7	79	CSS LABORATORIES, INC 139	156	KNAPCO 324
803	HARDWARE PROGRAMMERS	190	MICROVITEC 87	81	DATA GENERAL 250,251	448	KNAPCO E&W-58
34	AVOCET & QUELO 342	191	MICROVITEC 87	86	DELL COMPUTER CORP CII,1	449	KNAPCO E&W-58
51	BP MICROSYSTEMS 330	198	NANAO 156	87	DELL COMPUTER CORP 40A-B	213	PARA SYSTEMS, INC 89
55	BYTEK COMPUTER CORP 324	199	NANAO 156	101	DTK 144	552	TRIPP LITE NE-10
84	DATALIGHT 328	204	NEC TECHNOLOGIES, INC 12,13	102	DTK 144	553	TRIPP LITE NE-10
130	GTEK, INC 74	469	PHILIPS INTERNATIONAL E&W-45	117	FLYTECH TECHNOLOGY CO, LTD 299	572	TRIPP LITE SO-2
131	GTEK, INC 74	250	SAMSUNG 26,27	431	FORT WORTH COMPUTERS 342	573	TRIPP LITE SO-2
166	LINK COMPUTER GRAPHICS 327	251	SAMSUNG 26,27	434	FORTRON/SOURCE E&W-9	817	APPLE/MAC APPLICATIONS
167	LOGICAL DEVICES 335	810	NETWORK HARDWARE		GATEWAY 2000 22,23		Scientific/Technical
168	LOGICAL DEVICES 335	53	BUFFALO PRODUCTS 75	437	GOLDSTAR CO, LTD E&W-14,15	223	PRESCIENCE 249
169	LOGICAL DEVICES 335	71	COMTROL CORP 204	132	HAUPPAUGE COMPUTER PROD 137	239	QUINTUS COMPUTER 224
170	LOGICAL DEVICES 335	72	CONNEXPERTS 99	139	HOME SMART COMPUTING 338	240	QUINTUS COMPUTER 224
185	MICROCHIP TECHNOLOGY 328	424	CUBIX CORPORATION E&W-29	440	HWA HSIN ELECTRONIC E&W-42	818	APPLE/MAC - CAD
298	WINTEK CORPORATION 336	425	CUBIX CORPORATION E&W-29		IBM 52A-H	30	ASHLAR 259
299	XELTEK 322	80	CURTIS, INC 338		KILA SYSTEMS 333	819	APPLE/MAC - LAN
804	INSTRUMENTATION	89	DIGIBOARD 76	155	KNAPCO 324		TOPS E&W-31
75	CORTEX 338	90	DIGITAL PRODUCTS, INC 336	156	KNAPCO 324	820	IBM/MSDOS APPLICATIONS
85	DATAQ INSTRUMENTS, INC 324	429	D-LINK LTD E&W-84	448	KNAPCO E&W-58		Business Office
104	ELEXOR, INC 324	109	ESS 335	449	KNAPCO E&W-58	52	BRANDYWARE 327
145	IO TECH 149	442	INES GMBH E&W-54	538	MASCOT COMPUTER CORP NE-9	427	DEEPAK SAREEN ASSOC E&W-37
185	LAWSON LABS 327	252	SAMSUNG 121	181	MEGATEL 280		
304	SOLUS SYSTEMS, INC 282	253	SAMSUNG 121	186	MICRONICS 150		
277	TALL TREE SYSTEMS 342	300	XIRCOM 181	196	MULTIMICRO 80		
805	KEYBOARDS/MICE	811	PRINTERS/PLOTTERS	197	MULTIMICRO 80		
415	CHERRY MIKROSCHALTER GMBH E&W-56,57	487	HANZON DATA, INC PC-5	206	NORTHGATE 231		
		488	HANZON DATA, INC PC-5		NORTHGATE 232-235		
		134	HEWLETT-PACKARD PERIPH 115	482	OLIVETTI SYSTEMS & NETWORKS E&W-11		
				483	OLIVETTI SYSTEMS & NETWORKS E&W-13		
				512	OMEGA SYSTEMS MW-13		

REQUEST FREE INFORMATION BY FAX

Attention BYTE Readers!! Now you can fax your requests for free product and advertiser information featured in this issue.

Just fax this page to 1-413-637-4343. You'll save time because your request for information will be processed as soon as your fax is received.

- 1** Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.
- 2** Check off the answers to questions "A" through "C".
- 3** Print your name, address, and fax number clearly on the form.
- 4** Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name _____

Title _____

Company _____

Address _____

City _____

State/Province _____ Zip _____

Country _____

Phone Number _____ Fax Number _____

A. What is your level of management responsibility?

Senior-level Management

Other Management

Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

Administration

Accounting/Finance

MIS/DP/Information Center

Product Design and Development

Research and Development

Manufacturing

Sales/Marketing

Purchasing

Personnel

Education/Training

Other: _____

C. Please indicate your organization's primary business activity: (Check one.)

Computer-Related Businesses:

Manufacturer (Hardware, Software)

Computer Retail Stores

Consultants

Service Bureau/Planning

Distributor/Wholesaler

Systems House/Integrator/VAR

Other: _____

Non-Computer-Related Businesses:

Manufacturing

Finance, Insurance, Real Estate

Retail/Wholesale

Education

Government

Military

Professions (Law, Medicine, Engineering, Architecture)

Consulting

Other Business Services

Transportation, Communications, Utilities

Other: _____

I subscribe to BYTE. I do not subscribe to BYTE.

Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580
581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740
741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860
861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920
921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940
941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980
981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060
1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120
1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160
1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180
1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200
1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220
1221	1222	1223	1224	1225	1226	1227	1228	1229	1230										



APRIL 1990

FREE INFORMATION

Want More Information About the Products and Advertisers Featured in this Issue?

1

Circle numbers on reply card which correspond to numbers assigned to items of interest to you.

2

Check all the appropriate answers to questions "A" through "C".

3

Print your name and address and mail.

Fill out this coupon carefully. PLEASE PRINT.

