

Seventh Annual Extra All-IBM Edition

Display until January 18, 1991

BYTE

IBM SPECIAL EDITION

GUIDEPOSTS FOR THE 90s



**New Directions for
the World's Most Popular Computer Standard**

A Year's Worth of Benchmarks: PC vs. Mac vs. Unix Systems
Graphical One-on-One: Windows vs. OS/2

Graphics, Multimedia, Desktop Publishing
Notebook Computers, DVI, SCSI
Optical Storage, Expert Columnists



\$3.95 U.S.A.
\$4.95 IN CANADA
£2.95 U.K.
0360-5280

AN OPEN AND SH CASE FOR DELL.

Not only does our laptop cost \$2,500 less than their laptop, it also happens to give you a great deal more for your money.

Like a choice of 20 MB (which brings the price down to \$3,199) and 40 MB hard drives.

Dell's unique "Continuous Power Battery System" that allows you to maintain your screen and save your data, even while you're changing batteries.

An industry standard half-card 8-bit slot that can be used for a network card or other advanced communications. And a dedicated slot for a Dell Data/Fax modem.

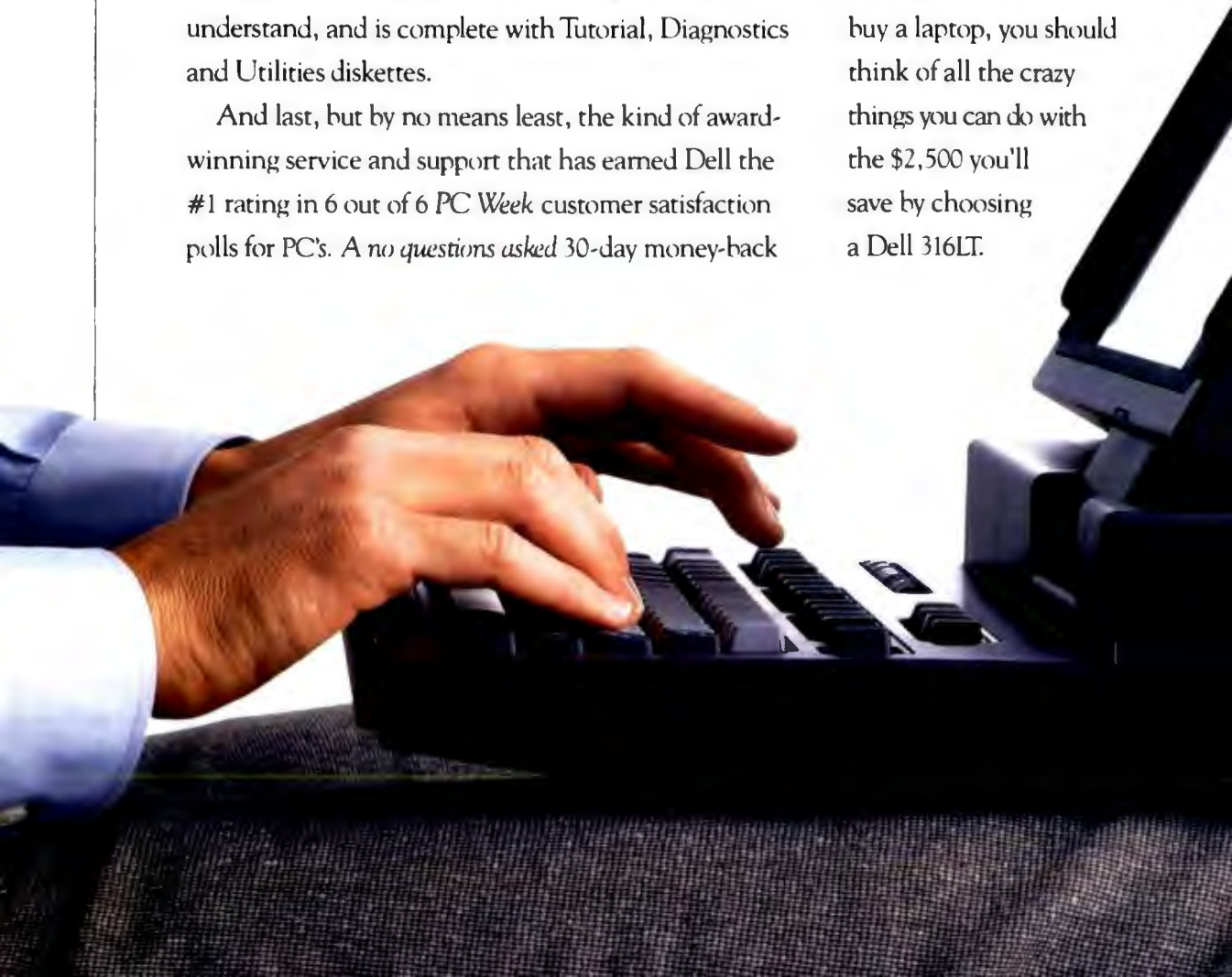
Illustrated documentation that's easy to read and understand, and is complete with Tutorial, Diagnostics and Utilities diskettes.

And last, but by no means least, the kind of award-winning service and support that has earned Dell the #1 rating in 6 out of 6 *PC Week* customer satisfaction polls for PC's. A *no questions asked* 30-day money-back

guarantee and one-year limited warranty with technical support. And a full year of on-site service from the Xerox Corporation. You get that service nearly anywhere in the world, even if you're a thousand miles from a service center. It means you'll never have to take any time off for service. Because when you buy Dell, the service comes to you.

Give us a call and we'll show you how easy it is to own the Dell 316LT through many purchase and lease plans that are available.

So, when it comes time to buy a laptop, you should think of all the crazy things you can do with the \$2,500 you'll save by choosing a Dell 316LT.



UT

...Toll-free
...xt business day,
...ion.^A And you
...contiguous US,
...r desk. Which
...back to a retailer
...Dell, service



THE NEW DELL 486™ 33 MHz AND 25 MHz EISA SYSTEMS.

The best value in high performance PCs, combining 486 performance, 32-bit EISA I/O bus, and the industry's top rated service and support.

STANDARD FEATURES:

- 486 microprocessor running at 33 MHz or 25 MHz.
- 32-bit EISA bus architecture (known and compatible with ISA).
- Standard 4 MB of RAM*, expandable to 16 MB on system board, using optional 1 MB and 2 MB SIMMs.
- VGA systems video adapter.
- Integrated 387 compatible math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- 5 half-height drive bays.
- Dual diskette and hard drive controller.
- Six 32-bit EISA (ISA compatible), plus two 16-bit ISA expansion slots.
- High-performance IDE (80 MB, 100 MB, 190 MB), and ESDI (330 MB, 650 MB) hard disk drives.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 230 watt power supply.
- 12-month On-Site Service Contract provided by Xerox.

*Commercial Lease Plan:

Lease for as low as \$246/month (433E) and \$232/month (425E).
Xerox Extended Service Plan pricing starts at \$617 (425E) and \$672 (433E).

	433E	425E
80 MB VGA Monochrome System	\$7,899	\$6,399
190 MB VGA Color Plus System	\$8,699	\$7,199
130 MB Super VGA Color System (800 x 600)	\$9,599	\$8,099
650 MB Super VGA Color System (800 x 600)	\$10,799	\$9,299

Prices listed include 1 MB of RAM, 100 MB hard drive configurations also available.



THE DELL SYSTEM 325 25 MHz, 186 AND DELL SYSTEM 310 20 MHz, 386

The best combination of performance and value available in their class.

STANDARD FEATURES:

- Intel® 80386 microprocessor running at 25 MHz (Dell 325) or 20 MHz (Dell 310).
- 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.
- Socket for Intel 80387 or WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- 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 \$131/month (325) and \$112/month (310).
Xerox Extended Service Plan pricing starts at \$370 (325) and \$251 (310).

	325	310
40 MB VGA Monochrome System	\$3,599	\$2,999
80 MB VGA Color Plus System	\$4,099	\$3,499
80 MB Super VGA Color System (800 x 600)	\$4,199	\$3,599
190 MB Super VGA Color System (800 x 600)	\$4,699	\$4,099

Prices listed include 1 MB of RAM, 100, 330 and 650 MB hard drive configurations also available.



THE NEW DELL SYSTEM 320LX 20 MHz, 386SX

One of the fastest SX's around.

STANDARD FEATURES:

- Intel 80386SX microprocessor running at 20 MHz.
- Standard 1 MB of RAM*, optional 2 MB or 4 MB expandable to 16 MB (8 MB on the system board).
- VGA systems include a high-performance 16-bit video adapter.
- LIM 4.0 support for memory over 1 MB.
- Socket for Intel 20 MHz 80387SX math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high-performance hard disk interface and diskette controller on system board (ESDI-based systems include a hard disk controller).
- 1 parallel and 2 serial ports.
- Enhanced 101-key keyboard.
- 200 watt power supply.
- 8 industry standard expansion slots (7 available).
- 12-month On-Site Service Contract provided by Xerox.

*Commercial Lease Plan:

Lease for as low as \$98/month.
Xerox Extended Service Plan pricing starts at \$261.

	320LX
40 MB VGA Monochrome System	\$2,599
40 MB VGA Color Plus System	\$2,899
80 MB Super VGA Color System (800 x 600)	\$3,199
100 MB Super VGA Color System (800 x 600)	\$3,399

Prices listed include 1 MB of RAM, 190, 330 and 650 MB hard drive configurations also available.



THE DELL SYSTEM 316SX 16 MHz, 386SX AND DELL SYSTEM 210 12.5 MHz, 286

The perfect low profile mainstream computers.

STANDARD FEATURES:

- Intel 80386SX microprocessor running at 16 MHz (Dell 316SX) or 80286 microprocessor running at 12.5 MHz (Dell 210).
- Standard 512 KB of RAM, optional 640 KB, 1 MB or 2 MB of RAM* expandable to 16 MB (8 MB (316SX) and 6 MB (210) on system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 640 KB.
- Socket for Intel 80387SX (316SX) and 80287 (210) math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- 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 \$73/month (316SX) and \$62/month (210).
Xerox Extended Service Plan pricing starts at \$196 (316SX) and \$158 (210).

	316SX	210
20 MB VGA Monochrome System	\$1,949	\$1,649
40 MB VGA Color Plus System	\$2,449	\$2,149
40 MB Super VGA Color System (800 x 600)	\$2,549	\$2,249
80 MB Super VGA Color System (800 x 600)	\$2,749	\$2,449

Prices listed include 1 MB of RAM, 2 MB versions of the above systems are available for an additional \$100, 100 and 190 MB hard drive configurations also available.



THE DELL SYSTEM® 316LT 16 MHz 386SX.

This 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 SIMMs).
- 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.
- Connector for external 5.25" 1.2 MB diskette drive.
- Two removable and rechargeable NiCad battery packs utilizing Dell's "Continuous Power Battery System" (patent pending).
- AC Adapter.
- 12-month On-Site Service Contract provided by Xerox.^A

*Commercial Lease Plan:

Lease for as low as \$120/month.
Xerox Extended Service Plan pricing starts at \$303.

20 MB, 1 MB RAM	\$3,199
20 MB, 2 MB RAM	\$3,399
40 MB, 1 MB RAM	\$3,499
40 MB, 2 MB RAM	\$3,699

The Dell Systems 433E and 425E are FCC Class A devices and for use in commercial environments only. *Performance Enhancement: Within the first megabyte of memory, 128 KB (316SX, 316LT and 210) or 384 KB (320LX, 310, 325, 425E and 433E) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 316SX and 210. All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. **Payment based on 36-month open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark and Dell and 425E are trademarks of Dell Computer Corporation. Intel is a registered trademark and 486, 486 and 386 are trademarks of Intel Corporation. Source: Dataquest Inc. (Sept./Oct. Spring 1990). UNIX is a registered trademark of AT&T in the United States and other countries. Other trademarks and trade names are used to identify the entities claiming the marks and names of 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. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract please write to Dell Computer Corporation, 9505 Arboretum Boulevard, Austin, Texas 78759-7299, ATTN: Warranty.

AD CODE 11E29



Toshiba
T3100SX
16 MHz
80386SX
40 MB
1 MB RAM
VGA
14.9 lbs

\$5,999

**YOU'D HAVE TO
BE CRAZY TO BUY
ONE OF THESE
AWARD WINNERS.**



Dell 316LT
16 MHz
80386SX
40 MB
1 MB RAM
VGA
15.0 lbs

The laptop above is ours. The Dell™ 316LT. It comes with an Intel® 386™SX CPU running at 16 MHz. 1 MB of RAM, expandable to 8 MB, and a backlit VGA display. With a 40 MB hard drive it weighs 15 lbs. It won the *InfoWorld* Exceptional Value Award, and was one of only two 386SX laptops to win the *PC Magazine* Editor's Choice Award.

The one with the reddish screen on the opposite

page is theirs. The Toshiba T3100SX. With the same configuration as our laptop. It didn't win the same award from *InfoWorld*. But it did tie with Dell for *PC Magazine* Editor's Choice Award.

Which is where the similarities stop.



ABOVE AND
BEYOND THE CALL

TO ORDER, CALL NOW.

800-365-1460

HOURS: 7 AM-7 PM CT M-F 9 AM-4 PM CT SAT

In Canada 800-387-5752 In the U.K. 0800 414515 In Germany 06103/701-0 In France (1) 30 60 68 00 In Sweden 0760-713 50

Operate your own BBS

with the world's most popular, expandable, flexible

Multi-User Online Bulletin Board System



The Major BBS® starter system:

A complete BBS software package for your PC, PS/2, XT, AT, 386, 486, or compatible. Includes electronic mail with binary and ASCII file "attachments", SIG conferencing or "forum" areas with configurable security level access control, file upload/download, message keyword searching, "quickscans" for fast access to new messages, message and file "threading", real-time multi-user "chat" and teleconferencing, "classified ad" and "user registry" databases, etc. Also includes accounting, Audit Trail, and timed usage-metering features, and hundreds of convenience features for the Sysop (System Operator), such as a full-screen configuration editor, the ability to import/export files to/from floppy without system shutdown, "SIG-Op" privilege delegation, and much more. Supports up to 2 simultaneous users (from a database of thousands) on a single CPU. Works with standard Hayes-compatible COM1/2/3/4 internal or external modems, or with serial ports up to 38,400 bps. Minimum RAM requirement 512K. Minimum disk requirement 20MB. Requires PC-DOS or MS-DOS 3.1 or later.

The Major BBS Standard Edition \$ 59

When you're ready to expand:

No LAN or multi-tasking OS necessary! Double the number of simultaneous users that your system can support, from 2 to 4, or 4 to 8, or any number up to 64 simultaneous users on a single CPU, for a flat \$300 software license fee per doubling. The upgrade process is quick, automatic, and fully upward-compatible — i.e. you can install an update or upgrade onto your existing system without disrupting any of your user account files, E-Mail messages, configuration variables, or any other aspect of your system. For up to 16 users, 640K RAM is sufficient; above 16 users, more than 640K may be necessary. Prerequisite: The Major BBS (any edition).

Users, per doubling (up to 64) \$ 300

If you need multi-modem hardware:

Our Model 2408 consists of up to 8 Hayes-compatible modems on a single circuit card, for the PC/XT/AT/386/486 family. Each modem operates independently at 300/1200/2400 bps (automatically switching to match the caller's bps rate). Built-in serial ports are not COM-port based, so this card can co-exist with other COM port hardware in the same machine (drivers for software other than The Major BBS are not included but may be written). RJ-11 telephone cables are included. MNP Class 4 (error correction) modems are available as an option.

	non-MNP	MNP Class 4
2408 w/2 modems	\$ 1536	\$ 1696
2408 w/4 modems	\$ 2090	\$ 2388
2408 w/6 modems	\$ 2644	\$ 3080
2408 w/8 modems	\$ 3198	\$ 3772



When you're ready for source code:

With the C source code to The Major BBS, you can add 3rd-party software, such as The Major Database (a general-purpose, configurable database manager), various multi-player real-time adventure games, dial-out utilities, global command utilities, accounting enhancements, and much more. Also, you can maintain your own copy of the BBS, or you can modify it to suit your own unique requirements. The Major BBS C source code package is fully documented, and it includes the Galacticcomm Software Breakthrough Library, plus all of the

utility object libraries, linker control files, and DOS "batch" files you will need, along with a detailed Programmer's Guide. Works with Turbo C 1.5, 2.0, or 2.01, Turbo C++, or Microsoft C 4.0, 5.1, or 6.0. Prerequisite: The Major BBS Standard Edition.

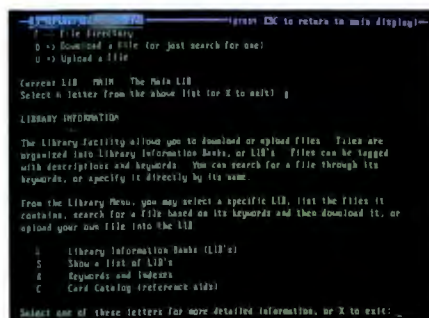
Standard Edition C source code \$ 285

For the ultimate in file transfer flexibility:

The File Library Edition of The Major BBS has everything that the starter system does, plus built-in ZMODEM, KERMIT, SuperKERMIT, YMODEM-g, and YMODEM (batch) file transfer protocols. Also, it offers super-fast pre-indexed keyword file searches, library-wide searches as well as constrained searches, special file upload/download accounting options, alternate DOS "paths" per sub-library, split paths for CD-ROM support, a transparent "DOS-only" sub-library option, and much more. This package is for you if the focus of your system will be the upload and download of large amounts of files. You can easily upgrade from the starter system to the File Library Edition, without losing any of your data files or configuration work you have already done. Prerequisite: The Major BBS Standard Edition.

File Library extensions \$ 199

File Library C source extensions* . . \$ 159



If you decide to offer online games and amusements:

The Entertainment Edition of The Major BBS has everything that the starter system does, plus Quest for Magic (a multi-player interactive text adventure game), Androids! (a multi-player arcade-style ANSI-graphics game), Flash Attack (a futuristic tank and laser battle for multiple players with IBM PC's), and the Action Teleconference Link-Up, which includes private "chambers", action verbs (grin, wink, nudge, etc.), the ability to link to other systems for huge multi-system teleconferences, custom entry/exit strings, user-configurable profiles, and much more. This Edition supports the Flash™ Protocol (where most of the game functionality is on the user's



end of the phone line), for which dozens of incredible new multi-user games are now being developed. Upgrading from the starter system to the Entertainment Edition is quick



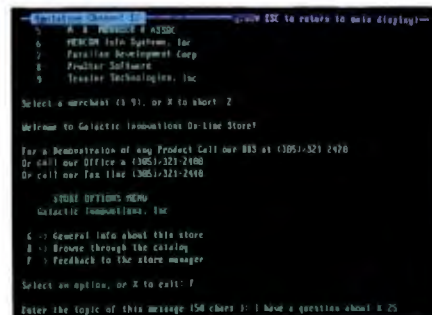
and easy and involves no loss of data or function. Prerequisite: The Major BBS Standard Edition.

Entertainment extensions \$ 149
Entertainment C source extensions* .. \$ 129

If your requirements include order entry and catalog sales:

The Shopping Mall Edition of The Major BBS has everything that the starter system does, plus online shopping. Your online mall can have multiple "stores", each run by its own separate "merchant", if desired. Each merchant has control over his or her own product line, pricing, discount structure, store welcome message, sales tax handling, etc. Also, each merchant may create up to 6 different payment methods (e.g. VISA, MC, AMEX, C.O.D., "bill me", etc.), and up to 6 different shipping methods (e.g. UPS, FedEx, US Mail, etc.), each with its own rates (flat rate, percent of sale, 1st-ounce/add'l-ounce, or 1st-pound/add'l-pound). Users may browse product catalogs at no obligation, or order products and services directly online! Orders generate invoices that are posted to the individual merchant as attachments to E-Mail. To upgrade from the starter system to the Shopping Mall Edition takes only a few minutes. Prerequisite: The Major BBS Standard Edition.

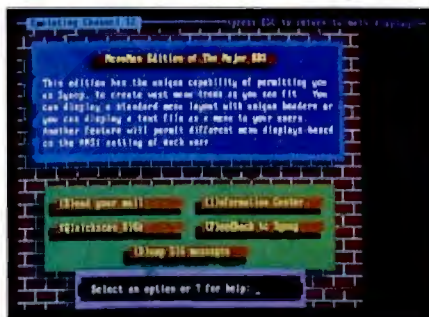
Shopping Mall extensions \$ 249
Shopping Mall C source extensions* .. \$ 189



For super-flexibility of menu trees and ANSI screens:

The MenuMan Edition of The Major BBS can do everything that the starter system does, and in addition you as Sysop can create your own menu trees, with menus leading to menus leading to menus, as deeply "nested" as you like. The "leaves" of your menu trees can be ordinary ASCII or ANSI files, which are simply dumped to the user's display (with or without automatic screen breaks), or they can be any of the built-in functions of the BBS such as scanning the user's incoming E-Mail or firing up a SIG quickscan. Includes commands like *GO <pagename>*, *FIND <topic>*, *USERS*, and for the Sysop, the equivalent of the DOS commands *DIR*, *RENAME*, *COPY*, *DEL*, *MKDIR*, and *RMDIR*, as well as a set of privileged commands for editing and extending the menu trees, remotely, while the BBS remains fully online. Upgrading from the starter system to the MenuMan Edition takes only minutes. Prerequisite: The Major BBS Standard Edition.

MenuMan extensions \$ 149
MenuMan C source extensions* \$ 129



As your system grows larger...

The GalactiBox™ is our 16-slot "expansion chassis", for large-scale systems. It has the unique ability to address individual modems by slot number rather than just COM port address, so you can use up to 16 standard internal modems in it, side by side, without conflict. Includes built-in 150W power supply, interface card for your XT/AT/386/486, cables, and full documentation. Up to 4 boxes may be attached to one CPU, for a total of up to 64-channel expansion capacity. Prices shown below are for standard 300/1200/2400 bps Hayes-compatible internal modems. We also have 9600 bps V.32/V.42 MNP Class 5 modems available, call for prices.

GalactiBox (unpopulated) \$ 1992
GalactiBox w/4 modems \$ 2416
GalactiBox w/8 modems \$ 2840
GalactiBox w/16 modems \$ 3688



...and that's not all! For advanced applications, we also offer an X.25 direct-connect software option, a protected-mode development toolkit, and special licensing arrangements for up to 256 simultaneous users! And don't forget the smorgasbord of 3rd-party add-ons available, such as The Major Database from Galactic Innovations. Custom programming and integration services are also available. Your system can grow in power and sophistication, far into the future, with The Major BBS.

Here's How To Order:

Just dial (305) 583-5990 and say, "I'd like to place an order!" We can generally ship your order within 48 hours. We accept major credit cards, or we can ship C.O.D. Prices shown do not include shipping or insurance.

For more information, you may either call the main order number and ask for a sales engineer, or dial (305) 583-7808 with your modem (8-N-1) for a free demo of most of our products. This demo system also contains an online Shopping Mall with many of the 3rd-party add-ons available for The Major BBS, operated by the 3rd-party vendors themselves.

Give us a call today!



The Major BBS, Flash Protocol, and GalactiBox are trademarks of Galacticcomm, Inc. PC, PS/2, XT, AT, and PC-DOS are trademarks of International Business Machines Corp. Hayes is a trademark of Hayes Microcomputer Products, Inc. The Major Database is a trademark of Galactic Innovations, Inc. Turbo C and Turbo C++ are trademarks of Borland International, Inc. MS-DOS and Microsoft C++ are trademarks of Microsoft Corp. UPS is a trademark of United Parcel Service. FedEx is a trademark of Federal Express Corp. MNP is a trademark of Microcom, Inc.

*The C source code extensions are necessary, if you wish to combine multiple extended Editions together, or add 3rd-party software, or develop your own modifications. Prerequisites, in each case, are the Standard Edition C source code, and the corresponding extended Edition.



Galacticcomm, Inc. 4101 S.W. 47 Ave.
Suite 101, Fort Lauderdale, FL 33314

Modem: (305) 583-7808
Fax: (305) 583-7846
Voice: (305) 583-5990

Circle 83 on Reader Service Card

IBM presents an offer on a truly grand scale.

Now your IBM Authorized Dealer has an offer that carries a lot of weight. When you buy selected IBM PS/2[®]s and an operating system during our "Grand Scale Sale," he's offering big rebates, over \$600 worth of free software, even quick credit and deferred payments.*

CASH REBATES.



Buy selected IBM Personal System/2[®]s, including the industry's best-selling personal computer, the Model 55SX,

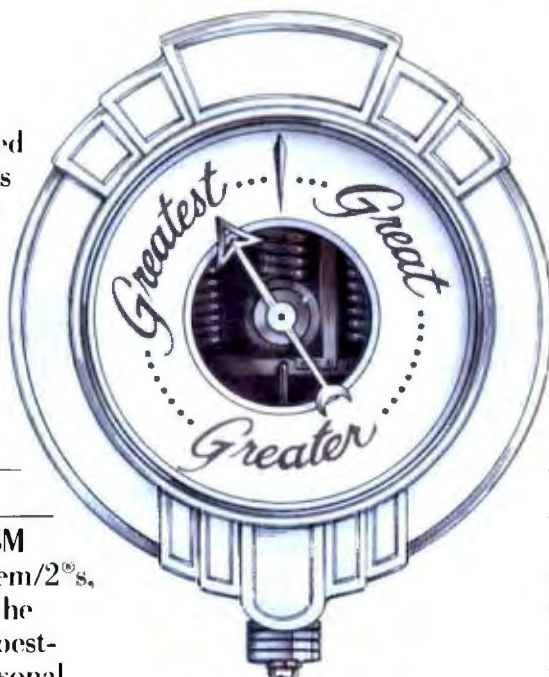
and you could get up to \$300 back. Buy any qualifying model and you could also get up to \$150 in rebates on selected IBM desktop printers like our high-speed IBM LaserPrinter.

FREE SOFTWARE.

Buy selected PS/2s, from Model 25 to 65SX, and you'll get over \$600 worth of free software designed to help increase your productivity. For work at the office or at home, there's LotusWorks, a powerful program that integrates spreadsheets, graphics, communications, word processing, spell checking and a



data base. PFS:First Publisher, a popular desktop publishing package, lets you create top-quality reports, newsletters and more. With Quicken[®], rated Best of 1989 by PC Magazine, you'll save hours of time and effort managing your business and personal finances. To keep track of meetings, dead-



lines and birthdays, and to manage multiple schedules, Calendar Creator Plus[™] lets you create customized calendars. Just for fun, you can play on the courses the pros play on with PGA TOUR[®] Golf. And Lotus[®] Magellan[®] ties all this free software together, which helps make it easy to install and use.

QUICK CREDIT.

The IBM credit card provides quick credit to all qualified buyers, so you can buy a PS/2 without using cash or any of your own credit cards.

NO PAYMENTS UNTIL FEBRUARY 1991.

When you purchase your PS/2 with an IBM credit card you can walk away from payments until next year.

TIP THE SCALES IN YOUR FAVOR.

If you want to take advantage of all these great deals, see your participating IBM dealer now. Offer expires January 15, 1991. For the name of the nearest IBM dealer, call 1 800 232-2300.

How're you going to do it? PS/2 it!


*Purchase of an IBM PS/2 and a DOS, OS/2[®] or AIX[™] IBM operating system required. Software value based on manufacturers' suggested retail price. Offer limited to the U.S.A. while supplies last. See your IBM Authorized Dealer for details. IBM, Personal System/2, PS/2 and OS/2 are registered trademarks and AIX is a trademark of International Business Machines Corporation. PFS:First Publisher is a trademark of Software Publishing Corp.; Quicken, a registered trademark of Intuit; Calendar Creator Plus, a trademark of Power Up Software Corp.; PGA TOUR, a registered trademark of PGA TOUR, INC.; Lotus and Magellan, registered trademarks of Lotus Development Corp. ©1990 IBM Corp.



VOLUME 15, NUMBER 11, 1990

BYTE

IBM SPECIAL EDITION

8 Editorial: Guideposts
by Gene Smarte

**15 COMPUTING AT
CHAOS MANOR**
Casting a Chaotic Network
by Jerry Pournelle

**37 BEYOND DOS:
WINDOWS AND OS/2**
**Money, SQL,
and Spreadsheets**
by Mark J. Minasi

41 MACINATIONS
Crossing Over
by Don Crabb

47 DOWN TO BUSINESS
Through a Window, Darkly
by Wayne Rash Jr.

51 THE UNIX /bin
**IBM and Unix:
Perfect Together?**
by David Fiedler

57 NETWORKS
Network Perestroika
*by Mark L. Van Name
and Bill Catchings*

244 Editorial Index
by Company

FEATURES

62 IBM in the Nineties
by Nick Baran

**75 Benchmarks at a Glance:
1990**
by Stanford Diehl

82 PC GUIs Go Head to Head
by Stan Miaszkowski

89 Stranger in a Strange Land
by Tom Thompson

97 Programming 32-bit OS/2
by Martin Heller

105 Multimedia: DVI Arrives
*by Greg Loveria
and Don Kinstler*

**113 DPMI: The DOS
Protected Mode Interface**
by L. Brett Glass

121 Optical Storage Primer
by David A. Harvey

133 Continental Computing
by Colin Barker

**137 Creating Virtual PCs
on the 386**
by Matt Trask

**153 Notebook PCs Set
the Portable Standard**
by Paul Schmidt

**161 Looking at the Graphical
User Interface**
by Bill Nicholls

169 Laying Out the Future
by Matt and Mary Page

175 Color for the Desktop
by Rick Cook

**183 The Migration of
the X Window System**
by David Moore

**187 SCSI: The I/O
Standard Evolves**
by Bruce Van Dyke

**193 Data to the Desktop:
The SQL Advantage**
by Robert J. Crutchfield

**203 Making the Micro-to-
Mainframe Connection**
by Sharon Fisher

207 Don't Worry, Use HLLAPI
by Mike Fichtelman

217 Adding Value to Your Data
by George Bond

**250 DOS Unbound:
Uses of Protected Mode**
by Andrew Schulman

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, \$34.95 per year. Single copies \$3.50 in the U.S., \$4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. Postmaster: Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 511, Hightstown, NJ 08520.

To see all its advantages,



NEC PowerMate 386/33E

Combining great power and speed with the enhanced compatibility of EISA architecture, the PowerMate® 386/33E is just what farsighted businesses need. For CAD/CAM. Financial modeling.

*The PowerMate 386/33E supports industry compatible graphics cards and displays. PowerMate, NEC, and C&C are registered trademarks of NEC Corporation.

PS/2 is a registered trademark and OS/2 is a trademark of International Business Machines Corporation.

you'll need powerful specs.

CPU

Intel 386™ microprocessor
33 MHz processing speed
(zero wait states)
8 MHz compatibility mode
(1 wait state)
Optional Weitek WTL 3167
or Intel 387 math coprocessor
Calendar/clock (with battery backup)

MEMORY

4 MB or 8 MB (80 ns)
memory standard
Dedicated 32-bit high-speed
Concurrent Memory Bus
architecture (33 MHz)
Total high-speed memory
expandable to 32 MB
64 KB (20 ns) SRAM cache

INTERFACES

Parallel printer port
Two RS 232C serial ports
PS/2® style mouse port
PS/2 style keyboard port

EXPANSION SLOTS

One 32 bit full-size memory slot
Five 8/16/32 bit ISA/EISA
full-size slots
One 8/16 bit full-size ISA slot
One 8/16 bit half-size ISA slot

STORAGE SLOTS

Five 5 1/4" half-height
Support for alternate two
full-height 5 1/4" and one
half-height configuration

KEYBOARD

101-key mechanical keyboard

Separate numeric and cursor
control pads

SYSTEM SECURITY

Power on password
Keyboard password
Network password
System cover lock (optional)

SOFTWARE/NATIVE MODE

SUPPORT

MS-DOS™
Windows™ 3.0
NEC-enhanced OS/2™ (optional)
SCO™ UNIX® System V (optional)
NEC-enhanced EISA
configuration utility

DATA STORAGE

Floppy disk drives
—1.2 MB 5 1/4"
—1.44 MB 3 1/2" (5 1/4" form factor)
Hard disk drives
—100 MB 3 1/2" ESDI
(< 23ms, 5 1/4" form factor)
—118 MB 3 1/2" SCSI
(< 20ms, 5 1/4" form factor)
—140 MB 5 1/4" ESDI (< 18ms)
—300 MB 5 1/4" SCSI (< 18ms)
—300 MB 5 1/4" ESDI (< 18ms)
—600 MB 5 1/4" SCSI (< 16ms)
Tape drives
—40 MB 5 1/4"
—150 MB high-speed 5 1/4"

DISK SUBSYSTEMS

EISA SCSI host adaptor (optional)
—EISA bus master capability
—support for 7 SCSI devices

—32-bit EISA bus interface
—33 MB/second burst rate
—scatter-gather transfer
—SCSI command queuing
—auto configuration
ESDI controller (optional)

NEC DISPLAY OPTIONS*

—MultiSync 2A
—MultiSync 3D
—MultiSync 4D
—MultiSync 5D

NEC GRAPHICS OPTIONS*

MultiSync® Graphics Engine™
—intelligent 50 MHz
TMS34010 processor
—VGA compatible (640x480,
16 colors)
—Super VGA (800x600, 16 colors)
—1024x768 (interlaced)
—1024x768 (non-interlaced)
—256-color version available

DIMENSIONS

Width: 21 2" (538 mm)
Depth: 17.7" (450 mm)
Height: 6.3" (160 mm)
Weight: 51 lbs (23 kg)

OPERATING ENVIRONMENT

Temperature—50° to 95° F
Relative humidity
—20% to 80% (non-condensing)
Power supply
—universal 115V/230V
—auto sensing
—325 watt maximum rated output

Multi-media. Presentation graphics. In short, for virtually any com-

MS-DOS and Macintosh are registered trademarks and Windows 3.0 is a trademark of Microsoft Corporation. IBM and PS/2 are trademarks of IBM Corporation.

plex application requiring the ultimate in 386 computing, it's a

MultiSync is a registered trademark and Graphics Engine is a trademark of NEC Technologies Inc. © 1990 NEC Technologies Inc.

perfect fit. For more details, call 1-800-NEC-INFO.

MultiSync is a registered trademark and Graphics Engine is a trademark of NEC Technologies Inc. © 1990 NEC Technologies Inc.

NEC

Circle 134 on Reader Service Card



GUIDEPOSTS

We'll point out the grand vistas as well as the intriguing side trips

It's hard to believe that this is the seventh annual *IBM Special Edition*. But IBM, its worthy competitors, and third-party suppliers have been such a force in this complex industry that we are again offering a bonus edition of *BYTE* to provide you with some direction and guideposts along the way.

You'll find an eclectic mix of articles in this issue, ranging from general-interest updates on important industry segments to more-detailed technical pieces on a wide variety of topics.

And a wide variety it is. Just as the microcomputing industry's boundaries are expanding and overlapping—what with DOS and its extensions, OS/2, Windows, Unix, mountains of compatibles, new microprocessors, networking, the Mac, and other hardware and software contenders—so, too, are the demands on *BYTE* readers to understand the “big picture.”

That's why there's such diversity in this year's *IBM Special Edition*, including information on the Mac and micro-to-mainframe communications.

The Big Picture

“IBM in the Nineties” is an overview of where the IBM world is heading. This article touches on key issues that will influence the way we work.

If you are wallowing in system manufacturers' endless claims about their hardware being fastest, “Benchmarks at a Glance: 1990” is for you. The *BYTE* benchmarks rank the top PCs, Macs, and Unix platforms, using comprehensive, unbiased testing from the pros in the *BYTE* Lab.

With all the hoopla and volumes of material being written about OS/2 and Windows 3.0, just what are the crucial differences to users? The graphical presentation of these two graphical user interfaces found in “PC GUIs Go Head to Head” makes it easy to compare their approaches.

Although once completely isolated from the IBM world, today the Mac fits in quite nicely, part of the expanding idea of communications among dissimilar platforms. If you work with Macs and PCs, the practical information provided in “Stranger in a Strange Land” will help you smooth out the data sharing.

And speaking of cooperative efforts, we also have “Making the Micro-to-Mainframe Connection” and “Don't Worry, Use HLLAPI,” a language that helps you work out shared processing tasks among PCs and mainframes. Along with those, “Adding Value to Your Data” delves into hardware and software approaches for moving data.

Finally, our man in London, Colin Barker, senior editor, surveys the European computing scene with particular emphasis on IBM in “Continental Computing.” He concludes that things are different from the U.S. when it comes to computing perceptions and expectations for both buyers and sellers.

Software Development

Microsoft's OS/2 2.0 Software Development Kit is going to affect future OS/2 software development that we'll all use. “Programming 32-bit OS/2” digs deep into this developing environment.

Maybe you need to run other operating systems within an operating system? “Creating Virtual PCs on the 386” by Matt Trask shows you how to do that and lots more. If you are curious about what 32-bit DOS means, Andrew Schulman's “DOS Unbound: Uses of Protected Mode” is a hands-on C tutorial for producing 32-bit protected-mode applications that run under our old friend, DOS!

Optical Report

Optical devices continue to climb onto the microcomputing juggernaut. In “Optical Storage Primer,” find out about different devices and how they and the available applications software performed. Also, the tremendous potential of digital video interactive is explored in “Multimedia: DVI Arrives.”

Desktop Publishing and Printing

First-hand business experiences and a desktop publishing wish list make up “Laying Out the Future,” which profiles the state of DTP today. For the DTP of the future, a deep look at color printing technology, its capabilities, and its costs, appears in “Color for the Desktop.”

Trends and Standards

In “Notebook PCs Set the Portable Standard,” you can find out where all this miniaturization is taking us, and when we will get there.

If you're interested in the world of graphics, “Looking at the Graphical User Interface” by Bill Nicholls covers hardware, software, and GUIs for today and tomorrow. Ever wonder why Structured Query Language hasn't caught on? Read about an emerging specification in “Data to the Desktop: The SQL Advantage.”

SCSI contributes widely to device compatibility. The latest incarnation emerges in “SCSI: The I/O Standard Evolves,” along with a hint at SCSI-3. “DPMI: The DOS Protected Mode Interface” is a revised Virtual Control Program Interface that tries to provide binary compatibility in software applications across many different platforms.

Despite the deserved attention to Windows 3.0, another windowing scheme is quietly growing in Unix-land and headed our way: “The Migration of the X Window System.”

—Gene Smarte

Special Projects Senior Editor
(BIX name “gsmarte”)



NOW YOUR SOFTWARE CAN TEST ITSELF.



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 (401) 351-2273. And put an end to your worst nightmares. Automatically.

CADRE

Cadre Technologies
19545 N.W. Von Neumann Dr.
Suite 200
Beaverton, OR 97006

Circle 37 on Reader Service Card

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

BYTE

EDITOR IN CHIEF
Frederic S. Langa

MANAGING EDITOR
Anne Fischer Lent

NEWS
New York: Managing Editor: Rich Malloy
Associate News Editor: Andrew Reinhardt
Peterborough: Senior Editor: Stan Miastkowski
Senior Editor, Microbytes: D. Barker
Associate News Editors: What's New: David Andrews, Martha Hicks
Editorial Assistant: Amanda Waterfield
San Francisco: News Editor: Owen Linderholm
Associate News Editor: Jeffrey Bertolucci
London: Senior Editor: Colin Barker

BYTOLAB
Managing Editor: Michael Nadeau
Technical Director: Rick Grehan
Senior Editor: Dennis Allen
Technical Editors: Alan Joch, Robert Mitchell, Tom Yager
Testing Editors/Engineers: Stephen Apiki, Stanford Diehl, Howard Eglowstein, Stanley Wozniak

STATE OF THE ART
Senior Editor: Jane Morrill 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. Minas, Wayne Rash Jr., Mark L. Van Name

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

COPYEDITING
Chief Copy Editor: Lauren A. 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

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

BIX BYTE INFORMATION EXCHANGE

DIRECTOR
Stephen M. Laliberte

MANAGING EDITOR
Tony Lockwood

MICROBYTES DAILY
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

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

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

ADVERTISING SERVICES (603) 924-8448
Director of Advertising: Lisa Wozniak
Assistant: Christine W. Tourgee
Customer Service Supervisor: Linda Fluhr
Senior Account Coordinator: Lyda Clark
Account Coordinator: Dale J. Christensen
Materials Coordinator: Karen Cilley
Advertising Assistant: Roxanne Hollenbeck
Creative Services Manager:
Susan Kingsbury
Production Artist: Lillian J. Wise
Quality Control Manager: Wai Chiu Li
Production Coordinator: Rod Holden

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: Glyn Standen
Subscriptions Manager: Paul Ruess
Assistant Manager, Subscriptions:
Margaret Liszka
Subscriptions Assistant: Holly Zilling
Newsstand 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,
Ed Codman

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

EXCHANGE EDITORS
Macintosh Exchange: Laurence H. Loeb,
IBM Exchange: Barry Nance, User Group
Exchange: David Reed, Interactive Game
Exchange: Richard Taylor, Amiga
Exchange: Joanne Dow, Writers Exchange:
Wayne Rash Jr., Tojerry Exchange: Jerry
Pournelle, Telecommunications Exchange:
Stephen Satchell

PUBLISHER
Ronald W. Evans

ADVERTISING SALES
Associate Publisher, Vice President
of Marketing: Steven M. Vito
Administrative Assistant: Carol Cochran
Eastern Advertising Director:
Arthur H. Kossack (312) 616-3341
Sales Assistant: Julie Barker
Western Advertising Director:
Jennifer L. Bartel (214) 701-8498
Sales Assistant: Susan Vernon

NEW ENGLAND
ME, NH, VT, MA, RI, CT, ONTARIO,
CANADA, & EASTERN CANADA
Daniel D. Savage (617) 860-8395

EAST COAST
NY, NY, NJ, DE, PA
Kim Norris (212) 512-2646
Ariane Casey (212) 512-2368

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA, MS, AR, LA,
DC, MD, WV, KY
John Schilin (404) 843-4782

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE,
IN, MI, OH
Kurt Kelley (312) 616-3328

SOUTHWEST, ROCKY MOUNTAIN
CO, OK, TX
Alison Keenan (214) 701-8498

SOUTH PACIFIC
SOUTHERN CA, AZ, NM,
LAS VEGAS, UT
Ron Cordek (714) 557-8282
Alan El Faye (714) 557-8282

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, WY,
NORTHERN NV, WESTERN CANADA
Bill McAfee (408) 879-0371
Roy J. Kops (415) 362-4600
Leslie Hupp (408) 879-0371

CATALOG SHOWCASE/OUTSERTS
Scott Gagnon (603) 924-2851

INSIDE SALES
Director: Liz Coymann
Administrative Assistant: Susan Boyd
Secretary: Vivian Bernier

NATIONAL SALES
Mary Ann Goulding (603) 924-2864
Patricia Payne (603) 924-2854
Jon Sawyer (603) 924-2885

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 Echavarria (603) 924-2574
Larry Levine (603) 924-2837

BYTE POSTCARD DECK MAILINGS
BYTE DECK
Ed Ware (603) 924-8168
COMPUTING FOR ENGINEERS DECK
Ellen Perham (603) 924-2588

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 247.

EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, NH
03458, (603) 924-9281

West Coast Branch Offices: 425 Battery St.,
San Francisco, CA 94111, (415) 954-9718;
3001 Red Hill Ave., Building #1, Suite 222,
Costa Mesa, CA 92626, (714) 457-6292.

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

BYTEnet: (617) 861-9784 (set modem at 8-1-
Nor 7-1-E; 300 or 1200 baud).

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

SUBSCRIPTION CUSTOMER SERVICE: Outside
U.S. (609) 426-7676; inside U.S. (800) 232-
BYTE. For a new subscription—(800) 257-
9402 U.S. only, or write to BYTE Subscrip-
tion Dept., P.O. Box 555, Hightstown, NJ
08520. Subscriptions are \$29.95 for one
year, \$54.95 for two years, and \$74.95 for
three years in the U.S. and its possessions
in Canada and Mexico, \$34.95 for one year,
\$64.95 for two years, \$87.95 for three years.
£41 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, \$50 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, \$4.50 in
Canada. Foreign subscriptions and sales
should be remitted in U.S. funds drawn on a
U.S. bank. Please allow six to eight weeks
for delivery of first issue.

EDITORIAL CORRESPONDENCE:
Address editorial correspondence to:
Editor, BYTE, One Phoenix Mill Lane,
Peterborough, NH 03458. Unacceptable
manuscripts will be returned if accom-
panied by sufficient postage. Not re-
sponsible for lost manuscripts or photos.
Opinions expressed by the authors are not
necessarily those of BYTE.

PHOTOCOPY PERMISSION:
Where necessary, permission is granted by
the copyright owner for those registered
with the Copyright Clearance Center (CCC),
27 Congress St., Salem, MA 01970, to
photocopy any article herein for personal or
internal reference use only for the flat fee of
\$1.50 per copy of the article or any part
thereof. Correspondence and payment
should be sent directly to the CCC, 27
Congress St., Salem, MA 01970. Specify
ISSN 0360-5260/90, \$1.50. Copying done
for other than personal or internal reference
use without the permission of McGraw-Hill,
Inc., is prohibited. Requests for special
permission or bulk orders should be
addressed to the publisher. BYTE is avail-
able in microform from University Microfilms
International, 300 North Zeeb Rd., Dept.
PR, Ann Arbor, MI 48106 or 18 Bedford
Row, Dept. PR, London WC1R 4EJ,
England.

OFFICERS OF MCGRAW-HILL, INC.:
Joseph L. Dionne, Chairman, President and
Chief Executive Officer; Robert N. Landes,
Executive Vice President, General Counsel
and Secretary; Walter D. Serwatka,
Executive Vice President; Frank D.
Pengelase, Senior Vice President, Treasury
Operations; Robert J. Bahash, Executive
Vice President and Chief Financial Officer;
Thomas J. Sullivan, Executive Vice
President, Administration; Mary A. Cooper,
Senior Vice President, Corporate Affairs,
and Executive Assistant to the Chairman;
Ralph R. Schulz, Senior Vice President,
Editorial.

Founder: James H. McGraw (1860-1948)

Copyright © 1990 by McGraw-Hill,
Inc. All rights reserved. BYTE and
BIX are registered trademarks of
McGraw-Hill, Inc. Trademark registered in
the United States Patent and Trademark
Office.

 Member
Audit Bureau of Circulation

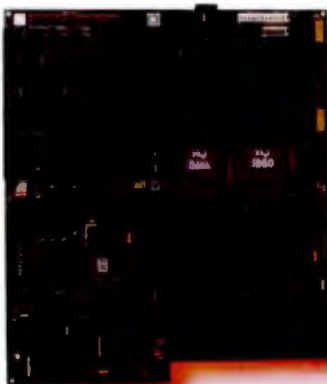
INTRODUCING THE 4860[®] MOTHERBOARD. YOUR ULTIMATE BUILDING BLOCK.

The Dynamic Duo. The 4860 is an industry-first MotherBoard that packs the power of the Intel 80486 CPU with the Intel 80860 RISC processor ($i486 + i860 = 4860$). With it, you can build mainframe power into PC's for applications including CAD, LAN and desktop publishing. Equally impressive, our 4860 pumps up performance in your UNIX workstations.

A PC Revolution. In the PC environment, the 4860 is a 486-based MotherBoard which runs over 2 times faster than 386 computers. It's fully compatible with DOS, IBM's OS/2, Novell Netware and UNIX. What's more, Hauppauge's 4860 supports up to 64 MBytes of memory *without* a RAM expansion board!

RISC-Y Business. Thanks to the 4860's symmetrical architecture, both the i486 and the i860 processors can access the full range of memory, I/O system, and the 64-bit expansion bus. The result? Unprecedented dual processor performance.

You'll find that the i860 processor is ideal in graphics applications, performing up to 25 million floating-point operations per second. That's more than 10 times faster than the i486 processor alone! There's even an optional 64-bit frame



buffer card for ultra high-performance workstation graphics. **For UNIX Workstations, Too.** The 4860 board makes a great foundation for high-performance RISC workstations that run advanced UNIX applications. Many workstation vendors are choosing the i860 processor as a standardized vehicle for CAD and simulation systems, and the 4860 is perfectly compatible with these applications.

Technical Features: • 4 Megabytes of high speed RAM expandable to 64 MBytes shared between i486 and i860 processors • Socket for optional 128K static RAM cache module for the i486 • Full size PC/AT form factor • Eight EISA I/O slots • 64-bit expansion slot • 1 parallel, 2 serial ports.

The 4860 MotherBoard. Built with the world's highest performing microprocessors. So you can build the world's highest performing PC's and workstations.

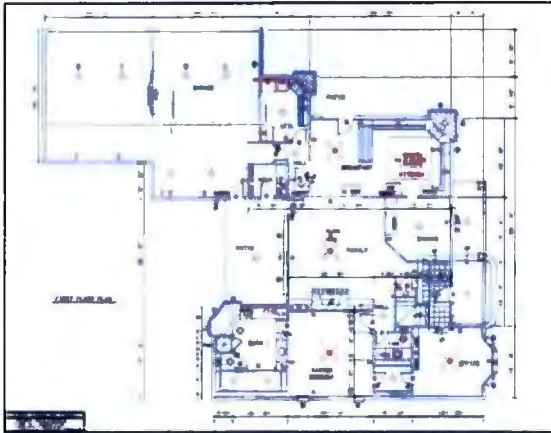
Hauppauge Computer Works, Inc.
91 Cabot Court
Hauppauge, New York 11788
Toll Free: 1-800-443-6284
In New York: 516-434-1600
In Europe: (49) 2161-17063

Hauppauge!

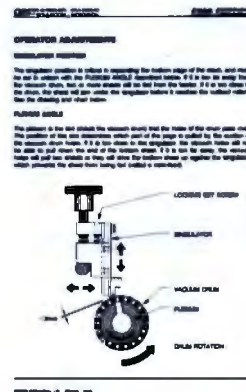
Trademarks: IBM AT and OS/2: IBM. Intel 386, i486 and i860: Intel Corp. DOS and XENIX: Microsoft Corp. 4860 MotherBoard: Hauppauge Computer Works, Inc.

Circle 97 on Reader Service Card

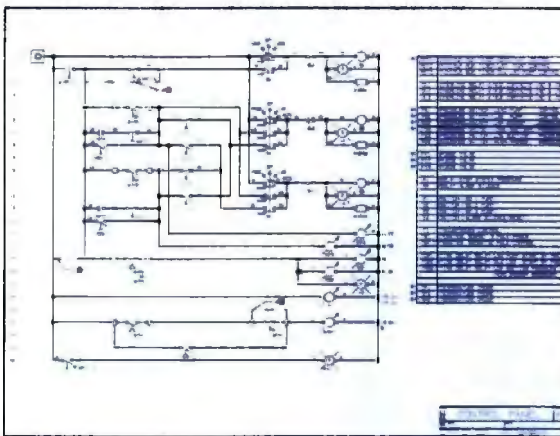
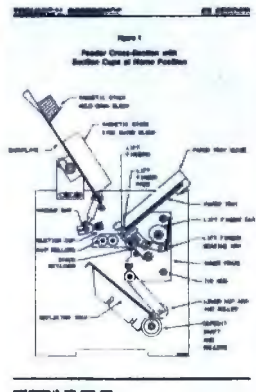
WHAT MAKES A BEST



A great plot begins with a great idea, easily translated through every phase of design with Generic CADD 5.0.



Exchange your DXF™ files with other CAD systems or insert designs into desktop publishing programs to create technical illustrations.



No matter the complexity, symbols keep your work flowing uninterrupted. Tap our professional libraries or create your own symbols.



Need to fit a conventional design in a nonconventional space? Revise and improve in less time with Generic CADD's one-stop convenience.

A GREAT

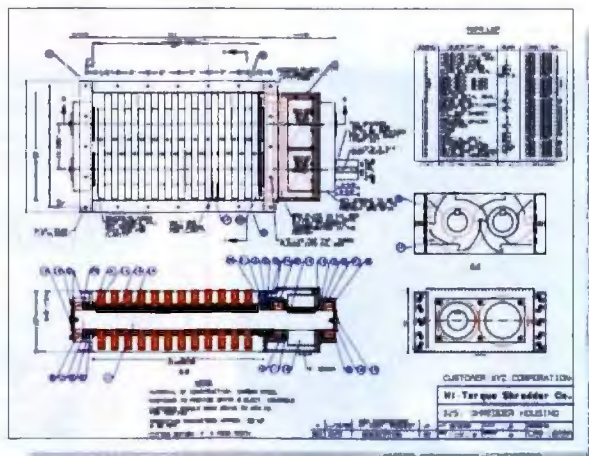
Ask any of over 250,000 users of Generic CADD.™ They've discovered CADD that's powerful without being complicated. And professional without being pricey.

Our latest version, Generic CADD 5.0, is just \$395. It's a complete design and drafting program backed by a support team that's drawing rave reviews.

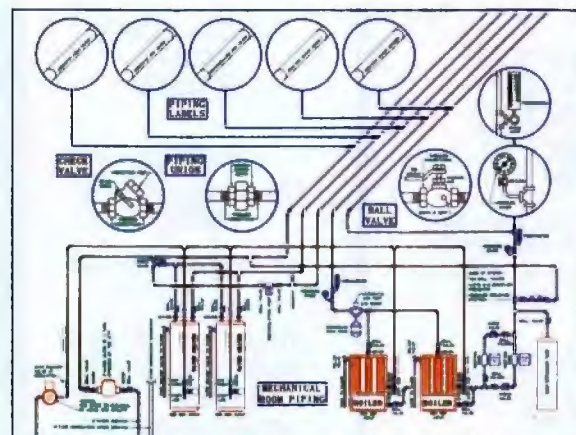
A BEST SELLER SELLER?



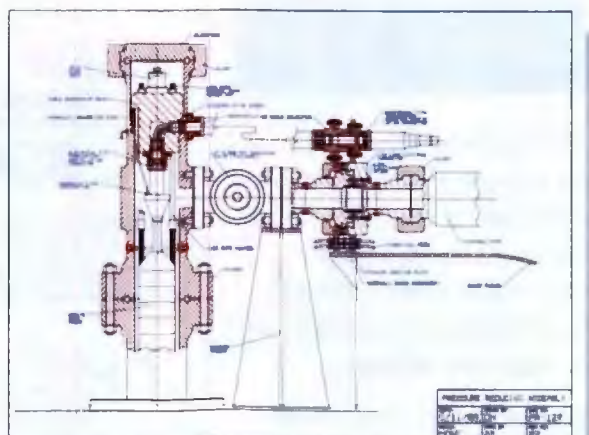
Whether it's millimeters or miles, count on Generic CADD for floating point precision at any scale.



Deadline pressure is a thing of the past. Designs can be quickly edited and annotated to produce final working drawings.



Generic CADD 5.0 supports plotters as well as dot matrix and laser printers, including PostScript® printers.



Any way you look at it, CADD is a natural tool for bringing clarity to complex ideas and designs.

PLOT.

Call us at 1-800-228-3601 for our free full-color CADDalog® and portfolio of CADD drawings.

You'll see every plot has a great ending.

Circle 84 on Reader Service Card (RESELLERS: 85)



Generic
SOFTWARE
An Autodesk Company

IT DOESN'T GET
ANY EASIER.



The 486 Champ

"...THIS COMPUTER DESERVES YOUR ATTENTION."

PC MAGAZINE - SEPTEMBER 11, 1990



"...probably has the best mix of support, service, and customer satisfaction policies of all the computers in this review."

PC MAGAZINE - July, 1990

"Support Policies - Excellent."
INFOWORLD - MAY 7, 1990

FLASH CACHE 486/25 \$5295

Complete with Intel's 80486 CPU, 64K RAM Cache, 4MB RAM, 1.2MB Floppy, 1.44MB Floppy, 200MB Hard Drive, 1024 x 768 SVGA Color Combo, Parallel & Serial Ports, and 101 Keyboard.

FLASH CACHE 386/33 \$3695

Complete with Intel's 80386 CPU, 64K RAM Cache, 4MB RAM, 1.2MB Floppy, 1.44MB Floppy, 200MB Hard Drive, 1024 x 768 SVGA Color Combo, Parallel & Serial Ports, and 101 Keyboard.

FLASH CACHE 386/25 \$2995

Complete with Intel's 80386 CPU, 64K RAM Cache, 4MB RAM, 1.2MB Floppy, 1.44MB Floppy, 104MB Hard Drive, 1024 x 768 SVGA Color Combo, Parallel & Serial Ports, and 101 Keyboard.

On the September 11, 1990, 24 of the industry's hottest 486 powerhouses went head to head for the honor of winning PC Magazine's coveted *Editor's Choice Award*. Tri-Star delivered knock-out punches in speed, price and virtually every other important category.

Once again the choice is clear. If you or your company demands the most performance for the money, the highest quality components and unrivaled 486 power, Tri-Star is more than the right decision - *it's the only decision.*

CAD WORKSTATIONS

All Tri-Cad Systems include the Flash Cache 386/486 complete with Math Co-processor, Nanao 16" non-interlaced display and a 12 x 12 Digitizer.

TRI-CAD PROFESSIONAL
325
\$4695

TRI-CAD ADVANCED
333
\$5495

TRI-CAD EXPERT
425
\$6495

UPGRADES:

RENDITION II/256 V
\$695

20" HITACHI MONITOR
\$995

"...THOSE OF YOU WHO WORK IN THE CAD ENVIRONMENT SHOULD INQUIRE ABOUT ITS (TRI-STAR'S) BUNDLED SYSTEMS."
PC MAGAZINE



ALL FLASH CACHE COMPUTER SYSTEMS INCLUDE:

- ◆ 60 Day Money Back Guarantee ◆ 2 Year Warranty
- Parts & Labor ◆ 12 Month TRW On- Site Service
- ◆ Lifetime Toll-Free Technical Support
- ◆ Air Express Parts Replacement

Circle 207 on Reader Service Card

All prices and specifications subject to change without notice. Money Back guarantee does not include shipping charges. All systems have been verified or certified to comply with part 15 of the FCC rules for a Class A or Class B computing device.



1.800.678-2799

707 West Geneva, Tempe, Arizona 85282

Tech Support 1.800.688-TECH
Telephone 602.829-0584
Fax 602.345-0110

Monday - Friday 7:00am-7:00pm MST
Saturday 9:00am-4:00pm MST

*Linking all the computers
at Chaos Manor
is a daunting task*

CASTING A CHAOTIC NETWORK

I think this is a first. Certainly I don't usually make shareware my lead item, but this time it's appropriate, since I usually look at some aspect of the state of the art in the annual IBM issue, and this is certainly state-of-the-art shareware.

If you happened to see *The Hunt for Red October*, you may have noticed a peculiar display on the wall behind the admiral: a Mercator world chart, with an odd curved shape of light and shadow splashed across it. It is, in fact, a clock, and quite authentic; just about every senior CIA officer has one. What it shows is which areas of the world are in light and darkness just at the moment. Naturally, those responsible for controlling the U.S. spy satellites find this interesting.

The odd curved shape, representing the parts of the world that are in sunlight, changes over the course of the year, being concave southward when it's summer in the northern hemisphere, and concave northward when the sun travels south.

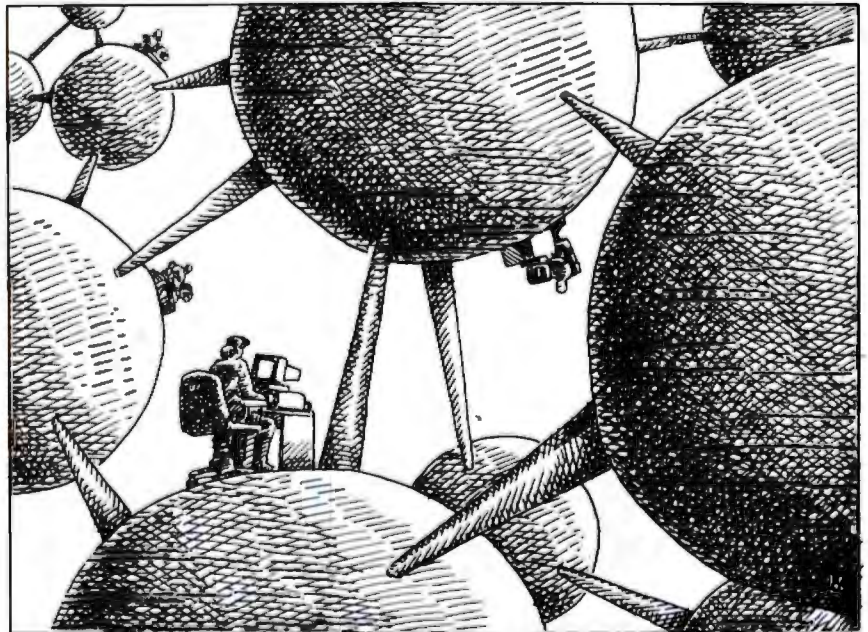
There was a clock like this in the science room of the Los Angeles Public Library. That clock was electromechanical, and it worked by moving the Mercator map on a continuous strip. I don't know how accurate it was. I always wanted one, but I found that the cost was higher than I cared to pay.

Now I have one, and it's better than the original.

Geoclock

Geoclock is a computer simulation of the mechanical clock. I have seen only the EGA and VGA versions, but I understand there's a CGA version as well. In EGA it's plain gorgeous, and I often put it up on the 19-inch Electrohome monitor just to have it as eye candy in the Great Hall.

The shareware version is plenty good enough, but when you send in your \$30 registration, you get a new version with a whole raft of extra features. Some, such as city names, I don't much care for, but



most of that can be turned off. One warning: the program needs to be installed, since it comes with compressed files; but, unfortunately, it won't install from the B drive. It happens that I got 5¼-inch floppy disks, and the A drive of the Zenith 386/33 that drives the Electrohome monitor is a 3½-inch drive, so I had to copy the 5¼-inch floppy disks over to 3½-inch floppy disks. That worked fine.

I'll have a downloadable copy of the shareware version in my BIX conference, but my advice is not to bother with it; send the \$30 and be done with it. It's inconceivable that you won't like this program. The graphics are great; every check I can make on the accuracy of the sunlight shape indicates that the programmer has it spot on; and there's even a little circle to indicate the exact spot that the sun is over at any given time.

Try Geoclock; you'll like it. It definitely gets a User's Choice Award. Highly recommended.

High End and Low End

It's understandable that most writers like to talk about high-end stuff. I know I do, because that's where the fun is. My latest toys are a Cheetah Gold 486, with a Perceptive Solutions disk drive controller and 15 megabytes of memory. It's so fast, it scares me. If that weren't enough, there's the Premier 9000 and an Arche Rival 33-MHz 386 system with a 300-MB hard disk drive and a tape backup unit. These machines rival anything on the market, and they're fun.

There's a point to writing about high-end equipment: we help drive the industry. Brit Hume, in a recent essay, says this is a conflict of interest. I don't see it that way; what possible conflict of interest have I? I don't own high-tech stocks, and I already have more computer equipment than I need. More than I want. Nearly more than I can endure. There's not room for much more. I can't sell the

continued

stuff, and returning it or giving it to schools or institutions takes time away from writing. What I can do is use it, determine what I like and dislike, and tell everyone in the hopes that the next models will be even easier to use. Today's Chaos Manor Dream Machine is tomorrow's mail-order special. I paid \$12,000 in 1977 for Ezekial, my friend who happened to be a microcomputer; think what that would buy today!

True, most of the PCs out there are not ultrafast 386s, or even 386SX machines. The number of XTs is steadily falling, but there are a fair number of them left, while the majority of PCs are 286 AT systems. However, nearly all the really neat new software is designed for the 386 machines; if we're to have an influence on where the industry goes, we've little choice on what to write about. The new software may work on a 286, but it will be slow and clunky.

Take Windows 3.0. This is pretty nifty on a fast 386 with a big hard disk and lots of extra memory. It's acceptable (but just barely) on a very fast 286. It's impossible on a standard 286.

Then there's Word for Windows. On

something like the 33-MHz Premier 9000 with Windows 3.0, Word for Windows screams along. It has a different philosophy from my current word processor and more features than I have any need for—my writing needs are pretty simple—but some people need the ability to print out text in fancy ways, while others figure they may need to do that some day. What Word for Windows will not do is run acceptably on a 286—or, for that matter, on a slow 386.

If you don't like Word, there's Ami Professional for Windows. It's an excellent word processor, with good feel, and I like it; but, once again, you need a fast 386 and adequate memory to run it. Put it on a clunky old 286, and I guarantee you'll hate it.

Moreover, despite the number of older and slower 286 machines out there, there's not going to be much in the way of new software for them. Just about all the development resources of the industry and by far most of the talent are aimed at software for the 386. Windows 3.0 has attracted the largest single block of that effort. Microsoft has come out with a winner, and there's a scramble to get on

the bandwagon. But you can't write off Quarterdeck, which makes both Desqview, which lets you do task switching and some multitasking, and the QEMM-386 memory management package, which is in many ways superior to both the Microsoft and Digital Research memory managers.

Desqview is not a graphical user interface; for that, Quarterdeck is working on a version of the X Window System. I've seen it at the company's annual Desqview seminar, and it looks pretty good. The company is shipping a toolkit for developers, but it won't be out for a few months. X was developed for Unix, but Desqview X is a program that runs under Desqview under DOS. However, I don't need a GUI, and some people don't much like them. I don't find the DOS C:\ prompt all that intimidating, and I suspect most of my readers don't; and there are plenty of programs being written for plain old DOS. Just about all of them work fine on a 386 running QEMM and Desqview; in fact, that's what I'm using as I write this. I like Windows 3.0 well enough, but I find I'm more productive

continued

This Should Go On Your Desk For The Same Reasons It Goes On The Road.

See us at COMDEX/Fall, Booth #N4438

Remember when sending a fax meant leaving your desk? Or when faxing on the road was almost impossible?

Those days are over. Introducing the WorldPort 2496™ portable fax and data modem.

Since it's external to your computer, it's easily shared around the office. And since it's battery powered and uses RJ11s or optional acoustic couplers, it connects to public phones and PBXs anywhere. Via Bell and CCITT standards worldwide. It even sends and receives fax and

data messages unattended or while you run applications.

But best of all, from your desktop or laptop, you can instantly connect with practically anyone anywhere who owns a fax or modem.

Unless, of course, they've ventured out on the road without one.

Call us today at 800-541-0345 (in New York, 516-261-0423) for more on the WorldPort line and the dealer nearest you.



Touchbase Systems, Inc.
160 Laurel Avenue
Northport, NY 11768
(516) 261-0423
Fax (516) 754-3491

WorldPort 2496 is a trademark of Touchbase Systems, Inc., © 1989 Touchbase Systems, Inc.

OmniTel

Solutions For Today And Tomorrow.



- ☐ OEM and Standard Products
- ☐ 386/486 Motherboards
- ☐ Data/Fax, V.32 modems
- ☐ VGA/Super VGA Adapters

1 (800) OMNITEL

Circle 137 on Reader Service Card

OmniTel Inc.

3500 W. Warren Avenue
Fremont, CA 94538

☎ (415) 490-2202

FAX (415) 657-4079

Finally, a fast, powerful text editor that integrates your favorite programming tools and uses no memory!

VEDIT PLUS



- Mouse support
- Pull-down menus
- Columnar blocks
- 1000 Level Undo
- Regular Expressions
- Small 70K, super fast
- DOS, UNIX/XENIX, FlexOS
- Also VEDIT \$69, VEDIT Jr. \$29

FREE Evaluation Copy Call 1-800-45-VEDIT

The new VEDIT PLUS is the productivity breakthrough programmers have been looking for. Run not only popular compilers, but all of your favorite tools from within the editor. When shelling to DOS, VEDIT swaps itself and any desired TSRs out of memory to give you more memory than when you entered VEDIT.

Only VEDIT gives you the advantages of a powerful and flexible editor without giving up the convenience of an integrated environment.

VEDIT offers stunning performance, versatility and ease of use. Completely written in assembly language, it's small and lightning fast. Edit text and binary files of any size, even 100+ megabytes. Installation is trivial; VEDIT.EXE and an optional help file are all you need - no overlays, no configuration files.

Other features include multiple file editing, windows, unlimited keystroke macros, "hot keys", context sensitive help, word processing, automatic indenting and total configurability. VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT PLUS adds a powerful "off the cuff" macro programming language, complete with source level debugging.

VEDIT PLUS - \$185 for DOS, \$285 for UNIX/XENIX. Call for a free demo today.

Greenview

P.O. Box 1586, Ann Arbor, MI 48106
(313) 996-1299 • Fax (313) 996-1308

when I'm running Desqview.

Desqview will also run many plain-DOS programs on a 286. You don't get real multitasking on a 286, but then, you don't get very good multitasking on a 386 either. Multitasking DOS programs is somewhat better with Desqview than it is with Windows 3.0, but neither is all that great. On the other hand, most of us don't really want true multitasking. What we want is rapid task switching, and you can get fairly rapid task switching on a 286, particularly if you have a fair amount of extended memory to swap the programs in and out of. Desqview will also swap to a RAM disk, or to your hard disk.

SemiDisk

One way to update a 286 is to add memory. I've elsewhere discussed the difference between expanded memory, which follows the EMS memory standard and can be used by programs written to use it (but only by them), and extended memory, which is extremely useful in a 386 but has limited utility in a 286. Desqview can make use of extended memory as an area into which it can swap programs, and if you have a 286 machine with extended memory, this is a good thing to do with that memory. You can also turn extended memory into a RAM disk.

The advantage of a RAM disk, especially on an older machine that is likely to have a slow hard disk drive and an even slower floppy disk drive, is that it is fast. The problem with a RAM disk is that it's not really a disk, and thus isn't permanent: any power-down, including a minor power failure, will cause everything in the RAM disk to go away.

There are a couple of ways out of that dilemma. One, of course, is an uninterruptible power supply; these are getting cheaper every year, and they save not only what's on a RAM disk, but anything you're currently working on. I'm on record as saying that anyone who does serious creative work on a computer is mad not to have a UPS, but then I'm known to be a bit monomaniacal on the subject.

The other solution is SemiDisk from SemiDisk Systems. Very longtime readers will recall that I used to use SemiDisk cards in Old Zeke, my S-100 computer. SemiDisk's great rival in S-100 times was Bill Godbout's M-Drive H, which did much the same job. The difference was that SemiDisk had a connection for an external battery backup.

SemiDisk Systems has retained that feature with its PCompatible cards. What this means is that if you have a power failure, you'll lose what's in mem-

ory, but, provided that your power is restored within a matter of hours, you'll be able to save what's on the SemiDisk.

SemiDisk is fast, a lot faster than the hard disk drives you'll find on a 286 system. It's pretty speedy on a 386, too, but there it's up against much faster hard disk drives. The SemiDisk can hold up to 8 MB and can transfer all that data in a few seconds, one-half to one-quarter the time required by a good hard disk drive. Of course, a fast 386 system can turn extended memory into a RAM disk, so the only real advantage of SemiDisk over extended memory on a 386 is the battery backup.

What to Do?

A year ago, I advocated that 286 owners try to sell their systems for as much as they could get, and buy a 386. It's too late for that now. You can't get much for a 286 computer.

This year, my recommendation is that you keep your old machine.

First, it may be good enough for a while. There's not a lot of new software being written for it, and I predict that you'll get tired of hearing about all the neat new stuff you won't be able to play with, but, in fact, a 286 AT with the software available at present is more machine than most of us had for the most critical years of the computer revolution. It ain't all that fancy, but for a while it may well be good enough.

Second, I don't recommend that you spend a lot upgrading it. Instead, save that money for the 386 you'll buy. Incidentally, I have no strong advice on the 386 versus the 486; I don't think there will be any great differences except for price. Think of the 486 as a combination 386/80387. Many think they don't need the 80387, but if you do any number crunching at all—as in simulations, cellular life experiments, playing with fractals, CAD, or big spreadsheets—you'll definitely want a math chip.

Third, when you get your 386, use the 286 as a network server where you can hang all your peripheral equipment. Give it the CD-ROM, voice mail, a modem, a fax if you use a computer for fax, a tape backup unit, and possibly even a WORM (write once, read many times) drive.

Here's how.

LANtastic

Artisoft's LANtastic is *not* the network you need if you have to connect a number of minicomputers, big workstations, and suchlike. But it is more than adequate for

continued



486/25

\$4,860

- Intel 80486, 25 MHz, 4MB
- 128K SRAM cache

“Without a doubt, the Tangent is the overall price/



- Fastest Super VGA adaptor in the industry
- 1024 x 768 VGA monitor
- 80 MB (19ms), w/cache
- 1.2 MB or 1.44 MB Teac
- 1 parallel & 2 serial ports; Enhanced 101 keyboard

performance winner of the group, and perhaps even



386 SVGA Systems
(2MB, 42MB HD):

- 80386SX, 20 MHz \$1995
- 80386, 25 MHz \$2295
- 80386, 33 MHz \$2995 w/cache

of 486 systems in general.” (Personal Workstation,



For a Quote or to Order,
Call 800-223-6677

415-342-9388

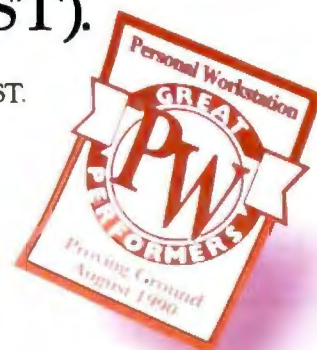
FAX 415-342-9380

Corporate P.O.s accepted



8/90 review of Tangent, Compaq, and AST).

In Personal Workstation's review, the Tangent 486/25 clearly outperformed both Compaq and AST. And Tangent was priced as much as 67% less! Get breathtaking graphics and unparalleled hard disk performance. Plus a 30-day unconditional money-back guarantee, and a lifetime, toll free technical support hotline. Call today, for this and other Tangent review reprints, and for a quote on a wide choice of EISA and ISA configurations.



Tangent Computer, Inc., 197 Airport Blvd., Burlingame, CA 94010.

© Copyright 1990 Tangent Computer, Inc.

Circle 187 on Reader Service Card



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

People like MKS Tools,
but they love ours . . .

The Berkeley Utilities

UNIX COMMANDS FOR MS-DOS

- ◆ 33 UNIX commands with all System V and BSD 4.3 options plus a number of DOS-specific enhancements
- ◆ Includes *awk*, *cp*, *diff*, *ech*, *ed*, *find*, *make*, *mv*, *rm*, *sed*, and *sort*
- ◆ Each utility is stand-alone, uses video attributes, and has a built-in Help screen
- ◆ Demos available on our BBS or on disk

Requires 256K and DOS 3.0 or higher
A hard disk is recommended

Order Now

\$200

800-542-0938

MasterCard or
VISA accepted

**30-Day Money-back
Guarantee**

OPENNetwork
POWER TOOLS FOR POWER USERS

215 Berkeley Place, Brooklyn, New York 11217
Voice: 718-398-3838 BBS: 718-638-2239

a surprising number of jobs. In particular, it's plenty good enough to give you a lot of use out of your old 286.

The simplest network involves only two machines. Setting that up is fairly simple. I say "fairly"; but do understand that all network setups are more difficult than you think they are, and even a simple two-station LANtastic network will take you all afternoon before it's done satisfactorily.

Moreover, I strongly recommend that before you begin work, you take an hour or two off to read the LANtastic documents—not only the installation sections, but those on network management. Mind you, I understand that's not how you generally work. It's not how I work. We have, in the past few years, become accustomed to just mucking about when it comes to new software and hardware; we don't need no stinking documents, except as reference works when something goes wrong. Alas, that's exceedingly unlikely to work here. Networks are complicated.

That's the bad news. The good news is that if you're diligent, LANtastic will eventually work to give you some real power capabilities; and once you understand how it operates, it's very easy to re-configure the network.

Decisions

The first thing you must decide is whether you are going for speed or memory savings. LANtastic comes in two flavors: Ethernet, and the company's older proprietary twisted-pair system. (*Twisted-pair* refers to the cable, which is actually nine-wire cable terminating in DB-9 connectors.) The decision is a nontrivial one, involving quite different hardware and software; while Ethernet LANtastic looks to the user much the same as the older LANtastic, the user interface is about all the two have in common.

The advantages of Ethernet are speed and a thin, standard, coaxial cable. Ethernet communications are about five times faster than twisted-pair. If you access a remote system's hard disk drive via Ethernet, you may not notice that you're working over a network at all. With twisted-pair you might, depending on the disk speeds you're used to.

The advantage of twisted-pair is memory savings: the twisted-pair LANtastic network software is installed in dual-ported RAM and runs on a Z180, which are both right on the network board. Ethernet software must be installed as a TSR program in your computer, where it eats 16K bytes of memory.

continued

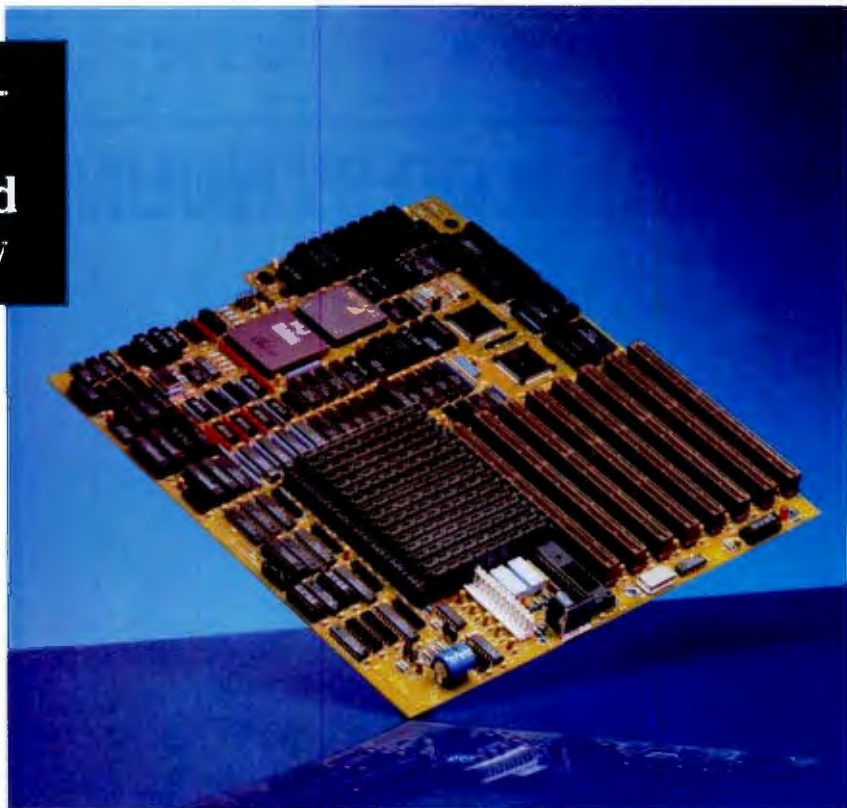
Unchartable Performance

Sun workstations...move over.
The Micronics 80486-33 EISA board is here.

- **Landmark 148+**
- **14 MIPS**
- **64MB On-board SIMM Capacity**

Fast. Micronics' 486 system board is designed for true 33MHz operation. The Micronics design also supports both the 80486 CPU burst mode and EISA burst mode for maximum CPU performance. It has write-through cache, which is essential for EISA bus architecture where DMA is frequently used. The write-through cache continually updates both cache memory and RAM memory so that after a DMA operation, the cache memory is always validated.

Powerful. Performing with 32-bit processing power, the Micronics 80486-33 EISA "machine" provides RISC-like performance in a CISC architecture. An ideal platform for UNIX/XENIX time sharing systems, high performance CAD/CAE and file servers. The 80486 EISA is also perfect for OS-2 Presentation Manager and X-Windows applications.



Solid. The 80486-33 EISA features 8 expansion slots with 6 EISA bus master slots, all of which allow for seamless integration of 16-bit and 8-bit AT/ISA I/O cards. Additionally, you'll have no more worries when your memory needs intensify. The 80486-33 EISA provides over ten various memory capacity choices from 1 to 64MB on-board! These memory configurations utilize 256K, 1MB or 4MB SIMM memory concurrently.

Micronics offers a complete line of advanced quality engineered 80386 and 80486 system boards.

*Watch us run
Landmark off the scale.*

MICRONICS
COMPUTERS INC.

232 E. Warren Avenue, Fremont, CA 94539
(415) 651-2300 Fax (415) 651-5666

save you 16K bytes in each of the machines you use it in.

LANtastic boards are well designed, but they come set up wrong.

PCompatible machines are "interrupt-driven," meaning that any device—keyboard, hard disk drive, communications ports, floppy disk drive—that has a task to perform must first get the computer's attention. That is done by interrupts.

However, when the AT came along, the bus was extended, and additional IRQs were made available. Alas, most hardware boards still make use of only the original group, and that crowds things a lot. However, some companies have got smart and added the capability to use additional IRQs. LANtastic is one of these: the company has physically connected IRQ 7, 10, and 15, as well as the original group. Which IRQ your board uses is set by a jumper on the LANtastic card. Unfortunately, the factory setting is IRQ 3, which is recognized by DOS as the COM2 interrupt. Thus, if you want to have more than one serial port on your machine—as in a modem and a serial mouse—you can't use IRQ 3. Fortunately, it's easy enough to set the board to use IRQ 10, which is what we've done.

Next, if you're using LANtastic to network a remote system hung with peripherals like CD-ROMs, WORM drives, and Bernoulli Boxes, it's likely that the LANtastic I/O port address will have to be changed, because two devices cannot use the same I/O port address settings. The factory default setting is 300 hexadecimal, but there's a provision for setting it to 320h, 340h, or 360h.

I now have a dilemma: for some readers, the above is old hat and boring. For others, it's incomprehensible; worse, while the Artisoft manual is remarkably clear in explaining *how* to set the IRQ and I/O port address, it has almost nothing to say about *why* you'd want to do that. My dilemma is that if I go into a long explanation, I'll lose two-thirds of my readers, and I hate it when that happens. Thus, a blanket statement: have faith. Even if all the above means very little to you, you *can* set up a LANtastic network. Just be prepared to spend a day at it, and understand that there'll be a lot of trial and error.

On that score: before you start, make up a "panic" floppy boot disk for your machine. Get it right, so that your system comes up recognizing all your peripherals. Test it. Now make a *copy* of that floppy disk, and use that copy to experiment with changes in CONFIG.SYS and

continued

Now, even complex flowcharts that once took days to perfect can be presentation-perfect—in no time!

Quick to master and a snap to use. Patton & Patton's flowcharting software is the standard of both large and small businesses around the world — and is available through all major software dealers.

See your dealer today! Or, for a "live," interactive demo disk, call: 800-525-0082, ext. BY35. International: 408-778-6557, ext. BY35.

Works on IBM & 100% compatible PCs, supports CGA/EGA/VGA and over 150 dot matrix and laser printers, with multiple print densities and 10 font sizes. **Creates multi-page charts, portrait or landscape, on most standard paper sizes.** Mouse or keyboard controlled.

IBM is a registered trademark of International Business Machines Corporation.



PATTON & PATTON
Software Corporation

Excellence in charting the flow of ideas!

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.

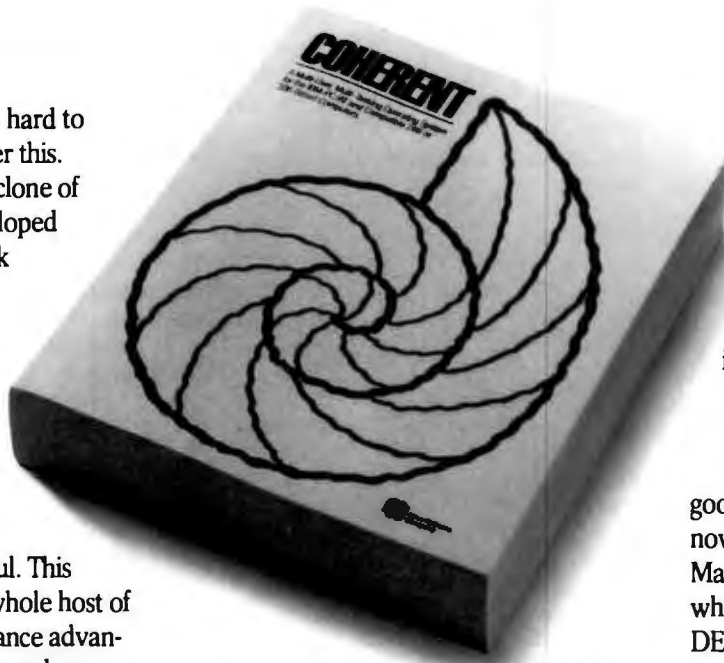
SMALLER, FASTER...BETTER.

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,

LESS IS MORE!	Coherent For the IBM-PC/AT and compatible 286 or 386 based machines.	
	Santa Cruz Operation's XENIX 286, Version 2.3.2	
No. of Manuals	1	8
No. of Disks	4	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	\$99.95	\$1495.00

*Byte Exec benchmark, 1000 iterations on 20 MHz 386.
Hardware requirements: 1.2 meg 5¼" or 1.4 meg 3½" floppy, and hard disk. SCSI device driver available soon. Does not run on Microchannel machines.



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 1-708-291-6700)
60-DAY MONEY BACK GUARANTEE!



**Mark Williams
Company**
60 Revere Drive
Northbrook, IL 60062

*Plus shipping and handling. Coherent is a trademark of Mark Williams Company. UNIX is a trademark of AT&T. XENIX is a trademark of Microsoft.

AUTOEXEC.BAT. It will take longer for your machine to boot up those experiments from a floppy disk, but you won't be worried that you've done something awful to your machine—and you will worry about that. Installing a network takes patience, great gobs of patience. And when you've locked up your system so thoroughly that only complete power-down will restore it to life, the rule is, Don't Panic.

Workstations and Servers

LANtastic is a "peer" network, but that doesn't mean that every machine in the network is equal. What "peer network" means is that any node on the network can be either a workstation or a server. Moreover, that status can be changed at any time. For the network to operate, at least one machine must be designated as a server, but it doesn't matter which one it is. Moreover, the server needn't be confined to being just a server, although in my own network it is.

What distinguishes a workstation from a server is that a server makes designated assets available to the network, while a workstation does not. Thus, a worksta-

tion may send to or take files from any device, including the hard disk, of a suitably configured server, but the server can neither send to nor access files of that workstation. This can have important security implications for businesses. In my own case, for example, I can set up the network so that I can send files to my children's machine, but no one can access my machine from theirs. Even more important for our present discussion, though, is that the workstation isn't running as much memory-resident network software as the server, and better yet, every bit of the workstation software can (on a 386) be stuffed up into high memory, either with QEMM.SYS, LOADHI.SYS for running with Desqview, or HIMEM.SYS for running with Windows.

Thus, what I have is Big Cheetah set up as a workstation, networked to the Zenith 386/25 as a server. The Zenith has a 150-MB hard disk drive, which I can use to store files, and as a place for backing up anything I write on the Cheetah. It has a pair of daisy-chained Denon CD-ROM drives, both completely accessible over the network. There's no reason why I

can't add other peripherals, like a scanner, a Bernoulli Box, and a Complete PC Phone System, all available over the network, and none of them taking up memory in the primary machine.

Setting Things Up

I don't have room to describe everything I had to do to get the network working. Devices conflict with each other and with the network. Desqview (which I run only on the Cheetah workstation, not on the Zenith server) adds complications; so does Windows. Seemingly minor changes have crashed the system, leaving me totally baffled for an hour as I tried to figure out why. A complete account of my experiences would fill this column and more.

I can assure you that it's worth it. You can, given time and patience, set up a bulletproof network. The results are well worth the effort, because you'll end up with much larger windows—Desqview or Windows 3.0—while still having access to CD-ROM and other memory-eating peripherals. I won't pretend that getting there won't be a frustrating experience.

continued

SAVE 30 MINUTES EVERY TIME YOU HAVE A PC PROBLEM!

**NEW VERSION 3.0
Now Available!**

By using Check✓It[™] to find out if the problem is
Hardware or Software

The second you suspect a problem with your PC, you should reach for Check✓It, the world's most popular PC diagnostic software. Running Check✓It should be the first thing you do -- because confirming or eliminating your PC's hardware as the source of the problem can save you time, money, and unnecessary repair calls.

Check✓It will test your PC's main system board, memory, hard disk drive and floppy disk drives, video subsystem, communication ports, printer, keyboard, mouse, or joystick. Check✓It will also display key software and setup data, including your PC's exact equipment configuration, current IRQ assignments, memory allocation, device drivers, and CMOS table.

Take a minute to run Check✓It the next time you have a PC problem. Then you'll know the answer to these key questions: Should you back it up, pack it up, and send it out for repair? Should you fix a hardware problem yourself? Or, should you concentrate on the software and configuration problems that you can correct?

The moment you suspect a PC problem, run Check✓It.
It's about time!

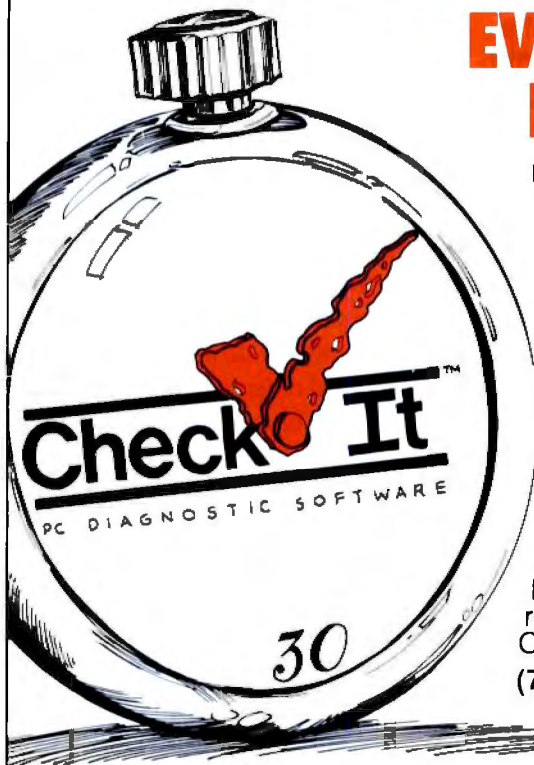
Look for Check✓It at leading
retail stores everywhere.
Or call TouchStone TODAY!

(714) 969-7746 or (800) 531-0450

TouchStone
Software Corporation

2130 Main Street, Suite 250, Huntington Beach, CA 92648

Check✓It is a registered trademark of TouchStone Software Corporation. Copyright ©1990 TouchStone Software Corporation. ALL RIGHTS RESERVED.



**NEW
"Basic
PC Maintenance"
Hands-On Video
Ask for it
TODAY!**

See Us At
COMDEX
Booth #151

MINUTEMAN[®]

UNINTERRUPTIBLE POWER SUPPLIES

TOTAL POWER PROTECTION

- ★ BLACKOUTS
- ★ BROWNOUTS
- ★ OVERVOLTAGE
- ★ UNDERVOLTAGE
- ★ SURGES
- ★ SPIKES
- ★ EMI/RFI

STANDBY UPS MODELS

- 250 VA To 2300 VA
- Sinewave output - 1 millisecond transfer time
- Communications interface and external battery packs available for extended run times

ON-LINE UPS MODELS

- 500 VA To 5,000 VA
- Static By-pass Standard
- True On-Line - Sinewave outputs
- Communications Interface and external battery packs available for extended run time



NETWORK MANAGER

- Shutdown software for unattended operation
- Only software to communicate with LANs and WANs
- Novell 286 VAP and 386 NLM
- SCO Xenix

SLIMLINE & UPRIGHT MODELS



COMMUNICATIONS INTERFACE

For Unattended System Shutdown

COMPATIBLE WITH:

- Novell
- LAN Manager
- ALTOS
- BANYAN
- VINES
- System V UNIX
- Custom Configuration Any System

NOVELL
Monitor Boards Available



1455 LeMay Drive
Carrollton, TX 75007

Telephone:
(214) 446-7363

FAX: (214) 446-9011 TELEX: 140275 OMEGA

1-800-238-7272

FOR L.A.N.
NOVELL LABS
TESTED AND
APPROVED
NetWare Compatible

"Distributed in over eighty countries"

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

BYIBM

*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
International Distributors Australia: 61 2 419 7177 Brazil: 55 11 825 1887
Central America: 506 28 07 54 Denmark: 45 42 887249 France 33 1
46092784 Italy: 39 45 584711 Japan 81 3 473 7432 Mexico 52 83 49 51 00
The Netherlands: 31 02159 46 814 Norway 47 244 8855 Sweden: 46 013
124780 Switzerland 41 64 517475 Taiwan 886 2 552 3277 Turkey: 90 1 152
0516 United Kingdom 44 0992 500919 Uruguay: 598 2 92 0959 USSR: 01 32
35 99 07; 812 292 19 65; 0142 437952 West Germany 49 07127 5244
Copyright ©1990 Raima Corporation. All rights reserved.
db_ is registered in the U.S. Patent and Trademark Office.

With that caution, here are some tips and principles.

First, *please* make sure that you have "panic" boot-up floppy disks for *each* machine that you'll be working with. Moreover, as you learn how to make things work, make updated boot floppy disks, but keep a copy of whatever worked last. There's nothing so frustrating as having to go back three steps be-

he loves it. Have faith.

Finally, if you're connecting up CD-ROM assets, you should read the entire CD-ROM section in the LANtastic manual. Even then, the manual won't make it clear that you do *not* need to run any CD-ROM software whatsoever—including MSCDEX.EXE—in the workstation. The only machine that is required to run MSCDEX is the server on which the CD-ROM is located. You *must* tell the network software (on the server) that the asset in question is a CD-ROM; if you don't, there's no way it will work. How to do this is explained in the manual, but not very well.

NetWORM

One thing that doesn't work very well over the network is the Maximum Storage WORM drive.

The first big problem is getting the WORM drive to work with the Denon CD-ROM drives. That can be done, but since the DENON drives are true SCSI, while the Maximum Storage WORM is "almost scuzzy," it's a bit tricky addressing each properly. That, however, is a minor detail. LANtastic and the Maximum Storage WORM drive won't work together even if the WORM drive is the only asset on the server.

When you set up a LANtastic network, you use the network manager software to tell the server what devices it will make available to remote workstations. That's when you tell the system if the asset is a CD-ROM. Of course, a WORM isn't a CD-ROM, so in my first attempt I didn't describe it as one.

The network appeared to work fine. The WORM worked fine when accessed on its own machine. The network software at the workstation told me I could access all the assets on the server, and I could, all but one; but when I asked for a directory of files on the WORM drive, I got nonsense. I then went back to the network manager software and designated the WORM as a CD-ROM; the next time I tried to get a WORM directory from the workstation, I still got garbage, although not as unintelligible as before. Frustratingly, it *almost* worked.

Almost isn't good enough. As I understand it, Artisoft and Maximum Storage are working together to correct the difficulty, but so far they haven't done it. However, I do have a way to use the WORM drive on the network. Alas, it's a kludge.

Recall that the WORM drive works fine when run from the machine that it's on. That is, if I bring the Premier 9000

continued

First,
*make sure you have
"panic" boot-up floppy
disks for each machine
that you'll be working
with. Second, proceed
systematically.*

cause you forgot how you made something work.

Second, be sure to proceed systematically. When I was in the aerospace industry, I acquired a hefty reputation as a troubleshooter, even though much of the time I was working with technology I didn't understand very well. My secret was what I called "the relentless application of logic." I never assumed anything was working until I'd tested it, and if I ran into trouble, I'd go back to a configuration that worked and add features until it failed; that way, I knew precisely what had caused the problem. From there, it was no great trick to find a solution.

My advice for setting up a network is to do much the same thing: reduce both computers to bare bones, and get the network working between them. Then add assets to the server, and fancy stuff like QEMM and Desqview to the workstation. When something crashes—and it will—go back a step and proceed a different way. Make use of Quarterdeck's Manifest, or System Sleuth, to look at what is going on in system memory. Eventually, you'll figure it all out. Many have. Retiring Science Fiction Writers of America president Greg Bear knows almost nothing about computers, but he was willing to experiment until he got things right. He now uses Microsoft Bookshelf inside WordPerfect 5.0, and

**SUPER
VGA
NOW SHIPPING**



**"The best 1024x768 monitor you can buy
until Tatung makes something else."**

The chart says it all.

Both the new Super VGA Tatung 98X Omniscan monitor and NEC's Multisync 3D™ monitor offer up to 1024x768 resolution,* superior 0.28mm dot pitch, and compatibility with IBM's newest monitor, the 8515™.

But the remarkable Tatung 98X Omniscan actually costs \$250 *less* than the NEC 3D.

Today, Tatung performance and value lead the industry.

In a recent comparison of 26 monitors from twenty manufacturers, *Byte Magazine* ranked another Tatung monitor first in performance.

"A rose among the thorns," said *Byte*.

"Best buy," confirmed *PC World*.

	NEC Multisync 2A	NEC Multisync 3D	Tatung Omniscan CM-1496X	Tatung Omniscan CM-1498X
1024x768 Max Resolution 8514/A Compatible	No	Yes	Yes	Yes
Super VGA (800x600)	Yes	Yes	Yes	Yes
Dot Pitch	0.31mm	0.28mm	0.31mm	0.28mm
Price †	\$799	\$1,049	\$749	\$799

* Interlaced resolution available with the ATI VGA Wonder™, Genoa Super VGA 6400™, Paradise VGA 1024™ and other leading IBM 8514/A™ standard graphics adaptors † Suggested retail price and features February 1 1990. All trademarks are the property of their respective owners.

But compare for yourself. Call Tatung at 1 (800) 827-2850, ext. 213. Tatung Company of America, Inc., 2850 El Presidio Street, Long Beach, CA 90810.

Because Tatung monitors are something else.



TATUNG®
Engineering at its best.

with its APX-5200 WORM drive into the network as a server, the Premier doesn't lose the WORM drive. Thus, if I run server software on Big Cheetah, making his hard disk drive accessible by the Premier, I can then walk over to the Premier 9000 and *from there* send files from the WORM to the Cheetah and copy files from the Cheetah to the WORM. Big Cheetah cannot find the Premier's WORM, but the Premier can. I hope that's all clear. If not, read it again, because the next step is where the real kludge comes in.

The Network Eye

Artisoft has another program, Network Eye, that works across LANtastic, and apparently any other network, to let you control one computer from another. That sounds simpler than it is, or at least I found myself confused when I first thought about it.

Let's drop back a step. Suppose I log onto the network, using Big Cheetah as a workstation, and through the network invoke Geoclock, which is on the Zenith's hard disk drive but not on Big Cheetah's. Big Cheetah reaches out through the net-

work; the network software accesses the Zenith's hard disk drive; and the Geoclock file is peeled off the Zenith's disk and brought into Big Cheetah, which runs it. Take another example: suppose I access MicroProse Railroad Tycoon across the network. Once again, the workstation is running the program; but this time, since Railroad Tycoon needs continuous access to disk files, from time to time the workstation will ask the network, and the network will ask the server, for disk information. Since the server has to provide that disk access, there's a sense in which the server is being remotely controlled; but the important thing to remember is that the only control you have over the remote machine is to order it to access its various assets. You can't tell it to run a particular program.

With Network Eye, you *can* tell the remote machine to run another program.

A second point of confusion: Network Eye designates machines as masters and slaves, and these terms have *nothing* to do with whether a machine is a workstation or a server. Thus, a server machine can be a master, and through Network Eye, that server can control a worksta-

tion. A server can't demand files from a workstation, but a server that's designated as a master can order the workstation to *send* files that the server could not itself access.

Sounds like Big Brother, doesn't it? Actually, a machine cannot become a slave without its own permission; you cannot remotely order a machine to run the slave software. That task must be done from the machine's own keyboard. Moreover, when you configure LANtastic and Network Eye, you can set up passwords for either or both (i.e., the password for logging onto the network may be one thing, and that for accessing a slave machine may be another).

Thus, the kludge: I bring up the Premier with the WORM drive and other peripherals and run the LANtastic software—for remote WORM access, it doesn't matter whether as workstation or server. The Premier also runs Network Eye and designates itself as a slave. Now I set up Big Cheetah as a LANtastic server and run the Network Eye master program. Then, as master, I access the Premier and tell it to do whatever I want

continued

All DDI ExecuTower Systems Run MS-DOS®, OS/2®, UNIX®, XENIX®

Standard Systems Include:

- ExecuTower System Unit
- VGA Video Card 1024x768, 512K Video RAM
- Super VGA 14" 1024x768, .28mm Color Monitor
- 85 MB SCSI Hard Disk
- 1.2 MB 5¼" AND
- 1.44 MB 3½" Floppies
- 2 Serial, 1 Parallel Ports
- 101-Key Enhanced Keyboard
- Mouse
- 30-day Money-back Guarantee
- 1 Year Warranty Parts & Labor
- 24-hour Parts Replacement
- Toll-free Technical Support

All systems delivered with MS-DOS installed, configured and ready to run!



**Complete
VGA Color,
85 MB
System Prices
Start At
\$2,195!**

**Call Us
TOLL FREE**

Call 1-800-331-1090
FAX 1-401-884-0770
In California Call
(213) 371-7568

Full Line of DDI ExecuTower Systems:

- 486™/33 MHz EISA Systems \$5,495 to \$14,995
- 486™/25 MHz ISA Systems \$4,295 to \$14,495
- 386™/33 MHz ISA Systems \$3,495 to \$3,995
- 386SX™/16 & 20 MHz ISA Systems \$1,995 to \$2,495

Digital Distributing, Inc.

20 Cavalier Drive, E. Greenwich, RI 02818 (401) 885-6697

486 and 386 are trademarks of Intel Corporation.
MS-DOS and XENIX are registered trademarks of Microsoft Corporation.
OS/2 is a registered trademark of IBM. UNIX is a registered trademark of AT&T.

We slash interface development time. (and we can prove it!)

C-PROGRAMMERS: See for yourself how Vermont Views™ can help you create user interfaces the easy way.

If you want to start saving a *tremendous* amount of time and effort, call for your free Vermont Views demo kit and put us to the test. Vermont Views is a powerful, menu-driven screen designer that comes with a C library of over 550 functions. Which means you can create user interfaces in just a fraction of the time it takes to write the code yourself!

Why try to reinvent the wheel when Vermont Views lets you interactively create pull-down menus, window-based data-entry forms (with tickertape and memo fields), scrollable form regions, choice lists, context sensitive help, and a host of other interface objects.

Vermont Views combines the convenience of a fourth generation language with the power, flexibility, and blinding execution speed of native C code.

Turn your prototype into the application.

Let's face it. With most systems, you have to throw away your prototype when coding begins. Which means you waste precious time

and effort. With Vermont Views, things are a lot different. In fact, the prototype actually *becomes* the application. So menus and data-entry forms are usable in the final application without change. Names of functions for retrieving, processing, and storing data can all be specified as the prototype is created. And that's just for starters.

Here's a truly universal solution.

When you create an interface with Vermont Views, you can port it among PC-DOS, OS/2, UNIX, XENIX, and VMS.

Vermont Views can be used with any database interface (most do), and will create interfaces for any roman-based language. Our form-locking version lets you develop quickly and safely on networks and multi-user operating systems, too.

If you need DOS graphics in your applications, we also have the answer. Vermont Views™ GraphEx allows all Vermont Views' windows, menus, and forms to work in CGA, EGA, VGA, and Hercules graphics modes.

So you can use your favorite graphics package to create charts, graphs, and other images to enhance text displays.



Vermont
Creative
Software

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

WE GUARANTEE YOUR SATISFACTION. FOREVER.

We're so sure you'll love Vermont Views that we make this iron-clad, money-back guarantee. If you're ever dissatisfied with Vermont Views, for any reason, return it for a prompt, no-questions-asked refund. (All you have to do is certify that you haven't incorporated our code into any application.)

Call for your FREE demo kit!

800-848-1248

(Please mention "Offer 073")

Don't take our word for it. Put Vermont Views to the test by calling for your personal, free demonstration kit. Or fax us at (802) 848-3502.



© Copyright 1990
Vermont Creative Software

"IMPEL is so much fun, it's almost a shame that it's useful too."
—New York Times

Desktop Animation

IMPEL system



Use IMPEL to make fully animated presentations without programming. It's perfect for demo disks, trade shows, point of sale, and business presentations.



- Works with all IBM graphic hardware: VGA, EGA, CGA, including 256 color and high resolution.
- Use IMPEL's embedded paint program or import graphics in .PCX, .LBM, .CUT, and Targa file formats.
- Optional compiler makes fast go faster, up to 70 Hz frame rates.

With IMPEL you make animation by intuitively picking and placing graphics on the screen. Click the shutter to record a frame. Instant playback and editing helps get the job done faster—including revisions!

IMPEL REQUIRES:

- IBM® PC-STANDARD COMPUTER, 640K
- GRAPHICS ADAPTER
- MS-DOS 2.0 (OR LATER VERSION)
- MOUSE OPTIONAL, BUT RECOMMENDED

SYSTEM INCLUDES:

- ANIMATION EDITOR
- PLAYBACK PROGRAM
- DEMONSTRATION DISKS
- ILLUSTRATED MANUAL

IMPEL

IMPEL is a trademark of Eastridge Technology. IBM is a registered trademark of International Business Machines Corporation.

IMPEL system (5.25" or 3.5") \$195
IMPC animation compiler (optional) .. \$100
Visa, MasterCard accepted.

E A S T R I D G E
T E C H N O L O G Y

37 Murray Street, New York, NY 10007
Phone (212) 267-7980 Fax (212) 608-5679

done with the WORM. Since Big Cheetah is at the moment a server, the Premier can access Cheetah's disk; but while Cheetah can't access the Premier's WORM, the Premier can, and thus can send and receive from it. Except, of course, I'm using Network Eye to have the Cheetah tell the Premier what to make the Cheetah send and receive.

If you read that about three times, it

Systat
*has become the
standard statistics tool
for everything from
law-enforcement
agencies to economics
shops to psychology
labs.*

will make sense.

As I said, it's a kludge, and not one I like; but it does illustrate the power of LANtastic and Network Eye.

The bottom line is that with LANtastic, you can use your old machine to add significantly to the power of your new machine.

Systat

Back in 1986, I got a letter from Leland Wilkinson of the Department of Psychology at the University of Illinois at Chicago. It accompanied a copy of Systat for the IBM PC. I set letter and program aside to be looked at later, and they fell into the chaos stream and disappeared from view. Then a couple of weeks ago, I was talking with Milt Stevens, who co-chaired the First Annual Space Development Conference with me many years ago. Milt works for the L.A. Police Department as a civilian analyst. "Well," he told me, "your microcomputers are finally having an effect on law enforcement. We're getting some PC compatibles in, and I've been learning Systat. Got some other people in the department looking at it, too."

I nodded sagely, and I dimly remembered that I had a copy of Systat somewhere, and I ought to look at it. In fact, it

wasn't hard to find, since it had gravitated to a high shelf in (nearly) plain view. It was also easy to see why this program has become the standard statistics tool for everything from law-enforcement agencies to economics shops to psychology labs. Even in the version I have, Systat is fast, accurate, and relatively simple to use. More than that, it's *complete*: it includes everything from the simplest possible statistics to factor analysis with rotations, stationary time series, cluster analysis, and a whole raft of stuff I would have lusted for back in the days when I ran an operations research shop.

The manual is complete, too: it varies in approach from simple conversational to academic with references and footnotes, but in all cases the approach is to get you to use the stuff and see what happens. I can see why Stevens and his associates find this package attractive. It's powerful enough to do anything they're likely to need, but well enough explained to let you, with effort, learn complex statistical analysis. I must say I found the manual a better course on the subject than some of the ones I took as a graduate student.

Wilkinson's letter from 1986 was interesting: he tells me that the original Systat was written on a CompuPro CP/M system remarkably similar to Old Zeke. He also asks that I not quote him, because many nonstatistician customers are frightened away when they discover that Systat was largely written by one person, while "a CP/M heritage can be a handicap." Now it can be told, since Systat has become darned near the standard in both academia and the business world. This is one I should have written about long ago. If you need a statistics package, the 1986 version I have here will more than do; I'm sure that it has been much improved since.

Short Shrift for Three Models

It's always a dilemma: I'm running out of space, and there's a huge stack of nifty stuff I want to tell people about. Now what? If I give it a brief paragraph, it looks as if I am slighting it, but it's worse if I don't mention it at all. Therefore, assume that I wish I could have written more about everything in this section.

First, CellMaster from Sintar Software is an instructive game that lets you set up cellular automata on your PC. Ever wonder what would happen in Conway's Game of Life if you could change one of the rules? This will let you do it. Simulate electronic circuits. Invent artificial life forms. It's not as addicting as

continued

Here's How We Protect Your Software And Profits Better.

**SOFTWARE
PROTECTION**

**Windows 3.0
Support Available**

We'll Never Tell...

... the world how we protect your hard work. But then, why should we? It's not that we're hard to get along with. On the contrary. We'll show you how our unworried approach to software protection can actually work better for you. We'll deliver the best balance of guaranteed copy control and cost-effective installation.

Unlike other manufacturers, our hardware is *uniquely custom-wired for each developer* and supplied with a specific *encrypted interrogation routine* for maximum security.

The precise routines assume responsibility for all hardware, software and timing issues so your time and money isn't wasted engineering protection schemes.

The Products That Protect Your Revenues

- ▶ **PROTECH KEY**
Identically reproduced packages.
- ▶ **MEMORY KEY**
MACINTOSH MEMORY KEY
NEC MEMORY KEY
Active protection, modular packages, customized packages, serialization, demo control, access control.
- ▶ **MEMORY-ONE KEY**
Customized packages, modular packages
- ▶ **MICROPROCESSOR KEY**
Non-operating system specific protection based on RS232C communications for minicomputers, workstations, etc.



In EUROPE:
MICROPHAR, 122 Ave. Ch. De Gaulle 92200,
Neuilly Sur-Seine FRANCE Tel: 33-1-47-38-21-21 Fax: 33-1-46-24-76-91

For distributors in:

- BELGIUM/NETHERLANDS. E2S (091 21 11 17) • SPAIN, (343 237 31 05)
- IRELAND, TMC (021 87 37 11) • GERMANY, Microphar Deutschland (06223 737 30)
- PORTUGAL, HCR (1 56 18 65) • UNITED KINGDOM, Clearsoft (091-3789393)
- SWITZERLAND, SAFE (024 21 53 86) • ITALY, Siosistemi (030 24 21 074)



PROTECH
MARKETING, INC.

1-800-843-0413

In the U.S., the AMERICAS & the PACIFIC:
PROTECH, 9600-J Southern Pine Blvd.,
Charlotte, NC 28217 **Se Habla Español**
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.
NEC is a registered trademark of NEC Information Systems, Inc.

For Europe Circle 155 on Reader Service Card

For Americas & Pacific Circle 156 on Reader Service Card

ITEMS DISCUSSED

CellMaster\$45

Sintar Software
1001 Fourth Ave., Suite 3200
Seattle, WA 98154
(206) 625-1213
Inquiry 1105.

**Crescent QuickPak
Professional Library
(QuickBASIC version)**\$169

Crescent Software
32 Seventy Acres
West Redding, CT 06896
(203) 438-5300
Inquiry 1106.

Desktop Molecular Modeler\$495

Oxford Electronic Publishing
Oxford University Press
200 Madison Ave.
New York, NY 10016
(212) 679-7300
or
Oxford Electronic Publishing
Oxford University Press
Walton St.
Oxford OX2 6DP, UK
011-44-865-56767
Inquiry 1107.

DOS Systat 5.0\$895

Systat
1800 Sherman Ave., Suite 801
Evanston, IL 60201
(708) 864-5670
Inquiry 1108.

Geoclock 4.2

5 ¼-inch floppy disk\$30
3 ½-inch floppy disk\$35
Geoclock
2218 North Tuckahoe St.
Arlington, VA 22205
(703) 241-7980 (BBS)
Inquiry 1109.

LANtastic LAN

2-Mbps Starter Kit\$525 (2 nodes)
**10-Mbps Ethernet Starter
Kit**\$725 (2 nodes)
2-Mbps Adapter Card\$249
10-Mbps Adapter Card\$349
Network Eye\$295
Artisoft
Artisoft Plaza
575 East River Rd.
Tucson, AZ 85704
(602) 293-6363
Inquiry 1110.

Olmsted Brain Simulation Series

Generic Reticular Formation\$35
Generic Tectum\$50
MVL Expert System\$150
MVL Talk\$100
MVL Template-1\$75
MVL Template-2\$125
Olmsted Brain Simulation Software
411 Briargrove St.
Slidell, LA 70458
(504) 649-7174
Inquiry 1111.

SemiDisk Blue Flame II

1-MB\$420
2-MB\$590
3-MB\$803
4-MB\$1015
5-MB\$1185
6-MB\$1355
7-MB\$1525
8-MB\$1695

SemiDisk Systems

Box GG
Beaverton, OR 97075
(503) 626-3104
Inquiry 1112.

Video ChalkBoard\$225

Video Titler EGA and VGA\$495
Entropy Engineering
12317 Village Square Terrace,
Suite 202
Rockville, MD 20852
(301) 770-6886
Inquiry 1113.

MicroProse Railroad Tycoon, but you'll learn more. Recommended.

Next up the scale is the Olmsted Brain Simulation Series. This is an odd but interesting software simulation of multivalued logic and neural networks that will let you build and manipulate simple brain models. Your first impression of this package is that it's a bit disorganized. Then, on reflection, you realize that the subject matter itself is disorganized. It's strictly for learning purposes, but there's a lot here worth learning. I enjoyed fooling around with it, and I learned something about brain models and multivalued logic.

Finally, we have a full-fledged professional program, Desktop Molecular Modeler from Oxford University Press. This program is largely for chemists, student and professional, and it runs on CGA and better PCompatible systems. You use it to build molecules on-screen, atom by atom: the program makes the atoms available. Once you have a mol-

ecule, you may validate its possibility and save it, or optionally output your molecule on a Hewlett-Packard plotter. Rotate and rescale, substitute different kinds of atoms, create new bonds, or alter bond lengths; what you have here is a sort of ultimate Tinkertoy set for playing with chemical models. It's not as much fun as my old chemistry set was, but it's a lot safer.

Winding Down

I'd meant to say some good words about Crescent Software's QuickPak Professional Library of routines, which you can graft into Microsoft QuickBASIC programs. This kit has saved me many hours of time. No one ever describes the company's software as being for amateurs; but while QuickPak Professional Library lives up to its name, it has certainly made life a lot easier for this amateur programmer.

I also need to talk about both Willow and US Video boards, which let you com-

bine video images (as from a camcorder) with what comes out of a computer program; and the Video ChalkBoard and Video Titler programs from Entropy Engineering, which mix in titles and free-hand drawings.

It has been a good year for microcomputers. Next year may be even better: maybe we'll get software that can challenge the new capabilities of our hardware. We'll see. ■

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."

CARRY-I

The World's First & Original Book-Size Desktop Computer

SAVES YOUR ENVIRONMENT



Good

Wt. (Monitor, CPU, Keyboard) = 59 lb.
Footprint (W/Keyboard) = 4 sq. ft.

BETTER

Wt. (Monitor, CPU, Keyboard) = 13 lb.
Footprint (W/Keyboard) = 1 sq. ft.



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

CARRY-I KEYBOARD

82 Key/XT-AT Autoswitch
Dimension: 310mm x 145mm x 27mm Weight: 0.7kg

CARRY-I 80286

12MHZ, 0 Wait State AT/AMI BIOS with Diagnostic/1MB RAM/20MB, 40MB HDD 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

CARRY-I MONITOR

9", Dual Frequency Weight: 3.4kg

See us at
COMDEX/Fall '90

Nov. 12-16, 1990, Las Vegas, NV
Sands Hotel, Booth: N4028



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 783-7970
TELEX 22233 FLTCO

FLYTECH TECHNOLOGY (U.S.A.), INC.
3008 SCOTT BLVD. SANTA CLARA CA 95054 U.S.A.
TEL (408)727-7373, 727-7374 FAX (408)727-7375

FLYTECH TECHNOLOGY HANDELS-GMBH
MENDELSSOHNSTRASSE 53
6000 FRANKFURT AM MAIN 1, WEST GERMANY
TEL (069)746-081 746-453 FAX (069)749-375

FLYTECH TECHNOLOGY (H.K.) LTD.
B12, 8 FL., BLOCK B, TONIC INDUSTRIAL CENTRE
19 LAMING ST. KOWLOON BAY, KOWLOON,
HONG KONG
TEL 305 1268 FAX 796-8427

Exclusive Distributors:

CANADA:
BUDGETRON INC
1320 SHAWSON DRIVE UNIT 1
MISSISSAUGA ONTARIO, L4W 1C3
TEL 1-416-564-7800
FAX 1-416-564-2879

FRANCE:
M3C L'INFORMATIQUE DU SUCCES
64, AVENUE CHARLES DE GAULLE 95160
MONTMORENCY
TEL 33 1 34175362
FAX 33 1 42355618

HONG KONG:
PARKLY TECHNOLOGY LTD
B12, 8 FL., BLOCK B, TONIC INDUSTRIAL
CENTRE 19 LAMING ST. KOWLOON BAY
KOWLOON
TEL 852-3051266
FAX 852-7968427

ISRAEL:
MLL COMPUTERS SYSTEMS LTD
9 HABONIM ST., RAMAT GAN P.O.B. 5195
TEL 972-3-7515511
FAX 972-3-7518615

ITALY:
PRIMA COMPUTER TRADING ITALIA
VIA UMBRIA, 16/A 42100 REGGIO EM
TEL 31 2968-84141 FAX 31-2968-97436

NETHERLAND:
KN
SCHIPHOLWEG 343, 1171 PL BADHOEVEDORP
TEL 31 2968-84141 FAX 31-2968-97436

NORWAY:
SECUS DATA A/S
GRENSEVN 68, 0663 OSLO 8, NORGE
TEL 47-2-722510 FAX 47-2-722515

SPAIN:
AT ELECTRONIC, S.A.
NUMEZ DE BALBOA,
114 OFICINA 717, 28006 MADRID
TEL 34-1-564-5434
FAX 34-1-411-0888

U.K.:
CENTERPRISE INTERNATIONAL LIMITED
HAMPSHIRE INTERNATIONAL BUSINESS PARK,
CROCKFORD LANE CHINEHAM, BASINGSTOKE,
HAMPSHIRE RG24 0GG
TEL 44-256-463754
FAX 44-256-843174

WEST GERMANY:
MACROTRON AG
STAHLGRUBERRING 28, D 8000 MUNCHEN 82
TEL 49 89 4208-0
FAX 49 89 423676

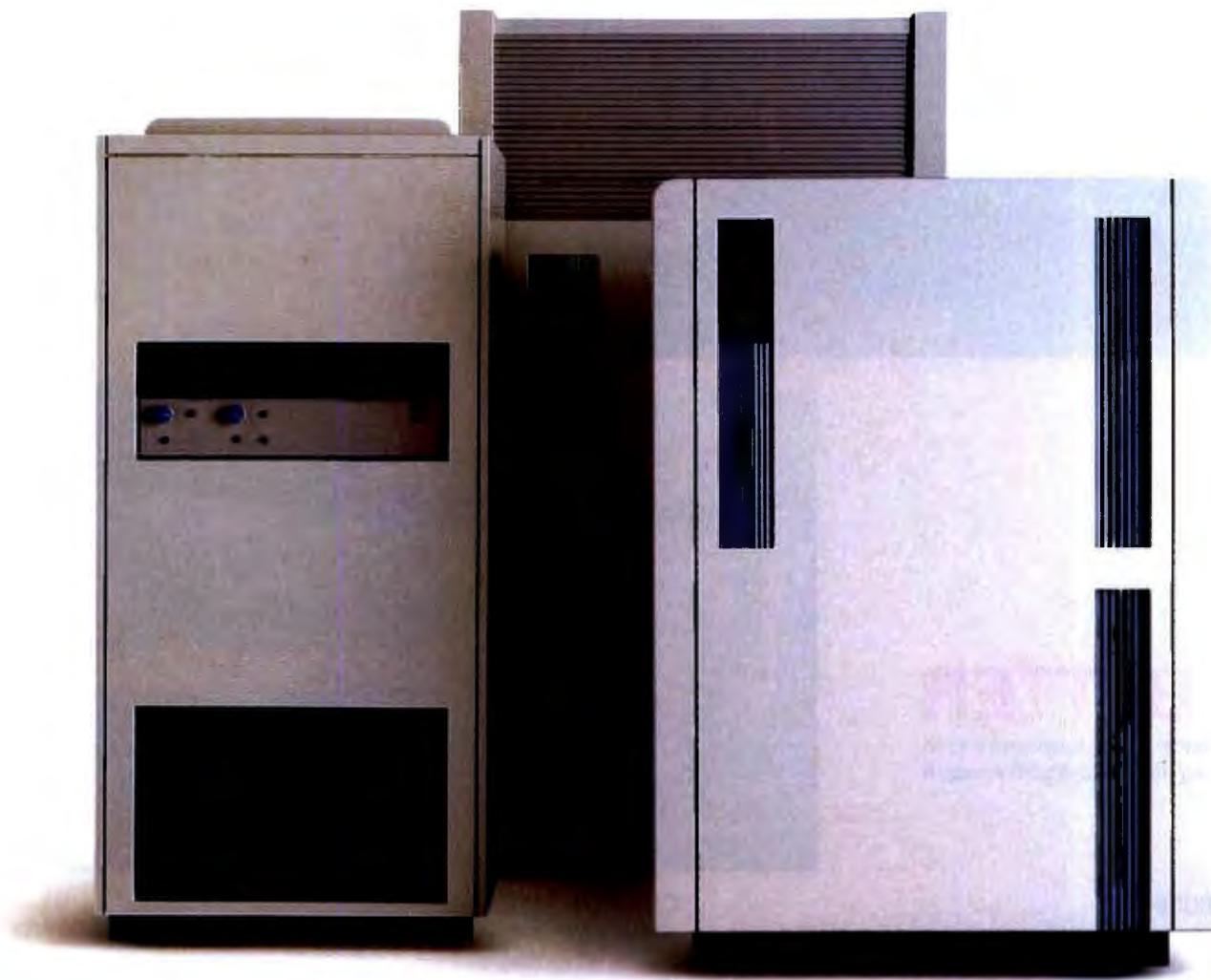
Authorized:

BELGIUM:
CELEM S.A.
BOULEVARD DE L'OURTHE, 28
B-4920 EMBOURG
TEL 32-41-876434
FAX 32-41-878515

BELGIUM:
DATATECH MICROSYSTEMS S.P.R.L.
CHAUSSÉE DE VLEURGAT 184
B-1050 BRUSSELS
TEL 32-2-6482290
FAX 32-2-6480937

Circle 80 on Reader Service Card

The Joneses.



Check out the benchmarks. When it comes to speed, pure and simple, mainframes are no longer the main attraction.

Introducing the Everex STEP 486/33 and STEP 486/25. Along with the STEP 486*is*, they give you desktop performance that was previously unheard of.

There are two reasons. The first, of course, is the 486™ chip. The other is AMMA™, Everex's proprietary Advanced Memory Management Architecture.

STEP 486/33	34,000 Dhrystones (19.4 MIPS)
CRAY X-MP/48	17,857 Dhrystones
IBM 3083	16,666 Dhrystones

AMMA uses "write-back" cache technology instead of the "write-through" technologies used in most PC's. The write-back cache was developed for mainframes. Everex was the pioneer in developing it for the PC. And in doing so, opened a whole new dimension in desktop performance.

With AMMA, you can write directly to the STEP 486's cache in nearly all cases. With write-through techniques, on the other hand, you lose most of the performance benefit of the cache.

And how to keep up with them.



That's because write-through forces you to write to main memory much more often. And main memory is slower than the cache.

This is especially important in 486 computing, where the CPU performs as many as four times the write operations as in 386. Which makes AMMA's write-back architecture, combined with the 486's embedded cache, a powerful combination indeed.

But the STEP 486 machines give you more than just speed. They come with Programmable Drive Select. If your drive isn't listed on the set-

up table, PDS™ lets you custom-configure the BIOS. It's good for virtually any hard drive.

What's more, all STEP systems come with a one-year extendable warranty and a one year renewable on-site service contract that also covers all Everex peripherals in the system.

To find out more, call 1-800-334-4552* for the name of your nearest Authorized Everex Reseller—every one a high performance expert.

Then you can let the Joneses try keeping up for a change.



Same Day
Shipping!

ALTEC TOWERS ABOVE THE REST

Now you can have the power and performance of Altec's fully loaded 486 EISA Tower delivered to your door! Check out these outstanding features:

486 EISA TOWER **CALL** for more information

Intel 486-25 CPU □ 4 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 150 MB 18ms ESDI hard drive □ ESDI controller w/32K cache □ 16-bit VGA card □ 14" VGA monitor (1024 x 768) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01 □ Eight 32-bits EISA slots



"AltecZip 586s are solid machines featuring brand-name parts. A good buy, they are clearly affordable"

PC Magazine, May 30, 1989

"Computer users should find Altec machine an excellent value with good performance."

PC Magazine, July 1990

Altec sets the standard for the highest quality design and manufacturing of all our products. We're fast, friendly, and ready to help you select the right features for your needs. Take a look at some of our other great systems:

386/33 VGA **\$3,595**

Intel 386-33 CPU □ 32K Cache □ 4 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 150 MB 18ms ESDI hard drive □ ESDI controller w/32K cache □ 16-bit VGA card □ 14" VGA monitor (1024 x 768) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01
(25 Mhz Cache System deduct \$400)

386/25 VGA **\$2,795**

Intel 386-25 CPU □ 4 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 105 MB 18ms IDE hard drive □ 16-bit VGA card □ 14" VGA monitor (1024 x 768) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01

386/SX VGA **\$1,895**

Intel 386SX-16 CPU □ 2 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 66 MB 25ms hard drive □ 16-bit VGA card □ 14" VGA monitor (640 x 480) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS-DOS 3.3 or 4.01
(20 Mhz 386/SX version add \$150)

286/12/66 MB VGA COMBO **\$1,795**

1 Meg RAM □ 1.2 MB 5.25" drive □ 1.44 MB 3.5" drive □ 66 MB hard drive □ 16-bit VGA card □ 14" VGA monitor (640 x 480) □ 2 serial, 1 parallel & 1 game ports □ 101-key Keyboard □ Genius Mouse □ MS DOS 3.3 or 4.01 □ Panasonic 1180 printer w/cable □ Surge Protector

286/12 VGA STAR **\$1,295 NEW**

□ 1 Meg RAM □ 1.2 M or 1.44 M drive □ 40 MB hard drive □ 16-bit VGA card □ 14" VGA monitor (640 x 480, 41 mm) □ 2 serial/1 parallel & 1 game ports □ 101-key Keyboard □ MS-DOS 3.3

Various hard drive capacity available



Technology Corp.

1-800-255-9971

Altec's Guarantee:

- 30 day money-back guarantee
- 1 year warranty for parts and labor
- Free 4 months on-site service
- Lifetime toll-free technical support



Policy: Same day shipping with standard configurations for orders before 3 PM EST. 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 number. 30-day money back guarantee does not include shipping. No surcharge for Visa & MasterCard, 2% for American Express.

*A few OS/2 products
let your spreadsheet
talk SQL*

MONEY, SQL, AND SPREADSHEETS

A client (a bank) approached my company for help with something called "SQL" that it had heard would solve all its data-sharing problems. "We've got a little problem, and we're wondering if you can help us."

There were, it turned out, a few stumbling blocks.

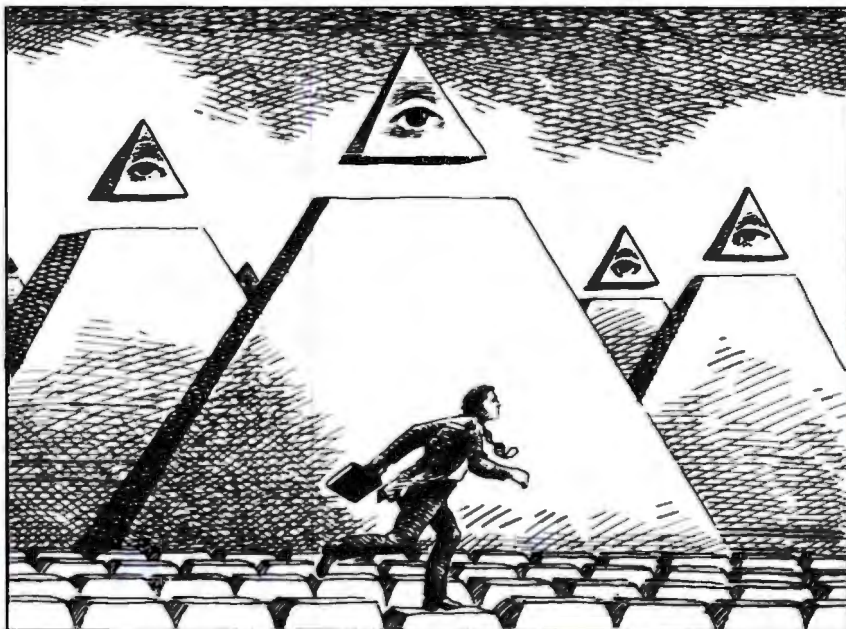
Like many firms, this bank relies heavily on Lotus 1-2-3. And, again like many firms, it has data at a centralized point (originally a mainframe, but it's moving to a LAN with a souped-up PC server) that it needs to get into 1-2-3.

Finally, like too many firms, it already has a kludgy solution: Download some data, run it through a program to massage it, and import it into 1-2-3. The bank had heard that Structured Query Language could help. That's where I came in, to determine which SQL-based product to buy and how to get 1-2-3 to talk to it.

One approach is to use a client program written in C, Pascal, COBOL, or any other language that can communicate with the SQL server by way of a SQL support library. (Generally, the database lives on the server machine, and the program that accesses it lives on the client machine.)

But my client (the human kind), like most PC users, is decidedly not interested in hiring C programmers. So to make a spreadsheet use the SQL-based server, I must make the spreadsheet a client process or somehow attach a client (the computer variety) process to the spreadsheet.

Furthermore, the client must be compatible with the server. Not every SQL client can talk to every SQL server. Given that SQL is billed as the lingua franca of the database world, this is surprising, but it's true. One of the leading SQL vendors, Gupta Technologies, counts among one of its greatest features the wide variety of SQL server products that it supports *besides* its own SQLBase



server. (That's what its SQLNetwork gateways do.) In general, you're best off getting your spreadsheet client code from the same folks who wrote your SQL server code.

In general, you've got to worry about three things:

- What spreadsheet does the client talk to, and is it DOS- or OS/2-based?
- What SQL server does the client talk to?
- What network/communications link do the client and server share?

I'll now look at these in a bit more detail.

Making Your Spreadsheet Speak SQL

There isn't, at least not yet, a "@SQL()" function in 1-2-3. So what's out there to solve the problems? There are three ways

to do this: Use an add-in or patch, redesign the spreadsheet to support SQL directly, or use a language that the spreadsheet already understands and a translator program to handle SQL.

The most direct method is a patch or, in the case of 1-2-3, an add-in. Releases 2.x and 3.0 don't directly support SQL. But two products—Gupta Technologies' SQLVision and Oracle's SQL Add-In for 1-2-3—can extend 1-2-3 to accommodate SQL.

Gupta's SQLVision works straightforwardly. You just type SQL commands into a range in your spreadsheet, load your add-in, and go. Users of 1-2-3 will like the fact that it also offers a /Data Query-like mode. SQLBase also comes with an interactive front end called SQLTalk, which I have found quite nice for trying out SQL. So the bank's techies just stuff some SQL into the 1-2-3 macros that get distributed to the users, and

continued

their problem is solved.

These Gupta products support only 1-2-3 release 2.x and Windows Excel, however, so you're going to end up leaving your workstations under DOS using this system.

SQLVision can talk to servers that are not Gupta products (including Extended Edition soon), so presumably your network could be LAN Manager-based, but having to stay in a networked DOS environment may make you gag.

Gupta, then, gets onions for offering only DOS clients for DOS spreadsheets. But it earns orchids for supporting a variety of networks (e.g., LAN Manager and NetWare) and a large range of servers, from its own SQLBase to IBM OS/2 Extended Edition, DB2, and Oracle.

Oracle's Add-In is basically the same story: No support for 1-2-3 release 3.0 yet, but it's coming, and no OS/2 support except, of course, on the server side.

WingZ-DataLink Skips the Clients

The second answer is to find another spreadsheet, one that supports SQL directly. Informix has been building SQL databases for a while, so it's no surprise

that its WingZ spreadsheet comes with SQL hooks. For those who haven't seen it, WingZ is fantastic: the usual spreadsheet stuff, nice statistical and matrix capabilities, more graphics awareness than Excel, and its HyperScript command language. I used HyperScript to put together a hexadecimal calculator for Presentation Manager (PM) in less than an hour.

If my client had more time, WingZ could be the answer. But the folks at the bank are leery of WingZ's newness, and since Informix doesn't provide for 1-2-3 clients, the SQL linkage won't do the bank any good. Moreover, it's limited in terms of the servers it can talk to. Too bad, because WingZ-DataLink—it's part of HyperScript—is a nifty tool. You can either punch straight SQL into your HyperScript program or direct HyperScript to put a query box on the screen. DataLink puts up query boxes, your users fill them in, and DataLink converts the queries to SQL.

Again, HyperScript is a pretty neat language, tons better than 1-2-3 macro language. It supports any TCP/IP network for server connection, and most of

the big network vendors support TCP/IP in some way, so that's good. But there's bad news on the server front. WingZ links PCs only to Informix SQL servers. And there's no SQL-to-Lotus link from Informix.

DDE Links Excel to SQL

The final approach is to avoid major surgery on the spreadsheet and instead use a built-in data exchange language that the spreadsheet already knows.

The best example here (in the Windows and OS/2 world) is the Dynamic Data Exchange facility. Microsoft's Excel supports DDE. A database client process running in the same machine as Excel can transmit SQL requests to the server via DDE; when the server returns the data, it is forwarded to Excel, again via DDE.

In fact, Gupta's SQLVision for Excel works like this, although I did not look at that specific product. Unfortunately, it's offered only for Windows Excel. Alternatively, Microsoft's OS/2 SQL Server talks DDE and thus has been massaged into talking to Excel. There is no turnkey

continued

Mail smarter and save money on your PC using the

One-Two Power Punch

ArcList—your first punch—lets you professionally manage your list on your IBM or compatible PC with 640K RAM and a hard disk.

SAVE MONEY:

- eliminate duplicates from dBase®, ASCII or ArcList files;
- take advantage of postal discounts by presorting according to USPS regulations.

AccuMail™—your second punch—lets you:

- easily knockout undeliverables with automatic address correction features;
- quickly knock down postal costs by inserting carrier route and ZIP+4 Codes into your existing dBase, ASCII or ArcList files.

Find out more about **ArcList** and **AccuMail**! For a FREE copy of "How to Manage Your Mailing List" call 1-800-368-5806 or write:

Group 1 Software, Inc.
Washington Capital Office Park
6404 Ivy Lane, Dept. P-BR70
Greenbelt, Maryland 20770-1400

GROUP 1
GROUP 1 SOFTWARE
The Direct Marketing Software Company

- ☐ Please rush me a FREE copy of "How to Manage Your Mailing List."
- ☐ I'm ready to see ArcList and AccuMail in action. Please contact me at once.

Name _____

Title _____

Organization _____

Street _____

City _____

State _____ Zip _____

Telephone (_____) _____

©1989 Group 1 Software, Inc.

P-BY00

Call for the dealer nearest you.

db_VISTA III for Windows 3.0™



The DBMS That Opens Windows™



Get High Performance Under Microsoft Windows 3.0™ With db_VISTA III DBMS.

Develop Windows applications that are better, faster, and more profitable. db_VISTA III combines speed, flexibility, and productivity into one DBMS tool for C and Windows programmers. Add db_VISTA III's high-speed SQL retrieval to your application and watch your users enjoy power they've never experienced before.

Built For Windows.

db_VISTA III for Windows 3.0 follows all of the Microsoft

guidelines for memory use. Dynamic linked libraries (DLL), multi-tasking, and multi-user environments are all supported. For even faster development, use db_VISTA III with products like ToolBook®, Windowcraft®, or Actor®.

No Other DBMS Opens Windows Like db_VISTA III!

- **Speed.** Benchmarks show db_VISTA III significantly outperforms any DBMS under Windows.
- **No Royalties.** Increase your profits; decrease your overhead.
- **C Source Code Available.** For total programming flexibility.
- **Portability.** db_VISTA III supports most environments.

db_VISTA III
Database Management System

Specifications: Single & Multi-user. Automatic recovery. Automatic referential integrity. Relational and Network data models supported. Relational SQL query and report writer. Complete revision capability. C source code is available. No royalties. **Supports:** MS Windows, MS-DOS, OS/2, VMS, UNIX, BSD, QNX, SunOS.

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA (206)747-5570 Telex: 6503018237 MCI UW FAX: (206)747-1991
International Distributors: Australia: 61 2 419 7177 Brazil: 55 11 829 1687 Central America 506 28 07 64 Denmark 45 42 887249 France: 33 1 46092784 Italy: 39 45 584711 Japan: 81 3 473 7432
Mexico: 52 83 49 53 00 The Netherlands: 31 02159 46 814 Norway 47 244 8855 Sweden 46 013 124780 Switzerland: 41 64 517475 Taiwan 886 2 552 3277 Turkey: 90 1 152 0516
United Kingdom: 44 0992 500919 Uruguay: 598 2-92 0959 USSR: 01 32 35 99 07; 812 292 19 65; 0142 437952 West Germany: 49 07127 5244
Copyright ©1990 Raima Corporation. All rights reserved.

db_ is registered in the U.S. Patent and Trademark Office. Windows 3.0, ToolBook, Windowcraft, and Actor are trademarks of their respective companies.

Special \$195 Developer's Edition

For a limited time only, you can get your hands on db_VISTA for Windows for only \$195. Call today and ask about our Developer's Edition and experience how db_VISTA III can open Windows for you.

Developer license only; not for distribution.

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

In Washington state call: (206) 747-5570

Full Raima Support Services - Including Training. Develop your applications even faster with Raima Training Classes:

Oct. 1-5, 1990	- Bellevue, WA
Oct. 1-5, 1990	- Germany
Oct. 15-19, 1990	- Switzerland
Oct. 19, 1990	- Taiwan
Oct. 29-Nov. 2, 1990	- Chicago, IL
Nov. 1-2, 1990	- United Kingdom

RAIMA™
CORPORATION BY IBM

OS/2 Excel-to-SQL server product that I'm aware of, however, so that looked to be quite a bit of work.

In the long run, though, this could be the best answer. The client talks to the PM application through DDE, a documented (and supported) interface. DDE, in turn, communicates through either a DOS-based SMB (Server Message Block) protocol or a named pipes interface (the preferred application-to-application method in LAN Manager). That

would open the door to either Microsoft's SQL Server or, by DDE and APPC (Advanced Program to Program Communication, IBM's alternative to named pipes), to OS/2 Extended Edition's Database Manager.

What Did I Do?

I was disappointed. WingZ would have been a nice answer, but the people at the bank know 1-2-3 and are loath to change. I can't blame them. Also, they're a True

Blue shop and would prefer to use IBM OS/2 Extended Edition or something like it as the SQL server. They suspect that they may end up keeping the data on an AS/400; WingZ talks only to Informix servers.

DDE and PM look good, too, but there are no turnkey systems yet (I'm sure there will be in a year or so, however), and I've learned all the DDE I want to for the moment. Some vendors raised an objection to DDE, however. They suggest that it can hamper performance.

It looks like they're going to put OS/2 SQLBase or Extended Edition Database Manager on an OS/2-based database server and have the 55 SX workstations run 1-2-3 release 2.2 under DOS 3.3 and Windows 3.0. It's not OS/2, but it's close. And I'll look at it again in about a year.

Choosing Your Own Path

How do you choose a spreadsheet/SQL client interface product? Consider these issues.

Does it support your spreadsheet? If you haven't picked a spreadsheet yet, this is irrelevant. Is it, like Gupta, limited to DOS spreadsheets?

Does it support your SQL server? In many cases, you won't presently have a SQL server, so there's no problem—you just buy the SQL client and server as a pair.

Alternatively, you may be forced to support an existing SQL server (OS/2 Extended Edition, in the case of the bank). Then a system like Gupta's would be attractive, because it supports Extended Edition, Oracle, Gupta, DB2, and more.

Does the client support your communications system? It may support only LANs, not Systems Network Architecture (SNA) or asynchronous links.

Do you have to write SQL code on the spreadsheet side, or is there a simplified user interface? If you're doing the same kind of queries all the time ("get customer X's balance"), there's no point at all in spending a lot of money on query by example—you should just have your systems people code the common queries into SQL. ■

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.



Pop Up Programs and Files

Switch-It automatically lists up to 100 of your commonly-used programs in a menu customized for your IBM PC. Start your programs by simply pointing to them on the menu. Then, whether you're in the middle of 1-2-3, Word Perfect or dBase, a key-stroke moves you instantly to another program or file. Then back, or switch to another. And another.

Forget save/exit/load/restore. Forget wasted time staring at a blank screen. Easily move data between previously incompatible programs without retyping.

Give your PC OS/2 features, today!

Switch-It (tm) Version 3.0
(c)1989 Better Software Technology

1 Dos Command Processor	550
2 Lotus 1-2-3 Spreadsheet	256
3 dBase III Plus	320
4 Lotus Metro	256
5 Lotus Agenda	450
6 Multi Plan Spreadsheet	320
7 Procomm Plus	192
8 Word Perfect	256
9 Ventura Publisher	550
10 Switch-It Configuration	256
11 Microsoft Excel	640
12 Cross Talk XVI	256
13 Sidekick Plus	256

F4 = Select, ← = Run, Del = Abort
<F12> = Switch

In Canada call: 800-663-6157

Free TSR Memory, Share Data

Switch-It uses your hard disk or EMS memory for swapping. You have full memory (up to 600K) available for every program, even if you have only 640K of RAM, and your memory-resident programs run free, in zero RAM! No more TSR conflicts or crashes. That's why PC Magazine stated "Switch-It proved to be remarkably free of glitches."

- Scans your hard disk and builds a menu of programs
- Cut & paste functions
- TSR manager & command line editor
- Network, mouse & graphics support
- Requires only 26K RAM

Order Toll Free: 800-848-0286

Visa/MasterCard accepted. Include \$5 s/h (overseas \$15). Technical Info: 508-879-0744

Switch-It™ \$99.95

Free ET-Phone™ with Switch-It Purchase.

Every imaginable phone directory and dialing function for your PC, including 2000 built-in phone numbers. \$79 if purchased separately.

Better Software Technology, Inc., 55 New York Ave., Framingham, MA 01701

In Redondo Beach, California . . .

You'll find breathtaking ocean views, sensational surfers and Gateway 2000 computers.

Dive 'N Surf, famous for Body Glove® fashions and watersports equipment, is a



Graham Pask, Computer Systems Manager for Dive 'N Surf, and his Gateway 2000 25 MHZ 386 network server.

member of the growing family of Gateway 2000 customers in California. Dive 'N Surf Computer Systems Manager Graham Pask chose a Gateway 25 MHZ 386 machine for his network server. The system runs point-of-sale, inventory control, word processing and desktop publishing software.

"I decided to buy a Gateway 2000 system because they had everything I wanted for a good price," said Graham. "But what really impressed me was the service. I had a problem with my 3 1/2 inch drive so they sent me a new drive the very next day."

Graham said he was so happy with his Gateway system at work that he bought a Gateway 2000 25 MHZ 386 Cache machine for his home.

Until well after sunset, surfers ride the big waves on the Pacific Ocean near Redondo Beach, California.

And In Barrow, Alaska . . .

Over 300 miles north of the Arctic Circle, you'll find polar bears, seals, whales, walrus, lemmings, snowy owls and what appear to be the largest mosquitoes in existence. On a summer afternoon you'll also see parka-clad tourists walking among local residents in shorts. And of course you'll find a good Mexican restaurant and Gateway 2000 computers.

Cape Smythe Air Service, a regional commuter airline serving Barrow, Kotzebue, Nome and remote villages in Alaska, has one of several Gateway 2000 computers operating in Barrow. Jeff Frier, Cape Smythe's accountant, chose a Gateway 2000 386SX to run spreadsheet, data base and accounting applications.

"I was trying to decide between Gateway 2000 and a competitor," Jeff commented, "so I talked to a person who owns the competitor's system. He was disgruntled about the service he received from them. Then I talked to another person in Barrow who has a Gateway and she was happy with the product and service. The choice was pretty obvious -- when you're doing business in a remote area, the most important things a vendor can offer are reliability and good service."

Jeff said he also appreciated Gateway's features and price. "When you have to pay \$6 a gallon for milk, it's nice to find a bargain somewhere." Jeff plans to buy another Gateway 2000 computer in a few months .



Jeff Frier, Cape Smythe Air Service, with his Gateway 2000 386SX.

On a mid-July day in Barrow, Alaska, fishing boats weave in and out of icebergs on the Chukchi Sea.



In Bradford, Pennsylvania . . .

You'll find a charming small city nestled in the Allegheny National Forest. The city's most prominent local business is the Zippo Manufacturing Company, where you'll find 18 Gateway 2000 computers in use.



Fred Gronemeyer, Zippo Manufacturing Company, and his Gateway 2000 20 MHz 386 system.

Zippo is known around the world for its windproof lighter made famous during the second World War, although today the company's product line includes many other specialty advertising items. Fred Gronemeyer, Systems Analyst for Zippo, chose Gateway 2000 as the company's standard PC.

"We needed to set standards for PC's and software to make the most efficient use of these tools," Fred remarked. "We started out with PC's from different manufacturers, but once I tried Gateway I was convinced we could get the highest quality, most reliable machines at the best price from Gateway 2000. I was also impressed by my salesman and the tech support people I've dealt with at Gateway."

Fred said by the end of the year Zippo will be running every system Gateway 2000 makes, from 286's up to a 486 and everything in between.

Main Street, U.S.A., is located in Bradford, Pennsylvania.

And In New York City . . .

You'll find your senses overwhelmed by the countless sights and sounds of this one-of-a-kind city. And of course you'll find thousands of Gateway 2000 computers here.

One New York City Gateway 2000 owner is



Jim Rondinelli, independent record producer and engineer, with his Gateway 2000 386SX.

independent record producer and engineer Jim Rondinelli. Jim uses his Gateway 2000 386SX with a sophisticated player piano sequencer to compose music.

"The software I use is written for the Mac and for IBM compatibles," Jim said, "but it runs much better on IBM compatibles. And it runs best of all on my Gateway. I travel often and I've used my software on a lot of other machines. They don't even compare with my Gateway 2000."

Jim said he bought his Gateway 2000 because it was equipped for the real world with ample hard drive capacity and RAM, both sizes of disk drives and color VGA graphics.

"It's the fastest file transfer computer I've ever used," continued Jim, "plus it ran right out of the box. One afternoon and I was fully functional on a brand new system."

The streets of Manhattan are a constant blur of activity.



Near Camp Verde, Texas . . .

You'll find the magnificent Hill Country of Texas with rattlesnakes, prickly pear cactus and huge cattle ranches. You'll also find Larry Mahan and his Gateway 2000 computer.

Larry Mahan is to rodeo what Jack Nicklaus

is to golf. He is Six Times World Champion All-Around Cowboy and is a member of the Cowboy Hall of Fame. But Larry also runs a cattle and horse ranch and is involved in a western apparel manufacturing company and a new Southwestern foods company. His Gateway 2000 20 MHZ 386 system is an integral part of his business operations. "We run cow and calf software for



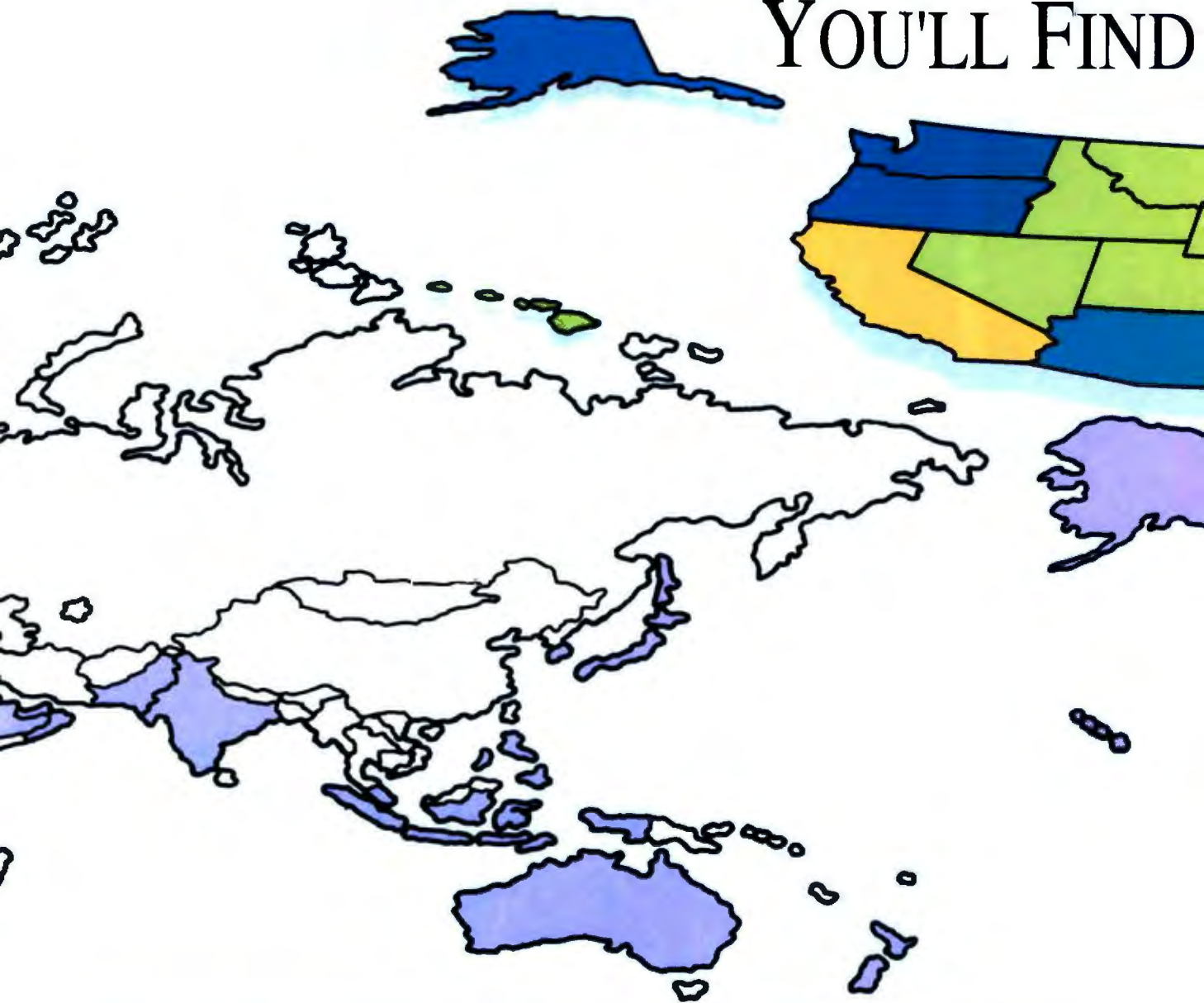
Larry Mahan, rodeo star, and his Gateway 2000 20 MHZ 386 system.

our Longhorn cattle herd," Larry said. "You can't really manage a livestock business efficiently without it. Plus we do accounting, spreadsheets and word processing on our Gateway 2000 computer."

Asked why he chose Gateway 2000, Larry said, "They had the best features and price – and I thought a computer company that puts pictures of cattle in their ads had to be my kind of people. And I was right. The people I've talked with at Gateway 2000 are honest-to-goodness nice folks. It's a pleasure doing business with them."

Larry Mahan raises registered Texas Longhorn cattle.

ACROSS THE COUNTRY YOU'LL FIND



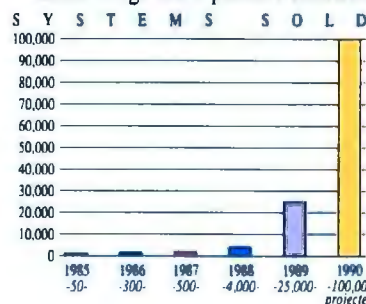
You'll find so many Gateway 2000 computers in so many places today because people everywhere know a good value when they see one. In all 50 states and in over 70 foreign countries, thousands of people are comparing prices, quality and service – and choosing Gateway 2000.

But value alone doesn't explain how a little company in the Midwest, started just five years ago, managed to outdistance hundreds of other companies, selling more systems through the direct market channel today than any other PC manufacturer in the country.

The explanation is that the company has always maintained a small company attitude. With Gateway 2000, you still get the little things

you'd expect only from a small firm.

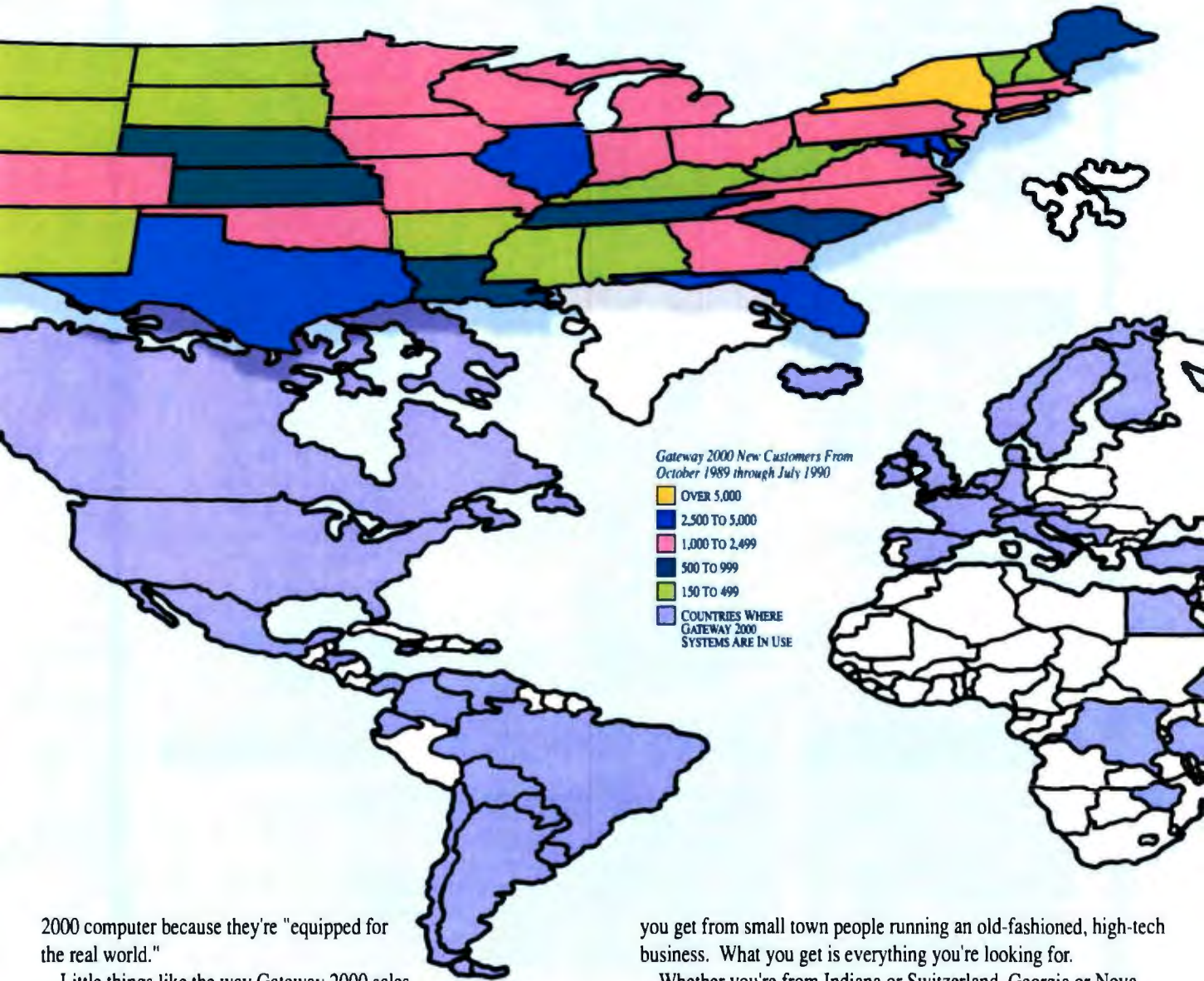
Little things like a positive technical support department. When



Graham Pask told his Gateway 2000 tech rep that his 3 1/2" drive didn't work, he received a new drive the very next day.

Little things like the way Gateway 2000 systems are fully loaded with all the features you want. Jim Rondinelli bought a Gateway

AND AROUND THE WORLD, GATEWAY 2000!



2000 computer because they're "equipped for the real world."

Little things like the way Gateway 2000 sales people develop excellent business relationships with their customers. Fred Gronemeyer tried his first Gateway because he was impressed by his sales person. Eighteen systems later, Fred is still impressed by his sales person.

And the biggest little thing of all is the feeling you get when you deal with the people at Gateway 2000. As Larry Mahan said, "they're honest-to-goodness nice folks."

Compare prices, quality and service. Then add up the little things

you get from small town people running an old-fashioned, high-tech business. What you get is everything you're looking for.

Whether you're from Indiana or Switzerland, Georgia or Nova Scotia, you've got a friend in the business at Gateway 2000.



8 0 0 - 5 2 3 - 2 0 0 0
610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

GATEWAY 2000 SYSTEMS

12MHZ 286VGA

- 80286-12 Processor
- 2 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 28ms IDE 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

\$1695.00

GATEWAY 386SX

- 2 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 40 Meg 17ms IDE 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
- MS WINDOWS 3.0

\$1995.00



20MHZ 386VGA

- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 80 Meg 17ms IDE 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
- MS WINDOWS 3.0

\$2595.00



25 MHZ 386 VGA
\$2695.00

25MHZ 386CACHE

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 110 Meg ESDI Drive
- ESDI 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
- MS WINDOWS 3.0

\$3395.00



33MHZ 386VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg ESDI Drive
- ESDI 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
- MS WINDOWS 3.0

\$3695.00



25MHZ 486VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg ESDI Drive
- ESDI 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
- MS WINDOWS 3.0

\$5295.00

CACHE SPECIAL

■ Same features as our PC Mag Editor's Choice 25 MHZ 386 Cache system except this machine has an 80 Meg 17ms Drive instead of the 110 Meg EDSI Drive.

\$2995.00

STANDARD FEATURES AND SERVICES

- Microsoft® WINDOWS™ with all 386 and 486 systems
- 30-day money-back guarantee
- One-year warranty on parts and labor
- New leasing options now available
- Toll-free technical support for the life of the machine
- Free on-site service to most locations in the nation
- Free overnight shipment of replacement parts
- Free bulletin board technical support

*If our standard configurations don't fit your needs, we'll be happy to custom configure a system just for you.
Due to the volatility of the DRAM market, all prices are subject to change.*



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

8 0 0 - 5 2 3 - 2 0 0 0

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

*New software makes it
easier to develop
HyperCard-like
applications on the PC*

CROSSING OVER

I have done a fair amount of cross-platform development in my time, and it has never been very easy. I can recall trying to convert some complicated economic forecasting programs back in 1978. I brought these FORTRAN IV programs with me when I moved from Ohio State University to the University of Chicago. They were crucial for my historical research at the time, but I had written them using the FORTRAN IV compiler on an IBM 370 mainframe at OSU. Chicago's IBM mainframe ran a different version of FORTRAN, so I spent a couple of months converting my old source code to work on the new machine and then recompiling and linking. Not a fun process, I can tell you, even with a good debugger and line editor.

As much of a pain as that was, cross-platform development is more difficult. I need to develop instructional software that will run under the Mac OS, Windows 3.0, and the Unix X Window System, yet take full advantage of each system's inherent graphical user interface (GUI). So far, I haven't been able to find anything that successfully crosses all three operating-system boundaries nicely, but there is hope. Over the last couple of months, I have been working with a development system called Plus, which is published by Spinnaker Software. Plus runs on the Mac, OS/2 Presentation Manager (PM), and Windows 3.0 on the PC. Although the PC version should be shipping by the time you read this, this column is based on my work with beta software, which was done mostly without the benefit of printed Plus documentation for the IBM PC.

A Plus for Porting

Plus lets you port existing HyperCard or Plus stacks from the Mac to IBM PCs and compatibles running OS/2 PM 1.2 or Windows 3.0. Plus is essentially a superset of HyperCard with improved object-oriented programming (OOP) features, a



much better editor, and real development utilities.

Plus has been around for a while, first sold by Format Software of Germany, then Olduvai Software of Miami, and now Spinnaker. It seems that Plus has really found a home at Spinnaker, since it has been revised to include the OS/2 PM and Windows 3.0 versions. Before Spinnaker took it over, Plus was strictly a Mac product. While the Mac version is shipping, the PC version is still beta (although it's due out by the time you read this), so keep that caveat in mind.

Plus is Spinnaker's idea of what HyperCard could be with the programming interface extended and improved and with a wish list of extensible features (e.g., color support, resizable and scrollable windows, resource editing and implementation, additional object types, and improved data typing) added. But Plus is still not true OOP, so don't expect to find niceties like polymorphism, true

inheritance, or a class browser. Plus also locks you into the same card metaphor as HyperCard, which may be unsuitable for your work. For mine, though, where I use HyperCard daily for instructional examples, Plus is just the ticket for simple cross-platform development and multiple system work.

The real beauty of Plus is that it's nearly identical on the Mac and PC. The only real differences are those nuances dictated by the underlying GUI. This means that Mac programmers should be able to port Plus stacks over to the PC without much PC experience, while PC programmers knowledgeable about PM or Windows will find their commute equally straightforward.

According to the Script

Spinnaker built Plus's script editor into the system, as is the case with HyperCard's. In fact, Plus works much like

continued

HyperCard on steroids—its interface looks a lot like HyperCard's with some new menu items (e.g., Navigation, Object, Text, Font, and Graphic) at the top level, with a tool palette just below these menus. If you are familiar with HyperCard, Plus will seem like a version 3.0.

The big drawback to Plus, though, is that it doesn't build stand-alone applications in the true sense of the term. You'll need a copy of at least the Plus run-time system on your machine to run a Plus stack. Fortunately, you can include the Plus run-time system with your stacks free of charge.

I used Plus to port some student HyperCard stacks over to Windows 3.0, and I was pleased with the results. The work of one student in particular, Suzanne Gurland, typifies the kind of final project stacks that are turned in for my Computer Science 110-111 class (Computer Programming as a Liberal Art I-II). Her HyperCard stack helps her keep track of her duties as a summer camp counselor. The stack uses her own ideas, bits of scripts and objects from Activision's Reports stack, and external text files. With some tweaking, I used Plus to convert this to a Plus stack first on the Mac and then on a Toshiba T5200 running DOS 4.01 and Windows 3.0.

Most of Suzanne's scripts were attached to buttons, since most new HyperCard programmers tend to forget about using the card and background objects as script associators. For example, here's her script for an enhanced Find command:

```
on mouseUp
  push card
  ask "Who would you like
    to find?"
  put it into lookFor
  if lookFor is empty then
    pop card
  end if
  find lookFor --lets the
    --user proceed directly to
    --a desired card without
    --having to "flip through"
    --the stack
end mouseUp
```

This script and its button, like all those in her stack, are directly readable by Plus on the Mac and convertible to Plus under Windows 3.0. I used an AppleTalk PC board and Sitka to transfer files between my Mac IIx and Toshiba T5200. The Plus Mac files are then directly readable by Plus on the PC.

Most students eventually learn to use the background for scripts whose func-

tions need to be available at all object levels in the stack where that background is present. Plus's improved script editor and its multiple platform availability means that some of my students can now work on their Mac programming homework using their own PCs, running Windows 3.0 and Plus. Background scripts, like this user-defined on handler from Suzanne's Camp Stack, also get ported over to the PC without any modifications:

```
on returnInField
  put number of target into
    holder
  if holder=18 then
    exit returnInField --since
    --this is the last card into
    --which the user enters
    --information, there is
    --nowhere to send cursor
  end if
  if holder<19 then
    select after text of
      field (holder + 1)
    --automatically sends cursor
    --to next field when user
    --presses "enter"
  end if
  if holder=19 then
    select after text of
      field 2
    --this had to be added because
    --a new field was created late
    --in the process and affected
    --the logical ordering of the
    --fields
  end if
end returnInField
```

Although I expect Plus to work well for my initial purposes—to make it easier for students with PCs to take our HyperCard-based classes and to foster OOP/hypertext thinking on the PC as well as the Mac—the beta PC version lacks the same important development features as the Mac version. These missing features include a debugger, high-quality script editor, data exchange with other applications, and the lack of user-definable object properties. The other big trouble spot in the PC version is with XCMDs and XFCNs (external commands and functions).

XCMDs and XFCNs get written in other Mac languages, like Pascal or C, and are compiled and linked in with a Mac Plus stack to provide some code functionality that would be difficult or impossible in HyperCard or Plus. Unfortunately, when you port your Plus stack over to the PC, the XCMDs and XFCNs simply will not work—mainly because

they were written to utilize certain Mac-specific features, such as color and sound. The porting process becomes pretty sticky at that point.

The first thing that you have to do is yank out the XCMDs and XFCNs from your stack using ResEdit on the Mac. Then you have to convert the modified stack to run in Plus and copy the modified stack over to the PC. But you're not done yet. Now you have to port over your original XCMD and XFCN source code to the PC, modify it to use PC-specific features, and then recompile it. Finally, you include it in the PC stack. This tiresome procedure was more difficult than it should have been because I was using a beta of PC Plus with almost no documentation, but it was still too complicated. This should be fixed before PC Plus is released. If it's not, the real utility of Plus as a Mac-to-Windows cross-platform development tool will be sorely limited.

Then There's the ToolBook

As I was finishing this column, I got a crack at another OOP-based hypertext system for Windows 3.0—Asymetrix's ToolBook. If you're looking for a more robust and truer OOP development environment for Windows 3.0 that still works as an amalgamation of OOP techniques and hypertext, you should consider ToolBook.

I've worked with ToolBook since it was released on May 21, and it definitely extends the hypertext metaphor (by emulating a book rather than a stack of cards) while retaining the building-block approach of HyperCard. A run-time version of ToolBook comes with every Windows 3.0 box, so if you build ToolBook applications, you can be sure that they'll have an audience. Currently, though, ToolBook does not run on the Mac, so it has no direct utility for cross-platform development.

Although ToolBook doesn't yet have a Mac-equivalent version, it is sufficiently like HyperCard and Plus to put some pressure on Spinnaker to improve its programming environment. In fact, I was so taken by ToolBook that I'm contemplating using it for some Mac-to-PC porting projects.

The reason is that ToolBook already looks a lot like HyperCard, except that it has replaced the card metaphor with that of a book. Stacks become books and cards become pages, while other HyperCard-like objects (e.g., fields, buttons, backgrounds, and foregrounds) are also available in ToolBook. Important differences abound, however, and the most

continued

PostScript Power To The People!

The QMS-PS® 410 Printer. Developed by the greatest minds in the industry. . . Yours.

Before engineering the QMS-PS 410, we performed one very important task. We listened. Then we took everything we heard, added a few surprises, and built a revolutionary laser printer with a suggested retail price of just \$2795!

You said make it Adobe® PostScript®. So we did. And now you can enjoy the design flexibility only PostScript offers as well as 45 resident typefaces and thousands of PostScript software applications.

You said make it reliable. So we used the Canon® LX print engine manufactured by the undisputed world leader in high-quality, easy-maintenance print engines.

You said make setup easy. So we made it truly and completely plug-and-play. Out of the box, it connects to IBM® PC's and compatibles, Apple® Macintoshes® and mini and mainframe computers.

You said make it flexible. So we added HP® LaserJet® Series II emulation to support non-PostScript printing applications.

You said make it simple. So we gave the QMS-PS 410 the intelligence to actually "think for you" by automatically switching between emulations and interfaces! This printer has ESP (Emulation Sensing Processor), which interprets incoming data and *automatically* chooses the appropriate printer language. And you can send data *simultaneously* to its AppleTalk®, serial and parallel interfaces! There's no need to change switch settings or send complicated software commands.

You said make it fast. So we created a super-fast controller with a 68020 processor and third generation QMS® ASAP™ technology (Advanced Systems Architecture for PostScript), which incorporates the latest in component and controller design.

You said make it expandable. So we made a variety of options available, including an HP-GL® emulation card, Adobe typeface cards, HP compatible font cards, memory upgrades and extended paper handling capabilities.



Call Now and Let the QMS-PS 410 Liberate You!

1-800-523-2696

In Europe (31)-30/420129

You see, listening to you gave us the insight to develop a printer that offers real world solutions to real world problems. And the QMS-PS 410 delivers PostScript power to the people by giving you more solutions than any other printer on the market. Affordable. Reliable. Flexible. Solutions that set you free!



POSTSCRIPT®

QMS™

The following are trademarks or registered trademarks of their respective companies: QMS, the QMS logo, QMS-PS and ASAP of QMS, Incorporated. IBM of International Business Machine, Incorporated. Adobe, PostScript and the Adobe PostScript logo of Adobe Systems, Incorporated. Canon of Canon USA, Incorporated. Apple, AppleTalk and Macintosh of Apple Computer, Incorporated. HP, HP-GL and LaserJet of Hewlett-Packard Company. Centronics of Centronics Data Computer, Incorporated.



REAL-TIME MULTITASKING KERNEL

8086/88, 80x86/88 80386
Z80, 64180, 8080/85 68000/10/20

- Fast, reliable operation
- Compact and ROMable
- PC peripheral support
- DOS file access
- C language support
- Preemptive scheduler
- Time slicing available
- Configuration Builder
- Complete documentation
- Intertask messages
- Message exchanges
- Dynamic operations
 - task create/delete
 - task priorities
 - memory allocation
- Event Manager
- Semaphore Manager
- List Manager
- InSight™ Debugging Tool

THE BEST

Join over 600 developers such as
IBM®, Xerox, Hewlett Packard,
Hayes, Hughes Aircraft and NASA.

CHOOSE AMX

The best low-cost, high-performance
real-time multitasking system
available today.

No Royalties

Source Code Included

Demo Disk **\$25 US**
Manual only **\$75 US** *Call for prices for*
AMX 86 **\$3000 US** *other processors.*
(Shipping/handling extra)

IBM is a registered trademark of IBM Corp.
Z80 is a trademark of Zilog, Inc.
AMX, AMX 86, InSight are trademarks of
KADAK Products Ltd

KADAK Products Ltd.

206-1847 West Broadway
Vancouver, B.C., Canada
V6J 1Y5



Telephone: (604) 734-2796
Fax: (604) 734-8114

ITEMS DISCUSSED

Plus\$495
(Until the PC version is released,
the Mac version is \$195.)
Spinnaker Software
One Kendall Sq.
Cambridge, MA 02139
(617) 494-1200
Inquiry 976.

ToolBook\$395
Asymetrix Corp.
110 110th Ave. NE, Suite 717
Bellevue, WA 98004
(206) 462-0501
Inquiry 977.

important is ToolBook's enhanced script editor and debugger. Both put Plus's currently weak efforts in these regards to shame. ToolBook also supports user-defined object properties and the Dynamic Data Exchange hot-links facility in Windows 3.0.

ToolBook scripts (the scripting language is called OpenScript and looks much like HyperTalk) can be clumsier than Plus's scripts. You also miss repeat structures, since you can't use repeat loops in your code; instead, you have to code a while control structure like this:

```
set ch to 1 --initializes the
--ch local variable
while char ch of filename
  <> "."
  put char ch of filename
  after title --Title
--is a local variable; put the
--character that is in the ch
--variable at the end of the
--value that is in the first
--variable
  increment ch
end while
```

I missed the loop structures like repeat, repeat until, and repeat while. Of course, a straight while structure functions nearly identically to a repeat, but sometimes touching base with commonly accepted syntax from other languages helps enfranchise more crossover programmers. ToolBook should have left in the repeat structures.

The ToolBook messaging system is a bit odd compared to Plus and HyperCard. Where all HyperCard objects generate messages for other objects when their handlers are correctly activated, the ToolBook messages are generated under more controlled circumstances. In some

cases, this control can force you to explicitly send a message from object A to object B, since you can alter the natural message-passing through an object hierarchy. This can be confusing, especially if you expect the message to be passed automatically to the correct target object.

Say you want to send a message from one handler in an object's script to trigger the execution of another handler in the same script. You would write something like this:

```
to handle buttonUp
  move circle "RoundOne" to
    110,310
  send buttonDoubleClick
  --sends the buttonDoubleClick
  --message to the object whose
  --script contains this
  --handler
end buttonUp
```

Another handler in the same object's script would handle the buttonDoubleClick message. If not, only then would the buttonDoubleClick message travel up the hierarchy of ToolBook objects.

My impression of ToolBook is that it's needed for the Mac and that the PC Windows version needs all those Mac ToolBook applications that would eventually spring up, especially among dyed-in-the-wool HyperCard/Plus developers. ToolBook is not true OOP, but it's closer than Plus, and its adherence to the basic tenets of hypertext can't be faulted. And for professional developers, it includes decent basic development tools and utilities and the support of many third-party vendors with add-ons.

In the long run, I hope that Plus improves its environment and utility, while ToolBook makes it to the Mac. Once that happens, you'll have two good cross-platform OOP/hypertext development systems to work with. Both Plus and ToolBook are bound to enfranchise a whole new group of PC users who will be building their own custom software for the first time. It should feel like the kick in the pants Mac users got in 1987 when HyperCard was released. ■

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.

Doesn't everyone want to improve the environment?

CORPORATE CUSTOMERS!

The PC environment, that is!

With the introduction of Microsoft Windows, came the development of business software packages expressly fashioned for this exciting new environment. And today's leading companies turn to CORSOFT to fulfill their specialized software needs. Select from over 4,500 titles, including all the newest Windows products!

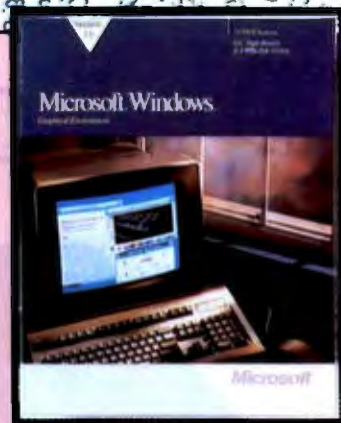
For instant information on these products, just pick up your FAX phone, dial the FAXcetera number below and follow the step-by-step directions:

201-389-8173

Microsoft Windows 3.0—The graphical user interface (GUI) environment instantly transforms your PC from a tool that runs only one character-based application at a time to a graphically oriented, multi-application environment that will make your productivity soar. Windows features: integration of text, numbers and graphics; WYSIWYG display; icons, pull-down menus and dialog boxes; on-screen manipulation of objects with a mouse; accessibility of network drives and printing.

You'll be getting a lot more accomplished with less effort...and isn't that why you bought a PC in the first place?

List: \$149 **Ours: \$92** FAXcetera #1269-0005



Microsoft®

We're CORSOFT! We specialize in servicing the corporate community. Get quick delivery and great prices on over 1000 publishers, including Microsoft, Lotus, and Borland. Ask about volume purchase agreements, contracts and personally assigned sales representatives. Call CORSOFT today and improve your computing environment!

CORSOFT
The Software Resource for Today's Leading Companies

Call for our latest free catalog! (800) 441-1511 or (201) 389-1700

Circle 47 on Reader Service Card

Lotus® 1-2-3 Release 3.1—The award-winning, true 3D spreadsheet offers a 3D design for easy spreadsheet organization, advanced analytical functions, access to external data, and powerful application development capabilities. Release 3.1 now provides the familiar 1-2-3 interface in an easy-to-use WYSIWYG screen display, graph and text editing tools, and printing power for users of DOS or DOS with Windows 3.0, on 286 and higher PCs.

List: \$595 **Ours: \$385** FAXcetera #4000-0005

Lotus.



Cricket Presents:

For development, management and delivery of desktop presentations, Cricket Presents brings integrated charting, drawing, text processing and image management to the Windows environment. Outliner and templates for automatic presentations complete with audience handouts and speakers' notes, in addition to autografix overnight slide service telecommunication support for producing 35 mm slides or transparencies.

List: \$495 **Ours: \$299** FAXcetera #1004-0001



Cricket Graph: Design technically-oriented charts and graphs with control over a variety of sophisticated attributes, including fonts, color and patterns. Interactive development editing and WYSIWYG output makes Cricket Graph a recognized leader in graphing programs!

List: \$195 **Ours: \$118**
FAXcetera #1004-0002

COMPUTER ASSOCIATES®

You can't be too rich, too thin or too smart



RICH

in features like a replace battery indicator, internal control language, site diagnostics, and full-time surge and noise suppression

THIN

to fit easily under the monitors of desktop servers and workstations

SMART

with an intelligent interface to allow automatic shutdown of network operating systems such as Novell, Lan Manager, Lan Server, SCO Unix, Banyan and more



Some people also say you can't be too powerful. But to a computer too much or too little power can be disastrous. Protect your desk space and your data with APC's new Smart-UPS™ 400, designed

specifically for servers or workstations such as the IBM PS-2/80 and the Compaq DeskPro 386. With PowerDoctor™ software, you can even monitor your site's power quality and export the data directly to popular spreadsheets. So even if

you're finding it hard to get rich or thin, protecting your data with an APC UPS will always make you look smart. Call 800-541-8896, Dept. A2 to receive your free Power Protection Handbook. Resellers ask about our extensive support programs.

The industry's leading UPS systems



"All Around
Reliable
Choice"
PCWEEK



Lan's Best Friend™

© 1990, APC, 132 Fairgrounds Rd., West Kingston, RI 02892 USA. Int'l headquarters at 2 bis rue P.H. Spaak, Esplanade Parc d'Enterprises, Saint Thibault des Vignes, 77462 Lagny sur Marne, Cedex, France, 011-33-1-64-021158. Products carry a two year warranty. Lan's Best Friend, Smart-UPS, PowerDoctor are trademarks of APC. All other trademarks are the property of their owners.

Circle 14 on Reader Service Card

Microsoft's answer to multitasking hasn't lived up to its claims, but there are other choices

THROUGH A WINDOW, DARKLY

For years now, we've been told that OS/2's Presentation Manager (PM) is the answer to the business user's requirements for productivity. In a fit not to be outdone by Apple with its Macintosh interface, IBM and Microsoft created this super windowing software package that is supposed to let us use a mouse to switch between applications as easily as we change channels on our TVs. The problem is, there aren't enough applications to make switching necessary.

Then, earlier this year, we were told that the new version of Windows would do the same thing for the DOS world. All of a sudden, we would be able to engage in real multitasking—running communications software in one window while using a word processor in another. Once again, the answer to the business user's need for productivity was at hand with Microsoft's graphical user interface. Of course, the fact that Quarterdeck had been doing this for years with Desqview (albeit without the GUI) was ignored.

Now, business users find themselves with two choices, each of which the heavy hitters say is the right GUI. One, OS/2, is supported by the heaviest hitter of them all, IBM. The other, Windows 3.0, is supported by Microsoft, which also wrote OS/2. OS/2 treats all your computer's memory as a big contiguous space in which to run programs. Windows 3.0 lets you load several DOS programs, each into its own 640K-byte segment. OS/2 also lets you have a DOS segment, but you can have only one, and not everything runs in it.

An Embarrassment of Riches?

Confronted with such choices, many business users might simply decide to ignore the whole thing and keep using plain old MS-DOS just as they always have. But can you afford to ignore either one of these? Can you afford to ignore both of them? Does either of Microsoft's GUIs have a place in your business?



To be useful in a business setting, a software package must do something to enhance the value of an employee. The employee must become more productive, more accurate, or more capable than before; otherwise, the software is just a waste of money. In addition, the software must not require resources that outstrip the value to be gained. If you have to spend \$10,000 on computer hardware and software to realize a productivity gain of \$5000 over the economic life of the computer, you have just thrown away the money you invested.

Accordingly, Windows and PM must do something worthwhile if they are to play a role in business, and, in addition, users should be able to justify them economically. I looked at Windows 3.0 and PM in a variety of environments to see if either of them makes sense. While I was at it, I checked out Desqview 386.

To make sure that I looked at machines similar to what most businesses

use, I tried Windows 3.0 and PM on an old 8-MHz, 286-based Zenith Z-248. I also sized up more modern equipment—a Zenith 386/33, a Cheetah 386/25, and a Gateway 2000 386/25. I did not test Windows 3.0 on an 8088-based machine, even though it will allegedly run on one, because of reports that the operation is so slow as to be ludicrous.