Name _____

Title _____ Phone _____

Company _____

Address _____

City _____ State _____ Zip _____

A. What is your level of management responsibility?

- 1 Senior-level Management
- 2 Other Management
- 3 Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

- 4 Administration
- 5 Accounting/Finance
- 6 MIS/DP/Information Center
- 7 Product Design and Development
- 8 Research and Development
- 9 Manufacturing
- 10 Sales/Marketing
- 11 Purchasing
- 12 Personnel
- 13 Education/Training
- 14 Other: _____

- 16 Computer Retail Stores
- 17 Consultants
- 18 Service Bureau/Planning
- 19 Distributor/Wholesaler
- 20 Systems House/Integrator/VAR
- 21 Other: _____

Non-Computer-Related Businesses:

- 22 Manufacturing
- 23 Finance, Insurance, Real Estate
- 24 Retail/Wholesale
- 25 Education
- 26 Government
- 27 Military
- 28 Professions (Law, Medicine, Engineering, Architecture)
- 29 Consulting
- 30 Other Business Services
- 31 Transportation, Communications, Utilities
- 32 Other: _____

C. Please indicate your organization's primary business activity: (Check one.)

- Computer-Related Businesses:
- 15 Manufacturer (Hardware, Software)

APRIL
IRSD002

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570
571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630
631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690
691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750
751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870
871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930
931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990
991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050
1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110
1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170
1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200
1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230

Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

READER SERVICE
PO Box 5110
Pittsfield, MA 01203-9926
USA



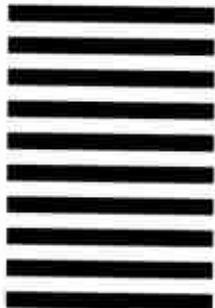
FREE INFORMATION

Want More Information About the Products and Advertisers Featured in this Issue?

- 1** Circle numbers on reply card which correspond to numbers assigned to items of interest to you.
- 2** Check all the appropriate answers to questions "A" through "C".
- 3** Print your name and address and mail.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE

READER SERVICE
PO Box 5110
Pittsfield, MA 01203-9926
USA



Fill out this coupon carefully. PLEASE PRINT.

Name _____
 Title _____ (Phone) _____
 Company _____
 Address _____
 City _____ State _____ Zip _____

- A. What is your level of management responsibility?**
 Senior-level Management
 Other Management
 Non-Management
- B. What is your primary job function/principal area of responsibility? (Check one.)**
 Administration
 Accounting/Finance
 MIS/DP/Information Center
 Product Design and Development
 Research and Development
 Manufacturing
 Sales/Marketing
 Purchasing
 Personnel
 Education/Training
 Other: _____
- C. Please indicate your organization's primary business activity: (Check one.)**
 Manufacturer (Hardware, Software)

- Computer Retail Stores
 Consultants
 Service Bureau/Planning
 Distributor/Wholesaler
 Systems House/Integrator/VAR
 Other: _____
- Non-Computer-Related Businesses:**
 Manufacturing
 Finance, Insurance, Real Estate
 Retail/Wholesale
 Education
 Government
 Military
 Professions (Law, Medicine, Engineering, Architecture)
 Consulting
 Other Business Services
 Transportation, Communications, Utilities
 Other: _____

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570
571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630
631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690
691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750
751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870
871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930
931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990
991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050
1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110
1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170
1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200
1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230

Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.

CHAOS MANOR MAIL

*Jerry Pournelle answers questions about his column
and related computer topics*

WordStar Supporter

Dear Jerry,

Your comments on WordStar 5.5 have been great. I switched back to WordStar from WordPerfect 5.0 because WordStar 5.5 does so much more, works so well with other programs, and doesn't tax my memory. I keep hearing about other word processors and the things that they won't do, yet WordStar 5.5 does them. But I've wondered why other reviewers are so adamant about WordStar 5.5 being so bad. I guess it's because they can't change, so they conduct a half-hearted review that makes the product appear ho-hum. WordStar does math; one "in depth" review never mentioned that or that it imports Lotus and dBASE files directly. Another said that the dot commands were outmoded, yet dBASE uses them, and no one is crying about that. I prefer the dot commands so I can see what the thing is doing.

It's nice to read articles from someone who isn't into marketing. BYTE has not succumbed to being a sales catalog for Lotus 1-2-3 or WordPerfect. I'm not cheering for WordStar International; I'm cheering that someone finally looked closely enough at this product.

Mike Gautier
Woodbridge, VA

Thanks. We do try to look at everything. And chances are it will be a long time before BYTE is a sales catalog for anything—we can't get four editors to agree as it is!—Jerry

Orange Aid

Dear Jerry,

I commiserated mightily when I read of your orange-soda-in-the-disk experience in the October 1989 Chaos Manor. The same thing happened to me, to a disk that contained an already late paper I was due to deliver in Kyoto. That experience led me to conduct some experiments as reported in my paper, which is due to be published in *Library HiTech*. (Isn't it amazing what we spend our time doing in library schools?)

Working with 5¼-inch 360K-byte

disks, almost nothing—from Chinese food to rye to cat urine—destroyed data. Mess 'em up, wash 'em off, use 'em again. Your event led me to sacrifice more disks: some Dysan high-capacity 5¼-inchers formatted in a 1.2-megabyte IBM drive, and some Verbatim 3½-inch ones, formatted double-sided in a Mac II. I didn't have any orange soda (we're hard-drinking buckaroos out here in Honolulu), but I did pour Pepsi over them, along with some other unpleasant substances. Result: no data loss. I actually had less trouble than I did with the 360K-byte samples (of course, the fact that these were new might have been significant).

The only difficulty that I experienced was in opening the 3½-inch case. I found that the best approach was to pry off the metal read-write slot protector (it's not really needed, anyway), slip a knife blade (tested to make sure it wasn't magnetized) into the edge away from the write-protect switch, and then twist it open like an oyster. I popped open three sides, leaving the left side (with the write-protect switch) attached. This did take a little effort—the things are glued together—but allowed the cookie (i.e., the floppy media proper) to be slipped out. After I washed the crud off the cookies, I dried them—first with a paper towel, then under hot air from the forced-air hand drier in the men's room. (I have never managed to get my hands dry under one of those things, but they work pretty well on disks.) Once the cookies were clean and dry, I put them into a new disk case. Every one of them read perfectly the first time.