PM and Windows 3.0 seem to be very similar at first glance. (For more information on the user interfaces, see "PC GUIs Go Head to Head" on page 82.) There are some significant differences in the software, however, and they can have a major effect on whether or not the packages will be useful to you and your business.

Is OS/2 the Answer?

OS/2's most important difference is that it's not MS-DOS. This statement may sound silly, but remember that most of

continued

ITEMS DISCUSSED

Desqview 386\$220

Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9701
Inquiry 1221.

OS/2 1.2

(with Presentation Manager)

Standard Edition\$340

Extended Edition\$830

Windows 3.0\$149

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(206) 882-8080
Inquiry 1222.

the software currently in use requires MS-DOS. While OS/2 does provide for a single MS-DOS session (some people call this the DOS "box"), that may not be what you are looking for.

There are some programs that don't run in the DOS session that OS/2 provides, including the standard DOS shell for Novell NetWare. This means you may not be able to use networked applications with OS/2 unless they recognize the OS/2 NetWare requester. In addition, some applications and utilities, including Procomm Plus, seem to run in fits and starts in the DOS session.

Also, to run at all, OS/2 requires a computer to have significant resources. You need several free megabytes on the hard disk and about 4 MB in system memory. Finally, you need an IBM Proprinter, since OS/2 doesn't recognize other printers. Neither VGA Video nor a mouse is required, but you should use both if you actually plan to make the GUI productive. If you plan to use OS/2's multitasking capabilities, you will need more memory than 4 MB.

Virtually all the software available for OS/2 is available for DOS. In addition, OS/2 seems to be the target of choice for applications being ported from the mainframe world to microcomputers. For example, in "Moving Down to Micros" (September BYTE), I wrote about SPSS for OS/2. This massive package requires OS/2 and uses PM as its interface for building user queries. If you plan to use software like this, you'll need OS/2.

Looking Through Windows

Windows 3.0, on the other hand, is a creature of the DOS world. It supports software designed for plain MS-DOS, as well as for earlier versions of Windows.

It does, however, have some major shortcomings. For everything to work as advertised, an application must be written specifically for Windows 3.0. Non-Windows applications and Windows applications written for earlier versions may not work as expected when run from Windows 3.0 unless you run them in what's called "real mode"—the bottom 640K bytes. The extra memory does you no good whatsoever.

While Windows 3.0-specific applications apparently aren't difficult to write, right now they aren't ubiquitous. It is likely, though, that they will become available more quickly than applications for OS/2. In the meantime, you have to be careful of software that doesn't like Windows. Novell's workstation shell, for example, will run on a workstation that's using Windows, but you must either use it in real mode or get a special version of the workstation software. You also can't use Novell's IBM 3270 gateway with Windows on the workstation, or the gateway will crash.

On the other hand, applications for Windows seem to be easy to create. I asked a programmer to look at the Windows Software Development Kit, and he reports that it's a significant improvement over earlier versions. Thus, you can expect applications converted for use with Windows 3.0 to show up more quickly than those for OS/2, which is still very difficult to write for.

A Multiple Look

Unfortunately, neither PM nor Windows 3.0 seems to handle multitasking very effectively, at least not with current software. PM will do fine with OS/2 applications, but the chance of finding more than one application that you need at any given time is pretty slim.

Windows 3.0 will switch any DOS program into the background, but it may need to be in real mode to work with some applications. And once switched into the background, it seems to go into suspended animation. A DOS application operating in the background with PM also seems to run very slowly.

As a result, without applications written specifically for the environment in use, you don't really get a productivity gain. You do get context switching, but you can't download from an on-line database in one session while doing word processing in another. In other words, the hype for OS/2 and Windows 3.0 promised a lot, but they didn't really deliver much except a pretty interface. If you want multitasking, you'll have to look elsewhere.

Real Multitasking

The best solution to multitasking that I've used is Desqview from Quarterdeck Office Systems. While it's not a GUI, Desqview works with Novell NetWare and does windows, and its multitasking works quite well. It really does give you the productivity boost promised but not delivered by the others. Of course, this solution is neither brand-new nor heavily hyped, so it may appear to be low-tech to your power users. But Desqview does have the distinction of working where the others do not.

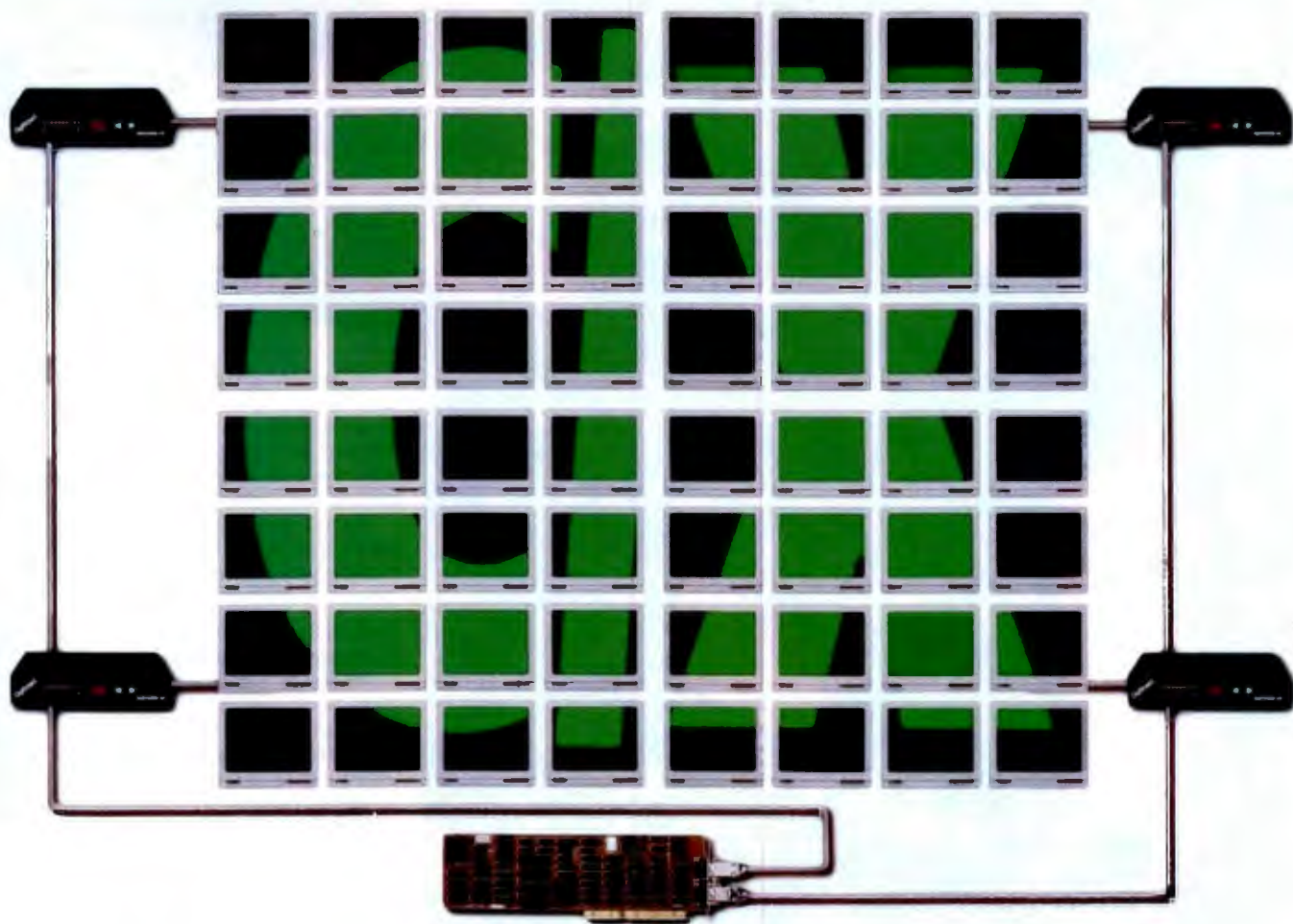
Eventually, perhaps by Fall Comdex, you will begin to see a number of applications that will work with Windows 3.0. Several manufacturers have announced versions of their packages for Windows 3.0, and as more computer manufacturers begin shipping Windows as part of their bundled software, you can expect more software manufacturers to follow suit. Meanwhile, though, your use of Windows 3.0 will be limited. You might as well wait until you really need it—either because an application you need requires Windows, or because it is included with a computer you just bought.

It's unlikely that you will ever see a great rush to PM. It seems to have missed its window of opportunity, and now it probably will find its niche supporting network servers and software packages that migrate from mainframes. The only real reason to buy OS/2 is because a specific application requires it. Otherwise, it's a waste of money.

The promise of a productivity increase based on multitasking remains unfulfilled, at least by Microsoft. Whether or not its GUI enhances your productivity is an open question. Meanwhile, right now you can get the next best thing by calling Quarterdeck. If you must decide between the Microsoft offerings, then the choice is clear. Unless a specific application drives you to OS/2, choose Windows 3.0. At least with Windows, the chances are good that you'll eventually be able to obtain some software. ■

Wayne Rash Jr. is a contributing editor for BYTE and technical director of the Network Integration Group 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.



How to see the Big Picture through a single slot.

Take a look at the DigiCHANNEL C/X System. You'll see up to 64 users working on 64 different jobs. All at the same time. All through a single expansion slot.

The C/X Adapter Card, with its own processor, slips into that slot. From there, it connects with up to four DigiCHANNEL C/CON-16 concentrator boxes. Each concentrator comes with a 16 MHz 80186 processor and 128K of zero wait-state RAM to handle I/O processing for 16 terminals. All of which is available for EISA, Micro Channel and ISA

buses, with support for most UNIX operating systems.

So you can configure up to four workgroups, each located up to 1000 feet from your CPU. Yet when all 64 users are on line, each one will be able to communicate at 38.4 KB. That's nearly twice as fast as anyone claiming to be competitive.

If you're looking for a better view of the Big Picture, give us a call. Ask about our NO-RISK 30-DAY TRIAL OFFER. We think you'll like what you see.

DigiBoard
Plugging you into tomorrow

6751 Oxford Street, Minneapolis, MN 55426 1-800-344-4273 In MN, 612-922-8055

The FairCom® Servers The developer's client/server technology

Faircom Server

Faircom Server

FairCom Server & SQL Server

■ Designed with developers in mind — you can incorporate the FairCom Servers directly into your applications. Something Oracle and MS/SQL Server won't let you do!

■ No other server can match the speed, flexibility or concurrency of FairCom Servers.

■ Multi-threaded design increases performance — the server utilizes all the previously unused time spent waiting for locks or I/O operations.

■ Industrial-quality transaction processing, including full commit and roll-back, intermediate save points and complete logging.

■ Compatible with c-tree plus, ANSI-standard SQL, QBE, "Just Ask"™ natural language query tool, and other interfaces.

■ Two configurations (FairCom Server or FairCom SQL Server) — each comes with a complete c-tree plus file handler; FairCom SQL Server also includes an ANSI-standard SQL engine.

FairCom introduced the first portable server to the developer community in 1988. Since then developers have been demanding increased user response time, faster server performance, more flexible interface options and industrial-quality transaction processing.

The kind of server technology that developers can incorporate into their applications to create more sophisticated, flexible and dependable DBMS products.

FairCom Servers. The server technology developers have been waiting for.

The FairCom Servers utilize high performance design features:

■ **Multi-threaded design**

■ **I/O minimization.** Sophisticated proprietary caching and compression algorithms reduces I/O functions

■ **Key locks.** Minimizes interference between users while maintaining maximum data availability.

Transaction Processing — The heart of the FairCom Servers.

FairCom provides industrial quality on-line transaction processing (OLTP) and fully automatic recovery, including full commit and roll-back intermediate, save points and complete logging. No other server can match the speed, flexibility or concurrency of FairCom Servers.

Complete interface flexibility.

FairCom Servers offer developers two configurations. The **FairCom Server** is an ultra-high performance server utilizing the widely accepted c-tree™ and c-tree plus™ Application Programmers Interface (API). The **FairCom SQL Server** includes c-tree plus and a full ANSI-standard SQL, serving both SQL and non-SQL clients simultaneously.

The FairCom Server can also be used in a stand-alone (vs. a network) configuration — it can be tightly coupled with a developer's application.

FairCom — A decade of performance and quality.

This new client/server technology breakthrough will come as no surprise to the U.S. and international software developers who have been utilizing FairCom products during the past decade. Our file handling technology is incorporated in the products of many leading companies including 3Com, Hewlett Packard, NCR, Cray, Informix, Sharp, Digital Research, IBM and others.

Call (800) 234-8180 to get a complete technical overview of the latest generation of servers — FairCom Servers.

The developer's client/server.

Circle 74 on Reader Service Card



FAIRCOM
corporation

4006 WEST BROADWAY • COLUMBIA, MO 65203 • PHONE 314.445.6833 • 800.234.8180 • FAX 314.445.9698

New Unix-specific machines from IBM indicate a new attitude toward Unix

IBM AND UNIX: PERFECT TOGETHER?

Everyone knows that AT&T wrote Unix. But that hasn't stopped IBM from developing products that have changed the face of the Unix industry and will continue to do so for some time. You could even say that IBM has been responsible for several of the more important de facto standards in Unix—and until recently, the products that have set these standards weren't even Unix products!

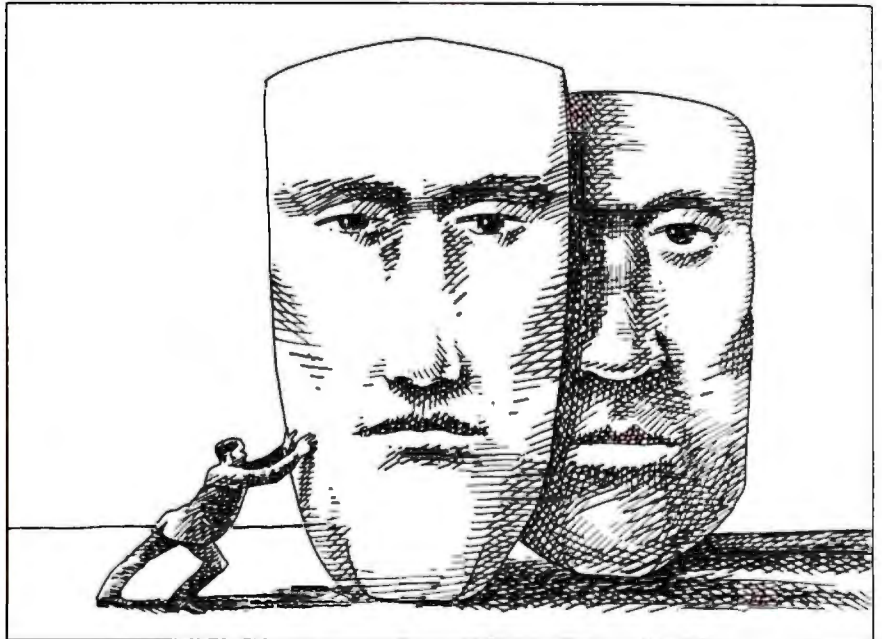
Look at the venerable IBM AT. Based on the Intel 286 CPU, the AT started to create interest in a modest way when firms such as Microport and The Santa Cruz Operation (SCO) ported Unix and Xenix for it. When multiport serial boards appeared on the market, the AT thus became a moderately priced, standardized base for multiuser applications.

In many ways, this was the true beginning of the low-end Unix market. Before the AT, low-priced Unix machines had been mostly 68000-based computers, with widely differing and incompatible architectures. The AT was a known entity with well-defined characteristics, and it had gotten into many developers' hands. So it was logical that it was a popular destination for DOS developers wishing to port their programs to Xenix and Unix: They already had the hardware, and so did their customers.

This is also how Xenix became so popular, since it was one of the first "serious" versions of Unix intended for small computers that had some of the extensions needed for business. SCO aggressively marketed Xenix to developers through direct sales and channels such as Tandy, which made its own series of Xenix-compatible computers (some of which were also based on Intel CPUs).

Chips Ahoy

The introduction of the Intel 386 CPU probably did more for this segment of the Unix market than any move AT&T ever made. The 386 was an instant success, but not quite the way IBM had planned.



While IBM's sole 386 machine belonged to its new line of Micro Channel architecture machines, everyone else started dropping 386 chips into reworked AT motherboards. Suddenly, the most-wanted personal computer in the IBM world was something that IBM didn't make (and still doesn't): a 386-based version of the AT.

In addition, although many DOS-based PC users looked at their 386 machines as an expensive status symbol (which was true in some cases where people weren't doing serious graphics and CAD work), Unix users knew just what to do with all that power. It was desperately needed for the multiuser applications that had been stretching the 286-based AT computers to their limit. 386 PCs running Unix could now become a major force in the market.

There were technical, not just market-driven, reasons for this. The 386 is a much more powerful processor, is faster

internally than the 286 while being upwardly compatible with it, and can run at clock speeds of up to 33 MHz. It has a fully separate supervisor mode, so a 386 Unix kernel can be run completely protected from the vagaries of user programs. Perhaps most important, the "virtual 8086" mode of the 386 CPU enabled software companies such as Locus Computing and Interactive Systems (together with Phoenix Technologies) to write emulators for MS-DOS that allow an entire DOS system to be run as a task under 386 Unix. This support of an IBM standard allowed more DOS users to see the potentials of Unix.

For the first time, Unix users could have a powerful processor at a reasonable price, on a totally standard hardware platform that was compatible with MS-DOS. Add to this the standard Unix ports available from AT&T, Interactive Systems, Intel, SCO, and others, and it's

continued

obvious why the 386 has redefined the lower end of the Unix market. Of course, the i486 is an even more powerful platform for Unix, although the ramifications of the battle between the Extended Industry Standard Architecture and Micro Channel architecture buses are too complex to be discussed here. Again, it was IBM's lead in the business arena that helped this standard come about (in comparison, Motorola 680x0-based computers are generally no longer in the high-volume low-end market).

Software Solutions

But there's more. For every user who has moved to Unix from DOS, there are still probably 80 who haven't. Even so, DOS users are using Unix, albeit often transparently or as a back-end server. The programs that make this possible are things like PC XSight from Locus, PC-Connect from VisionWare, and PC-Interconnect from Motorola.

All these programs allow DOS users to access both Unix and DOS programs more or less (depending on the product) transparently. The Unix programs are expected to reside and run on a different

DOS users
are using Unix, albeit
often transparently or
as a back-end server.

machine, generally connected to the PC via Ethernet. The DOS side may look like an ordinary DOS screen, or like an X Window System terminal, or even like Microsoft Windows. The better programs even allow cutting and pasting between DOS and Unix programs. The result is that you can keep your IBM PC running DOS, while getting the benefit of the departmental or companywide Unix machine (see "DOS and Unix: On Speaking Terms," June BYTE).

IBM and Workstations

IBM has not been ignoring the mushrooming workstation market, either.

IBM took early steps a few years ago with its RT computer, which was supposed to become a hot entry in the scientific market due to its use of RISC technology and Unix. In an attempt to ensure software availability, IBM went out of its way to make RT machines available at extremely good prices to software developers and porting houses. Although IBM was the originator of RISC technology in the first place, the scientific community didn't seem to find the RT very interesting. The original RT was underpowered compared to its competition, and the version of Unix that finally came out of IBM was simply nonstandard enough to cause problems.

All those software developers did play an important role, however. Once the initial cachet of working with IBM wore off, developers needed a way of recovering some of the costs involved in buying their RTs and porting their software. By selling both the IBM hardware and software to the business market, they were able to accomplish this, while introducing many executives to the idea of workstations in general.

continued

Multiple-Choice



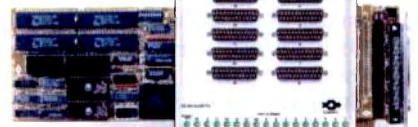
4-8

Our Hostess multiuser serial controllers are an excellent choice for up to eight occasional users. The Hostess 550 provides buffering for even higher performance. And for truly high performance, choose the Ultra 8.



16

Expand up to 16 users with the Ultra 16 high performance intelligent serial controller. But if your multiuser requirements are more modest a 16 port Hostess 550 controller makes an equally intelligent choice.



64+

Our Ultra Cluster gives you the flexibility and power for virtually limitless growth. Starting with an Ultra 8 base board, you can expand 16 users at a time, while maintaining current levels of performance every step of the way.

MULTIPLY YOUR CHOICES

At Control we pioneered multiuser technology. And we know that there are no single solutions to multiuser environments. That's why we offer more choices than any other company...from text to graphics...for modest users to over 64 users supported by a single PC. And we've not only multiplied your choices, we've multiplied performance, allowing you to expand without the high cost of adding computers.

MULTIPLIED PERFORMANCE

No company offers you more performance than Control. In fact, our new DT Express driver transforms our Ultra Series into the highest performing controllers available today. DT Express dramatically

reduces host utilization and significantly increases throughput by managing all data transmission and data transform functions on the controller. So now as you add users, no one gets caught in a wait state.

■ Performance remains high as you add users.

■ Host utilization decreases.

MULTIVISION. FOR CHOICES BEYOND WORDS

When graphics enter the equation, MultiVision enters the picture. A fully functional multiuser system for up to 16 users, MultiVision speeds images to the screen at a blistering 100 megabits per second. As a result, you'll experience near instantaneous transmission of your graphics.

With software that enhances standard operating system graphics drivers, MultiVision is compatible with virtually any monitor, keyboard, mouse or VGA controller supported by the operating system. MultiVision can also run applications designed for the "X" environment. But unlike a LAN-based "X" terminal, MultiVision is a multiuser system that transfers data up to 100 times faster. When you compare that performance with the cost of an "X" terminal... MultiVision's advantages really compute.

MULTIPLIED PROTECTION

We back our products with an uncompromising 30-day satisfaction guarantee, a 5 year warranty, complete technical support, and most importantly...a company that's easy to do business with. It all adds up to the best protection plan available. And if you're a VAR, call us about our Reseller Program that provides you with options designed exclusively for your needs.

*1 yr. MultiVision

See us at
COMDEX/Fall '90
November 12-16, 1990
In Bally's Booth B540
Las Vegas, Nevada

for Multi-Users.

Options

Our products offer serial port and memory options that are field upgradable; compatibility with ISA (AT), MicroChannel and EISA buses; RS232, 422, 485 and Current Loop interfaces and DB 9, DB 25 and RJ 45 connectors.

Graphics

When your needs move beyond text, MultiVision moves into view—a high speed (100 megabits per second) communications controller that offers near instantaneous multiuser graphics like you've never seen before.



Control

A Control Systems Company

Multiply your choices. Call Control today.

1-800-926-6876

Control Corp., 2675 Patton Road, P.O. Box 64750 St. Paul, MN 55164

© 1990 CONTROL CORPORATION. All rights reserved. All other brand names and product names are trademarks or registered trademarks of their respective holders.

Circle 46 on Reader Service Card

It seems that some businesspeople weren't ready to deal with upstart companies like Sun Microsystems and concepts like workstations and networks, but of course, they would *always* buy hardware with the IBM name on it. So the IBM RT workstations found a niche in business, which became a bit larger when the RT was redesigned to make it even faster. Even so, the market share of the RT was microscopic compared to the rest of the workstation market.

The New IBM RISC Line

IBM's recent announcement of the powerful RS/6000 line of RISC workstations and servers (see "Sizzling RISC Systems from IBM," April BYTE) overshadowed what is probably more important: IBM's major new commitment to Unix. After talking to several top IBM executives, I am convinced that IBM is now absolutely serious about Unix and considers it as much a part of its strategy as AT&T does. The RS/6000 line, in particular, will

play a large role at IBM for the foreseeable future. And IBM will be supporting the RS/6000s the way you might expect it to take care of its mainframe customers, including 24-hour hot-line support.

Whatever the competition may think about the speed of the RS/6000, one thing is certain: These machines have a great deal of power. Even if you were to assume that IBM's own benchmark figures are greatly exaggerated, the slowest machine in the RS/6000 line would still be one of the fastest computers in its class. And since this entry-level workstation, the Powerstation 320, costs less than \$13,000 (including AIX, 8 megabytes of RAM, a 120-MB hard disk drive, and a 19-inch monochrome display), you can expect that IBM will be tough competition for traditional workstation manufacturers. IBM itself thinks it will be a leading player in the workstation market by 1992.

The software delivered with the RS/6000 line sets a few standards, too. AIX 3 is a Posix-compliant, security-minded, and significantly enhanced version of Unix (although rumor has it that programmers may have to work around a few nonstandard features). AIX 3 will eventually be the standard Unix available for the IBM PS/2s and 370 mainframes, as well.

Along with the standard C compiler and development package, AIX users on the RS/6000 receive OSF/Motif and X under the name AIXwindows. The NextStep development system will also be available, meaning that developers will have two state-of-the-art development environments to work with. Naturally, both IBM and NeXT are hoping that NextStep becomes a standard the way X is and Motif is rapidly becoming. And IBM took care to ensure that many high-end applications were available for the RS/6000 line of machines at the time of its announcement.

IBM has not only played an important part in setting standards that have affected everyone in the Unix industry but is also creating new products that will themselves set the standards to come. It will be an exciting future. ■

David Fiedler is executive producer of Unix Video Quarterly and coauthor of the book Unix System Administration. He has helped start several Unix-related publications. You can reach him on BIX as "fiedler."

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

— Circle 126 on Reader Service Card

Instant Embedded Controller ... Just Add Software

High-level integration makes the MicroFrame 386S the perfect embedded controller. All you have to do is add software and expansion boards specific to your application. All basic system components and peripheral controllers are already on-board:

- 80386SX processor
- 80387SX math coprocessor socket
- Super VGA controller
- IDE hard disk interface
- Dual floppy disk controller
- Two serial ports
- One parallel port
- PS/2 compatible mouse port
- 512KB to 4MB of RAM
- Four AT expansion slots



Building with the MicroFrame 386S greatly reduces your design time. We've engineered in compatibility and reliability using industry-accepted standards. You can concentrate your development efforts on software.

Down time is reduced, too. Time-consuming troubleshooting is eliminated. One spare is all you need. Backed by a five-year limited warranty, and Made in America, the MicroFrame 386S is in control. Call or write today!

1-800-525-7661



All the features of HP BASIC, and more. For less.



HTBasic	BASIC FEATURES:	HP BASIC
YES	IEEE-488 GPIB (HP-IB), RS-232 Instrument Control	YES
YES	Integrated Environment: Mouse, Editor, Debugger, Calculator	YES
YES	Supports 16 Megabytes of Memory (breaks DOS 640K barrier)	YES
YES	Engineering Math: Matrix Math, Complex Numbers	YES
YES	High Level Graphics: Screen, Plotter, Printer	YES
YES	Structured Programming with Independent Subprograms	YES
YES	Runs on Industry Standard Personal Computers	NO*
YES	Industry Standard Graphic Printer Support: Epson, IBM, lasers, etc.	NO
YES	Industry Standard Network Support: Novell, IBM, Microsoft, NFS, etc.	NO
YES	Industry Standard IEEE-488 Support: National Instruments, Iotech, etc.	NO
YES	Exchange data files with Industry Standard PC applications	NO*
YES	No-charge Telephone Technical Support	NO
YES	Instant on-line HELP system	NO

A Costly Situation. Every engineer needs the power and features of a "Rocky Mountain" BASIC workstation, but not everyone can have one. They simply cost too much. Fewer workstations, less productivity. **The Best Way.** TransEra HTBasic software provides the *only* way for serious technical computer users to turn their PC into a workstation without having to add costly hardware. Powerful workstations for everyone means greater productivity. **Extraordinary Versatility.** In addition, TransEra HTBasic works with the Industry Standard Personal Computer hardware, software, and networks. It even allows you to easily exchange data between your favorite DOS programs and the files you create in the BASIC workstation environment. All at a fraction of the cost of other solutions.

More compatibility. More versatility. More possibilities.
Less expense. Less hassle.

To find out more, call 1-801-224-6550.

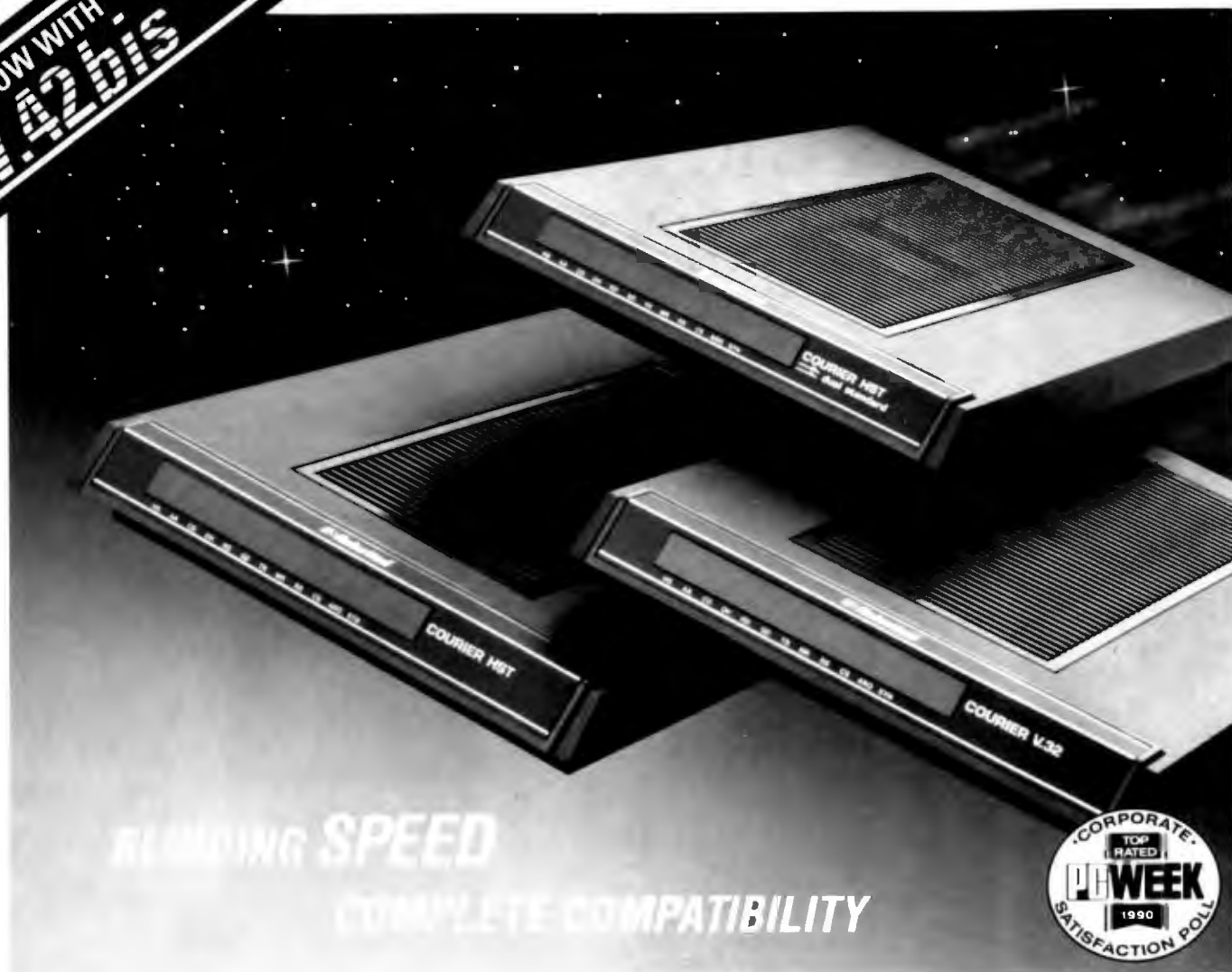
TransEra
Engineering Excellence for 15 Years™

Circle 200 on Reader Service Card (RESELLERS: 201)

* Without the addition of a costly 68000 co-processor © Copyright 1990 TransEra Corporation. All rights reserved. HP, HP BASIC, and HP-IB are registered trademarks of Hewlett-Packard Co.



NOW WITH
V.42bis



Introducing the high speed modems from U.S. Robotics Now with V.42bis

Until now, high speed modem users had the best of one world. They either had speed or compatibility. U.S. Robotics just changed all that.

THE BEST OF ALL WORLDS...

With the new line of high speed modems from U.S. Robotics – the Courier HST, the Courier HST Dual Standard and the Courier V.32 – you can now have both the highest speeds and the most compatibility.

For speed – it's the Courier HST which delivers throughput up to 35,500 bits per second with MNP® level 1-5 error control and V.42bis. And it still costs less than \$1,000.

For Compatibility – the Courier V.32 provides CCITT standard modulations from 300 bps to 9600 bps for under \$995. And with MNP levels 1-5 and V.42bis you will get complete data integrity plus throughputs approaching 24,000 bps.

For the best of all worlds – it's the Courier HST Dual Standard, combining the blinding speed of the Courier HST with the compatibility of the V.32. At \$1,295, it costs less than some featureless V.32-only modems.

U.S. ROBOTICS – THE EXPERT'S CHOICE

You would expect the broadest high speed modem line from U.S. Robotics. We manufactured our first HST in 1987, and it quickly became the standard on over 8,000 bulletin boards and for over 40,000 users. Rated #1 by *Data Communications* magazine, it confirmed what our customers knew all along – U.S. Robotics delivers the best modem value. And we've been doing that for 13 years – for over 1,000,000 customers.

When you look for high speed modems, don't settle for half a solution. Look to U.S. Robotics. Call today for details on the high speed modems that give you the best of all worlds.

Call 1-800-Dial USR. (1-800-342-5877)

U.S. Robotics®

The Intelligent Choice in Data Communications

8100 North McCormick Boulevard, Skokie, Illinois 60076

U.S. Robotics, Courier and HST are trademarks of U.S. Robotics, Inc. Other computer and software names identified by ® or ™ are trademarks of their respective manufacturers. Prices are suggested retail prices in U.S. Dollars. For sales in the United Kingdom, please call Miracom, Ltd., Ipswich, England. Telephone: 0473 233888. For Canadian sales, call 1-800-553-3560.

Can NetWare and LAN Manager learn to get along?

NETWORK PERESTROIKA

Any carpenter can tell you which tool is the right one for a given task. The same thing is true of LAN administrators selecting a LAN operating system; in both cases, you choose the one that best meets your requirements.

But it's not that simple. That strategy works when you choose your first LAN operating system, but what about the next time? Do you go with the LAN operating system you bought earlier, or do you choose the one that's right for your second job? They aren't always the same.

If you stick with a single LAN operating system, making your LANs work together is fairly simple; most vendors do a decent job of ensuring that their own products integrate reasonably. Choose two different LAN operating systems, however, and it's a whole different story.

We're faced with that situation in our lab, where NetWare and LAN Manager servers sit on the same Ethernet wire. And we are not alone. LAN Manager (as offered by such vendors as IBM, 3Com, and Microsoft) and NetWare are the two biggest PC LAN operating systems. More and more large organizations are in the awkward position of trying to let their network users work with both NetWare and LAN Manager servers.

What You Want

What's so frustrating about that situation is that the ideal answer is obvious: You want all your client PCs to be able to work with both types of servers simultaneously. Each client PC should be able to take advantage of the file, printing, and other services of both the LAN Manager and NetWare servers. Even more frustrating is that this solution is technically possible—but not likely. To see both how this solution could work and why it's not likely to happen, let's look closer at a single server function: file services.

NetWare and LAN Manager client PCs have the same three basic types of file-service software: a device driver, a



protocol stack, and a redirector. The device driver lets the higher-level software talk to the network adapter card, such as the Ethernet cards we use in our lab. The redirector intercepts server file requests and makes them happen. Between the device driver and the redirector sits a protocol stack that sets up and manages communication sessions with the server.

Thus, to let a single client PC use both NetWare and LAN Manager servers, we need one device driver, one protocol stack, and two redirectors—one for the NetWare requests and one for the LAN Manager requests. Put another way, all we need is for Microsoft and Novell to agree to use the same device drivers and protocol stack, and we're in business.

Not a chance. At least, not yet. Both vendors have their own device driver standards and their own protocol stacks. Both are even working on their own standards for those parts. Novell's Open Link Interface defines a standard inter-

face between device drivers and the protocol stack. The Microsoft/3Com LAN Manager equivalent is the Network Driver Interface Specification.

Unfortunately, the two standards are different. Worse, they're likely to remain that way. It's like the old joke: How many psychiatrists does it take to change a light bulb? Only one, but first the bulb must want to change. Microsoft and Novell don't want to use the same protocol stacks, so they won't.

What You Need

Because Microsoft and Novell won't change, we can't get the ideal solution that we want. We might, however, be able to get what we need.

For example, if we can't have a single standard software set, how about a way to run two sets at once? All we need is two device drivers, two protocol stacks, and two redirectors—and the redirectors

continued

have to be smart enough to pass on any requests not destined for them.

We saw such a product at the Fall 1989 Comdex. Schneider & Koch & Co., a West German company, showed a single PC using the file services of a NetWare and a 3+Open server simultaneously. The second thing we did upon seeing this product (the first was to verify that it was working) was to run CHKDSK on the demo client. About 300K bytes of the PC's precious 640K bytes was gone, consumed by the protocol stacks. It's bad enough squeezing many applications into the memory left over after NetWare or LAN Manager loads; now double the memory loss—not a pretty sight on a standard 640K-byte DOS PC.

Still, there's hope for this approach. 3Com has announced (and should have shipped by now) 3+Open Connection for NetWare. This product, in conjunction with 3Com's Demand Protocol Architecture, lets a single PC run multiple protocol stacks with a single device driver and network board. 3Com's NetBIOS stays in memory constantly, while you load NetWare's SPX/IPX protocol stack in and out of memory as you re-

Racal *InterLan's LMN Server supports two protocol stacks.*

quire. The swapping is manual, so you must issue explicit commands to use a NetWare server. Furthermore, when you connect to a NetWare server, you pay the substantial memory overhead of having both the NetBIOS and SPX/IPX protocol stacks in memory at once. Consequently, while this product is a useful way to work with NetWare servers occasionally, its memory overhead is still too high for constant use of both servers.

Another possibility is to work in a PC environment, such as OS/2 or Windows 3.0, where 640K bytes is no longer a limit. OS/2 doesn't help the vast majority of DOS users, but Windows 3.0 might.

Unfortunately, Microsoft didn't think

about this problem when it designed Windows 3.0. You can load two protocol stacks, but only if you do so before Windows starts. Once Windows is running, it knows how to mount network disks—but only for a single network. With just a little work from Microsoft, however, Windows could “learn” to work with more than one protocol stack at a time. Microsoft, are you listening?

Let the Server Do It

Another option is to stop making the clients do all the work and shift the burden to the server: Make the server support both protocol stacks. Racal InterLan's LMN Server does just that. LMN Server runs on a LAN Manager server, where it intercepts NetWare-format requests destined for that server and translates them into requests that LAN Manager can understand. NetWare clients then can treat that LAN Manager server just as they would any NetWare server.

Of course, LMN Server is only half of the answer; it doesn't help LAN Manager clients get to NetWare servers. For that, we'd need a Value Added Process

continued

MetaMedia presents

CD-ROM Subsystem Kits for the IBM PC XT/AT, PS/2®.*

These complete kits are now available through a cooperative hardware agreement between IBM and MetaMedia Systems, Inc.

The PCD Series Subsystem kits include the Toshiba® industry-leading, high performance XM-3201 CD-ROM drive for complete plug-and-play capability!

Contact MetaMedia or your local IBM Marketing Representative for additional information. Refer to announcement #190-098.

* Models 25, 30 and 30-286 only.

**MetaMedia
Systems, Inc.**



20251 Century Boulevard Germantown, Maryland 20874 (301) 601-2224 FAX (301) 601-2449

IBM, XT, AT and PS/2 are registered trademarks of International Business Machines Corporation. Toshiba is a registered trademark of Toshiba Corporation.

Up to 32 Simultaneous PC-to-Mainframe Connections with *No Impact* on Your DOS or UNIX Applications!

Your applications shouldn't have to compete with 3270 communications for your PC's scarce resources.

That's why we deliver our

Supports NetView, HLLAPI 3.0, and CLEO'S own API.

DataTalker 3270 high-performance PC-to-mainframe connectivity software on powerful

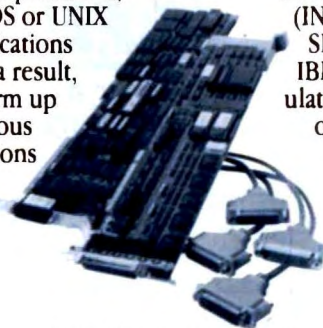
co-processor boards with on-board memory.

With DataTalker 3270, you can offload all communications processing and screen storage to the co-processor, freeing your DOS or UNIX system for applications processing. As a result, users can perform up to 32 simultaneous mainframe sessions

without affecting performance.

DataTalker 3270 provides full emulation of IBM 3278 terminals and 3274 controllers, along with 32 LUs, 512K

RAM, file transfer (IND\$FILE), BSC or SNA support, and IBM 3287 printer emulation. Line speeds of up to 56K baud are supported.



Adds only 1K to DOS applications, 40K to UNIX

To learn more, 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.

AVAILABLE WORLDWIDE!

In Europe, call Sintec Peripherals Ltd. in Slough, England, at 0753-811888 (FAX: 0753-811666).

(for NetWare 286) or a NetWare Loadable Module (for NetWare 386). Given those components, however, we'd have a reasonable way for the two worlds to co-exist—and the added benefit of affecting only the servers, not all the clients.

Applications, Anyone?

All the solutions we've discussed so far are for general file services. In many cases, a general answer isn't crucial; all that's necessary is some way to make

specific applications work on both LANs. (If those applications work with whole files, however, then direct file access is still critical, and we're back where we started.)

Client/server applications are natural starting points for this approach. In fact, one of the first applications that led to an interesting LAN Manager/NetWare link was the Microsoft/Sybase SQL Server. SQL Server is a database server that runs on an OS/2 workstation. It receives client

requests via Microsoft's Named Pipes (a Microsoft standard interface between applications and the network protocol stack). The SQL Server client software on a DOS or OS/2 PC hands request messages to the client Named Pipes software, which in turn hands it down to that system's network protocol stack. When the requests arrive on the server, they flow back up through the server's network protocol stack, to the Named Pipes software on the server, and then to the actual SQL Server database software.

Note the use of the Named Pipes standard interface on both the client and the server; Novell did, and the result was its NetWare Requester for OS/2 software. That software gives OS/2 server packages a Named Pipes interface to NetWare's protocol stacks—so NetWare clients can talk to those applications. It's not an answer to all the problems we've presented, but it is, at least, a potentially good way to let LAN Manager and NetWare clients use some of the same client/server applications.

The Bigger Picture

We've intentionally cheated a bit so far by restricting the playing field to NetWare and LAN Manager. The same problems also exist for those who use two or more other LAN operating systems. We have, for example, omitted Banyan's Vines. Banyan is clearly aware of the need to work with other LAN operating systems, and the company is working with Microsoft to find ways to let Vines and LAN Manager work together. Other vendors are hashing out their own deals.

While all those deals are cooking, those of us who want to have client PCs using two or more LAN operating systems at the same time are out of luck. We'd love to see the major vendors standardize the client software and leave their innovations to the server side, but we doubt that it will happen. In the absence of such standards, let's hope that some of the approaches we covered above mature enough to become common and reliable ways to make different LAN operating systems coexist. ■

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 "mvannname" and "wbc3," respectively.

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

CD-ROM Publishing on Your IBM® Mainframe

*OPI offers you the
choice of developing
your commercial
database on CD-ROM
using:*

OPI IBM Mainframe Software Products

- Optical Image Build – OPI's pre-mastering package
- Optical Convert – OPI's data conversion package
- Optical Prep – OPI's key pull package
- CD/ACCESS/370 – OPI's CD emulation package

OPI Consulting Services

- Database Design
- Retrieval Specifications
- Data Conversion
- Pre-Mastering

CD-Simulator™

- A powerful system to design, simulate, debug, and optimize CD-ROMs in the PC environment.

Call today for information
1-800-869-7989 x119



IBM is a registered trademark of International Business Machines Corporation
CD-Simulator is a registered trademark of Elektroson B.V.



**OPTICAL
PUBLISHING
INC.**

155 West Harvard Street
Fort Collins, Colorado 80525
(303) 226-3466 FAX (303) 226-3464



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.

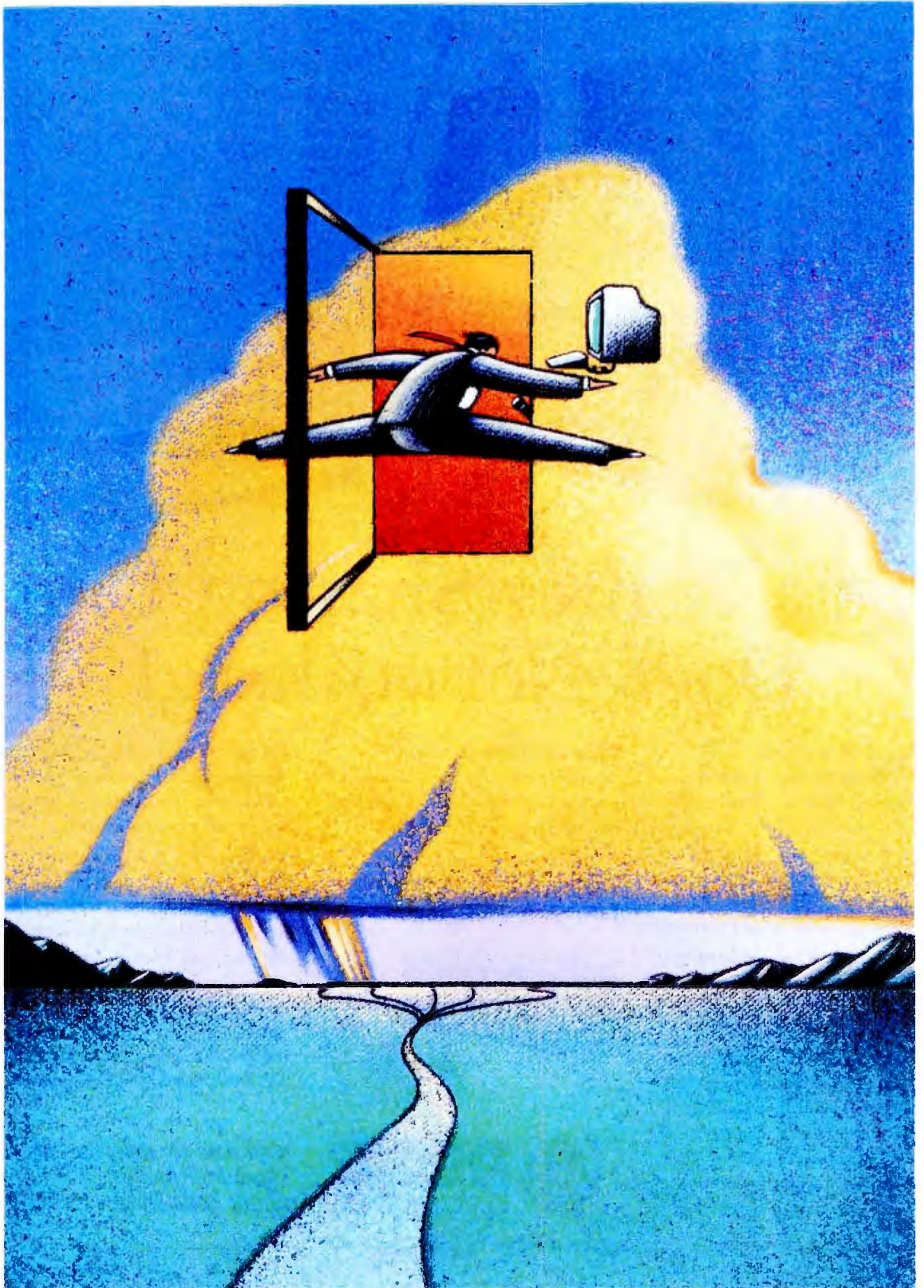
Commitment to Excellence

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



IBM IN THE NINETIES

*A look at what lies ahead for Big Blue
in the coming decade*

Nick Baran



Nowadays, when you hear talk of IBM, it's no longer just the company that's being referred to, but an entire industry. Personal computer owners who say they have an "IBM" may very well be referring to a PC clone from Korea or Taiwan. Virtually every new technology in the microcomputer industry finds its way into IBM-compatible machines.

The Personal Computer Coup

As IBM enters the 1990s, the company faces a drastically different set of challenges than it faced a decade ago. When IBM introduced the PC in 1981, the personal computer was sort of a special project for IBM—an experiment. In spite of its unexpectedly enormous success, the PC in those early years accounted for only about 5 percent of IBM's gross revenues. Today, "the personal systems business," as IBM's James Cannavino calls it, accounts for about 16 percent of IBM's revenues, about 10 billion dollars' worth in 1989, according to figures given by Cannavino at a speech in New York last April.

Nevertheless, IBM enjoyed a much more comfortable situation in the early 1980s. Its main business consisted of mainframes and minicomputers, which yielded large profit margins and guaranteed additional future income in the form of maintenance contracts and leased software. Little did IBM know that its PC experiment would unleash a revolution in computing that would forever change IBM's standing in the marketplace—from a position of dominance to that of having to keep up with relentless competition and technical innovation.

IBM's dependence on its personal systems business will undoubtedly continue to grow as desktop computers based on Intel's 386 and i486 processors replace older minicomputer systems like the IBM System/38 as database and file servers for networks of personal computers. In addition, IBM has aggressively entered the Unix workstation market with its RISC-based System/6000 line of machines, which must also be classified as personal systems. Note that IBM now refers to "personal systems" rather than "personal computers," empha-

sizing the concept of a complete office system rather than a stand-alone computer for individual users.

In fact, personal computing on an individual basis is no longer the driving force behind the personal computer industry. The driving forces now are workgroups and organizations that share information and resources on a network. Initially, the personal computer was popular because it let you work independently on your own computer, away from the controls of system administrators, endless print queues, and the unpredictable performance fluctuations of mainframe or minicomputer systems. Now, the trend is back to organizational computing. But instead of centralized minicomputer and mainframe hosts, we now have distributed computing; each node on the network has its own processor, as well as access to the other processors and peripherals on the network.

Another trend has been toward computers with graphical user interfaces, which require graphics-based displays rather than character-based or alphanumeric displays. GUIs, along with the organizational computing model, have forced personal computer designers to make changes in the basic design of small computers.

New Hardware for Networks and Graphics

The trends toward GUIs and "workgroup" computing have led PC designers to adapt the basic model of a single processor—with a single, buffered I/O bus—to the more demanding requirements of multitasking, networking, and high-speed graphics. Recently, several vendors, including IBM, Hewlett-Packard, and Compaq, have introduced powerful extensions to the basic IBM PC architecture to provide the additional horsepower required by the networked and graphical environment.

For example, IBM introduced a new version of its Micro Channel architecture that supports data transfer rates of up to 40 megabytes per second, about twice as fast as the maximum performance of the original Micro Channel architecture bus. Compaq included dual-processor capability in its Systempro to

continued

THE SOLUTION

... to your data collection and data entry problems!

The Psion Organiser II & dCAPP

Psion Gives You the Answers!

With eight different Organiser II models to choose from, Psion lets you select the Organiser II that best meets your needs. Standard configurations are available with or without built-in software programs, and provide the options of either two or four lines of LCD



display, several different keyboard designs, and from 32K to 96K of internal RAM memory. All Organiser units can use our removable and interchangeable memory modules, allowing the Organiser II to be configured to meet your unique data and program memory requirements.

POWER

The Organiser II is a powerful hand held computer capable of running a broad range of pre-written programs. When an off the shelf program just won't do, you can custom program the Organiser II to the unique requirements of your application. From inventory control to remote sales order entry, the Organiser II has the power to do the job.

PERIPHERALS

For jobs ranging from simple data collection to an RS-485 factory floor network, the Organiser II has the right tools for the job. Peripherals include Bar Code Wands, Laser Scanners, Mag Card Readers, Portable Modems and Printers, Carrying Cases, all the way to a broad range of interfaces which include serial, parallel and multiple types of SPC devices.



dCAPP Gives You the Solution!!

• dCAPP data collection software is completely user configurable allowing even non-programmers the ability to create their own custom data collection program for the Organiser II in a matter of minutes, including its own operating instructions manual. • dCAPP data collection software is completely user configurable. Keyboard, Magnetic Card, or BAR CODE input. • Direct Interface to most Database and Spreadsheet programs; (dBASE 3, dBASE 4, Lotus 123, D.I.F., and many others).

TYPICAL APPLICATIONS: Inventory Control; Stock Taking; Tools and Equipment Control; Sales Route Accounting; Quality Control and Inspection Reporting; Tank Farm Gauging; Stores Accounting; Plant Inspection; and More...

For more information, contact:

XEC Products

13630 58th Street North, Suite #103

Clearwater, Florida 34620

(813) 531-1422

Lotus 123 is a registered trademark of Lotus Development Corp.
dBASE is a registered trademark of Ashton-Tate Corp.
IBM PC is a registered trademark of International Business Machines Corp.

provide the additional horsepower required of a high-performance network server. Hewlett-Packard provided a high-speed graphics bus (40 to 60 MBps) in its Vectra 486 computer to accommodate the demands of high-performance CAD and graphics-intensive tasks. And NetFrame introduced an Intel-based network server that provides multiple I/O channels, each with its own microprocessor.

The demand for high-speed buses and multiple processors has not gone unnoticed by chip-set manufacturers, either. A new company called S3, founded by engineers and marketers from several established Silicon Valley companies, has introduced a modular chip-set architecture that includes a high-speed bus called the Advanced Chip Interconnect. Using the concept of modular and scalable building blocks, the ACI architecture lets you design anything from a standard 386 or 486 PC with a single CPU and bus, to multiprocessing systems with multiple CPUs and buses. You simply add chip modules and address lines to the ACI. The ACI supports cache coherency, distributed interrupts, and interprocess communications, allowing PC manufacturers great design flexibility. Depending on the bandwidth of the address lines to the ACI bus (16, 32, or 64 bytes) and the clock speed of the host system (25 or 33 MHz), data transfer rates ranging from 60 to 120 MBps can be achieved.

While S3's approach may not appeal to manufacturers like IBM or Hewlett-Packard, which can fabricate their own chips and circuits, many of the so-called clone manufacturers will be able to compete at the high-performance end using off-the-shelf components based on the ACI architecture. And you can expect other chip-set vendors, such as Chips & Technologies and Headland Technology, to provide similar solutions at the system-board level for high-performance network and graphics computing.

A Better Way: Data Compression

High-speed buses and multiple processors are powerful but very expensive solutions to the problem of manipulating the enormous amounts of data that graphics applications require. Another approach, which is ultimately much more elegant and economical, is to use data compression to reduce the size of those data files representing graphics images. Such a technique is the objective of the Joint Photographic Experts Group (JPEG) standard compression algorithm, which is supported by IBM, Digital Equipment, and NEC.

A new company called C-Cube Microsystems has implemented the JPEG algorithm in an application-specific IC that can perform data compression at ratios of up to 60 to 1 in real time. The basic compression technique involves discarding data in the graphics image that describes frequencies that are not visible to the human eye. Thus, with compression ratios of 10 to 1 for screen images and 25 to 1 for print images, the difference in visual quality is hardly noticeable, although much of the high-frequency content of the image has been discarded by the compression algorithm. The key here is that the data is discarded, not restored at the other end of the transmission path. For example, a full-color 8 1/2- by 11-inch image at 300 dots per inch requires 25 MB of storage. The ability to cut these storage requirements by as much as a factor of 25 means faster transmission rates and much smaller memory, storage, and bus bandwidth requirements, and it will eventually make 24-bit color available on low-end PCs.

You can expect to see data compression processors like the C-Cube start to appear as add-in boards or even directly on the system board in the personal computers of the 1990s.

continued



TimeWands - The Obvious Choice

You have specific bar coding requirements.
That's why we give you a choice!

The **TimeWand II** is a **ruggedized** bar code reader ready for heavy-duty use. Its programmability allows your custom applications to be pre-set with prompts and cross-reference files. The large internal memory sizes of 32, 64, and 128K easily hold a day's worth of transactions along with the date and time of each entry.

If your data collection needs are simpler, the original **TimeWand** offers a cost effective alternative. The TimeWand date and time stamps each bar code scan, like the TimeWand II, but is contained in a smaller and lighter package. Even though it is compact, the TimeWand can still gather an impressive 2000 scans.

Videx and TimeWand are registered trademarks of Videx, Inc.

Both TimeWands transfer their data through the host computer's serial port where the data is stored in an ASCII text file. This allows the data to be easily combined with a wide variety of software packages.

Choosing either the original TimeWand or TimeWand II provides you with a quality bar code reader at an affordable price. **Call Videx at 503-758-0521 and ask for your free information kit.**

TimeWand (8K).....\$248.00
 TimeWand II (32K).....\$698.00

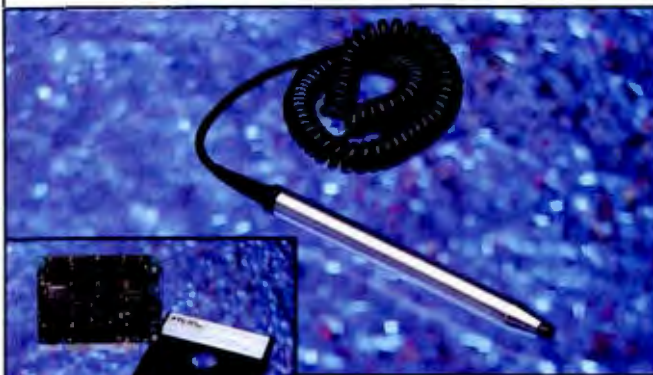


1105 NE Circle Blvd.
 Corvallis, OR 97330-4285
503-758-0521 * FAX 503-752-5285

*See us at COMDEX, November 12-16, Las Vegas,
 BOOTHS #2998 and #N4571*

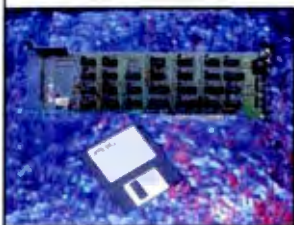
Circle 212 on Reader Service Card (RESELLERS: 213)

No More Mousin' Around



FTG-1000 Precision Light Pen

AT-Bus Interface Card



Micro Channel Interface Card

Draw, point, click, drag, position--FTG's light pen does all this faster, easier and quicker than a mouse and does it without using your valuable desk space. Take a look at a sensible input alternative with FTG's 30-day trial offer.

FTG DATA SYSTEMS

10801 Dale Street
Stanton, CA 90680
714-995-3900 800-962-3900
FAX 714-995-3989



IBM IN THE NINETIES

Some Folks Are Going Wireless

Another important trend that the IBM world will see in the 1990s is wireless LANs, in which PCs on the network are linked by radio waves rather than by hard-wired coaxial or twisted-pair cable. A leader in this area is a small start-up company called Agilis, which makes hand-held workstations as well as wireless network components for Ethernet-based networks.

The Agilis wireless network is based on spread-spectrum technology, which allows signals in a narrow frequency band to be spread and transmitted over a broad range of frequencies with a lower energy content (e.g., a collection of weak signals), thus minimizing noise and interference with other radio devices. The signal is then collapsed back to its original narrow frequency band at the receiving end of the transmission. Agilis uses a technique for spreading and collapsing the data signals called *direct sequencing*, which involves a sequencing algorithm that is set at both the transmitting and receiving ends to selectively pick up the desired signals. The Agilis system works at distances of up to 100 meters indoors and up to 1 km outdoors.

While the Agilis system in its present form is geared primarily toward "mobile networking" and exchanging data or E-mail in warehouses and retail facilities, manufacturing facilities, and service centers, and on trade- or convention-show floors, to name a few applications, the technology will also begin to appear in wireless office LANs. Obviously, wireless networks offer the major benefit of eliminating the installation of cabling throughout an office building, often a cumbersome and expensive task. The biggest limitation is the current maximum transmission rate of 236,000 bps (hard-wired Ethernet transfers data at 10 megabits per second). Advances in radio transmission technology should allow higher transmission rates in the near future, according to engineers at Agilis.

Going After Unix

So far, IBM's forays into the Unix workstation market have had limited success. The IBM RT was overpriced and had serious performance limitations as well as limited support from third-party software vendors. But IBM's new System/6000 workstation line is a different story. The System/6000 is based on a second generation of IBM's RISC architecture, which includes separate fixed-point, floating-point, and instruction/branch units that can operate in parallel. The System/6000 offers stunning performance (27 million integer instructions per second and 7.4 million floating-point operations per second) for a price that is competitive with those of workstation offerings from Sun and Hewlett-Packard. When IBM introduced the System/6000, over 70 software vendors showed products (primarily engineering and scientific applications) running on IBM's latest version of AIX, its own version of Unix.

In spite of the impressive performance of the System/6000, IBM faces intense competition in the Unix market, particularly on the software side. In an attempt to cover all bases, IBM is supporting the OSF/Motif GUI from the Open Software Foundation (a consortium of Unix vendors, including Hewlett-Packard, IBM, DEC, and several others), as well as the NextStep interface developed by NeXT and licensed to IBM. NextStep will probably be available on the System/6000 before Motif, since it is already a commercial product, whereas Motif is still under development and is not expected to be ready until sometime in 1991. Meanwhile, the Open Look GUI from Sun and AT&T is starting to appear in third-party applications for Sun workstations, giving Sun a head start in the Unix GUI battle.

continued

Stepstone

The Leader in Object-Oriented Technology

Objective-C

The **Single** object-oriented solution
for **IBM** environments



Objective-C solutions
available on
IBM

PS/2 AIX
PS/2 OS/2
PS/2 MS-DOS
PC-AT MS-DOS
RISC System/6000 AIX
PS/2 SCO UNIX SYS V

75 Glen Road, Sandy Hook CT 06482

1-203-426-1875 1-800-289-6253 FAX 203-270-0106

Taking DB2 data to the desktop

ORACLE gives PC and Macintosh users direct access to mainframe data.

Many large companies are wasting millions of dollars worth of vital business information. Data critical to their operation is isolated from the employees who can really use it, locked away in the mainframe database.

ORACLE® provides a direct link between the data users need and the PC and Macintosh applications they already know how to use.

Users can query and update DB2, or other databases such as IBM's SQL/DS or DEC's RMS and then manipulate the data using PC and Mac applications such as

Lotus 1-2-3, Hypercard, 4th Dimension, ORACLE for DBASE and Professional ORACLE.

And while users put the data to work, MIS departments still have total control over security and passwords because they determine access issues at the mainframe.

Oracle backs all of its products with the largest database service and support

group in the world. If not satisfied, users can return ORACLE in 30 days for a full refund.

Professional ORACLE Tools and Database cost \$1299. The ORACLE Tools alone are \$799. ORACLE for 1-2-3 and ORACLE for DBASE are just \$299. And ORACLE for Macintosh is \$699. All come with full phone installation support and the 30-day guarantee.

Call 1-800-ORACLE1 ext. 4901 and turn your company's most valuable commodity into its most productive asset.

Oracle makes accessing corporate information from the mainframe as easy as getting gum from a machine.

Users can update the mainframe from the PC just as easily. To learn more, call now. 1-800-ORACLE1 Ext. 4901.

ORACLE®

Compatibility • Portability • Connectivity

TCP/IP for Windows

Network Windows... Software Development Kit

Features:

- ┐ Support for TCP/IP and UDP/IP communication protocols.
- ┐ A client implementation of NFS utilizing RPC/XDR as a dynamic-link library for Microsoft Windows.
- ┐ Small 40K memory resident socket interface.
- ┐ Conforms to FTP Packet Driver Specifications.
- ┐ Support for virtually all Ethernet boards including 3COM and Western Digital
- ┐ Windows 3.0 compatible.
- ┐ Supports any host system running TCP/IP and/or NFS; among them:
 - ◆ SunOS
 - ◆ DEC Ultrix and VMS
 - ◆ IBM AIX, VM and MVS
 - ◆ Interactive 386/ix
 - ◆ SCO Unix, others

Benefits to you:

- ┐ No networking experience required. Our library is a network replacement for the Microsoft C run-time library
- ┐ Only one version to maintain, support and market. Some code supports network and stand alone
- ┐ Minimal investment required. No host system is required to test your Network Windows application
- ┐ Little time needed for network adaptation. Existing Windows applications can be converted in a few hours
- ┐ Instant access to the rich Fortune 1000 PC-to-Host connectivity market

Distinct Corp.
P.O. Box 3410
Saratoga, CA 95070

(408) 741-0781
\$495.00

Socket and NFS Toolkit

Do Your Own Windows!

Write Windows™ 3.0 Applications Quickly and Easily with Software Engineer™.

- A complete LISP programming environment including a LISP-aware program editor.
- Supports Dynamic Data Exchange (DDE) at a higher level than the SDK. Create both client and server applications.
- Supports GDI, the clipboard, dialog boxes and menus.
- Sample programs supplied include DDE sessions with Microsoft® Excel and Micrografx® Charisma™
- Requires 386-based or fast 286-based machine and Windows™ 3.0.

\$249.95

To order Software Engineer
or for more information,
Call (214) 234-2611
or FAX (214) 234-2674


**RAINDROP
SOFTWARE**

845 Arapaho Road • Suite 105 • Richardson • Texas • 75081

Some names mentioned above may be trademarks or registered trademarks of their respective holders.

But with the System/6000, IBM has made a strong statement that it's in the Unix market for the long haul. Undoubtedly, IBM will be a formidable competitor in the Unix arena in this decade.

IBM Has Seen the Future, and It's SCSI

SCSI has become the standard interface in Unix workstations and Macintosh computers for connecting to peripherals such as disk and tape drives, CD-ROM drives, and scanners. Until a few months ago, however, IBM did not support SCSI on its PC and PS/2 machines. Now, IBM has announced new versions of its PS/2 Models 70 and 80 that include SCSI adapters. And SCSI is the standard interface on the System/6000 workstations, which feature a blazingly fast 320-MB hard disk drive with 12.5-millisecond access time.

While IBM won't publicly admit it, it appears that SCSI will become the new standard on IBM hardware, marking the gradual demise of the ESDI and ST506 disk interfaces that IBM has used in its high-performance and low-end PCs, respectively, as well as the Centronics parallel port used for PC-compatible printers. But IBM obviously sees the writing on the wall. In this age of connectivity and office environments with multiple platforms and operating systems, SCSI is the de facto standard for peripheral interfaces. SCSI also offers the major advantage of allowing daisy chaining of as many as seven devices off a single SCSI port.

IBM's adoption of SCSI is good news for the rest of the industry and for end users as well. Vendors of Unix workstation and Macintosh peripherals will now have another substantial market for their products, thus increasing competition and presumably forcing prices to come down, particularly on optical and CD-ROM drives, which remain overpriced in the current market due to small demand.

The Belated Marriage of OS/2 and Windows

Microsoft's and IBM's crusade to make OS/2 the dominant operating system for Intel-based machines has so far been a dismal failure. Most MS-DOS users would rather fight than switch, and those who are ready to make a change find Unix an attractive alternative to OS/2. From a developer's standpoint, Unix is easier to work with, offering a full 32-bit paged memory model rather than the 16-bit segmented memory model of OS/2. And from an end user's standpoint, Unix is beginning to develop a strong library of applications, particularly on Sun workstations and Intel-based machines running on The Santa Cruz Operation's Xenix.

But OS/2's 16-bit limitations will go away this year when Microsoft introduces OS/2 2.0, which is a full 32-bit implementation with paged memory. In addition, OS/2 2.0 offers numerous other improvements in file and disk management functions, as well as greatly improved support for MS-DOS running as a subtask (see "Programming 32-bit OS/2" on page 97). Most analysts agree that 2.0 is the version of OS/2 that Microsoft should have come out with in the first place.

Nevertheless, OS/2 may end up taking a backseat to Windows 3.0, Microsoft's latest release of its MS-DOS-based windows product. Although the new version requires a minimum of 1 MB of memory, it is an excellent compromise between the high memory and performance overhead of OS/2 and the lack of a GUI in MS-DOS. In fact, Microsoft appears headed toward a merging of OS/2 and Windows. Microsoft executive Steve Ballmer recently referred to OS/2 as "Windows Plus." To strengthen the ties between Windows and OS/2, Microsoft has introduced a Software Migration Kit that will make porting

continued

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.

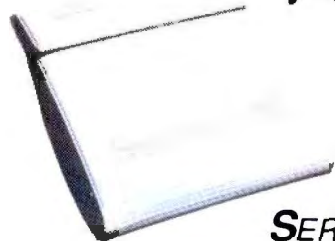


Phar Lap Software, Inc.
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

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 150 on Reader Service Card

Want to save Time, Money,
& Headaches?



GET SUPERSOFT'S SERVICE DIAGNOSTICS

All the software, alignment diskettes, parallel/serial wrap-around plugs, ROM POSTs and extensive, professional documentation to provide the most comprehensive testing available for IBM PCs, XTs, 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
System Expansion & Extended Memory	Monitors
Floppy, Fixed & Non-standard Disk Drives	Parallel & Serial Ports
Standard & Non-standard Printers	Mono, CGA, Hercules & EGA
System Board: DMA, Timers, Interrupt,	Adapters
Real-time Clock & CMOS config. RAM	All Keyboards & the 8042 Controller

"EDITOR'S CHOICE" — PC MAGAZINE August 1990

Service Diagnostics for PC, PC/XT, and compatibles only	\$169
Alignment Diskette for PC, PC/XT and compatibles (48 tpi drives)	\$ 60
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)	\$ 60
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)	\$ 60

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 PO Box 4178, Mountain View, CA 94040-0178
(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.

Windows applications to OS/2 a straightforward procedure for software developers. Microsoft has also announced its intentions to provide binary compatibility between Windows and a future release of OS/2, allowing Windows applications to run under Presentation Manager with no modification.

In the long run, OS/2 will run on network servers with the PC nodes all running Microsoft Windows. Corporate users will get the benefits of OS/2, while individuals will get essentially the same interface but with less power in Microsoft Windows. There are also moves afoot to provide protected-mode operation of MS-DOS with a product called DOS Protected Mode Interface. Who knows—OS/2 may be obsolete before it ever gets a chance to prove itself.

Then There's That Other Three-Letter Word: SQL

Structured Query Language has been talked about in the press for the last two years, but very few products actually implemented the SQL interface to networked database servers. However, 1990 looks like the year when the hype is turning into reality. First of all, some of the vendors who promoted their SQL products two years ago but had nothing to deliver are finally introducing SQL interfaces this year. These companies include Lotus with its DataLens product; Borland with a SQL interface for Paradox; Software Publishing, which has quietly been working on an OS/2-based SQL interface for a couple of years; and, of course, Microsoft SQL Server, which is actually commercially available. Look for Gupta's SQL Windows to be a big success with Windows 3.0 running on networks with OS/2 servers.

But more important, SQL products are becoming a reality because connectivity to database servers is becoming a reality. Network operating systems like Novell's NetWare and Microsoft's LAN Manager are making big inroads into corporate America. With the proliferation of networks will come a proliferation of relational database servers. Of course, IBM is also heavily promoting its Extended Edition database server for OS/2 and connectivity to its mainframe and minicomputer systems running DB2. You can expect many more organizations to adopt SQL-based interfaces for their corporate databases.

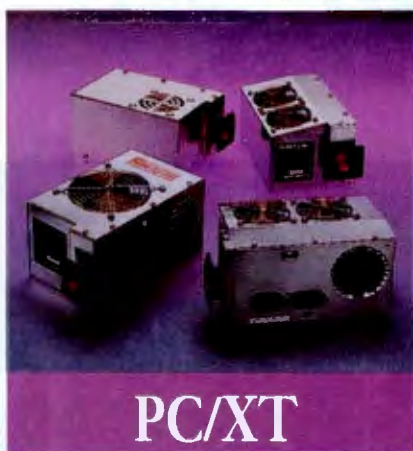
The High Road and the Low Road

Not everything in the 1990s will involve networks, high-speed graphics, paged memory, and other high-end applications. There will also be major changes in the low end of the market—the 286 and 8088 markets. You can expect to see ever-more-compact laptops featuring minimal power consumption and higher-resolution displays. While chip-set manufacturers are focused on developing workstation capabilities with high-speed bus and multiprocessor architectures, there is also a continuing trend toward greater and greater chip integration, with more and more functions being placed on a single chip. Soon there will be complete 286 computers on a couple of chips. These integration levels will make possible the power consumption and size and weight improvements that you can expect in laptop computers.

In addition, IBM has recently proclaimed its intention to launch another attack on the laptop and home computer markets. You can expect to see a new line of 286-based machines from IBM, running Microsoft Windows and using SCSI drives. Also look for a good-quality laptop from IBM. And don't forget to start saving up for that notebook computer with handwriting recognition. It's all coming down the pike. ■

Nick Baran is a consulting editor for BYTE. He can be reached on BIX as "nickbaran."

Cool, Quiet, Reliable Power.



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 noise with the Silencer 150. Its large, low speed, 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, Turbo 450, and InnerSource 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**

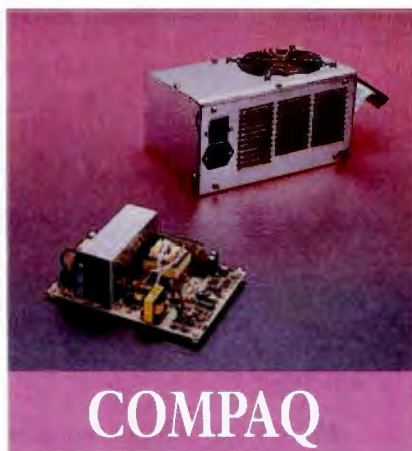
Ultra-Quiet Unrattle your nerves with the Silencer 220. Its high-efficiency, adjustable-speed fan offers 69% less noise with standard cooling. Quieter than most hard drives. Great in the executive suite or home office.

TURBO-COOL 300 **\$189**

High Performance Protect your investment! Upgrade your AT/386 with our powerful, wide-input Turbo-Cool 300. 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 450 **\$349**

Maximum Performance The choice of PC professionals, our Turbo 450 features built-in line conditioning, autoselect input, independent regulation, external DC voltage adjustment, triple-stage output filter, remote switch option, 50cfm cooling fan, UL/CSA/TUV approval, 48 Hr. burn-in 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 new InnerSource 2210 is the first AT/386 power supply with a *built-in* UPS. Its auto-recharge battery provides 5 - 10 minutes of reliable backup power for both your PC and monitor. This complete protection costs less than an equivalent 550VA external UPS and it doesn't take up *any* space. \$449

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 147 on Reader Service Card (RESELLERS: 148)

Can you stomach spending an extra \$10,000 for a PC network or UNIX® workgroup server with dubious service?

We can't. Workgroups are too critical to leave in the hands of amateurs.

So Dell has gone overboard in servicing servers. In fact, we just won the PC Week Poll for Corporate Satisfaction for servers, where our reliability and service were rated far above our competitors.

Which brings us back to our question:

Would you spend an extra \$10,000 for iffy service?

We think it's a no-brainer.

We have two new 486™ EISA servers. Dell

gives you a choice of the 25 MHz Dell™ 425TE and the 33 MHz Dell 433TE.

TO ORDER, CALL
800-365-8811
HOURS: 6 AM-9 PM CT M-F 8 AM-4 PM CT ON SAT.
FOR NETWORKING/UNIX INFO
800-678-UNIX
IN CANADA, CALL 800-387-5752

The 25 MHz Dell System® 425TE has up to 64 MB of RAM capacity, 11 storage bays, and a whisper-quiet 300 watt power supply. We've also built in features such as password protection, a software controlled reset switch, and an efficient cooling system to protect component life.

What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

For even more performance, the 33 MHz Dell System 433TE is everything our 425TE is, with 32% more speed. The Dell exclusive memory design with a 128 KB external cache gives it maximum throughput.

UNBELIEVABLE PRICES.



\$11,799
Dell System 433TE
Lease: \$423/mo.*

\$9,599
Dell System 425TE
Lease: \$359/mo.*

THE NEW DELL SYSTEM 433TE 33 MHz EISA i486™ AND THE NEW DELL SYSTEM 425TE 25 MHz EISA i486.

- Intel® 80486 microprocessor running at 33 MHz (433TE) or 25 MHz (425TE) with 8 KB internal cache
- 128 KB external cache (433TE)
- Standard 4 MB of RAM* expandable to 64 MB (eight internal SIMM sockets, each accepting a 1 MB, 2 MB, 4 MB, or 8 MB SIMM, installable in matched pairs)
- Socket for WEITEK 4167 math coprocessor
- 11 internal half-height drive bays
- Eight 32-bit EISA expansion slots (six EISA master slots and two EISA slave slots)
- High performance IDE (80 MB, 100 MB, 190 MB) and ESDI (330 MB, 650 MB) hard disk drives

650 MB VGA Color Plus System
Using 2 MB SIMMs
Using 4 MB SIMMs
Prices listed include 8 MB of RAM

	433TE	425TE
\$11,799	\$11,799	\$9,599
\$12,199	\$12,199	\$9,999

AD CODE 11E31



UNBELIEVABLE.

course, they're completely compatible with all major network operating systems, including Novell, 3COM and Banyan.

In a UNIX environment, the 425TE and 433TE are perfect for workgroups supporting either traditional multiuser or

high-speed client/server environments.

You can buy Dell servers preloaded with UNIX System V, making them literally plug and play. Even more impressive is the fact that UNIX system administration can be done by Dell, remotely.

Servicing servers is beyond most Compaq dealers. If a server happens to go down, your whole company can go down with it.

Would you trust some unknown technician to bring it back up?

We wouldn't.

That's why we have a special advanced systems hotline so you can call us direct. Dell is an AT&T UNIX source code licensee and an authorized Novell Network Reseller.

On those rare occasions we can't fix it over the phone, Xerox technicians will come to your office with the solution or part in hand.^Δ

"Server problems? Just ship 'em back, okay."

"I know those babies like a cat knows her kittens."

"Where's the power switch?"

"My UNIX guy actually talked to the factory once."

"But he's on vacation for two weeks. Sorry."

\$24,698

Compaq SystemPro 486/333

■ **From this foundation, create a powerful PC network or UNIX workgroup.** Dell's new systems have more than enough performance to function as a LAN Server and WAN or internetworking gateway. So they're capable of supporting the most demanding server use—a multi-function network. Of

There's a lot more to know before you buy a server.

When you call Dell, our experts will give you the help you need to buy an advanced PC or UNIX server.

Then we'll send it off with a 30-day no questions asked money back guarantee, and a one year limited warranty.

Call us.

We'd like to make believers out of you.

Above and beyond the call.



The Dell System 433TE and 425TE are Class A devices sold for use in commercial environments only. Performance enhancements within the first megabyte of memory. 384 KB is reserved for use by the system to enhance performance. All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. **Payment based on 36-month, open and lease. Leasing arranged by Leasing Group, Inc. In Canada: configurations and prices may vary. DELL SYSTEM is a registered trademark. Dell and SmartVu are trademarks of Dell Computer Corporation. Dell UNIX System V/3.2 is based on INTERACTIVE Systems Corporation's 386/ix. Intel is a registered trademark and i486 and 486 are trademarks of Intel Corporation. (From Compaq July 23, 1990 press release. UNIX is a registered trademark of AT&T in the United States and other countries. 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 remote locations. Shipping, handling and applicable sales tax not included in the price. For information on and a copy of Dell's 30-day Total Satisfaction Guarantee, limited warranty, and Xerox's Service Contract, please write to Dell Computer Corporation, 9505 Arborvitae Boulevard, Austin, Texas 78759-7299, ATTN: Warranty. ©1990 Dell Computer Corporation. All rights reserved.



Chinese characters translate as "Great Wall."

Times Change. The Need To Protect Doesn't.



9292 Jeronimo Road, Irvine, CA 92718
TEL: (714) 454-2100 • (800) 852-8569 (Outside CA)
FAX: (714) 454-8557 • AppleLink: D3058
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Road
Slough, Berkshire SL3 8QY, TEL: 0753-41512 • FAX: 0753-43610



Whether you're protecting frontiers and temples in Manchuria, or software and data on the PC or Mac, the Great Wall is a lesson Rainbow Technologies has learned very well.

Software developers must deal daily with the consequences of unauthorized copies and millions of dollars in lost revenue. At the same time, both individual and corporate users must be able to make and distribute copies within legal guidelines.



Today's information-driven companies must secure their data files against theft and unauthorized access. No less than protecting personal wealth and tangible property, guarding data files is a necessary investment in competitive survival.

Protecting "intellectual property" is the security challenge for the '90s. Which is why Rainbow Technologies builds a little of the Great Wall into every key it makes.



For developers, the Software Sentinel™ family of keys protects IBM, PS/2 and compatible software, while Eve™ guards software for the Mac. Rainbow's DataSentry™ is the solution for PC data protection.

Software and data protection from Rainbow Technologies. Information on how you can have a little piece of the Great Wall to protect your software and data worldwide is as close as a toll-free call.

Copyright ©1990 Rainbow Technologies, Inc.



BENCHMARKS AT A GLANCE: 1990

*BYTE's performance rankings of popular
IBM PC compatibles, Unix systems, and Macs*

Compiled by Stanford Diehl

We've just about run out of adjectives to describe the steady supply of new machines arriving at the BYTE Lab for benchmarking: smoking, screaming, blazing, barn-burning... Each time we think "they can't get much faster than *this*," a new system proves us wrong. Speeds for 386-based systems steadily rose from 20 to 25 to 33 MHz, and then when the processor speed topped out, we started receiving high-performance file servers stocked with megabytes of hard disk caching. Now the i486 has arrived, setting a new performance standard. Intel's latest processor, already available in 25- and 33-MHz flavors, will soon reach 50 MHz and beyond. One day soon, we expect a sonic boom to blast from one of these boxes.

continued



Compaq Systempro

BYTE DOS BENCHMARK INDEXES (VERSION 1.0) WITH MATH COPROCESSOR

Table 1: The SIA 386/33 file server, packed with an optional (and expensive) 4.5-megabyte hard disk cache, tops the final listing of BYTE's version 1.0 benchmarks. All systems were tested with a math coprocessor installed. All indexes are based on an 8-MHz IBM PC AT. Longer bars indicate better performance.

Computer	Month appeared	Low-level				0	10	20	30	40	50	60
		CPU	FPU	Disk	Video							
SIA 386/33 ¹	IBM Spcl. 89	6.27	14.97	8.99	3.27							
Mylex 486/EISA ^{2,3}		6.21	27.44	15.44	2.98							
Micro Express ME 386/33 ¹	IBM Spcl. 89	5.66	15.06	7.02	2.97							
Dyna Micro AIR486-C	July 90	6.21	28.79	2.19	1.75							
AST Premium 486/25	June 90	6.75	28.46	1.78	2.77							
National Micro Systems Flash 386/33 ¹	IBM Spcl. 89	6.06	15.07	6.48	2.01							
FiveStar Model 33/D (386/33) ¹	IBM Spcl. 89	5.74	15.75	7.14	2.22							
Dolch-P.A.C. 486-25	May 90	6.20	28.20	2.48	1.81							
Spear Super 486/25U	July 90	6.20	27.78	2.21	2.56							
Compaq Deskpro 386/33	IBM Spcl. 89	6.09	15.50	2.90	4.53							
Dyna Cache 386/33	IBM Spcl. 89	5.67	14.86	2.56	3.85							
ALR FlexCache 33/386	IBM Spcl. 89	6.74	15.66	2.60	2.83							
Blackship 386/33	IBM Spcl. 89	6.03	13.71	2.37	3.61							
Compaq Systempro	Mar. 90 FI	6.63	15.21	2.65	4.70							
Fortron NetSet 333 (386/33)	Jan. 90	5.65	14.85	2.45	3.76							
AST Premium 386/33	IBM Spcl. 89	4.80	14.21	2.32	3.89							
Everex Step 386/33	IBM Spcl. 89	6.84	15.48	2.45	4.26							
PC Link 386/33	IBM Spcl. 89	5.10	14.87	2.83	2.11							
ALR FlexCache 25386	Nov. 88	5.07	10.55	2.74	2.57							
Tangent 333 (386/33)	IBM Spcl. 89	5.73	14.83	2.28	1.79							
Acer 1100/33	Dec. 89	6.60	14.84	2.29	2.01							
Zenith Z-386/33	IBM Spcl. 89	4.79	15.10	2.96	5.05							
Matrix MDP 386/33	IBM Spcl. 89	5.75	15.07	1.93	5.73							
ALR PowerFlex i486	June 90	4.25	25.47	1.88	3.87							
AST Premium 386/25 ²		3.78	9.92	2.49	2.34							
Dell System 310 (386/20)	Oct. 88	3.91	8.38	3.21	2.45							
Compaq Deskpro 38620	Feb. 88	3.61	8.34	2.23	2.54							
Toshiba T5200/100 (386/20)	Aug. 89	3.96	8.27	2.22	2.16							
ALR MicroFlex 7000 (386/25)	Sept. 89	4.99	10.29	2.41	2.97							
Compaq 386/20e ²		3.62	8.19	1.89	3.03							
IBM PS/2 Model 70-A21 (386/25)	July 89	4.71	10.23	1.64	2.96							
Dolch-P.A.C. 386-25	Aug. 89	3.84	8.77	2.12	2.64							
Micro Express Regal II (386/20)	Aug. 89	3.30	8.08	2.51	2.50							
FiveStar Model 320 (386/20)	June 89	3.31	7.99	1.66	2.11							
Tandy 5000 MC (386/20)	Feb. 89	3.71	7.91	1.25	2.26							
Tandon 386 (386/20)	June 89	3.30	8.02	1.49	1.71							
Compaq Portable 386 (386/20)	Aug. 89	2.82	7.34	1.60	2.46							
IBM PS/2 Model 80-111 (386/20) ²		2.68	6.97	1.53	2.31							
IBM PS/2 Model P70 386 (386/20)	Aug. 89	2.66	6.98	1.62	2.16							
IBM PS/2 Model 70-121 (386/20)	Jan. 89	2.66	6.84	1.74	2.34							
NEC ProSpeed 386 (386/16)	Aug. 89	2.41	6.00	2.15	1.59							
AST Premium 386SX	June 90	2.36	5.17	1.70	2.06							
Compaq 386s (386SX/16)	Nov. 88	1.86	5.03	1.78	1.87							
ADC Powerlite 386 SX	Dec. 89	1.92	4.88	2.64	1.37							
PC Brand 386/SX-16	Mar. 90	2.44	5.04	1.50	1.92							
Toshiba T5100 (386/16)	Aug. 89	2.38	5.90	1.34	1.32							
Swan 386SX (386SX/16)	Nov. 89	1.90	3.06	2.07	1.23							
Zenith TurboPort 386 (386/12)	Aug. 89	1.96	2.36	1.48	1.91							
Gateway 386SX	Mar. 90	2.43	5.07	1.37	1.81							
ALR PowerFlex 386SX	June 90	1.80	5.14	1.63	1.79							
IBM PS/2 Model 70-E61 (386/16)	Jan. 89	2.11	5.50	1.55	1.93							
Mitac 2386 (386/16)	Oct. 89	2.04	4.41	1.38	1.57							
GridCase 1530 (386/12.5)	Aug. 89	1.76	2.69	1.55	1.24							
IBM PS/2 Model 55 SX	Oct. 89	1.78	4.02	1.36	2.42							
GridCase 1535 EXP (386/12.5)	Aug. 89	1.76	2.68	1.55	1.20							
Wedge Turbo 286 (286/24)	Nov. 89	1.58	1.60	1.40	1.07							
ALR PowerFlex 286	June 90	1.66	1.88	1.38	1.51							
Compaq LTE/286	Dec. 89 FI	1.59	1.99	1.39	1.40							
AST Bravo/286 (286/8)	Sept. 89	1.48	1.03	1.12	1.18							
IBM PC AT (286/8) ²		1.00	1.00	1.00	1.00							
IBM PC XT (8086/4.7) ²		0.22	0.71	0.32	0.25							

¹ Optional hardware disk cache installed

² Systems listed for reference only

³ Not a commercial system; technology demonstration unit

FI — First Impression, not a full review

Computer	Applications					0	5	10	15	20	25	30	35	
	WP	SS	DB	Sci./Eng.	Cmplr.									
SIA 386/33 ¹	5.49	4.32	8.09	7.42	7.32									32.64
Mylex 486/EISA ^{2,3}	6.53	5.25	5.30	6.04	8.68									31.80
Micro Express ME 386/33 ¹	4.76	4.32	5.83	7.12	5.55									27.58
Dyna Micro AIR486-C	5.14	5.30	2.92	9.07	5.11									27.54
AST Premium 486/25	5.93	5.58	2.21	9.81	3.83									27.36
National Micro Systems Flash 386/33 ¹	5.08	4.35	5.77	6.00	5.37									26.58
FiveStar Model 33/D (386/33) ¹	4.82	4.31	5.91	5.90	5.53									26.47
Dolch-P.A.C. 486-25	5.18	5.35	2.68	8.15	4.94									26.31
Spear Super 486/25U	5.22	4.67	1.75	9.18	4.25									25.06
Compaq Deskpro 386/33	4.28	5.01	3.00	7.86	4.46									24.61
Dyna Cache 386/33	5.02	4.27	2.91	7.51	4.42									24.13
ALR FlexCache 33/386	4.61	4.50	2.88	7.18	4.86									24.02
Blackship 386/33	4.69	4.45	2.89	7.30	4.44									23.77
Compaq Systempro	4.45	4.59	2.85	7.80	4.00									23.69
Fortron NetSet 333 (386/33)	4.37	4.27	2.88	7.57	4.04									23.13
AST Premium 386/33	4.11	4.22	3.01	7.23	4.11									22.69
Everex Step 386/33	4.43	3.93	1.96	8.05	4.25									22.62
PC Link 386/33	5.03	4.43	2.68	5.51	4.36									22.01
ALR FlexCache 25386	4.41	4.13	2.83	5.80	4.08									21.24
Tangent 333 (386/33)	4.57	4.45	2.45	5.43	4.27									21.17
Acer 1100/33	4.10	4.16	2.33	6.03	3.69									20.32
Zenith Z-386/33	3.91	3.97	1.87	6.59	3.85									20.19
Matrix MDP 386/33	3.95	3.90	1.74	7.09	3.43									20.11
ALR PowerFlex i486	3.90	4.97	1.81	5.89	2.69									19.26
AST Premium 386/25 ²	3.62	3.93	2.60	5.36	3.68									19.20
Dell System 310 (386/20)	3.45	3.56	2.84	4.98	3.41									18.24
Compaq Deskpro 386/20	3.20	3.51	3.09	4.67	3.45									17.93
Toshiba T5200/100 (386/20)	3.34	3.66	2.57	4.89	3.40									17.86
ALR MicroFlex 7000 (386/25)	3.54	3.82	1.50	5.45	3.30									17.61
Compaq 386/20e ²	3.26	3.64	2.62	4.68	3.07									17.26
IBM PS/2 Model 70-A21 (386/25)	3.42	3.75	1.52	5.33	2.62									16.64
Dolch-P.A.C. 386-25	3.16	3.14	2.37	4.67	3.11									16.45
Micro Express Regal II (386/20)	2.93	3.18	2.22	4.29	3.14									15.76
FiveStar Model 320 (386/20)	3.07	3.21	1.49	4.31	2.59									14.67
Tandy 5000 MC (386/20)	2.97	3.23	1.50	4.35	2.23									14.27
Tandon 386 (386/20)	2.91	3.19	1.52	3.97	2.41									14.01
Compaq Portable 386 (386/20)	2.68	3.11	1.49	3.73	2.32									13.33
IBM PS/2 Model 80-111 (386/20) ²	2.81	3.07	1.45	3.63	2.21									13.16
IBM PS/2 Model P70 386 (386/20)	2.99	2.88	1.35	3.58	2.22									13.02
IBM PS/2 Model 70-121 (386/20)	2.63	2.74	1.46	3.75	2.15									12.72
NEC ProSpeed 386 (386/16)	2.34	2.33	2.14	3.11	2.37									12.29
AST Premium 386SX	2.36	2.47	1.85	3.21	2.14									12.03
Compaq 386s (386SX/16)	2.24	2.15	2.06	3.01	2.05									11.51
ADC Powerlite 386 SX	2.38	2.25	2.48	2.24	2.13									11.47
PC Brand 386/SX-16	2.21	2.17	1.77	3.00	2.01									11.16
Toshiba T5100 (386/16)	2.25	2.48	1.69	2.64	1.97									11.04
Swan 386SX (386SX/16)	2.25	2.23	2.01	2.38	2.14									11.02
Zenith TurbosPort 386 (386/12)	1.93	2.22	2.00	2.73	1.97									10.84
Gateway 386SX	2.24	2.11	1.32	3.06	1.89									10.62
ALR PowerFlex 386SX	2.09	2.27	1.60	2.93	1.65									10.55
IBM PS/2 Model 70-E61 (386/16)	2.28	2.18	1.35	2.94	1.78									10.52
Mitac 2386 (386/16)	2.08	1.82	1.36	2.76	1.67									9.70
GridCase 1530 (386/12.5)	1.78	2.01	1.81	2.17	1.82									9.58
IBM PS/2 Model 55 SX	2.07	1.97	1.21	2.61	1.67									9.53
GridCase 1535 EXP (386/12.5)	1.69	2.04	1.78	2.13	1.80									9.44
Wedge Turbo 286 (286/24)	1.92	2.02	1.40	1.82	1.62									8.78
ALR PowerFlex 286	1.83	1.73	1.52	2.14	1.43									8.65
Compaq LTE/286	1.77	1.66	1.52	1.93	1.61									8.50
AST Bravo/286 (286/8)	1.57	1.30	1.22	1.53	1.27									6.89
IBM PC AT (286/8) ²	1.00	1.00	1.00	1.00	1.00									5.00
IBM PC XT (8086/4.7) ²	0.33	0.28	0.22	0.35	0.29									1.47

¹ Optional hardware disk cache installed.

² Systems listed for reference only.

³ Not a commercial system; technology demonstration unit.

BYTE BENCHMARK INDEXES (VERSION 1.0) WITHOUT MATH COPROCESSOR

Table 2: Zenith's EISA offering posted the best version 1.0 indexes for those systems tested without a math coprocessor installed. All indexes are based on an 8-MHz IBM PC AT. Longer bars indicate better performance.

Computer	Month appeared	Low-level			
		CPU	Disk	Video	
Zenith Z-386/33E	July 90	5.41	3.46	3.85	
Everex/SDI FileMaster II	July 90	6.88	2.92	5.42	
Acma 386/20 ¹		3.07	1.73	2.08	
Northgate 386/20 ¹		2.68	1.60	2.27	
Bitwise 386/20 ¹		2.38	1.51	2.23	
Tandon LT/386	May 90	1.90	1.76	1.56	
Zenith SupersPort SX	May 90	1.93	2.12	1.81	
Dell 316LT	May 90	1.82	2.05	1.77	
Compaq SLT/286 (286/12)	Mar. 89	1.59	1.77	1.43	
NCR 386SX (386SX/16) ¹		1.87	1.34	1.11	
Toshiba T3100SX	May 90	1.88	1.50	1.63	
Ogivar 286 Laptop (286/12.5)	Mar. 89	1.70	1.19	1.38	
Zenith SupersPort 286 (286/12)	Feb. 89	1.55	1.06	1.38	
Mitsubishi MP-286L (286/12)	Feb. 89	1.62	0.92	1.29	
NEC UltraLite (V30/9.83)	Aug. 89	0.93	1.42	0.80	
Sharp PC-4641	Jan. 90	0.68	0.83	0.65	
GridCase 140 XT	Jan. 90	0.53	0.49	0.47	
Zenith MinisPort	Aug. 89 FI	0.40	2.86	0.49	

¹ Systems listed for reference only.
FI — First Impression, not a full review.
N/A = Not applicable

BYTE BENCHMARK INDEXES (VERSION 2.0) WITH MATH COPROCESSOR

Table 3: Version 2 of the BYTE benchmarks tests four low-level components and seven application categories. All indexes are based on an 8-MHz IBM PC AT. All systems were tested with a math coprocessor installed (or with an integrated FPU). Longer bars indicate better performance.

Computer	Month appeared	Low-level				
		CPU	FPU	Disk	Video	
Club 386/33 ¹		4.71	14.42	2.91	4.83	
Dell System 325 ¹		3.37	8.91	2.44	4.94	
Compaq Deskpro 386/25e	Aug. 90	2.97	8.91	2.22	9.90	
Compaq 386/20 ¹		2.58	7.15	1.72	8.21	
Compaq 386/20 SX ¹		1.76	6.59	2.17	8.34	
Micro Express ME 386SX	Aug. 90	2.67	3.30	2.61	6.04	
Dell System 320LX	Aug. 90	2.19	6.11	1.86	7.10	
Everex Step 386is	Aug. 90	2.52	5.22	2.82	4.06	
AT&T 6386/SX	Aug. 90	2.30	5.06	2.41	3.02	
Zeos 386/SX	Aug. 90	2.35	3.15	2.06	5.52	
Tatung TCS-8800	Aug. 90	2.29	5.05	1.84	3.27	
Hewlett-Packard Vectra QS/16S	Aug. 90	1.77	4.94	2.58	3.67	
Acer 1100/SX	Aug. 90	1.97	5.18	1.77	6.01	
Epson Equity 386SX	Aug. 90	2.13	4.92	1.82	3.98	
Club American 316/SX	Aug. 90	2.08	5.15	1.68	2.06	
NEC PowerMate SX Plus	Aug. 90	1.97	4.76	1.93	4.52	
CPI Goupil Golf	Aug. 90	2.18	5.18	1.86	3.46	
Acma 386 SX	Aug. 90	2.29	5.06	1.81	4.33	
Arche Rival SX	Aug. 90	2.12	5.12	1.96	3.07	
CSR 386/SX-16	Aug. 90	1.78	3.89	1.20	5.69	
DTK Peer\1660	Aug. 90	1.78	4.91	1.89	5.34	
Samsung SD700	Aug. 90	1.80	5.05	1.69	2.61	
Tandy 4016SX	Aug. 90	1.95	4.73	1.51	2.77	
Wang PC350/16S	Aug. 90	1.77	4.91	1.82	4.40	
Dell 316SX	Aug. 90	2.10	4.88	1.95	3.50	
Ultra-Comp Ultra 386SX Appeal	Aug. 90	1.78	3.85	1.73	4.12	
Hyundai Super-386s	Aug. 90	1.81	5.08	1.24	5.61	
Zenith Z-386SX	Aug. 90	1.49	5.02	1.67	5.09	
CompuAdd 316S	Aug. 90	1.51	4.78	1.90	3.92	
IBM PC AT ¹		1.00	1.00	1.00	1.00	

¹ Listed for reference only

BYTE BENCHMARK INDEXES (VERSION 1.0) WITHOUT MATH COPROCESSOR

Computer	Applications					0	5	10	15	20	25	
	WP	SS	DB	Sci./Eng.	Cmplr.							
Zenith Z-386/33E	4.73	4.17	4.38	2.23	4.91							20.42
Everex/SDI FileMaster II	5.32	3.93	1.80	2.28	3.96							17.29
Acma 386/20 ¹	2.64	2.55	2.14	1.15	2.67							11.14
Northgate 386/20 ¹	2.73	2.65	1.87	1.16	2.54							10.95
Bitwise 386/20 ¹	2.53	2.46	1.68	1.08	2.24							9.99
Tandon LT/386	2.10	1.96	2.72	0.84	2.17							9.79
Zenith SupersPort SX	2.17	2.14	2.05	0.83	2.13							9.32
Dell 316LT	2.09	1.97	1.94	0.83	2.13							8.95
Compaq SLT/286 (286/12)	1.77	1.67	1.95	0.61	1.69							7.70
NCR 386SX (386SX/16) ¹	2.11	1.70	1.28	0.72	1.71							7.52
Toshiba T3100SX	1.94	1.91	1.02	0.78	1.62							7.28
Ogivar 286 Laptop (286/12.5)	1.75	1.63	1.34	0.62	1.45							6.79
Zenith SupersPort 286 (286/12)	1.59	1.53	1.28	0.64	1.40							6.43
Mitsubishi MP-286L (286/12)	1.45	1.41	1.05	0.59	1.13							5.64
NEC UltraLite (V30/9.83)	N/A	0.90	N/A	0.35	0.99							N/A
Sharp PC-4641	0.82	0.67	0.72	0.24	0.64							3.10
GridCase 140 XT	0.61	0.51	0.55	0.18	0.49							2.34
Zenith MinisPort	N/A	0.47	N/A	N/A	0.63							N/A

¹ Systems listed for reference only
N/A=Not applicable

BYTE BENCHMARK INDEXES (VERSION 2.0) WITH MATH COPROCESSOR

Computer	Applications							0	5	10	15	20	25	30	35	
	WP	DTP	DB	Cmplr.	CAD	Sci./Eng.	SS									
Club 386/33 ¹	4.02	3.79	3.29	4.34	6.61	6.07	4.70									32.82
Dell System 325 ¹	2.92	3.76	3.37	3.81	5.23	5.63	4.37									29.09
Compaq Deskpro 386/25e	2.60	2.94	3.14	3.63	5.26	5.84	4.44									27.85
Compaq 386/20 ¹	2.20	2.92	2.87	3.03	4.63	4.67	3.24									23.56
Compaq 386/20 SX ¹	2.14	2.57	2.59	2.92	3.78	4.35	3.10									21.45
Micro Express ME 386SX	2.17	2.84	2.41	2.61	2.71	3.20	2.61									18.55
Dell System 320LX	1.90	1.99	2.05	2.30	3.23	3.53	2.36									17.35
Everex Step 386is	1.95	2.31	2.06	2.44	2.96	3.10	2.35									17.16
AT&T 6386/SX	1.85	2.08	2.15	2.28	2.63	2.92	2.15									16.05
Zeos 386/SX	1.90	1.81	2.11	2.31	2.58	2.53	2.45									15.69
Tatung TCS-8800	1.79	2.05	1.95	2.06	2.60	2.94	2.24									15.63
Hewlett-Packard Vectra QS/16S	1.65	1.95	2.15	2.21	2.61	2.89	2.12									15.58
Acer 1100/SX	1.68	1.54	2.02	2.06	2.74	3.12	2.31									15.47
Epson Equity 386SX	1.67	2.00	1.89	2.02	2.64	2.89	2.24									15.34
Club American 316/SX	1.72	1.89	1.88	2.05	2.73	2.86	2.14									15.29
NEC PowerMate SX Plus	1.61	1.98	2.09	2.06	2.51	2.87	2.15									15.28
CPI Goupil Golf	1.70	1.94	1.90	1.93	2.66	2.85	2.16									15.14
Acma 386 SX	1.93	1.87	1.69	1.99	2.58	2.57	2.05									14.67
Arche Rival SX	1.64	1.64	1.90	1.98	2.54	2.91	2.05									14.67
CSR 386/SX-16	1.63	1.99	1.91	1.91	2.36	2.54	2.11									14.45
DTK Peer 1660	1.24	1.61	1.78	1.87	2.57	3.18	2.06									14.31
Samsung SD700	1.49	1.96	1.74	1.94	2.45	2.64	2.03									14.25
Tandy 4016SX	1.59	1.79	1.89	1.89	2.48	2.67	1.95									14.25
Wang PC350/16S	1.62	1.84	1.71	1.97	2.37	2.75	1.92									14.17
Dell 316SX	1.66	1.76	1.73	1.83	2.42	2.66	1.78									13.86
Ultra-Comp Ultra 386SX Appeal	1.65	1.74	1.73	1.96	2.38	2.44	1.94									13.84
Hyundai Super-386s	1.55	1.79	1.54	1.75	2.47	2.55	1.92									13.56
Zenith Z-386SX	1.34	1.48	1.78	1.77	2.33	2.90	1.60									13.20
CompuAdd 316S	1.30	1.55	1.65	1.62	2.35	2.62	1.80									12.89
IBM PC AT ¹	1.00	1.00	1.00	1.00	1.00	1.00	1.00									7.00

¹ Listed for reference only.

BYTE BENCHMARK INDEXES—MACINTOSH FAMILY

Table 4: The Mac IIx dominates the field of Macintosh systems. The FPU index is based on the Mac II. All other indexes are based on the Mac SE. Longer bars indicate better performance.

Computer	Month appeared	Low-level				
		CPU □	FPU ¹ □	Disk □	Video □	
Mac IIx	Sept. 90	12.36	3.83	3.82	6.73	
Mac IIfx	Oct. 89 FI	7.27	1.87	3.83	4.49	
Dynamac	Sept. 90	4.62	1.16	4.20	2.53	
Mac IICx	Sept. 89	4.61	1.15	3.65	2.58	
Mac SE/30	June 89	4.61	1.16	3.01	2.33	
Mac IIfx	Dec. 88	4.57	1.16	3.02	2.59	
Mac II	Oct. 87	3.81	1.00	2.56	2.35	
Mac Portable	Oct. 89 FI	1.96	N/A	2.51	1.43	
Mac SE	Aug. 87	1.00	N/A	1.00	1.00	
Mac Plus	Nov. 86	0.81	N/A	0.75	0.91	
Outbound ²	Sept. 90	2.07	0.29	N/A	1.52	

¹ The FPU index is based on the Mac II. All other indexes are based on the Mac SE.

² The Outbound could not run the Scientific/Engineering suite of tests; therefore, it did not post a cumulative application index.

N/A=Not applicable

BYTE BENCHMARK INDEXES—UNIX FAMILY

Table 5: Most of the workstations the BYTE Lab tested outperformed the baseline Everex Step 386/33 running Xenix 2.3.1.

	C Compiler □	DC Arithmetic □	Tower of Hanoi □	System Loading (8 concurrent tasks) □	Dhrystone 2 □	Floating Point □
Silicon Graphics Personal Iris Turbo	0.95	3.00	1.87	1.50	0.97	5.90
Opus 8140-PM	0.83	2.52	2.00	1.38	3.64	3.11
DECstation 3100	0.58	1.31	1.33	1.33	1.67	4.91
Opus 8110-PM	0.62	2.10	1.51	1.08	2.98	2.48
Everex Step 386/33	1.00	1.00	1.00	1.00	1.00	1.00
NeXT Computer	0.37	0.97	0.34	0.52	0.43	0.92

Note: Indexes show relative performance. For all indexes, an Everex Step 386/33 running Xenix 2.3.1 = 1. Longer bars indicate better performance.

To meet the challenge of the hardware vendors, the BYTE Lab introduced a new generation of system benchmarks in the August BYTE. Exercising the latest versions of PC software, the new benchmarks test four low-level components (CPU, FPU, disk, and video) as well as seven application categories (word processing, desktop publishing, database management, code compilation, CAD, scientific/engineering, and spreadsheets). The changes are significant enough that the new benchmark indexes should not be compared to the old indexes. With that in mind, this update offers a final listing of the old benchmark indexes (see tables 1 and 2) as well as a glimpse ahead at the new indexes (see table 3).

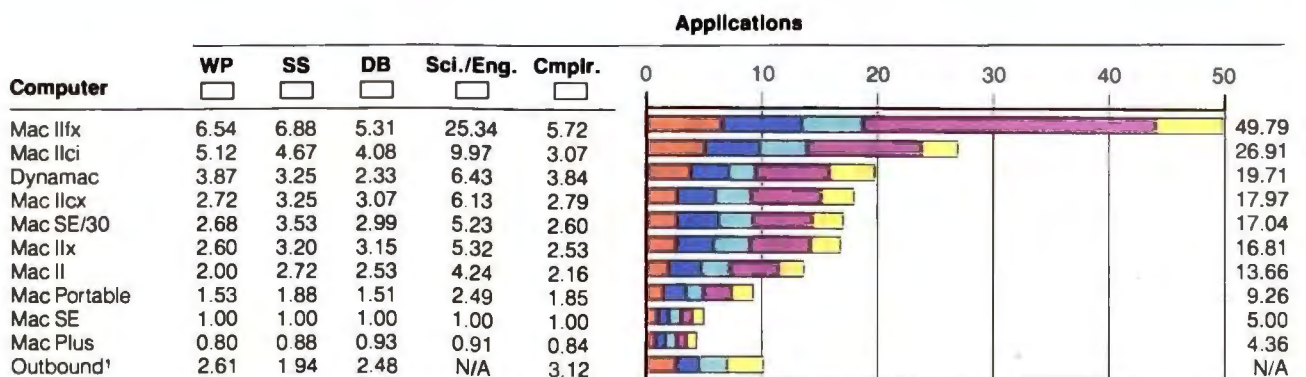
Our low-level suite tests a machine at the component level. If you are looking for a machine with a fast disk drive or strong video performance, the low-level indexes will give you a means of comparison. On the other hand, if you have specific applications in mind, consult the application indexes. They will give you a good idea of how a system will perform when running a broad range of application categories. If your work load involves heavy database use, word processing chores, or CAD applications, you should compare machines using the specific index corresponding to your specialized needs.

The BYTE benchmark indexes are relative. The PC indexes, old and new, are referenced to an 8-MHz IBM AT with an 80287 math coprocessor. The baseline AT registers a 1.00 on

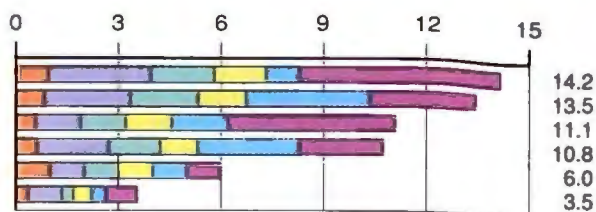


Silicon Graphics Personal Iris Turbo

BYTE BENCHMARK INDEXES—MACINTOSH FAMILY



¹ The Outbound could not run the Scientific/Engineering suite of tests; therefore, it did not post a cumulative application index
N/A=Not applicable



all tests. The cumulative application index represents an overall score based on the seven application categories, so the AT posts a 7.00.

We tried to test the machines as configured by the vendor, with some exceptions. We disabled any software caching and, for the new benchmarks, installed extended-memory drivers. Machines tested without a coprocessor are listed separately. Every system tested with the new benchmarks has a coprocessor installed (or, as is the case with the i486, includes an integrated FPU).

We discouraged vendors from sending us systems with optional caching disk drive controllers installed, as that inflated the disk I/O and cumulative application indexes. Those machines that have been benchmarked with caching controllers are marked in table 1 with a footnote.

The 40-MHz Mac IIfx leads the march of Mac boxes (see table 4). The 68000 processor inside the Mac SE, the Mac Plus, and the Mac Portable doesn't support an integrated math coprocessor, so those machines could not generate an FPU index. For the same reason, the Mac FPU indexes are referenced to the Mac II, while all other indexes are based on the Mac SE. The Mac indexes should not be compared to the PC indexes.

New for this benchmark roundup are the Unix indexes. Table 5 provides a broad means of comparison among several Unix boxes and Intel-based PCs running SCO Xenix.

Comparing speed indexes is fun, and it can be valuable when deciding among the varieties of CPUs and clock speeds. But speed should not be the sole criterion by which you judge a PC. Construction quality, customer support, compatibility, and price are just as important—perhaps more so, if your application does not require a great deal of performance from the hardware. In the tables, we've referenced the BYTE issue in which the review of each system appeared. If you're using this listing to shop for a PC, please read the full review for the whole picture.

So now we're ready for the latest stream of speed demons. We have the two things we needed most: new benchmarks and a bigger thesaurus. ■

Stanford Diehl is a BYTE Lab testing editor/engineer. You can reach him on BIX as "sdiehl."



Mac IIfx

PC GUIs GO HEAD TO HEAD

*A user's view of Windows 3.0 and OS/2 reveals
inconsistency within the consistency*

Stan Miastkowski



Over the past several months, tens of thousands (perhaps hundreds of thousands) of words have been written about the relative technical merits of Microsoft Windows 3.0 versus the

current version (1.2) of OS/2. That's the problem: The words have concentrated on the *technical* merits, largely ignoring what's ultimately one of the most important factors in the equation: how you *use* them. While the technical intricacies of the two pack-

ages have a crucial role in the ultimate acceptance of both packages, and which environment (or both) developers opt for, the ultimate test of both Windows 3.0 and OS/2 are how they play in Peoria, or—more important—

continued

BASIC OPENING SCREENS

The basic opening screens of both Windows 3.0 and OS/2 look very different at first glance, but they share Common User Access traits, including three-dimensional buttons and pull-down menus. The screens shown here are what you see the first time you start the systems; you can customize them to fit your own preferences and work habits.

What Windows 3.0 calls the *Program Manager* and OS/2 calls the *Desktop Manager* are both essentially on-screen starting points. As you can see, Windows 3.0 has a more eye-catching look and feel and relies more on the visual metaphors of carefully designed and finely sculpted icons.



WINDOWS 3.0

OS/2



FILE MANAGERS

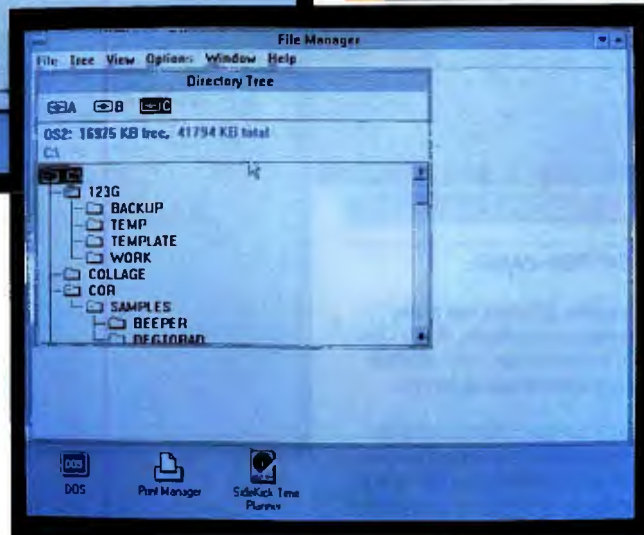
The File Managers of Windows 3.0 and OS/2 are nearly identical at first glance—with Windows again showing the more finely detailed icons. On start-up, Windows 3.0 shows only the top-level subdirectories, while OS/2 displays all directories and subdirectories. (As with other options, every time you start the File Manager, you can easily customize what it shows.)

Note that OS/2 is missing a *Disk* pull-down menu in its File Manager. In the Windows 3.0 file manager, this menu contains the necessary copy and formatting commands for floppy disks. Of course, these are available in OS/2, but they're hidden in the Utilities Group. OS/2 also contains a Fixed Disk utility that lets you create and modify hard disk partitions. While useful, it can be dangerous in inexperienced hands (which is evidently why it's missing in Windows 3.0).



▲ WINDOWS 3.0

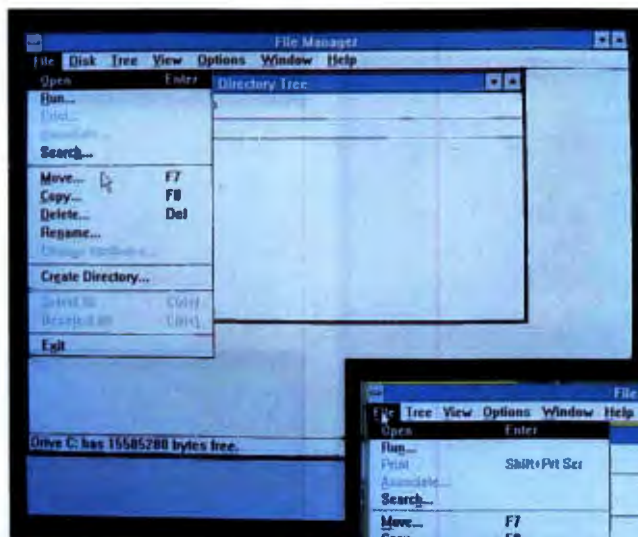
▼ OS/2



FILE MENUS

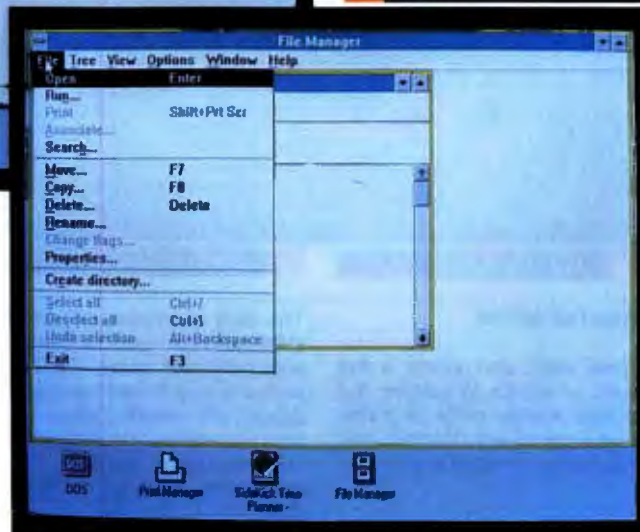
You'll spend a great deal of time in the main file pull-down menus of both Windows 3.0 and OS/2. The choices here are nearly identical, with a few notable exceptions. OS/2 contains a *Properties* option that lets you view extended information on your files (e.g., the icon, the subject, the date, and the time last changed). Also peculiar are the *Change Attributes* option in Windows 3.0 and the *Change flags* option in OS/2. Although they have different names, they do the same thing—they let you change the file type (e.g., hidden, system).

One thing that's still missing from both Windows 3.0 and OS/2 is the ubiquitous Trashcan that Macintosh users have grown to know and love. In both the Windows 3.0 and OS/2 environments, the Delete key does the job, although not as elegantly (if you can call a Trashcan elegant).



▲ WINDOWS 3.0

▼ OS/2





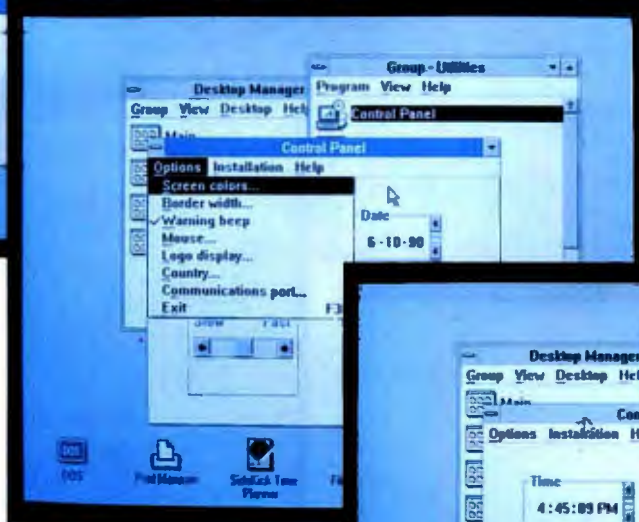
▲ WINDOWS 3.0

CONTROL PANEL

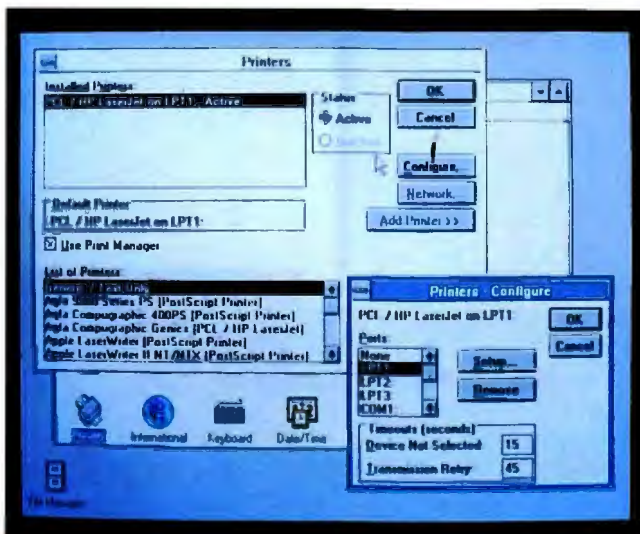
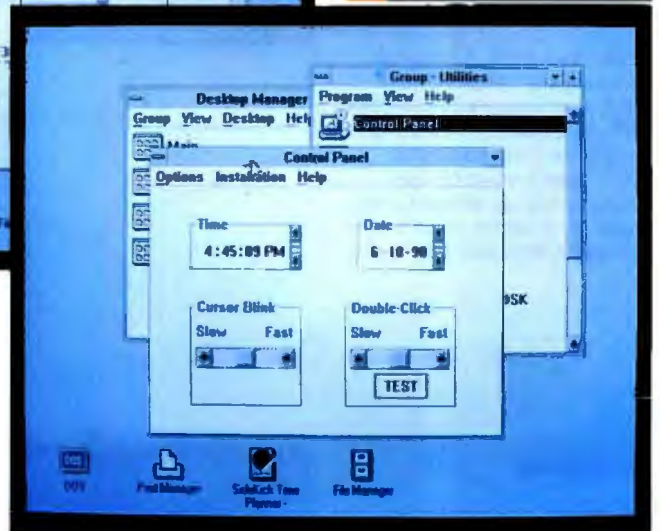
Windows 3.0 puts the many (necessary) options of the Control Panel in one child window using easy-to-grasp icons.

OS/2, on the other hand, puts a very limited selection on the first screen. All the options are available in OS/2, but, as shown in the second OS/2 screen, they're arranged in a pull-down menu that lacks icons.

▼ OS/2



▼ OS/2



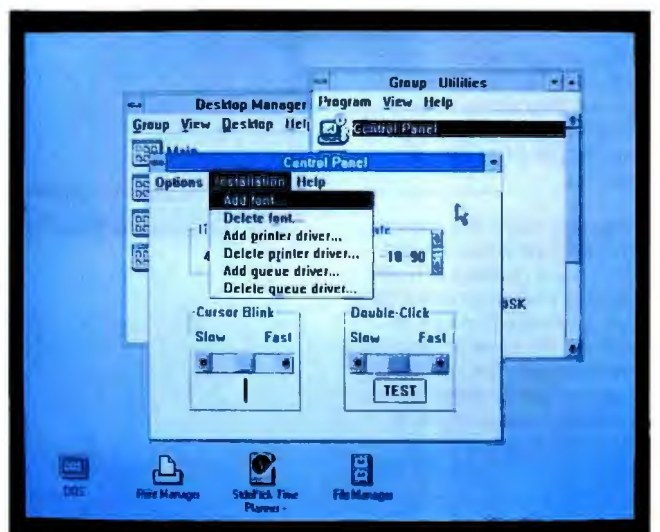
▲ WINDOWS 3.0

▼ OS/2

PRINTER SETUP

Printer setup and options is one area in which Windows 3.0 shines. A wide range of printer drivers comes with Windows, and they're easy to install and set up.

The lack of printer drivers in OS/2 has been (and remains) a sore point with users. OS/2 includes a very limited number of drivers, and installing them is far from an intuitive task. It requires numerous steps, and the drivers themselves must be on floppy disks.



DESKTOP DESIGN

(a) In Windows 3.0, Microsoft has created nearly limitless options for customizing the look and feel of the desktop. Besides being able to choose basic colors for desktop elements, you can also fine-tune them through a virtually unlimited palette.

(b) Hidden farther down in the menus are options for "wallpaper" (the screen background) and even the patterns that show on the background of individual windows.

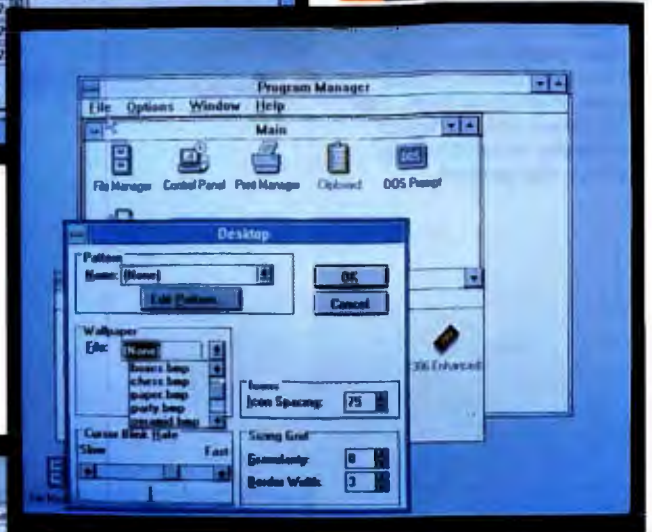
(c) Windows' concentration on bright windows and icons almost makes you feel like an interior decorator.

(d) OS/2 offers a severely limited choice of colors for individual screen elements, and no choice at all for screen background patterns. What you see is what you get.



(a) WINDOWS 3.0

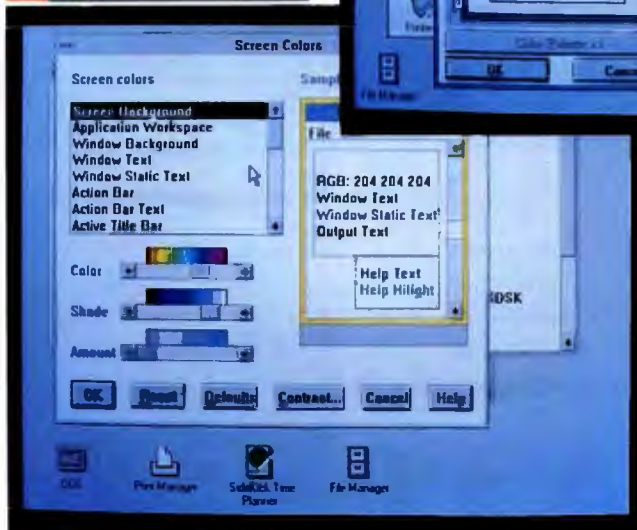
(b) WINDOWS 3.0



(c) WINDOWS 3.0



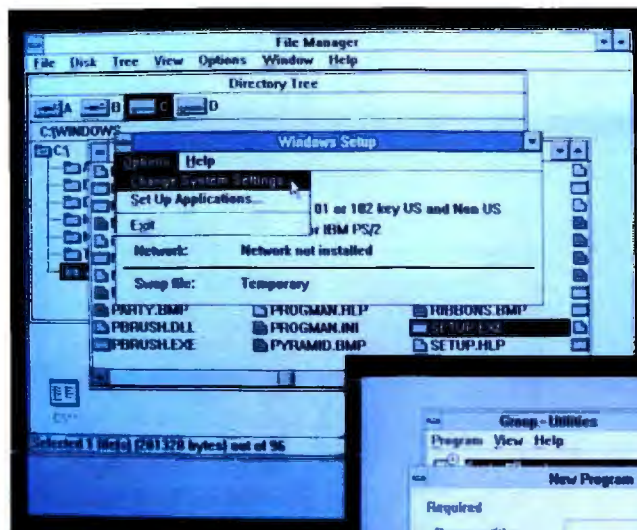
(d) OS/2



APPLICATION SCREENS

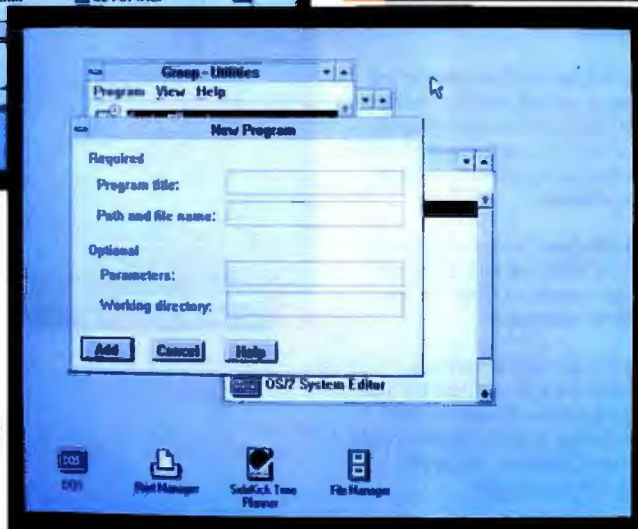
Because it's a DOS add-on instead of a full-fledged operating system, Windows 3.0 offers an easy way to modify system settings and to set up applications. It will also automatically search the disk for application files, create icons for both Windows and non-Windows applications, and place the icons in the correct groups.

There's no comparable screen shown for OS/2 because it doesn't have one. Making major changes in OS/2's setup requires reinstallation of the entire operating system. On the application side, OS/2 applications create their own applications and (usually) let you choose where to put them. The OS/2 screen shown is one of the screens necessary for installing a new program.



WINDOWS 3.0

OS/2



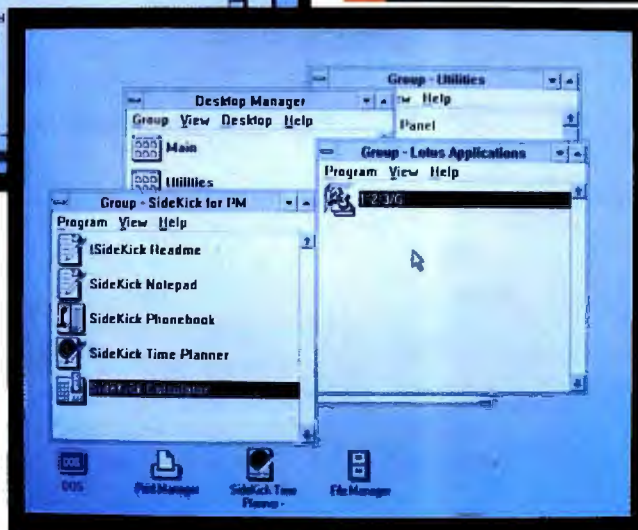
THE BASIC GUI

One of the biggest differences between Windows 3.0 and OS/2 is that Windows 3.0 makes much more extensive use of the graphical user interface and relies heavily on detailed icons.



WINDOWS 3.0

OS/2



PC GUIS GO HEAD TO HEAD

with your screen, mouse, and keyboard.

Even though Windows 3.0 and OS/2 come essentially from the same parentage (i.e., the programming gnomes at Microsoft), there are some differences. Although at the most basic level, both are Common User Access-compliant—part of IBM's omnibus Systems Application Architecture specification, both packages represent an evolution, with Windows 3.0 the latest incarnation in the march toward the ultimate graphical user interface (GUI) design.

Fair Comparisons

One thing that people seldom mention in the "Great Windows 3.0 versus OS/2 Debate" is that in certain ways, comparing the two is like comparing apples and oranges. After all, Windows 3.0—at its heart—is simply a graphical DOS shell (albeit a very sophisticated one). OS/2, on the other hand, is much more a full-fledged multitasking, multithreading operating system. That crucial difference is the reason that you interact with Windows 3.0 and OS/2 differently.

What follows is a gallery of comparisons that show some of the key user interface differences (and consistencies) between Windows 3.0 and OS/2. Like a gallery owner setting up an art show, We've chosen the best—the highlights of what have become (for better or worse) the leading GUIs of the PC world. Not only do both environments have hundreds of screens and pull-down menus, they're also highly customizable to fit your own preferences and graphical prejudices.

Your ultimate choice of an operating environment depends on a wide range of factors, including your needs and the size of your wallet. But like choosing a car, when you have to live with a system from day to day, the ultimate question is: "How well does it drive?"

What of the future? OS/2 2.0 (for 386- and i486-based systems only) will probably have many of the graphical elements of Windows 3.0. OS/2 2.0 is due at the end of the year. Time will tell. ■

Stan Miastkowski is a BYTE senior editor. He can be reached on BIX as "stanm."

Space-Saver Keyboard



Save an amazing 60% of the desk or counter space now taken by a standard keyboard and enjoy improved functionality at the same time. Actual size is 10.75" x 6.0" (273 x 152mm). The new MICROTYPE keyboard is rapidly gaining acceptance as a truly advanced alternative to the original IBM layout for many applications. Reliability of the MICROTYPE has been amply proven through extensive use in trading areas of the NYSE, The New York and Chicago Mercantile Exchanges as well as in many banks, brokerages, stores and at factory work stations.

Space is saved by compressing rows (not columns) and eliminating wide borders. Re-arranging and elevating the auxiliary key clusters also saves space while improving accessibility with reduced eyescan and head movement. Keys have full travel with a light tactually responsive touch. All standard features such as auto-repeat, caps, num and scroll lock are included on the MICROTYPE.

PC XT/AT, PS/2 IBM and clone compatibility. Available in US and most European language versions. Made in USA with 1 year warranty.

... beautifully sensitive and handles both typists with light touch and those who really bang away ...

COMPUTER BUYERS GUIDE

... This could be the perfect layout for an enhanced keyboard that must fit into a small area ...

COMPUMAG

Order direct from stock with 15 day full return privileges. VISA, MasterCard, Eurocard charges accepted.

USA	1-800-DATALUX	Fax 703-662-1682	\$124.50 + 6.00 s/h	Extra charges for PS/2 adapters,
CANADA	514-694-0870	Fax 514-694-0871	\$189.00Cdn + s/h	air shipments. OEM and reseller
EUROPE	44 + 306-76718	Fax 44 + 306-76742	£99.00 + VAT + P&P	volume discounts available.

Normal size of 101
key enhanced keyboard



When it comes to saving space, there's no comparison.

DATALUX

DATALUX CORPORATION 2836 Cessna Drive, Winchester, Virginia 22601

WHOA DUDE!!*



* Translation:

Gadzooks! Wow! Many other expletives! The infinite forces of reality have converged upon my enlightened mind, and have filled it with wonder at the subtleties, complexities and (once in a great while) seriously solid hardware values that the Universe has to offer. I have seen THE SUNBURST, and it is good. I shall offer it to the marketplace, and they will exclaim (as one): "WHOA, DUDE!"

It's not often anymore that a great product is introduced into the marketplace; but, once in a great while, a product is brought to market that no one can ignore... announcing **The Sunburst 8514/A Graphics Card**. The new standard in personal computing.

The fastest graphic card on the market... including 34010 based cards. Supports up to 1280x1024 in 256 colors. 512K, 1MB & 2MB configurations using 256Kx4 dual ported VRAM. Vector Intensive for CAD/CAM applications. Graphic computation is offloaded from the CPU. Chip count is just eight, to ensure highest reliability. Scissoring, line drawing, patterning, color mixing, bit block transfer. Supports interlaced and non-interlaced display modes. **The Sunburst** is hardware-accelerated to support hi-res 8514/A monitors and compatibles (pixel clock runs up to 80 MHz). Runs any register level compatible or free AI driver, such as Windows & Presentation Manager. 7 year warranty.

An incredibly strong price/performance ratio... guaranteed to "enlighten" you and your customers as to what real graphics value is all about. Groundhog offers you complete dealer support, including an intense advertising campaign. Call now for details on becoming an authorized Groundhog dealer.



**GROUNDHOG
GRAPHICS, INC.**

101 East Mahoning St.
P.O. Box 325
Punxsutawney, PA 15767
(814) 938-8943
(800) 283-2322
FAX (814) 938-7035

Circle 90 on Reader Service Card (RESELLERS: 91)

STRANGER IN A STRANGE LAND

It's easier than you might imagine to share information among the Macintosh and other personal computers

Tom Thompson

Just a few years ago, it was an uphill battle to get an Apple Macintosh computer through a corporation's doors. Now, they can be found peppering desktops in offices everywhere. No, they haven't taken over: Many tasks are better handled by PCs. But the Mac *earned* its spot on a desk, simply because its superior graphics capabilities produced professional artwork (e.g., charts, figures, and logos) better and faster than your garden-variety PC.

But as the Mac uniquely solves some business problems, it also adds some complications. You might, for example, want a Mac program to draw a chart that uses numbers computed on a Compaq Deskpro. Ideally, this should not be a problem. Practically, however, the disparate file formats that exist between PCs and Macs—and even among programs on the same computer—can make achieving this ideal a major headache. Suddenly, the Mac appears like a stranger, speaking in an unknown tongue.

But information sharing between PCs and Macs is not impossible. How the Mac handles data isn't that much

different from how a PC handles it, although it may seem that way when you hear Mac folks talking about a file's *data fork* and *resource fork*. If you understand how the Mac handles data, you can convert a file's contents into something that any machine can use. Furthermore, a number of vendors (e.g., Microsoft, Aldus, and WordPerfect) have written programs that operate on both Macs and

PCs while using the same file format.

I'll start by showing how to exchange files between Macs and PCs. I'll gloss over networking solutions, since implementing these is an article in itself. I'll discuss ways to make use of the file's information, whether you're using it on a Mac or sending it to a PC. Along the way, I'll provide hints on potential problems, even if you're using a vendor solution like Microsoft Word.

Dealing with Disks

Trying to move a file from a PC floppy disk onto a Mac floppy disk used to be a major chore, even though both machines use the same 3½-inch floppy disks. That's because each computer uses a different data-encoding method to record information.

The PC uses MFM for its floppy disks, while the Mac uses group-code recording (GCR). The end result is that neither computer reads the other's disks. In a large office, a network (e.g., Novell NetWare or Dayna Communication's DaynaNET) that links both computers bypasses this problem, but for a small office there used to be no easy solution.

The need for data exchange

continued



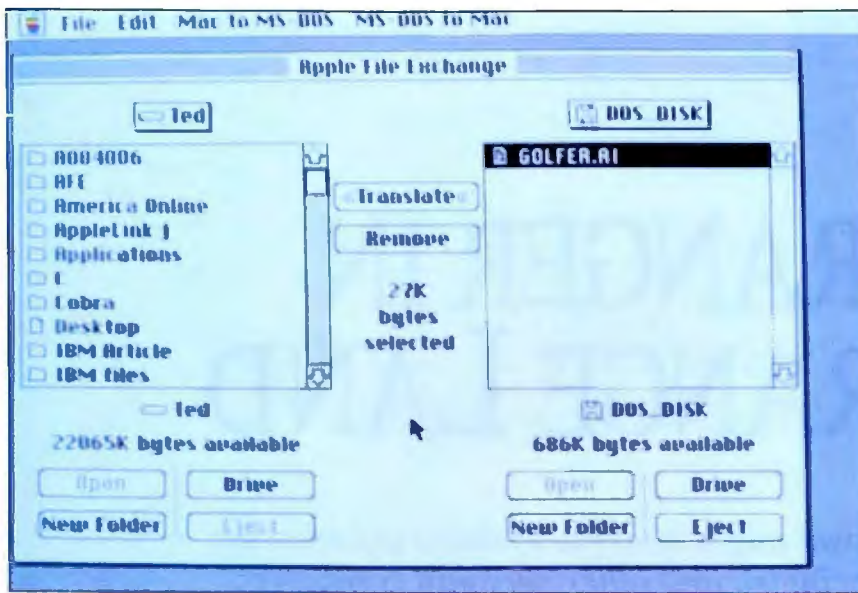


Photo 1: The Apple File Exchange program copying a file from an MS-DOS disk.

was so acute that vendors devised solutions that do not require a network. MatchMaker from Micro Solutions Computer Products is an Industry Standard Architecture (ISA) board for the PC that connects to an external Mac floppy disk drive. Using special DOS commands, you can examine Mac floppy disks and copy files.

Apple addressed the problem with its FDHD drive, dubbed the SuperDrive, which was first introduced on the Mac IIx. A SuperDrive can format, read, and write to double-sided or high-density 3½-inch 1.44-megabyte floppy disks, using either MFM or GCR encoding. With the exception of the Mac Plus, every Mac from the Portable to the IIfx is shipped with a SuperDrive. (The 68020-based Mac II, which had only a double-sided floppy disk drive, has been discontinued. Since September 1989, the Mac SE has been equipped with a SuperDrive instead of the double-sided floppy disk drive.)

By itself, the SuperDrive isn't enough to deal with an MS-DOS or OS/2 disk: The Mac Finder won't recognize the foreign file format and will ask to format the floppy disk for you. Instead, you must launch the Apple File Exchange (AFE) program, which assumes control of the SuperDrive and lets you copy files to or from a PC floppy disk (see photo 1).

AFE has a modular structure that lets you add extra procedures called *filters*, which translate the file as you copy it. Third-party vendors offer filters that perform conversions between a variety of PC and Mac file formats.

For example, DataViz offers MacLink Plus/Translators, a package that features an extensive library of filters that can translate, say, an MS-DOS WordPerfect file into a Mac Microsoft Word file while retaining the document's typefaces and styles. Even if your PCs and Macs are networked, you can use the DataViz translators with AFE to convert database, spreadsheet, and word processing files. DataViz also provides a stand-alone program to operate its filters if the AFE program isn't available.

The Serial Solution

OK, so maybe you've got a vintage Mac that doesn't have a SuperDrive, or your PC uses a 5¼-inch floppy disk drive. And still no network. What then? The answer is simple: Use the computers' serial ports. By connecting the serial ports of both machines with the appropriate cable, you can use terminal programs to transfer files.

Moving files this way can be frustrating, since there are many little details to get right before the transfer works. Telecommunications experience is a plus, because the file transfers are identical to downloading and uploading files to a BBS or on-line systems like BIX or GEnie. The difference is that the source machine is the PC rather than a mainframe.

The most crucial component in this operation is having the right cable. If the computers can't send signals to one another, they won't be sending files, either. You'll need a *null modem* cable whose connectors match the serial ports on both computers. The cable's name is couched

in data communications jargon, but what it means is that the cable's transmit and receive data lines are switched between the two connectors. Or, put another way, the cable arranges the signals so that each computer's serial transmitter is sending to the other computer's serial receiver—precisely what's required for the two machines to exchange data.

The best ready-made null modem cable was the original ImageWriter printer cable. It was properly wired, and the male DB-25 serial connector for the printer made it ideal for hooking into most PCs' 25-pin serial ports. If you cannot find one of these cables (plus an adapter cable to convert the original Mac's DB-9 serial connector to the current mini-DIN-8 connector), you could try a computer store that specializes in custom cables.

While on the subject of adapters, if you have an AT-class machine, you've probably got a DB-9 serial port, which requires a 25-pin-to-9-pin adapter plug to complete the connection. For those who want to roll their own, the schematic in figure 1 shows the connections you need to make.

With the cable in place, you start the terminal programs on both computers. Both programs must be configured for the appropriate serial port, and settings like baud rate, number of bits, and stop bits must match exactly. A good starting point is full duplex, 19,200 bps, 8 bits, and no parity. If everything is set right, you should be able to type text on the Mac's keyboard and see the same text on the PC's screen. If this doesn't happen, the machines aren't communicating, so double-check everything. Once all problems are fixed, you're ready to transfer files.

Since many of the files you'll be moving contain binary data (e.g., formatting information), you need to use a protocol transfer (i.e., XMODEM, YMODEM, ZMODEM, or Kermit) to do the job—not ASCII capture. Using one of these protocols, select the file to send from the PC. Then have the Mac receive the file, using the same protocol.

An important point: On Mac terminal programs, disable the MacBinary conversion feature (if it has it), which either strips or adds a header of Mac-specific information to the file. MacBinary is required for serial file transfer from one Mac to another, but the unintentional modification to a PC file can make its contents unusable. (For more information, see the text box "The Fork in the File" on page 92.)

As a general rule, XMODEM, YMO-

DEM, and ZMODEM transfers usually want the sending machine ready to go before the receiving machine starts. There might be a delay as the computers synchronize the transfer, but the file should then be transmitted rapidly. It might take you several attempts to get the hang of this, but once you do, you'll be able to move files easily from one system to another.

If all this sounds daunting, a variety of packages on the market can assist you with serial transfers. Both DataViz and Traveling Software offer packages (MacLink Plus/PC and LapLink Mac III, respectively) that include both software and a special serial cable.

Same Data, Different Machine

Now that you've got that PC file on a Mac (or vice versa), it's time to make use of it. You'll have little difficulty if you use a program like PageMaker, which runs on both machines. For other programs, some preparation might be necessary. I used a Compaq Deskpro 386/20 running Windows 2.11 to generate PC files that I transferred to either a Mac II or Mac IIfx to evaluate just how difficult it is to use data generated on a different platform. As long as you work within the limits of both machines, sharing information can be surprisingly easy.

I just mentioned PageMaker, and for good reason. Its interface is consistent on both computers, and there has never been a problem with exchanging its files. While there are other page-layout programs, PageMaker's reliable performance across diverse machines is an asset. It runs faster on an equivalent PC than on a Mac II, which means that for some page-layout work you're better off using PageMaker on a PC.

Be certain to use the same version of PageMaker on both computers: The file format differs slightly from version to version. That is, you can exchange files between a Mac and a PC if they're both running PageMaker 3.0. But if you're using PageMaker 1.0 on a PC and PageMaker 3.0 on a Mac, a file exchange won't work. You'll have to upgrade the PC version of PageMaker to ensure file compatibility.

If you're using PageMaker on the Mac to incorporate different PC files (e.g., scanned images or PostScript figures), you'll have to modify the file's type so that PageMaker recognizes the file's data format. See the text box "A Matter of Type" on page 92 for details.

The PC version of Autodesk's AutoCAD (release 10c2) had no difficulty reading Mac AutoCAD files, nor did the

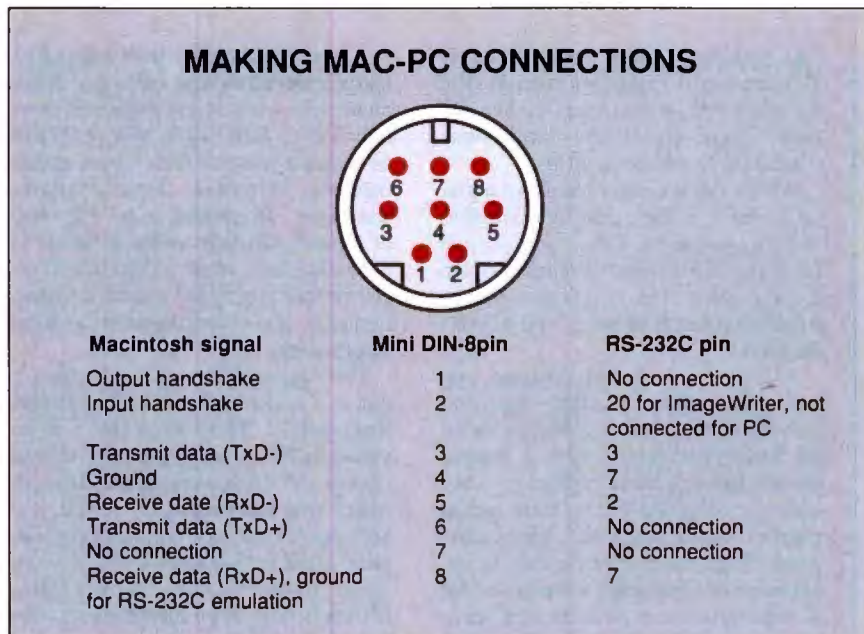


Figure 1: The schematic for a null modem cable to connect the serial ports of a Macintosh and an IBM PC. You can order an ImageWriter II extension cable and cut it in half to obtain the male DIN-8 connector. The DB-25 connector is available from most electronics stores.

Mac version (release 10c5) with PC files. WingZ for OS/2 and Windows 3.0 shares the same files with the Mac version. The same is true for Microsoft Excel: Its files are completely interchangeable between Excel 2.1 (PC) and Excel 2.2 (Mac). No file conversions were necessary, and the transfers were painless.

However, Microsoft complicated the situation with its word processors. First, there are two PC versions: Word 5.0, for a command-line interface (CLI) environment, and Word for Windows 1.0, for a graphical user interface (GUI) environment. On the Mac, there's Word 4.0. The different version numbers aren't so bad. However, if you misstep with the file format when saving the document, you wind up with a file that can't be used elsewhere.

The Word 5.0 file can be opened directly by Word 4.0 on the Mac. But if you're using Word for Windows 1.0 for its WYSIWYG display, be sure to save the file *not* in its default format (Normal), but as Word for DOS. On the Mac, you should configure Word 4.0 for Full Menus. When you save the file, click on the File Format button in the Standard File dialog box. Select the MS-DOS—not Normal—format and then save the file. Both Word 5.0 and Word for Windows 1.0 will read this Mac file and restore the formatting.

It sounds more complicated than it

actually is, but as long as you remember to save the files in MS-DOS Word format, you will have no problems exchanging files. WordPerfect's word processors (5.1 for the PC and 1.0.4 for the Mac) have a similar gotcha: Save both as WordPerfect 5.0 documents.

Adobe Illustrator also has its share of quirks when it comes to file exchange. Illustrator 1.9.3 on the Mac readily accepts files from its PC cousin, Illustrator 1.0. However, when you save an Illustrator file for export to the PC, you first need to save it as a version 1.1 file (there is a version format problem similar to PageMaker's). Also, don't save the file with a preview (i.e., a bit-mapped image used to help place the graphic in a page-layout program).

Be aware of some differences between the two programs. On a Mac, you can add color to your artwork and view it (see photo 2) and have access to a blend tool (for blending colors).

On the PC, you can add color to the artwork, but your results will be guesswork, since you can preview the artwork only in shades of gray (see photo 3). And there is no blend tool. Also, you lose some information in a Mac Illustrator file when you convert it to transport to the PC.

A lock function, which is used to prevent the selection of overlapping objects,

continued

The Fork in the File

A Macintosh file is basically a collection of bytes on a disk—the same as a PC file. However, the Mac OS makes some significant distinctions when it deals with those bytes.

A Mac file is composed of two parts, called *forks*. A file's *data fork* is used to store a program's data, such as text from a word processor or numbers from a spreadsheet. The program is free to write anything it chooses into a file's data fork.

A file's *resource fork* contains special objects that are called—appropriately enough—resources. Much of what the Mac is and how it runs is accomplished through these resources. They store the operating-system code and its patches and a program's executable code. Other resources describe the appearance of a program's windows, the dialog boxes, menu contents, and possible alert sounds. The resource fork is accessed by a collection of Mac Toolbox routines termed the Resource Manager. The formats of certain resources (e.g., the window and sound resources) are precisely defined. It's possible to create custom resources for special purposes by using the Resource Manager.

A Mac file can have both a data fork and a resource fork, or only one. Document files, created by programs, have only a data fork, while Mac programs have only a resource fork. There are exceptions, of course. Some programs store user information (e.g., the owner's name and registration number) in their data fork, while a document's resource fork might hold special information (e.g., the color palette for an 8-bit color image).

The important thing to remember is that a resource fork typically contains Mac-specific information that's of no value to a PC. When you prepare to send files to a PC, take a moment to find out where this information is stored. CE Software's DiskTop is an excellent file-utility desk accessory that you can configure to show the size of a file's forks. If there's little or no information in the data fork, check to see that you saved the document in the proper format.

What Is MacBinary, Anyway?

By now, you might be wondering how a Mac handles a file download. Out of that stream of bytes marching into the serial port, how can it tell which bytes

go to a file's data fork, and which to the resource fork? Mac terminal programs use a *MacBinary standard* that supplies this crucial information.

When a Mac file is uploaded to a BBS or an on-line system, the terminal program supplies a 128-byte header inside the first packet that is transmitted. This header provides the actual filename (an MS-DOS or Unix system can't deal with lengthy Mac filenames, including embedded blanks), Finder attributes (i.e., the file's creator and type, plus bits describing certain file characteristics), and the size of the file's two forks.

When a Mac terminal program downloads the file, it strips this header off, while using the information in it to reconstruct the file. The terminal program does this by copying the stated number of bytes into the data fork and then into the resource fork, setting the file's type and creator, and finally renaming the file.

When sending files to a PC, it's important to disable this feature in Mac terminal programs. Otherwise, a MacBinary header gets tacked onto the front of the file. Its presence will confound a PC program trying to read the data.

A Matter of Type

On PCs and the NeXT Computer, a file's contents are described by the filename's extension (e.g., .TXT is a file containing ASCII text, .AI is an Illustrator file, and .DOC is a Word file).

On the Mac, the file system saves extra information describing the file's creator (i.e., what Mac program made the file) and its type (or contents). When you double-click on a data-file icon on the Mac, the Mac OS uses the creator information to determine what program to start. The program uses the file type information to deal with the file's data.

These maneuvers by the Mac OS spare you from figuring out what pro-

gram to use and how the programs deal with the file. However, when you transport files from a PC, you can throw a wrench in the works. That's because a Mac terminal program typically assumes a default creator (MacWrite) and type (TEXT) when receiving foreign data.

When receiving files from a PC, give the Mac file a descriptive name (AutoCAD file) or an extension (.DWG). This will help you keep track of the file until you need it. Next, start the desired program and try opening the file. If you can open it, immediately save it into another file so that the program writes the appropriate creator and type information

along with the data.

Some programs look only for files of a specific type. If your file is of the wrong type, its name won't appear in the program's Standard File dialog box. To get the program to recognize the file, you'll have to modify its type information. A number of utilities let you modify the file's type and creator. The DiskTop desk accessory does this, and you don't have to exit the program to fix the file.

Some useful file types to know are TEXT (the file contains ASCII text), TIFF (the file has a TIFF image), EPSF (it's a PostScript file), and EPS (it's an Encapsulated PostScript file).

is absent in the PC version of the program. Mac documents with locked objects lose this characteristic if the file is sent to the PC and back. Illustrator is a graphics-intensive program that brings out the best in a Mac: It performs faster and better on a 16-MHz 68020-based Mac II than on a 20-MHz 386-based Compaq.

Tailoring the Data to Fit

What happens if you're not using Excel or you're using a word processor other than Word on the Mac? With some care, you can still swap information. Some data formats serve as a common ground for data exchange. Be aware that you might have to tinker with files to make

the data palatable to certain programs. What follows are some useful data formats, along with some guidelines to help you.

ASCII text is still the most reliable means of moving bulk text across different machines. No, there is no fancy

continued

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

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

American Small Business Computers • 327 South Mill Street • Pryor, OK 74361 U.S.A.

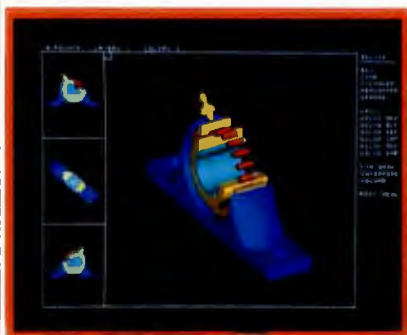
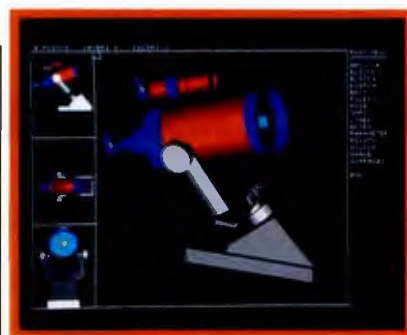




Photo 2: Adobe Illustrator 1.9.3 on a Mac II in the preview mode. (File courtesy of Adobe Systems)



Photo 3: The PostScript file from photo 2 on a Compaq Deskpro 386/20 running Adobe Illustrator 1.0 in the preview mode. Note the absence of the measure and blend tools.

ITEMS DISCUSSED

Adobe Photoshop Illustrator

Adobe Systems, Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA 94039
(800) 922-3623
(415) 961-4400
Inquiry 1146.

AutoCAD

Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965
(800) 445-5415
Inquiry 1147.

ColorLab 100

Computer Presentations, Inc.
1117 Cypress St.
Cincinnati, OH 45206
(513) 281-3222
Inquiry 1148.

DaynaNET

Dayna Communications
50 South Main St., Fifth Floor
Salt Lake City, UT 84144
(801) 531-0600
Inquiry 1149.

DiskTop

CE Software, Inc.
1854 Fuller Rd.
P.O. Box 65580
West Des Moines, IA 50265
(800) 523-7638
Inquiry 1150.

FDHD (SuperDrive)

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(800) 282-2732
(408) 996-1010
Inquiry 1151.

JX-100

Sharp Electronics Corp.
Systems Division
Sharp Plaza
Mahwah, NJ 07430
(201) 529-9500
Inquiry 1152.

LapLink Mac III

Traveling Software, Inc.
18702 North Creek Pkwy.
Bothell, WA 98011
(800) 343-8080
(206) 483-8088
Inquiry 1153.

MacLink Plus/PC

MacLink Plus/Translators
DataViz, Inc.
35 Corporate Dr.
Trumbull, CT 06611
(203) 268-0030
Inquiry 1154.

MatchMaker

Micro Solutions Computer Products
132 West Lincoln Hwy.
DeKalb, IL 60115
(815) 756-3411
Inquiry 1155.

NetWare

NetWare for Macintosh
Novell, Inc.
122 East 1700 South
Provo, UT 84606
(801) 379-5900
Inquiry 1156.

PageMaker

Aldus Corp.
411 First Ave. S, Suite 200
Seattle, WA 98104
(206) 622-5500
Inquiry 1157.

Spectrum/24 Series III

SuperMac Technology
485 Potrero Ave.
Sunnyvale, CA 94086
(408) 245-2202
Inquiry 1158.

Word

Word for Windows
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
Inquiry 1159.

WordPerfect

WordPerfect Corp.
1555 North Technology Way
Orem, UT 84057
(800) 321-4566
(801) 225-5000
Inquiry 1160.



Photo 4: An image scan on a Sharp JX-100 scanner using ColorLab 100 scanning software on a Compaq Deskpro 386/20.

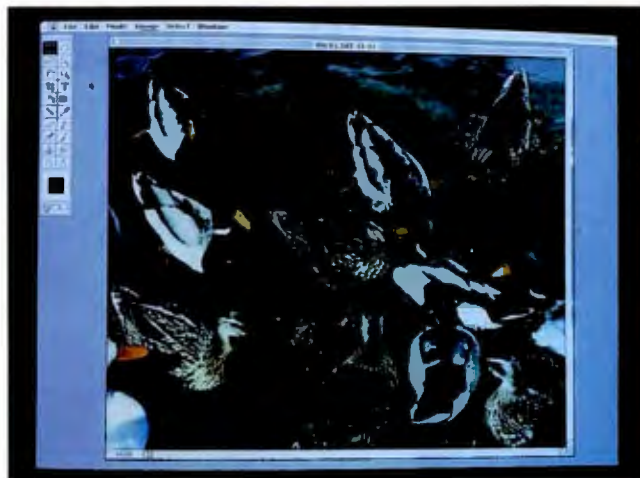


Photo 5: The image in photo 4 was saved as a 24-bit TIFF file and transported to a Mac II. The image is being viewed with Adobe Photoshop using a 24-bit color SuperMac video board.

formatting information, but quite often text transfers are done so that the receiving computer can merge the text into one document. You then add the typefaces, style, and graphics to this combined document. Where and with what program you finish the document doesn't matter: It could be PageMaker on either machine, Quark XPress on the Mac, or Ventura Publisher on the PC.

Also, tab-delimited text (i.e., ASCII numbers separated by tab characters) is useful for shipping tables of numbers. For example, those Compaq numbers mentioned at the start of this article can be saved as a tab-delimited table, which you send to a Mac. Cricket Graph can read tabular data in this format and produce a graph of the information in a matter of minutes.

When moving files from the PC, remember that its ASCII text files normally end with a carriage return/linefeed pair. On the Mac, text files end with just carriage returns. So remember to strip or add the linefeeds as you move raw text from one machine to the other.

PostScript is a fairly reliable means of exchanging graphics. Here at BYTE, we have moved graphics between Unix systems, PCs, and Macs using PostScript. Since PostScript commands are text-based, you can use ASCII file capture to move files around in a pinch.

However, Illustrator gets downright cranky when you try to get it to read PostScript files not made in Illustrator. The same goes for Encapsulated PostScript files: Some programs will read them; others won't. Since there's no reliable way to determine beforehand what files cause problems, you'll just have to

experiment until you hit on a working combination of programs and settings. Or, stick with Illustrator exclusively.

TIFF was originally developed by Aldus to transport bit-mapped images across different computers. The specification is now in the public domain and is maintained by a number of vendors. It's also a reliable exchange medium. I've scanned images on a PC using a Sharp JX-100 scanner (see photo 4) and Computer Presentations ColorLab 100 software. I had ColorLab 100 save the images as 24-bit TIFF files and then transmitted the files to the Mac. On a Mac II equipped with a SuperMac Technology 24-bit color video board, the results—created on a PC—can be spectacular (see photo 5).

The biggest problem with TIFF files is how well vendors implement the specification. Some programs handle only 1- or 8-bit TIFF files, so that a 4-bit TIFF file (from a NeXT Computer) or a 24-bit TIFF file (from either a Mac or a PC) causes them to crash and burn.

Other potential problem areas in the specification are data compression and how the image is stored. In the latter case, the Motorola processor organizes its data in the reverse from how an Intel processor handles data storage. This potential problem is dealt with by information in the TIFF file that describes its data organization. A decent TIFF reader can read this information and reorganize the data as it accesses the file. Some programs don't. As is the case with PostScript, you'll have to experiment with various programs to see what works.

Finally, check to see what formats your target program can accept. Data

compatibility might be just a matter of looking in the manual. For example, many Mac spreadsheet programs can read PC files saved in the SYLK format. Word and Word for Windows can save Rich Text Format files that describe the document's typeface and style information as text commands. These RTF files can be read by WriteNow or MacWrite II on the Mac, via filters.

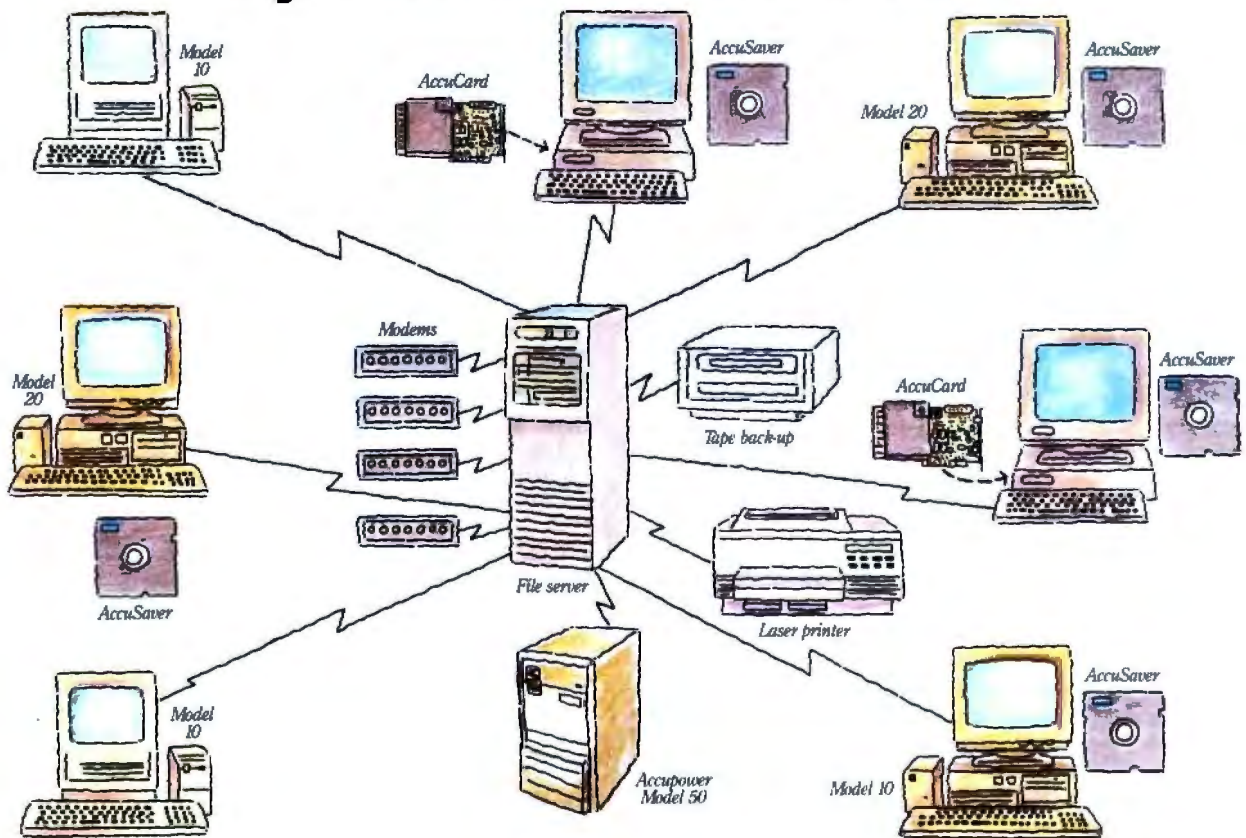
Medium of Exchange

As you have seen, the Mac no longer works in isolation from its PC and workstation counterparts. Programs are available that let office workers use the same set of keystrokes and mouse actions to do the job, no matter what type of microcomputer they're using. Furthermore, copying files back and forth is no longer a nightmare. Instead, it's a convenient way to move the information from one user to the next. Even if you don't use WordPerfect, Illustrator, PageMaker, or the like, exchanging data is now more a science than an art.

Macs and PCs give today's office the best of both worlds. PCs can be used to their best advantage, and so can Macs. The ability to easily exchange information between the two creates a synergism resulting in work that's better than anything done by a single type of computer. Because information is easily shared nowadays, the Mac isn't a stranger in the office. Rather, it is an important ally in dealing with the Information Age. ■

Tom Thompson is a BYTE senior editor at large with a B.S.E.E. degree from Memphis State University. He can be reached on BIX as "tom_thompson."

Introducing The Total LAN Plan. Only Emerson UPS has it.



Novell
Banyan
3Com
LAN Manager
UNIX

It's the first systems approach to network power protection.

Total network protection.

With the price breakthroughs we've achieved on our Accupower® line, you can now protect a file server and five to six PC nodes. All for what you'd expect to pay just for file server protection.

And Emerson UPS has the broadest range of LAN interface cables and software in the industry. From Novell's Netware to the new IBM RS/6000 AIX.

But that's just the first of many unique solutions that only Emerson offers.

A UPS that fits in a slot.

There's our unique AccuCard™, for instance.



A low-cost UPS-on-a-card that fits right into an unused slot in your PC. It features complete data save and restore, self-diagnostics and unattended operation on your nodes.

And cable adapters make AccuCard compatible with virtually all desktop computer brands.

Plus there's our proprietary AccuSaver™ software.

AccuSaver software is activated by any data-threatening power problems. While the battery backup capability of the Emerson UPS supplies emergency power to the system, our AccuSaver software orchestrates a controlled shutdown on all your PC nodes.

Then, when power is restored, you can either manually or automatically restore your workstation.

And you get our money back guarantee.

We're so confident in the absolute reliability of our network protection systems, we'll refund your money if, for any reason, you're not satisfied with your UPS system.*

Think about it. Absolute reliability. More power protection solutions than any other company offers.

And a money-back guarantee. All at truly affordable prices.

The Total LAN Plan.

For more information or the name of the distributor nearest you, just call 1-800-BACK-UPS.

EMERSON UPS
The power to keep up.

Accupower is a registered trademark and AccuCard, AccuSaver and the Total LAN Plan are trademarks of Emerson Computer Power, a division of Emerson Electric. PC and LAN Manager are registered trademarks of International Business Machines Corporation. Novell and Netware are registered trademarks of Novell, Inc. UNIX is a registered trademark of AT&T Bell Labs. Banyan and 3Com are registered trademarks of those respective companies. *Some restrictions apply. See your reseller for details or call Emerson UPS direct. Offer ends December 1991. ©1990 Emerson Computer Power, a division of Emerson Electric Co.

Circle 71 on Reader Service Card (RESELLERS: 72)

PROGRAMMING 32-BIT OS/2

*Working with
the OS/2 2.0 SDK*

Martin Heller

As the next generation of operating system for personal computers, OS/2 2.0 has generated more than its share of media attention. What I'd like to do here is to strip away the hype and speculation and get down to the bare facts. I am working with the OS/2 2.0 Software Development Kit (SDK). This is a \$2600 product that allows developers to use early versions of the operating system and development tools to prepare their applications.

Just the Facts, Ma'am

OS/2 2.0, a multitasking, single-user operating system for PCs, is based on the Intel 386 and i486 CPUs. It builds on the technologies found in earlier versions of OS/2 and in Windows/386. OS/2 2.0 offers many features:

- linear or "flat" 32-bit memory model
- paged virtual memory
- full use of the 386 instruction set
- support for existing DOS and OS/2 1.2 16-bit applications
- multiple virtual DOS machines (MVDMS)
- High Performance File System (HPFS)

- extended file attributes
- long filenames
- greatly expanded system limits
- support for Windows applications through the SMK

C Programming Models

OS/2 2.0 supports multiple programming models. Applications written for the Presentation Manager and built with

the 32-bit tools have full access to the PM's user interface and graphical programming services. These applications will run only under OS/2 2.0 (although you can build 16-bit versions from the same sources to run under OS/2 1.2).

Character-mode applications don't need to use the PM to get the advantages of the flat 32-bit memory model. These programs are written using the C run-

time library facilities and built with the 32-bit tools; they can also use the OS/2 2.0 application programming interface. Character-mode 32-bit applications (e.g., 32-bit PM applications) will run only under OS/2 2.0. Again, you can build 16-bit applications from the same source code—but if you use OS/2 2.0 APIs, you will need to make some adjustments so that they will be compatible with the OS/2 1.2 APIs.

The 32-bit model paves the way for a lot of Unix programs that haven't yet been ported to OS/2. That's mainly because Unix code assumes that pointers can look anywhere in memory, whereas OS/2 1.x programs target an architecture made up of many small, protected segments. OS/2 2.0 eliminates

continued



Listing 1: OS/2 1.x supports memory objects larger than 64K bytes, but not very efficiently.

```

SEL sel1, sel2;
PCH pabObject1, pabObject2;
USHORT offselector;
/* Method 1 - allocate two selectors */
DosAllocSeg ((USHORT) 0, &sel1, SEG_NONSHARED);
DosAllocSeg ((USHORT) 4096, &sel2, SEG_NONSHARED);
pabObject1 = MAKEP(sel1, 0);
pabObject2 = MAKEP(sel2, 0);
/* Code must use pabObject2 for memory references
above 64K bytes */
/* Method 2 - use DosAllocHuge */
DosGetHugeShift (&usShiftCount);
offselector = 2 << usShiftCount;
DosAllocHuge ((USHORT) 1, (USHORT) 4096,
               &sel1, (USHORT) 2, SEG_NONSHARED);
pabObject1 = MAKEP(sel1, 0);
pabObject2 = MAKEP(sel1 + offselector, 0);
/*
Code can use pabObject1 and pabObject2 as above, or take
advantage of the arrangement of the huge selectors by using
pointers of the type:
pch = MAKEP (sel1 + offset >> 16, offset / 16)
*/

```

that architectural mismatch.

In addition to the new 32-bit character-mode and 32-bit PM application models, OS/2 2.0 supports all OS/2 1.2, DOS, and (with a conversion) Windows models. Complicated? Yes. But for the user, the result is an operating system that runs existing applications with confidence.

Developers now need to choose their models carefully, balancing portability, performance, and development effort. One strategy might be to write a 16-bit PM application but include conditional 386 code that will run if the 386 instructions are available. This approach gains transparent portability between OS/2 1.2 and OS/2 2.0, but it doesn't take advantage of flat memory.

Another strategy is to write a PM application with conditional source code for 16- and 32-bit versions. The result here would be two separate executable images generated from a single set of sources. You can then choose the program file that is appropriate for your computer when installing the application. This approach takes maximum advantage of the new features of OS/2 2.0, but the developer will have to maintain complicated conditional code.

One "gotcha": If you have existing OS/2 programs written to the character-mode 16-bit API using OS/2 video, mouse, or keyboard functions, you will have difficulty converting them to 32-bit applications. The 16-bit video, mouse, and keyboard functions have no 32-bit analogs; you can either maintain these 16-bit applications as they are, rewrite the unsupported API calls as C function calls to convert to 32-bit character mode, or rewrite heavily to convert to PM.

Status of the SDK

The first release of the OS/2 2.0 SDK had a few problems. To begin with, the installation procedure took over the whole machine rather than coexisting with older versions of OS/2. The system was not totally stable. It provided only the debugging kernels, and these were slow, occupied a lot of memory, and monopolized a serial port. The on-line documentation was incomplete; the printed documentation consisted of a manual for the MEP editor and an eight-page letter. A few rather important things were broken; for example, the system would refuse to install if you had a numeric coprocessor in your computer. There were only three sample programs: one to demonstrate the new semaphore APIs, one to demonstrate the new memory management APIs, and one to serve as a 32-bit PM application template.

On the other hand, the system, toolkit, samples, and virtual DOS support all worked moderately well. Anyone who was willing to dedicate a machine to the OS/2 2.0 SDK was able to start developing 32-bit applications.

As of this writing, the second release of the OS/2 2.0 SDK is about to ship. It should fix most of the problems of the first release and include a LAN Manager redirector, substantial printed documentation, complete help files, better MVDMS, and a floppy disk boot option (so that it can coexist with other versions of OS/2).

OS/2 2.0's 32-bit API

The OS/2 2.0 kernel API is largely compatible with the OS/2 1.2 kernel API. The biggest difference is that OS/2 2.0

allocates memory by object, not by segment. This happens because the 2.0 memory manager uses demand-paged virtual memory rather than segment compaction and swapping. Another important change has to do with semaphores: The 32-bit semaphore functions are completely incompatible with the 16-bit versions. There are minor changes in some of the tasking functions, queues, and anonymous pipes.

Paged memory in OS/2 2.0 is similar to that in Phar Lap's 386/VMM DOS extender, Berkeley Unix, and VAX/VMS. The application asks for memory as needed, and the system manages the mapping of 4K-byte pages of memory to and from disk. The fixed size of memory pages simplifies allocation (compared to the allocation for the variable size of segments) but requires hardware support for "page faults"—that is, the attempt to read or write a page that is not currently in memory. The 386 chip supports paged virtual memory; the 286 chip does not.

OS/2 2.0 is unusual in the way that it differentiates between allocation and commitment of memory, and in the use of guard pages. The new `DosAllocMem` function in OS/2 2.0 replaces calls to both `DosAllocSeg` and `DosAllocHuge` and allows control of memory commitment—independent of memory allocation. The new `DosSetMem` function can selectively commit memory and change the access type of committed pages of memory. There are four access types: read, write, execute, and guard page. The guard page access type causes an exception to be raised in a process that attempts to access the memory. An exception handler could respond to the guard page signal by committing more pages.

Under OS/2 1.2, you could allocate a large memory area by using multiple selectors or by using `DosAllocHuge` (see listing 1); either way, using multiple segments is inefficient. Under 2.0, you simply allocate a single memory object by typing the following:

```

PCH pabObject;
DosAllocMem (&pabObject, (ULONG)
             69632, PAG_COMMIT | PAG_READ |
             PAG_WRITE);

```

This gain in simplicity comes at a cost. In OS/2 1.x, you can find common memory allocation errors by relying on the protection mechanisms—but in OS/2 2.0, protection violations are raised only when the program addresses an invalid 4K-byte page. You may want to keep a copy of OS/2 1.2 for debugging purposes even after you have switched to OS/2 2.0

for your day-to-day development.

Note that in the example of `DosAllocMem` I used the `PAG_COMMIT` flag to commit all the memory allocated. To allocate sparse memory, you would leave out the `PAG_COMMIT` flag and change the access of selected pieces of the allocated object with `DosSetMem`. You can decommit memory in the same manner. For example, you may want to allocate and fill a large memory buffer for print spooling and then decommit pages once you have printed the contents.

Another effect of the change from segment-based memory management to object-based memory management is the need to modify device drivers. In practice, you must revise base device drivers (e.g., disk drivers) to use 32-bit `DevHlps` (operating system services made available to drivers), but mouse drivers from OS/2 1.2 should work properly. Screen drivers from version 1.2 will most likely work under version 2.0, but they won't support EGA or VGA graphics in virtual DOS machines until you update them. It should not take long for you to update screen drivers for OS/2 2.0. Printer drivers from OS/2 1.2 may or may not work in version 2.0, depending on how they do their memory management.

Semaphores

Semaphores are system "flags" used to coordinate multiple tasks. There were several problems with the design of semaphores in OS/2 1.x. Many of the problems in OS/2 1.x occurred because a single type of semaphore was being used for multiple purposes. The 32-bit semaphore functions in OS/2 2.0 use a different design that should solve these problems, although the 16-bit semaphore functions are unchanged for compatibility. In addition to the new semaphore APIs, the total number of system semaphores was increased greatly, to 64 shared plus 64 private per process. OS/2 2.0 has three separate types of system semaphores: mutual exclusion (mutex), event, and multiple wait.

Mutex semaphores are designed to be used by several threads within a process, or by several processes, to protect access to a critical region. A typical use would be to prevent more than one thread at a time from updating a file on disk. Only one thread at a time can own a mutex semaphore. The OS/2 kernel blocks threads that are waiting for an owned mutex semaphore and queues multiple requests for a single semaphore. This grants ownership on a first-come, first-served basis.

Event semaphores have two states: re-

Mutex
semaphores are
designed to
protect access to
a critical region.

set and posted. They provide a signaling mechanism among threads or among several processes. You might typically use them to manage shared memory: Process 1 writes into the shared region and then uses a signal semaphore so that processes 2 and 3 can proceed to access the shared data. A little thought will convince you that what is fail-safe behavior for an event semaphore is unsafe for a mutex semaphore, and vice-versa.

Multiple-wait semaphores are designed to allow a thread to wait on several mutex or event semaphores at once (although all the semaphores in the multiple wait must be of the same type). A typical use would be a thread that requires access to several shared regions of memory at once. By using a multiple-wait semaphore, the thread can block until the system has gathered ownership of all the regions. The thread can then proceed to process the data, while being assured that the critical resource is protected from all other threads.

The multiple-wait mechanism is important because it avoids deadlock situations. Suppose, for instance, that a multiprocess transaction-processing system needs simultaneous access to both the debit and credit ledgers. Transaction A may gain access to the debit ledger, while transaction B gains access to the credit ledger. Neither transaction will be able to complete, and neither will yield. However, if you use multiple-wait semaphores, and the transactions block until both ledgers are available, each transaction can proceed in turn.

Threads and Processes

The OS/2 2.0 `DosCreateThread` is more convenient than its 1.2 counterpart. To begin with, you can now pass a single doubleword argument to the thread—which can be the address of an argument list. You can start the thread in either the active or the suspended state. Best of all, the system automatically allocates stack for the thread.

The automatic stack allocation is not initially committed beyond the first 4K-byte page, so the application can ask for a large stack without a performance penalty. When the stack grows down to the guard page, the system will automatically create more stack space by committing the guard page and moving it down.

A few other minor problems have been cleared up. A new error code to `DosKillProcess`, "Process is Zombie," reflects the situation of a process that is dead but hasn't been reaped by its parent. And a new function, `DosWaitThread`, allows one thread to wait for another to die.

Queues and Anonymous Pipes

The 32-bit queues in OS/2 2.0 look very similar to 16-bit queues—at least on the functional level. However, the system resources that they create are not the same. 32-bit queues are completely incompatible with 16-bit queues. You cannot read or write 32-bit queues with 16-bit functions, nor 16-bit queues with 32-bit functions. In practice, this is not likely to be a severe restriction, since you could write a 32-bit "bridge" task that could connect a given 32-bit queue to a 16-bit queue.

The OS/2 1.2 function `DosMakePipe` is called `DosCreatePipe` in version 2.0. These two functions do the same thing. The 64K-byte restriction on the advisory size is removed in the 32-bit version; this can be a benefit if you really need to create a large pipe (e.g., if you want to pipe a fast stream of real-time data into a process to analyze and save the data). In this case, you wouldn't want the real-time process to block just because a pipe filled up, because that would mean losing data.

MVDMs

One of the major enhancements in OS/2 2.0 is support for MVDMs. An MVDM tries to make a user's transition from DOS to OS/2 relatively painless: It supports major DOS applications, protects the system from the cavalier way DOS programs sometimes act, and provides performance that is as good as or better than that of DOS.

DOS programs typically assume that they are all alone in your computer and can use whatever resources they can find. For instance, a DOS program will typically look at the ROM data area to determine the computer's configuration and then stuff bytes directly into video memory to write on the screen. DOS programs don't have to worry about refreshing their displays on demand—they

continued

assume that nothing can overwrite their displays.

The screen is not the only system resource that OS/2 programs need to share. They also need to share the mouse, keyboard, CPU, and peripherals such as printers and floppy disk drives. The keyboard polling issue can be serious; however, the MVDM code detects keyboard idle loops (on interrupt 28) and reduces the idle application's CPU time by a user-adjustable amount. Applications can help by explicitly yielding the CPU during their idle loop; this is done by an INT 2F with 1680H loaded into the AX register. (The same "yield" mechanism can help applications that are running under Windows 3.0.)

The "sharing" problem was partially solved in OS/2 1.2—but only for a single DOS box running in real mode in the actual lower 640K bytes of RAM. Under OS/2 1.2, a DOS application would have access to perhaps 510K bytes of RAM, and no EMS or Extended Memory Specification (XMS) memory. With OS/2 2.0, each MVDM—running in the 386 chip's virtual 8086 (V86) mode—has over 600K bytes of RAM available to it, as well as XMS and EMS memory. Even memory-hungry CAD and database programs that couldn't start in the OS/2 1.2 DOS box run well in the MVDM.

Is the MVDM a Better DOS Than DOS?

There is a friendly rivalry between the DOS and OS/2 groups at Microsoft—and one of the taunts that's tossed over the schoolyard fence is that OS/2's MVDM is a better DOS than DOS. In terms of the amount of RAM available to an application, MVDM can actually be better than DOS. In terms of performance, it may not be as good.