I hope this little bit of advice helps you if you ever mess up a disk again. The secret is to take the cookie out before you wash it off, and then put it back in a clean case.

Larry N. Osborne
Honolulu, HI

Thanks. I'm not sure where to get new disk cases, although I suspect that I could find them with some effort. I also wonder if disk cases come with the little felt-like

cleaner thing that goes between the cookie and the hard shell?

Mostly I hope it won't happen to me again, but it probably will.—Jerry

Dear Jerry,

Here's what to do when you pour orange soda over your irreplaceable 3½-inch floppy disks:

1. Carefully (so as not to damage the disk itself) disassemble the shutter assembly of the drenched disk and break open the case
2. Do the same for a discarded disk, this time taking care not to damage the case too much.
3. Wash the drenched disk under running water with any mild dishwashing detergent, and dry with a clean, soft, lint-free cloth.
4. Reassemble the washed disk into the new case. Forget about the shutter unless you really can't copy the data off the disk.

I followed the four steps outlined above with complete success for a disk that I had been carrying in a pocket of my new stone-washed jeans; stone-washed denim contains a good deal of fine sand even after the first few washings, and the disk made unfortunate grating noises when I turned it by hand. Nonetheless, I managed to retrieve all the data.

In general, if a liquid is suited for human consumption (with the possible exception of tequila), it should leave the magnetic coating of the disk intact.

Christopher Ferebee
Königstein, Federal Republic of Germany

Thank you for the instructions; next time I have a disk disaster, I'll be sure to try it!—Jerry ■

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. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryip."



1.5 DECADES OF APRIL FOOLS

All right, maybe you can fool some of the people some of the time

Kenneth M. Sheldon

What do Hindsight Engineering, Soy cure Systems, and the Famous Programmers' School have in common? Well, for one thing, they're all enterprises that have existed only in the minds of BYTE editors. Over the years, as we've wrestled to keep on top of the fast-moving microcomputer world, we've occasionally taken time out to poke a little fun at ourselves and the industry that we love.

The tradition started in our first April issue (1976), with a Technology Update on the first practical Touring Machine—a bicycle—with a unary relocatable-based operator (i.e., the person on the bike).

Later items detailed such arcane procedures as refolding the fanfold instruction card that came with the MC6809 microprocessor. In 1981, our What's New column featured a new addition to the small components market, the 7N-∞ BHD (black-hole diode), useful mostly for GI (garbage-in) applications. Unfortunately, due to the light-absorption characteristics of the device, we were not able to provide a photograph of the BHD.

Sometimes, items that seemed funny at the time have become, over the years, amazingly prescient: Take the 5-mega-byte hard disk drive for the tiny Sinclair ZX81 (marketed in this country as the Timex/Sinclair 1000) that we announced in our April 1982 issue. Hundreds of readers wrote to Hindsight Engineering in "Peanutbutter, New Hampshire" for more information. (Credit the local post office for figuring out where to send the wacky mail.) Nowadays, you can buy a portable as small as the Timex/Sinclair with hard disk drives of up to 100 MB!

Our April 1982 issue also saw the birth of an institution: the Famous Programmers' School. In a full-page "advertisement" that asked, "Do you have a restless urge to program?," readers were offered the rare opportunity to study with such software greats as Bennett Lisp, Bruce Fortran, Red Basic, and the immortal Ignatious "Call Me Blaise" Pascal. Interested parties were asked to take a free aptitude test, with such challenging questions as, "Write down the numbers from zero to nine and the first six letters of the alphabet." Numerous readers took the challenge and responded by sending the required \$1000 in small unmarked bills. (Unfortunately, the bills were always Confederate, Monopoly, or homemade money.)

So successful was the Famous Programmers' School that we offered, in the April 1983 issue, a follow-up seminar on pocket-computer local-area networks. The accompanying photo showed the school's stellar staff with pocket computers in hand (and pocket), strung together by a wide ribbon cable.

That seemed pretty funny at the time, but now, with the advent of Xircom's Pocket Ethernet Adapter—a device that lets you attach portable computers to an Ethernet LAN—it seems eerily prophetic. (Note that we considered filing a "look and feel" lawsuit against Xircom but opted instead to give them a BYTE Award of Excellence in our January issue. It's still a good idea, even if we thought of it first.)

The Famous Programmers' School (and most of its instructors) had a last gasp in April 1984, with a plea to "Help the Old Programmers' Home." Situated in a large brick building that looked oddly reminiscent of BYTE's headquarters, the home was founded to provide a calm, tranquil shelter for programmers who were "too old or too burnt-out or have to pay too much alimony." Residents were provided with "good hearty fast food, and an unlimited supply of cola and fanfold paper." Age was of no concern; in fact, some of the residents were "over 35 years old."

Continuing the tradition, our April 1985 issue featured a special "What's Not" section that described several innovative products, such as MacKnifer, a peripheral that attached to the original single-disk Macintosh and let you sharpen knives, scissors, and lawn-mower blades while waiting for files to open.