You really can't expect a computer that is running multiple DOS and OS/2 sessions to run any individual session as quickly as it could if that session was by itself in the machine. There is a certain amount of overhead from the virtual device drivers, some more from the OS/2 kernel, and more yet from the time-slicing that is done to support multiple sessions.

Yet, in special circumstances, a few DOS applications will run better under MVDM than under DOS. If DOS applications are constrained by memory under DOS and tend to be disk-bound, the increased memory available with MVDM and the increased disk speed that HPFS supplies can actually allow them to run better under OS/2 2.0.

On the other hand, the keyboard and

There is a friendly rivalry between the DOS and OS/2 groups at Microsoft.

mouse response in an MVDM is not as smooth as under DOS. You can run VGA arcade games in an MVDM, but the mouse may be jerky and the screen might show occasional hash. (But you didn't want OS/2 for shoot-em-ups, did you?)

How They Do It

The 386 chip's V86 mode traps sensitive instructions and I/O attempts. Using a lookup table called the I/O permission map, the CPU can tell if the current task is allowed to use a given peripheral directly or whether the I/O attempt needs to be passed to a virtual device driver. The CPU redirects some instructions to software that maps, or "virtualizes," them. These include instructions to turn interrupts on and off, to push and pop the state flags, and to use and respond to software interrupts.

Under OS/2 1.x, the space in the DOS box was limited because the DOS kernel and all device drivers had to go into real memory. In V86 environments under DOS (e.g., Desqview), both DOS and the environment take up space. This leaves even less room for applications. In OS/2 2.0's MVDM architecture, there is no need to use real mode at all—the OS/2 kernel, file system, and device drivers all run in protected mode. As many as 16 MVDMs can run as if they each had 640K bytes of low memory, 32 MB of EMS memory, and XMS memory. Of course, much of this "memory" may turn out to be disk space—but OS/2 2.0 handles the overcommitment by using its demand-paging mechanism.

MVDMs can run in text windows on the PM screen, in the background as an icon, or on a full screen. They have full access to HPFS files (except for long filenames) and have cut-and-paste facilities: You can copy screen text and graphics from a DOS application to the PM clipboard and then paste text into the DOS program. The MVDM emulates DOS 4.0; it supports serial communications at up to 9600 bps without losing characters.

The High Performance File System
HPFS was introduced in OS/2 1.2 and OS/2 Lan Manager. OS/2 2.0 continues to support HPFS but uses 32-bit assembly code for its implementation, as opposed to the 16-bit C code that OS/2 1.2 uses.

HPFS is considerably more robust than the file allocation table (FAT) system that DOS (and OS/2) use. HPFS implements long mixed-case filenames with embedded blanks and multiple "." characters, extended file attributes, and several features to increase file access speed, reduce disk fragmentation, and ensure that files are not lost.

Long filenames can make it much easier for users to identify file contents. Likewise, extended attributes can make it easier for programs to identify their data files.

HPFS gains performance by using sophisticated disk data structures, multiple levels of caching, asynchronous read-ahead and write-behind, and strategic file allocation algorithms.

HPFS Implementation Details

When HPFS allocates a file, the data immediately follows the file control structure. This cuts down on unnecessary head motion. Data space is pre-allocated to reduce the amount of updating needed when writing the file. HPFS allocates simultaneously open files apart from each other on the disk, reducing the probability of their data areas interleaving. HPFS deals with the disk in sectors (generally 512 bytes) as opposed to the clusters (generally 2048 bytes or four sectors) that the FAT file system uses. Allocating sectors reduces wasted space on the disk—a significant problem when there are many small files.

HPFS organizes the disk using a B+ tree approach. This approach guarantees that a file will be found in three seeks to the disk. The root of the tree is the *super block*, which points to the *spare block* and the root FNODE. All the directories and files on a disk partition depend on the root FNODE. Directory FNODEs are the branches of the tree; file FNODEs are the leaves. Directory FNODEs can point to other directory FNODEs or to file FNODEs; file FNODEs point to the file allocation information.

The B+ trees are inherently efficient structures. On any given level of tree, either all entries have down pointers or none do; this simplifies the algorithms for searching. Tree traversal to any given file takes on the order of the log of the total number of files. For 13-character

continued

I N T R O D U C I N G **HARDLOCK™**



The Ultimate in Hardware Based Copy Protection

Compatible

Hardlock is designed for the "real world". Side effects from printers, laptops and technical issues such as static and true IBM printer port compatibility are virtually non-existent.

Reliable

Our unique ASIC (Application Specific Integrated Circuit) extends the Hardlock's operating range below 2 volts. Since no idle current is required, there is no additional loading on the printer. Electronically erasable memory requires no battery.

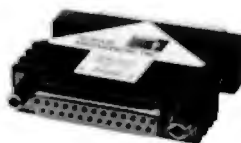
Flexible

Field programmability is now possible. Additionally our optional Crypto Programmer board permits the Hardlock to be uniquely programmed for your company.

Space-Saving

Hardlock measures only 1.75". Three of our units fit in approximately the same space as only two others. Hardlock with Memory may also be purchased on the smallest PC board you've ever seen. Perfect for those who don't want the device on the exterior of the computer.

Hardlock
Hardlock with (128 bytes) Memory
Hardlock with Memory on a Board



**Hardlock...
Not Hardluck**

The Security System You've Asked For.

**GLENCO
ENGINEERING INC.**

SERVING THE SOFTWARE INDUSTRY SINCE 1979

1-800-562-2543



Hardlock is a trademark
of Fast Electronic GmbH.

270 Lexington Drive · Buffalo Grove, IL 60089 · 708-808-0300 FAX 708-808-0313

Circle 88 on Reader Service Card

filenames, a single-level tree can handle 45 entries, a two-level tree just under 2000 entries, and a three-level tree almost 80,000 entries.

HPFS uses three separate cache areas: one for disk sectors, one for directories, and one for paths. The disk sector cache, whose size is controlled by the `-C:xx` option to the IFS command in `CONFIG.SYS`, allocates up to 1000 blocks of 2K bytes each; it uses a least-recently-used algorithm. The directory cache block holds directory entries; this speeds file accesses within a directory. Path caching employs a "directory lookaside" algorithm to speed up multidirectory searching.

HPFS disk access is faster than FAT access in almost all cases. It may take a little more time to open a file, and the improvement on random reads may be insignificant. But file creation and deletion are much faster under HPFS. Sequential reads and both sequential and random writes are anywhere from 20 percent to 30 percent faster.

When the HPFS system starts, it automatically checks each HPFS partition for integrity, repairs the tree, and recovers lost files if necessary. The repair process is aided by signatures on disk data structures, duplication of filenames in the FNODEs, and "hot fixing" of the tree. HPFS doesn't support the Norton Utilities—but it doesn't really need it.

The TrueType Saga

Desktop publishers have been asking for high-quality scalable printer and screen fonts for DOS, Windows, and OS/2. The current technology in Windows requires bit-mapped screen fonts—a less-than-ideal situation. What is really needed is a unified imaging method—or rasterizer—that works fast enough to be used on-screen and well enough to be used on high-quality laser printers.

The two major candidate technologies for this role are Adobe's Type Manager and Apple's TrueType. While IBM has licensed ATM, Microsoft has licensed TrueType—leading to market confusion. Nevertheless, TrueType is scheduled to ship in Windows 3.1, OS/2 2.0, and Macintosh System 7.0. TrueImage, an embedded printer implementation of TrueType, is also in the works. However, it is not clear which printer manufacturers (besides Apple) will actually ship TrueImage printers.

Adobe designed its fonts with Bézier curves and "hints" for drawing small point sizes without losing the character of the outlines. TrueType fonts have quadratic B-splines. The practical differ-

Desktop
publishers have been
asking for high-quality
scalable printer
and screen fonts.

ence between the two types of curves is that Bézier outlines require fewer points for definition but more CPU time for rasterizing; B-spline outlines need more points for definition—making the outline files bigger—but rasterize more quickly. Apple benchmarks imply that TrueType may have a speed advantage of a factor of 2 over Adobe's technology, but at a cost of a 25 percent enlargement in the font outline files.

Part of why TrueType appeals to implementers is that it is a full type description language. A TrueType font file contains the TrueType code to draw each letter in the font. To display the letter A, the rasterizer interprets the TrueType code for the letter A.

But what about the installed base? TrueType will coexist with Hewlett-Packard, Bitstream, and Adobe fonts; with most current word processing software; and with existing printers. Most of the major DOS word processors will license it; Windows and OS/2 will include it; and all the major digital-type foundries have announced support for it. A TrueType font cartridge will be available for HP LaserJet printers, and you'll be able to download TrueType to existing PostScript printers.

On the other hand, TrueType may not really be necessary now that the Microsoft-Apple alliance has forced Adobe into opening up the PostScript specifications. And while TrueType's speed and quality appear to be superior to Adobe's Type 1 PostScript and Type Manager technology, Adobe's fonts are good enough for all practical purposes.

The 32-bit Toolkit

Experienced PM developers will find that they can convert their PM applications to 32-bit PM with very little effort. Generally, applications that follow the guidelines for the use of integer types (e.g., `USHORT` rather than `int`) convert almost automatically. You can debug converted applications fairly mechani-

cally—you run the application until it faults, fix the line in error, rebuild, and continue testing.

In OS/2 2.0, the familiar Compile and Link (CL), Macro Assembler (MASM), and related compilation tools have been replaced with CL386, MASM386, LINK386, and CV386; obviously, you don't want a name conflict between your 16-bit tools and your 32-bit tools. The compiler apparently branches from Microsoft C Compiler 5.2; the tools are intermediate between Microsoft C Compiler 5.1 and 6.0, with the required changes for 32-bit code.

However, RC, NMAKE, LIB, ICON-EDIT, FONTEDIT, DLGBOX, IPFC, MEP, and H2INC have not been renamed. Some tools (e.g., LINK386) are backward compatible with OS/2 1.2; others (e.g., RC) aren't. RC, in particular, now exists in versions for OS/2 2.0, OS/2 1.2, Windows 3.0, and Windows 2.1; developers need to be careful to use the correct version for the target being built.

The System Migration Kit

Until recently, OS/2 has suffered badly from a lack of true PM applications. At the same time, Windows has attracted hundreds of applications. Microsoft's System Migration Kit (SMK)—like Micrografix's Mirrors—is intended to allow developers to port "clean" Windows applications to OS/2 PM.

By "clean," I mean code that runs correctly in protected mode. Most Windows developers have clean code simply to support Windows 3.0; it shouldn't be much of an effort to relink these applications to the SMK libraries. Voilà! A PM application.

The SMK won't take Windows applications to 32-bit code—Microsoft suggests using the SMK as a stopgap to help ship 16-bit PM applications while working on 32-bit PM versions. If you build applications with the SMK, they will run under OS/2 1.2 and OS/2 2.0.

But an even easier alternative will exist for OS/2 2.x users: Microsoft plans to release a binary-compatibility layer for OS/2 2.0 or 2.1 that will allow Windows executables to run under PM. This layer will not be available for OS/2 1.2. The dynamic link libraries for Windows binary compatibility will be another enhancement available only in OS/2 2.x.

Final Testimony

You could certainly fault Microsoft and IBM for setting the price of the SDK so high. \$2600 is more than most small

continued



THE CONCEPT BEHIND OUR CASE PRODUCT.

System Architect is perfect for the beginning CASE user, yet has the power and flexibility to meet the needs of the most experienced users and largest applications.

System Architect has the power and flexibility you need from a CASE product. It works with today's most popular methodologies, including DeMarco/Yourdon, Gane & Sarson, Ward & Mellor (real-time), entity relation diagrams, decomposition diagrams, object oriented design (optional), state transition diagrams, and flow charts. It supports an integrated data dictionary/encyclopedia, and allows multi-user support both with and without a network. What's more, System Architect's open architecture lets you easily import and export data to other products.

"We're surprised with its flexibility and much taken with the idea of being able to link different kinds of diagrams, in effect moving between analysis and design and back again..." *Cutter Information's CASE Strategies, July '89*

Automated
documenta-
tion facility

RELEASE 2.0

SQL-like
custom
reporting

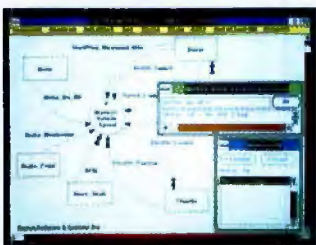
Windows-
based

Multiple
methodologies

User-defined
attributes

Requirements
traceability

Rules &
balancing



Import/export
capability

\$1,395

Network
version
available

Matrix
reporting

Auto
leveling

Integrated
data
dictionary

Yet System Architect is more than just powerful. It's easy to use. Microsoft Windows-based and graphics oriented, System Architect lets you get up and running right away. And if you get lost, you can call on a

context-sensitive help facility as well as a novice mode.

"We found System Architect to be extremely easy to use." *ISI Systems, CASE Trends, Nov/Dec '89*

At \$1,395, System Architect is quite affordable. It runs on almost any PC, and it won't run away with your budget.

"Think productivity has to be pricey? Think again. This product is truly a price performance leader" *System Builder, Oct/Nov '89*

If you're looking for a CASE product with power, ease of use, and affordability, look to System Architect. It's a concept whose time has come.

SystemArchitect

Popkin Software & Systems Incorporated
11 Park Place, 19th Floor, NY, NY 10007

TO ORDER, CALL (212) 571-3434
Fax: (212) 571-3436



MICROSOFT
WINDOWS
Version 3.0 Compatible Product



Supporting IBM's AD/Cycle

System Architect logo is a trademark of Popkin Software & Systems Incorporated. IBM is a registered trademark of IBM Corp. Microsoft is a registered trademark of Microsoft Corp. Price shown valid only for USA & Canada. All prices and specifications are subject to change without notice at the sole discretion of the company. Product delivery is subject to availability.

Circle 151 on Reader Service Card

People are talking about us.

F77L-EM/32

Port 4GB mainframe programs to 80386s with this 22-bit DOS-2.11 compiler. The Winner of PC Magazine's 1988 Technical Excellence Award just got better. New Version 3.0 and OS include: Editor, Make Utility, Virtual Memory Support, DESQview Support, New Documentation and Free Unlimited Runtime Licenses. F77L-EM/32 \$895 OS/386 \$395

F77L

The compiler of choice among reviewers and professionals. Includes a Debugger, Editor, Profiler, Linker, Make Utility, Weitek and 386 Real-Mode Support, Graphics. \$595

Lahey Personal Fortran 77

New Version 3.0: Full ANSI 77, Debugger, Editor, Linker, Library Manager, Microsoft and Borland C interfaces, 400 page Manual, Unbeatable Price. \$99



When people talk about FORTRAN the name mentioned most often is

Lahey
Computer Systems, Inc.

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

developers can afford to pay for an early look at OS/2 2.0. On the other hand, it is understandable that Microsoft and IBM would want to limit the distribution of alpha-level code to a relatively small group of developers—for support reasons, as well as to minimize the impact of design changes during the development of the system.

Still, the OS/2 2.0 SDK seems to be coming along well. Compared to the OS/2 1.0 SDK and the Windows 1.0 SDK at similar points in their development, the OS/2 2.0 SDK has more of the projected features already implemented, and fewer ways to crash. Once OS/2 2.0 stabilizes a bit more, I'll try to find device drivers that will give it the same 1024- by 768-pixel screen resolution that I have in Windows and OS/2 1.2. Then I'll try to get drivers for my CD-ROM drive and printers.

Once I've got all that installed, the only reasons I would boot DOS would be to run extended-DOS programs with no OS/2 2.0 equivalent; to run Windows programs that haven't yet been converted to PM; and to do final compatibility tests of software that is targeted for DOS or Windows. The only reasons I would boot OS/2 1.2 would be to debug subtle memory-access problems and to do final compatibility tests of software targeted for 16-bit OS/2.

In short, I fully expect OS/2 2.0 to be my standard operating system by 1991, and I expect many other software developers to make the same choice. I also expect many Unix, CMS, VMS, and MVS developers to start thinking about OS/2 ports to their software once a moderately priced OS/2 2.0 toolkit is available.

It will be some time before most users replace DOS with OS/2, simply because of the huge installed base of 8088- and 286-based PCs. But I expect that the shipment of OS/2 2.0 late this year, and the perpetual trend toward faster computers with more storage for less money, will help that transition happen by the mid-1990s.

The bad news is that until the DOS-to-OS/2 transition is complete, PC software developers will have to deal with the complexities of developing for DOS, extended DOS, Windows, 16-bit OS/2, 32-bit OS/2, and Unix. The good news is that developers will be able to do over 90 percent of that work on an OS/2 2.x platform. ■

Martin Heller (Andover, MA) develops software and writes about technical computer applications. He can be reached on BIX as "mheller."

SUNDAY 10-5

COMPUTERS

APPLE: Mac II 40 HD \$799.99, Mac II 40 \$699.99, Mac II 40 4MB \$849.99, Mac II 40 8MB \$949.99, Mac II 40 16MB \$1049.99, Mac II 40 32MB \$1149.99, Mac II 40 64MB \$1249.99, Mac II 40 128MB \$1349.99, Mac II 40 256MB \$1449.99, Mac II 40 512MB \$1549.99, Mac II 40 1024MB \$1649.99, Mac II 40 2048MB \$1749.99, Mac II 40 4096MB \$1849.99, Mac II 40 8192MB \$1949.99, Mac II 40 16384MB \$2049.99, Mac II 40 32768MB \$2149.99, Mac II 40 65536MB \$2249.99, Mac II 40 131072MB \$2349.99, Mac II 40 262144MB \$2449.99, Mac II 40 524288MB \$2549.99, Mac II 40 1048576MB \$2649.99, Mac II 40 2097152MB \$2749.99, Mac II 40 4194304MB \$2849.99, Mac II 40 8388608MB \$2949.99, Mac II 40 16777216MB \$3049.99, Mac II 40 33554432MB \$3149.99, Mac II 40 67108864MB \$3249.99, Mac II 40 134217728MB \$3349.99, Mac II 40 268435456MB \$3449.99, Mac II 40 536870912MB \$3549.99, Mac II 40 1073741824MB \$3649.99, Mac II 40 2147483648MB \$3749.99, Mac II 40 4294967296MB \$3849.99, Mac II 40 8589934592MB \$3949.99, Mac II 40 17179869184MB \$4049.99, Mac II 40 34359738368MB \$4149.99, Mac II 40 68719476736MB \$4249.99, Mac II 40 137438953472MB \$4349.99, Mac II 40 274877906944MB \$4449.99, Mac II 40 549755813888MB \$4549.99, Mac II 40 1099511627776MB \$4649.99, Mac II 40 2199023255552MB \$4749.99, Mac II 40 4398046511104MB \$4849.99, Mac II 40 8796093022208MB \$4949.99, Mac II 40 17592186044416MB \$5049.99, Mac II 40 35184372088832MB \$5149.99, Mac II 40 70368744177664MB \$5249.99, Mac II 40 140737488355328MB \$5349.99, Mac II 40 281474976710656MB \$5449.99, Mac II 40 562949953421312MB \$5549.99, Mac II 40 1125899906842624MB \$5649.99, Mac II 40 2251799813685248MB \$5749.99, Mac II 40 4503599627370496MB \$5849.99, Mac II 40 9007199254740992MB \$5949.99, Mac II 40 18014398509481984MB \$6049.99, Mac II 40 36028797018963968MB \$6149.99, Mac II 40 72057594037927936MB \$6249.99, Mac II 40 144115188075855872MB \$6349.99, Mac II 40 288230376151711744MB \$6449.99, Mac II 40 576460752303423488MB \$6549.99, Mac II 40 1152921504606846976MB \$6649.99, Mac II 40 2305843009213693952MB \$6749.99, Mac II 40 4611686018427387904MB \$6849.99, Mac II 40 9223372036854775808MB \$6949.99, Mac II 40 18446744073709551616MB \$7049.99, Mac II 40 36893488147419103232MB \$7149.99, Mac II 40 73786976294838206464MB \$7249.99, Mac II 40 147573952589676412928MB \$7349.99, Mac II 40 295147905179352825856MB \$7449.99, Mac II 40 590295810358705651712MB \$7549.99, Mac II 40 1180591620717411303424MB \$7649.99, Mac II 40 2361183241434822606848MB \$7749.99, Mac II 40 4722366482869645213696MB \$7849.99, Mac II 40 9444732965739290427392MB \$7949.99, Mac II 40 18889465931478580854784MB \$8049.99, Mac II 40 37778931862957161709568MB \$8149.99, Mac II 40 75557863725914323419136MB \$8249.99, Mac II 40 151115727451828646838272MB \$8349.99, Mac II 40 302231454903657293676544MB \$8449.99, Mac II 40 604462909807314587353088MB \$8549.99, Mac II 40 1208925819614629174706176MB \$8649.99, Mac II 40 2417851639229258349412352MB \$8749.99, Mac II 40 4835703278458516698824704MB \$8849.99, Mac II 40 9671406556917033397649408MB \$8949.99, Mac II 40 19342813113834066795298816MB \$9049.99, Mac II 40 38685626227668133590597632MB \$9149.99, Mac II 40 77371252455336267181195264MB \$9249.99, Mac II 40 154742504910672534362390528MB \$9349.99, Mac II 40 309485009821345068724781056MB \$9449.99, Mac II 40 618970019642690137449562112MB \$9549.99, Mac II 40 1237940039285380274899244224MB \$9649.99, Mac II 40 2475880078570760549798488448MB \$9749.99, Mac II 40 4951760157141521099596976896MB \$9849.99, Mac II 40 9903520314283042199193953792MB \$9949.99, Mac II 40 19807040628566084398387907584MB \$10049.99, Mac II 40 39614081257132168796775815168MB \$10149.99, Mac II 40 79228162514264337593551630336MB \$10249.99, Mac II 40 158456325028528675187103260672MB \$10349.99, Mac II 40 316912650057057350374206521344MB \$10449.99, Mac II 40 633825300114114700748413042688MB \$10549.99, Mac II 40 1267650600228229401496826085376MB \$10649.99, Mac II 40 2535301200456458802993652170752MB \$10749.99, Mac II 40 5070602400912917605987304341504MB \$10849.99, Mac II 40 10141204801825835211974608683008MB \$10949.99, Mac II 40 20282409603651670423949217366016MB \$11049.99, Mac II 40 40564819207303340847898434732032MB \$11149.99, Mac II 40 81129638414606681695796869464064MB \$11249.99, Mac II 40 162259276829213363395993738928128MB \$11349.99, Mac II 40 324518553658426726791987477856256MB \$11449.99, Mac II 40 649037107316853453583974955712512MB \$11549.99, Mac II 40 1298074214633667907167949911425224MB \$11649.99, Mac II 40 2596148429267335814335899822850448MB \$11749.99, Mac II 40 5192296858534671628671799645700896MB \$11849.99, Mac II 40 10384593717069343257353592911401792MB \$11949.99, Mac II 40 20769187434138686514707185822803584MB \$12049.99, Mac II 40 41538374868277373029414371645607168MB \$12149.99, Mac II 40 83076749736554746058828743291214336MB \$12249.99, Mac II 40 166153499473109492117657486582428672MB \$12349.99, Mac II 40 332306998946218984235314973164857344MB \$12449.99, Mac II 40 664613997892437968470629946329714688MB \$12549.99, Mac II 40 1329227995784875936941259892658429376MB \$12649.99, Mac II 40 2658455991569751873882519785316858752MB \$12749.99, Mac II 40 531691198313950374776503957063371744MB \$12849.99, Mac II 40 1063382396627900749553007914126743488MB \$12949.99, Mac II 40 2126764793255801499106015828253486976MB \$13049.99, Mac II 40 4253529586511602998212031656506973952MB \$13149.99, Mac II 40 8507059173023205996424063313013947904MB \$13249.99, Mac II 40 17014118346046411992848126626027895808MB \$13349.99, Mac II 40 34028236692092823985696253252055791616MB \$13449.99, Mac II 40 68056473384185647971392506504111583232MB \$13549.99, Mac II 40 136112946768371295942785013008223166464MB \$13649.99, Mac II 40 272225893536742591885570026016446332928MB \$13749.99, Mac II 40 544451787073485183771140052032892665856MB \$13849.99, Mac II 40 1088903574146970367542280104065785331712MB \$13949.99, Mac II 40 2177807148293940735084560208131570663424MB \$14049.99, Mac II 40 4355614296587881470099120416263141326848MB \$14149.99, Mac II 40 8711228593175762940198240832526282653696MB \$14249.99, Mac II 40 17422457186351525880396481665052565307392MB \$14349.99, Mac II 40 34844914372703051776792963330105130614784MB \$14449.99, Mac II 40 696898287454061035535859266602102601296MB \$14549.99, Mac II 40 13937965749081220710717185332042052025932MB \$14649.99, Mac II 40 2787593149816244142143437066408410451864MB \$14749.99, Mac II 40 5575186299632488284286874132816820891728MB \$14849.99, Mac II 40 11150372599264976568573748265633637383456MB \$14949.99, Mac II 40 22300745198529953137147496531267274766912MB \$15049.99, Mac II 40 44601490397059906274294993062534549533824MB \$15149.99, Mac II 40 89202980794119812548589986125069099067648MB \$15249.99, Mac II 40 178405961588239625097179972250138198135296MB \$15349.99, Mac II 40 356811923176479250194359944500276396270592MB \$15449.99, Mac II 40 713623846352958500388719889000552792541184MB \$15549.99, Mac II 40 1427247692705917000777439778001105584182368MB \$15649.99, Mac II 40 285449538541183400155487955600221116376576MB \$15749.99, Mac II 40 570899077082366800310975911200442232753152MB \$15849.99, Mac II 40 1141798154164733600621951822400884465506304MB \$15949.99, Mac II 40 2283596308329467201243903644801768931012608MB \$16049.99, Mac II 40 4567192616658934402487807289603537862025216MB \$16149.99, Mac II 40 9134385233317868804975614579207075724050432MB \$16249.99, Mac II 40 18268770466635737609951229158414151448100864MB \$16349.99, Mac II 40 36537540933271475219902458316828302896011328MB \$16449.99, Mac II 40 73075081866542950439804916633656605792022656MB \$16549.99, Mac II 40 146150163733085900879609833267313211584045312MB \$16649.99, Mac II 40 29230032746617180175921966653462642316808624MB \$16749.99, Mac II 40 58460065493234360351843933306925284633617248MB \$16849.99, Mac II 40 116920130986468720703687866613850569267234496MB \$16949.99, Mac II 40 233840261972937441407375733227701137344668992MB \$17049.99, Mac II 40 467680523945874882814751466455402274689377984MB \$17149.99, Mac II 40 935361047891749765629502932910804549378755968MB \$17249.99, Mac II 40 1870722095783499531259005865821609098757511936MB \$17349.99, Mac II 40 3741444191566999062518011731643218197515037872MB \$17449.99, Mac II 40 7482888383133998125036023463286436395030075744MB \$17549.99, Mac II 40 14965776766267996250720046926572732700060151488MB \$17649.99, Mac II 40 299315535325359925014400938531454640001202896MB \$17749.99, Mac II 40 598631070650719850028801877062909280002405792MB \$17849.99, Mac II 40 1197262141301439700057763754125818400048011584MB \$17949.99, Mac II 40 2394524282602879400115527508251636800096023168MB \$18049.99, Mac II 40 4789048565205758800231055016503273600192046336MB \$18149.99, Mac II 40 9578097130411517600462110033006547200384092672MB \$18249.99, Mac II 40 1915619426082303520092422006601308800768114544MB \$18349.99, Mac II 40 3831238852164607040184844013202617600153628888MB \$18449.99, Mac II 40 7662477704329214080369688026405235200307257776MB \$18549.99, Mac II 40 15324954408658428160739376052810470400614515552MB \$18649.99, Mac II 40 30649908817316856321478752105620940801229031104MB \$18749.99, Mac II 40 61299817634633712642957504211241880164581822208MB \$18849.99, Mac II 40 12259963526926742525911500842248376032913644416MB \$18949.99, Mac II 40 24519927053853485051823001684496752065827288832MB \$19049.99, Mac II 40 49039854107706970103646003368993504131654577664MB \$19149.99, Mac II 40 98079708215413940207292006737987008263309155328MB \$19249.99, Mac II 40 196159416430827880414584013475974016526618310656MB \$19349.99, Mac II 40 392318832861655760829168026951948033053236621312MB \$19449.99, Mac II 40 784637665723311521658336053903896066106473242624MB \$19549.99, Mac II 40 1569275331446623043316672079807792132212946485248MB \$19649.99, Mac II 40 3138550662893246086633344159615584264425892970496MB \$19749.99, Mac II 40 6277101325786492173266688319231168528851785940992MB \$19849.99, Mac II 40 12554202651572984346533376398462337057137371881984MB \$19949.99, Mac II 40 25108405303145968693066752796924674114274743763968MB \$20049.99, Mac II 40 50216810606291937386133505593849348228548487527936MB \$20149.99, Mac II 40 100433621212583874772267011187686896457089695055872MB \$20249.99, Mac II 40 200867242425167749544534022375373792914179390111544MB \$20349.99, Mac II 40 401734484850335499089068044750747585828358780223088MB \$20449.99, Mac II 40 803468969700670998178136089501495171656717560446176MB \$20549.99, Mac II 40 1606937939401341996356272179002903443313431208912352MB \$20649.99, Mac II 40 3213875878802683992712544358005806886626862417824MB \$20749.99, Mac II 40 6427751757605367985425088716011613773253724835648MB \$20849.99, Mac II 40 128555035152107359708501774320222275465074496713088MB \$20949.99, Mac II 40 257110070304214719417003548640444550930149994426176MB \$21049.99, Mac II 40 514220140608429438834007097280891018660299988852352MB \$21149.99, Mac II 40 1028440281216858877668014014561782037320599977704704MB \$21249.99, Mac II 40 2056880562433717755336028029123564074641199955409408MB \$21349.99, Mac II 40 411376112486743551067205605824712814928339991081888MB \$21449.99, Mac II 40 822752224973487102134411211649425629856679982163776MB \$21549.99, Mac II 40 1645504449946974202668822423298851297113359964327552MB \$21649.99, Mac II 40 3291008899893948405337644846597702594226719928655104MB \$21749.99, Mac II 40 6582017799787896810675289693195405188453439873310208MB \$21849.99, Mac II 40 13164035799575793621350578386390810369068879446620416MB \$21949.99, Mac II 40 26328071599151587242701156772781620738137758893240832MB \$22049.99, Mac II 40 52656143198303174485402313545563241476275517786481664MB \$22149.99, Mac II 40 105312286376606349770804627091124822952551035572963328MB \$22249.99, Mac II 40 210624572753212699541609244182249645905100711145866656MB \$22349.99, Mac II 40 42124914550642539908321848836449929181020014229173312MB \$22449.99, Mac II 40 84249829101285079816643697672899858362040028458346624MB \$22549.99, Mac II 40 168499658202570159633287395345799116724080056916693248MB \$22649.99, Mac II 40 33699931640514031926657479069158223344816011383338688MB \$22749.99, Mac II 40 67399863281028063853314958138316446

MULTIMEDIA: DVI ARRIVES

The promise of DVI is becoming realized with commercial products by IBM, Intel, and third-party developers

Greg Loveria and Don Kinstler

The Mayans flourished for more than 1000 years on the Yucatan Peninsula in Mexico before their culture crumbled in the sixteenth century. Now, thanks to Digital Video Interactive (DVI) technology and New York City's Bank Street College, the Mayan civilization can return to life with a single keystroke.

Bank Street College's CD-ROM program, called the Palenque Museum DVI application, provides just one example of how DVI is being developed today: in this case, for surrogate travel. For example, if you select the Palenque application's Rain Forest Room icon, the exotic flora and fauna of the Yucatan Peninsula move across your VGA screen. If you click on an ant icon (appropriately located on a tree's leaf), you'll see a 30-second video and audio explanation of leaf-cutting ants at work.

Other sequences take you up the steps of a Mayan ruin. From there, you can look 360 degrees around, up, or down, just as if you were actually there.

While some computer veterans scoff at the publicity that currently surrounds mul-

timedia, the melding of digital video and audio is producing concrete results for many areas (e.g., armchair travel, education, industrial training, and business presentations). According to Kathy Wilson, the Palenque project's director, a consumer version of the application will be available in the second quarter of next year.

Bank Street College is also working

with the Metropolitan Museum of Art and the Chicago Art Institute to develop similar applications for the fine arts. The first implementations of these art databases will appear in interactive touch-screen kiosks for museum visitors.

The kiosks will use a combination of DVI technology, videodisk players, Targa boards, and hard disks. These applications may later be ported down to consumer DVI software releases on CD-ROM.

R&D Roots

While IBM, Intel, and others champion DVI, there are other technologies for melding digital sight and sound (see "The Four Multimedia Gospels," February BYTE). Proponents of other platforms, including those of the Amiga and the Macintosh, believe that those approaches may better exploit the multimedia market.

Nevertheless, DVI's roots are firmly established. They reach back to 1982 when RCA and General Electric engineers began their R&D efforts. Intel announced its commitment to the technology in 1987.

DVI technology is now owned by Intel and is under

continued





Photo 1: With Bank Street College's Palenque Museum DVI application, surrogate travelers can climb Mayan ruins and view a 360-degree panorama as the compressed digital image is unwrapped in real time.

the control of its Princeton Operation Division. Commercial DVI products are a blend of Intel/IBM add-in boards, software, system products, and third-party software.

The first of IBM's commercial DVI products include two ActionMedia 750 boards for Micro Channel architecture machines. The \$1995 "delivery" board displays DVI-compressed video and audio data files from CD-ROMs, optical disks, or standard hard disk drives. A \$2150 "capture" board enables users to produce digitized audio and video. Both products were announced last February and began shipping last spring. Intel distributes the ActionMedia board for Industry Standard Architecture (ISA)-bus computers.

After their joint-venture announcement early last year, Intel and IBM's first priority was to scale down the unwieldy seven-board DVI developer's platform to a two-board end-user version, aimed at training, point-of-sale, and desktop computer applications.

DVI merges TV and computer technologies that enable VGA-equipped computers to display full-motion video sig-

nals. The American TV format, NTSC, transmits and displays video signals on our TVs at 30 frames per second. Frames move in rapid succession at a 512-pixel (horizontal) by 482-pixel (vertical) resolution. Each frame of NTSC video can display as many as 16 million colors. By comparison, the standard VGA output from a PS/2-class machine can display only 16 colors at 640- by 480-pixel resolution, or 256 colors in 320- by 200-pixel mode.

To produce portions of the Palenque application, a photographic slide of actual ruins was shot with a 13-inch fish-eye lens, producing a distorted circular image. The slide was then input to the computer with a color scanner and converted to a DVI-encoded graphic. The resulting single frame of DVI is unwrapped mathematically in real time as the user looks around the panorama (see photo 1).

A single color frame of NTSC video requires from 500K bytes to 2 megabytes as a computer data image file. One second's worth of full-motion video data (30 NTSC frames) can be as large as 60 MB. Intel's i750 video processing chip

set, a primary component of the Intel and IBM boards, digitally compresses and expands full-motion video and audio files (sometimes called data streams) in real time. This ability to compress, store, and expand video signals in real time, with full-motion playback, contributes to the commercial promise of DVI.

Two main chips make up the i750 chip set: the 82750PA Pixel Processor (running at 12.5 million instructions per second) and the 82750DA Output Display Processor. The ODP chip can display digital video at varying resolutions of from 256 by 200 pixels to 1024 by 512 pixels, in 8-, 9-, or 16-bit colors. (At press time, the vendors were developing 24-bit color.) The technology can display full motion, digital-image output with a multitude of special effects (e.g., shrink, mirror, and wrap) because the i750 chip set's microcode can be reprogrammed at full operation speeds.

Blending Digital and Analog

Working in conjunction with an existing 640- by 480-pixel by 16-color VGA display adapter, the ActionMedia 750 boards blend 16-million-color digital video with the VGA analog output. Intel's ISA delivery board connects to the VGA card via the VGA feature bus. IBM's PS/2 version mixes digital video through the Micro Channel bus to the VGA circuitry on the PS/2 motherboard. You can then merge the digital video output within a DVI application using the analog VGA output for generating graphical overlays (e.g., icons or text) on or in the DVI video window. Since all the video generated is digital, you can move, shrink, stretch, and position the DVI window anywhere on the VGA screen.

The delivery board requires that you input video data in the DVI encoded format from an existing software file originating from a hard disk drive, a CD-ROM, or other optical storage device. This provides finite frame-accurate display control over each frame of the compressed video and audio data. DVI application programs let you search and display video pictures in the same way that you would manipulate a database. Like DOS, DVI can converse with a computer like a hardware/software operating system, but in the digital video dialect of DVI.

According to Intel, the motion-video file compression and decompression ratio is almost 160 to 1. That is, a compressed 4.5K-byte, single-motion frame of video/audio information can be expanded for viewing on the fly, back to its

original file size of 720K bytes. This allows a typical CD-ROM disk to store 72 minutes of DVI-compressed motion video and stereo audio information. (The same CD-ROM disk could store only 28 seconds' worth of uncompressed data.) However, CD-ROM access speeds are slower than hard disk data-retrieval speeds (approximately 1 second versus 20 milliseconds, respectively). DVI's 4.5K-byte compressed frame files can be streamed off the CD-ROM fast enough for real-time decompression and display.

Saving Changes

In addition to motion video, the DVI format can compress big collections of still images (e.g., photographs or artwork). Resolution and antialiasing (often referred to as the *jaggies*) for still images is more critical than for motion video. Therefore, DVI compression ratios are generally only 25 to 1 for stills (versus the 160 to 1 possible for moving pictures).

This noticeable difference in compression ratios is due to the way DVI stores full-motion images. In several successive frames of motion video, very little of the picture may change from one frame to the next. Since storing all this redundant information over and over serves no purpose, the DVI system only stores the *changes* in each successive frame to keep the video file size to a minimum. For example, the DVI system would update a dancer twirling onstage but would not update the motionless stage background. The DVI system is smart enough to know when the scene has changed too radically for this method to work (e.g., panning the camera) and will store another "reference frame" from which successive mini-frames can again be interpolated.

Another phenomenon that helps to reduce motion-video file size is the human eye's inability to focus accurately on a moving object's edges (versus the focusing ease and closer scrutiny of viewing a still image). Because of this, antialiasing requirements can be lower for motion video than for still frames. Combined with the motion compensation technique—and other algorithms like it—these algorithms allow the huge compression ratios possible under DVI.

At present, DVI motion video has around 200 lines of resolution, which is less than VCR quality. Users who require higher DVI quality can use Production Level Video (PLV), which is VCR quality. For PLV quality, you must send your audio/video master tape to Intel's DVI/PLV production service, where a powerful mainframe compression sys-

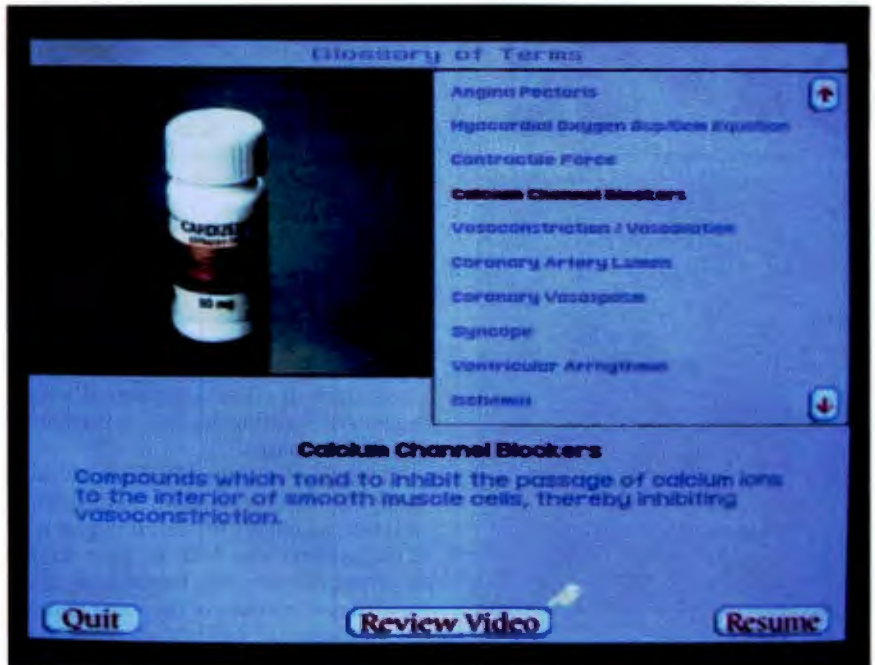


Photo 2: Anderson Consulting's DVI-based medical application trains medical workers about the effects of prescription drugs on the heart. If a technician encounters an unfamiliar medical term, a click on an icon displays information about the subject.

tem generates DVI files. The PLV service creates CD-ROM masters used for duplicating application disks for mass distribution. The average cost for PLV service is about \$250 per running minute of final videotape. Both the PLV and Real Time Video (RTV) lose some focus, and colors tend to smear somewhat during playback.

As high-definition TV looms on the horizon, Intel's goal is to have RTV meet near-TV standards and PLV to meet TV-quality levels (512 scan lines) or even HDTV quality by 1992. HDTV offers resolutions of 1050 lines (consumer grade) or 1125 lines (broadcast production equipment). Since DVI is digital, you can theoretically scale it to almost any resolution factor. Some observers believe that HDTV screens may well be lurking behind present-day VGA monitors, with technologies like DVI evolving to leapfrog HDTV's line resolutions.

Standards committees, such as the Moving Pictures Expert Group, coordinate and implement video standards. One MPEG member mentioned that the group is targeting video compression/decompression quality levels to exceed the current resolution of motion picture film—around 4000 lines. Instead of receiving two to three large reels of 35mm motion picture film, movie theaters would be able to receive the latest box

office hit from Hollywood on a DVI encoded CD-ROM.

As communities meld existing telephone networks to fiber-optic links, cable companies will broadcast compressed video data. Instead of visiting the local video store, you'll download your choice of movie titles over the fiber-optic network.

Commercial and Educational DVI Applications

In addition to the Palenque tour, many other commercial and educational DVI applications are out. Applied Optical Media Corp.'s truck-driving safety simulation consists of an enclosed truck cab kiosk with a brake pedal, steering wheel, accelerator, and dashboard controls. Students face various DVI-based driving sequences similar to what they might see from the cab of an 18-wheeler, including full-motion video running in rearview side mirrors. AOMC is scheduled to ship about 27 of the simulations by 1991. Interestingly, the DVI boards in last year's simulations cost \$9500, while the DVI technology going into the 1990 units costs just \$2500. This is a price reduction of more than two-thirds in 12 months.

AOMC's Photobase and MediaSource disks are databases containing over 2000 DVI format images on CD-ROM. These

continued

386/SX/486 Speedster

WORKSTATIONS AND NETWORK SERVERS



Some of our recent awards.



"Blackship 386XS-16 . . . High-speed, excellent price, and great expandability. This system is one of the best bargains in the round-up."

PC World, August 1990

"Of our seven contenders, the Blackship 486-25 earned the top value."

InfoWorld, March 12, 1990

"With its winning combination of quality off-the-shelf parts, the Blackship 386-33 offers solid performance at an affordable price."

PC Magazine, February 13, 1990

"Blackship 386/25: Reliability at a Good Price . . . the only machine tested that was entirely trouble-free."

PC World, August 1989

"The Blackship 386-33 offers low price 33-MHz performance . . . we rate it a very good value."

InfoWorld, July 1989

We have a complete range of 286 to 486 systems. Make Blackship your single source for all your system and networking needs.



BLACKSHIP
COMPUTER SYSTEMS

Call Toll-Free

1-800-877-6249

4031 Clipper Court • Fremont, CA 94538
Tel: 415-770-9300 • Fax: 415-770-8674

MULTIMEDIA: DVI ARRIVES

optical disks provide multimedia resource material for DVI developers. Photobase's 512- by 480-pixel resolution images are categorized by photo-term topics, by photo ID numbers, or by a hypertext search feature called Lateral Browse. Both Photobase and Media-Source incorporate file format image conversions to paint packages (e.g., Lumen from Time Art) and are accessed from pull-down menus. The Media-Source disk includes digitized sound effects and background music for use in constructing actual TV-style program presentations. The Uniphoto Picture Agency of Washington, D.C., distributes Photobase images.

Orleans, also from AOMC, is a visual database that manipulates high-quality still images in DVI format. It targets real estate brokers who wish to show homes to prospective buyers. Buyers may click on different portions of the home to show explicit views of individual rooms or of the surrounding landscape.

Business Applications

Bethlehem Steel's DVI training application shows machine operators the complex workings of a steel mill. A graphical layout, which details the complete steel manufacturing procedure, shows machine icons at their positions in the manufacturing process. Selecting a specific machine icon displays a still of the machine, overlaid by a small motion video window of an instructor, who details the correct operation procedure for that machine. Selecting a button or hand-lever icon on the machine opens another motion video window that shows the specific machine action for the icon that was selected. This DVI application quickly educates new operators not only on specific machines but also on exactly how each machine fits into the overall manufacturing process.

Anderson Consulting of Dallas develops and implements specialized DVI applications for medicine, geography, and manufacturing. Its Process Analysis Workbench application creates working DVI applications similar to Bethlehem Steel's training application. Its DVI medical applications include a video study on Cardizem, a prescription drug, and its effects on the heart. You can select the Coronary Blood Flow option and watch a motion video on the topic or test your knowledge by answering multiple choice questions. If a medical term or phrase, such as "calcium channel blockers," sounds unfamiliar, you can click on an icon to get further information on the subject (see photo 2).

Authoring programs allow creation of simple DVI slide presentations to almost full-blown TV productions. Authology:Multimedia, from CEIT Systems, is a DVI program development tool that uses a mouse and standard windowing interface with pull-down menus. Developers create menus and graphical icons that future users will select for branching through the finished DVI application. After a user selects more information on a specific topic, motion video or graphical still images are displayed within rescalable windows.

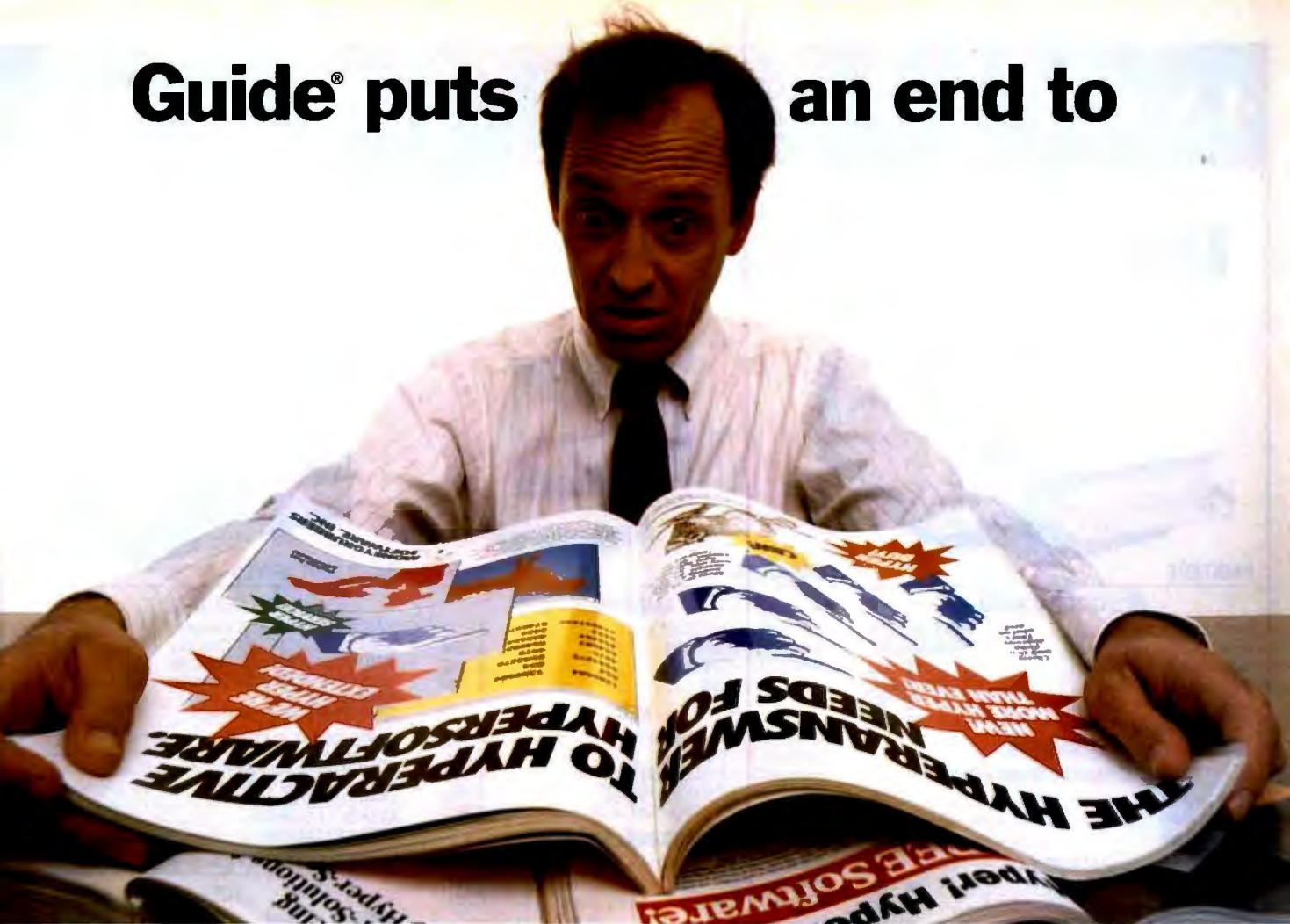
Authoring packages let the DVI developer become a desktop TV producer. Just as the producer of a TV show decides which sequences of videotape will be displayed at certain times in the show, a DVI developer also decides where motion video and graphical stills will fade in or be cued at certain edit points in the script. Stereo digital audio for narrative or background music to accompany appropriate portions of the program can also be edited. Unlike a TV show viewer, however, the DVI end user has complete control over the finished production and can browse at will through specific topics of interest. (At last you can sidestep the commercials!)

Authology is expensive. At \$4500 it is targeted toward developers who want to market and create commercial DVI applications. For playback of applications, CEIT Systems offers its Authology: MultiMedia Presenter, a \$300 run-time software package for end-user systems. As the prices of the DVI boards themselves come down (Intel sources expect \$1000 boards by 1991, \$500 boards by 1992), you can expect DVI authoring system software prices to decrease, too, bringing them into the consumer mass market.

As entry-level prices of DVI products decrease, new applications may emerge. Computer users might generate their own DVI-TV productions and distribute them via BBSes, circumventing traditional distribution methods. New and exciting TV fare will be as close as dialing out with your modem and downloading the latest shareware video releases. The real question to ponder is, "What will the reruns look like in the year 2015?" ■

Greg Loveria is a technical writer, animator, and DTP computer graphics consultant. Don Kinsler is a freelance technical writer, avid C programmer, and computer applications instructor. Both reside in Binghamton, NY. You can reach them on BIX c/o "editors" or as "dkinsler," respectively.

Guide® puts an end to



Hyperbabble

Hypernavigate, hyperlinking, hypersource... who can keep up with what's fact and what's fiction in multimedia software?

Behind the hype and confusion there really is a valuable technology. As the first company to introduce a hypertext product for the PC, we've helped hundreds of companies create practical working applications for hypermedia and we can help you cut through the hyperbabble.

Let's get serious about hypermedia.

With Guide, you can assemble and manage vast amounts of information. You create multilevel electronic documents with extensive cross referencing so that people accessing your data can quickly find what they're looking for.

Guide enables you to combine media such as text, data, graphics, audio, and video into a dynamic presentation on your screen. You communicate information in a more powerful and compelling way than was ever possible on paper.

Communicate any information more effectively.

Anyone can create simple text-based electronic documents or complex hypermedia presentations. Because Guide runs under Microsoft Windows™ you can exchange data with other Windows applications.

Do your job better.

Guide is perfect for corporate trainers who combine pictures, video and text to add vitality to training sessions... teachers who create interactive lessons that catch and hold the attention of students... business people who take volumes of paper documents out of files and make them available electronically to people throughout their company.

We're ready if you're ready.

Don't wait. The first 5,000 callers will receive a FREE demonstration video of Guide along with a demo diskette and hypermedia Q&A workbook. And, if you purchase Guide before December 31, you'll receive a set of authoring templates (a \$200 value) that will get you up and running fast.

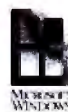
To take advantage of this exciting offer or to receive more information call 1-800-344-9737, Ext. 701. In Europe call (+44) 31-557-5720, Ext. 206, or FAX (+44) 31-557-5721.

Guide is covered by a 30-day money-back guarantee.



OWL International, Inc.
Bellevue, WA 98007 USA
Telephone (206) 747-3203
FAX (206) 641-9367

Guide is a registered trademark of OWL International, Inc. Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation.
© Copyright 1990 OWL International, Inc. • Subsidiary of Matsushita Electric Industrial Co., Ltd.



Circle 142 on Reader Service Card



**HEWLETT
PACKARD**



PRINTERS

HEWLETT PACKARD

Laser Jet III	PRICE MATCH!
Laser Jet II P	PRICE MATCH!
Laser Jet II D	\$CALL
Desk Jet/Desk Jet Plus	\$CALL
Laser Jet Toners	\$ 79.
250 Sheet Paper/Letter Tray	\$ 59.

KENSINGTON

100% HP Compatible Memory Boards

1 MG Upgrade	CALL
2 MG Upgrade	CALL
4 MG Upgrade	CALL

PANASONIC

KXP 1180 192 cps, 80 col. 9-pin	\$ 164.
KXP 1124 192 cps, 24-pin	\$ 275.
KXP 1624 192 cps, 132 col. 24-pin	\$CALL
KXP 1695 330 cps, 132 col. 9-pin	\$CALL
KXP 4420 Laser, 8 page per minute	\$CALL

EPSON

LX810 180/30, 9-pin	\$ 175.
FX850 330/88, 9-pin	\$ 325.
LQ850 330/88, 24-pin	\$ 515.
LQ950 264/88, 24-pin	\$CALL
LQ510 180/60, 24-pin	\$ 314.
FX1050 264/54, 9-pin	\$ 429.
LQ1050 330/88, 9-pin	\$ 699.
LQ2550 400/108, 24-pin	\$CALL

LAPTOPS

TOSHIBA

Toshiba T1000	\$ 575.
T1000 SE	\$CALL
T1000 XE	\$CALL
T1200 XE	\$CALL
T 1600 286 20MB	\$2350.
T 1600 286 40MB	\$2650.
T3100 E 286 40MB	\$2550.
T3100 SX 40MB	\$3550.
T3200 SX 40MB	\$3700.
T5100 386 100MB	\$4250.
T5200 386 40MB	\$4500.
T5200 386 100MB	\$4900.

COMPAQ

Deskpro 286E 20mb/40MB	\$ 2050/2350.
Deskpro 386S	\$CALL
Deskpro 386/20E 40MB	\$4225.
Deskpro 386/20E 110MB	\$4750.
Deskpro 386/25E 84MB	\$5450.
Deskpro 386/25E 110MB	\$6150.
Deskpro 386/25E 300MB	\$8450.
Deskpro 386/33 84MB	\$7200.

MODEL 486/25N

120MB/320MB/650MB	\$CALL
Portable III 20MB/40MB	\$ 3350/3950.
Portable 386 40MB/100MB	\$ 4750/5550.



SAMSUNG



MONITORS

SAMSUNG

1257 Amber (12" 720x350)	\$ 74.
1464 RGB (14" 640x200)	\$ 205.
1453 EGA (14" 690x350)	\$ 319.
VGA (14" 720x580)	\$ 349.

NEC

Multisync 2A 14" (800x600) VGA	\$ 460.
Multisync GS 14" Mono	\$CALL
Multisync 3D 14" (1024x768) EGAVGA	\$ 580.
Multisync 4D 16" (1024x768) .28DP	\$CALL
Multisync 5D 20" (1280x1024) .31DP	\$CALL

PACKARD BELL/PGS/SONY

Mono 12" Amber 720x350	\$ 74.
PGS Ultrasync 14" VGA	\$CALL
Sony 1302/1304	\$CALL

VIDEO CARDS

PARADISE

VGA 1024x768 with 512K	\$CALL
------------------------	--------

PC BRAND

Mono Graphics w/Printer Port	\$ 34.
Color Graphics w/Printer Port	\$ 34.
EGA (640x480) Autoswitch	\$ 85.
VGA 16 Bit	\$ 149.

HARDWARE

AT 12 MHz (exp. 4 meg 0 wait)	\$ 165.
XT 10 MHz Turbo (exp. 0 wait)	\$ 69.
Power Supply 200 Watt	\$ 49.
Power Supply 150 Watt	\$ 39.
XT Case (w/hardware)	\$ 34.
Baby AT Case (w/hardware)	\$ 52.
AT Case (Full Size)	\$ 59.
Keyboard 84 Key (tactile touch)	\$ 40.
Keyboard 101 key (tactile touch)	\$ 54.
Multi I/O Card	\$ 34.
Floppy Controller Card	\$ 21.
FHDC (1.44/1.2/720K/360K)	\$ 45.
AT I/O	\$ 32.
Serial Card	\$ 20.
Parallel Card	\$ 20.
Game Card	\$ 20.

LAPTOPS - continued

ZENITH LAPTOPS

Minisport 2MB RAM NOTE BOOK	\$CALL
Supersport 184	\$1150.
Supersport 184-2	\$1650.
Supersport 286 20MB	\$2450.
Supersport 286 40MB	\$2650.
386SX 40MB	\$3850.

NEC LAPTOPS

Prospeed 286 20MB	\$1650
Prospeed 286 40MB	\$2425.
Prospeed 386SX	\$2650.
Prospeed 386 40MB	\$3550.



Seagate



HARD DISK DRIVES

SEAGATE

20MB 65MS ST225 w/XT Controller	\$ 229.
20MB 35MS ST125 w/XT Controller	\$ 299.
30MB 65MS ST238 w/XT Controller	\$ 239.
30MB 35MS ST138 w/XT Controller	\$ 345.
40MB 28MS ST251-1	\$ 339.
80MB 28MS ST4096 Full Height	\$ 535.

HARD DRIVE CARDS

XT MFM (20mg Controller)	\$ 55.
XT RLL 27x(30mg Controller)	\$ 59.
AT MFM 2:1 Controller	\$ 79.
AT MFM 1:1 Controller	\$ 105.
AT RLL 1:1 Controller	\$ 110.

FLOPPY DISK DRIVES

TOSHIBA

360K 5.25" HH Black	\$ 59.
720K 3.5" HH w/5.25" Mount	\$ 64.
1.2MB 5.25" HH Grey	\$ 69.
1.44MB 3.5" HH Grey w/5.25" Mount	\$ 75.

TEAC

360K 5.25" HH Black	\$ 59.
720K 3.5" HH w/5.25" Mount	\$ 64.
1.2MB 5.25" HH Grey	\$ 69.
1.44MB 3.5" HH Grey w/5.25" Mount	\$ 75.

FUJITSU

360K 5.25	\$ 59.
1.2, 5.25	\$ 69.

SONY

720K 3.5	\$ 64.
1.44, 3.5	\$ 75.

MODEMS

Mastercom - 1200B (internal)	\$ 44.
Mastercom - 2400B (internal)	\$ 75.
US Robotics, Courier HST/9600B	\$ 615.

SOFTWARE

Wordperfect 5.1	\$CALL
Lotus 1-2-3 2.2/3.0	\$CALL
Microsoft ALL	\$CALL

MOUSE

Genius Mouse, GM6X	\$ 35.
Genius Mouse F301	\$ 50.
Logitech Mouse C9	\$CALL

INTEL

ALL CO-PROCESSORS	\$CALL
-------------------	--------



Day After Day More Corporations, Businesses and People just like you . . .
Choose I.S.C. for Outstanding Service, Quality & Pricing!



286 Power System

- 6/12 MHz Motherboard
- 80286 CPU
- Norton Si Rating 15.3
- 0 Wait State
- 1.2MB High Capacity Floppy
- 1 Meg RAM Expandable to 4 MB
- Serial Port/Parallel Port
- 1.2MB Floppy Controller
- 8 Expansion Slots
- 6-16 Bit, 2-8 Bit Slots
- 200 Watt Power Supply
- AT Style Keyboard
- Mono Card/Parallel Port
- Monochrome Amber Monitor

\$ 675.

XT Power System

- 4.77/10 MHz Motherboard
- 8088-10 CPU
- (1) 360K Floppy Drive
- 640K RAM/Floppy Controller
- 8 Expansion Slots
- 150 Watt P.S./AT Style Keyboard
- Serial/Parallel/Clock & Game Port
- Mono Card/Parallel Port
- Monochrome Amber Monitor

\$ 459.

386SX Power System

- 16 MHz Motherboard
- 80386SX CPU
- 1 Meg RAM (80 nsec.) Installed
- 1.2MB or 1.44MB Floppy Drive
- 2 Serial Ports
- 1 Parallel Port
- 80387SX Co-processor Socket
- Floppy Drive Controller
- Hard Drive Controller
- 8 Expansion Slots
- 5-16 Bit, 3-8 Bit
- RAM Upgradable to 8 Meg
- 200 Watt Power Supply
- 101 Key Enhanced Keyboard
- Clock/Calendar w/ Battery Backup
- Mono Card/Parallel Port
- Monochrome Amber Monitor
- AC Power Pad

\$ 849.

386 Power System

- 20/25 MHz Motherboard
- 80386 CPU
- AMI Bios
- 1 Meg RAM/Upgrade to 8 Meg
- 1.2MB/1.44 High Capacity Drives
- 2 Serial Ports/1 Parallel Port
- 80387 Co-processor Socket
- Floppy/Hard Drive Controller
- 8 Expansion Slots
- 2-32 Bit, 5-16 Bit, 1-8 Bit
- 230 Watt Power Supply
- 101 Key Enhanced Keyboard
- Clock/Calendar w/ Battery Backup
- Mono Card/Parallel Port
- Monochrome Amber Monitor
- AC Power Pad

\$ 1,275. 20MHz

\$ 1,375. 25MHz

386 Power System

- 33 MHz Motherboard
- 64K Cache Memory
- 80386 CPU
- AMI Bios
- 1 Meg RAM (80 nsec) Installed
- 1.2MB/1.44 High Capacity Drives
- 2 Serial Ports / 1 Parallel Port
- 80387 Co-processor Socket
- Floppy/Hard Drive Controller
- 8 Expansion Slots
- 2-32 Bit, 5-16 Bit, 1-8 Bit
- RAM Upgradable to 8 Meg
- 230 Watt Power Supply
- 101 Key Enhanced Keyboard
- Clock/Calendar w/ Battery Backup
- Mono Card/Parallel Port
- Monochrome Amber Monitor
- AC Power Pad

\$ 1,749.

486 Power System

- 25 MHz Motherboard
- 80486 CPU
- AMI Bios
- 4 Meg RAM
- 1.2MB/1.44 High Capacity Drives
- 2 Serial Ports
- 1 Parallel Port
- 80487 Co-processor Socket
- Floppy/Hard Drive Controller
- 8 Expansion Slots
- 2-32 Bit, 5-16 Bit, 1-8 Bit
- RAM Upgradable to 16 Meg
- 230 Watt Power Supply
- 101 Key Enhanced Keyboard
- Reset Button / Keyboard Lock
- LED Power & Turbo Indicators
- Clock/Calendar w/ Battery Backup
- AC Power Pad

\$ 3,900.

HARD DRIVE OPTIONS

- 20MB Seagate Hard Drive \$175.
- 30MB Seagate Hard Drive \$185.
- 40MB Seagate Hard Drive \$339.
- 80MB Seagate Hard Drive \$525.

MONITOR OPTIONS

- Monochrome Amber Monitor
- Mono Card/Parallel Port \$108.
- EGA Monitor
- EGA Card \$419.
- VGA Monitor
- VGA+16 Card +512K \$436.

All System Parts can be purchased separately.

We also carry
 HP, Epson, Panasonic,
 Samsung, NEC, Software
 and MORE . . .

90 DAY MONEY BACK GUARANTEE - 3 YEARS PARTS & LABOR

QUICK SHIPMENTS TO US/OVERSEAS

C.O.D. AVAILABLE

HOURS: MON - FRI 8AM to 5PM

CUSTOMER/TECH SUPPORT: 9:30AM to 4:30PM

Prices subject to change without notice



ORDERS ONLY - 800-955-4858

Customer Service Only - 800-933-5161

Technical Support: 213-379-9209 - FAX: 213-318-0555

2629 Manhattan Avenue #235 - Hermosa Beach, CA 90254

More Box For The Buck.

See us at **Sands #N3242**
 **COMDEX/Fall '90**
 November 12-16, 1990
 Las Vegas, Nevada



DTK 386 systems deliver superior performance at prices that are hard to beat. **33MHz Cache.** Take our KEEN-3300 Series for example. Its innovative high speed writeback 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 Cache. The KEEN-2500 Series has the same lightning fast cache memory as the 33MHz and delivers 6.2 MIPS. It's Novell NetWare and XXCAL Labs certified for compatibility with a long list of hardware, operating systems and software.

Key Features	KEEN-3300 Series	KEEN-2500 Series	KEEN-2530 Series	PEER-1630 Series
Processor	80386-33	80386-25	80386-25	80386SX-16
Configurations				
Tower Model	KEEN-3304	KEEN-2503	—	—
Desktop Model	KEEN-3302	KEEN-2500	—	—
Mini-AT Model	—	—	KEEN-2530	PEER-1630
DRAM on Motherboard	Up to 8MB	Up to 8MB	Up to 4MB	Up to 5MB
32-bit DRAM (max.)	16MB	16MB	16MB	5MB
Cache Memory	64/256KB	64/256KB	—	—
Landmark Rating	59MHz	44MHz	32MHz	20MHz

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."

Non-Cache. DTK also offers you a choice of dependable, high performance, non-

cache 25MHz 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 are 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 69 on Reader Service Card (RESELLERS: 70)

DPMI: THE DOS PROTECTED MODE INTERFACE

A new standard provides binary compatibility for protected-mode applications

L. Brett Glass

In the April installment of *Under the Hood*, I described the way DOS extenders surmount the limitations of DOS by allowing programs to run in protected mode. I limited my discussion to situations where an extended DOS application could safely take complete control of the machine—that is, I assumed that no multitasking or protected-mode environment was running. This, of course, is not the case in many real-life situations. When you fire up Desqview, OS/2, or Windows (in standard or extended 386 mode), you don't want to lose the ability to run extended applications. By the same token, you don't want to give an extended application the ability to destroy other applications' data structures, stop applications from multitasking, or crash the whole system.

The Virtual Control Program Interface was developed by Quarterdeck Office Systems (developer of Desqview), Phar Lap, and other vendors of multitaskers and DOS extenders (see "Stretching DOS to the Limit," *IBM Special Edition*, Fall 1989). VCPI is a set of conventions that allow extended DOS ap-

plications to run in the presence of multitasking environments and memory managers (such as QEMM) that put the 386 into virtual 8086 mode. It works well for its intended purpose; however, VCPI does not prevent the extended application from exhibiting destructive behavior.

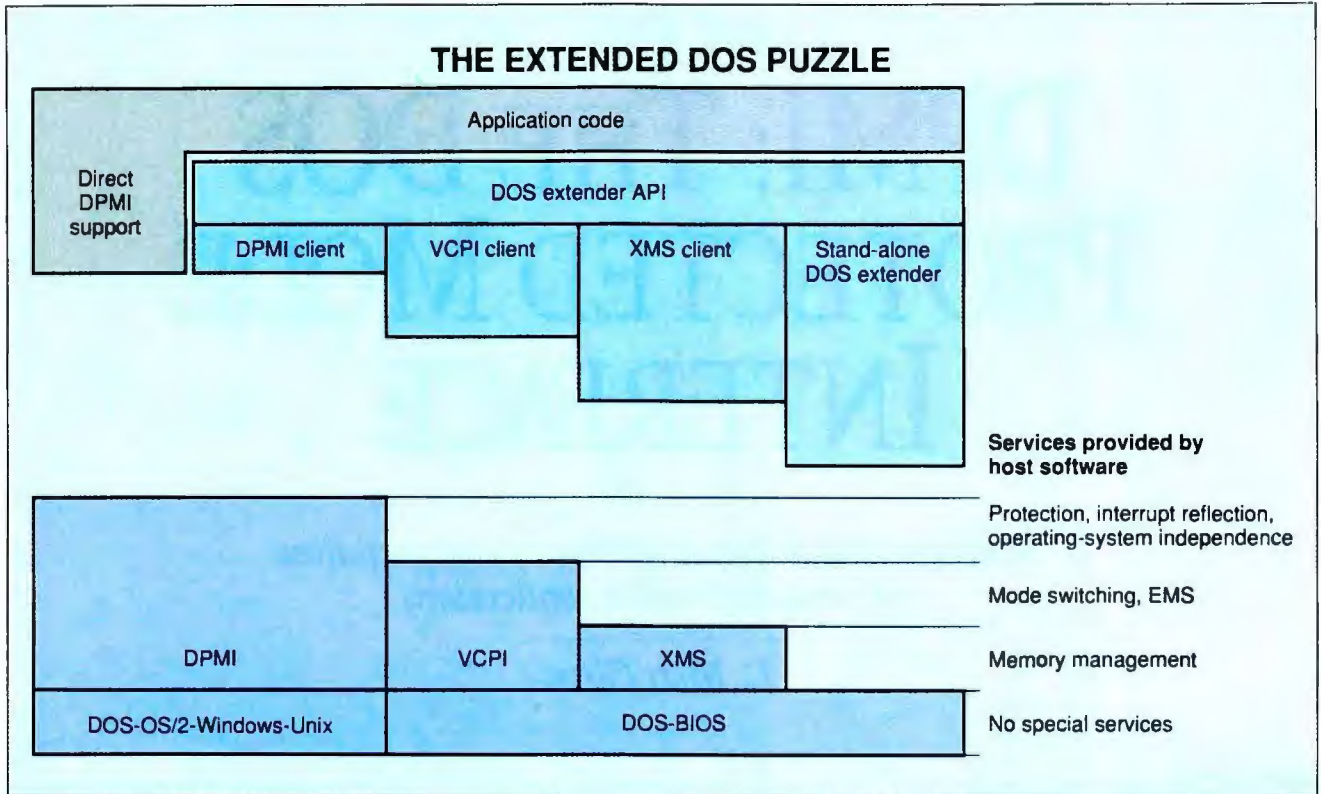
An application that uses VCPI runs at ring 0, the most privileged level of the Intel protection scheme. It has access to

all of the machine's resources and can take over at will, potentially causing data in other sessions to be lost. Microsoft correctly noted that extended-DOS applications should really run in ring 3—the least privileged level—if they are to coexist with other programs and work with multitasking environments. It's also appropriate for extended-DOS applications to *ask* for the use of system resources rather than simply commandeer them. The authors of "DOS boxes" for Unix concurred. On Unix systems, which can serve many users, it's especially important that the kernel retain full control over the machine's resources. Thus, the DOS Protected Mode Interface was born.

Some DOS-extender vendors grumbled when Microsoft told them about DPMI. They feared, with some justification, that Microsoft might use it to stifle environments that could compete with Windows or OS/2. However, a series of DPMI summit meetings—attended by Borland, Eclipse, IGC, Intel, Locus, Microsoft, Phar Lap, Phoenix, Quarterdeck, and Rational—produced a published standard to which all members agreed. This was

continued





Many combinations and configurations of software run extended DOS applications. Here are all the services provided by the host environment, atop which runs the application.

DPMI 0.9, and it first became available to the general public in May 1990.

The Specs

DPMI 0.9 specifies a set of calls that an extended-DOS application program can make to set itself up, enter protected mode, and—once there—manage memory and interrupts. Microsoft's original version of the standard went further; it defined the subset of real-mode DOS and BIOS calls that would be available to an extended-DOS program running in protected mode. In other words, it was a complete specification for a DOS extender. As I mentioned in my earlier column, each DOS-extender vendor supports its own unique repertoire of DOS and BIOS functions. Some of them, for instance, save code space by not implementing the antiquated DOS calls involving file control blocks (FCBs), a relic of CP/M. Others limit the sizes of memory blocks that programs can use as parameters to DOS calls. And all offer unique memory and interrupt management services.

Because conforming to Microsoft's specification might have "broken" the code now in use by each vendor's customers, the committee members opted to remove all information regarding supported DOS and BIOS calls from the

specification. Thus, DPMI 0.9 does not mention which (if any) DOS and BIOS functions are available to the extended application; the use of those functions is, at least for now, the province of the individual DOS extender's manual. Still, since Windows 3.0 and future versions of OS/2 are expected to support the functions Microsoft originally documented, DOS-extender makers may choose to gravitate toward that set—and more specifics may appear in DPMI 1.0.

The Protected-Mode Puzzle

The environment seen by an extended-DOS application may be very different each time it's run. If the program is running under POD (plain old DOS), or a pseudoPOD (such as DR-DOS), the DOS extender must provide all mode-switching and memory management services. If an Extended Memory Specification driver is present, it's best to let XMS manage extended RAM, but the DOS extender will still have to switch the CPU in and out of protected mode.

If a 386 extended-memory manager with VCPI, such as QEMM or 386Max, is loaded, VCPI will handle switches between protected mode and virtual 8086 mode (the mode in which DOS and BIOS calls are processed). However, the DOS

extender must still take responsibility for fielding each DOS or BIOS call, asking VCPI to do a mode switch and reissuing the call in virtual 8086 mode.

If DPMI is present, it can handle the job of "reflecting" software interrupts to real mode on behalf of the DOS extender. In fact, in some cases, DPMI may decide it's faster not to perform a mode switch at all. For example, if a DOS extender asks DPMI to make a real-mode DOS call to open a file, and the underlying environment is OS/2, DPMI might route the request directly to OS/2's file system, which runs in protected mode. However, DPMI does provide low-level, or "raw," mode-switch functions for DOS extenders that wish to handle nearly everything on their own.

The figure puts all these scenarios in perspective. The bottom piece of the puzzle represents services provided by the host environment—from unenhanced DOS (which provides the fewest services) to a host with DPMI (which provides the most). The top piece shows the application program, which will, in most cases, have a DOS extender bound to it. Note that the DOS extender must be adaptable; it must "fill in" any services the host doesn't supply.

continued



INSTANT MAINFRAME. JUST ADD SCO.

Not too long ago, a few dozen people sharing the same programs, resources, and information on a single computer at the same time meant only one thing—a mainframe.

Powerful, big, expensive, and proprietary.

More recently, the same people could be found doing exactly the same things—simultaneously sharing programs, resources, and information—on a minicomputer.

A lot cheaper, a lot smaller, yet powerful enough to do the same jobs. And just as proprietary.

Then along came the latest generation of advanced personal computers. And now, the same people are more and more likely to be found doing exactly the same things—simultaneously sharing programs, resources, and information—on a PC.

And not a whole officiful of PCs networked together, either, but *a single PC powering the whole office at once.*

A lot cheaper, a lot smaller, yet still easily powerful enough to do the same jobs. Built to non-proprietary, open system standards that allow complete freedom of choice in hardware and software.

And running the industry-choice multiuser, multitasking UNIX® System V platform that gives millions of 286- and 386-based PC users mainframe power every business day.

The UNIX System standard for PCs—SCO.*

The SCO family of UNIX System software solutions is available for all 80286, 80386, and 80486 based industry standard and Micro Channel™ computers.

Today, SCO UNIX System solutions are installed on more than one in ten of all leading 386 computers in operation worldwide.

Running thousands of off-the-shelf XENIX® and UNIX System-based applications on powerful standard business systems supporting 32 or even more workstations—at an unbelievably low cost per user.

Running electronic mail across the office—or around the world in seconds.

Running multiuser PC communications to minis and mainframes through TCP/IP and SNA networks.

Running the most compute-intensive jobs on advanced multiprocessor PCs that are actually more powerful than many mainframes.*

And doing some things that no mainframe—or even DOS- or AOS/2™-based PC—ever thought about, such as running multiple DOS applications. Or networking DOS, OS/2, XENIX and UNIX Systems together. Or running UNIX System versions and workalikes of popular DOS applications such as Microsoft® Word, 1-2-3®, and dBASE III PLUS®.

Or even letting users integrate full-featured, multiuser productivity packages *of their choice* under a standard, friendly menu interface.

Today's personal computer isn't just a "PC" anymore, and you can unleash its incredible mainframe-plus power for yourself—today.

Just add SCO.

*Using SCO MPX™, the multiprocessor extension to SCO UNIX System V/386 Release 3.2.

SCO, the SCO logo, and Open Desktop are registered trademarks of The Santa Cruz Operation, Inc. in the U.S.A. and other countries. SCO MPX is a trademark of The Santa Cruz Operation, Inc. UNIX is a registered trademark of AT&T in the U.S.A. and other countries. Microsoft and XENIX are registered trademarks of Microsoft Corporation. OS/2 and Micro Channel are trademarks of International Business Machines Corporation. 1-2-3 is a registered trademark of Lotus Development Corporation. dBASE III PLUS is a registered trademark of Ashton-Tate. © 1990 The Santa Cruz Operation, Inc. 400 Encinal Street, P.O. Box 1900, Santa Cruz, California 95061 USA. The Santa Cruz Operation Ltd., Croxley Centre, Hazards Lane, Watford WD1 8YH, Great Britain. +44 (0)923 816544. FAX: +44 (0)923 817781. TELEX: 917572 scoam c



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

Circle 168 on Reader Service Card

FAMOUS MAKER

286 AT COMPUTER WITH 14" HIGH RESOLUTION VGA COLOR MONITOR and 30 MB HARD DRIVE



- 80286 microprocessor, 12.5/6.25MHz switchable.
- One MB RAM on motherboard, expandable to four MB
- 30 MB hard drive
- One 5.25" 1.22MB floppy drive.
- High resolution VGA monitor: 640 x 480.
- Socket for 80287 math co-processor
- 16-bit VGA card; 800 X 600 resolution.
- IBM compatible.
- Three expansion slots—two 16-bit and one 8-bit.
- One serial port.
- One parallel port
- PS/2 compatible 6-pin mouse port
- Real time clock/ calendar
- Phoenix 286 ROM BIOS
- AT style 101-key enhanced keyboard.
- Includes MS-DOS 4.01 with DOS Shell utilities and GW BASIC™
- PC dim.: 4-1/4"H x 15"W x 15-1/2"D
- Monitor dim.: 13.9"W x 14.7"D x 14.1"H
- One Year Manufacturer's Warranty!
- Factory New! Factory Perfect!

FREE BONUS SOFTWARE:
Spinnaker "Easy Writer" word processing, "Ace2" interaction game & "Splash" demo program. Also includes coupon to buy "Splash" at great savings!

Mfr. Sugg. Retail:
\$2,293.00

DAMARK PRICE:

\$999.99

Item No. B-2358-149047
Insured Ship/Hand... \$49.00

**FOR FASTEST SERVICE
CALL TOLL FREE**

1-800-729-9000



DAMARK INTERNATIONAL, INC. 7101 Winnetka Ave N,
Minneapolis, MN 55428-1619

Customer Service
612-531-0082

DAMARK

Please rush me: **Famous Maker Computer(s)**
@ \$999.99 each, plus \$49.00 s/h each.
Item No. B-2358-149047
MN res. add 6% sales tax.

Name _____
Address _____
City/State/Zip _____

☐ Check/MO ☐ VISA ☐ Master Card ☐ Discover

Card No. _____

Exp. Date _____ Ph # () _____

Signature _____

Copyright 1990 DAMARK International, Inc.
All rights reserved.

DELIVERY TO 48 U.S. STATES ONLY

DPMI: THE DOS PROTECTED MODE INTERFACE

The scenario on the far left is the one DOS-extender vendors may not want to contemplate. It is also the scenario that applications vendors, who don't want to pay royalties to the DOS-extender suppliers, are eyeing carefully. It's possible today to write applications that, because they interface with DPMI directly, don't need DOS extenders to run. Two things are required to make this approach practical for the average developer: DPMI drivers for all the major host operating systems, and development tools that help build the applications. Both of these requirements may be met very soon.

Windows already has DPMI built in, as will OS/2. DOS boxes on Unix machines, multitaskers such as Desqview and VM/386, and multitasking DOS replacements such as PC-MOS will follow. Third-party DPMI drivers for plain old DOS are a logical product offering. Finally, it's not inconceivable that Microsoft will put DPMI into future versions of MS-DOS (Digital Research may get it into DR-DOS first). And as for development tools: No announcements have been made at this writing; however, there are four language vendors on the committee that's charting the future direction of DPMI, and lots of other companies that may want to get in on the action.

Hello, Protected-Mode World!

How does a DPMI client application start running? DPMI takes a straightforward (and downward-compatible) approach to this problem: The program begins execution in real mode and switches to protected mode once it has made sure that DPMI is present. Unfortunately, since the DPMI standard does not specify a file format, every DPMI application must carry with it a loader that performs fix-ups on the protected-mode portion of the code. (See "Gateways to Protected Mode," April BYTE.)

To detect the presence of DPMI, the application executes an INT 2Fh (the multiplex interrupt) with the value 1687h in the AX register. If DPMI is present, the AX register is cleared and system information is returned in the other registers. A flag in BX indicates whether 32-bit programs are supported; a code in CL gives the processor type (286, 386, or i486). DX contains the DPMI version number, and SI contains the amount of DOS memory, in paragraphs, that the application should allocate for DPMI's private use. Finally, the register pair ES:DI contains the address of a procedure to call to enter protected mode.

After allocating any required DOS RAM, the application calls the procedure

at ES:DI. Hopefully, when the call returns, the program finds itself in protected mode. It's possible for the mode switch to fail, so the code immediately after the call must be executable in either mode. All the DPMI function calls, most of which the program can access via INT 31h, are available immediately after a successful switch to protected mode.

DPMI Services

The DPMI services fall into 14 distinct groups, some of which—at least for the moment—contain only one function:

The *program termination* function ends the program. This is the only INT 21h function that is officially defined by DPMI. The program executes the software interrupt with 4Ch in AH, just as it would in DOS, but it must be in protected mode at the time.

The *mode detection* function tells the program if it is running in protected mode under DPMI. If either of these conditions is not met, the caller receives a negative answer. Because this function has to work in either protected or real mode, programs access it through the DOS multiplex interrupt (2Fh).

The *LDT management services* let the program allocate, deallocate, and manipulate LDT (local descriptor table) descriptors. (For security reasons, the program cannot gain access to the global descriptor table.) It's possible to allocate several descriptors for a "huge array" at one time. When this is done, the descriptors appear evenly spaced in the LDT so that the arithmetic the program will need to perform on the descriptors is less cumbersome than it might have been.

The *DOS memory management services* shepherd precious real-mode memory. Blocks of memory in this area may be necessary when your program is making calls to software that runs in real mode and cannot reach beyond the 1-megabyte limit (NetBIOS is an example of such software).

The *interrupt services* let a program field interrupts and exceptions generated in both real and protected mode.

The *translation services* let protected-mode programs make calls to real-mode software, and vice versa. When a protected-mode program calls a real-mode procedure or software interrupt, the translation services can set up a stack that's reachable by the real-mode stack pointer and load appropriate values into all the registers. Another function of the translation services lets a real-mode program call a protected-mode program, necessary in cases such as network and

continued

PC-MOS

The Multi-User Solution For The Multi-Dimensional Company

Odds are, you're part of a multi-faceted organization, one that's involved in many different projects and activities. Every day you juggle dozens of tasks. So why are your PCs still doing one thing at a time — for one person at a time?

Today's 286 and 386-based PCs provide the power to do much more. PC-MOS is the multi-user, multi-tasking software that unleashes that power, making your PCs as multi-dimensional as your business.

Minicomputer Power For The Cost Of A PC!

PC-MOS lets several users simultaneously run different programs on a single, high-performance PC. One user can run a spreadsheet, while another uses the word processor and several others access a database — all at the same time! So instead of replicating expensive PCs, each user has an inexpensive monitor or terminal. The benefits are lower cost, more control, better security and consistency across applications. And at \$595 for a 5-user version, you can afford to get started today!

DOS Compatibility, NetWare Connectivity

PC-MOS lets users run the popular DOS programs they use now — even Microsoft® Windows 286. Our gateway to NetWare lets you expand your Novell

network inexpensively and easily. And PC-MOS requires no expensive wiring, and no network management headaches.

Proven Reliable With 100,000+ Users

Because PC-MOS was the first DOS-compatible multi-user operating system, it offers broad compatibility and the reliability of time-tested software. More than 100,000 satisfied users trust their work to PC-MOS each day. Our latest version features an easy-to-use install program, lets you re-boot individual workstations, and supports high-resolution, bit-mapped color graphics.

Call us today. We'll show you how to add multiple dimensions to your PC.



THE SOFTWARE LINK

3577 Parkway Lane, Norcross, GA 30092

1-800-451-LINK, (404) 448-5465

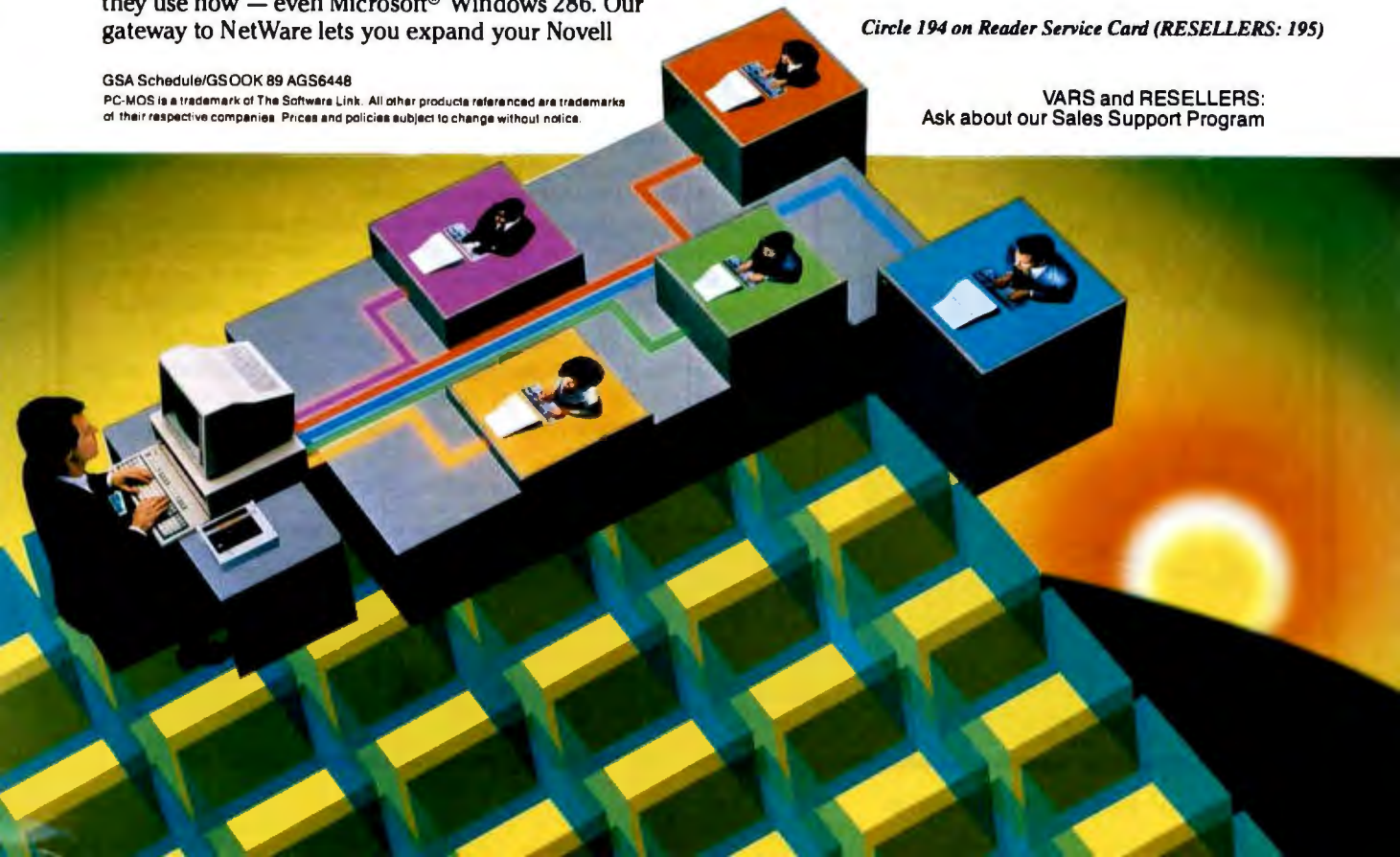
FAX: (404) 263-6474 TELEX: 4996147 SWLINK

Circle 194 on Reader Service Card (RESELLERS: 195)

GSA Schedule/GSOOK 89 AGS6448

PC-MOS is a trademark of The Software Link. All other products referenced are trademarks of their respective companies. Prices and policies subject to change without notice.

VARS and RESELLERS:
Ask about our Sales Support Program



mouse drivers that run in real mode but must use interrupt completion routines to signal an event to code running in protected mode. Yet another function provides the address of a routine that does a "raw" mode switch (for compatibility with the code of DOS-extender vendors).

The *memory management services* allocate linear (as opposed to virtual or physical) address space.

The *page locking services*, which work on systems with virtual memory, allow the application to lock pages into memory. Locked pages cannot be swapped out as the system attempts to grant a memory request. The *demand paging performance tuning services* do the opposite; they let the application mark a page as a good candidate for swapping, or tell the memory management software that the contents of a page need not be saved (i.e., discarded rather than swapped).

The *physical address mapping* function maps a range of physical addresses to linear addresses by creating entries in the 386 or i486 page table. This is useful when software needs to access memory-mapped peripherals.

The *virtual interrupt state services* let

a task ignore interrupts it has "hooked." In a protected-mode operating system, individual tasks cannot execute the CLI instruction and really turn off interrupts; it might hang the entire system. Therefore, DPMS, like many protected-mode operating systems, provides these functions, which let a task ignore hardware interrupts during a critical section of code.

The *get vendor-specific API entry point* function allows vendors of DOS extenders and implementors of DPMS to add their own extensions. This function does what amounts to a dictionary lookup: Your program can call it with a null-terminated string containing the name of the extended function. On return, your program receives an address it can call to access the extended function.

Finally, the *debug register support* functions allow an application to set and clear debugging watchpoints. Because the built-in debugging registers of the 386 and 486 can only be accessed from ring 0, and DPMS applications run at ring 3, these functions are necessary to let a program such as a debugger manipulate the debug registers.

Putting It All Together

Using DPMS's array of services, it's simple to build an extended-DOS application. The hardest part will most likely be creating a protected-mode loader; hopefully, these will be available from tool vendors by the time you read this. Since the specification doesn't give many hints on how to fit everything together, you may wish to bone up on protected-mode programming techniques and DOS-extender principles before getting started.

DPMS shows great promise as a standard for extended-DOS applications—and not just because it affords better protection from system crashes. DPMS realizes an ideal not yet achieved in any other environment: binary compatibility across dozens of vastly different operating systems. If you're concerned about paying again for all your software as you move to the operating systems of the future, DPMS applications might be the soundest investment you can make. ■

L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

Customize Your IBM® Keyboard

See us at FALL COMDEX
Sands Booth N2293



Customize your keyboard with a total line of keyboard enhancements from Hooleon, including:

- **Custom Key Imprinting**—All IBM and most compatibles supported.
- **IBM Key Kits**—Supporting WordPerfect®, 5250 Emulation, Do-It-Yourself! Individual IBM Replacement Key Caps Available!
- **Custom Adhesive Label Kits and Services**—Self-adhesive keytop label kits supporting DisplayWrite™; WordPerfect; languages; large print; 5250, 3270, or 5520 emulation; Data Entry, APL; many more. Or custom made to your specs!
- **Northgate™ Keyboards**—The finest IBM-compatible keyboard available.
- **Mextel AutoKey™ 20/20**—Store up to 400 macros at your fingertips!
- **Chameleon™ Keyboard Customizers**—Remap your keyboard to any configuration, set up macros, change key repeat rates while using no host memory.
- **FlexShield™ Keyboard Protectors**—Protects from dirt and liquids without restricting use.
- **KeyStopper™**—Patent Pending. Individual key lockouts.

Call for your
FREE CATALOG!

Custom Hotline 800-937-1337

Hooleon
CORPORATION

P. O. Box 230 • Dept. BYTE • Cornville, AZ 86325 • 602 634-7515 • FAX 602 634-4620

from the Leader in Keytop Innovations™

We put 25 font cartridges in one because the perfect printer is just a dream.

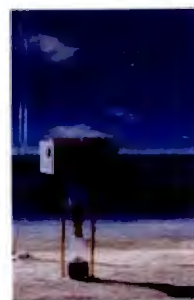


Let's face it. There hasn't been a printer built that has all the fonts you need. Which is why we created 25 Cartridges in One!

It has fonts from 25 Hewlett-Packard cartridges, saving you hundreds of dollars. You get 172 fonts and symbol sets such as Prestige Elite, Tms Rmn style and Helv style types. And our 3.6 pt AFS typeface so you can print full Lotus and Excel worksheets. Plus 69 international fonts.

Just plug 25 Cartridges in One! into your LaserJet*. It's compatible with virtually all major word processing software. And even works with our Headlines in a Cartridge product offering 14-48 pt fonts.

25 Cartridges in One! can help make your dream of the perfect printer a reality. To learn more, call or write: Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121, (619) 552-0880. Fax (619) 552-0889.



PACIFIC
DATA PRODUCTS

*Versions of 25 Cartridges in One! are compatible with HP LaserJet Series II, IIP, IID and III
© Copyright 1990 Pacific Data Products, Inc. LaserJet Series II, IIP, IID and Series III are registered trademarks of Hewlett-Packard. AFS, 25 Cartridges in One! and Headlines in a Cartridge are trademarks of Pacific Data Products, Inc. All other company and product names are trademarks of the company or manufacturer respectively



DESK NOT BIG ENOUGH?

*17 million business documents
are lost or misfiled each day.*

Announcing a major breakthrough in image storage and retrieval:

**Paper
Tamer**

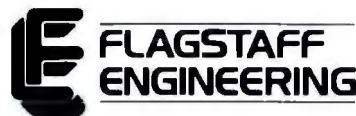
PaperTamer offers more power and flexibility than other existing document storage and retrieval systems—and *PaperTamer* costs 1/10th of the price.

PaperTamer is designed to eliminate the need to run to the file room every time you need information. *PaperTamer* provides immediate access to over a million images, documents, memos and articles.

Flagstaff Engineering offers a complete line of peripheral products to provide complete image storage and retrieval systems including scanners, optical drives and mass storage devices.

No one delivers rock solid solutions like Flagstaff Engineering, the company that continues to help people read a world of information.

Circle 79 on Reader Service Card



Domestic Sales and Marketing
1120 Kaibab Lane
Flagstaff, AZ 86001
(602) 779-3341 / FAX (602) 779-5998

International Sales
1930 S. Alma School #C202
Mesa, AZ 85210
(602) 831-5100 / FAX (602) 831-0684

GSA APPROVED

OPTICAL STORAGE PRIMER

What you need to know to take advantage of the most significant advance in computer storage since the floppy disk

David A. Harvey

Once considered little more than a fringe technology, optical storage devices for personal computers have hit the mainstream with a vengeance. They enable you to store—at a minimum—hundreds of megabytes of data. In fact, devices that store over a gigabyte are not uncommon, and even terabyte storage is available through disk-changing systems (the so-called “jukebox” systems). The question is: What do you do with all this storage space?

When the only storage devices available for your PC were single-sided 5¼-inch floppy disk drives, you used disk storage for programs and discrete data files. Optical technology enables you to view data storage in a new light. In conjunction with your computer, it offers far more than a dumping ground for data.

Data into Information

Computer storage lets you sort, search, and manipulate information in ways that were never before possible. For example, in just minutes, a business executive can sort—and group by region—the total sales for his or her company

for a decade; a doctor can retrieve a concise and diagramed summary of a particular ailment and information about treatment; and a programmer can trace every instance of a particular variable in an enormous program.

The ability to instantly recall large amounts of data in a multitude of formats lets you look at that data from many different perspectives. This lets you better

use that information—to find solutions that may have eluded you, or to see patterns that may have been previously hidden.

Visible Benefits

Along with the benefits of storing information come a series of nightmares. Traditional magnetic storage devices (in which an electromagnetic head flies just microns above the surface of the medium) are susceptible to errors, head crashes, and corruption of data. Indexing and keeping track of files and backups on a gigabyte-plus system can become a major headache. When the hard disk is full, it's full—and there isn't much else to do but buy bigger, faster drives.

Optical technologies offer the beginnings of a solution to all these problems:

- They are interchangeable: When the disk is full, you can just slap in a new one.
- The media are generally far more stable—either (as in the case of WORM [write once, read many times] and CD-ROM) there isn't any magnetization involved, or, as in the case of magneto-optical drives, the drive employs a

continued



medium that (at standard temperatures) is resistant to change.

- You can put documentation on CD-ROMs and keep it on-line—this makes finding solutions or troubleshooting code a nearly instantaneous activity.

Inner Workings

Optical storage devices use a source of coherent light—usually a semiconductor laser—to read and write data. There are three big advantages to using a laser: size, safety, and portability. Because you can focus a laser onto an area that is approximately 1 micron in size—a far smaller area for encoding a bit of data than conventional magnetic drives—you can fit more data into the same area than you could if you were using magnetic storage.

Optical media are also far more stable than metal-oxide disks. They aren't affected by light, normal temperatures, or electromagnetic fields, and the read/write head never gets as close to the medium as it does in conventional disk drives. Because optical disks are interchangeable, you can remove them and take them off-site far more easily than hard disk drives.

Some manufacturers of magneto-optical and WORM drives use proprietary file systems. Some of these vendors build an almost-universal system within their system. As long as all your components are from one manufacturer, you can use the cartridges under just about any operating system with no special modifications. Given the right software, most operating systems can read almost all CD-ROM databases on the market today.

While it provides many advantages, the technology still has growing pains. Optical storage comes in three basic flavors: CD-ROM, WORM, and erasable. The differences in the technologies determine the applications that are best suited for each.

WORM at Work

WORM drives offer you a permanent and virtually incorruptible storage medium. They are ideal for applications that require a lot of data security. Not only is your data safe from disaster, but because the medium is removable, you can safely lock it away from prying eyes.

Most vendors use their own proprietary file format for their WORM subsystems. Thus, a WORM disk created on one manufacturer's drive will likely not be readable by a drive from another vendor. In other words, the WORM medium is not universal. On the other hand, the proprietary nature of the file systems

means that you can probably use the same manufacturer's drive and medium under multiple operating systems.

Of all optical technologies, WORM drives will probably come to occupy the most specialized niches. Although a WORM drive is ideal for backup purposes, it isn't terribly cost-effective unless you have large amounts of data and need file-tracking features. Most WORM drives can keep an audit trail of

Optical
media are also far more
stable than metal-oxide
disks. They aren't
affected by light,
normal temperatures,
or electromagnetic
fields.

different versions of a file.

If you need to keep a record of every version of a file and need to be able to easily access and compare those versions, WORM technology is for you. If you measure the size of your backups in gigabytes—particularly if you want to access those backups randomly—you'll also want a WORM drive.

WORM Guts

WORM media consist of either a polycarbonate or hardened glass substrate and a recording layer made of a highly reflective substance—either a dye-polymer or a tellurium alloy. The recording layer is covered by clear plastic to protect the recording medium.

WORM systems use a laser beam to record data sequentially. A write beam burns a hole—usually called a pit—in the recording medium. This produces either a change in the reflectivity or a change in the phase of a lower-powered read beam. The result depends on the composition of the recording layer. Photosensors pick up the reflection of the read beam. Special electronics translate the information in the beam into binary information.

Most WORM drives use SCSI and proprietary device drivers. While some ven-

dors use the DOS file system, others use a TSR interrupt 21 hexadecimal interpreter, which mediates between DOS and the device driver. The interrupt-handler software usually does not support all normal DOS file operations, and you have to invoke the TSR to access the WORM. The advantage of the interrupt-handling strategy is that it maximizes the version-tracking abilities of the WORM; this can result in better performance.

Using a proprietary file structure also means greater portability of data. For example, if you had a WORM drive that used a straight DOS file structure, you couldn't hook it up to a Mac or Unix box to get at your data. With a proprietary file structure—assuming the vendor supports those other operating systems—all you'd need would be the device and file system drivers.

WORMs are not a universal solution. With access times of 90 milliseconds and more, and data transfer rates in the 600,000-bps range, they are too slow to use as a replacement for a hard disk drive. And if you run a program from a WORM drive, you'll need to direct any temporary files that the program creates to a conventional hard disk drive. If you need permanent data storage and extensive file tracking, a WORM drive is indispensable.

Write and Rewrite

The fastest moving optical technology is erasable or rewritable technology, which is best represented by magneto-optical drives. Magneto-optical technology is fast approaching the point where its access and transfer times will be equivalent to those of current conventional magnetic media (the performance of magnetic media technology, of course, also continues to evolve). Magneto-optical drives offer huge storage potential on a medium that is far more stable than the one that is used in hard disk drives. In many situations it has the potential to displace magnetic media.

Conventional mass storage media are extremely susceptible to magnetic fluxes and mechanical disruption. Because the recording material in magneto-optical disks is encased in plastic, there is little chance of encountering the type of head crash you often see with conventional media. Because it is rewritable, you can use magneto-optical drives as you would conventional hard disk drives.

Hot Point

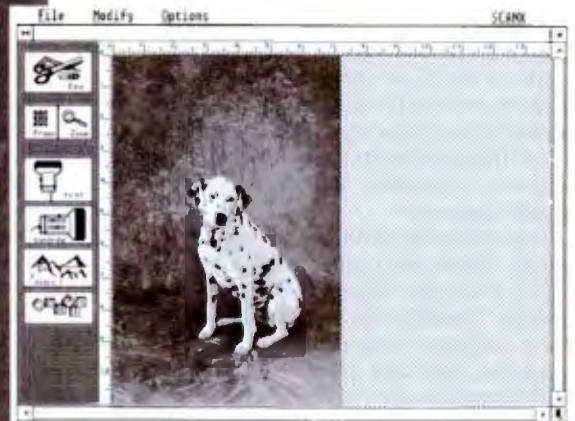
The magneto-optical medium makes use of a recording material that, at room

continued

THIS IS NOT A BLACK & WHITE AD!



This is a two hundred and fifty six shades of gray ad.



When it comes to photographic-quality scanning, NISCAN/GS gives you a shade more for your dollar.

A break-through in imaging technology provides NISCAN/GS with the same true gray-scale output as scanners costing five times as much.

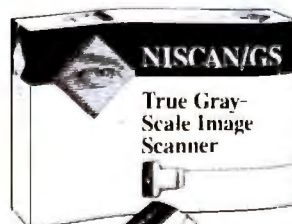
NISCAN/GS has an array of editing tools that can help you effect a subtle retouch or completely remake an entire image. All for \$369.00*.

So if you want professional image quality but you don't think it should cost more than your PC, give NISCAN/GS a try.

Call **1-800-245-SCAN** for your nearest NISCAN/GS dealer.

NISCAN/GS Image

Output: Linotronic 300
DPI: 175 (25 - 400 Possible)
Screen: 100 Line
Shades: 256
Scale: 100%



 **NISCAN/GS**
image is everything®

**NISCA Incorporated, 1919 Old Denton Road,
Carrollton, Texas 75006, 214-242-9696**

NISCAN/GS is compatible with most popular desktop publishing and paint programs. NISCAN/GS supports IMG, PCX, & TIFF compressed and uncompressed formats.

*Manufacturers Suggested Retail Price

Circle 136 on Reader Service Card

temperature, is resistant to changes in magnetization. The measure of this resistance is called coercivity. The coercivity of the material used in magneto-optical drives can be altered only at a high temperature—the so-called *Curie point*. At high temperatures—around 150°C—the coercivity of the recording material becomes 0, and the material can be magnetized.

This is where the laser comes in. The heat of the laser brings the recording material to the Curie point. Then, a bias magnet reverses the magnetic field of the heated area (which represents 1 bit). Because the laser beam is approximately 1 micron in diameter, it does not affect nearby data areas.

One problem with magneto-optical drives is that you can't change a bit directly from one magnetic orientation to another. Initially, the medium has a uniform magnetic orientation. Once the magnetic field has been changed, you can't simply write new data to it like a conventional hard disk drive. Thus, magneto-optical drives need to make an erase pass prior to every write. The first (erase) pass shifts the magnetization of a

bit back to its original state. The second (write) pass actually encodes the data.

You use a low-power laser beam to read the data on a magneto-optical disk. The polarization of the read beam as it reflects off an area of the recording medium changes, depending on the magnetization of that area.

This polarization difference is known as the *Kerr effect*. The read beam is bounced off the disk, directed through a polarized beam splitter, and picked up by one of two detectors. One detector finds areas of positive polarization; the other detects negative polarization. These areas correspond to the on and off bits of the disk.

Magneto-optical disks consist of a polycarbonate substrate with pressed guide grooves and address pits. The guide grooves operate like the grooves on a record album—they keep the magneto-optical drive's laser where it belongs. Address pits are basically the same as the pits used to encode data on WORM and CD-ROM drives. They are laid down at the beginning of each sector. The magneto-optical layer is made up of several layers, including the magnetic alloy. It is

sputter-plated onto the substrate and covered with a plastic coating.

DOS Considerations

Almost all magneto-optical drives are completely transparent in terms of operating system. You don't need to load a device driver or any TSR software to be able to use the drive. You simply partition it with FDISK and format it.

Without a driver, however, the drive will be treated as a fixed hard disk. In order to use an optical drive as a removable medium, you'll need to load a device driver that lets DOS treat the drive as an enormous floppy disk. Even with the driver loaded, though, the volume will be completely DOS-compatible. This is fine if you are using the device in a DOS or networked environment. However, if you need portability between operating systems, see a vendor who offers a proprietary file structure and supports all the platforms you'll be working with.

Magneto-Optical Gets Small

One of the more exciting developments on the horizon is the 3½-inch rewritable

continued

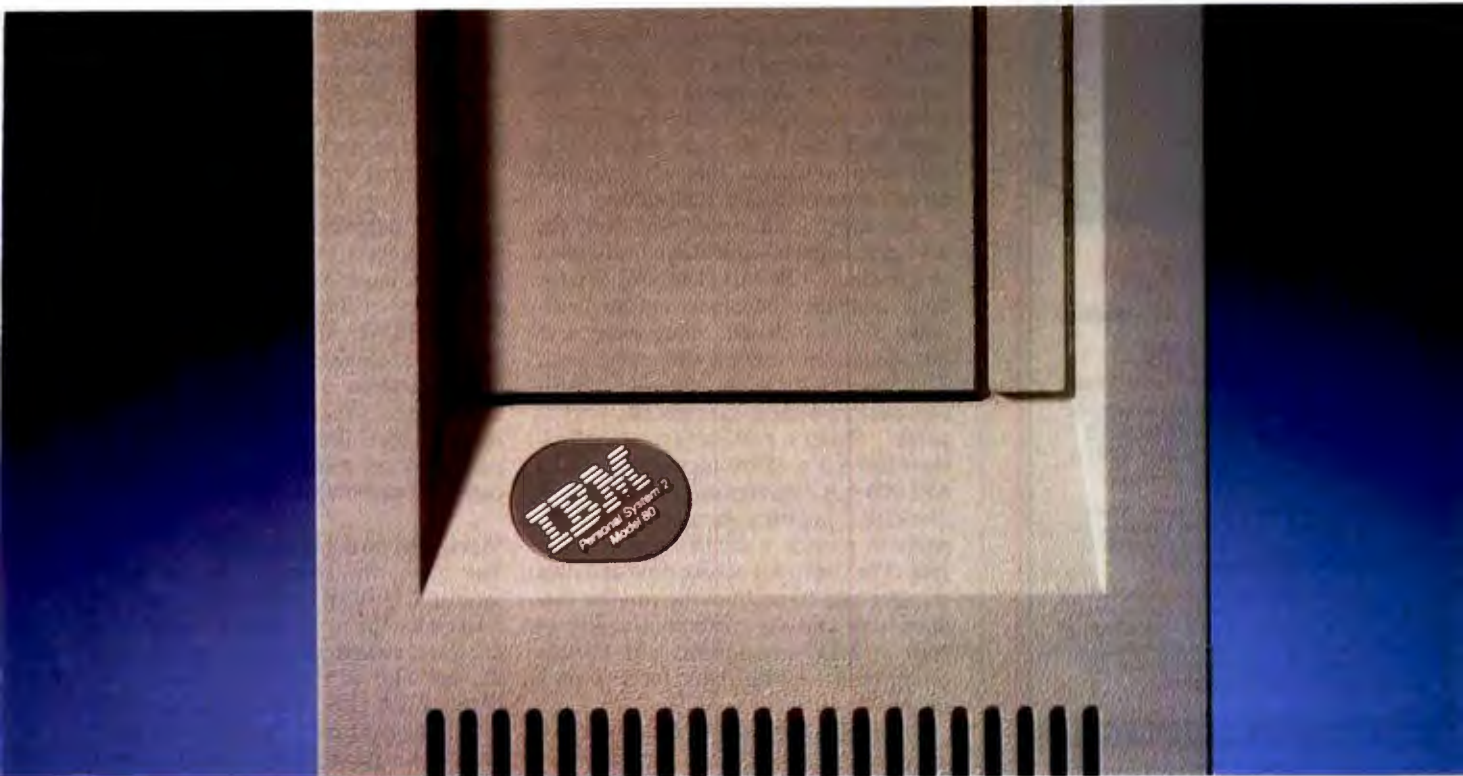
SOFTWARE/SCIENTIFIC

FREE CATALOG

800-942-MATH

MicroMath Scientific Software
Salt Lake City, UT 84121-0550

PS/2® Micro Channel. It Just Got Better.



Again.



Micro Channel "just got better" with IBM's recent introduction of their most

powerful personal systems ever. And when you add our

SpeedStor® disk subsystems, it gets better yet. Inside and out.

The reason is *performance matching*™, Storage Dimensions' systems-engineering approach that assures maximum system throughput and the most intelligent expansion options for these advanced new computers.

Start inside with SpeedStor 155 and 335 megabyte internal ESDI subsystems. Average

seek times are among the fastest available, always under 16.5 ms. And each is designed, tested and factory-formatted for easy installation and optimum performance with IBM's ESDI controller.

On the outside, our SpeedStor external SCSI subsystems deliver unparalleled Micro Channel performance in the most demanding applications. With capacities that range from 150 megabytes to over 2.6 gigabytes. And even more by linking subsystems together.

Get better with SpeedStor. Better performance, today and tomorrow. Better delivery. And better value. Better get on the phone. (408) 879-0300. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.



STORAGE DIMENSIONS

Call me, I'm interested, circle 181 on Reader Service Card.

Please send literature, circle 182 on Reader Service Card.

© 1990 Storage Dimensions. Performance Matching is a trademark and SpeedStor is a registered trademark of Storage Dimensions.

VGA

COMPUTER
IMAGES

MasterCard



Super VGA

Also VGA/EGA/HGC/CGA and Animation

1024x768x256

Photographic Quality Real Color Images

ASTRONOMY • NATURE • SCENIC
FULL COLOR VIDEO MOVIES
HUGE ADULT SECTION • GIRLS

You must be at least 21 for adult images

Now you can experience your computer's maximum graphics ability! We create the worlds highest quality images and video movies. In business since 1979, we helped pioneer the color imaging market.

GIF images for MS-DOS, MAC II, Amiga, Atari and most other computers in your favorite GIF resolutions, EGA to VGA 320x200x256 to SVGA 1024x768x256 and all resolutions between. Viewing computer images is much easier than you might think. We have all the image utilities for printing, display, and editing.

TWO WAYS TO BUY OUR IMAGES

32 Line BBS: 503-777-1578 • You'll have full unlimited access to 1400 megabytes of images and programs on our 24 hour 32 line BBS. Only \$10/hr, no uploading required, no time limits. Free demo and images for new callers. 9600 baud: HST 503-777-0971; V 32 503-777-3794. Must be 21 for adult areas. Buy time online with credit card on the world's largest Online Graphics System!

CATALOG MAIL ORDER: 503-697-7700 • Save long distance phone charges. Order anything found online through our Mail Order Catalog. Also ask about our Starter Packages, any resolution, category including adult; \$39 ea. World-wide shipment. COD, credit card, cash, check. Same day shipment, US Mail, UPS, FEDEX, anywhere.

Free Disk Catalog: If you don't have a modem or wish to order by mail and need more info then call for our free MS-DOS CATALOG on diskette with full descriptions of Images and Order Forms. Easy and fast. Call 503-697-7700 9am to 9pm.

Event Horizons

141 N. State St., Suite 350
Lake Oswego, OR 97034
Information 503-697-7700
Fax 503-836-0495 24 hrs



PRINTS & SLIDES CONVERTED

AMERICAN IMAGING will convert your prints, slides, transparencies, Xrays, or artwork into the highest quality computer images in any resolution or colors, b&w or grayscale. Strengthen your Business, Medical, Science, and Graphics Presentations with photo quality full color images in all MS-DOS, TARGA (all formats), TIF, GIF, PCX, IMG, RIX and most DTP/printer formats. NEXT DAY RUSH JOBS. Quantity discounts. Business accounts. Call for full information.

AMERICAN DIGITAL IMAGING

141 N. State St., Suite 158
Lake Oswego, OR 97034
Business 503-635-8896
FAX 503-636-0495

OPTICAL STORAGE PRIMER

drive. When the International Standards Organization wrote the standard for 5 1/4-inch drives, there were already a number of drives on the market. Consequently, the standard was written loosely in an effort to encompass all these drives. To avoid this problem with 3 1/2-inch media, manufacturers are waiting until the ISO standard is complete before moving forward with their 3 1/2-inch drives—this will help to ensure that all manufacturers' drives are interchangeable.

According to Sharp's Greg Peel, the 3 1/2-inch magneto-optical drive will use a single-sided 128-MB medium. Sharp, Sony, and other manufacturers are developing 3 1/2-inch drives. Sharp expects to introduce some models early next year. The 3 1/2-inch drive may provide significant performance enhancements. For example, Sharp's preliminary specifications call for a 45-ms access time and a 640,000-bps data transfer rate. By using the SCSI-2 interface standard, Sharp expects to provide a 2-MB burst transfer rate. The improved access time and data transfer rate come from the smaller medium size and the medium's ability to spin at 3000 revolutions per minute (compared to 2400 rpm for 5 1/4-inch models).

Rewritable optical disk drives are fast approaching a price and performance level that will make them a viable alternative to hard disk drives. Although the overall costs for a magneto-optical drive are high—in the \$5000 range—the cost per megabyte of storage is lower than that for hard disk drives (once you factor in the comparative costs of buying a whole new drive versus picking up a new cartridge).

Speed is the critical factor. Until the drive can erase and record data in one pass, and until the optical head is made smaller and faster, optical disk drives aren't going to be able to compete with hard disk drives. Panasonic has announced a read/write optical disk drive that uses phase-change technology to feature one-pass writes. Whether the medium is durable enough for continuous use remains to be seen.

CD-ROM

Unlike rewritable and WORM media, CD-ROM is a publishing tool. Although it's possible to produce a CD-ROM disk in-house, the time and expense that it requires makes this a cost-effective solution only if you need many copies of the same data, and if that data is unlikely to change over time. Even then, unless the data has special indexing requirements, you would probably be better off hanging

a WORM drive off a network.

The best way to envision CD-ROM is as an alternative way of accessing information that's traditionally printed on paper. The advantage to CD-ROM is that you can instantly—or almost instantly—access information from the comfort of your desk. You don't have to leaf through the large volumes of information on your bookshelf or at a library.

In the real world, CD-ROM is being used for everything from medical diagnoses to troubleshooting telecommunications switches. A pathologist can use CMC's Cancer Abstracts to take a prepared slide, compare it to an image on the CD-ROM, and make a diagnosis. Many manufacturers are putting their documentation on CD-ROM. Boeing, DEC, Mac Trucks, and Compaq (to name a few) already offer their documentation on compact disk—and other companies are following suit.

Strengths and Limitations

Too often, the charges that are levied against CD-ROM fail to take into account what the technology is designed to do. Sure, compared to even the lowest of the low end in hard disk drives, CD-ROM is dog-slow. But compared to the time it would take to perform the same tasks with paper media—well, you're talking "warp drive" here. And yes, there is no killer application for CD-ROM, but then again, the form and shape of a book hasn't exactly been revolutionized in the last 500-odd years. You need to view CD-ROM technology through a different pair of glasses.

As CD-ROM technology improves, the speed differences between it and traditional media will begin to evaporate. For now, you need to realize the unique advantages of CD-ROM to make the fullest use of this technology. Before CD-ROM can really blossom, display technology needs to improve. Until a screen can duplicate the clarity and resolution of the printed page, reading large amounts of text on a monitor is not going to be comfortable or practical. Even so, CD-ROM will be used increasingly as a reference tool. I can easily envision using a dual-monitor setup—one dedicated to CD-ROM, and the other a standard computer display.

Making It Go

Left to its own devices, DOS cannot recognize the file structure of a CD-ROM. (DOS versions 3.3 and lower are also unable to deal with the size of the CD-ROM volume, which can be up to 660 MB.) To

continued



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®**

Circle 127 on Reader Service Card

Nantucket Corporation 11001 West Jefferson Boulevard, Los Angeles, CA 90066 213/390-7923 FAX 213/397-4669 TELEX: 650 2574125 Nantucket the Nantucket logo and Clipper are registered trademarks of Nantucket Corporation. Other brand and product names are trademarks of their respective owners. © 1989 Nantucket Corporation.

get a CD-ROM to run under DOS, you need a hardware-specific device driver and the Microsoft CD-ROM extensions. The extensions are installable file system drivers that utilize the network interrupt 2F hexadecimal.

A CD-ROM volume name looks like a network volume. Therefore, when DOS gets a file I/O request, it generates the network interrupt. The extensions then look at the volume name; if it really is a CD-ROM device, the extensions pass control to the device driver. To support the extensions and the device driver, you'll need at least 34K bytes of memory (the extensions use 23K bytes).

Fortunately, you can load both the extensions and the driver into high memory; this saves RAM in that precious lower 640K bytes. I had no problems loading the extensions into high memory with Quarterdeck's QEMM or loading them into individual Desqview windows. As a result, I can have two CD-ROM disks on-line at all times. You can also save RAM by telling the extensions to load part of themselves into expanded memory.

Version 2.2 of the extensions should be

out by the time you read this. Microsoft says that it has been working closely with its licensees for this upgrade; the extensions will provide fixes for problems encountered in multitasking environments and for unclear error messages. Another enhancement will let you load 12K bytes more of the extensions into memory.

Although the extensions seem to work seamlessly with DOS and I had no major problems getting them to handle more than one drive at a time, the extensions are really only a fix—not a solution. Microsoft would not comment on what it plans for the forthcoming version of DOS (except to say that it's exploring various approaches). Hopefully, CD-ROM extensions will become a permanent part of DOS.

For OS/2, the problem of getting a CD-ROM to talk to the operating system is greatly simplified by OS/2's installable file system. Microsoft says it is currently working closely with device vendors who are helping to write installable file system drivers for OS/2. Sony and others have already announced IFS drivers—expect to see them later this year or early next year.

In the Marketplace

The CD-ROM player market is growing quickly, and prices are falling. Today, you can purchase a player for as little as \$600. Players come in a range of shapes and sizes, from single-drive units (internal or external) to jukebox-style multi-disk players to daisy-chained units that are housed in one enclosure.

Which route you take depends on your needs. If you're a home user, you could probably make do with a single unit—although if you plan on accessing more than one database at a time, you may want to get two or three. If you're in a business or government environment, you may want to get either a multidrive system or a jukebox-style unit.

The major manufacturers in the CD-ROM player market are Sony, Hitachi, NEC, and Philips. Most companies offer both a proprietary and a standard SCSI; most claim that their proprietary interface offers additional features not available through a standard SCSI.

The CD-ROM market needs to standardize its hardware. It looks like SCSI is going to take over in the long run, and

continued

graphics-MENU 3.0

A sophisticated GUI for Turbo Pascal, Turbo C, Turbo C++ & Microsoft C



\$179 graphics-MENU
\$379 graphics-MENU with source
\$ 99 Data-Entry
\$224 Data-Entry with source
\$549 Pro-Pak (full src & lib's)
Specify BGI, META or Microsoft Graphics
ASK about Genus GX Graphics support
VISA & MASTERCARD accepted

Island Systems
7 Mountain Road
Burlington MA 01803
VOICE (617) 273-0421
FAX (617) 933-1152

DEMO AVAILABLE

FAST SCSI STORAGE

Compatible with 286/386/Laptop, AppleII, Atari, Amiga, Sun, Macintosh, Silicon Graphics, Next

A-Hive & Jr.(3.5") - Enclosure for SCSI Drives

•Room for 2-HH or 1-FH drive	40 Watts	\$119.
•Incl. all internal cables	65 Watts	\$169.



Half Shell-Compact Hard Drive (1.4"x5.5"x7.5")
low power 40MB \$599

Hermit Crab-Portable Hard Drive (2.8"x5.5"x7.5")
32MB to 200MB 28msto12ms \$399

Laptop SCSI Drive 32MB-1.5GB \$595

SCSI Hard/Floppy Drive 2MBto1.5GB \$289

Cartridge Hard Drive 44MB \$499

SCSI Tape Drive 50MB-155MB \$389

2HD/4Floppy 286/386 Controller
1:1 16MHz MFM/RLL

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

**Announcing the end of the
SCSI compatibility crisis:**

SmartConnex


TM



**The SCSI disk controller from DPT
that's so intelligent, it doesn't
need special software drivers!**



See DPT at Booth #115

 **COMDEX/Fall '90**

November 12-16, 1990
Las Vegas, Nevada

*Makes the grade
without software drivers*

SCSI connectivity hassles are a thing of the past! SmartConnex makes it possible for the first time to run SCSI disk drives without special software drivers or BIOS ROMs that cause compatibility problems. Just plug in SmartConnex and you're all set—exactly as though you were using a standard ST506 drive. And, you'll enjoy optional connectivity to hundreds of other peripherals with appropriate software, including tape and optical drives.

A Ph.D. in compatibility

SmartConnex is compatible with all PC ATs and operating systems, and is guaranteed to work with all existing AT applications. So it isn't necessary to buy new programs or make any changes to system software. No matter what operating system or SCSI disk drive you use, you won't have to worry about controller compatibility.

A 68000 I.Q. on board

SmartConnex's on-board 68000 processor and custom-designed ASIC chips make it the highest-performance controller on the market. Its unique design pushes the fastest SCSI disk drives to their top performance limits!

An A+ in affordability

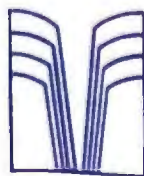
SmartConnex costs less and performs better than other products—it's that simple. When you consider cost along with SmartConnex's other great advantages, there's no smarter move!

Backed by the best: DPT

Distributed Processing Technology was the first to develop caching disk controllers and hardware disk mirroring 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.

Put SmartConnex to the test!

Call today and find out more about the end of the SCSI compatibility crisis—with SmartConnex, from DPT.



**DPT
Distributed
Processing
Technology**

132 Candace Drive
Maitland, FL 32751
Phone: (407) 830-5522
FAX: (407) 260-5366

this seems like a very good thing. You can interface a standard SCSI drive with both IBM and Macintosh platforms. The SCSI bus lets you daisy chain up to seven SCSI peripherals, including other vendor's CD-ROM drives, hard disk drives, magneto-optical drives, and WORMs. With the advent of SCSI-2 and the increased focus by manufacturers on standardizing this technology, you should see a whole host of drives with better performance and compatibility.

In the future, you may see CD-ROM readers integrated into magneto-optical drives (à la NeXT), but that shouldn't deter you now. Of all the optical technologies available, this is the most stable and developed platform. Literally thousands of databases are now available, and it isn't going to cost you a great deal to get started.

Standard Questions

Optical drives are here to stay. With continued improvements in interfaces and hardware, coupled with falling prices, there will be a lot more of them on desktops. At the same time, there is no question that you will continue to use hard

disk drives. Hard disk drive technology has been around longer and is more developed. Although the cost per megabyte for optical drives is lower than for hard disk drives, the start-up costs are far greater.

With the introduction of SCSI-2, the next year will see a general move toward standard SCSIs. This will result in faster data transfer rates and make it far easier to have multiple optical units hanging off the same controller. This may result in standardized interface cards and interchangeable device drivers. This year should also bring many OS/2 installable file system drivers for both WORM and CD-ROM technologies.

You're also likely to see more vendors offering file structures for both erasable and WORM media; this will allow portability between operating systems. The 3½-inch rewritable magneto-optical disk will allow greater use of read/write optical drives in transportables.

Overall, standardization is the next necessary step for optical storage. When drivers, file structures, and hardware can be mixed and matched, optical storage will be as convenient as floppy disk

and hard disk storage. In the long term, you're likely to see greater compatibility between the different optical technologies (e.g., drives that can create both write-once and read/write disks and can read ISO-9660 and High Sierra CD-ROM disks).

Optical Future

Whether the optical disk will ever fully replace conventional magnetic media is impossible to predict. I think that it's unlikely within the next five years. One thing's for sure: Optical technologies, led by CD-ROM, are going to find their way into a great many computers in the very near future. Already, Tandy and Headstart sell systems with CD-ROM drives as standard equipment, and IBM has introduced a CD-ROM drive for its PS/2 line.

Although the information age has been around for over a decade, it will be optical technologies that finally make it fly. ■

David A. Harvey (Houston, TX) is a freelance computer journalist. You can reach him on BIX as "daharvey."

HASP™ -Hardware for Software Protection

Since 1984, HASP has enabled thousands of software developers in more than 30 countries to protect their software. HASP-3 and MemoHASP offer you:

- Asic-based technology providing the highest level of transparency and compatibility.
- Full software support, including access passwords, antidebugging, encryption and virus detection options.
- Interfaces for dozens of languages, under MS DOS, OS/2, SCO XENIX, UNIX and MS WINDOWS.
- MemoHASP has 1K or 4K bits of memory which can be read and written without any special equipment.

HASP - Because there are certain risks you just can't take.

We are seeking **DISTRIBUTORS** in North America. Come meet us at the Israeli stand in COMDEX Fall.



15 Beit Oved St., Tel-Aviv, Israel
P.O. Box 11141 Tel-Aviv 61110.
Tel: 972-3-5375795
Fax: 972-3-5375796

USE YOUR PC'S MORE EFFECTIVELY!



- Extend the distance between Keyboard/Monitor and CPU up to 600 feet with: **Extender**
- Connect 2 or 3 Keyboards and Monitors to 1 CPU with: **COMPANION**
- Control 2 to 96 PC File Servers with a single Keyboard and Monitor with: **COMMANDER**
- Boot up your PC by phone with: **PhoneBoot**
- Reboot your PC File Servers by phone with: **REBOOT**

These Quality Products from CYBEX are guaranteed to your satisfaction, or your money back.

Cybox Corporation

2800H Bob Wallace Ave. • Huntsville, AL 35805
(205) 534-0011 • FAX (205) 534-0010



Now you can build more in a day.

HyperPAD® 2.0, a powerful software construction set for MS-DOS® systems, dramatically increases your productivity. Applications that might take months to build with tools like Pascal, C, or BASIC now take only minutes.

PC Week calls HyperPAD "the first PC program that can compare with HyperCard®." HyperPAD 2.0, now updated with over 100 new features and improvements, has almost limitless potential for creating and customizing tutorials, help systems, software prototypes, front ends to databases, networks, or CD-ROM devices, executive information systems, and dozens of other applications.

It's easy. HyperPAD's object-oriented environment gives you all the building blocks you need for maximum productivity. Its English-like scripting language is easy to use and learn, with dozens of samples to get you started.

It's flexible. HyperPAD will take you into the 90's with a full set of development tools. Its open architecture lets you easily use data stored in dBASE and ASCII files. If you need to, you can even write C or assembly language extensions.



It works on your PC. HyperPAD 2.0 is compatible with almost all PCs. You don't need a high-performance processor, multiple megabytes of memory, a graphics card, or a mouse. You get the benefits of a graphical user interface without investing in Microsoft® Windows™ or OS/2.

And now it's only \$59.95 for Pascal and BASIC users. Order before December 31, 1990, to get HyperPAD 2.0 for **only \$59.95 directly from Brightbill-Roberts** (suggested list \$149.95). Mention this ad and receive a royalty-free runtime module. 60-day money-back guarantee. VISA, MasterCard, American Express, or C.O.D.

Call 1-800-444-3490 today.

Try HyperPAD 2.0 on your next project. No one will ever know how much time you didn't spend.



Brightbill-Roberts

120 E. Washington St., Syracuse, N.Y. 13202

One Word About Your Hard Disk Controller

SLOW

One Word About the PSI hyperSTORE Controllers

FAST

Intelligent Mass Storage Controllers

Virtually all applications are disk bound. Today's PCs have over 60 times the power of their ancestors of just ten years ago, while hard disk performance has only just tripled. This makes mass storage the PC's worst bottleneck. PSI has eliminated this bottleneck with the hyperSTORE Caching Disk Controller, a sort of mass storage co-processor. The hyperSTORE

does for disk-intensive programs what a math co-processor does for number-crunching software. Databases, file servers, multiuser systems, and other disk-hungry applications start screaming . . . frustrated users stop screaming! Call (800)486-FAST now to find out more about PSI's line of intelligent controllers. All you have to gain is time.

hyperSTORE FEATURE HIGHLIGHTS

- Works in any 286, 386, or i486 system
- Simultaneous support for any interface: MFM, RLL, ESDI, SCSI, or AT/IDE
- Can control up to 28 physical disk drives
- 0KB to 20MB of SIMM-based cache memory
- Supports all standard operating systems: DOS, Windows, UNIX/Xenix, Netware, etc.
- Data mirroring option for fault tolerance
- No device drivers are required

PSI

Perceptive Solutions, Inc.

2700 Flora Street · Dallas, Texas 75201
800-486-FAST · 214-954-1774 · Fax: 953-1774

European Inquiries: 415-284-9505

"This thing is literally faster at disk access than the original PC was at memory access."

-Jerry Pournelle, *Info World*, June 11, 1990

"PSI has created the power user's ultimate Lego set for disk controllers: the hyperSTORE/1600"

-Alfred Poor, *PC Magazine*, June 12, 1990

"The real-world result will be blazing record handling from within a data file as well as unstopably fast program loads."

-Bill O'Brien, *PC Magazine*, February 13, 1990

CONTINENTAL COMPUTING

Despite IBM's success there, Europe is a diversified marketplace for computer companies foreign and national

Colin Barker

If I had to pick out the most important month in the history of personal computing in Europe, the choice would be easy: January 1983. That month I attended two press events and saw products that have completely reshaped the European personal computer market and decimated the indigenous U.K. microcomputer industry.

The Beginnings

The first event was a "hands-on" demonstration of a new Apple computer. It was a secret meeting at Apple's European headquarters in Hemel Hempstead in England. After solemnly signing nondisclosure agreements, I sat down in front of a funny-looking computer called the Lisa and was amazed at what I saw. This was probably the easiest-to-use computer ever invented, shown in all its glory, albeit not in its final form—we had a year to wait for the Mac—and I left the demonstration convinced that I had seen the future of personal computing, and it was good.

Two weeks later, I pressed into a room with around 150 other U.K. computer journalists and waited with bated

breath for the "big news" from IBM. It was the belated launch of the IBM PC in Europe, a full 18 months after its U.S. debut. What I saw was a basic, and not particularly well-designed, 8-bit computer dressed up in semi-16-bit clothes. It had a new operating system that looked a lot like CP/M, a keyboard that had important keys in the wrong places, a noisy fan, and slow and noisy disk drives. The

monitor was poor: It was big and clunky, you couldn't tilt it, the poor phosphor quality hurt your eyes, and it had a weak character set. (For ergonomic reasons, it was not legal in Sweden and Germany.) The PC had nothing special to offer over existing systems. Compared to the stately elegance of the Lisa, it stank. But the price was a lot better.

At the time that these two systems were being launched, Europe had a thriving microcomputer industry. In fact, it had many different industries that all contributed to the "new technology" boom. The IBM PC and, to a lesser but still important extent, the Macintosh, changed all that. In the next four years, the U.S. computer industry would come to dominate the European microcomputer market. Why was this so?

Europe Is Different

"One of the biggest mistakes you can make when you launch a European subsidiary is to assume there is some kind of United States of Europe," says Don Taylor, an American with considerable experience establishing European subsidiaries for U.S. computer companies. He is

continued



right. The U.S. is a land of over 200 million people with widely varying ethnic backgrounds, united by a common language, a Constitution, and a belief in "American values." Europe is a land of over 300 million people of widely varying ethnic backgrounds, with no common language (there are at least 40 major European languages), no constitution, and very few common beliefs.

Three separate trade groupings give some areas of Europe a semblance of uniformity. The European Community (EC), formerly the nations of Europe, includes West Germany, France, Italy, the U.K., Ireland, Denmark, Belgium, The Netherlands, Luxembourg, Spain, Portugal, and Greece. The Eastern bloc is a rough grouping of Soviet satellites and includes East Germany, Hungary, Bulgaria, Poland, Romania, Czechoslovakia, and Russia (that part of Russia that lies to the west of the Ural Mountains is considered to be geographically and culturally part of Europe). The third grouping is the European Free Trade Area (EFTA). This is a loose association of the non-aligned states and includes Norway, Sweden, Finland, Austria, and Switzerland. Outside of these groupings are some independent countries (e.g., Yugoslavia and Albania) and a network of semi-independent or completely independent principalities, bailiwicks, and tax havens.

The biggest and most important economic unit is the EC. The idea for the EC was developed in 1952, and the Treaty of Rome established it in 1957. Its aim is "to lay the foundations for a closer union between the peoples of Europe on the basis of a common internal market, the gradual approximation of member states' economic policies, and a framework of common debate."

Within the EC there are no internal tariffs or trade barriers; any citizen of an EC country is free to visit, work, or live in any other EC country. There is a common sales tax (value-added tax, or VAT), and common rules govern agriculture, the sale and packaging of goods, taxes, pollution control, and human rights. But none of this means that there is a "United States of Europe."

By the end of 1992, there will be much closer trade ties between the EC countries; many barriers that exist today will come down. There is talk of introducing a common currency before the end of the century, and some would like to see a full political union follow that. But this all seems to be a long way off.

For now, Europe is a collection of separate countries and separate markets,

each with its own characteristics. The microcomputer revolution is affecting each country differently. As far as PCs are concerned, there is a lot of common ground, but there are also some interesting discrepancies.

The Players

There are some strong computer companies within Europe, but few of them have made any impact in the U.S. One of the exceptions is Groupe Bull. This French company entered the computer industry by signing a deal with Honeywell to set up a jointly owned computer company, Cii Honeywell Bull, in France. While Honeywell Information Systems set up subsidiaries in the rest of Europe, CiiHB prospered, and eventually Bull took over Honeywell's systems interests. Bull is a major player in the systems market (with around \$5.5 billion in revenues last year), and its purchase of Zenith Data Systems earlier this year has strengthened its presence in the PC market.

The Siemens group has dominated the German computer industry. This conglomerate is involved in many areas of manufacturing, from heavy engineering to computer systems to consumer goods. Siemens Information Systems' revenues were around \$6 billion last year. Like Bull, the company has produced primarily mainframe and minicomputer systems. Earlier this year, Siemens took over Nixdorf, the second largest German computer company, with annual revenues of around \$3 billion. Nixdorf is a general systems supplier, but in recent years it has been most successful in supplying electronic point-of-sale terminals.

In the Netherlands, Philips (with annual revenues of around \$3 billion) is the leading computing and electronics manufacturer. Based in Eindhoven, it is a leading company in home electronics and communications.

The U.K. is the home of International Computers Ltd., now owned by Standard Telephone and Cable. ICL traces its genealogy back to some of the first companies that built electronic computers. The going got tough in the 1980s, but the company is now stable. ICL has systematically bought technology from other countries. It uses Fujitsu processors in its mainframes, Sun's SPARC processors in its departmental servers, and a variety of suppliers for its low-end products. The joint STC/ICL group has annual revenues of around \$2.5 billion.

Italy has Olivetti. This company was a late entrant to the computer market. It started with office products, but it is

probably the most successful supplier of midrange systems and microcomputers in Europe. With annual revenues of around \$5.5 billion, it is the second largest supplier in Europe (Siemens is first). It sells Unix minicomputer systems and a wide variety of PC compatibles. Digital Equipment relabels Olivetti PCs in the European market.

Who Is Number One?

Although these companies represent the top six indigenous technology companies in Europe, they are not the biggest. IBM Europe's revenue last year was more than 50 percent of the combined revenue of these six companies. There is no doubt, in Europe or the world, about who is number one.

If you talk to the average European IBM executive, you'll find that the IBM corporate culture is the same there as it is in the U.S. But European executives will point out that they do not work for a U.S. company. The *I* in IBM stands for "International," and the belief among European IBM employees is that their company is a truly international one that just happens to be based in the U.S. For example, if you go to the Hannover Faire in Germany, you will find that IBM GmbH carries all the appearance of a German data-processing company. And IBM (U.K.) Ltd. proudly boasts that it is the largest computer-industry employer in the U.K.

In the 18 months between the launch of the first IBM PC in the U.S. and its European debut, IBM did not waste any time. The initial success of the PC in the U.S. had caught the company by surprise, and it could sell as many of the machines as it could make. Many of the earliest models found their way to Europe, especially the U.K., as so-called "gray imports." IBM anticipated great success in Europe and set up a manufacturing facility in Greenock, Scotland. This facility builds virtually all the PCs and PS/2s sold in Europe today. IBM found the competition in Europe to be stiffer than it was in the U.S. Before the PC arrived in Europe, almost all the major hardware vendors in Europe and the U.S.—from Philips to DEC to ICL to Data General—had launched their own personal computers.

In addition, many suppliers had built up a loyal customer base for their own products. The Commodore Pet and the Apple II were successful in Europe, as were the Tandy TRS computers and the ACT Sirius (a 16-bit microcomputer that was also known as the Victor). While Pets and TRS-80s were considered to be

home or hobbyist computers in the U.S., they were used by both small and large businesses in Europe.

But none of this stopped IBM. With a corporate steamroller approach, IBM launched a blanket marketing campaign and went after its traditional customer, the corporate data-processing manager. It took IBM longer to get the PC off the ground in Europe than it did in the U.S., but it succeeded.

The control that IBM holds over the market is not absolute, however, and there are some notable exceptions to it. And while the big names in the PC software, hardware, and networking business in the U.S.—Lotus, Ashton-Tate, Borland, AST, and Novell—are big in Europe as well, the market is *not* a reflection of that of the U.S. In Germany and Denmark, the Commodore Amiga is popular as a business system; the Germans like the Atari systems as well. If you thought that Digital Research's Concurrent DOS and GEM were "dead" packages, you'll be surprised to find that they sell well across Europe. Multiplan is the most popular spreadsheet in France, where they love the Macintosh. A PC database called DataEase outsells both dBASE III and IV in the U.K.

Timing and Attitude

Two major factors that help determine if a company will succeed in a particular country are timing and attitude: the timing of the move to Europe and its attitude toward Europe.

The classic—and mistaken—way for a U.S. company to approach the European market is to set up a subsidiary in the U.K. or Ireland, launch products there, and (if successful) try to extrapolate the reasons for that success across Europe.

This is an understandable course of action, since it gives the company a chance to try to understand the European mentality, market, and culture while dealing in a common language. The problem is that the U.K. is atypical of Europe. Of all the European PC software and hardware markets, the U.K.'s is the closest to the U.S.'s. A "top 10" of PCs, software, and hardware would be more like the U.S.'s top 10 than any other market's in Europe.

Some companies began early with Europe and learned quickly. One such company is Digital Research. It opened its European offices in the U.K. in the days when CP/M was virtually the only microcomputer operating system available on more than one type of machine. It licensed the system to many local hardware suppliers, first in the U.K. and then

all over Europe. While Microsoft was sweeping the boards in the U.S. after the launch of the PC, Digital Research plugged away first with CP/M-86 and then with Concurrent DOS and GEM. Microsoft arrived in Europe, via the U.K., soon after the PC was launched in the U.S. Microsoft did well, but Digital Research had done enough work to ensure that it had a future in Europe.

On the hardware side, it is a similar story. IBM cut a swathe through the suppliers of microcomputers, and now the IBM PC standard dominates—with some exceptions.

Two major factors that help determine if a company will succeed in a particular country are timing and attitude.

Of Apricots and Acorns

Before the PC arrived, the U.K. boasted more than 20 domestic manufacturers of microcomputers, all different, with different operating systems and no standards. Most have long since vanished. One supplier that held out longer than most is Apricot. This company came out of a systems house called ACT. ACT first became involved with microcomputers when it won the rights to sell the Sirius microcomputer in the U.K. From there it was a short step for the company to set up its own manufacturing arm to make the Apricot computer.

This was an interesting system: It was one of the first to use 3½-inch floppy disks as standard, which meant that although it was based on the 8086 processor and could run MS-DOS, it was not IBM PC-compatible. A neat design with an excellent screen made it a system that disparaged the IBM PC. It was semiportable—in the same way that the early Macintoshes were—and packed more power than an IBM XT into a very small box.

Its success was helped by the fact that many data-processing managers (the biggest PC customers) were familiar with

the ACT. It was like buying from IBM; the Apricot came from a company people thought they could trust. But, like everybody else, Apricot had to fall into line, and, in recent years, the only personal computer products coming out of the company have been PC compatibles. This year, ACT sold the Apricot portion of its business to Mitsubishi.

Acorn is the only other major personal computer supplier to survive the last six years in the U.K. This company produced an 8-bit computer that, thanks to generous government support, became the standard for use in British schools. It was also successful as a home computer. As times got tough in the home-computer marketplace, Acorn diversified into Unix systems. The company produced the excellent Archimedes computer for the home/educational market and the R100 series of Unix workstations based on its own RISC technology. This was not enough, though, and Acorn is now owned by Olivetti.

Survivors

Look around Europe, and you'll see similar tales of manufacturers struggling to come to terms with IBM and either going out of business, finding a benefactor, or falling into line and producing PC compatibles. Olivetti has been the most conspicuously successful company.

With a solid background in office systems, Olivetti first moved into the PC market with the M24. This PC compatible was stylish, performed better than anything IBM offered (although tweaking the system gave it some compatibility problems), and was very well designed. It took up just over half the desk space that the IBM PC required, but it still had the same number of slots and a much better screen. In fact, Olivetti tried to repeat the success of Compaq by offering compatibles with added value and Italian élan. It was hugely successful in Europe; it was also Europe's last great shout in the PC market.

Over the last four years, the European market, like the U.S. market, has become a commodity market and is much more price-driven than before. Suppliers from Japan and Taiwan have moved in and have been very successful. But the European suppliers will not lie down; they still add variety and interest that you will not see anywhere else. Olivetti still produces the prettiest and most elegantly designed PCs. Victor of Sweden produces PCs with lots of power in a small box. Schneider of Germany produces PC compatibles that are to the PC industry

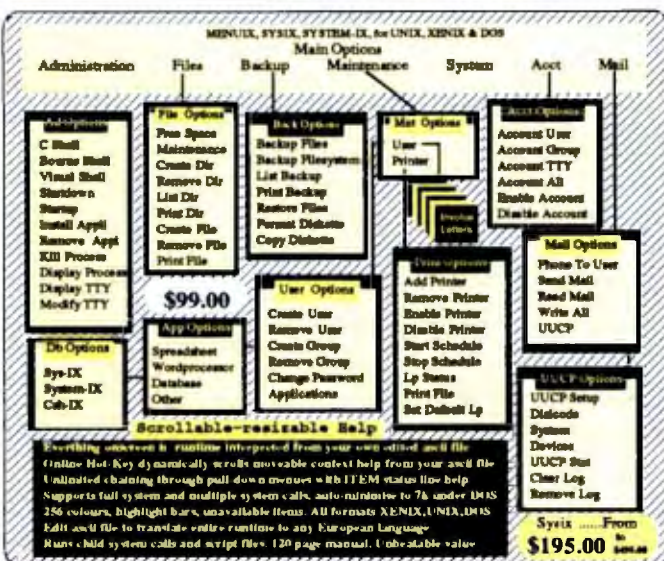
continued

G.W. Computers Inc.
ADC1, 4 Eagle Square
E Boston, MA 02128
U.S.A.

Tel: 617-569-5990
Fax: 617-567-2981

System IX (Network Ltd.)
55 Bedford Court Mansions,
Bedford Avenue, London
WC1B 1AD U.K.

Tel: 071-636-8210
Fax: 071-255-1038



NO Compiling
NO Programming
NO Hassle
C Source code
is available
if desired

DESIGN
YOUR OWN
MENUES AND
FORMS
DATABASES
WITH JUST AN
EDITOR ON A
TEXT FILE
THAT GETS
LOADED
AT RUNTIME

YOU ARE IN
CONTROL OF
EVERYTHING
ON-SCREEN

MULTI
LINGUAL
RUNS IN
STANDARD
ASCII BASED
LANGUAGES:
FRENCH
GERMAN
SPANISH
ITALIAN

FOR DOS
UNIX & XENIX

EXECUTES
SCRIPTS
PROGRAMS
BATCH FILES
SCREEN-SAVER
TIMEOUT WITH
OPTIONAL
PASSWORD
RE-ENTRY

CONTINENTAL COMPUTING

what Volvos are to the car industry—not the prettiest devices in the world, but ones that you know will last.

Apricot invests a lot of money in R&D in its bid to stay one step ahead of the Japanese. Other companies, such as Tulip of Holland, Mission of the U.K., and Philips, are all trying to get an edge through technology or price and are adding variety to the market.

Then there is Amstrad. This home-electronics company is run by Alan Sugar, who decided five years ago he could produce a fully functioning business computer with monitor, drives, printer, and software for less than £500 (about \$900). He was spectacularly successful. His completely non-IBM-compatible system sold by the millions. (He eventually moved to IBM compatibles as well, with slightly less success.) He is one European who realized very quickly that, like soap, cars, and bicycles, computers are commodities. If your expectations are big and your pockets are small, then Sugar is your man.

Sugar established that a target price-point in the U.K. for a complete computer system for home use was £500. This is a trend that other companies have followed. But that is at the lowest end of performance and cost; in concentrating on that end of the market, Sugar is a specialist and also an exception in Europe. His is one company that can enjoy some success by competing price-wise in the PC market with the Eastern suppliers.

The rest of the European PC manufacturers are looking elsewhere for growth and profit. The two key areas that they are concentrating on are high-end i486-based PC systems and the Unix or Open Systems market.

Analysts believe that the Unix market is growing more quickly in Europe than anywhere else in the world. Workstations are beginning to take business away from the PC in the general computing market. European suppliers are desperately hoping that this will continue, because Unix systems mean big file servers, complex networks and terminal connections, expensive software, and the opportunity to sell personal computer systems the way minicomputers used to be sold: with high margins and big profits. European companies find it difficult to compete with the rest of the world on price and quality. The European suppliers hope that the tastes of PC users will continue to change. ■

Colin Barker is a BYTE senior news editor in London. He can be contacted on BIX as "colin.b."

You know the terminology... but can you spell it?



TAKE the guesswork out of spell checking by adding TechWords to your word processor's spelling checker. TechWords contains over 40,000 words which are missing from popular word processor spelling checkers. You can select the categories which are most appropriate for your needs. Some of the categories included are:

- Earth & Planetary Science
- Life Sciences
- Computer Science
- Chemistry
- Math & Physics
- Engineering

TechWords is only \$79.00

To order TechWords or for more information,
CALL GEOCOMP at (800) 822-2669



GEOCOMP Corporation
66 Commonwealth Ave.
Concord, MA 01742

CREATING VIRTUAL PCs ON THE 386

*They said it could be done but never told how;
here is how!*

Matt Trask

With the introduction of the Intel 386 microprocessor, it became possible to create virtual machines with a desktop personal computer. Although there has been a long tradition of VMs in larger computer systems, such as the Wang VS series and the IBM 360 with CP/CMS, this is the first time this kind of capability has been available to the small-computer user. OS/2 2.0, Alloy's 386/MultiWare, Microsoft Windows/386, and the Borland Turbo Debugger all use this new operating mode.

Even if you are not trying to create the next great hypervisor for MS-DOS, the emulation techniques discussed here will show you how to use the 386's virtual 8086 (V86) mode to virtualize an IBM PC compatible in your favorite 386 operating system.

Although the Intel literature makes the statement that "the 80386 can switch rapidly between its protected mode and V86 mode, giving it the ability to multiprogram 8086 programs," there is very little information available for the programmer on how to implement such a system. I will draw on my experiences with Phoenix's VP/ix and Control/

386 projects, as well as the Stellar "MS-DOS in an X Window" project, to describe the various methods used in creating a virtual PC (VPC).

A Historical Perspective

For the purpose of this discussion, I'll define a VM as any combination of hardware and/or software that creates an environment in which a piece of software

can be fooled into believing that some hardware feature or operating-system capability exists when it really doesn't. A good example of this is the familiar RAM disk programs that are used on many PCs. This combination of RAM and software creates the illusion of a very fast disk drive that an application program cannot distinguish from the real thing.

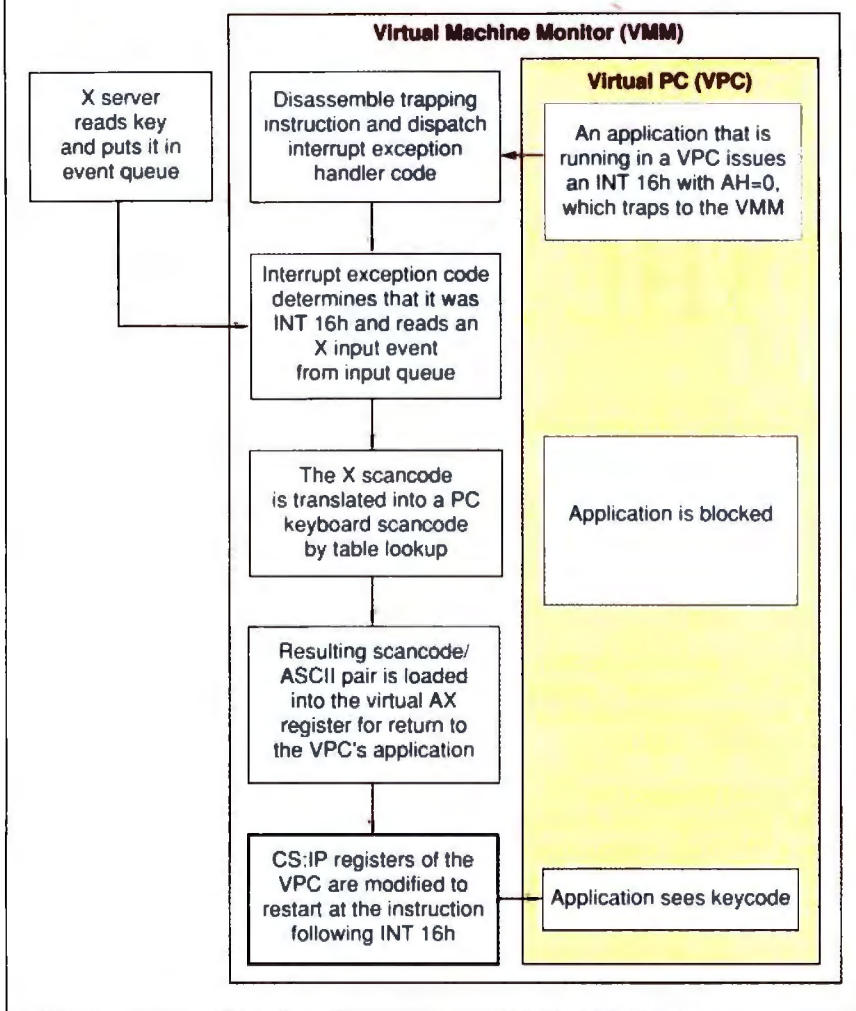
VMs have traditionally been offered as a way of maintaining backward compatibility with an existing software base when a computer manufacturer introduces newer, incompatible hardware or operating systems. In this way, vendors can offer newer technologies while leaving their customers with that warm fuzzy feeling as they continue to use all that expensive software and data they accumulated with older systems. IBM's System 370 with VM/370 is a good example of this, because it can actually run OS/370 batch jobs faster in individual VMs than if the jobs are all multitasked under OS/370.

Although VMs may seem to be the sole province of large computer systems, the PC community also has a long

continued



VIRTUAL MACHINE AND X WINDOW SYSTEM



A virtual machine using an X window for its user environment. The X client is running separately on the host. The X server is wherever the user may be.

tradition of such necromancy. Products such as MultiLink from The Software Link and DoubleDOS by SoftLogic Solutions allow more than one DOS application to run concurrently on a PC by providing each program with the illusion of its own PC operating environment, albeit with limited memory for each program. Another example is the hardware co-processors created by Phoenix Technologies for Unix workstation companies like Sun and Apollo—these allow DOS applications to run in systems that do not have Intel-family CPUs or PC-compatible expansion buses.

One VM system that failed in the PC marketplace is the NEC V20 microprocessor. Although this CPU is capable of executing the 8080 instruction set and

this ability can be used to virtualize the CP/M 2.2 operating system, it was never a smashing success. I attribute this to the lack of a widespread, large investment in CP/M applications software. Computers with 8088 processors were capable of running most of the same applications as CP/M (e.g., WordStar, dBASE II, and Crosstalk) under a very similar operating environment, MS-DOS. With no 64K-byte limit, there was no incentive to develop virtual CP/M systems.

The 386 arrived at a time when large corporations had tremendous investments in DOS software, such as Lotus 1-2-3 and Microsoft Word, none of which can execute directly in the 386's native protect mode or be easily ported to run in such an environment. This large soft-

ware base will ensure the success of VM products that are based on the 386.

It is important to note that although the V86 capability of the 386 can be used to emulate operating systems such as MS-DOS, greater success comes from emulating the PC itself, because its large base of installed software is heavily dependent on the vagaries of PC hardware.

Current Products That Use 386 VMs

Before digging into the hows and whys of emulation, here's a look at some of the products that use the V86 mode of the 386 and where they fit in. I'll divide these products into three groups: hypervisors, applications, and control programs.

A *hypervisor* is a multitasking environment that allows concurrent execution of more than one VM. Each VM may be running a copy of DOS or some other PC operating environment, such as CP/M-86. Windows/386, Alloy's 386/MultiWare, and Intelligent Graphics' VM/386 are good examples of hypervisors because they all use V86 mode to run multiple copies of MS-DOS, each with real-mode DOS applications. I'll also put The Software Link's PC-MOS under this category, although there is a fine line beyond which it would have to be called an operating system instead of a hypervisor because it also provides a native execution environment for new software development.

VP/ix from Phoenix Technologies/Interactive Systems and Merge 386 from Locus Computing are both examples of what I'll call *applications*. Rather than providing the multitasking environment of a hypervisor, they provide the ability to execute DOS in VMs while running as an application under various 386 Unix operating systems. They get their multitasking ability as a result of the environment that they run in. The Sun386i workstation demonstrates this "DOS under Unix" technology—older Sun systems require the addition of emulation hardware in order to run DOS, but the 386i comes with DOS built in because of the V86 capability of its 386 CPU.

The last group of 386 VM products is the *control* programs. These use the new capabilities of the 386 to enhance the use of the system but do not attempt to be operating systems in their own right. Compaq's CEMM program allows DOS to run in V86 mode while using the CPU's page-translation hardware to emulate the operation of an AboveBoard. Qualitas's 386Max provides similar functionality for 386-based machines. Phoenix Technologies provides Control/386 to OEMs

for more specialized uses, such as back-filling DOS memory to 640K bytes in machines that are capable of adding only 512K bytes below the 1-megabyte boundary. Debuggers such as Nu-Mega Technologies' Soft-Ice/386 and the Borland Turbo Debugger are among the more interesting applications that can be found in the control-program genre. These products operate on real-mode DOS applications and run them in 640K-byte VMs. By keeping their own code outside of the DOS address space and using the CPU's hardware debug registers, they can provide functionality similar to that of much more expensive in-circuit emulators.

My own Stellar MS-DOS project falls into the control-program category. Its primary function is to run a 386-based service processor built into the Stellar Model GS1000 Graphic Supercomputer. In this capacity, it boots the big CPU and handles low-speed I/O devices, such as mouse, keyboard, and serial lines, on behalf of the GS1000's native Stellix operating system. Because this places little demand on the 386 CPU, all extra cycles are used to run MS-DOS in a VM that displays its output through the Stellix X Window System display manager as if it were a native Stellix application.

How to Virtualize

Emulation is the technique of gaining control of the CPU from a program that is executing and passing the program's execution to some sort of a monitor or supervisor program. This monitor then determines what the original program was trying to do, causes the desired result, and restarts the original program at the place at which it would have normally arrived if it was not in an emulated environment. This taking of control is referred to as *trapping* and usually requires hardware support. On the 386, trapping generally takes the form of a general protection (GP) interrupt. An example of software-based trapping would be a virtual disk device driver that is chained onto the Int 13h vector so that it gets control every time a disk request is made.

The 386's V86 mode provides many trapping mechanisms you can use to support emulation of PC-compatible hardware. It is possible for a VM monitor (VMM) to set up trapping on accesses to I/O ports, interrupts, operations that affect the interrupt flag (IF), and attempts to execute privileged operating-system instructions, such as those that enter and leave protected mode.

The figure describes the flow of control in a keyboard emulation. PC-based

Address Translation

The 8086 and 8088 CPUs generate linear memory addresses from two components—a segment and an offset. The segment address is shifted left by 4 bits, and the offset is added to the result, giving a 20-bit linear address. A 286 or 386 in real mode generates addresses in the same fashion.

The segment component is renamed to selector when running in protected mode. Instead of being a value that can be used directly to compute an address, a selector is an index into a table of segment descriptors. Each descriptor contains information about the location,

size, and protection attributes of an area of memory. When a selector is loaded into one of the segment registers, its associated descriptor is used to calculate linear memory addresses instead of the older shift-and-add method.

When the 386 CPU is run in virtual 8086 mode, address translation is done as if it were an 8086 CPU. This means that all virtual PC address space must begin at an offset address of zero. Protection in a multitasking system must be provided by the memory management unit because segment descriptors are not used.

application programs typically get keystrokes by using Int 16h to read them from a ring buffer. The data objects in the ring buffer are a combination of an ASCII value and the scancode of the key that was pressed. In the Stellar MS-DOS implementation, all keystrokes are received from an X window and must be translated into a form that is useful to PC applications. If a trap is taken every time an Int 16h is issued, the VMM can read an X keyboard event, translate it into an ASCII/scancode pair, load this value into the AX register, and resume execution at the instruction following the Int 16h.

Other examples of emulation are the so-called limulators—products that provide the same functionality as an Intel AboveBoard by trapping all use of Int 67h and using the 386's page-translation hardware to remap extended memory in the same way that the AboveBoard's hardware remaps extended memory.

Why Virtualize?

By supporting VMs, an operating system can execute other operating systems as if they were applications, or perhaps just execute applications that would normally run under some other operating system. An example of the latter would be a version of Unix that has been extended to directly execute OS/2 binary programs.

One primary reason for virtualizing an operating environment is to provide the illusion of hardware support for peripheral devices that do not really exist. Often the host system will have peripheral devices such as floppy disk drive controllers or video controllers that are not compatible with the NEC 765 and Motorola 6845 used in the PC; in this

case, the emulation software can translate I/O requests into a format that is meaningful to the native devices. An equally important reason for virtualizing an operating environment is to provide for the sharing of devices like serial lines and floppy disk drives in multitasking environments.

Although it is possible to create an environment that directly virtualizes MS-DOS by trapping at Int 21h and virtualizing the individual DOS calls, I believe that a more thorough and compatible job can be done by emulating the hardware of the PC itself. In the past, operating systems like Concurrent DOS (also known as Concurrent CP/M) provided less-than-complete emulations via the use of filter programs and case-by-case exception handling to run only the most popular applications software.

386 Support for VMs

The 386 has many advanced features that support the creation of VPCs. These include multitasking, virtual memory, memory protection, and I/O protection. The 386 multitasking model provides for hardware-based task switches in which the registers associated with an outgoing task are dumped by the CPU into an area of memory called a task state segment, and the registers for the incoming task are restored from its TSS. V86 mode is a special kind of task—when bit 17 of the EFLAGS register is set, address translation for the associated task is done as it would be on an 8088 (see the text box "Address Translation" above). There are also changes to the way that I/O protection is handled that make it easier to do device emulations.

continued

Virtual memory is the ability to remap memory resources as needed to locations other than the physical addresses associated with them. You can use this to create the illusion of greater system memory than actually exists because some of a process's memory can be stored on disk

when it is not needed. In addition to 286-compatible segment-based address translation, the 386 is capable of doing page-based address translation. With its built-in memory management unit (MMU), the 386 can map any 4K-byte page of physical memory to any virtual address

within the CPU's 4-gigabyte linear address space. Virtual memory is particularly important when emulating a PC because all VPC memory maps must originate at logical address 0:0.

Memory protection is a fundamental requirement of a multitasking system; if a task could arbitrarily alter another task's memory, the system could crash at any time. The 386 provides two types of memory protection: descriptor-based and page-based. Descriptor-based protection is the technique used by OS/2 1.x to protect an application's memory segments. This method is not appropriate for a V86-mode task because segment descriptors are not used. Page-based protection uses the MMU to create a unique address space on a per-task basis by changing the memory map on each task switch. You can obtain additional protection on a per-page basis by defining supervisor (kernel) and user (V86 task) page attributes. Later I will show how page-based memory protection can be exploited to emulate a memory-mapped video system.

The 386 CPU provides for I/O protection to trap any or all accesses to I/O port addresses. The 386 version of the I/O privilege level (IOPL) mechanism is an extension of the 286 that includes a selective trapping mechanism. The 386 uses an I/O permission bit map for each V86 task with a bit corresponding to each byte-wide port. By setting and clearing these bits, a VMM can take traps on devices that need to be emulated or shared while allowing direct access to selected hardware by VM application programs.

Emulation Techniques

Once the VMM has gained control of the VM due to a general-protection trap, there are many different techniques that you can use to perform an emulation. For the purpose of discussion I'll assume that the GP trap handler is entered by a task switch so that the VM's TSS will contain a snapshot of the VPC's registers. By using the stored CS and IP values from the TSS, the VMM can build a pointer to the instruction that caused the trap; by disassembling the instruction, it can determine what type of emulation is appropriate. After the required result is obtained, the VMM "fixes up" the TSS so that when the VPC task restarts, it begins execution at the first instruction after the one that was trapped.

I/O trapping is the most straightforward method of emulating PC peripheral devices. This emulation is simplified by the register-based interfaces to VLSI

continued

Listing 1: The UART defined as a state machine with a C structure.

```
struct uart {
    u_char iob; /* Tx/Rx buffer */
    u_char dll; /* divisor latch LSB */
    u_char dlm; /* divisor latch MSB */
    u_char ier; /* interrupt enable register */
    u_char iir; /* interrupt ID register */
    u_char lcr; /* line control register */
    u_char mcr; /* modem control register */
    u_char lsr; /* line status register */
    u_char msr; /* modem status register */
    u_char scr; /* scratch register */
};
```

Listing 2: Flow of control during reflected interrupt and IRET trap.

```
/*
 * REFLECT() - cycle a VPC interrupt service routine.
 */
reflect(regs, intnum)
regs_v86_err_t *regs;
u_char intnum;
{
    u_short *mem_ptr;
    u_short flags;

    /* calculate flags image from virtual flags */
    flags = regs->FLAGS;
    if ((*VIRTUAL_FLAGS & IF) { /* is virtual IF set? */
        flags |= IF; /* yes, set it here */
    }

    /* "PUSH" FLAGS, CS, and IP registers */
    mem_ptr = (u_short*)((regs->SS << 4) + regs->SP);
    *--mem_ptr = flags;
    *--mem_ptr = regs->CS;
    *--mem_ptr = regs->IP + 2; /* fixup for restart */
    regs->SP -= 6; /* fixup SP */

    /* calculate new CS and IP from interrupt number */
    mem_ptr = (u_short*)(intnum * 4);
    regs->IP = *mem_ptr++;
    regs->CS = *mem_ptr;
}

/*
 * IRET_HANDLER() - VPC trapped on an IRET instruction.
 */
iret_handler(regs)
regs_v86_err_t *regs;
{
    u_short *stk_ptr;

    /*
     * "POP" CS, IP, and FLAGS registers, force IOPL to zero
     * and clear the interrupt flag in case v86 code modified
     * the flags image on the stack
     */
    stk_ptr = (u_short*)((regs->SS << 4) + regs->SP);
    regs->IP = *stk_ptr++;
    regs->CS = *stk_ptr++;
    *VIRTUAL_FLAGS = *stk_ptr; /* save virtual IF */
    regs->FLAGS = *stk_ptr & 0x0dff; /* IOPL=0, CLI */

    /* fixup stack after 3 "POPs" */
    regs->SP += 6;
}
```


Celebrating Eight Years Of Quality GTEK Products!



MODEL 9800

- Programs 8 parts at a time
- Programs up to 4 megabit parts, including single chip processors
- Operates serial to 56Kbps or stand alone

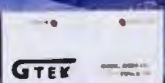


MODEL 9000

- Fastest programmer on the market
- Quick & Intelligent programming algorithms
- Programs up to 4 megabit parts, including single chip processors
- Programs largest variety of chips including Prom replacements, Eproms and EEproms

ROMX-2XL EPROM EMULATOR

- Emulates 2716-27010 oproms
- 256K to 1024K memory available
- Battery backed up, auto emulate on power-up
- Low-cost, pays for itself on first project
- Free 19.2K serial communication software



QUALITY PRODUCTS
MADE IN THE
USA!

PCSS-8IV INTELLIGENT SERIAL COPROCESSOR

- Compatible with PCSS-8I
- Up to 768K of Dynamemory™
- Utilities provided to download and execute 8086 code on the board
- DOS, SCO™, XENIX® drivers



PCSS-8I INTELLIGENT SERIAL COPROCESSOR

- On board 15MHz processor handles serial communications
- 32K of Dynamemory™ included
- Reduces host processor overhead
- DOS, SCO™, XENIX® drivers



MCSS-9IM INTELLIGENT SERIAL COPROCESSOR

- For Micro-Channel™ computers
- Up to one megabyte of Dynamemory™
- 9 serial channels per card



MCSS-8TX SERIAL BOARD

- 8 DOS compatible COM ports for Micro-Channel™ computers
- BIOS enhancement software included



MODEL 2020



- Cost controller board
- RS232/485/422
- Stackable option boards

PCSS-8X SERIAL BOARD

- Eight RS232 ports per card (optional 4 port)
- All eight ports 100% DOS compatible
- 32 ports may be added to a PC
- Optional RS422 to 4000 ft.
- Interrupt driven BIOS enhancement software included



MODEL 2010

- 64 bit digital I/O board
- Each bit programmable as either input or output



MODEL 2010 SINGLE BOARD COMPUTER

- 2010B: 8052AH - basic V1.1 solid state EEprom disk system
- 2010M: Machine language with built-in assembler/disassembler
- 64KByte RAM, 40 bit programmable I/O lines
- RS232 and expansion interface



PCSS-8TX SERIAL BOARD

- Compact half sized version of the PCSS-8X with RJ-11 jacks
- Order PCSS-8TH for SCO™, XENIX®

GTEK® INC.

Development Hardware & Software
P.O. Box 2310, Bay St. Louis, MS 39521-2310
Order Toll Free 1-800-282-GTEK (4835)
Fax: 1-601-467-0935
MS & Technical Support 1-601-467-8048

peripheral devices such as the interrupt controller, floppy disk drive controller, universal asynchronous receivers/transmitters, and video controller. The 8250 UART is a good example of a device that is easy to emulate directly. I start by defining a state machine as a standard C structure (see listing 1).

Whenever an application outputs to the COM1 address range of 3f8h through 3ffh, the VMM fills in this structure with the data byte that is being written. An input trap at one of these ports will return the value that is stored in the structure. A VMM armed with this information can do emulation in a few different ways. One way is to translate 8250 UART I/O to commands that are meaningful to some other UART—like an 8251 or 8530—that is available in the system.

If the VMM is hosted by an operating system such as Unix, the emulation code would use control outputs that set the data transfer rate, raise DTR, and so on to do `ioctl()` calls to the standard Unix serial device driver. In this case, the VMM stores the status returned by the driver in the structure's status registers until an input trap is taken. The VMM makes the translation between the inputs and outputs at the virtual Tx/Rx buffer port, and the reads and writes of a file descriptor associated with the Unix serial driver.

Interrupt Reflection

Interrupt reflection is a technique whereby the VMM takes a trap on an `INTnn` instruction but does not immediately attempt to do any emulation. Instead, it fixes up the V86 task's TSS to the interrupt state. The VMM uses the SS:SP registers to build a pointer to where the CS, IP, and FLAGS registers would be written with the three PUSHes used to save them. SP is modified as if these three PUSHes had been done, and the register values are written at the address pointed to by SP. Next, the VMM gets the interrupt handler's address from the table in low memory and writes it as CS:IP in the TSS. When the VPC is restarted, it executes the interrupt service routine that the vector table pointed to. The IRET instruction at the end of the ISR is trapped. The VPC reverses the situation by retrieving CS, IP, and FLAGS from the place where it synthetically PUSHed them. The SP register is restored to its original values.

Listing 2 shows code fragments from the Stellar MS-DOS VMM code that reflect interrupts and handle the IRET instruction used to return from a reflec-

tion. This technique is most useful with BIOS interrupts where it is desirable to wait for the BIOS port accesses and use the I/O trap as the entry point into emulation code.

In my task-switching GP trap model, reflection is not very useful as a way to handle real hardware interrupts because of the latency of 538 clock ticks associated with doing a task switch on every external interrupt. Even if this were not a problem, a multitasking system that is running more than one VPC might have the task with the proper interrupt handler idle or swapped out at the time the interrupt occurs. This means that the kernel must be able to participate in interrupt handling on behalf of the VM. Device drivers with intimate knowledge of the interrupting hardware can field the actual interrupt and save the data or other interrupt event information in a queue for later delivery to the VPC's ISR. A signal is then sent to the VMM indicating that an interrupt reflection is required for the VPC to process the interrupt as if it were an asynchronous event.

Memory Translation

Memory translation and protection can also be used for device emulation. Memory pages that have been mapped to the video regeneration buffer addresses of B000h and B800h can be marked as read-only, which causes a page-fault trap whenever an application attempts to write directly to video memory. The page-fault handler can then dispatch to video emulation code, which determines what the application was trying to do and causes the same effect on the computer's display.

In the Stellar MS-DOS project, I used a hardware assist in video emulation—there is a block of shared memory that is used for interprocess communication between the 386 kernel and Stellix. This memory is doubly mapped so that it can be accessed either as ordinary RAM or as first-in/first-out RAM. When pages are mapped from the FIFO address range into video buffer locations, all writes by PC applications to this RAM have their addresses encached in the associated FIFO. The video emulation code that is running under Stellix can retrieve these addresses and use them as indexes into the shared memory array to obtain video updates rather than using the less efficient method of comparing the whole video buffer with a local copy. You can also use memory translation to solve the infamous A20 wrap problem by aliasing the first 64K bytes of memory to the 1-MB boundary.

How to Emulate a PC

Now that I've illustrated some emulation techniques, I'll create a working definition of what it takes to virtualize a PC-compatible system. Remember that you are emulating the hardware of a PC rather than just the MS-DOS operating system, so every standard PC peripheral device must be accounted for. Of the subsystems that I'm about to describe, most are best emulated by I/O trapping when the BIOS or an application attempts to directly access the device.

The keyboard is both simple and complex to emulate. In its simplest form, you can emulate the keyboard by trapping Int 16h, reading data from the keyboard or device driver, and returning this input data to the VPC in the TSS register image. The complexity occurs when you consider the other functions of the keyboard controller and the real devices that you can use to emulate the keyboard. The 8042 keyboard controller chip is also responsible for software CPU resets and gating the A20 line to cause megabyte wraps on AT-type systems. A PC keyboard generates scan codes that identify which key you've pressed and whether it was a downstroke or an upstroke (i.e., make or break codes). If you are using an ordinary ASCII terminal (e.g., a VT100) as the VPC's console, some translation must be done from ASCII to scan code, and break codes must be synthesized. Stellar MS-DOS uses X as the source for input, so the translation is pretty easy; X input events include a scan code equivalent and press/release information, so it is just a matter of doing a table lookup to find the corresponding PC-compatible scan code.

Console emulation must provide a PC-compatible display, such as MDA, CGA, or Hercules, in addition to being a source of keyboard input. You can use serial terminals as VPC consoles by emulating PC video attributes (e.g., inverse video, underlining, and flashing) with whatever capabilities exist in the terminal. You can simplify this task by using terminals like the Wyse 60 and the Kimtron, which have PC-compatible display attributes and can be programmed to generate scan codes.

Video emulation is usually a combination of memory-based protection (as mentioned above) and I/O trapping on ports associated with the 6845 CRT controller. Lotus 1-2-3 is one of the main reasons for this combination—it uses BIOS and direct video memory accesses for most of its work, but goes directly to the 6845 when entering a graphics display mode. Because of this, an interrupt

trap on the video BIOS alone would be inadequate to emulate all 1-2-3 output. The consensus among many 386 VM developers is that EGA graphics emulation is too difficult to perform in software. The complex architecture, combined with many write-only control registers, would consume too much compute power in return for a very-low-performance emulation. VGA, on the other hand, may provide new opportunities, because a simple hardware assist can intercept the video data at the auxiliary video connector after the VGA has done all the hard work but while the output data is still in a digital form.

Emulating Disks and Drives

Floppy disk emulation is a challenge because of the secretive nature of the copy-protection industry. You can emulate normal disk operations, such as sector reads or writes, by trapping Int 13h and reading from or writing to a 360K-byte file containing the image of a disk. This facilitates device sharing by allowing each user to have his or her own floppy disk image.

When dealing with copy-protected applications, it is usually easiest to disable trapping in the VPC I/O permission bit map so that direct access to the floppy disk drive controller chip is possible. Of course, this will work only if an NEC 765 or compatible FDC chip exists in the system at addresses 3f0h through 3f7h. The real floppy disk drive can be shared among multiple VPC users when you implement a trap on the first access algorithm; this releases I/O trapping when a VPC first attempts use, and reenables trapping when the application has completed its use of the floppy disk drive.

Hard disk drive emulation is similar to floppy disk drive emulation with one notable exception—it would not be desirable to keep a 30-MB emulation file hanging around waiting to be filled just because a type-3 drive is being emulated. The VP/ix emulation uses a minimal-size file that is extended as needed when files are written to it. This is most useful for booting MS-DOS and for programs that can install their copy protection on a hard disk.

A better way to emulate large mass storage devices is a file redirector that translates requests (e.g., open, close, read, write, and find first) into requests for the native file system on the host operating system. Stellar MS-DOS uses this method because it has the additional benefit of allowing DOS and Stellix files to be shared transparently from either environment.

Clocks and Interrupts

The battery-backed real-time clock chip (also known as the CMOS) must also be emulated, because it provides information to the VM about memory size and device configuration. It would be inappropriate to allow direct access to the real CMOS (if any), because it is used to boot the host operating system and must be protected from capricious changes. A 64-byte data file containing the image of a CMOS can be maintained for each VPC, allowing all users to have their

One
interesting fact
about the MS-DOS
operating system is that
it does not need a
real clock in order to
function correctly.

own configuration and concept of time and date.

Many PC applications make direct accesses to the 8254 counter/timer chip in order to generate unusual sounds, measure real-time events, or provide a periodic timer tick interrupt at a higher rate than the PC-standard 18.2 Hz. A state-machine timer emulation needs to receive periodic signals from the host operating system to keep track of the passage of time. An interesting fact about the MS-DOS operating system is that it does not need a real clock in order to function correctly. One way to take advantage of this and improve VPC performance might be to give just one or two timer signals per second to the VMM and adjust the tick count in the VPC's low memory every 15 seconds or so to the correct value. This would allow time to pass for file-system time stamps and applications, such as the Brief editor, that have on-screen clock displays.

An emulation of the 8259 programmable interrupt controller (PIC) chip plays a role in many of the other emulations. Before acting on a queued interrupt signal for a timer tick or an incoming serial line character, the VMM must examine the state of the PIC emulation to determine

whether this interrupt level is enabled and not masked. Similarly, the state of the virtual IF in the VPC's FLAGS register must be checked to ensure that an application has not issued the CLI instruction to disable external interrupts.

Other Devices

Sound emulation can be a particular challenge because of the diverse uses placed on this seemingly unimportant subsystem. You can emulate the standard beep tone that is generated by the ASCII BEL character (^G) on just about anything, even on a serial terminal console device, but you can emulate the more complex sounds that are used with game programs only if there is adequate hardware support.

You can support serial communications using the example I gave earlier for emulation techniques. One copy of the UART structure would be required for each emulated port. This is a place where the VMM must use interrupt queuing and signals, because incoming data and UART status might be lost if the VPC task is not running when the real hardware interrupt occurs.

Sharing a printer is not a problem that most PC applications are concerned with, since each PC usually has its own. But in a multiuser system or a system in which a 386-based VPC is hosted under an operating system like Unix, printer control is managed by a spooler program rather than directly. The VPC can trap BIOS outputs that use Int 17h. When the VPC receives the interrupt message, it can direct the outgoing characters to a disk file. When the print job is done, the VPC can then send the file to the print spooler. Spooling is a major problem in the PC environment because there is no real concept of job end or end of file when printing. There are three strategies that the VMM can use to detect this condition and submit a print job: time-out, program termination, and direct user interaction. A time-out would close the file and send it to the spooler after some duration since the last character output. The VMM would detect the termination of a program by a trap on Int 20h and the DOS Int 21h subfunctions 00h, 31h, and 4ch. Direct user interaction is the simplest and least elegant method—the user would have to run a short program or make a selection from a system menu with a mouse to start the printing job.

Mouse emulation is the one type of emulation where the least amount of slop can be tolerated—since the mouse is a high-performance component of many

continued

user interfaces, any noticeable delay between mouse movement and mouse cursor movement could affect its usefulness. This is a particular challenge in multiuser time-sharing systems such as VP/ix, where the DOS application is drawing the mouse cursor but the Unix serial driver is taking the mouse interrupts. If the DOS task is sleeping or swapped out when the mouse is moved, the jerky motion could be intolerable.

Network emulation can usually be accomplished by the file-system redirector (mentioned earlier in the discussion of hard disk drive emulation). This allows the VPC to take a free ride using whatever network services are provided for remote file systems in the host environment. If desired, you can emulate NetBIOS by trapping its entry point, or you can emulate individual network cards (like the 3Com 3C501 and the SMC ARCnet adapter) by I/O trapping.

The last remaining emulation is an EMS expanded memory manager that provides over 640K bytes of RAM to DOS applications. Although this emulation is not required for PC compatibility, the 386's MMU makes it easy because you can use page translation to map memory in much the same way that a real expanded memory manager does hardware-based memory mapping on an AboveBoard. You can emulate this device by trapping `Int 67h` and letting the VMM do the emulation, or by running a real expanded memory manager (like the one Intel provides) and trapping on the I/O port accesses when it tries to manipulate its AboveBoard-control registers.

Problems of Emulation: Civilizing MS-DOS

While all the above descriptions may make you think that the creation of a VPC is a fairly simple task, there are problems with emulation, performance, and system security that must be addressed. It is not possible to emulate a native 286 operating system, such as OS/2, on the 386. A number of the privileged system programming op codes (e.g., `LMSW`, `ARPL`, `CLTS`, and `LLDT`) that the 286 operating system would use cannot be emulated because the 386 kernel uses them. (For more insight into what would be required for 286 emulation, see "Emulating the 386" in the May/June 1988 issue of *Programmer's Journal*.)

Performance is probably the single biggest issue in VPC creation. In the good old days, end users had lower expectations for their PCs—an emulation that ran as fast as a 4.77-MHz XT would have been considered acceptable. Nowadays,

Performance is probably the single biggest issue in VPC creation.

most typical users have been exposed to MS-DOS running on 20- to 33-MHz 386 AT clones. A VPC with anything less than 6-MHz AT performance would probably be considered unacceptable.

MS-DOS exhibits a behavior considered antisocial in larger multitasking systems such as OS/2 or Unix—it "busy-waits." What this means is that when there is no work to do, DOS soaks up all available CPU cycles by polling the keyboard and network (if any) in an idle loop. If it were allowed to do this when running as an application in a VP/ix system, all other programs running concurrently would be penalized. Another contributing factor to VPC inefficiency is the overhead associated with trapping to the VMM. Unlike a slow 8088, where saving every CPU cycle improves the performance of an application, the 386 shows a speedup only when major algorithmic changes are made. If you can minimize the number of task switches that must be made in order to do an emulation, the overall speed of the VPC improves.