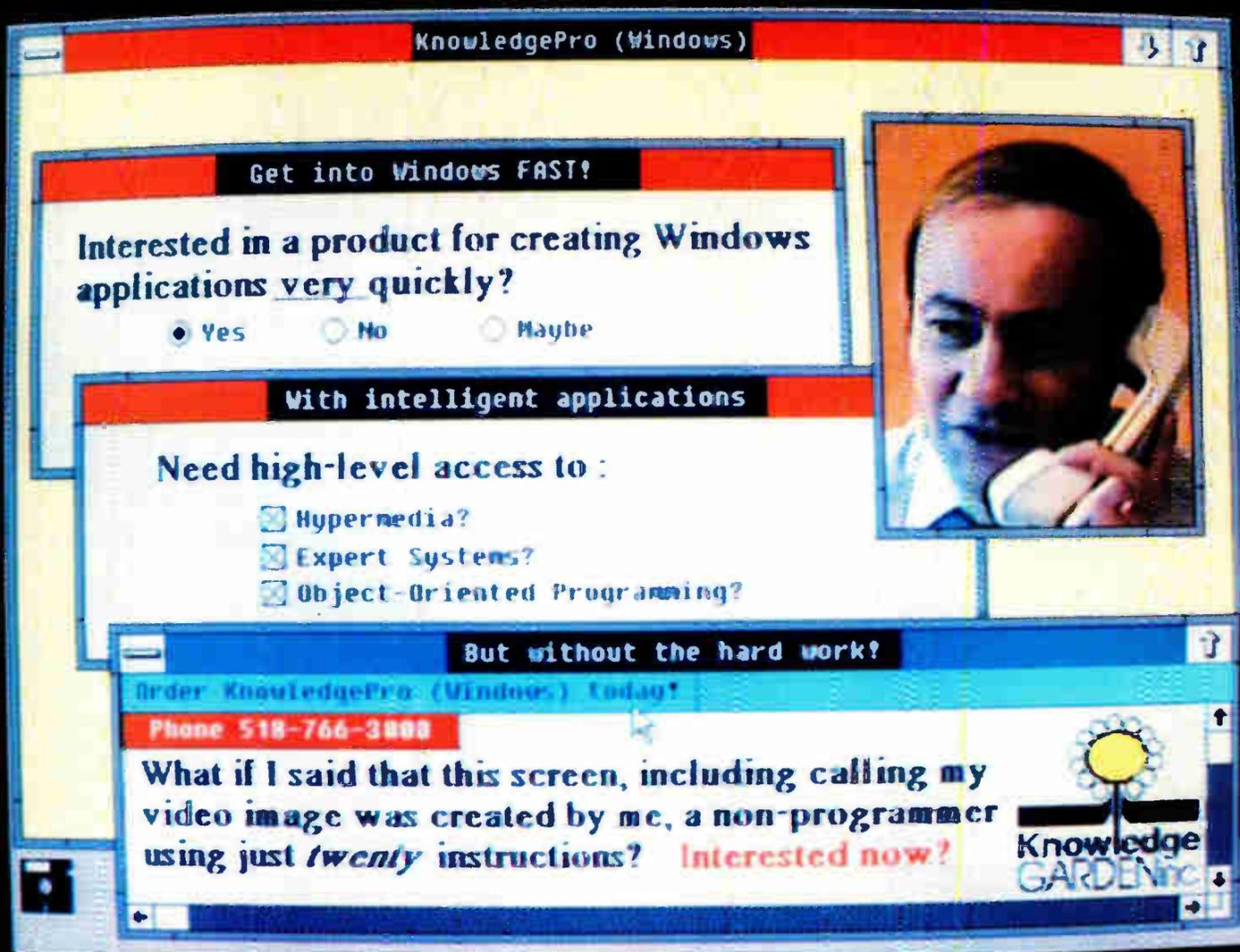
After that issue hit the stands, we received a call from a woman who said that she'd checked every computer store in town trying to find the Parasoya Disks (made of processed soybeans) that we'd written about. The disks, which were supposedly readable, writable, and edible, were for people who were *really* concerned about protecting sensitive data. Needless to say, she was embarrassed when we explained that the disks (from Soy cure Systems) were an April Fools' item.

The very next day, a reporter from *USA Today* called us. He wanted more information about the Transporter, a portable computer that, with a few simple twists, transformed into a single-passenger automobile. They were thinking of running an article about it in their newspaper, but he thought he'd better call first, just to check. Needless to say, that item never appeared in the paper.

As a result of all this, you will find no bogus products in this issue of BYTE. Anything that looks odd or funny—intentionally or not—is thanks to the manufacturer of the product or its advertising agency.

We've learned our lesson. ■

Kenneth M. Sheldon is a senior technical editor for BYTE. He can be reached on BIX as "ksheldon."



Un-retouched VGA screen image. Special hardware required for motion video.*

Introducing the door into Windows!

Easy access to Windows

KnowledgePro (Windows) contains high-level commands for manipulating screen objects, lists, text, fonts, rules, external files and bitmap images. DLL and DDE support lets you integrate your own C routines with KnowledgePro and link your application directly to Excel and other Windows programs.

At a price you can afford

KnowledgePro (Windows) costs \$695 with no runtime fees for applications. KnowledgePro for DOS costs \$495. The systems run on IBM PC, XT, AT and PS/2 compatible machines with 640k of memory and a hard disk. KnowledgePro (Windows) requires Microsoft Windows 286 or 386 version 2.x or greater.

Call 518-766-3000 (FAX 518-766-3003) for more information or write to: Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123 USA. Amex, Visa or M/C accepted.

Another
intelligent
tool from



PRINT QUEUE

Hugh Kenner

Advise and Compute

A lawyer looks at computers, copyrights, and "look and feel" lawsuits

Thought is structured around certain absolutes: that light moves in vacuo at 299,792.458 kilometers per second; that the mean free path of molecules between collisions is 905 angstrom units; that the worst food in the known universe is on sale in the "A" terminal of the Newark airport.

Human interactions, though, are partly governed by law, and law's benchmarks tend to be prior legal decisions—that is, what someone once persuaded a judge to decide in a case that we are hoping another judge will agree is similar to the case we are now litigating. Trace such a chain back to a primal decision, and behind that you'll expect to find statute law. However, some unclarity as to how the law applied necessitated a first decision.

Concerning software, law has been unclear from the start, as Anthony Clapes details in *Software, Copyright, and Competition: The "Look and Feel" of the Law* (1989, Quorum Books, Westport, CT, \$39.95). On page 11 of his highly readable book, Clapes notes that the Founding Fathers in 1788 were at their deliberations nine years before J. M. Jacquard would unveil "the first programmable machine in history," the loom that took an artist's instructions from punched cards. So Article I, Section 8, Clause 8 of the Constitution had no programs in mind when it gave Congress power "To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

In 1790, Congress enacted the first copyright statute; it covered maps, charts, and books. In 1802, printmakers and graphic artists got included. In 1831, composers of music. In 1865, photographers. In 1870, makers of "paintings, drawings, chromos, statuettes, statuary, and models or designs of fine art." In 1912, the newfangled motion pictures. In 1971,

sound recordings (tapes were getting pirated). You see the pattern. Technology kept pushing.