VP/ix addresses the DOS busywait problem by detecting idle loops—DOS and applications will exhibit characteristic behaviors such as polling the keyboard without getting input when idling. This is used to lower the task's priority or even to put the task to sleep. Another improvement can be made by "short-circuiting" the entry into an emulation. For example, a trap on the `Int 10h` write-teletype function can do simple output faster than a reflected interrupt that must take multiple traps as the `Int 10h` BIOS accesses the 6845 video-controller registers. The address-caching FIFO described earlier for the Stellar video emulation is an example of how a simple hardware assist can improve emulation performance.

An improvement that is more difficult to implement is changing the trapping model from a task switch to a level switch. Instead of using a task gate for the GP interrupt handler, you can use a trap gate to cause a change in Current Privilege Level from application (level 3)

to kernel (level 0). This is not as simple as a task switch, because the GP handler doesn't get a nice snapshot of the VPC in a TSS. It must do its own register preservation and work from the state that is saved on the stack in order to dispatch a proper emulation. But this complexity can save 317 clock ticks round-trip on each trap—a task-switch `INT/IRET` sequence takes 538 clock ticks, while a level-change `INT/PUSHA/POPA/IRET` takes only 221 clock ticks.

The other major performance booster is the use of `IOPL=3`. By definition, the CPL of a V86-mode task is always 3, so if `IOPL` is less than 3, instructions that modify the interrupt flag like `CLI/STI/PUSHF/POPF/INTnn/IRET` will cause GP traps so that the IF can be virtualized. If `IOPL=3`, these operations are no longer privileged, allowing the VPC application programs to have direct access to the CPU's IF, thus minimizing the number of traps that must be taken.

This leads right into another emulation problem: system security. What if a bug causes a DOS application to crash after it turns off external interrupts with a `CLI`? Any timer tick-based multitasking would cease to function, and it would be time to reach for the big red switch.

To determine the appropriateness of using `IOPL=3`, you must look at what the system is being used for. In a Unix system, where security and reliability are very important, it would not meet the needs of other system users if a VPC could bring down the house. But with Windows/386, a single-user system, it might be appropriate because performance is more important than security, and the user can't hurt anyone else with a bogus program.

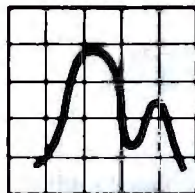
For the Stellar MS-DOS implementation, I defined the shared memory interface between the 386 kernel and Stellix as the security point. If the 386 were to crash for some reason, it would not affect any Stellix applications that were running; thus, the 386 could be rebooted without anyone other than the MS-DOS user noticing. To this end, I have installed a hardware assist—a watchdog timer that issues a nonmaskable interrupt to the 386 if it is not reset periodically by the normal timer-tick ISR. This guarantees that the 386 kernel will be able to recover from the above scenario and terminate the offending DOS application with no further side effects.

The Future of VMs

OS/2's DOS compatibility box on 286 systems can be considered a VM by any

continued

STATISTICS & GRAPHICS from:



StatSoft™

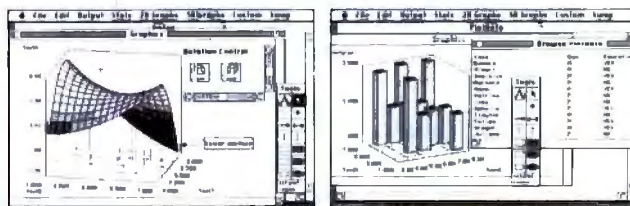
CSS/3 (Complete Statistical System). A comprehensive statistical data analysis system ■ Over 1,000 presentation-quality graphs fully integrated with all statistical procedures (on-screen graph customization) ■ Exploratory techniques, multi-way tables with banners, nonparametrics, distribution fitting, multiple regression, unconstrained nonlinear estimation methods, Logit and Probit analysis, general ANOVA/ANCOVA/MANOVA/MANCOVA with contrast analysis, log-linear analysis, multidimensional scaling, canonical correlation, item analysis/reliability, survival analysis techniques, time series techniques with modeling and forecasting, quality control methods, experimental design (with Taguchi), and much more ■ Menu/mouse or command user-interface ■ Exchanges data and graphics with all industry standard applications (including Excel, Lotus 3, and dBASE IV) ■ Data files of unlimited size, extended precision, unmatched speed ■ Optimized user interface, macros, mouse support, 50 lines per screen display ■ Runs on DOS compatible computers; expanded and extended memory and coprocessors supported but not required ■ Price: \$595.

Quick CSS. Contains all basic statistical modules of CSS/3 (including data management) and the full, presentation-quality graphics capabilities of CSS/3 ■ Price: \$295.

CSS:GRAPHICS. A comprehensive graphics/charting system with data management ■ All graphics capabilities of CSS/3 and, in addition, extended on-screen drawing facilities, 20 scalable fonts, special effects, and multi-graphics management ■ Hundreds of types of graphs ■ Over 30 categories of fully customizable and interactively rotatable 3-dimensional graphs with animated stratification (cross sections) ■ Facilities to custom-design new graphs and to add them permanently to the main menu ■ Expanded and extended memory and coprocessors supported but not required ■ Price: \$495.

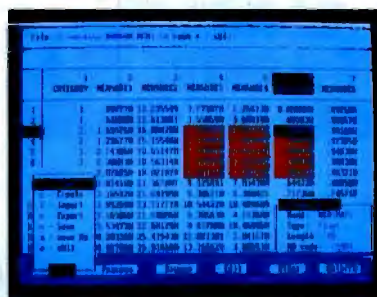
CSS:STATISTICA. A fully integrated system that combines all the capabilities of CSS/3 and CSS:GRAPHICS into a single extremely comprehensive data analysis package ■ Price: \$795.

STATISTICA/Mac. A CSS:STATISTICA-compatible data analysis and graphics system designed specifically for Apple Macintosh ■ Comprehensive selection of statistical methods with fully integrated, color-shaded,



presentation-quality graphics (including EDA graphs, multigraphs, a wide selection of interactively rotatable 3-dimensional graphs, and MacDraw-style tools integrated with all graphical procedures) ■ Data files of unlimited size, extended precision, unmatched speed ■ Exchanges data with Excel and other applications ■ Price: \$395

MEGAFILE MANAGER (Analytic data base management for large data sets). Complete data base management for huge sets of data: over 8 megabytes (up to 32,000 fields) per record,



unlimited number of records ■ Maintain large archival data sets; create subsets for use with other applications ■ Merge multiple files from various applications; download files from mainframes, scanners, or data acquisition equipment ■ Exchange files with dBASE IV, all versions of Lotus, Symphony, Excel, CSS, SAS, SPSS, DIF, SYLK, all ASCII; relational merge, split ■ Spreadsheet-like

operations (move/copy/transpose blocks, rows, columns, nested sorts, search/replace, etc.) can be quickly performed on megabytes of data ■ Unlinked transformations and recoding of all types of data ■ Powerful numerical data analysis facilities (e.g., correlation matrices of unlimited size, descriptive statistics, frequencies, modeling, simulations) ■ Presentation-quality tables ■ Powerful programming language with integrated editing/debugging environment ■ Optimized user interface, macros, mouse support, 50 lines per screen display, super-fast operation ■ Megafile Manager is included in CSS/3 (separately: \$295).

Shipping and handling add \$7.00 per product

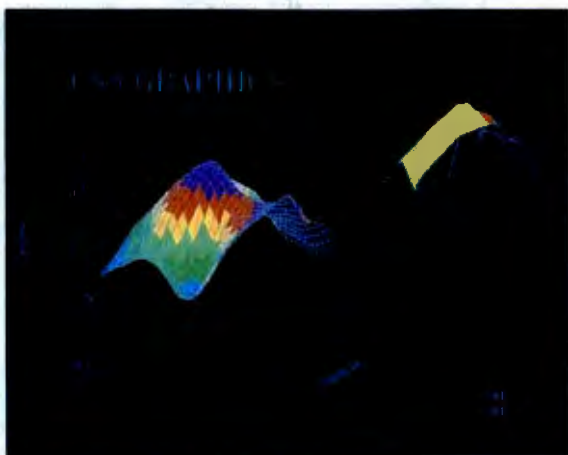


StatSoft™

2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149 • FAX (918) 583-4376

Overseas Offices: StatSoft of Europe (Hamburg, FRG), 040/4200347; StatSoft UK (London, UK), 0462/482822; StatSoft Pacific (Melbourne, Australia), 613-497-4755

Circle 180 on Reader Service Card



A Breakthrough in CONVERTER Technology



**NOW
Communicate with
RS485 Devices
Through
Conventional
RS232 Modems!**

Cincinnati Time's state-of-the-art TC Converter:

- has the **UNIQUE** capability to accommodate RS485 multi-drop half-duplex communication at the receiving end of a common RS232 modem.
- controls communications in either direction **AUTOMATICALLY** or by the use of the request-to-send (RTS) signal from the RS232 side of the converter.

For a limited time only!

Offer expires December 31, 1990.

\$199.00

For immediate delivery.

Call toll-free for credit card orders:

1-800-241-TIME

In Ohio or Canada call (513) 241-5500



1733 Central Ave. • Cincinnati, OH 45214

BACKPACK. IT'S A DRIVE OF A DIFFERENT COLOR.



Add a disk drive without horsing around inside your computer — just plug Backpack into your parallel port! Connect your printer to the Backpack drive. No tools. No hassles. No interface cards. Backpack works with IBM and compatibles including PCs, XT's, AT's, PS/2's, PS/1's, and



laptops. It's available in 5.25" and 3.5" and comes complete with everything you need.

So see your dealer or get it straight from the horse's mouth and call us about Backpack today!

MicroSolutions

Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115
815-756-3411 Fax: 756-2928

of the definitions used here. It is a combination of software and hardware that lets most DOS applications believe that they are running under standard MS-DOS on a PC. OS/2 2.0 is a native 386 version with even greater performance and functionality. Its multiple DOS compatibility boxes are much simpler than the contortions that had to be used to make a single compatibility box work on the 286. Segment sizes for protected-mode applications are essentially unlimited, making more sophisticated applications possible—the VPCs for this system are implemented as applications just as VP/ix was implemented for Unix. Page-based virtual memory allows multiple VMs to run more efficiently than is possible with 286-style segment swapping.

Rumors of multiprocessor i486-based systems that run a "new technology" portable OS/2 are just starting to get around in the development community. The Motorola 88000 RISC CPU is rumored to have enough microcode space left on its die to implement and decode the full 386 instruction set. Clone chips like the Nexus F86 chip set will provide full 386 binary compatibility with much greater performance than can be had from a single-chip microprocessor.

Even if none of these rumors is borne out, the future is promising for soft coprocessor technologies, such as the ones that Insignia Solutions and Phoenix Technologies offer. These software-only VMs are similar to language translators in that they compile or interpret an 8086 instruction stream. Like the hardware-based VPCs that I have described here, they must also emulate I/O devices to be fully PC compatible. Future generations of CPUs, such as the i860 and MIPS R6000, both with horsepower in the 40- to 60-million-instruction-per-second range, will be able to run MS-DOS on these soft VPCs at least as fast as the current 8- to 10-MHz 286-based AT systems. But by then I'm sure we'll find nothing less than 20-MHz 386 DOS performance acceptable. ■

ACKNOWLEDGMENTS

Thanks to Bob Vandette and Ken Sarno for input on VP/ix, Bud Smith for assistance with VM/386, and Max Smith for the history of virtual machine systems.

Matt Trask is the principal of Communica, Inc. (Monument Beach, MA), a firm specializing in PC and OS/2 systems programming. He was one of the original programmers for Phoenix Technologies' VP/ix and Control/386. He can be contacted on BIX as "matt.trask."

CACHE486 Gets Your Heart Racing!

Windows 3.0
compatible!

Punch the accelerator of your new CACHE486-33 and watch the MIPS-ometer peg at 15! Diagnostics flash by. Applications scream into view. Your heart pounds. You're thrown back in your seat. Your hair is on fire! Well, almost ...

Available with Intel's 25 or 33MHz 80486, these boards are built for speed. Add up to 128K of external cache and the 16-bit ISA "AT" bus or the new 32-bit EISA bus for the ultimate in graphics workstations, network file servers or multiuser/multitasking platforms.

As your "one-stop shop," Cache offers a complete line of high-performance system boards backed by our commitment to product excellence, "Made in America" reliability and great customer service.

CACHE386-33

- 25 or 33MHz 386
- 64K or 128K of cache
- 16MB of onboard SIMMs
- "AT" or Baby "AT" form factor

CACHE386-25

- 20 or 25MHz 386 with cache
- 16MB of onboard SIMMs
- 32K, 64K, or 128K cache

SX386-20

- 16 or 20MHz 386SX on a "Baby AT" form factor
- Up to 8MB onboard SIMMs
- Two year warranty!

Call today for
a test drive.
If you dare ...

486

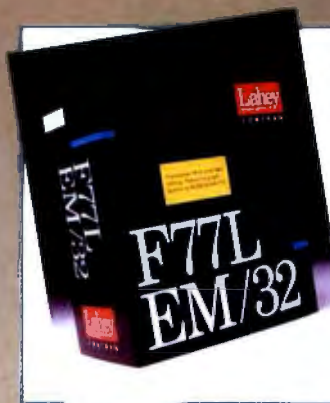
cache

Computers Inc.

46714 Fremont Boulevard
Fremont CA 94538
Phone: (415) 226-9922
FAX: (415) 226-9911

Circle 36 on Reader Service Card

Professional developers require



F77L-EM/32 & Lahey Ergo by Lahey Computer Systems, Inc.

Write and port programs as large as 4 Gigabytes on 386/486s with this fast and powerful 32-bit Fortran compiler. Full ANSI 77, VAX and IBM VS extensions, fast compilation, excellent diagnostics, debugger, editor, make utility, and video graphics. New custom Lahey Ergo OS/386 includes: virtual memory, DESQview compatibility, free unlimited runtime licenses. Another outstanding product from the Fortran experts.
LIST: \$1290 **PS Price: \$1055**
FastFacts 334-023



The UnMouse - More Speed in Less Space by MicroTouch

The UnMouse is a touch-sensitive tablet that gives you faster cursor speed - in a fraction of the space a mouse takes up. Plus you can slip templates under its glass to access up to 60 Power KeyPad functions or use its stylus to draw, trace or input graphics.

LIST: \$235 **PS Price: \$219**
FastFacts 2918-002

386 DEVELOPMENT TOOLS COBOL

386 Max 5.0	Cost \$109	MS COBOL V3.0	639
386 ASM LINK by Pharlap	485	Realia COBOL	859
DESQview 386	189		
F77-EM32 + Lahey Ergo	1055		
FoxBASE+/386	479		
Metaware High C 386/486	919		
NDP Fortran w/VM	829		
NDP C - 386	829		
QEMM 386	95		
VM-386	229		
WATCOM C8.0 386 Prof.	1155		
WATCOM C8.0 386 Stand.	795		
Zortech C++ 386 Dev.	865		

COMMUNICATIONS ADD-ONS

C Asynch Manager 3.0	139
Essential COMM by S. Mtn.	259
Greenleaf Comm Library	329
QuickComm	129

DBASE

Clipper 5.0	550
dBASE IV	499
dBFAST/PLUS	325
dBMAN V	275
dBXL	209
FoxPro	495
FoxBASE + - V2.1	279
QuickSilver	399

DBMS

Cause Professional	719
CLARION Prof. Dev. V2.1	549
D the data language	359
Magic PC	349
Paradox V3.0	479
R:BASE 3.1	499

DBMS TOOLS & LIBRARIES

AdComm for Clipper	279
Artful.Lib	200
BALER Spreadsheet Compiler	349
CLEAR + for dBASE	179
dBASE BlackBox	65
dBASE Online	129
BRIEF w/dBRIEF	Call
dBX/dBport	549
dGE 4.0	279
dQUERY MU	179
dSalvage Professional	195
FLIPPER Graphics Library	179
FUNCKY.LIB	179
Genifer - code generator	269
Net Lib	229
Pro Clip	149
R&R Relational Reportwriter	139
R&R Code Generator	129
Scrimmage	139
SilverComm Library	179
SilverPaint	100
Steve Straley's Toolkit	169
Sunshow Adv. Image Toolkit	239

AI-LANGUAGES

ARITY Combination Package	989
LISPC	269
PC Scheme LISP	85
TransLISP PLUS w/source	99
PDC Prolog Compiler	229

ASSEMBLERS

MS MASM	105
Turbo Debugger & Tools	119
Visible Computer:80286	85

BASIC & ADD-ONS

BAS-C Commercial	439
dB/LIB Professional	179
MS QuickBASIC V4.5	69
QBase	139
QuickPak Prof. V3.16	139

C LANGUAGE COMPILERS

Instant C	769
Lattice C - 6.0 Compiler	189
Microsoft C 6.0	349
Microsoft QuickC	69
WATCOM C8.0/286 Prof.	429
WATCOM C8.0/286 Stand.	359

CASE & PROTOTYPERS

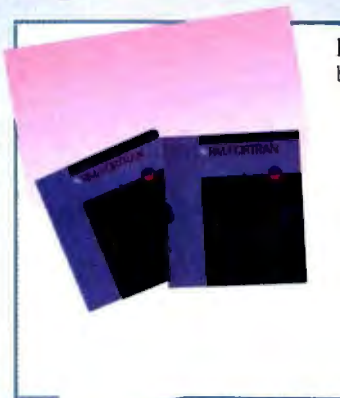
Dan Bricklin Demo II	185
EasyCase Plus	275
EasyCase Plus Prof. Pack	365
EasyFlow	135
Instant Replay III	119
Matrix Layout	179
MetaDesign by Meta Software	295
Pro-C 2.0w/Workbench Combo	735
ProtoFinish by Genesis	279
Show Partner F/X	279
Visible Analyst	585



The Shadow by Groundhog Graphics

Groundhog Graphics is setting new standards in the graphics arena with The Shadow - the industry's hottest 1MB VGA Card. Displays an incredible 1024x768 in a brilliant 256 colors! Built-in cache memory FIFO's for the ultimate in speed and performance. Interlaced and non-interlaced in one configuration. Ships free with ColorIX Junior and Lightning Zoom! Multiple Viewpoint Driver. Includes an unprecedented Seven Year Warranty.

LIST: \$399 **PS Price: \$319**
FastFacts 2871-001



RM/FORTAN

by Language Processors, Inc.

RM/FORTAN is a high resolution ANSI 77 FORTRAN compiler for DOS and OS/2. It includes RM/Forte, an advanced programming environment giving you instant access to editing, compiling, linking, debugging, and file management utilities at a single keystroke. You easily move between tasks and the tools you need, productively developing your solutions.

LIST: \$595 **PS Price: \$499**
FastFacts 437-009



Ami Professional by Samna Corporation

Ami Professional is the award winning word processor for Windows. Designed for the power user, Ami features ease of use combined with high-end features like macro programming, a thesaurus, tables, integrated drawing and charting capabilities and much more! Ami Professional has won most industry awards, including the #1 rating from Software Digest, PC Magazine's Editor's Choice, and PC Week's Poll of Corporate Satisfaction.

LIST: \$495 **PS Price: \$399**
FastFacts 2068-003

more than just products...



Database Professional Fast Screen Utilities by Sun Country

Clipper, dBASE III+, FoxBASE+, and others are image databases with the Database Professional Fast Screen Utilities. Add images to existing applications. Examine, convert and manipulate image files and modes. Support for TARGA, PCX, PIC, GIF, and TIF; CGA, EGA, VGA or even SVGA (up to 1024 x 768). Device drivers for many popular scanners and image capture boards.
LIST Price \$250 **PS Price: \$239**
FastFacts 1629-002



GENIFER by Bytel

Genifer builds complete business applications in dBASE, Clipper, FoxPRO, FoxBASE+, dBLX, and Quicksilver. "The generated code is very clear, modular, and well documented...Genifer serves as an excellent example of modular design and error handling." - InfoWorld. FREE Demo Disk available!
LIST Price \$395 **PS Price \$269**
FastFacts 670-003



PC-INTERLINK by Softworx

Use PC-INTERLINK to connect up to four PC's to simply and easily share printers, transfer files and send messages. Installation uses standard telephone cable and requires no tools or external power to have you up and running in minutes. The complete four user kit, including integrated print spooler, comes with everything you need to connect four PC's and their attached printers.
LIST: \$229.95 **PS Price: \$199**
FastFacts 2930-002



PerFORM Designer & Filler 2.1 by Delrina

Save money by automating your forms with this award winning forms processor.
• Design, fill-in and print professional looking forms.
• Imports, exports and looks up ASCII or dBASE files.
LIST Price: \$ 295
PS Price: \$ 239
Less Delrina rebate: \$ 30
Your Final Price: \$ 209
FastFacts 2093-001

Tom Rettig's Library 85
UI2 Developer's Release 479

DEBUGGERS/ DISASSEMBLERS

C-DOC 139
DASM 225
Dis Doc Pro 229
Multiscope for DOS 149
Periscope IV Varies
RE:Source by Genesoft 119
SoftProbe 86/TX 345
Sourcer 486 w/BIOS pre-proc. 129
Trapper 189

DEVELOPMENT TOOLS

ASMFLOW 89
CLEAR+ for C 169
Codan 349
Buzzwords dANALYST 269
The Documentor 245
INSIDE! 119
MKS Lex & Yacc 199
MKS RCS 175
PC-Lint 120
Plink/LTO 439
PolyMake 159
PVCS Professional 439
ROM-Link 339
.RTLINK - by Pocket Soft 279
.RTLINK Plus 419
Source Print 97
TLIB 89
Zortech C++ Tools Call

EDITORS

BRIEF Call
Cheetah 195
EDT+ 5.0 275
Epsilon 119
KEDIT 139
QEdit TSR 89
Sage Professional Editor 249
SPF/PC - V2.1 129
Vedit + 139

EXPERT SYSTEMS

Eclipse 386 560
Exsys Professional 695
Logic Gem by Sterling Castle 89
Personal Consultant Plus 1999

FILE ADD-ONS

Accsys for Paradox w/source 739
CBTREE 179
C-Data Manager 279
CodeBASE 4 279
CQL - w/ source 359
c-tree by Faircom - source 329
C-TRIEVE 229
db_FILE/RETRIEVE - SU 229
Faircom Toolbox Prof. 889
Faircom Toolbox Special 539
WKS Library 149
XQL 649

FORTRAN

FOR C w/source 789
Lahey FORTRAN F77L 549
Lahey Personal FORTRAN Call
MS Fortran Opt. Compiler 309
RM/FORTRAN 499

GENERAL ADD-ONS

C Tools Plus - V6.01 98
C Utility Library 189
Greenleaf SuperFunctions 239
Opt-Tech Sort 119
Turbo C Tools by Blaise 109

GRAPHICS

Code Master II w/source 369
Essential Graphics v3.0 349
GraphicC 319
graphics-Menu 165
GSS Graphics Dev't Toolkit 525
Halo 279
HSC Sunscan 289
LaserControl 139
MetaWINDOWS 209
MetaWINDOW/PLUS 289
PCX Programmer's Toolkit 229

HARDWARE

ALL Chargecard 399
Capital Equipment Corp.
OS/RAM32 0M 225
OS/RAM8 0M 299
OS/RAM4 0M 179
DigiCHANNEL COM/8i 875
DigiCHANNEL MC/8i 949
DPT
SmartCache ST506 1099
SmartCache RLL 1099
SmartCache ESDI 1099
Disk Mirroring Module 685
Emerson UPS
Model 10 UPS 169
Model 20 UPS 319
Model 40 UPS 699
AccuCard 209
AccuSaver 69
EtherCard Plus 239
EtherCard Plus/A 349
Erasable Optical Drive Call
IIT Adv. Math Coprocessors
3C87-25 450
3C87-33 559
2C87-20 329
2C87-12 279
Intel Math Coprocessors
80387-25 555
80387-33 675
J T Fax 9600 595
KickStart I 179
KickStart II 399
KickStart III 689
LANStor LAN150S 1599
LaserStor WORM Drive 3295
Personal Modem 2400 179
QX/12K Modem 699
QX/V.32c Modem 1349
Seagate 5T-125-1 20M 299
Seagate 5T-4096-1 80M 639
Seagate 5T-251-1 40M 339
SentinelScout (kit of 10 keys) 265
SpeedStor AT 320S 1999
Smartmodem 2400 (Ext.) 459
The Shadow SVGA1024K 319
VGA WONDER 512K 359

NETWORKS

dBXL/LAN 519
Btrieve Dev. Kit 479

THE PROGRAMMER'S SHOP 1-800-421-8006

The Programmer's Shop is



WindowsMAKER

by Candlelight Software

WindowsMAKER generates structured code for complete Windows 3.0 applications. Prototype the entire user interface (menus, icons, buttons, controls, etc.) in a WYSIWYG editor, then generate MS C code for Windows. Preserves custom code during regeneration. It handles message processing, memory management, compiler settings, child windows, debugging, MDI, and much more. Saves you time and money; 30 day money-back guarantee.

LIST: \$795 PS Price: \$715
FastFacts 2001-002



Clarion Prof. Dev 2.1

by Clarion Software

A powerful, easy-to-use DBMS application developer, can cut development time by 50%. Imports/exports dBase, BASIC, and DIF files; interfaces with routines from C and Assembler. Includes Report Writer for creating ad-hoc reports and queries. Built-in LAN support: no run-time system required for distribution. Recent winner of PCWeek poll of corporations using programmable databases.

LIST Price: \$845 PS Price \$549
FastFacts 1005-004

Netware SQL	519
Netware C Interface	239

Turbo Professional	109
--------------------	-----

OBJECT-ORIENTED/C++

Intek C++ 80386	469
Smalltalk/V	85
Smalltalk/V-286	185
Turbo C ++	159
Turbo C ++ Prof.	259
Zinc Interface Library	179
Zortech C ++ w/ source	269
Zortech C++ Debugger	150
Zortech C ++ Dev. Edition	399

TEXT SCREEN ADD-ONS

AEWINDOS	459
C Communications Toolkit	129
C Worthy w/Forms w/ARCH	359
Greenleaf DataWindows	339
HI-SCREEN XL Professional	289
MEWEL Window System	169
POWER SCREEN by Blaise	103
Vitamin C - source, menus	169
VC Screen - painter	119
Vermont Views Obj. + source	819

OS SUPPORT

DESQview	109
OS/286	619

OTHER LANGUAGES

Modula-2 Dev. System	229
RPG II Dev. Systems	1469
TopSpeed Modula-2	189
StonyBrookProf. Modula-2	249

OTHER PRODUCTS

Carbon Copy Plus	159
COTERM/220	219
Dan Bricklin's PageGarden	89
Fast!	89
File Shuttle	109
Flow Charting II Plus	179
HEADROOM	89
HiJaak	139
LapLink III	129
Link & Locate ++ - ROM MSC	349
Math Advantage	475
Norton Utilities Advanced	119
PAGINATE by AccuMatics	89
pcANYWHERE III	129
PC Tools Deluxe 6.0	109
PC-KWIK Power Pak	119
Pre Cursor	96
Remote2	139
SpinRite II	89
Systat & Sygraph Combo	839
System Sleuth	89
The Duplicator Toolkit-Pro 3.0	119
TimeSheet Prof.	135

TURBO PASCAL

MetaWare Pascal 386/486	839
Turbo ASYNCH PLUS	119
Turbo Pascal 5.5 by Borland	109
Turbo POWER TOOLS PLUS	98

UNIX/XENIX

C++ Compiler for Unix 386	439
C++ for Unix	469
db_FILE/RETRIEVE	569
Edix - editor	409
ESIX Systems	
ESIX/V 386 Dev. (2 user)	569
ESIX/V 386 Dev. unlt'd	769
Guidelines C++ for 386 V2.0	479
Informix SQL	929
Interactive Systems	
Architect Wrkstn Platform	1199
Architect Wrkstn Developer	1850
Norton Utilities for Unix	279
Oregon C++ by Oregon SW	979
Recital Standard SU	699
WordTech Quicksilver Diamd.	839
XENIX 386 Dev. Sys.	689

WINDOWS & OS/2

Actor 3.0	639
Brief for OS/2	Call
Case: W	905
Case: PM (for C or C++)	1469
C talk/Views	419
C-Trieve/Windows	329
dBFAST/Windows	329
Graphics Server SDK	455
Instant Windows	895
KnowledgePro Windows	589
MKS Toolkit	229
MS Windows 3.0	119
MS Windows Dev. Dr. Dev. Kit	365
MS Windows Soft. Dev. Kit	365
Multiscope OS/2 Debugger	375
Multiscope Windows Debug.	315
Object/1	895
OS/2 PM Toolkit	369
RimStar PM:Editor	190
Smalltalk/V PM	469



dBXL

by WordTech

A superior alternative to dBASE, dBXL relational database is an easy to use interpretive environment adding extended language (XL) features to the dBASE language. It includes WordTech R&R Relational Report Writer, full dBASE compatibility (files & syntax), and special menus for first time database builders. Also has memory swapping, advanced memo field handling, macros, true windowing multi-dimensional arrays, graphing and EMS support. Requires 440K memory.

LIST: \$249 PS Price: \$209
FastFacts 971-003



ZORTECH C++ V2.1 UNIX 386 Compiler

by Zortech, Inc.

Zortech's C++ V2.1 386 compiler for UNIX makes it easy to port applications among DOS, DOS 386, OS/2, and SCO UNIX 386. With the same tight, fast, globally optimized code of the DOS and OS/2 versions, the compiler takes full advantage of the 386. Included is an ANSI/UNIX/Zortech C++ compatible library.

LIST: \$500 PS Price: \$439
FastFacts 1108-045



Vitamin C

by Creative Programming

Easily create a spectacular user interface with the most versatile and powerful C library available. Functions include overlapping virtual windows, data entry fields and forms, multi-level pop-up and pull-down menus, context sensitive help, a pop-up text editor, and much more! Even library source is included, and applications are royalty free. Available for DOS, OS/2, Unix, Xenix and VAX.

LIST: \$225 PS Price: \$169
FastFacts 0031-007

THE PROGRAMMER'S SHOP 1-800-421-8006

your source for solutions!



LOTUS MAGELLAN 2.0

by Lotus Development Corp.
 Lotus Magellan 2.0 is the fastest way to organize and use PC information. It combines the most requested utilities in an easy-to-use package. Magellan 2.0 works the way you do, focusing on the information in your files rather than the files themselves. A simple, powerful viewing environment lets you look at the contents of a file right alongside its name—without loading the application that created it. And this includes word processing files, spreadsheets, databases, graphic files, and more.
 LIST: \$139 **PS Price: \$119**
FastFacts 1917-012



Sage Professional Editor

by Sage Software
 The Sage Professional Editor is designed to create the applications of the 90's. It's highly configurable and has an advanced windowed user interface with integrated mouse support, on-line help and menu-driven commands. Has emulations for Brief, Vi, EMACS/ Epsilon and WordStar, and a virtual memory system for large files. Includes MS-DOS, OS/2 and Dual Mode versions on 3.5" and 5.25" diskettes.
 LIST: \$295 **PS Price: \$249**
FastFacts 0111-060



BALER

by Baler
 The BALER Spreadsheet Compiler turns .WK1 worksheets into tamper-proof, standalone executable programs. BALER is easy to use—if you can use Lotus 1-2-3, you can use BALER. It is compatible with nearly all the commands and functions of your spreadsheet, including all of the Lotus Advanced Macro commands. Save time with the speed of executable files. Save money since users don't need the original spreadsheet program. And BALER is royalty free!
 LIST: \$495 **PS Price: \$399**
FastFacts 0808-002



.RTLink/Plus

by PocketSoft
 PocketSoft's .RTLink/Plus is the premier linker for professional developers. With typical image reductions of 33-67%, CodeView support, smart overlay caching and optimized source code with built-in CPU profiles, .RTLink/Plus beats the competition. Rated top linker in recent *PC Week* poll.

LIST Price \$495 **PS Price \$419**
FastFacts 1277-003

FREE Catalog!

THE PROGRAMMER'S SHOP CATALOG is the definitive source book for serious software development professionals.

Over 1,700 development products listed, including:

- applications
- books/training
- communications
- hardware
- languages
- LANs
- libraries
- operating systems
- tools
- UNIX/XENIX
- utilities



Call today for this valuable guide to programming productivity.

What is FastFacts?

You now have access to literature on any of our products via FAX machine. **FREE!**

1. Call 617-740-0025 from your FAX machine's phone.
2. Follow the voice computer's instructions and enter your product's code number (listed in each product box or in our catalog).
3. Hang up the phone and await your instant print out of product literature.

Call 617-740-0025 from any fax phone!

THE PROGRAMMER'S SHOP

800-421-8006 National Accounts **800-446-1185**

MMC
 of the Direct Marketing Association, Inc.

5 Pond Park Road, Hingham, MA 02043 • Canada 800-446-3846 • Mass. 617-740-2510 • FAX: 617-749-2018
 Credit card orders processed *only* when product is shipped. All prices subject to change. Int'l. prices will vary.

BY10901





This Noisy World Is Out To Crash Your Data

New **BLAST** Solves Your Connectivity Problem

Now with new, easier-to-use, more compatible **BLAST** you can have the same robust, professional software used by the most demanding data communications managers and VARs.

BLAST guarantees fast, 100% error-free file transfer and terminal emulation to connect UNIX and XENIX systems with PCs, Macs, VAXs, and mainframes. With **BLAST** you have *one* easy-to-use interface, *one* set of commands, *one* protocol, and *one* scripting language common to all systems.

BLAST Clears Your Data's Path

Data communications is a dirty business – but you have to do it. Whether you send critical financial data, access your company's mini or mainframe, or simply tap into your favorite bulletin board, today's dirty, noisy phone lines conspire to distort, delay, and destroy your data.

BLAST communications software is engineered for high speed, error-free performance over today's real-world phone lines. It gets your data through when other programs have given up.

You'll Appreciate **BLAST** Every Time You Use It

To learn more about noisy phone lines, how they can affect your data communications, and what you can do about it, give us a call at **800-24-BLAST** in the U.S.; **504-923-0888** outside the U.S. Or, send in the coupon for your free copy of our booklet:

*"Everything You Always Needed To
Know About Dirty Phone Lines
But Were Afraid To Hear."*

BLAST

Call 800-24-BLAST

504-923-0888 FAX 504-926-2155

Communications Research Group
A U.S. Robotics Company

YES!!! I want to know what I can do about dirty phone lines.
Please send my free booklet to:

Name: _____

Company: _____ Title: _____

Address: _____ City: _____

State: _____ Zip: _____ Phone: _____

Mail to: **Communications Research Group**
5615 Corporate Boulevard, Baton Rouge, LA 70808

United Kingdom: 44-71-987-9021 • France: 33-01-6930-7172 • Germany: 49-02018-20190
Italy: 39-02-837-8341 • Netherlands: 31-040-416-355 • Australia: 61-03-528-2711

Circle 29 on Reader Service Card
(RESELLERS: 30)

BLAST is a registered trademark of Communications Research Group. Other product names are used for identification purposes only and may be trademarks and/or registered trademarks of their respective companies.

NOTEBOOK PCs SET THE PORTABLE STANDARD

*Today's state-of-the-art totable computers pack
AT-class power into about 6 pounds*

Paul Schmidt

The portable computer market is an exciting, dynamic arena. It seems that every new model introduction advances the state of the art. Portables are receiving more development attention as sales increase; they are becoming a very important segment of the PC market. According to International Data Corp., about 9 percent of PC sales in 1987 were portables; by 1992 that market segment should jump to 15 percent.

But what defines the state of the art in portable technology? What sets a portable ahead of all the others in its price bracket? The factors that are most often evaluated are form factor (i.e., its physical design and dimensions), weight, screen quality, and battery life.

I will focus on a class of portables known as notebook PCs. These represent the fastest growing segment of the portable computing market. They range in size from about 8 by 11 by 1½ inches to 10 by 12 by 2 inches, and weigh 4½ to 8 pounds. Notebook PCs pack most of the utility of an AT-class desktop into the smallest possible package. Although seemingly a narrow

niche, notebook PCs offer a lot of variety in terms of power (9-MHz 8088 to 12.5-MHz 286 CPUs), features, and price (\$1800 to \$5000). The photo shows some popular notebook models.

Other classes of portable PCs include hand-helds, laptops, and luggables. No "official" classifications of portable PCs exist; I use these terms for the benefit of this article. Hand-held PCs are battery-

powered, weigh about 1 pound, and can fit in a coat pocket. The best examples of this genre are the Poqet PC and the Atari Portfolio.

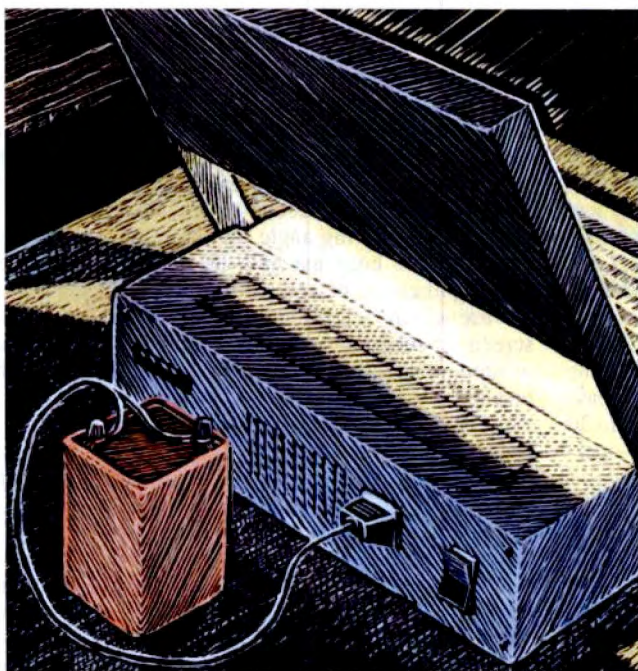
Laptops are either battery- or AC-powered. They weigh between 8 and 17 pounds, almost always use more powerful 386SX or DX CPUs, and measure up to 15 by 16 by 4 inches. The Compaq SLT and the Toshiba T5100 are popular laptops.

Luggables are sometimes referred to as "lunchbox" PCs because of their shape, but not all luggables have that form factor. All luggables are AC-powered and provide the greatest performance in terms of CPU (386 or i486), mass storage, RAM, and video. The heaviest units (some of which have color LCDs) weigh up to 27 pounds—more than some desktop PCs. The Dolch-P.A.C. 486-25 and the IBM Model P70 are examples of luggables.

Notebook Limitations

The screen and keyboard are the limiting variables in the design of notebook PCs. The current state of the art in keyboards is an 84-key design, with a numeric keypad embedded in the alphanumeric

continued



keys (external keypads are common options). Control, Shift, Alt, and similar keys are standard size and in their familiar locations. Keys that you use infrequently (e.g., Print Screen and Scroll Lock) are sometimes smaller and in less familiar locations. A standard keyboard requires 11 inches; however, some vendors "squeeze" this to achieve a smaller form factor.

The amount of key travel needed to provide good feel dictates the thickness of the keyboard. Around 0.15 inch—the same as a standard AT-style desktop keyboard—is best. Half that thickness is acceptable if strong tactile feedback is present; otherwise, you might feel like you are banging your fingers on a hard surface when you type. Nearly all notebook makers use membrane-type, rather than mechanical, keyboards to minimize thickness. A membrane keyboard uses a rubber grommet with carbon contacts under the key caps. Pressing a key causes the contact to complete a circuit with a polyester sheet that is embedded with conductive material.

Display Technology

Readability limits the display size. The display must provide adequate visual resolution to someone who views it at a typical operating distance. Preferably, it should have a 1-to-1 aspect ratio (i.e., the display shows the true shape of the text and graphics, not a compressed version to compensate for a shortened screen). The current panels are around 11 inches diagonally and are 11 to 12 inches wide to accommodate the display circuitry. The overall thickness of the panel is between $\frac{1}{4}$ and $\frac{1}{2}$ inch. VGA, with a resolution of 640 by 480 pixels, is rapidly becoming the standard display mode.

The display portion of the laptop can also be extremely power-hungry, nearly rivaling the electronics in its appetite. Some display panels draw extremely low current, but they are also the least pleasing to view. Because of this trade-off, the display design is one of the most difficult aspects of laptop engineering.

Various types of LCDs are by far the most prevalent panels used today. The only exception is the gas-plasma display; however, the power it consumes (20 to 30 watts) is greater than most battery-operated systems will tolerate, so it's usually relegated to AC-only laptops.

All LCD panels have similar construction. The liquid crystal material is sandwiched between two plates of glass, which are, in turn, sandwiched between two polarizing filters. Each glass plate carries transparent conductors made of

indium tin oxide—one aligned vertically, the other horizontally. By passing current along one pair of intersecting horizontal and vertical electrodes, the liquid crystal material at the intersection becomes polarized and blocks the light at that point. The display electronics sequentially scans each pair of conductors, addressing all points of the display.

Because of the small size of the conductors, only a limited amount of current can be delivered at any given time. This limits the rate at which the liquid crystals become polarized and increases the time each pair of conductors must remain powered. As a result, the image appears to smear when text or graphics move rapidly across the screen.

It is also difficult to restrict the area of liquid crystal that becomes polarized. The pixels can become ill-defined around the intersection of the address lines, exacerbating the smearing. This becomes more acute as the resolution increases; adjacent pixels are closer together, and conductor size decreases, further limiting the polarizing current. Fortunately, this problem can be controlled somewhat by reverse-biasing adjacent electrodes.

The twisted-nematic display was most commonly used in machines built from 1984 to 1986. It was inexpensive and consumed relatively little power—usually under 1 W. This was normally a small text-only display and rarely displayed the full 25 rows by 80 columns we've come to expect. The twisted-nematic display is almost never used today, as this material has an extremely narrow viewing angle and a low contrast ratio that make it difficult to read in some situations, even when viewed straight on.

Supertwist LCDs are the current standard for low-end notebook PCs. They make a much more pleasing display than the twisted-nematic, with a significantly higher contrast ratio (about 4 to 1) and a much wider viewing angle, maintaining a reasonable contrast at a 50-degree viewing angle. (The contrast ratio is the difference in brightness between the screen's background and the characters printed on it; the viewing angle tells you how far to the left or right you can clearly view the screen.) Supertwist LCDs are also available with a range of graphics resolutions; some provide monochrome EGA capability.

While the quality of the supertwist display is higher, the materials and construction of the unit bring a disagreeable blue or yellow cast to the image. Unit costs are somewhat higher than those of twisted-nematic panels. Power consump-

tion is also somewhat higher (slightly over 1 W), but supertwist LCDs do not require backlighting—although it is frequently used to enhance readability.

Dual supertwist is the standard display on today's midrange and high-end notebook PCs. It is constructed using two separate LCD panels. The active bottom panel uses the standard supertwist material, while the passive top panel uses a different liquid crystal material that compensates for the color distortion that the bottom layer creates. This produces a highly readable paper-white display, with contrast ratios of around 14 to 1. While the viewing angle is not markedly widened, the contrast at its lowest limit is still around 5 to 1, instead of the 2 to 1 that supertwist and twisted-nematic panels have. Generally, these supertwist displays are high-resolution VGA displays with 16 gray-scale levels. The first flat-panel color displays use this technology.

You can measure the drawbacks to this type of display in both dollars and battery life. Because the unit has two supertwist panels, material and assembly costs are higher than those of a standard supertwist display. Obviously, two panels draw more current than one, but the dual supertwist also requires brighter backlighting than the twisted-nematic and supertwist displays, thus incurring a power penalty of another 8 W. However, newer panel and backlight combinations have reduced power consumption, down to as little as 1.5 W.

A significant improvement on the dual supertwist display is the film double-twist display. Film double-twist uses a polarizing plastic film instead of the compensating LCD panel. This design cuts panel power consumption significantly and does not require high-power backlighting like the conventional dual supertwist display.

A few manufacturers are currently developing active-matrix LCD panels. This type of unit uses a switching transistor at each pixel location and provides power and ground planes across the entire surface. This allows a much higher polarizing current; the addressing conductors carry only the low-current switching signal.

Because the polarizing current is both higher and better controlled, the visual contrast ratio is extremely high—on the order of 100 to 1. Power consumption is on a par with the dual supertwist panels. The main drawback of the active-matrix display is a relatively low manufacturing yield; a million or so transistors must be placed evenly across 30 or 40 square



Three popular notebook PCs (from left to right): The Zenith MinisPort, the Compaq LTE, and the NEC UltraLite. The MinisPort and LTE weigh in at over 6 pounds each, while the UltraLite weighs only 4½ pounds.

inches of glass, and any single failure ruins the display.

Power Management

By carefully selecting a display, an engineer can design a computer that is pleasing to use yet operates for a reasonable period of time on battery power. But simply choosing the right low-power components is not enough for a state-of-the-art laptop. Today's machines also manage power on the fly by selectively turning off unneeded portions of the machine.

Because the LCD and its backlighting consume large amounts of power, these components have been targets for dynamic power management. The idea is to shut down the display and backlighting whenever you aren't using them. The most convenient way to do this is to let the computer control the power automatically.

Special logic circuits can monitor the CPU address lines and capture memory accesses to the screen. When custom hardware is not available, the BIOS or a TSR-like program can monitor the display interrupt service routine. Because many applications bypass the BIOS and write directly to the screen, the software also monitors the keyboard hardware interrupt routine. Regardless of the method used, if the monitor does not see any activity within a given time period, it turns off the display subsystem. Any subsequent keystroke or screen write restores power.

The latest hard disk drives have 2-inch platters, hold 20 megabytes of data (40 MB by the end of the year), and easily fit into a shirt pocket. The size of the drive is obviously important with small computers, but careful power management is crucial for battery operation.

Unlike displays, hard disk drives never operate on a constant basis; an application is loaded and a data file is read in,

but after that, almost all processing takes place in memory. There may be some occasional disk activity, but the disk is not needed again until you want to update a file. If the drive is off when you don't need it, you can save a significant amount of power.

While you can monitor and control drive activity with software, several hard disk drives now have specialized power management electronics. These drives use programmable internal timers to decide when to drop back to a low-power state. When a drive switches into this mode, it removes power from portions of the drive electronics and, optionally, the spindle motor. When the CPU attempts to access the disk, it must be held off for a short time (at worst, only a few seconds) while the drive returns to an active state.

The PrairieTek hard disk drive is a good example. It has three operating modes: active, power save, and standby. In the power-save state, it powers down some electronic components. In standby, it turns off the spindle motor. The BIOS boot code programs the drive to automatically switch between states by setting timers in the drive to the desired values. After this initial programming, no further CPU intervention is required.

This can achieve considerable battery savings; when the drive is active, it draws from 1.2 to 3.5 W of power (the latter during platter spin-up). In the power-save state, the drive draws 0.9 W; in the standby state (motor stopped), it draws a mere 0.06 W. This power savings barely affects performance: It takes only 3 seconds to spin up the platter from standby to active, and only 100 milliseconds to get from power save to active.

With the increasing efficiency of hard disk drives and display panels, the power drain from the notebook's electronic components becomes an increasingly significant fraction of overall power con-

sumption. One design goal to limit this consumption is to reduce the number of ICs required.

The most effective way to cut the chip count is to use a special set of IC chips that replace the functions formerly provided by numerous discrete logic components. Several manufacturers have various chip sets that have reduced costs in PC-compatible desktops. Other forms of integration, such as application-specific ICs, and surface-mount technologies also help reduce size and power requirements.

Because the amount of power that the computer's electronics consumes is proportional to the rate of logic switching, slowing the clock speed brings corresponding power savings. Virtually all chip sets provide programmable system-clock dividing circuits, allowing the CPU to slow itself down. The trick is to decide when to slow down the clock. If an application is simply waiting for keyboard input, then the CPU can slow down drastically (or even stop) with no discernible impact on performance. Unfortunately, current techniques cannot detect the difference between a genuinely idle condition and a complex spreadsheet recalculation; in the latter case, both the screen and the hard disk drive are inactive for a time even though the CPU is working furiously. Despite this deficiency, CPU speed management is a popular feature of notebook PCs.

Several new chip sets have been introduced recently (e.g., Genesis and 82340 from Intel, and LEAP from Chips & Technologies). In addition to saving on power and chip count, they monitor and control various system activities (e.g., video access) in hardware.

Suspend/resume features are also a type of power management. This utility preserves the state of the system and then

continued



■ Good news from the BIX community:

You can read and talk with Jerry Pournelle about the unedited text of his *Computing At Chaos Manor* column—weeks before BYTE hits the newsstands—on your computer. (Why settle for writing letters to him *after* the fact, when you have a shot at influencing his thinking—and maybe the content of the column itself?) You can also take part in a variety of other discussions with Jerry—on such subjects as computers, science, space exploration and habitation, cognitive psychology, natural and man-made disasters, education, and mathematics. Any of which discussions could work its way into his next column or book. You can even cast your vote with Jerry for the best and worst products of the year. And download 147 programs—free. All it takes is a subscription to BIX. Call our special Customer Service number for more information: 1-800-227-2983 (in NH, call 603-924-7681).

BIX

shuts down the CPU, support electronics, and peripherals. Later, you can resume the session where it left off. You can invoke Suspend in several ways: by pressing a key or a special button, closing the computer's lid, or leaving the machine idle for an extended period. The system may also be suspended if the battery reaches a critically low level. Several methods can preserve the system state; one uses the main DRAM memory in a slow refresh mode. Other systems use low-power battery-backed CMOS RAM or write the information to disk.

Battery Technology

Since batteries are a significant fraction of a computer's weight, laptop designers are closely examining new battery technologies. The perfect battery would be small and lightweight and would supply endless power. In an effort to approach this ideal, manufacturers are refining existing battery chemistries, as well as combining new materials.

Lead/acid batteries (the same type found in your automobile) are found in a few portable PCs. You can easily measure their state of charge and recharge them. These batteries have a significant power-to-weight problem: They are too heavy for the amount of power they produce. The sulfuric acid-based electrolyte poses its own problems. Very few new portables feature these batteries (the Macintosh Portable is a notable exception).

The current standard laptop battery is the nickel cadmium. It is relatively lightweight, small, and available in a wide range of configurations. One of its greatest advantages is that its output voltage is nearly constant regardless of its state of charge. This makes the design of the laptop voltage regulators and associated electronics easier, but it also makes it difficult to determine the battery's state of charge. However, recent advances in power measurement techniques are eliminating this drawback.

Another problem with nickel-cadmium batteries is that they exhibit "memory" in their charge/discharge cycle. If you routinely recharge the battery after using it only a short while, it soon becomes incapable of delivering more than a portion of its normally available power. Several vendors have found ways around this, and since its other flaws are minor, the nickel-cadmium battery will remain in popular use for the next few years.

An emerging battery that is a cousin of nickel cadmium is nickel hydride. It promises to provide about twice the energy of a similar-size nickel-cadmium

battery, and it will not have nickel cadmium's recharging problems. These batteries are still in the prototype stage, have not yet measured up to expectations, and will cost more than nickel cadmiums. Production quantities should be available next year.

Lithium batteries have been available for many years, but they have significant drawbacks. They are not rechargeable and are more expensive than nickel cadmiums. Also, all but the smallest sizes show a tendency to explode when shorted or overheated. Some new chemistries have alleviated this problem, but lithium batteries are still subject to hazardous-materials shipping restrictions.

The future of lithium batteries is looking up, however, as different chemistries have produced rechargeable designs. Their big advantages are that they are only one-third the size and one-quarter the weight of nickel cadmiums of similar capacity and that they will survive more charge/discharge cycles than other available chemistries. Unfortunately, the rechargeable lithiums are still explosive under the right conditions; if this problem is solved, they will be widely used.

A new kind of battery based on polymers is under development, and it could prove to be a notable success by the latter half of the decade. This battery is composed of either vanadium oxide or titanium sulphate attached to a polymer substrate. All component chemicals are solids, and because of their plastic base, they can be formed into nearly any shape. Polymer batteries should be extremely light and small; they may be as little as one-fifth the size of current batteries with the same power capacity. They will also have a much longer life span—it is claimed that they survive as many as 1500 charge/discharge cycles (versus 200 for nickel cadmium) and have a longer shelf life. Polymer batteries are still in the research stage and are unlikely to become commercially available for several years. However, they may become the new standard notebook power source for the late 1990s.

Getting Small in the Future

Because of recent technological advances, it is difficult pick a single notebook PC as today's standard. The market is still young, but it will stabilize quickly over the next few years. I expect that within the next five years, it will be as mature as the desktop-clone market is today.

Notebook PCs in 1995 will not be much smaller than today's models, due

continued

The new look of power.

See us at
COMDEX/Fall '90
Booth #1842, Las Vegas
Convention Center

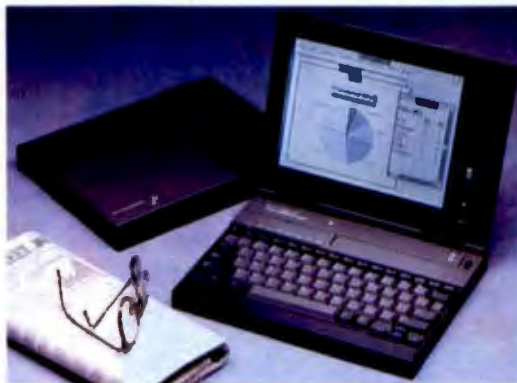


**286 processing in a computer that's notebook size,
1.4" thin and 4.4 lbs. light.**

**Introducing the TI
TravelMate™ 2000
notebook computer —
from the company
that pioneered portable
computing solutions.**

Since inventing the first portable data terminal in 1969, TI has led the way in packing more and more functionality into smaller and smaller products. Now TI brings you the next generation in portable computing — the TravelMate 2000.

This sleek, 4.4-lb. notebook computer gives you the power of a PC-AT® in an ultrathin 8½" x 11" package. It's designed to fit your workstyle — wherever you work — in the office, at home or on the road. Just slip it in your briefcase with your file folders, journals and other business materials, and you're ready to go.



**Large VGA screen with
leadership display technology.**

You'll appreciate the technology behind the 10" diagonal VGA display. It's a remarkable feature for a computer that's notebook size. The high-resolution 640 x 480 supertwist screen easily handles demanding windowing and graphics applications.

**More features to meet
your application needs.**

The TM 2000 has the power to run your favorite software — 12 MHz 80C286 processor, 20MB hard disk drive and 1MB of RAM. A built-in, rechargeable battery lets you work up to two hours. With an optional add-on battery, you can work up to five hours — enough for coast-to-coast flights.

You also get a full-function AT enhanced keyboard, so you can work with the same feel of your desktop PC.

In addition, we've loaded MS-DOS® and LapLink™ in ROM, and preformatted the hard disk.

For more information call
1-800-527-3500.


**TEXAS
INSTRUMENTS**

Circle 190 on Reader Service Card

to limitations in keyboard and display size—roughly 8 by 10 inches will be the standard flat dimension. However, these notebook PCs will be significantly thinner. Recent advances in displays (6- to 7-mm panel thickness) and hard disk drives (less than ¾ inch high) indicate a trend toward devices in a 1-inch-thick package.

The CPU will be a CMOS version of the 1994 standard CPU (which might be a 586SX). A single support chip will provide timers, DMA, serial ports, a disk

drive controller, a video controller, and a memory controller. I expect that 8 MB will be the standard memory configuration, with 32 MB and 64 MB available as options.

You'll still be using floppy disk drives in 1995, but only as a distribution and transfer medium; both 3½- and 2-inch disks will be available, with capacities in excess of 20 MB. Magnetic hard disk drives with capacities of 300 MB and up will be standard; some high-end laptops

and luggables will offer optical drives boasting capacities of nearly a gigabyte.

Recent industry standards for both hardware interface and software have been announced for battery-backed IC memory cards. These cards contain no moving parts to consume battery life, and they weigh considerably less than conventional mass storage devices. The Poqet PC and the NEC UltraLite are the best known examples of small computers that use this technology. The drawbacks to using this medium are high cost (up to \$500 or more per megabyte) and a limited selection of commercial software. By 1995, as production quantities increase, prices will drop dramatically (perhaps to less than \$50 per megabyte). This should become a popular software distribution medium, since most major hardware and software manufacturers in the small computer market seem committed to the standard.

The popular display will be VGA- or MVGA-compatible color active-matrix LCD; the quality will be identical to that of today's CRTs. Developers are introducing various prototype heads-up displays (e.g., Reflection Technology's Private Eye virtual monitor), but people who are not touch-typists may find them awkward to use. Keyboards will be essentially unchanged; they will become thinner while retaining a comfortable feel. Handwriting and voice-recognition algorithms are improving each year, but I don't expect that in 1995 they will be ready for the noisy, bumpy environment of trains and airplanes.

The 1995 portable PC will use either nickel hydride or variations of the lithium battery. The batteries will be in sizes that fit the 1-inch thin notebook case. Because of improved power management techniques, you will be able to run the average notebook PC for 12 to 24 hours before recharging the batteries. A suspended machine will be able to retain its state for many months.

In 1995, a notebook PC will appear similar to some of today's models—until you turn it on. Available processing power, display quality, and amount of mass storage will exceed those of all but the most advanced desktops today. The era of portable computing has been heralded for some time, and it will certainly be in full swing by the middle of this decade. ■

Paul Schmidt is a member of the technical staff at Interleaf, Inc. (Cambridge, MA). When he wrote this article, he was a senior editor at Phoenix Technologies. You can reach him on BIX as "p.schmidt."



FAILED?

CSS Has The Quick Fix!



Use Our 24 Hour Advance Exchange

Quick exchange is the key. It takes five minutes to pull your PS/2 planar board. Now place a one minute call to CSS. We'll reach into our Parts Vault and express a replacement board right from stock. (Just send us your bad board in our own shipping package.) In 24 to 48 hours, most customers are back in business.

Model	Part #	Price
8530	61X8907	\$290
8530-286	27F4069	\$390
8530-286	34F0046	\$390
8550	72X8516	\$390
8550Z	90X9533	\$430
8560	72X8538	\$490
8570	90X9355	\$540
8570	90X8623	\$590
8580	72X6668	\$590
8580	33F8416	\$590

- No expensive service calls
- New low prices on PS/2 board exchanges
- 120 day warranty

Call the Parts Vault for any of your parts needs. CSS... We're dedicated to extending the life of your computer with people, parts, and packages.

Call our Technical Help-Line





In the US: **1 800 255-7815**

International: 32 • 52-46 1748 US: 1 603-437-0634

COMPUTER SERVICE SUPPLY

C O R P O R A T I O N

P.O. Box 673 • Londonderry, NH USA 03053

IBM and PS/2 are Registered Trademarks of International Business Machines Corporation.



Until now, you've only seen a tulip standing in a vase. Until now, there's only been one way of looking at data. Now there's **ThinX™** software. The revolutionary Windows® program that finally links graphic images with databases and spreadsheets and lets you see data in a whole new way. 1-800-688-4469.



The IIT Advanced Math Coprocessor is the only Math Coprocessor with the power of 4X4.

The Future is Now – Ask for the Math Coprocessor with Certified 4X4 Power

See what EVOLUTION COMPUTING and SCHROFF DEVELOPMENT say about the power of 4X4:

- "Evolution Computing agrees with IIT – The future is now. The ability of FastCAD[®]3D/FastCAD Render Man and all IIT math coprocessors to support matrix transformations provides the user with unparalleled speed and performance."
— EVOLUTION COMPUTING
- "SilverScreen will benefit greatly from the coprocessor's ability to move matrix transformation onto the chip itself," says Jeff Howe, Schroff Manager of R&D. "We did not have to change any of SilverScreen's code to be able to run with any of the IIT math coprocessors. With the implementation of the 4X4 instruction set by the IIT products, SilverScreen now offers the user the ultimate in 3-D performance! Workstation functionality is now available at the DOS level."
— SCHROFF DEVELOPMENT

The Most Advanced Math Coprocessor

The 4X4 matrix transformation instruction is an exceptionally powerful addition to a floating point processor when working with three-dimensional CAD. Plug in the IIT Advanced Math Coprocessor for remarkably increased productivity.

Warranted Compatibility

- Software and socket compatible
- Backed by one of the strongest 5-year limited warranties in the industry/Made in USA
- Benchmark software included

IIT Sets New Standards

- Built-in 4X4 matrix instruction set
- Advanced CMOS technology for higher reliability
- Fewer cycles to execute existing instructions
- 3C87 instruction set in the 2C87
- Twenty-four additional 80-bit numeric registers

Full Line of 2C87 and 3C87 Math Coprocessors

- Completely compatible with existing 287 and 387 sockets



Look for the 4X4 Symbol – Plug in the Power

These software innovators are some of many developers to incorporate the strength of 4X4, the most powerful number-crunching tool available. Call your local dealer and ask for the IIT Advanced Math Coprocessor, the one with the power of 4X4. Or call Specialty Software Development Corp. at (512) 327-8608 for the name of the dealer nearest you.



Marketed by:
SPECIALTY SOFTWARE DEVELOPMENT CORP.
1001 Capital of Texas Highway So., Bldg. I
Austin, Texas 78746 • 512/327-8608

Circle 176 on Reader Service Card

LOOKING AT THE GRAPHICAL USER INTERFACE

*Graphics capability is reaching a critical mass stage,
with a number of high-quality choices*

Bill Nicholls

Graphics, like the year of the LAN, will sneak up on us. In the next few years, most larger systems will use a graphical user interface. By then, the rationale for a GUI will be obvious, yet today the GUI is a hotly debated issue, and the outlook for its success is far from certain. To understand why I think this will change requires a look into the components of the GUI, especially the enabling graphics technology.

The question of graphics is broad, spanning a range of issues from the user who is the object of the graphics to the technology used to deliver the graphics. The various components are the display, the controller, the software environment, the application, and the user—two hardware, two software, and one jelly-ware.

Hardware has been the primary constraint on the broad availability of graphics, since the other components have been available for varying lengths of time and with varying degrees of capability. Recent developments in all the component areas have made the success of graphics, and of the GUI, almost inevitable.

Hardware

Starting with display technology, we can see two tracks: the traditional CRT and the newer flat-panel (FP) technology. The CRT represents a mature technology that is being pulled by consumer demand and pushed by its competition to lower prices and raise performance.

The once-expensive EGA display has been replaced by VGA-capable displays

that cost less than a CGA display I got in 1984. Super VGA (800 by 600 pixels) displays are an incremental cost increase over VGA, and displays supporting 1024-by-768-pixel resolution are now under \$1000 at mail-order prices. We can expect higher-resolution displays to follow VGA down the cost curve.

FP technology is currently on the warm-up track, replacing the CRT where the FP advantages in size, power, and ruggedness outweigh its cost and performance disadvantages. With the exception of units like IBM's large plasma display, FP displays do not replace the CRT. Rather, they supplement the CRT and are usually sold as an integral part of a portable system.

Because FP technology is just beginning to mature and CRTs are near the peak of their maturity, I expect the penetration of FP displays to begin to increase. FP technology will probably show up first in mass-market TV sets and will later displace CRT units in the computer environment.

Graphics display controllers are on the fast track. From the basic Hercules chip to the VGA "Tower of Babel"

continued



to fully programmable controllers, price decreases and performance increases are coming with astonishing frequency. With the dominance of Texas Instruments' TMS34010 chip, the acceptance of the Texas Instruments Graphics Architecture (TIGA) standard for software, the establishment of the Video Electronics Standards Association (VESA) Super VGA standard, and the agreement of an IBM 8514/A register standard, choices in terms of both cost and performance have never been better.

Standard VGA cards cost about \$150, and Super VGA-capable cards are not much higher. VGA cards have become a commodity. The price difference between an 8-bit standard VGA card and a 16-bit Super VGA card mostly reflect the differences in production and marketing cost, with little added for hype.

Given the advantages of the VGA instruction set and its wide support, even monochrome displays should be driven by VGA. Super VGA cards are an easy choice if you do graphics, even if your current display can't show the card's full resolution. Among the several varieties of cards, the ones to buy have 16-bit bus interfaces and room for 512K bytes of memory for the display. These represent what I consider the low end for future graphics and GUI support.

The middle of the market, which as recently as a year ago was considered the high end, is in a real state of flux. The 1024- by 768-pixel resolution level can be reached by a few Super VGA cards and all the cards that are driven by either a TMS34010 chip or the IBM 8514/A controller. The Super VGA cards are pushed to the limit here and are limited in performance and colors compared to the others.

This many pixels (786,432) demands a graphics processor for good performance, especially if you are using 256 colors (8 bits per pixel). Either the IBM 8514/A or the TMS34010 can provide a performance boost, leaving more cycles for applications to use. In a GUI environment, I consider this assist necessary.

Similar to VGA cards, prices are being aggressively reduced for cards driven by the TMS34010. At Fall Comdex in 1989, the \$1000 list price barrier was broken, and by the end of the show, vendors were talking about \$795 cards. By the time you read this, I expect to see \$595 (list price) cards driven by a TMS34010. IBM 8514/A cards lag behind TMS34010 cards because the chip set is not as mature. But this year's Fall Comdex should show the IBM 8514/A repeating the same experience/cost curve.

The graphics hardware is here today for almost any graphics application or GUI, but the transition to a GUI is not happening fast. The major factors slowing this transition are the limited number of applications available, the installed base of PC- and XT-class machines, and the choice of a GUI environment.

Software

The magic word for graphics success is *standards*. Why is this so important? Simply put, only companies the size of Lotus and Microsoft have the resources to support every possible system and display in graphics mode, and it is not easy even for them. But reduce the number of graphics environments to a reasonable number, and smaller software companies can support a large enough user base to make a profit. Since the great majority of software comes from smaller companies, this should lead to an explosion of GUI-compatible software.

We're not quite there. For IBM, with Windows, OS/2 Presentation Manager (PM) 2.0 with full 386 support, GEM and Desqview with an X.11 graphics window, Hewlett-Packard's NewWave enhancement to Windows, and other options, 286 and higher systems have a variety of GUI choices.

Atari has GEM, the Amiga has Intuition, and the Macintosh has its Toolbox and standards that create the Mac user interface (UI). Unix has X.11 from MIT, with Open Look and Motif GUIs and Open Desktop as a graphics organizing tool.

While this is probably too many GUIs, it is a step in the right direction. Windows has been around long enough to establish a broad base of software, and X.11 has taken the Unix world by storm. Those two GUIs, along with the Mac, will clearly be among the winners of the GUI competition. Desqview's user base is big enough (over 1 million), and its choice of an X.11 window on Unix servers is an interesting alternative.

GEM, PM, and NewWave are less obvious, but NewWave's features make it a good choice for integrated DOS/Unix networks. For Unix, Open Look and Motif will both succeed, and they may in time merge in capability.

Another straw in the wind is the recent appearance of two companies, Glockenspiel and Advanced Programming Institute, that offer multi-GUI systems, requiring only a recompile for different GUIs.

Applications are the final technical issue. Those requiring graphics (e.g., desktop publishing and CAD) have long

been available, but until recently, DTP was the only one available in a GUI environment. Now, CAD and word processing join DTP under Windows and other GUI environments. Other applications will soon cover a user's major needs.

One of the major reasons for the slow development of GUI applications has been the major shift in program dynamics—away from the applications driving the user toward the user driving the applications. Most programs outside CAD and DTP have traditionally led the user, but this technique fails to provide the kind of flexibility needed for the future, and users are becoming more insistent about being in control of the application.

From a programming point of view, this user-driven perspective requires a dramatic change in program structure and is not easily retrofitted into an existing program. The need for new calls to the GUI for a wide variety of services also contributes to the conversion time. Once restructured, however, a program can be more easily ported to other GUIs. I expect the current slow start in GUI applications to become a rush as tools arrive and companies get past the first conversion.

Jellyware

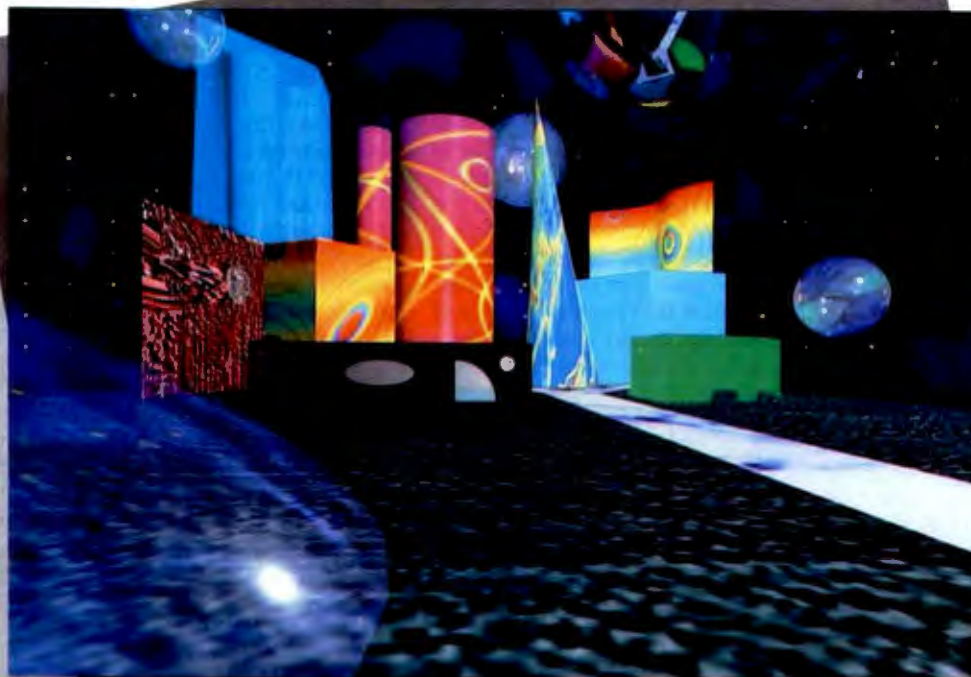
Why use a GUI? Beyond having easier access to graphics applications, there are a number of less obvious benefits. Ease of use and reduced training are two of the most compelling.

To achieve these goals, the GUI imposes a set of restrictions on the methods for program and user interaction, with a suggested set of standards based on experience and UI research. Not only is this usually better designed than the ad hoc UI of current applications, it is consistent across the application spectrum. Learning a new application under a GUI benefits from the transference of previous learning because of UI consistency. Except for the initial learning curve for the GUI and the first application, this is a significant benefit. The Mac is the best example of this.

Another benefit of a GUI is the enhanced interapplication capabilities, such as Windows' Dynamic Data Exchange and NewWave's links. The provision of standard facilities for interapplication communications in the GUI and the support of those by the applications provide new capabilities for the user. We don't have to wait for the application designer to provide a specific function, nor do we need a special program. We can now link one tool to another, generating

continued

“When I bought my TARGA[®] board back in '85, it was the most sophisticated product on the market. It still is.”



Graphic created by Jonathan Herbert, using the TARGA board with TIPS[®], RIO[™] and TOPAS[™]. For more information contact Jonathan Herbert at (718) 383-1251.



Jonathan Herbert
Computer
Illustration
New York, New York

“I bought one of the first TARGA boards ever made. Now, there are lots of other boards on the market, but I've never given them a second look.”

Just look at us now. Today's TARGA+ supports multiple platforms, including PS/2, and multiple display resolutions in both interlaced and non-interlaced modes. And, with our new VGA overlay feature, you can superimpose VGA graphics directly onto your non-interlaced output. Looks like we've done it again.

Introducing the Truevision TARGA+. The next generation TARGA for the next generation TARGA user.



7340 Shadeland Station, Indianapolis, IN 46256
INTERNATIONAL: Canada 416/940-8727 France 33-1-3-952-8253 Italy 39-2-242-4551
Switzerland 41-1-625-0949 U.K. 44-628-77-7800 West Germany 49-89-612-0010 Other 617/229-6900
RIO and TOPAS are trademarks of AT&T.

Circle 208 on Reader Service Card

Call
800-858-TRUE
For more information

something new, without special programming.

This new user programming has the same kind of potential that spreadsheet programming brought to numeric analysts. It enables problem solving by anybody who wants to learn the basics of linking two tools together. The major difference here is that the range and value of user-created solutions will be much greater than the range of spreadsheet applications. Instead of moving the three-year application backlog from the mainframe to the PC, we can empower the end users to provide their own solutions and (mostly) eliminate the backlog.

The Dilemma of Decision

Along with the opportunity of choice comes the dilemma of decision. The benefits of a GUI don't come free—there are hardware and software upgrades, and basic training is needed.

Choosing a GUI involves a complete reassessment of your system and your needs. Every item, from the hard disk drive to the display, will be affected by this change. More important, however, is that the way you work will also have to change to make best use of the GUI. I'll now look at what those changes will involve.

Hardware Upgrades

Consider first that a GUI is more compute-intensive. A screen display, multitasking, and bigger applications simply can't be supported well with less than a fast 286-based machine and plenty of memory. And while the screen display issue gets most of the attention, multitasking will become the key element in the GUI success. This is already heralded by the success of DOS multitasking. Once users experience not having to wait on anything, from a printer to a slow recalculation, there will be no going back. Real productivity gains will also come from users being able to respond to interruptions without losing track of what they were doing.

Starting with the base platform, we must face the final obsolescence of PC- and XT-class machines. With adequate peripherals and power, a \$200 motherboard upgrade to a 12-MHz 286 system and \$100–200 for additional memory is a minimal cost for enabling technology. A \$300 CPU upgrade will get you a 16-MHz 286 processor with hardware EMS 4.0 built in. There is no longer any reason to handicap people with obsolete technology.

For more demanding needs, a 16- to 20-MHz 386- or 386SX-based system

with 2 to 6 megabytes of memory, with room for more, should be adequate. For the power-hungry, people whose applications always run too slowly, a 25- or 33-MHz 386 with 8 MB should ease even their impatience. Along with all this will be the need for more hard disk drive capacity—more than you might expect. Consider 60 MB as a minimum, and 100–200 MB as more typical. Although these systems may seem large for the simple use of a word processor, the GUI benefits are good reasons for increasing capacity, and the hardware is no longer priced out of reach.

Getting the graphics in front of the user is next. A basic VGA and display gets you minimum resolution for graphics work. But if you are upgrading, you can get Super VGA capability for only a small increase in cost. Match the display against your processor capability—consider the sum of the processing power of the CPU and the display controller, measured against the combined processing/graphics load.

For example, a 25-MHz 386 machine will drive a Super VGA display to the limit of the controller's capability and still have quite a few cycles left for computation. A 12-MHz 286 will be slowed quite a bit by Super VGA, so use standard VGA, upgrade the processor, or off-load the graphics to a graphics processor on the controller board.

TMS34010 and IBM 8514/A cards offer an alternative to upgrading the whole system. You may choose to upgrade the controller to a graphics processor first, and wait on a processor upgrade. The higher your planned graphics resolution, the more processor power you need for equivalent performance. As a rule of thumb, an AT slower than 12 MHz should limit its display to 640 by 480 pixels. Processors that are 16 MHz and faster are needed for Super VGA (800 by 600 pixels), and by the time you reach 1024 by 768 pixels, a graphics processor is almost a necessity.

Software Upgrades

The environment you choose will depend in great part on the applications you are running and those you want to add. A DOS application user's simplest move is to Windows or, less easily, OS/2 (which requires more in platform resources but offers more capability). For many users, Windows is a logical choice because of lower platform requirements and a larger application base. OS/2 may be considered an evolutionary step beyond that.

Another option for DOS users with minimal resources is Desqview. This is

multitasking without the graphics overhead, yet you can still run most graphics applications. Desqview offers its own set of interface calls, but the requirement for a standard UI is not there. Desqview is most functional on a 386, less so on a 286 with EMS 4.0 support, and least flexible without EMS. Each application still has its unique UI, which can be confusing.

Unix is in a different ballpark. First, the required resources start where OS/2 starts, but they grow larger in many cases. Second, the applications do not overlap the DOS environment very well, and running DOS emulation should be limited to a few necessary tasks. Third, Unix requires technical support not easily found in many businesses.

Why then would Unix be of any interest? For use with a powerful workstation with X.11 graphics or for special applications, Unix excels with large and complex tasks, particularly in networking. Networking (i.e., the sharing of files, devices, and peripherals—even CPU cycles) is part of the standard Unix software. For uses like a database server, Unix offers a broader and more powerful set of platforms. Currently, it is more likely that you would network into a Unix server than run a Unix workstation on your desk, but that may change as more powerful hardware and applications make Unix attractive.

Success of the GUI

Success ultimately will be determined by what best serves the user, as the user's needs are what justifies the cost of computer use. User needs drive the whole process, from applications to new display technology. As we evolve into networked environments that feature increased complexity and more powerful applications, there will be a greater need for the user to respond to ad hoc questions without custom programming.

Something must be done to prevent that complexity from requiring all computer users to be software gurus just so they can accomplish their workday tasks. That *something* is the "single system image" concept, where the complexities of the environment are hidden behind a user-oriented interface. That *something* is a GUI.

Current problems with cost/performance issues will be resolved quickly by improved implementations and faster, less expensive technology. New display and controller technology is an important part of making that happen. The other part of the picture is the user/software interface. User productivity

continued



1. Help Icon 2. AutoCAD Sub-Menu Icon 3. Icons Are Made In AutoCAD 4. GT Top 10TM
5. Bird's-Eye Icon 6. GT Flexicon Pops Up At Cursor 7. Hot Spots to Nested Sub-Menus 8. Reassignable Icon 9. Resize Icon

Give Your AutoCAD[®] A New Interface.

If you use AutoCAD 386, here's some uplifting news. *GT Flexicon*[™] software does more than move your tablet from the table to the screen. As the industry's first fully automated, user-definable interface, *GT Flexicon* allows you to step through commands so naturally, you'll view AutoCAD

Suddenly, you realize how productive you are. Soon, you wonder how you could have worked any other way.

GT Flexicon runs with ARTIST XJS, XJ12, XJ10, 12MC or any VGA card.



ARTIST Graphics keeps pace with AutoCAD changes and upgrades.

▲ Pop-up AutoCAD GT Flexicons appear instantly at your cursor.

Compatible with our popular ARTIST graphic controllers or any VGA card, *GT Flexicon* takes only seconds to appreciate. Simply scroll over your favorite GT commands, and soon you'll be panning and zooming from a bird's-eye-view. To help you hold your thoughts, we've added reassignable icons that can be assigned and re-assigned to any AutoCAD command, lisp routine or macro during your drawing session, so your eyes never leave your work.

in a whole new way.



GT Flexicon. It's more than new software. It's a new point of view.

For your nearest dealer, call

"1-800-6-ARTIST"



ARTIST GRAPHICS

A Control Systems Company

ARTIST is a U.S. registered trademark of ARTIST graphics. AutoCAD is a registered trademark of Autodesk, Inc. © Copyright ARTIST Graphics. All rights reserved. Specifications subject to change.

Token Ring Network



Breakthrough

Sim Ware's new SAM (Single-station Action Access Module). Innovative. Flexible. Cost effective. Now you can create or expand Token Ring networks one port at a time as needed. Here are some of the ways SAM will cut your costs:

- Connect two PCs together to form a two station Token Ring
- Add a ninth port to a single populated MAU without purchasing another MAU
- Create a Token Ring Network without a MAU
- Expand an existing network by using Token Ring Concentrators and SAMs instead of MAU and patch Cables

Send for brochure SAM 9905 today. Sim Ware, Inc.
11881 Belden Court, Livonia, MI 48150, or call
(313) 422-5470

Sim Ware is a leading U.S. manufacturer of IBM compatible components, including a full line of passive and active MAUs.

SWI

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



GRAPHICAL USER INTERFACE

will be enhanced by the GUI ease of use—the dynamic and user-built links and data access through networks that are transparent to the user.

In short, quicker learning and much greater functionality will drive the transition to a GUI. It will be aided by reducing the effort and complexity required to generate new solutions. Thus, as the computer penetrates further into business and home, the non-computer-literate population is the new audience. The GUI will broaden the base of people able to produce results from computers with these new tools. ■

BIBLIOGRAPHY

- Apiki, Steve. "New CAD Test Shuffles 34010 Pack." *BYTE*, May 1990.
- Apiki, Steve, Howard Eglowstein, and Rick Grehan. "The Brains Behind the Graphics." *BYTE*, November 1989.
- Cahill, Ben. "Drawing on the 8514/A." *BYTE*, March 1990.
- Diehl, Stanford, and Howard Eglowstein. "A VGA on Every Desk." *BYTE*, March 1990.
- Eglowstein, Howard. "Behind the Scenes." *BYTE*, April 1990.
- Giguere, Eric. "Skin and Bones." *Computer Language*, April 1990.
- Hayes, Frank. "From TTY to VUI." *BYTE*, April 1990.
- Hayes, Frank, and Nick Baran. "A Guide to GUIs." *BYTE*, July 1989.
- Lussmyer, John. "Windows Rides a New Wave." *BYTE*, April 1990.
- Moote, Robert. "Virtual Memory: The Next Generation." *BYTE*, November 1989.
- Schulman, Andrew. "Glockenspiel Puts C++ to Work." *BYTE*, January 1990.
- Smith, Ben. "High-Fashion Unix on a PC." *BYTE*, December 1989.
- Southerton, Alan. "Many Paths to X Window Programming." *Unix World*, May 1990.
- Thompson, Tom. "How to Put 16 Million Colors to Work." *BYTE*, December 1989.
- Udell, Jon. "OS/2 2.0: It's a Family Affair." *BYTE*, April 1990.
- Van Name, Mark L., and Bill Catchings. "Transparent and Portable." *BYTE*, April 1990.
- Walker, Bruce J., and Gerald J. Popek. "A Transparent Environment." *BYTE*, July 1989.
- Wood, Lamont. "Word Processing in Windows." *BYTE*, April 1990.

Bill Nicholls has a B.S. degree in physics from Notre Dame and is the owner of BGW Systems in Puyallup, Washington. He can be reached on BIX as "billn."

Now 4 can share HP's LaserJet III printer...



...with BayTech's LaserShare® — expansion is made easy!

LaserShare is an expansion card that allows four users to connect simultaneously to one laser printer. Just check out our outstanding features:

✓ HP LASERJET III COMPATIBILITY

Also works with HP LaserJet II, IID, Canon LPB8II, LPB8III, Brother HL8e, and Wang LDP8 laser printers.

✓ 256KB, 1MB OR 4MB BUFFER

✓ SIMPLE INSTALLATION

✓ AVAILABLE MODELS

- 4A - 4 parallel ports
- 4C - 4 serial ports
- 4E - 2 parallel/2 serial ports
- 4CB - 4 serial (256KB, Brother)

✓ SAVES MONEY AND TIME

✓ UNMATCHED PRODUCT SUPPORT

With several users having access to one laser printer, the per-user cost of your laser printer is dramatically reduced. And there's no more waiting for the printer. With LaserShare, everyone's printing needs are accommodated. BayTech's LaserShare — it's worth checking out! Call now for details!

Circle 20 on Reader Service Card (RESELLERS: 21)

INTERNATIONAL DISTRIBUTORS

Australia
Melbourne
Shuttle Technologies, Ltd.
(03) 587 4920

Melbourne
Goya Tech, Pty. Ltd.
(03) 747-8455

Belgium
Multiway Data Belgium
016-29 22 78

The Netherlands
Multiway Data Netherlands
079-424 111

Denmark
Trend Communications
53 65 23 45

Finland
Genine Oy Impdata
(921) 335700

France
Suresnes
Komdex International
(1) 47 72 63 11

Paris
Gradco France
(1) 42 94 99 69

Germany
Munich
AMS Computech GmbH
(089) 126806-0

Dusseldorf
Multiway Data Germany
0211-25 18 75

Italy
Torino
BRM Italiana
(011) 771 00 10

Milano
I.T.D.
(02) 749 0749

Norway
A/S Kjell Bakke
47-6-832000

Singapore
Mark Systems (FE) Pte. Ltd.
65-2261877

Spain
Vidmar Control
(93) 2454803

Sweden
Solna
Microcom/Maldata
(08) 7344100

Sollentuna
Beon Data
08-628 92 26

Switzerland
Sengstag Computers AG
0041 1 950 54 44

United Kingdom
Leicester & London
A-Line Dataspeed Devices, Ltd.
0533-778899

Buckinghamshire
Trend Datalink, Ltd.
(06285) 30611



Because Resources Should Be Shared.

BayTech

Data Communications Products Division
200 N. 2nd St., P.O. Box 387 Bay St. Louis, MS 39520
Fax 601-467-4551 Phone 601-467-8231 or toll-free

800-523-2702

*All product or company names are trademarks of their respective holders.

Quarterdeck Presents A Glimpse into the Future

DESQview/XTM

Extending DOS into the 21st Century

If the booklet has already been removed,
call and we'll send you another.



150 Pico Boulevard, Santa Monica, CA 90405
(213) 392-9851 Fax: (213) 399-3802

Circle 159 on Reader Service Card

LAYING OUT THE FUTURE

Increased capabilities and color should give desktop publishing a rosy future

Matt and Mary Page

Our perspective on the future of desktop publishing is that of a small business, specifically an advertising agency. Our capital expenditures for computer equipment have to be carefully researched, as the difference between a good and a bad buying decision can ultimately mean the difference between staying in business as a profitable entity and struggling month to month. Discussing some current issues facing DTP is a good starting point for leading into what the future holds for DTP.

First, Some Background

Back in November 1987, we started Page After Page, a small, full-service advertising agency in Rutland, Vermont. Most of our business comes from small- to medium-size companies. DTP can be lucrative; we've doubled our sales each year and added two more people to our staff.

We help our clients plan their marketing and advertising strategies, as well as design, develop, and produce everything from print ads, brochures, newsletters, and corporate identity programs to radio and TV spots and books. Recently, designing

and writing software documentation has become a major portion of our business. An important production tool in the daily operations is DTP, and it has surely added to our company's success.

Hardware/Software

We have grown up with and currently use IBM PC compatibles, as well as two Macs. Table 1 has a list of the equipment

we're using. It's a mix of the new and the old—a mix that we think is typical of small DTP services.

But times are changing, and we'd like to keep current. As money and the business permit, we're planning strategic upgrades to enhance the performance of the software we have and to add new capabilities. Color figures heavily into the upgrade equation, as do beefier processors and higher display resolution. Table 2 shows our planned upgrades and our wish list.

Eek! A Mouse!

The transition from keyboard to mouse was the first hurdle to get over when we started with DTP. The nature of our business compelled us to investigate the Mac because of its command of the graphics environment.

With the type of work we do, keeping current in both environments is essential for serving our customers and keeping a competitive edge. The ability to exchange disks with our clients has been an important asset. And the fact that most businesses use IBM PCs or compatibles ensures that we will maintain and, hopefully, progress with DTP trends on both platforms.

continued



CURRENT EQUIPMENT**Table 1:** *Our current flock of hardware and software, typical of many DTP environments.***COMPUTERS AND OTHER HARDWARE**

IBM XT enhanced with 12-MHz 286 Sota motherboard, 1 MB of RAM, monochrome VGA, and 30-MB hard disk drive
 ALR 386 running at 16 MHz with 2 MB of RAM, a 66-MB hard disk drive, and a Cornerstone SinglePage monitor
 Mac II with 4 MB of RAM, a 65-MB hard disk drive, and a Cornerstone DualPage monochrome monitor
 Mac SE/30 with 2 MB of RAM and a 40-MB hard disk drive
 NEC 690 Silentwriter PostScript laser printer
 20-MB removable Bernoulli drive, used for backups
 Microtek International MSF-300C 2-bit scanner (1987 technology)
 Orchid fax/modem

MAJOR SOFTWARE

Aldus PageMaker for Macs and PCs
 Arts & Letters Graphics Editor 2.0
 Microsoft Word for Windows
 Microsoft Word for Macintosh
 MultiMate Advantage II version 1.0 for the PC
 EyeStar Plus scanning software for Microtek International scanner
 Ventura Publisher 1.1 for the PC
 Adobe Illustrator 88
 DeskDraw and DeskPaint by Zedcor
 Mind Your Own Business accounting software by Teleware
 Reports by Activision for HyperCard (we created an invoicing system with HyperCard and Reports)
 Microsoft Windows
 TOPS AppleTalk network for all computers

PROSPECTIVE EQUIPMENT**Table 2:** *Planned expansions and a few items that, while not critical, would be wonderful to have.*

High-resolution PostScript-output laser printer—possibly the LaserMax 1000
 Abaton or Hewlett-Packard gray-scale scanner with ColorSet by Studiotronics (turns a gray-scale scanner into color) or Microtek International MSF-300Z scanner for color and gray scales
 RasterOps 24-bit color board with 14-inch monitor (Sony or NEC)
 Aldus PrePrint
 SyQuest 44-MB removable cartridge drive
 Network upgrade (we will need a faster network in the future, and it will probably be an Ethernet with a dedicated file server)
 Additional PostScript fonts on an as-needed basis
 9600-bps modem when a real standard emerges

KEEPING OUR FINGERS CROSSED

Polaroid Bravo Slide Maker
 Radius Two-Page 24-bit color display with QuickDraw accelerator
 Mac IIx
 QMS ColorScript printer
 Linotronic L300 Imagesetter

PC World Issues

Many of our concerns in the PC environment revolve around memory issues—specifically, the memory limitations of the Windows/DOS world—and the non-graphical nature of DOS. For instance, we use Arts & Letters as our primary drawing and clip-art package for the PC. We like it, but it's painfully slow when working with a complex drawing, and it takes forever to print. In comparison, we use several drawing packages on the Mac, including Adobe Illustrator 88. For the most part, the functionality of A&L and Illustrator is comparable. But since the Mac's operating system was designed to be graphically based, Illustrator on the Mac prints much faster than A&L under Windows, and the Mac maintains a consistent interface between packages.

We've seen Windows 3.0, and we're pleased with the performance increase and the improved memory support. But now we must wait and be prepared to pay: Which software packages will be compatible with Windows 3.0, and at what cost?

The lack of graphics standards in the PC world poses other concerns, too; it's easy to be confused by all the different file formats. If you are not sure which package you will ultimately be placing a graphic into, or if you want to bring it into another graphics package first to change something—good luck! No two software packages seem to read or interpret these formats the same way.

Drawing on PostScript

It will be great if IBM's endorsement of PostScript means that we'll finally be able to see fonts correctly on-screen. But while screen appearance is important, the biggest issue with PostScript is lack of speed. Fortunately, this is being addressed by some printer vendors. Newer printers have faster processors and resolutions higher than 300 dots per inch.