By 1976 it finally had pushed computer programs into the purview of Congress, and Congress was most unhappy. All Congress found itself able to say in 1976 was that computer programs were, yes, protected. But they were to have "no greater protection than they had enjoyed under prior law," which had never mentioned them.

Do not hasten to acclaim our Congresscritters. For by 1980 they'd enacted a most equivocal law, which (1) defined a "computer program"; (2) said that if you owned a copyrighted program you weren't infringing if you used it in a computer (!) or made an archival copy; and (3) deleted the "prior law" clause of 1976, which was meaningless anyhow. And that's where things stand today.

So we're back in the courts, where, says Clapes, lawyers fall very neatly into four categories: They either (1) haven't got time to learn what programming is all about, and don't; (2) decide not to take the time to learn, because judges and juries will never figure it out either, and don't; (3) being Luddites at heart, are constitutionally incapable of learning about programming, so don't; or (4) think they, yes, understand programming, but don't.

Which sets the stage for the generic case, *Apple v. Franklin*, 1982. The Franklin Ace, if you recall, was an Apple clone, back when Apple was synonymous with personal computing. And at Franklin, the company had simply copied the Apple operating system into ROM, so clumsily that one Apple programmer's name was left embedded in the code, as was the word *Applesoft*.

Franklin never denied the copying. The company's argument was this: For a machine to run existing Apple software, it needed to have

continued



©1990 Palindrome Corporation

Network Archivist is a trademark of Palindrome Corporation.

palindrome



NOVELL LABS TESTED AND APPROVED NetWare® Compatible

Announcing instant relief for LAN backup headaches.



The Network Archivist™ Software.

Now LAN Managers suffering from endless 2.2 gigabyte tape backup headaches can get instant relief.

Just replace your present system's software with Palindrome's Network Archivist. The retrofit is simple. The cost is nominal. And the result is complete management of your LAN backup files.

The Network Archivist retrofit uses the same software that powers all of Palindrome's impressive LAN backup tape systems. It's a smart, economical way to optimize virtually any 2.2 gigabyte system (or other selected systems), instantly.

Here's what you get:

Automatic File Management—Palindrome's expert system automates the backup process, keeping track of backup data, determining tape rotations and updates.

Faster Backup—Our automatic LAN archiving is two to

five times faster than conventional backup systems. Tapes are updated—not overwritten.

Easier Recovery—Our on-line catalog lets you easily locate files from 2 minutes, 2 days or 2 years ago without even mounting a tape.

Permanent Archiving—The Network Archivist keeps a history of when files were modified, permanently capturing stable files; managing your entire tape library using 50% to 70% fewer tapes than competitive systems.

In a July 17 review of the Emerald, ARCserve and Palindrome systems, *PC Week* said, "for features and software design, the clear all-around choice is Palindrome's Network Archivist." See for yourself.

For a free demonstration disk and list of dealers, call us at (708) 505-3300 or send in this coupon.



The backup system that knows what it's doing.

Circle 305 on Reader Service Card (DEALERS: 306)

World Radio History

"LAN Manager
Dream-Top Pick!"
PC WEEK, July 17, 1989



Please send me my free Network Archivist LAN Backup Management Evaluator's Kit.

Name: _____

Job Title: _____

Business: _____

Address: _____

City: _____

State: _____ Zip: _____

Phone: _____

Type of Network: _____

No. of servers: _____

LAN capacity: _____

Send coupon to the Palindrome Corporation, 850 E. Diehl Road, Naperville, IL 60563. (708) 505-3300.

the operating system just about exactly as it was, since the operating system offered so many "entry points" that various software writers were using. The governing ideas, true, Apple couldn't copyright those; but compatibility with all that software—the only reason for a clone—had tied Franklin to nearly line-for-line specifics.

A Philadelphia judge named Newcomer nearly bought that; or rather, he bought something far more sweeping, the idea that programs, since their binary code isn't meant to be read by

This
book clarifies why
court decisions
are not intuitive.



humans, aren't covered by any statute governing "expression." He feared a step "into the world of Gulliver, where horses are 'human' because they speak a language that sounds remarkably like the one humans use." Do such sequences as 0010100100110000 merit the protections we accord to *Moby Dick*?

(Thought experiment: Pascal, for instance, is plainly meant to be read by humans. Might someone claim exemption from infringement after merely translating Pascal code, line by line, into C, a process so straightforward it's been automated? In 1978, a judge named Higginbotham ruled that no, someone couldn't. He even said it would "probably" be a violation to translate a flowchart into a computer language.)

Apple carried Judge Newcomer's ruling to the Court of Appeals, where on August 30, 1983, Judge Dolores K. Sloviter upheld Apple. She brushed aside what had given Judge Newcomer pause, the question whether a machine or a person was the destined reader of the code. Utilitarian? Aesthetic? The Copyright Act, she held, did not distinguish. What she did zero in on was whether Franklin could have simulated the Apple operating system without copying it line by line; for if idea and expression merge, Apple has no valid copyright, because that would amount to copyrighting an idea, which can't be done.

The line between the two, she said, must be "pragmatic," legalese for "what follows is a hunch." For "many of the courts which have sought to draw the line between idea and expression have found difficulty in articulating where it falls." Judge Sloviter wasn't presented with a case of "not copying except where necessary," hence didn't decide such a case. She was presented with a case of line-for-line copying, and Apple and Franklin took her hint to settle out of court. So "except where necessary" remains undefined, likely only addressable, says Clapes, "on a case-to-case basis." Case by case, though, *Apple v. Franklin* won't go away.

For here's another nugget from Judge Sloviter. There may be, as Franklin alleged, only a limited number of ways to write an Apple-clone operating system. Fine, that says there's more than one, so over at Apple idea and expression haven't merged, and copyright holds. But if Franklin got hemmed in by its desire for a clone that would run *all* available Apple software, that was "a commercial and competitive decision," and they should have had the wit to scale it down.

(Analogy, from me, not from Clapes: If you want a script that will produce in a theater *exactly* the effect of Shakespeare's *Hamlet*, then you've no recourse save to copy out Shakespeare's *Hamlet*. But you've made a commercial, not an artistic, decision. On the other hand, Tom Stoppard's *Rosencrantz and Guildenstern Are Dead*, though arguably parasitic on *Hamlet*, is a piece of artistry that infringes nothing.)

And Clapes argues throughout that programs "are literary works," and "not just in a copyright sense but as a matter of social taxonomy." They are literary works "in the way that a musical score or the 'shooting script' of a movie are literary works: One doesn't read them through like a novel, but they have the attributes common to all literary works." These include "structure, flow, logic, design, naming conventions, commentary, and resultant style."

Which brings us to look and feel, which apparently derives from the phrase "total concept and feel" in "a twenty-year-old case involving the copying of thematic and stylistic features of a line of greeting cards." The dashboard analogy has been popular lately; if you can drive one car you can drive them all, because controls and gauges are in pretty well standard locations. Judge Higginbotham even alleged 12 years ago that the gearshift *H*-pattern was "idea," not "expression," and hence not protected at all.

But the law doesn't work (as I've noted) from absolutes like the *H*-pattern gearshift or the velocity of light; it works tortuously, through a maze of decided cases, and chapter 20 of Clapes' book ("The 'Look and Feel' Cases") brings no easy comfort. Look-and-feel defendants will be spared liability "if, when everything is eliminated except the expression that may not be copied in the plaintiffs' user interfaces, it is found that they have not copied that expression." That seems to mean, if you take away everything except what looks like an elephant, and the elephant wasn't really copied, you're clear. Lawyer Clapes will perhaps forgive me if I say that the progress toward such a finding resembles the passage of a ball through a pinball machine (bounce, bounce; left? right? What did Judge A make of question X? Judge B of question Y?).

The man who stood up after a Clapes presentation to say "I disagree with everything you say" was understandably impatient. Your right in what you're doing seems very clear as you program. But you program out in a world where other programmers have been weaving trails that their employers may have protected. "Because the look and feel of a program is the part with which the user most clearly identifies, and the part that cannot be hidden from competitors, there would be absolutely no point in the development of innovative user interfaces if the results of those investments could be freely copied by others."

True. But the dashboard analogy? Is it simply that no one thought to sue when clutch left, brake right—the *H*-pattern for that matter—got copied and recopied? I've not been able to find a historian of these automotive matters. Clapes, I may as well tell you, is "a Senior Corporate Counsel at IBM," although he's careful to deny giving things an IBM slant. What his book clarifies is why court decisions are not intuitive, the way programmers would like them to be. Law works its uneasy way through precedent, precedent. *Software, Copyright, and Competition* may, at the very least, teach us all patience. ■

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times and Harper's. His recent books include A Sinking Island and Mazes. He can be contacted on BIX as "hkenner."

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

They Left out Features.... We Left out the **COMMA!**

The only thing missing...

is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. **DesignCAD 3D** sells for \$399.00. Period. No Comma!

In order to draw the complex pictures shown below it is desirable to have the following 3D features:

- Interactive design with 3D cursor
- Blending of surfaces
- Boolean operations such as add, subtract, and intersection
- Complex extrusions
- Cross sectioning
- Block scaling
- On screen shading
- Shaded output to printers and plotters

All of these competitors left out one or more of these desirable features in their standard package. They didn't forget the most horrible feature - the comma.

DesignCAD 3D offers **ALL** the listed features plus many more!

If **DesignCAD 3D** has the power to create the 3D objects shown below, imagine how it could help with your design project!

DesignCAD 3D sells for \$399. We left out the comma. We didn't think you would mind!

PC MAGAZINE SAYS...

DesignCAD 3D, the latest feature-packed, low-cost CADD package from American Small Business Computers, delivers more bang per buck than any of its low-cost competitors and threatens programs costing ten times as much. For a low-cost, self-contained 3D package... DesignCAD's range of features steals the show."

\$399

American Small Business Computers • 327 South Mill Street • Pryor, OK 74361 U.S.A.

AutoCAD rel. 10	\$3,000.00	AutoCAD AEC \$1,000.00 AutoShade \$500.00
CADKEY 3.12	\$ 3,195.00	Solids \$995.00 IGES translator \$1,995.00
DataCAD with DC Modeler	\$ 3,990.00	DataCAD Velocity \$2,000.00
DesignCAD 3D ver. 2.0	\$ 399.00	NO expensive options! IGES Free, Shading Free
MaxxiCAD 1.02	\$ 1,895.00	N/A
Mega Model	\$ 995.00	MegaDraw \$195, List \$295, MegaShade \$395
MicroStation PC 3.0	\$ 3,300.00	Customer Support Libraries \$1,000.00
ModelMate Plus 2.8	\$ 1,495.00	N/A
VersaCAD Design 5.4	\$ 2,995.00	N/A

Source: Byte Magazine

BYTE MAGAZINE SAYS...

"At \$399, DesignCAD 3D was the least expensive package we saw, yet it was one of the more powerful. ..Don't be fooled by the remarkably low price, this program can really perform."

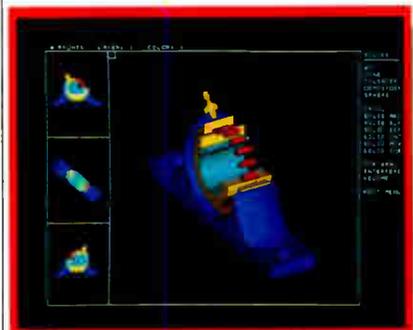
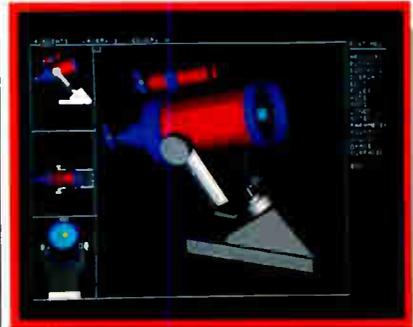
May 1989, page 178

Complete 3-Dimensional design features make it easy for you to construct realistic 3-D models. With full solid-object modeling capabilities you can analyze your drawing to determine the volume, surface area or even center of gravity! **DesignCAD 3-D** even permits you to check for interference between objects! Aeronautical Engineers can now find the center of gravity for a new airplane design with a couple of keystrokes. The Architect can determine the surface area of a roof for decking in a matter of minutes. The Civil Engineer can calculate the volume of a lake or dam in seconds. The Mechanical Engineer will know for sure if certain parts fit together without interference. The uses for **DesignCAD 3-D** are only limited by YOUR imagination!

HOW DO I GET ONE?

DesignCAD 3-D and **DesignCAD 2D** are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. All you need to run **DesignCAD 3-D** is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free information and a demo disk are available by faxing (918) 825-6359 or telephoning:

1-(918) 825-4844





TO BOLDLY BENCHMARK

A giant leap
in our 15-year mission
to seek out new means
of testing computers

Over the years, BYTE has pioneered the use of benchmark tests as a means of evaluating which computer system is right for you. Just last month, we rolled out our latest suite of benchmarks, designed to test and compare Unix-based systems.

But our most exciting project to date is one that could change forever the way benchmark tests are conducted. Until now, security precautions and the sensitive nature of the project have prevented us from discussing it. However, starting in September, with our fifteenth anniversary issue, BYTE will add an entirely new suite of tests to its benchmark series.

The Final Frontier

In the days to come, exploiting new opportunities in space will become increasingly important to maintaining our economic position in the marketplace. Computers will become an even greater part of business and technology. But present-day tests are useless for evaluating the kinds of conditions under which computers in space will have to operate.

To address these new considerations, we've designed a series of tests to be conducted on each new system reviewed in BYTE. Beginning in September, we'll report the results of the tests, which will

Stop Bit is an open forum for informed opinion on topics related to personal computing. The opinions expressed are those of the author and not necessarily those of BYTE or its staff. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

be carried out through a special arrangement with mission specialists on regular flights of NASA's space shuttle. Developed with the assistance of Dr. Thomas Fulery of the Wisconsin Institute of Technology, the tests will subject review systems to conditions that we can expect to be operating under in the days ahead.

The Tests

As we venture farther into space, we may find that gravity is a luxury that we can't always afford. How will this affect your new computer's ability to perform sensitive calculations? To test this, the BYTE *nul-grav* benchmark will measure a system's ability to perform floating-point operations in a zero-gravity environment.

The *hatch-activation-loop* test will measure each system's ability to perform extensive repetitions of ordinary tasks. This HAL test will determine how many times the system can open and close the space shuttle's pod-bay doors in one hour and whether the system loses track of whether the door is open or closed.

Of course, not all computing will be done in a human-friendly environment. Thus, we have designed several benchmarks for extra-vehicular execution. The *totality-rad* test, for example, will measure the length of time that the review system can withstand exposure to cosmic radiation without producing computation errors.

Another extra-vehicular test will analyze a system's susceptibility to stresses and strains caused by breeches of security that might affect its operation and thereby present a threat to life-support systems. Based on our now-classic Sieve of Eratosthenes benchmark, the *Strain of Andromeda* test (named for the mythical goddess who was rescued from a monster) will analyze systems for possible infection by computer viruses.

During the (of necessity) final benchmark test, the review system will be ejected from the shuttle and allowed to reenter the earth's atmosphere. For this

burn-in test, each unit will be equipped with a radio-transmitter modem and will transmit signals back to earth, where BYTE editors will record the exact time and height at which the system ceases to operate. Any system that continues to operate until it reaches the ground will automatically receive a BYTE Award of Excellence for endurance.

On the outside chance that a review system might spin off into space rather than come back to earth, we have written the new benchmark tests in BASIC. In the unlikely event that the system is intercepted by extraterrestrial life forms, we believe that BASIC is the language most likely to run on any given alien system.

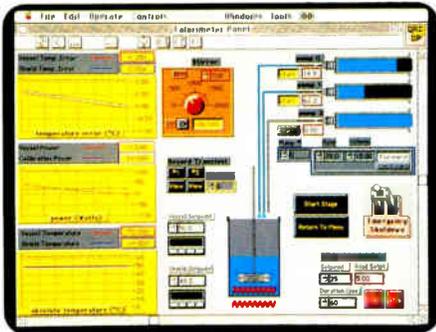
Now It Can Be Told

As you might expect, developing the new BYTE benchmarks has required months of negotiation with the administration of our nation's space program. Unknown to the general public, the most recent flight of the space shuttle carried a preliminary test machine on which shuttle personnel conducted the new BYTE benchmarks. According to mission specialist Irving M. Kidden, the tests were almost a complete success. "The only problem came when one of the guys was making some Tang during the *nul-grav* test," he said. "Some of the powder got into the disk drive and really gummed up the works." This mishap, however, provided an opportunity for the new benchmarks to display their user-friendly, plain-English system of error messages: The affected machine promptly displayed the message, "He's dead, Jim."

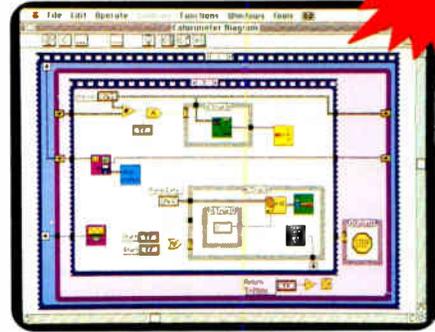
It is with great pleasure that we announce the new BYTE On-Going Utility in Space tests. For more information on our new benchmarks or to receive a copy for your own use, please see the box on page 343. ■

Kenneth M. Sheldon is a BYTE senior technical editor. He can be reached on BIX as "ksheldon."

If you haven't seen LabVIEW[®] 2, ask someone who has...



LabVIEW 2 front panel user interface



LabVIEW 2 block diagram program

"Perhaps the new version of National Instruments' LabVIEW will emerge as a de facto standard."

– **John M. Fluke, Jr., Chairman,**
John Fluke Manufacturing Co., Inc.

"LabVIEW 2 is the leader of data acquisition software, probably the most powerful product for data acquisition, analysis, and control on any microcomputer."

– **John Rizzo, Technical Editor,**
MacUser Magazine

"The flexibility of LabVIEW 2 has prompted me to use it as the cornerstone of my future business."

– **Steve Conquergood, Chief Design Engineer,**
CXT Limited

"LabVIEW has been the most valuable computer-based tool I have encountered in the past 10 years. I estimate the LabVIEW programming effort at two man-months, as opposed to the two man-years requested for our advanced workstation."

– **Gary W. Johnson, Electronics Engineer,**
Lawrence Livermore National Laboratory

"We did it! LabVIEW 2 is everything we visualized when we set out over six years ago to create the next generation instrumentation software technology. Our free LabVIEW 2 upgrade program is our way of thanking the thousands of pioneering users who helped make this revolution possible."

– **James Truchard, Ph.D., President,**
National Instruments

"Compared to the already excellent release 1.2, LabVIEW 2 is improved in virtually every way. Compared to 'traditional' software, it's almost shocking. Worth the wait? You could say I've been waiting nearly a decade, since personal computers first came out, for something to bring it all together the way LabVIEW does."

– **Scott Jordan, Product Line Manager,**
Newport Corporation

"With LabVIEW's modular system, I can visualize my test systems as a hierarchy of individual, interchangeable components, resulting in shorter development time, increased functionality, and greater execution efficiency."

– **Michael Porter, Test Systems Engineer,**
CODEX Corporation

"I give LabVIEW high marks for its conceptual ease and its ability to adapt. Using LabVIEW, I have developed a sophisticated process control system for our distillation laboratories that is comprehensive yet can be easily configured."

– **Glenn Graham, Research and Development Engineer,**
Union Carbide Corporation



6504 Bridge Point Parkway
Austin, TX 78730-5039
(512) 794-0100
(800) 433-3488 (U.S. and Canada)
Fax (512) 794-8411

Nihon National Instruments K.K. (Japan) (3) 788-1921 • National Instruments of France (1) 4865 3370
National Instruments of Italy (2) 4830-1892 • National Instruments United Kingdom (06) 355-23-545

Circle 203 on Reader Service Card

World Radio History

MANAGEMENT

Tandy[®] Business Systems

Step up to
power planning.

What the future holds is in your hands . . . today. With a 386™-based Tandy Business System, you'll have the power you need to set—and reach—your strategic objectives.

Quickly transform raw data into useful information. Compile a spreadsheet to compare current and previous figures, then graph the results to see once-hidden trends.

Pinpoint those areas needing improvement, outline your plan and create PERT charts to support your formal proposal.

You won't be charting your course alone—Radio Shack offers the best support services in the industry.

Success? Plan on it with a Tandy Business System.

Radio Shack[®]
COMPUTER CENTERS

A DIVISION OF TANDY CORPORATION

386/TM licensed from Intel Corp.

Circle 242 on Reader Service Card

General Machining and Tool Company Fiscal Year Ending 1988

Balance Sheet	January	February	March	April	May	June	July	August	Sept.
Current Assets									
Cash & Equivalents	\$15,000	\$15,000	\$18,281	\$31,031	\$34,128	\$32,749	\$32,384	\$31,454	\$35,111
Accounts Receivable	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Inventory	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Other Current Assets	40,000	35,785	43,281	61,171	59,708	53,650	52,384	51,102	51,102
Total Current Assets	70,000	75,785	86,562	117,202	118,836	111,399	110,868	108,656	112,213
Plant, Property, & Equipment	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Less: Accumulated Depreciation	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
Net Plant, Property, & Equipment	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Other Noncurrent Assets	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Total Assets	95,000	100,785	111,562	142,202	148,836	146,399	145,868	143,656	147,213

General Machining and Tool Company - Sales Forecast

Forecasting Inputs	January	February	March	April	May	June	July	August	Sept.
Initial Cash Investment	\$15,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
Profit Investment Ratio	12.00%	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Initial Tax Reinvestment Ratio	8.00%	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Profit Discount Rate	12.00%	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Initial Tax Discount Rate	8.00%	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Gross Sales									
Cost of Sales									
Cost Center 1 Costs	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500
Cost Center 2 Costs	0	0	0	0	0	0	0	0	0
Cost Center 3 Costs	0	0	0	0	0	0	0	0	0
Interest Expense	0	0	0	0	0	0	0	0	0
Marginal Income Tax Rate	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
Depreciation	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Other Noncash Expenses	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Other Cash Noninterest	22,500	20,000	17,500	15,000	12,500	10,000	7,500	5,000	2,500
Gross Profit	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500	28,500
Transaction/Disposal Costs									
Operating Profit Before Tax	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
Nonrecurring Portion of Result	(2,500)	(2,500)	(2,500)	(2,500)	(2,500)	(2,500)	(2,500)	(2,500)	(2,500)
Adjusted Tax Rate on Result	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Profit and Loss Statement									
Net Sales	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Cost of Sales	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Margin	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Expenses									
- Item 1	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
- Item 2	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
- Item 3	485	485	485	485	485	485	485	485	485
Operating Expenses	\$1,985	\$1,985	\$1,985	\$1,985	\$1,985	\$1,985	\$1,985	\$1,985	\$1,985
Income	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015
Expense									
- Item 1	500	500	500	500	500	500	500	500	500
- Item 2	500	500	500	500	500	500	500	500	500
- Item 3	500	500	500	500	500	500	500	500	500
Income Before Tax	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000
Tax Expenses (Savings)	(1,250)	(1,250)	(1,250)	(1,250)	(1,250)	(1,250)	(1,250)	(1,250)	(1,250)
Income After Taxes	\$23,750	\$23,750	\$23,750	\$23,750	\$23,750	\$23,750	\$23,750	\$23,750	\$23,750