We are currently considering the purchase of a high-resolution, plain-paper device. We've looked at the Varityper VP600, the NewGen Systems PS400, and the LaserMaster LaserMax 1000; the latter two are PostScript clones. NewGen's PS400 seems to have some incompatibilities, but so far the LaserMax looks pretty good. Presently, a high-resolution service bureau and traditional typesetting have enabled us to get the high print quality we need.

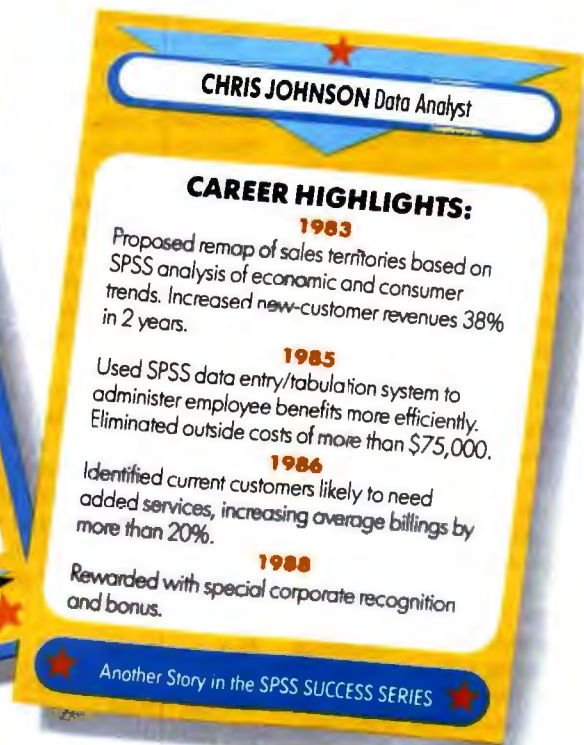
Desktop publishers have made a huge investment in PostScript—not only in equipment, but also in fonts. With this in mind, reinvestment in another standard

continued

We'll take your stats and make you the most valuable player in your league.



March 14, 1989



Data analysis software from SPSS gives your PC a winning advantage.

It doesn't matter which field you play hardball in. With the right combination of equipment and ability, you can be a hero. You get that ability with SPSS.

Whether your equipment runs on MS-DOS™ or PC-DOS™ OS/2™ or a Macintosh™. So you turn raw data into useful facts. And yourself into a smarter decision maker.

With SPSS and its options, you can interface directly with data from your database, spreadsheet or other

application software. Then manipulate it in countless ways. From data entry to advanced statistics, forecasting, presentation and more.

Voted #1 by the fans.

When the readers of *PC Week* chose the top statistical software for "user satisfaction" (12/5/88), their choice was SPSS. And no wonder.

SPSS is designed not only for your computer's operating system, but also for its operator. With menu and help systems, plus an on-line statistical glossary. So you're always in control. For market research, sales analysis, quality control and more.

And you can always count on the training, support, and ongoing upgrades of SPSS. The team that's come through for over 1 million users since 1968.

Find out how SPSS can make you first in your micro league, by calling

[312] 329-3315.

We'll give you the numbers to really stand out in your field.

SPSS inc.

Best in the final analysis.

444 North Michigan Avenue, Chicago, Illinois 60611
SPSS International BV: Avelingen West 80,
P.O. Box 115, 4200 AC Gorinchem,
The Netherlands

SPSS is a registered trademark of SPSS Inc. PC-DOS and OS/2 are trademarks of International Business Machines Corporation. MS-DOS is a trademark of Microsoft Corporation. Macintosh is a registered trademark of Apple Computer, Inc. Not all options are available on all operating systems.

Circle 178 on Reader Service Card

seems out of the question unless someone develops a truly outstanding language and offers customers some sort of trade-in incentive.

Microsoft's new font technology is interesting. In our opinion, however, for it to gain market share quickly, it must be able to overcome the speed difficulties PostScript currently has, while keeping the ability to handle current PostScript-based applications and fonts. Again, we feel forced to take a "show me" stance. Will we have to update our software again with this new technology? And at what cost?

In Living Color

Color is a huge issue for us in advertising. The costs can be astronomical. Being able to see what a Pantone Matching System (PMS) color will look like on the screen is great for layouts and compositions; however, the next question from our client would be, "Can I have a copy to show so-and-so?" So we're not just talking about a color monitor and display board—we'd need a color printer, too. You can see where this is leading.

In any case, we have investigated color technology and think that the current costs are prohibitive. However, our future purchase plans include a 24-bit color board and a color monitor. Even without a printer, there still is value in being able to switch PMS colors on the screen and allow our clients to view the different versions.

We would use Aldus Separator and PrePrint for spot color only. Traditional methods of producing four-color separations are better for four-color photographs. Doing the same job with computer software is truly labor-intensive, and the output we have seen is substandard. For example, when you see a color scanner demonstrated, its output looks impressive on a computer screen, but the output printed on a PostScript printer looks nothing like it does on-screen. The color gradations have a linear, stepping effect. Besides, we would need to have a substantial amount of color work all the time to justify the costs of having a full-time color specialist, a color scanning device and software, and an adequate output device.

Back to the Drawing Board

There are other subissues as well. First, look at how you create a color layout. For us and many other graphic designers, it is simply uncomfortable to create layouts on a computer. The techniques of using a pen, paintbrush, marker, or airbrush cannot be duplicated to our satisfaction.

When artists draw, they look simultaneously at their hands, their tools, and what they are creating. Blending, shadowing, showing light on a subject from a certain angle, and showing reflections are all difficult techniques to duplicate electronically. Working on the computer is frustrating and, frankly, too slow. We can have a few layouts done manually in the time it takes to orchestrate one on the computer, so it usually does not make sense to use the computer for that particular process. And since designs are typically billed on an hourly rate, we would be doing our clients a disservice.

But have faith—we're sure that someone will develop a true designer's drawing board for microcomputers with the necessary tools: a larger, horizontal touchscreen with levels of pressure sensitivity, and styli that resemble markers, pens, and airbrushes. The analogy of paper on a drawing board is fundamental to designing and should be the basis of the design of an effective input device. Affordability would be key, too, for folks like us, or even for the freelance designer market.

It's when the layout is completed that DTP truly has value. Trying different typefaces—slanted, outlined, justified, or centered—and moving text and graphics around to get different effects are just a few of the time- (and money-) saving features. Previewing the output before committing it to the printer has saved many a disaster.

Dots per Inch

For many of the pieces that we produce, 300-dpi output is sufficient. Newspaper ads (they massacre everything anyway), newsletters, direct-mail letters, and so on all look just fine at 300 dpi. But for some of the more sophisticated multicolored collateral material and books, we send our files to an output service for 1800-dpi resolution.

There are desktop laser printers that do better than 300 dpi, but we weren't truly impressed until the LaserMax 1000 printer, with 1000 by 1000 dpi, became available for about \$8000. Without a loupe, it's difficult to tell the difference between its output and that of a higher-resolution device (offering 1200 to 1800-plus dpi). Even 7-point type is readable and not fuzzy. Sure, it would be wonderful to have a Linotronic Imagesetter and be able to print out 1800-plus dpi in our shop. But at over \$30,000 (plus the costs of paper, supplies, chemicals, and maintenance), it would be hard to justify the \$22,000 differential for what we think is a minimal increase in quality.

Where Do We Go from Here?

In terms of page-layout packages, PageMaker 4.0 should answer many of the complaints that we have with PageMaker 3.0. Most of these complaints revolve around text editing. Because we need both IBM and Mac versions, we'll wait until we hear when the IBM version is to be released before we update.

The documentation work we've been involved in lately has confirmed the need for a true object-oriented DTP package with good text-editing capabilities. This would alleviate much repetitive work when editing copy related to one topic; it would also reduce errors. Also, in supplying documentation via electronic media, it would be beneficial to be able to find any or all references to a particular topic and browse through them.

Synergy, if not total integration, of DTP and multimedia already exists. As with any new technology, educating people about its benefits and capabilities takes time, so the process of market penetration is slow. Only a limited number of our customers would use this new form of communication. We give it a year or so before it truly catches on.

Staying technologically current makes sense only if you can afford to, or can't afford *not* to. As a small company, we try to keep down our expenses for new equipment and technology. But as computer enthusiasts, it's fun to investigate and to hope that if something is terrific, it will become affordable.

Our philosophy has been to embrace technology where it makes sense. We've stuck with traditional methods of design and production when moving up would be too expensive or labor-intensive. We use DTP, not because it lets us work faster, but to give us more control over how the final product looks and when it will be delivered. DTP's biggest failing is the initial learning curve. The time savings come only after many hours (or years) of learning and making mistakes.

Communication and professional presentation are essential to the success of any business, and that is what DTP is all about. As we see it, DTP can't help but increase its market share and mature and expand its focus. ■

Matt and Mary Page own and operate Page After Page, a small DTP company in Rutland, Vermont. Prior to starting their own company, Mary was the director of product management and Matt was the director of operations at MultiMate International, creator of the MultiMate word processor. They can be reached on BIX c/o "editors."

Our VT240 terminal emulator has changed the meaning of portability.



What does VT240 portability mean to you?

- **Portable across operating systems!** Our ZSTEM 240 software runs under both MS-DOS and Unix 386 System V, making your PC look and act like a VT240/340 terminal on either operating system.
- **Portable across machines!** ZSTEM 240 runs on IBM PCs, XTs, ATs, PS/2s and compatibles, from AT&Ts to Zeniths!
- **Portable across portables!** ZSTEM 240 runs on portable PCs, letting you connect to your office systems when you're on the road.
- **Portable across video adapters!** ZSTEM 240 supports all standard video adapters: VGA, EGA, CGA, MCGA, AT&T, Hercules and many extended adapters. No matter what adapter/monitor combination you use, ZSTEM 240 displays double-high/double-wide characters, 132 columns,

and VT340 ReGIS, sixel and Tektronix graphics.

- **Portable across networks!** ZSTEM 240 connects to your favorite networks, including Novell, 3COM, TCP/IP, Ungermann-Bass, Excelan, Wollongong, FTP, Sun and DEC's CTERM and LAT.

Of course, ZSTEM doesn't *really* come with a handle. What it does come with is our top-notch technical support and documentation, plus a solid warranty, so you can be assured of quality products backed by quality people. Call today about our complete line of VT emulation products.

KEA Systems Ltd.
3738 North Fraser Way, Unit 101
Burnaby, B.C., Canada V5J 5G1
Telephone: (604) 431-0727
FAX: (604) 431-0818

Toll-Free Order Desk
1-800-663-8702



ZSTEM and the KEA and ZSTEM logos are trademarks of KEA Systems Ltd. All other brand and product names are trademarks or registered trademarks of their respective holders.
© Copyright KEA Systems Ltd., 1989. All rights reserved.

Circle 110 on Reader Service Card

1,000 Words On Quality.



See the picture of quality for yourself. Discover the unsurpassed picture crispness, brilliance, and infinite range of color of the CTX monitors.

Compare the superlative quality with the rest. Then check the affordable prices.

1,000 words won't do it justice.

Available from CTX is a full range of powerful 14" color monitors: from the top-of-the-line Multiscan to a Super VGA and Deluxe and Standard VGAs as well as EGAs and CGAs.

	Multiscan	Super VGA	Deluxe VGA	Standard VGA
Model	3436	5468	5432	5439
Resolution	1024x768	1024x768	640x480	640x480
Horiz. Freq.	15.75-38 KHz	30-38 KHz	31.5 KHz	31.5 KHz
CRT Dot Pitch	.28 mm	.28 mm	.29 mm	.39 mm

Add to all these features complete IBM and Macintosh compatibility, handy up-front controls, non-glare direct etch screens, detachable tilt/swivel bases, and reliable nationwide servicing, and you will agree that the CTX monitors are the best deal available on the market.



WHERE MONITORS ARE CTXELLENT

—Technological Excellence.

—Unbeatable Performance.

—Exceptional Pricing.

For a real picture of quality, see your local CTX dealer or contact:

CTX INTERNATIONAL, INC.

161 Commerce Way, Walnut, CA 91789
714/595-6146, FAX 714/595-6293

CTX SOUTH, INC.

6090-F Northbelt Parkway, Norcross, GA 30071
404/729-8909, Fax 404/729-8805

Factory:

CHUNTEX ELECTRONIC CO., LTD.

6F, No. 2, Alley 6, Lane 235, Pao Chiao Rd.
Hsin Tien, 23115 Taipei Hsien, Taiwan, R.O.C.
886-2-9175055, Fax 886-2-9172736

Watch for CTX's new 17" and 21" Large Screen Displays coming soon.



IBM is a registered trade mark of International Business Machines. Macintosh is a registered trade mark of Apple Computer, Inc.

Circle 48 on Reader Service Card (RESELLERS: 49)

COLOR FOR THE DESKTOP

*New printer technologies offer
color at a price*

Rick Cook

The average color printer is about four times as complicated as a monochrome printer with the same resolution. Color brings with it a whole raft of difficulties that you don't have in designing a monochrome printer.

Because of the problems and added costs, color printers are not likely to sprout up on everyone's desk in the next few years. They are getting less expensive and more flexible, however, and new computers and new kinds of software are making them more attractive all the time. A color printer also increases the scope of a computer system, so some users are willing to pay extra for them. Thus, color printers for desktop systems represent a fast-growing segment of the printer market.

There are three major technologies used to build color printers for desktops: dot matrix, ink jet, and thermal wax. A fourth technology, dye sublimation, is beginning to show up in small computer applications, and several other methods, such as color laser and dye transfer, will probably appear during the next two or three years.

The Challenge of Color

The basic problem with color printers grows out of the way they print color. All existing color printers build up reflective colors by applying primary-color inks to the paper. In printing, those colors are cyan (blue-green), magenta, and yellow. All other colors can be blended from them. Since it is hard to get a good, solid black by mixing colors, almost all print-

ers include black as a fourth color. This is called the CMYK system, K being the printers' designation for black.

The mechanical problems that this blending causes are obvious. The printer has to have four print heads or make four passes to lay down all the primary colors. To get the colors in the right place, the paper alignment with the print head, or *registration*, has to be tightly controlled.

This is particularly true of page printers that use thermal wax or sublimation processes, in which the sheet of paper is run through the mechanism four times.

Beyond mechanical considerations, however, there is a whole other class of problems that grows out of the nature of color itself. For example, one-color printers are judged almost entirely on resolution. Resolution is important in color printers, too, but it doesn't tell the whole story. A sublimation printer at 160 dots per inch has a much better apparent resolution than a 300-dpi thermal wax printer, because a thermal wax printer produces visible dots and a sublimation printer doesn't.

On a one-color printer, black is black, pretty much. Gray scales are also pretty

continued





Photo 1: The Hewlett-Packard PaintJet XL ink-jet printer.

much the same from printer to printer. On color printers, things are not nearly that uniform. A medium yellow on one printer doesn't necessarily look anything like another printer's medium yellow, or like the medium yellow you saw on the screen.

Finally, ink and paper technology is much more important in color printing than in monochrome printing. Getting an ink that stands up to the rigors of the printing process, blends well with other colors, doesn't smear in paper handling, and is absorbed into the paper properly is not an easy job. In fact, most of the ink formulations used in conventional printing simply will not work. Besides, most printer inks are made with solvents you don't want in the air in your office.

As for paper, everything from absorbency to thermal characteristics plays a role. Papers differ in these characteristics, even among batches of the same kind of paper from different manufacturers. Ideally, users would like to be able to print on "plain paper"—which translates into "any paper I want." Some color printers, notably dot-matrix and ink-jet printers, come close to this ideal. Some, like sublimation and dye-transfer printers, cannot do this because they demand specially treated paper.

Dithering

Desktop printers can manage 300 dpi of resolution—but, because of the characteristics of color printing, 300 dpi isn't really 300 dpi. In fact, it can be more like 35 dpi. The problem is that colors must be mixed to get shades, and most desktop color printers on the market today have

fixed dot sizes. In other words, they put down either no ink or a fixed amount of ink in a particular color. This is very different from ordinary color printing, where the photoengraving process produces a range of dot sizes.

With the primary colors and fixed-size dots, you can actually get only eight colors in a single dot: paper white, black, cyan, magenta, yellow, red, green, and blue. The last three are made by placing two dots of the appropriate complementary colors on top of each other. With most technologies, the other colors are produced by dithering.

Dithering originally meant introducing a small amount of random noise into a system to smooth out artifacts (system-induced features). This is analogous to what color printers do.

Color printers dither by combining dots into blocks and then varying the number of dots of each color within the blocks to get the right shade. In effect, each block becomes a superpixel whose color is determined by the number of dots of the primary colors laid down in the block. The most common sizes of blocks are 4 by 4, 5 by 5, 6 by 6, and 8 by 8 dots.

Dithering is effective, but it imposes a trade-off. The smaller the block size, the higher the resolution but the fewer shades you can have in that block. It also introduces a couple of problems of its own.

At first glance, you would think that dithering takes us back to the dark ages of desktop printers. A 4- by 4-dot dither pattern on a 300-dpi printer gives a resolution of 75 dithered blocks per inch. That implies that a 300-dpi color printer is no better than a coarse dot-matrix

printer. In fact, this isn't as much of a problem as it seems.

Dithering reduces the effective resolution of the color image, but not as much as simple division suggests. Once you get about 6 inches away from the picture, your eye starts integrating the dots into areas of solid shade. Also, because each block contains several separately addressable pixels, antialiasing is built in. This eliminates the jaggies caused by low resolution. The result is a lack of apparent sharpness, rather than the effects normally associated with low resolution.

However, there are other problems with dithering besides low resolution. The pattern of colored dots within each block can produce unwanted effects. The most extreme are the *moiré* (watered silk) patterns you get with a large area of very regularly patterned dots. Another is the banding of an area that is supposed to be smoothly shaded. Other problems include lack of perceived sharpness over and above the lack of sharpness that comes from the superpixels in the first place, and muddy colors.

Many different dithering patterns can be used to print color from dots. Most color printers have several patterns available, and some, like Hewlett-Packard's PaintJet (see photo 1) and some Tektronix models, examine the image and automatically choose the most appropriate dithering pattern for it.

Dot-Matrix Printers

Far and away the most numerous color printers are the dot-matrix printers. Many dot-matrix printers from companies such as Epson and Citizen can produce color output simply by using a ribbon with the primary colors on it.

As almost anyone who has ever used a computer knows, a dot-matrix printer uses wire-like elements driven by individual solenoid hammers to press an inked ribbon against paper to produce an image. In almost all desktop models, the print head has between 9 and 24 wires and is mounted in a carriage that moves it across the paper.

Dot-matrix printers are the most popular color printers on today's desktop. They are simple, cheap, and reliable, and they do a good job on graphs and most other kinds of simple presentation material—the major part of the market for color desktop printers today.

The biggest problems with dot-matrix printers are resolution and color quality. Nominally, some dot-matrix printers go as high as 180- by 360-dpi resolution. In practice, the resolution tends to be somewhat lower because of perceptual factors

and because of the size of the print-head wires.

Given multirow print heads, it is possible to lay down dots on 1/300-inch centers, but this isn't the same as having true 300-dpi printing. The other limiting factor is the diameter of the wires in the print head. Thinner print-head wires are more delicate and can't take the pounding of the solenoid hammer. Also, it gets harder to keep the wires from binding in the head as the mechanism heats up in use. For these reasons, the printing elements tend to be larger than the nominal resolution of the printer in high-resolution units. The printer may produce 300 dpi, but the dots overlap, and the image doesn't look as sharp as a true 300-dpi image.

Colors on a dot-matrix printer tend to be muddy. This is partly because of the inks used, and partly because the ribbon tends to become contaminated by other colors as it makes multiple passes across the paper.

The other problem is that, while dot-matrix printers can do color, they lack the specialized features built into other kinds of color printers. For example, dot-matrix printers usually do not have the processing power needed to support elaborate dithering algorithms. It is hard to avoid banding, moiré patterns, and other artifacts, especially in large areas of color. Photographic and other continuous-tone images suffer particularly.

Ink-Jet Printers

An ink-jet printer can be thought of as a dot-matrix printer without the wires. Instead of using hammers to press wires through an inked ribbon, ink-jet printers spray drops of color onto the page. At low resolution, the result looks like dot-matrix printing. However, ink-jet printers are capable of higher resolution than dot-matrix printers. They also avoid some of the problems of dot-matrix color printers, at the expense of adding some problems of their own.

Some color ink-jet printers use solid ink (melted before spraying onto the paper); others use solvent-based ink. But most ink-jet desktop printers use water-based ink.

There are three main types of ink-jet printers, classified by the way they generate the droplets of ink. Some large ink-jet printers (but no desktop models) use a pressurized ink feed combined with fast-acting valves to produce ink drops. An electrostatic system steers the drops to the paper. Desktop ink-jet printers use either a piezoelectric crystal or a burst of heat from a resistor in the print head to



Figure 1: An image created on an HP PaintJet XL ink-jet printer. Resolution is 180 dpi, and the original shows a lack of sharpness in areas such as the feather edges. Hewlett-Packard and others are developing 300-dpi ink-jet printers.

generate ink drops. The heating print head ("thermal ink jet" in Hewlett-Packard parlance, and "Bubble-Jet" to Canon) can be made small. But the ink in a heating ink-jet printer has to be able to withstand the heat, and that further limits the ink choices.

Although some large, expensive ink-jet printers have resolutions as high as those of laser printers, the models on desktops are more comparable to dot-matrix printers. The limiting factor on ink-jet resolution is not the print head but the interaction of the ink and paper.

The thermal/Bubble-Jet ink-jet heads are fabricated using techniques for building ICs, and they can be made small enough to put 1000 ink-dot orifices side by side. Piezo mechanisms tend to be a little bigger, but there are methods (e.g., staggering the orifices) of making a 1000-dpi head with that technology, as well. The trouble comes when all those droplets of ink hit the paper. Unlike the ink in thermal printers, which is fluid only because it is heated, the ink in ink-jet printers is a liquid that soaks into the paper; adjacent dots can bleed together if they are close enough. Because of the characteristics of the printer, ink-jet ink has to flow freely. That is one of the reasons ink-jet printers work best on more absorbent papers.

Hewlett-Packard has been doing extensive research in the area of ink-jet printer inks for several years. One result was the HP DeskJet, a 300-dpi one-color

ink-jet printer that sells for less than \$1000 and produces nearly laser-quality print. But the DeskJet also illustrates the problems of high-resolution ink-jet printing. The main complaint about it is that its ink is extremely water-soluble, even after it has dried. Anything printed on a DeskJet has to be kept dry or it becomes illegible. Hewlett-Packard had a lot of trouble finding an ink that would work at 300 dpi, and the DeskJet ink is the best the company could come up with. The problem is worse with color, because different colors can bleed together and change shade noticeably (see figure 1).

One way around this is to use special paper with controlled characteristics. Hewlett-Packard says it could have introduced a 300-dpi color ink-jet printer more than a year ago if it had been willing to take that approach. Instead, the company is concentrating its efforts on making a printer that will work with any common kind of paper. Although Hewlett-Packard isn't saying, observers are betting that it will be at least two years before the company can bring such a printer to market.

One possible method of getting better resolution and color from an ink-jet printer is to vary the dot size. This has the effect of mixing the colors right on the paper.

In multidot printing, the basic unit of ink is much smaller than one full dot's worth, and dots are built up with multiple

continued



Photo 2: Some thermal wax printers, such as the QMS ColorScript 100, are PostScript compatible.

units. The printer combines many tiny dots of the appropriate colors to produce a full-size dot of the finished color. This works especially well with ink-jet printers because the inks they use are very transparent and mix easily. Some very expensive ink-jet printers, such as ones from Iris, use this system. Its application on the desktop is more difficult.

For one thing, the orifices in the ink-jet head have to be much more precisely manufactured because they are smaller. That is hard to do in a printer inexpensive enough to sit on your desktop.

There is also the problem of mixing colors on the fly. The printer needs the processing power to figure out the best way to mix each drop of ink to get the proper color, and it has to make that calculation for each of the million or so dots on a page.

Furthermore, the process is limited by the quantization of the amounts of ink that can be applied. Compared to conventional printing, which can vary the amount of ink applied to a dot smoothly over a wide range, a multidrop printer would have a fixed, limited number of ink units per dot. This puts limits on color matching without going back to dithering and superpixels.

Thermal Wax Printers

If you want quality that goes beyond what an ink-jet or dot-matrix color printer can give, a thermal printer will probably be

your choice. At \$5000 to \$15,000, they are expensive but not totally out of reach. Colors are bright and saturated, and most models have a resolution of 300 dpi.

A thermal printer has an array of individually heated wire-like print elements. Heating an element melts a dot of wax-



Figure 2: Thermal wax prints, printed on a Tektronix Phaser PX thermal wax printer, show the printer's 300-dpi resolution and highly saturated colors. What is less obvious in this reproduction is the way the dithering of the dots reduces the effective resolution.

like ink onto the paper. Because the elements don't have to move, as dot-matrix printing elements do, they can be thinner, allowing higher resolutions.

One thermal wax printer, the \$200 Okimate 20, uses a moving head and cartridge ribbon like a dot-matrix printer. However, its print quality is poor for a thermal wax printer. The professional models, such as the Tektronix Phaser PX (see figure 2) and the QMS ColorScript 100 (see photo 2), use a fixed sheet-wide print head and a sheet-wide ribbon.

One advantage of thermal wax printing is that it puts less demand on the inks than some other technologies do. Basically, the ink only has to melt at a given temperature and adhere to the paper. Because the ink requirements are less demanding, thermal wax printers tend to have more saturated primary colors than other common kinds of color printers. This translates into a wider range ("gamut" in printer talk) of available colors, although not as wide as with sublimation or some other advanced technologies.

Although thermal wax printers can print on plain paper, they produce their best results on special, smooth-surfaced papers. Thermal printing doesn't work well on textured surfaces, and even the way the paper responds to heat has an effect on how the image appears.

Like most other color printers, a thermal wax printer can't print a bleed page in which the color runs to the edge of the paper on all sides. At least one edge is covered by the gripping mechanism that moves the paper through the printer.

Unlike in ink-jet and dye-sublimation printing, the dots from a thermal printer don't spread on the paper at all. At its worst, this produces an effect similar to that of the rotogravure process used to print the Sunday comics: You get the same sort of red-speckled flesh tones you see in the comics (see figure 3).

Just don't expect cheap prints. With the exception of the remarkable little Okimate 20, the materials are expensive. Thermal-printer ribbons are typically more than \$100 each, and each ribbon can be used only once. As a result, prints from a thermal printer cost between 25 cents and \$1 apiece.

Color Laser Printers

Color laser printers exist, but they are expensive. They have remained in the \$50,000 to \$100,000 category, although there are now a few edging down into the \$25,000 bracket.

The fundamental problem with a color laser printer is that the paper has to pass through the print engine four times to

ITEMS DISCUSSED

Hewlett-Packard PaintJet XL

Hewlett-Packard
Customer Information Center
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Inquiry 851.

QMS ColorScript 100

QMS
One Magnum Pass
Mobile, AL 36618
(800) 631-2692
Inquiry 852.

Tektronix Phaser PX

Tektronix
Graphics Printing and Imaging
Division
P.O. Box 1000, MS 63-630
Wilsonville, OR 97070
(800) 835-6100
Inquiry 853.

desktops. So far, only dye sublimation is a competitor to thermal wax, ink jet, and dot matrix, but others have at least the potential to show up on desktops.

Sublimation printers are first cousins to thermal wax printers. They, too, use a thermal print head composed of an array of wires. But instead of turning liquid under the heat of the printing head, the inks in sublimation printer ribbons vaporize. The vapor crosses a small air gap to the specially treated paper, to which the color is fixed.

Superficially, a sublimation printer looks like a thermal wax printer. Indeed, one company, Mitsubishi, packages its thermal wax and sublimation printers in the same case. Paper handling and electronics tend to be very similar as well. But the print engines are very different.

The printing elements in a sublimation printer are heated to as much as 400°C (752°F), much higher than the elements of a thermal wax printer. Because of the high heat, and because the ribbon isn't actually in contact with the paper, the resolution tends to be lower than with thermal-transfer printers. Most desktop models are around 150 to 160 dpi.

But this means less than you might think. The most remarkable thing about a sublimation printer is that the image shows no dots. The inks blend on the paper to produce smooth, even tones with no need for dithering. A print looks like a color photograph.

It also costs like a color photograph. Sublimation printers cost about \$12,000 and up. The ribbons and treated paper are also expensive—typically, prints cost \$5 a copy.

Another printing technology is Mead Imaging's Cycolor process. It uses dyes in microcapsules similar to the ones used on carbonless forms. The "ribbon" is a special paper or film coated with microcapsules, each of which contains a dye

and a compound that hardens the capsule when it is exposed to light of the proper color. The paper is then impregnated with an acid resin that develops the dye that comes in contact with it.

Exposing the sheet with the dye capsules to colored light hardens those capsules that aren't needed to produce the color. Then the color sheet and the receiving sheet are pressed together by pressure rollers. The unhardened capsules rupture, their contents mix with the resin on the paper, and the image forms.

Cycolor printing does a very good job of capturing fine gradations in color. It is expensive, however, and the color saturation isn't as good as in some other processes. The materials are also photosensitive, which means that they must be handled like lithographic film.

Finally, there are several color printing methods that use techniques much like color photography. They include photographs produced by color film recorders, Honeywell's dry-silver process, and several others. All of them use special media, and usually the media are light-sensitive. In most cases, the medium contains layers of dyes that are activated when light of the proper color strikes them. The processes differ in how the image is developed. The Honeywell process uses heat; some others use chemical solutions.

As a class, these processes are characterized by saturated colors and excellent handling of fine gradations in tone. They are generally expensive and, in some cases, cumbersome for desktop use.

Color for the Future

One thing you can always safely predict about computer equipment is that the price will drop. In the last three years, the price of the cheapest color thermal printers has fallen by about half.

But there are limits to how low prices

can go. By its nature, a color printer has to be more precisely constructed than a monochrome printer of the same resolution. The mechanical components that are needed to move and position paper don't follow the same price curve as electronics, and, in general, the more mechanisms a device needs, the higher its price will remain.

On the electronics side, there is a lot more to a color printer than to a monochrome one. This is especially true of RAM. Like a laser printer, a thermal wax printer needs 1 megabyte of RAM to store a full-page image at 300 dpi in one color. That means 4 MB to store a color image, and, unlike a monochrome laser printer, a thermal wax printer can't economize by storing only part of a page at once. Because it makes multiple passes to print the image, it has to have all of the image in memory at the same time. Still, you can reasonably expect that over the next two years 300-dpi color printers will drop into the same price range as medium-price (\$2000 to \$3000) desktop laser printers.

The first contenders for "low-cost" 300-dpi color printers will probably be ink-jet models. Late this year or early next year, 300-dpi color ink-jet printers will probably hit the market. The first ones will probably cost \$5000 to \$8000 and will require special paper. Follow-on models will drop in price and be capable of printing on most kinds of paper.

There is a definite trend toward plain-paper printers. This works in favor of technologies like ink jet and laser, and against thermal, sublimation, and some other forms of dye-transfer printers. But the trend shouldn't be over-emphasized. If someone comes out with a good sublimation printer that sells for \$1000 less than a thermal or ink-jet printer of the same quality and that uses special paper, most users will probably learn to live with the paper issue.

Theoretically, a color laser printer has a lot of advantages, not least of which is a combination of high resolution and plain-paper printing for a fairly low cost per copy. In the next several years, color laser printer prices may drop to as low as \$10,000. Something like an LCD shutter or LED-type printer might go lower yet.

No matter what technology is used, color printers aren't for everyone. But as they get better and cheaper, you'll undoubtedly find one for your desktop. ■

Rick Cook is a freelance writer specializing in computers and high-technology subjects. He can be reached on BIX as "rcook."



A MAJOR BREAKTHROUGH FOR WINDOWS USERS.



Introducing FaceLift™ software from Bitstream.* For the first time ever, you can get near laser quality documents from



Without
Bitstream
FaceLift

a dot matrix printer.

Designed to enhance Microsoft® Windows,™

FaceLift enables you

to make any size type instantly.

And it comes with 13 different typefaces. The characters you

see on the screen appear the way they'll look when printed.

So you can go from rough to readable as fast as it takes to

read this sentence. FaceLift is

that quick and easy to use. And affordable.

Windows makes you look good. Now,

FaceLift makes you look better.

Another home run from the

leader in PC type.



With
Bitstream
FaceLift

FaceLift works with Windows-supported monitors, dot matrix and laser printers.

To order, call 1.800.522.FONT or see your local dealer.



THE LEADER IN PC TYPE

Circle 26 on Reader Service Card

BREAK AWAY FROM BLACK, WHITE AND GRAY!

Presenting DFI's CHS-4000 Color Handy Scanner®



Deart from the humdrum of ordinary handheld scanners. To get your message across in a world of color, the usual black, white and gray just don't measure up. Until now. Presenting DFI's CHS-4000 Color Handy Scanner.

For the serious scanning enthusiast, the CHS-4000 has the features that let you realize your full creative potentials. 400 dpi resolution, color gray scale output, six gamma correction patterns among others. Plus PC Paintbrush IV+, the world's best. And the quality that you've come to expect from the company that started handheld scanning.

Live up to your creative scanning possibilities with DFI's CHS-4000. Who knows where it will lead you to?

Circle 59 on Reader Service Card

DFI®

West Sacramento, CA
Tel 916 373 1234
Fax 916 373 0221

East Brunswick, NJ
Tel 201 390 2815
Fax 201 390 2817

West Germany
Tel 305 477 3988
Fax 305 594 0607

West Germany
Tel 040 234 786
Fax 040 233 656

United Kingdom
Tel 0689 891 755
Fax 0889 691 765

Taiwan, ROC
Tel 02 543 3966
Fax 02 537 7458

THE MIGRATION OF THE X WINDOW SYSTEM

A standard windowing system may be in everyone's future

David Moore

Windowing systems used to be novel; now they are commonplace. Working with a windowing environment was once a treat; working without one is now a burden. But the windowing systems in use on personal computers today are all different, and it's hard to move an application program from one system to another. Developers can't afford to support all the windowing systems; neither can they afford to restrict their market to users of one system. Consequently, few applications take advantage of any of the existing windowing environments.

For window-based applications to become the norm, a standard windowing system is needed. This is particularly important in the personal computer world, where there are at least three incompatible windowing systems—GEM, Microsoft Windows, and OS/2 Presentation Manager (PM). Ideally, the standard should run on a variety of machines, rather than just on personal computers, so that familiar application products will rapidly support hardware advances (e.g., fast RISC-based machines).

Manufacturers of popular

personal computers view the prospect of increased competition from alternative hardware platforms with trepidation. It's easy for them to see increased competition decreasing their market share. It is much more difficult for them to see their sales increasing overall because of an expansion in the size of the market. You cannot look to them for a standard windowing environment.

Fortunately, MIT has been working on the X Window System for many years. This system began as a windowing environment for Unix, but it is spreading to other platforms, including MS-DOS.

The Origins of X

When Unix first became widespread in the mid-1970s, users worked at teletype-writers and simple video terminals. On the earliest video terminals, text appeared at the bottom of the screen and scrolled up and off the screen as more text was written. These video terminals, commonly called "glass teletypes," were simply more convenient replacements for the terminals that printed on rolls of paper.

The modern video terminal responds to a variety of commands that control how and where text is displayed on the screen. This allows a modern Unix application to format screen output. There are numerous makers of terminals—many with incompatible command sets—but Unix can automatically handle these differences. An application programmer does not have to be familiar with every type of terminal in existence. Instead of writing to

continued



the terminal directly, the programmer talks to the terminal through a library of software routines.

While Unix can run several programs at once, it has no standard facility for organizing their output. Early windowing systems used the capabilities of intelligent text-based terminals to separate the output into windows. As terminals became more powerful, graphics terminals appeared.

Unfortunately, as with text-based terminals, each make of graphics terminal had its own set of commands, and different models of the same make had slightly different specifications, requiring slight differences in the code that drove them. Workers in the MIT Athena project were faced with having to individually program hundreds of different graphics terminals.

The X project was conceived to address this problem. X produced a windowing environment that was more sophisticated than the environment of text-based terminals. As the design of X progressed, so did the goals of the project. The result is a windowing system that is far more capable than any of the proprietary systems found on personal computers. The present version of X not only supports a windowing environment on a range of graphics terminals, it also supports distributed execution of applications. A graphics terminal does not have to be connected directly to the machine that runs a program; it can be anywhere on a network.

X can display output from several programs at once, and these programs can run simultaneously on different machines. X allows you to access any machine on a network as if it were directly connected to your terminal. The machines do not have to be the same type or run the same operating system. Everything in X is treated as a window, even drop-down menus and radio buttons.

How X Works

X defines two sorts of programs: servers and clients. An X server is the program that actually manipulates images on a terminal. Clients are user applications that use X facilities and X utility programs.

A client talks to a terminal's server rather than writing directly to the terminal. The server is customized to work with a particular type of graphics terminal. It can perform various primitive graphics operations and display text in a variety of fonts. Consequently, many of the messages from the client to the server are quite short, containing only a high-

level command and some parameters, rather than the pixels required to draw an object. In addition to commands flowing from the clients to the server, keyboard and mouse actions (*events*) cause messages to flow from the server to clients. These events normally go to the application that owns the window in which the mouse is positioned. So, when running several applications at once, you input to an application by first moving the mouse pointer into one of the application's windows. If a special client called a *window manager* is running, it determines which window receives input and how the windows are stacked, and gives you the tools to move and resize them. Without a window manager, X can be manipulated only by the application and a handful of command-line utilities.

Selecting a window manager has little impact on client programs, but it can change the way windows look on the screen, and it affects the way you manipulate windows. For example, if you don't like having windows disappear under other windows, you can select a window manager that "tiles" windows, so that they never overlap. The Motif graphical user interface, for instance, has a window manager that gives all windows a distinctive "chiseled" border.

X provides several utility programs that run as X clients. The most commonly used of these is *xterm*, which makes a window look like either a DEC VT102 text terminal or a Tektronix graphics terminal. Under *xterm*, a user can run anything that will run on a conventional text-based terminal. The *xterm* utility captures all the output from the program and redirects it to X; it also captures all of the program's attempts to read from the keyboard and directs these requests to X.

You gain several advantages running under *xterm* rather than on a simple terminal: Multiple copies of *xterm* can run simultaneously, allowing many programs to run at once; *xterm* can use any of X's fonts, so you can tailor the style and size of the text to your liking; and you can scroll back through text that has disappeared from your screen.

A cut-and-paste facility allows you to move text between windows. You do not have to run an application to do a paste; you can cut a line out of a help file in one window and execute it as a system command in another. Other utility programs include such things as a bit-map editor, a scientific calculator, a manual browser, and programs that let you see how X is performing. In addition to the standard X utilities, a given implementation is

likely to have several utilities that were contributed by X users.

Motif and Open Look

One of the original goals of X was to impose no style of interface on its users. The designers recognized that no one interface would be suitable for all applications and did not want to produce a windowing system that was good for only some applications.

Other windowing systems, such as those of the Mac and OS/2's PM, do much more than just manipulate windows. They define guidelines for how applications should interface with the user, and they provide libraries that support (and enforce) these interfaces. Under X, a layered graphical user interface (GUI) provides similar facilities.

An X GUI consists of a window manager that imposes consistent appearance and behavior characteristics on X top-level windows, and a software library that supports the creation of applications that adhere to the style guidelines of the GUI. The libraries support the various objects that you would expect in a windowing environment: menus, dialog boxes, selection lists, and radio buttons. There is also likely to be a resource compiler, so you can define the contents of your objects outside your compiled code. Two GUIs have gained wide support: Motif and Open Look. Motif is produced by The Open Software Foundation. Open Look is the result of the combined efforts of AT&T and Sun Microsystems. Motif has been adopted as part of a standard version of Unix in Europe, where computer companies see Unix as a bulwark against the inroads foreign computer manufacturers are making into their market.

The existence of two competing GUIs should not have a major impact on users. While it is possible to produce applications that critically depend on the window manager being used, this is poor practice. If applications are written correctly, it should be possible to run an Open Look application under Motif and a Motif application under Open Look. There may, however, be some problems for developers if a particular machine does not have an implementation of their chosen GUI.

Workstations and Terminals

For some time after the introduction of X, the only way to run it was on an expensive graphics workstation. A recent development is the availability of X terminals. These terminals are working computers in their own right, but dedi-

cated to a single task: running an X server. The terminal must be attached—either through a network or through a serial cable—to one or more hosts on which the X clients will be run. The terminal itself cannot run client programs.

It would seem logical that any computer advanced enough to run an X server should be capable of managing other tasks as well. This thinking led to the birth of PC X server software.

A PC X server, in effect, turns your PC into an X terminal for as long as it runs. True to its "terminal" image, it is incapable of executing X clients. What's more, most PC X servers can't run other DOS programs while X is running; X must be suspended until the DOS program is finished.

Quarterdeck Office Systems, maker of the Desqview multitasking environment that runs under MS-DOS, is working on an implementation of X for Desqview. What's unusual about this project is its goal: to provide not only an X server that runs alongside DOS, but an environment under which X client programs can be written and executed on DOS systems. Quarterdeck intends to support both Motif and Open Look and will make developer's packages available for both of these environments, as well as for the basic X interface.

I was fortunate enough to see an early version of this software running on one of Quarterdeck's development machines. Despite the developer's warnings that this was still an early version, the software ran wonderfully.

When I sat down at the demonstration machine, four programs were running—each with its output displayed on a separate, Motif-style window. Only two of the programs were running on the PC; the other two were actually running on a networked Unix box in another room. Quarterdeck's implementation can also run applications on other networked MS-DOS machines running Quarterdeck's version of X. Only a seasoned X user would fail to be impressed by this level of functionality. For each application, Desqview maintains information on where the program is and which directory it is to run in. When running the X environment, you can specify a machine name in addition to a directory name. Once this is done, starting the application is completely transparent to the user.

Of course, as with standard Desqview, you can run all your existing MS-DOS applications in the new environment. You can also run all your existing Desqview-specific software. You can use any of the standard window managers with Quar-

The X Window System *promises to become the standard windowing environment.*

terdeck's X system. In addition, a window manager that looks and behaves like the standard Desqview window manager has been implemented. This window manager is much smaller than the standard ones.

Quarterdeck is attempting to make the process of transferring software from Unix to X under Desqview as easy as possible. To minimize the changes programmers have to make to their code, Quarterdeck is even implementing a number of Unix C calls that have no real equivalents in MS-DOS.

I am told that the Desqview environment will support virtual memory on both the 286 and 386 and will support programs written using the protected mode available on these processors. Application developers will not have to shoehorn large Unix applications into DOS's 640K-byte memory, although they may have to use a DOS extender to make that extra memory available. The entire environment, including Quarterdeck's window manager, will fit in less than a megabyte of memory, so it will be possible to use Desqview/X on a 2-MB machine. This compares well with OS/2 PM, but with memory costing around \$100 per megabyte, memory use is only an issue if your machine lacks expansion capability. If you want to do serious multiprocessing, I recommend 4 MB.

Quarterdeck intends to release a run-time-only version of its X implementation, so developers will be able to sell to all MS-DOS users, not just those who use Desqview/X. This software makes it easier for Unix developers to move their software to MS-DOS. Without a compatible environment, this process is prohibitively expensive for most developers. Not only does it require considerable work to move the software to a foreign platform the first time, but much of the work must be repeated each time there is a new release.

The process will also work the other way: Developers of MS-DOS software

will implement under X so that they can later move up to the Unix workstation market with little extra effort.

X—An Emerging Standard

X promises to become *the* standard windowing environment. It is the only windowing environment that is not tied to a single operating system, and its distribution is not subject to the commercial interests of any one supplier. Anyone who wants to port X to a new system can get the source code free from many locations; you can also buy it from MIT for the cost of duplication. Any machine that supports multitasking and interprocess communication and has a C compiler can support X. Although MIT retains the copyright on X software, it allows the software to be freely distributed, provided that MIT's copyright notices are maintained.

X is already the standard on Unix workstations. It is available under AIX on the PS/2s, Interactive Systems' 386/ix, and The Santa Cruz Operation's Unix System V/386. For larger systems, it can be run on VAXes, Crays, and Data General's MV series, among others. You can also expect to see third-party implementations on OS/2, and probably even on the Mac under System 7.0.

Should developers write to plain MS-DOS, or should they embrace a windowing system? MS-DOS has given good service for a number of years, but it must gradually become obsolete. For all but the largest software companies, making the wrong decision could be fatal. X provides a neat way to avoid this dilemma, and you can expect many developers to embrace it. If some of the larger MS-DOS developers also adopt X, its future as a standard will be ensured, and proprietary windowing systems will come under severe scrutiny. On the other hand, if the large companies do not support X, they could face difficulties as the distinction between personal computers and workstations becomes increasingly blurred.

In any case, the likelihood is that users will demand the ease of use and cross-platform compatibility that only X can deliver. No matter how apparently committed particular vendors are to some proprietary windowing interface, the drive for standards will eventually push them toward X. ■

David Moore is a programmer working on FORTRAN for Yarc Systems' (Agoura Hills, CA) AMD 29000 RISC-based computers. He can be reached on BIX as "damoore."

On the Left... 3 Good Cartridges On the Right... 1 Great Cartridge!

**425
Fonts!**

For HP LaserJet II, IID, IIP and III

SuperSet+ has **425 fonts in one** great cartridge for HP LaserJet II, IID, IIP and III printers. It has **all** the fonts you'll find in HP's "**ProCollection**", Pacific Data's "**25 in One!**" and HP's "**Microsoft**" font cartridges... **Combined!** Plus more!

This new JetWare cartridge gives you *genuine LinoType* Helvetica and Times fonts, with crisp, clean type quality you've grown to expect from JetWare. And, SuperSet+ is the only cartridge that includes our exclusive 12/30 spreadsheet fonts for printing up to 40,000 characters on a standard page.

SuperSet+ drivers make printing a breeze with popular programs like *WordPerfect*, *Microsoft*

Windows, *Word*, *PageMaker*, *WordStar*, *Multi-Mate* *Lotus 1-2-3* and more.

You'll get headline fonts, complete symbol sets with International characters, Dingbats, PC and Tax linedraw. All in a standard HP size cartridge, compatible with sheet-bin feeders.

For a great font cartridge, get the right cartridge, SuperSet +... 425 in One! Call your nearest dealer.

JETWARE™ by Computer Peripherals, Inc.
667 Rancho Conejo Blvd. • Newbury Park, California 91320
805-499-5751 • Toll Free: 800-854-7600 Canada 800-233-3320

The above product names are registered trademarks or trademarks of the respective manufacturers.

Circle 43 on Reader Service Card

SCSI: THE I/O STANDARD EVOLVES

Now in its second revision, the SCSI standard is about to become the universal interface for microcomputer peripherals

Bruce Van Dyke

Over the years, microcomputers have grown to meet the demands of the information industry. New software allowed them to meet these demands. For example, microcomputers couldn't perform CAD jobs until someone wrote CAD software. This is partly because microcomputers' processing power has grown to meet the demands of certain jobs (e.g., file servers managing network cards and large hard disks).

Although the PC's processing power has grown, I/O throughput hasn't. Many file servers don't function at maximum performance because they are I/O bound (i.e., waiting for I/O to a peripheral device to complete). In addition, microcomputers continue to evolve into increasingly complex configurations; this further complicates the performance issue. Today's desktop PC frequently has one or more hard disk drives, a tape backup unit, a network card, a scanner, and a laser printer. Add to that the prospect of emerging storage technologies, such as CD-ROM and optical storage drives, and system complexity grows exponentially.

Trying to get all these devices to cooperate can be a user's nightmare. That's because each peripheral might have a different hardware interface or use a driver that can conflict with other drivers or software. System users must consider these diverse peripherals and help them work synergistically. This is where SCSI comes in. SCSI is a PC interface that boosts I/O performance, while eliminat-

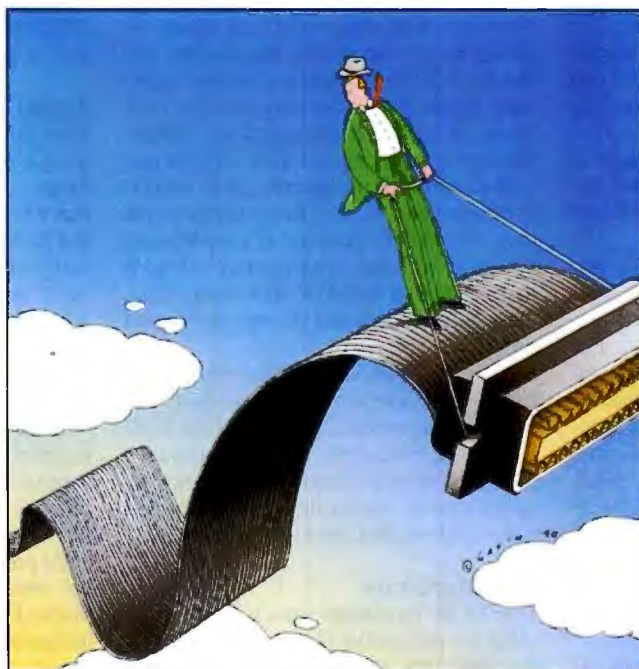
ing the difficulties of attaching peripheral devices and reducing software problems.

Although SCSI might be somewhat new to PCs, its origins are much older. SCSI is based on the same architecture as the block-multiplex channel found in early IBM mainframe systems. This I/O bus could deal with several peripherals simultaneously.

In the early 1980s, ANSI started work on a microcomputer I/O bus standard based on the block-multiplex channel functions. This work evolved into a SCSI specification in 1984 and was approved as a standard in 1986 (ANSI X3.131-1986). For further details on SCSI, see the two-part article "The SCSI Bus" in the February and March BYTE.

Certain microcomputer vendors adopted the SCSI bus some time ago. Apple first used an embedded SCSI bus on its Mac Plus in 1986; every Mac introduced since then has one. Commodore offered a SCSI adapter board for its Amiga 2000 in 1987 and made it an embedded bus on the Amiga 3000. Many workstation vendors also use the SCSI bus to connect to both

continued



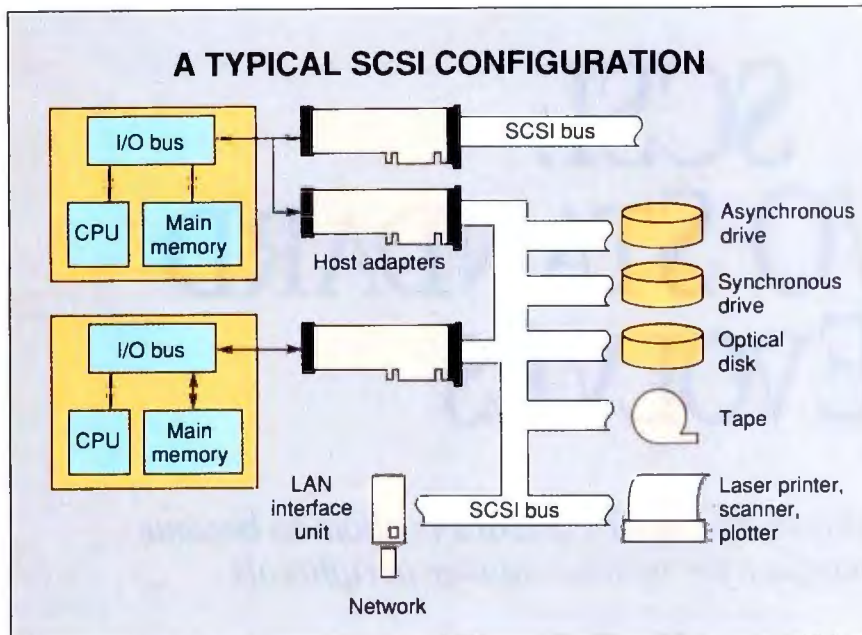


Figure 1: The SCSI bus standard allows the bus to extend beyond the microcomputer chassis via a 50-pin cable. Its protocols allow connections to different I/O devices.

internal hard disk drives and external peripherals. Interestingly, IBM (which normally set the standards in the microcomputer industry with its IBM PC and the Industry Standard Architecture bus) just adopted the SCSI bus as standard equipment in the PS/2 Model 80 and Model 60 SX last March.

The SCSI Advantage

Like Micro Channel, VME, and NuBus, SCSI is a true bus: It defines standard physical and electrical connections for devices. The fundamental—and distinguishing—difference between SCSI and the other buses is that SCSI facilitates the use of many diverse peripherals. Its communication protocols treat peripherals as logical devices that use a defined set of commands, which eliminates hardware incompatibilities.

The SCSI specification outlines several commands for many device types: hard disk (random access), tape (sequential access), printers, and others. The specification includes mandatory, optional, and vendor-unique commands. The SCSI bus treats a hard disk as a defined-capacity random-access device that responds to standard format, read, and write commands. The actual hardware might be a hard disk drive that uses an MFM, RLL, ESDI, or even a proprietary interface. A built-in SCSI controller translates the commands into interface-specific control signals.

Furthermore, SCSI lets the physical

bus exceed the bounds of a typical microcomputer chassis. You can “stretch” the SCSI bus via a cable of up to 6 meters in length by using single-ended drivers, or via a cable of up to 25 meters in length by using differential drivers. This eliminates the problem of trying to pack every peripheral into the computer. It also allows you to connect large peripheral devices, such as scanners, that wouldn’t fit anyway (see figure 1).

This combination of connectivity and economy of hardware delivers many capabilities to users with demanding I/O needs. SCSI’s standard connectors allow easy connection to many peripherals, while its standard command set simplifies the system design. This lets the end user select SCSI peripherals from several different vendors with the assurance that they will be compatible. It’s significant that SCSI’s versatile nature has helped it to emerge as a standard on most companies’ system-level and storage peripheral products.

To see how SCSI’s role as a peripheral I/O bus standard evolved, you must first examine the various elements of the SCSI ANSI specification, which include a hardware specification, a signal-timing specification, and a device-independent command-set description.

SCSI Hardware

The SCSI hardware specification description details the physical characteristics: the cable, signal pin-outs, connector

types, and so on. There are two commonly used types of SCSI connectors: a standard 50-pin ribbon cable header for connecting internal peripherals, and a Centronics-style 50-pin cable for connecting external devices. Apple chose instead to use an external 25-pin high-density connector using single-ended drivers for the Mac. (Recent Macs use the standard 50-pin ribbon SCSI connector for internal hard disk drives while still using the external 25-pin connector.) Both the Amiga and the NeXT Computer use Apple’s external connector and signals; this lets them access devices and cables made for the Mac. To further complicate matters, when IBM announced its SCSI host adapters for the Micro Channel, it chose a 60-pin connector.

Although this seems like a failure of the SCSI hardware specification, these peripherals use the standard 50-pin SCSI connectors. Most of the time, you just connect the first SCSI peripheral to the host computer with an adapter cable and then use standard cabling to chain to the other SCSI peripherals.

As with any standard bus, the wires in a SCSI cable resemble transmission lines, which can generate undesirable effects, such as signal reflection and uneven loading of the line drivers. To reduce these effects, you must have termination resistors at the two physical endpoints of the SCSI cable. Termination resistors are usually located at the beginning of the SCSI bus (typically inside the computer) and on the last device attached to the cable (typically using a plug-in resistor pack). Improper termination of the SCSI bus results in erratic device operation or general bus failure.

Signal Transmission

The SCSI signal specification defines delays, minimum pulse widths, and hold times for the SCSI bus. However, you don’t need to worry about these because the SCSI protocol chips manage the majority of the timing constraints. Some of these protocol chips include Adaptec’s AIC-6250 (found on SCSI host adapters made by Adaptec and IBM) and NCR’s 5380 and 5390 (used in the Mac and other computers).

SCSI uses an interlocked handshake to transfer information across the bus. The communication protocol is based on this request-acknowledge handshake. SCSI bus states are called *phases*. There are eight possible bus phases (see table 1); all but one use an asynchronous transfer mode. In the data phase, information can be handshaked in one of two modes: synchronous or asynchronous. Synchronous

data transfers occur only after both the host and the target device agree to such a transfer. Data is transferred in parallel across the bus, 1 byte at a time, using eight data lines. The typical asynchronous transfer rate is about 2 megabytes per second; the synchronous transfer rate can reach a maximum of 5 MBps.

What's Your ID?

Every device on the SCSI bus requires a SCSI ID number. These IDs are generally configured with jumpers, although some external Mac peripherals have a thumbwheel for setting them. The SCSI ID serves two purposes: It uniquely defines each peripheral's device address, and it determines the device's priority on the bus during the arbitration phase. The arbitration phase determines which device will own the bus when two or more devices simultaneously request to use it. During arbitration, each data line represents a single device, so there can only be a maximum of eight devices on a SCSI bus. ID 7 has the highest priority, and ID 0 has the lowest. Logical unit numbers are secondary addresses associated with each SCSI ID. There can be up to eight LUNs for each target ID.

The *initiator* is the SCSI bus controller that selects the target device at which commands are directed. The *target* is the SCSI bus controller that receives commands from the initiator. The initiator is generally located in the host computer; the target is typically a peripheral device (e.g., a disk drive or tape drive). Once the initiator selects the target, the target is in complete control of the bus. The data transfer direction is always defined with respect to the initiator. See figure 2 for a typical sequence of SCSI bus phases during an I/O operation.

The SCSI bus allows multiple I/O operations to run concurrently between different devices on the bus. The disconnect and reconnect (D-R) capabilities defined in the standard allow this to happen. D-R lets a device relinquish control of the bus while it is conducting a lengthy operation (e.g., a seek on a disk drive or a tape rewind). This allows other devices to use the bus while that device is busy. When the SCSI bus is free and the device is ready to complete its command, it can reconnect to the bus. This combination of high throughput with multiple device support gives SCSI the potential for handling large applications that require lots of processing power.

IBM is using SCSI to maximize performance and peripheral connectivity in the Micro Channel architecture. Moreover, SCSI is expected to become the pe-

SCSI BUS PHASES	
Table 1: The various bus states (phases) defined in the SCSI standard. These phases are used to communicate with peripherals, control access to the bus, and transfer data.	
Phase	Purpose
BUS FREE	Bus is available.
ARBITRATION	Device obtains control of bus via arbitration.
SELECTION	Target device is selected by the initiator.
RESELECTION	Target device selects initiator and reconnects to the bus.
COMMAND*	Target device requests command information.
DATA*	Data is sent to or from target device.
STATUS*	The target device requests to send status data.
MESSAGE*	Messages are sent to or from the target device.

*These phases are termed the "information transfer phases."

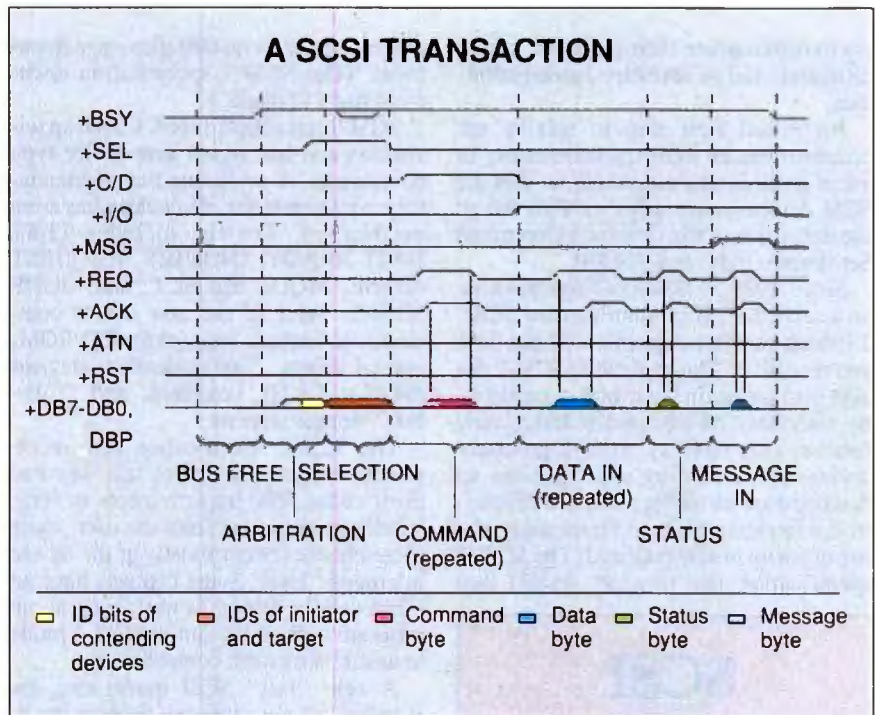


Figure 2: SCSI bus timing. During a transaction, the signals and phases can occur in the sequence shown. The *ARBITRATION* phase, which was optional in the original SCSI standard, is now mandatory in the new SCSI-2 standard described in the text. The target may disconnect during a lengthy operation, freeing the bus for other devices. The device reconnects later by use of a *RESELECTION* phase (not shown).

ripheral I/O interface for other architectures, such as EISA. Almost every major peripheral device manufacturer now offers SCSI products. Some devices (e.g., CD-ROM) rarely have other interfaces.

Enter SCSI-2

The first SCSI peripherals suffered from compatibility problems. These problems existed not because there was an inadequate standard or a faulty device design, but because there was too much flexibil-

ity in the specification. The original specification (SCSI-1) allowed so many variations in a SCSI controller implementation that the early SCSI peripherals weren't compatible. For example, the use of parity on the bus was an option: SCSI peripherals that used parity obviously wouldn't work with devices that didn't. Also, there were numerous permutations of the SCSI commands; this led individual device manufacturers to

continued

WHAT DOES THE SCSI-2 STANDARD ACCOMPLISH?**Table 2:** *The new SCSI-2 standard adds features while remaining compatible with the existing SCSI standard.*

Refined physical specifications to promote plug-and-play:

- Better definition of who supplies terminator power (the initiator)
- Use of parity required on bus
- Arbitration required

Refined message specifications to promote device compatibility:

- Synchronous protocol better defined
- Number of mandatory commands expanded
- Sense codes for error recovery added

New features added:

- New devices and commands defined
- Fast synchronous protocol doubles transfer rate to 10 MBps
- Optional "B cable" expands SCSI bus from 8 to 16 or 32 bits, allowing a possible transfer rate of 40 MBps

try to differentiate their products, which ultimately led to software incompatibilities.

An initial first step to solving the problem was an industry-wide effort to adopt a minimum command set that all SCSI devices must support. This led to the definition of the Common Command Set (known today as CCS 4B).

Since 1986, ANSI has been working on a second SCSI standard, called SCSI-2 (which should be approved by the time you read this). The goal of the SCSI-2 design is to maintain backward compatibility with the SCSI-1 bus while adding new features (see table 2). SCSI-2 precisely defines some existing specifications so that there are no ambiguities in SCSI controller implementations; for example, the use of parity is now required. The SCSI-2 specification also provides insight into

command use in its 600-plus-page document. (The SCSI-1 specification document had 212 pages.)

SCSI-2 has adopted the CCS 4B specification and has added new device type commands. A minimum set of mandatory commands for all devices has been established. The list includes TEST UNIT READY, INQUIRY, REQUEST SENSE, MODE SELECT, and MODE SENSE. Some of the new device command sets include support for CD-ROM, optical drives, communications devices (SCSI-to-LAN), scanners, and "juke-box" storage systems.

The SCSI-2 specification also incorporates standardized error recovery and error codes. The improvements in error handling are hidden from the user, since these changes occur mostly at the device microcode level. Some changes have an impact on the drivers as well, but you can program a device to run in SCSI-1 mode to ensure backward compatibility.

A new "fast" SCSI mode uses the standard 50-pin cable and doubles the 8-bit SCSI bus's maximum transfer rate to 10 MBps. It accomplishes this by cutting the synchronous transfer timings in half. There is also a "wide" SCSI option that uses a second 68-conductor cable (called the B cable). This cable contains an additional 24 data lines that allow 16-bit and 32-bit data transfers. (The other 8 bits are handled by the standard 50-pin A cable.) A negotiation process similar to synchronous negotiation in SCSI-1 enables both wide and fast SCSI. This allows SCSI devices with different data bus widths and data transfer rates to co-exist on the same bus. Using both the fast and wide SCSI capabilities of SCSI-2, it's possible to achieve a 40-MBps transfer rate.

Generally, all SCSI-2 improvements are backward compatible with SCSI-1.

Existing SCSI-1 devices that adhered closely to the standard should be able to share a bus with SCSI-2 devices, but they will reject extensions in the SCSI-2 protocols. The new device support and fast SCSI option are welcome additions to the standard. However, the two-cable wide SCSI implementation isn't expected to find wide acceptance in the PC market. That's because it costs more and requires more space to provide a second connector. And there's no room at all for a second connector on certain peripherals, such as 3½- and 5¼-inch internal hard disk drives.

Implementing the fast and wide capabilities of SCSI-2 will probably require silicon changes to today's SCSI protocol chips. It's expected that in the future, manufacturers will start by supporting 8-bit fast SCSI that uses the existing 50-pin cable. You should be careful in your purchase of SCSI-2 peripherals. It's possible that you could buy a SCSI-2 device (say, a hard disk drive using the fast SCSI capability) only to find that the adapter card in your PC doesn't support this option.

SCSI Software

SCSI software compatibility has been an industry-wide problem. On the peripheral side of the bus, the SCSI-2 command set goes a long way toward solving communication problems. However, there are also problems on the initiator's side of the bus, especially for software drivers that use SCSI adapter cards in the host. All too often, the program that uses the SCSI peripheral (e.g., the scanning software for a SCSI scanner) won't work with a particular SCSI adapter, or it won't share the adapter with another peripheral's program (perhaps the backup program for the tape drive). The end result is that you usually fill up your computer's slots with a SCSI adapter card for each peripheral—hardly what the SCSI designers had in mind when the standard was made.

A Common Access Method committee met to implement a common SCSI interface across different machines. Adaptec has developed the Advanced SCSI Programming Interface software specification—now a working document of the CAM committee—that addresses this problem. ASPI defines a standard software interface to the SCSI bus; this interface is independent of the host bus adapter manufacturer's hardware implementation. It provides a protocol that allows multiple SCSI device drivers and programs to submit I/O requests to one adapter card, independent of the card

SCSI Specification

The SCSI specification is available for \$25 from ANSI, 1430 Broadway, New York, NY 10018, (212) 642-4900.

The X3T9.2 committee working documents, Common Access Method (CAM) committee documents, and the most current draft of the SCSI-2 specification are available for downloading from the SCSI BBS at (316) 636-8700 (300, 1200, or 2400 bps; 24 hours).

A paper copy of the SCSI-2 draft specification is available for \$60 from Global Engineering Documents, 2805 McGaw Ave., Irvine, CA 92714, (800) 854-7179 or (714) 261-1455.

manufacturer's implementation.

The ASPI architecture reduces the number of software drivers required to support a host adapter and its peripherals under various operating systems. ASPI's modular design lets you use only the drivers that go with your SCSI peripherals. As you add more devices, you add the corresponding interface modules. ASPI also facilitates the addition of new devices without disturbing the existing drivers or peripherals.

A *more radical approach that is being considered is implementing the SCSI bus by using optical driver technology.*

Microsoft has adopted a software architecture for OS/2 that is similar in approach to ASPI. Its layered device drive architecture, called LADDR, defines an application programming interface that is independent of the host adapter. This approach simplifies support for multiple host adapters and allows up to seven SCSI devices per adapter.

The Future: SCSI-3

As SCSI-2 nears completion, work is under way for a SCSI-3 standard. Although it is in its early stages, the proposed features for SCSI-3 include a 16-bit data path on a single 68-pin connector; more than eight SCSI IDs on a SCSI bus; longer cable lengths; bus fairness; more command sets (e.g., digital audio tape and file server); and a fiber-optic option as an alternative data transfer medium.

SCSI-3 will probably be the first to implement wide SCSI. SCSI-3 uses the SCSI-2 high-density 68-pin connector (the B cable) for the primary cable instead of the standard 50-pin A cable defined in SCSI-2. You can connect both the 68-pin and 50-pin devices to the same cable because there are nine new signals added to each side of the 50-pin connector. This connector will provide periph-

eral manufacturers with a smaller footprint while adding the flexibility to either implement 16-bit wide SCSI or remain in standard 8-bit mode.

Since SCSI-3 proposes a 16-bit data path on a 68-pin cable and a 32-bit data path with a second 68-pin cable, 32 devices or IDs can be supported on the bus. A proposed "fairness" scheme would periodically give the bus to devices with lower IDs that have not been able to win arbitration.

Placing 16 devices on a 6-meter, single-ended cable will be a difficult task, because most of the devices may be located in an external cabinet. The industry expects that improvements in terminator designs and driver technology will be required to facilitate this change and to support fast SCSI. Single-ended drivers may not be able to support fast SCSI (10 MBps) at the maximum 6-meter cable length. However, internal devices on a properly terminated short cable should work. Differential drivers should provide the signal quality necessary to drive a cable of more than 6 meters at fast transfer rates.

A more radical approach being considered is implementing the SCSI bus by using optical driver technology. This could stretch the SCSI cable well beyond its current length limits while still maintain high-speed data transfer. A fiber-optic implementation would use information packets for data transmission—a dramatic departure from the current architecture.

It might seem premature to consider what's beyond the SCSI-2 standard, especially since it will take time for SCSI-2 features to show up in today's peripherals. Nevertheless, this shows the success of the SCSI standard itself. Even IBM has adopted SCSI for its peripherals; that makes the SCSI bus more universal than either the Mico Channel or EISA. It promises not only to establish an I/O bus standard on microcomputers, but to make peripheral devices accessible to all computer users, no matter what platform or operating system they use.

Hardware standards provide definitions that allow different machines and technologies to connect and communicate, and SCSI seems to have succeeded in this area. However, as existing technologies become faster and new technologies evolve, then the standards must evolve as well. SCSI is evolving to meet these new demands. ■

Bruce Van Dyke is an applications engineer at Adaptec, Inc. (Milpitas, CA). He can be reached on BIX c/o "editors."

MORE THAN YOU ASKED FOR?

Contact Us To Stop Unwanted Advertising Mail.

Most folks like advertising mail. They get special offers, sweepstakes chances, free gifts, good prices on things they can't find anywhere else. And shopping by mail or phone is quick and simple.

But if you're one of those people who would rather not receive advertising mail, we can help.

Send us your name and full address and we'll tell participating national mailers to remove your name from their mailing lists.

After all, they want to talk to people who want to listen.



Mail Preference Service

Direct Marketing Association
11 West 42nd Street
P.O. Box 3861
New York, NY 10163-3861

Name _____	
Street _____	Apt. _____
City _____	
State _____	Zip _____
Variation of my name _____	

SHECOM

386 SX-16 MHZ

386-25 MHZ 0 CACHE

386-25 w/64K CACHE

386-33 MHZ w/64K CACHE

BABY CASE W/200 WATT P/S

- 1 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 40 MEG HARD DISK DRIVE
- 2 SERIAL / 1 PARALLEL GAME PORT
- MONOCHROME GRAPHICS CARD
- 12" AMBER MONITOR
- 101 KEYBOARD
- 1 YR. ONSITE WARRANTY

STANDARD FEATURES:

- 2 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 1.44 MB FLOPPY DISK DRIVE
- 65 MB HARD DISK DRIVE
- WA6 1:1 RLL CONTROLLER
- MONOCHROME GRAPHICS CARD
- 12" AMBER MONITOR
- 2 SERIAL / 1 PARALLEL AND GAME PORT
- 101 KEYBOARD
- 1 YR. ONSITE WARRANTY

STANDARD FEATURES:

- 2 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 1.44 MB FLOPPY DISK DRIVE
- 65 MB HARD DISK DRIVE
- WA6 1:1 RLL CONTROLLER
- 14" VGA MONITOR
- HI RES VGA CARD w/512K
- 2 SERIAL / 1 PARALLEL AND GAME PORT
- 101 KEYBOARD
- 1 YR. ONSITE WARRANTY

STANDARD FEATURES:

- 2 MEG MEMORY
- 1.2 MB FLOPPY DISK DRIVE
- 1.44 MB FLOPPY DISK DRIVE
- 65 MB HARD DISK DRIVE
- WA6 1:1 RLL CONTROLLER
- MONOCHROME GRAPHICS CARD
- 12" AMBER MONITOR
- 2 SERIAL / 1 PARALLEL AND GAME PORT
- 1024 x 768 MULTI SYNC MONITOR
- HI RES VGA CARD w/512K
- 101 KEYBOARD
- 1 YR. ONSITE WARRANTY

\$1,195.00

\$1,750.00

\$2,495.00

\$2,695.00

SIMM/SIP

256K X 8 70, 80, 100 NS
256K X 9 70, 80, 100 NS

1 MEG X 8 60, 70, 80, 100 NS
1 MEG X 9 60, 70, 80, 100 NS

4 MEG X 8 80 NS
4 MEG X 9 80 NS

MEMORY UPGRADES

IBM, COMPAQ, APPLE, MACINTOSH, EVEREX, HEWLETT PACKARD, TOSHIBA, ZENITH, AST, AT&T, EPSON, NORTHGATE, SHARP, MITSUBISHI, SUN MICRO SYSTEMS, ALR

MATH CO-PROCESSORS

IIT

8087-3
8087-2
8087-1

CYRIX

80287-6
80287-8
80287-10

INTEL

80287-12
80287-XL
80387-SX-16

80387-16

80387-20
80387-25
80387-33



HITEK
KEYBOARD

\$42

MOUSE
By Logitech

\$35

WA6
1:1 MFM
CONTROLLER
w/Cables

\$75

HI RES
VGA
CARD
w/256K
(exp 512)
\$95

SHECOM COMPUTERS, INC.
22755-G Savi Ranch Parkway
Yorba Linda, CA 92686
Tel: 714-637-4800
FAX: (714) 637-6293

HOURS (PDT)
M-F 8 AM-6 PM



Quantity Pricing Available
All Merchandise carries
full manufacturers
warranty.
Prices subject to change
without notice.

Circle 172 on Reader Service Card

SALES ORDERS CALL 1-800-366-4433

DATA TO THE DESKTOP: THE SQL ADVANTAGE

*The plethora of SQL implementations
limits data exchange*

Robert J. Crutchfield

While the 1980s will be remembered as the era of the microcomputer revolution, the 1990s are shaping up as the age of the database explosion. The battle for the desktop has been won. Microcomputers are more powerful than ever, and the increased processing power is being used for applications traditionally reserved for minicomputers and mainframes, like database management. The desktop has become a window to access corporate information.

Broader Access

Indeed, we have undergone an information revolution. Users now have access to more information than ever. This is due to the changing computer environment—that is, moving from host-based to network-based systems. The decentralization or flattening out of the corporate structure, coupled with the desire to move information closer to the people, has greatly changed the data-processing shop. The data center has evolved from single-vendor computing to a decentralized multivendor environment.

During the 1980s, spreadsheet vendors like Lotus and

VisiCalc turned a generation of middle managers into accountants and, at the same time, created one of the most widely used PC applications of the decade. In the 1990s, developers of advanced fourth-generation languages and computer-automated software engineering tools have the potential to turn today's users into programmers. Granted, there will always be a need for professional

software developers. However, the applications backlog is forcing many users to develop applications using 4GLs. And many of these applications are used in conjunction with databases.

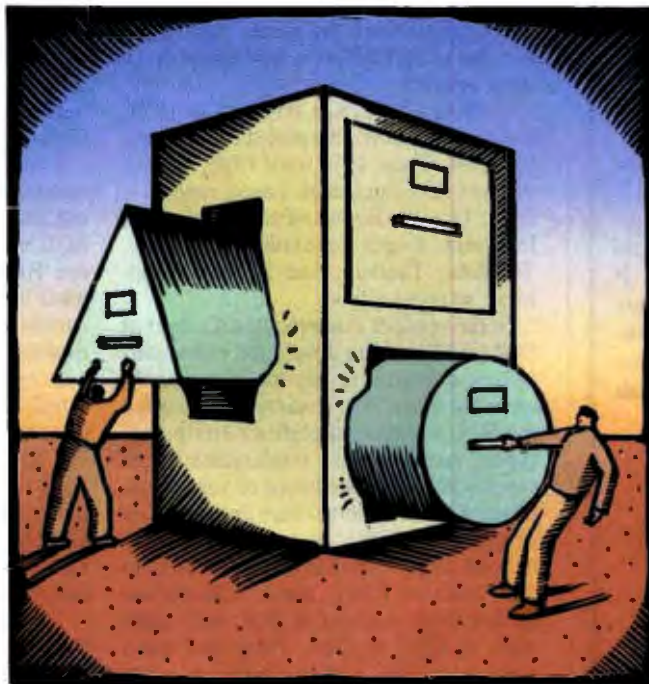
Over the last decade, database management has evolved from a mundane, "glass room" process into a process that offers companies a competitive advantage through applications like on-line

transaction processing, decision support, and executive information systems. Structured Query Language (SQL) based relational databases, the client/server architecture, improved user interfaces, and distributed computing are all allowing users greater access to almost instantaneous information to make mission-critical business decisions.

The relational model of data was introduced by Dr. Edgar F. Codd in 1969. The IBM Research Labs developed SQL in 1974 to support the Codd model; it was designed to interrogate and process data in a relational database.

SQL is rapidly becoming the preeminent database structure because of its functionality and its flexibility. SQL-based relational data-

continued



BBS Sysops

- Are you looking for ways to improve your board? Something that will set you apart from other boards in your area?
- Are your subscribers interested in Microcomputers? Listen to this!

Announcing the Bulletin Board EXchange

The Bulletin Board Exchange allows you to become a publisher of Micro-BYTES Daily, an on-line news service from BYTE. Bulletin Board Exchange/MicroBYTES is a custom package of news and features designed especially for local BBSes, and is available only to sysops.

Every Monday through Friday you get articles about developments in micro-computing, telecommunications and selected new product announcements. Get the latest news about MS DOS machines, Macintoshes, Unix workstations, Amigas, Atari STs, peripherals and software. All the stories are reported, written, and edited by the staff of BYTE Magazine, BYTEweek and BIX, and our world-wide network of reporters and editors.

Not only do you get a great resource for your subscribers, but you also get access to BIX which will cut your cost of exchanging information and conducting BBS network business.

All this is just \$49 a quarter.

Your one-year subscription to the Bulletin Board Exchange (billed quarterly) may be cancelled any time without further charge; just notify us. If you prefer, you may subscribe for three months only, at just \$69.

If you call BIX direct, you pay no hourly telecommunications charge. If you call using Tymnet, the rates are only \$3/hour on evenings and weekends and \$6/hour on weekdays. You may also purchase unlimited off-peak Tymnet for just \$20 a month.

Subscribe today.

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983
In NH 603-924-7681

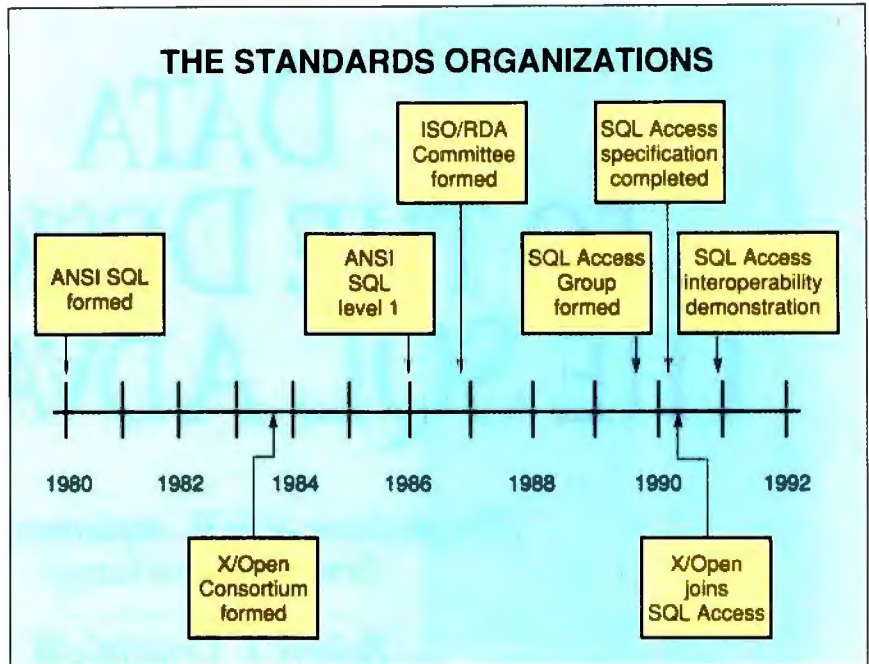


Figure 1: The time line shows the development of SQL standards organizations.

bases are arranged as tables, with pieces of information residing under columns or fields. SQL commands are used to search data by its field and database. SQL can also be used to write information into an existing table. With SQL, users can create, access, and update data within a database.

SQL-based relational database management systems gained in popularity and acceptance throughout the 1970s and into the 1980s. During that time, SQL was implemented in some form by a number of RDBMS developers and hardware vendors.

Although SQL was invented in 1974, it did not become a formal standard until late 1986. From 1974 until 1986, various vendors developed SQL-based systems—IBM, Oracle, Hewlett-Packard, Ingres, Informix, Gupta Technologies, Sybase, Teradata, Tandem, and Digital Equipment, to name a few.

Some vendors implemented a subset of SQL, while others developed extensions to it or altered it to suit their computing environments. For example, although the SQL standard specifies certain data types, most vendors implemented data types with some extensions or variations. Most of these systems were developed as single-node RDBMSes; some were enhanced to provide distributed access to their data or hosts. Some vendors extended their versions of SQL with gateways to DB2 or IMS. Even end users were using SQL and beginning to write

their own RDBMSes. With the proliferation of SQL, ANSI, a quasi-governmental body made up of vendors and users who set standards, formed a SQL committee in 1980.

After six years of work, the ANSI committee released ANSI SQL level 1, its first attempt to develop a set of SQL standards (see figure 1). In 1987, the International Standards Organization, which is made up of national standards organizations like ANSI from throughout the world, formed the ISO/Remote Data Access Committee. The ISO/RDA Committee is defining a standard interface between a program (client) and a database (server) on different systems.

Since 1987, both the ANSI and ISO committees have been meeting and refining their standardization efforts. ANSI SQL level 2 should be published in 1991; the RDA work will not be completed until 1992. This means that the industry cannot achieve heterogeneous access to multiple databases until at least 1993.

Along with the national and international standards organizations, a number of vendor-driven associations are working on standards issues in the areas of SQL, Unix, networking, and open systems. These groups include the X/Open Consortium, Unix International, the Open Software Foundation/UniForum, and the SQL Access Group.

Most of these vendor-driven associations have been formed to react quickly to the dramatic changes occurring in the

Forging a Standard

Client/server computing is rapidly advancing information management. This architecture benefits users while creating challenges and opportunities for MISes, database administrators, hardware vendors, and software developers alike.

With many companies using multiple relational database management system products on multiple hardware platforms, it will be a major challenge to manage information that is scattered across an organization under different RDBMSes and various computing environments. And although advances in multivendor integration enable different systems to be networked together in a distributed computing environment, Structured Query Language (SQL) based RDBMSes and application tools from different vendors still do not have the ability to interoperate.

Recognizing this problem, a group of companies, including Ingres, Sun Microsystems, Digital Equipment, and Tandem Computers, began meeting informally to discuss how to achieve interoperability and portability of SQL-based RDBMSes. These vendors determined that while standards organizations like ANSI and the International Standards Organization (ISO) had made progress toward standardizing SQL, their work did not go far enough to solve the RDBMS interoperability problems in multivendor environments.

Out of these early meetings, the SQL Access Group was formed. The group's mission is to develop a technical specification that will allow one vendor's SQL application to access data in other vendors' SQL servers, thus enabling RDBMSes and application tools from different vendors to work together.

The SQL Access Group published its technical specification last March and plans to demonstrate a working prototype in early 1991, running on the hardware and software of the various member companies. The work is based on existing standards developed by ANSI and ISO, as well as guidelines published by the X/Open Consortium's Portability Guide.

The group's work is in response to the growing need for users to create applications that will operate with multiple RDBMSes, regardless of the platform the data resides on. The group is tackling two major technical barriers that currently prevent intervendor SQL access; eliminating them would allow users to operate more than one heterogeneous SQL RDBMS at a time.

First, each brand of SQL is different. While the ANSI committee sets standards, many areas of ANSI SQL (SQL 1, 1986) are left up to the user or vendor to define. The SQL Access Group is standardizing many of the implementer-defined items in the application programming interface, including:

- Association management statements (connect, set connect, and disconnect)
- Three-level object names
- Standardized system catalog name
- New catalog tables (SQL languages and server defaults)

Second, because of the different client communication protocol, one vendor's SQL client cannot connect to other vendors' SQL servers across the wire because of the different client/server protocol and client/server message formats. Standardization of SQL

communication is handled by the ISO's Remote Data Access committee. The SQL Access Group is making the following contribution to the ISO/RDA Formats and Protocols work:

- Mapping of SQL statements to RDA services
- Encoding of SQL data (including ASCII and EBCDIC)
- Authentication and access control
- Diagnostic messages
- Choice of communication protocol
- Extended Get Diagnostics statement
- Inclusion of Dynamic SQL (RDA currently doesn't allow it)

The SQL Access Group will make its technical specification available to the X/Open Consortium for inclusion in the 1991 edition of its Portability Guide.

The SQL Access Group (996 Redondo Ave., Suite 515, Long Beach, CA 90804, (213) 438-5788) is a nonprofit association and is open to all vendors of RDBMS or server products. There are two levels of membership: reviewers and producers. Reviewers have access to the technical specification and provide feedback to the group. Producers must also provide technical resources, in the form of software developers and equipment, to help develop the technical specification.

The group was founded in 1989; its members include Ashton-Tate, Bull, Cincom Systems, Digital Equipment, Fujitsu America, Hewlett-Packard, Infocentre, Informix, Ingres, Metaphor, Microsoft, NCR, Oracle, Progress Software, Retix, Sun Microsystems, Sybase, Tandem Computers, Teradata, Unify, and X/Open.

market and to respond to user needs. As more power is moved closer to the user, companies are changing the way they allocate computer resources. The trend over the last several years has been toward decentralization. Now, instead of companies keeping all their data on centralized mainframes, they distribute the information throughout the enterprise to minicomputers and workstations. Large corporations often have one brand of mainframe and other brands of minicomputers and workstations. In fact,

large computing environments usually have a mix of on-line transaction processing software, application development tools, RDBMSes, and hardware, along with user-developed applications and off-the-shelf software.

Decentralized or distributed computing is an excellent way to put information closer to the user. Over the last few years, the client/server architecture has enabled companies to access and manage their data more efficiently. Today, workstations perform many database opera-

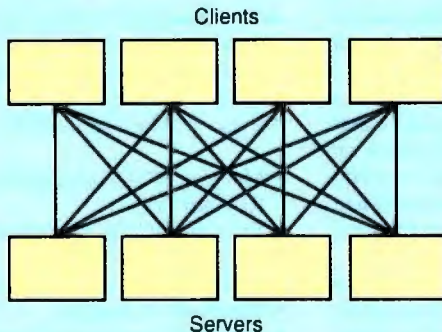
tions that were once relegated to minicomputers or mainframes. They let users update, store, and send data without having to rely on a host computer.

In client/server computing, the client, or workstation, sends requests for data to the server (which is usually a minicomputer or mainframe) and then receives data. The server receives requests and sends data. SQL-based RDBMSes play an important role in client/server computing. On the client, or front end, a

continued

THE SOLUTIONS

Now: Connections =
(number of clients) x (number of servers)



SQL Access connections =
(number of clients) + (number of servers)

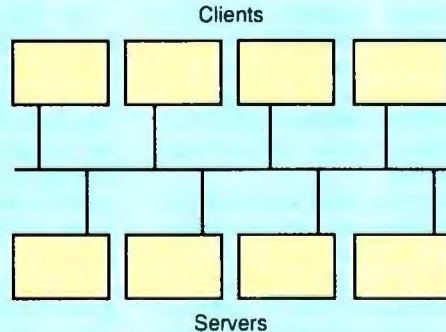


Figure 2: Without a SQL standard, a separate gateway has to be written for each client and server in use. The SQL Access Group technical specification, when adopted by the industry, will enable SQL software interoperability, as well as portability of SQL applications.

program is written using 4GL tools to write applications that access data from a SQL-based RDBMS on the server, or back end. And because each brand of SQL is different, users must single-source their SQL software. This prevents them from achieving true intervender SQL interoperability—the ability of SQL-based RDBMSes and application tools from multiple vendors to work together.

SQL Tower of Babel

Graphical user interfaces and distributed networking don't guarantee a user the ability to interoperate with multiple heterogeneous databases. Currently, two problems prevent intervender SQL access. First, each vendor's implementation or brand of the SQL standard differs enough that one vendor's SQL client cannot access data in other vendors' SQL servers, rendering the different SQL dialects incompatible. According to industry estimates, there are more than 140 implementations of SQL RDBMSes in use. Second, because of different client communication protocols and message formats, one vendor's SQL client cannot connect to other vendors' servers.

Users are requesting connectivity between multiple databases on disparate personal computers, minicomputers, and mainframes. They would like to build applications with interoperable components to run on personal computers and workstations that access databases on mainframes and minicomputers. This kind of access is called heterogeneous access, because it involves at least two different RDBMSes.

To allow access to multiple heteroge-

neous databases, two items must be considered: the Application Programming Interface, which allows SQL dialects to understand each other, and the Formats and Protocols Standard, which determines how SQL is sent over a network. The API, seen only by an application programmer, consists of SQL and the syntax for the protocol services. The FAP defines message formats for SQL requests and replies, and for connection to a SQL server. It also defines data types, lengths, and representations.

Until these items are addressed, users can't move applications from one client/server platform (e.g., DOS/Unix) to another (e.g., Unix/MVS). The inability to access multiple databases is very limiting to users who need information from different back-end databases through a single front end.

For the most part, users have to acquire their SQL client and server software from a single vendor. They can't mix and match client software and server software; nor can they write vendor-independent applications. Thus, users can't implement different clients and servers that are best suited for their jobs.

In multivendor computing environments, having access to multiple heterogeneous SQL RDBMSes is more critical than ever, as is the ability to mix and match front ends. For example, you may have a checking account, a credit card, overdraft protection, and a loan all at the same bank. Information for each of these bank services could very well reside on different databases. If you move and submit an address change, the chances are that all the records will have to be up-

dated individually, because each bank service's information likely resides on a different heterogeneous database.

Recognizing the industry's need for access to multiple clients and servers, many vendors and industry associations are working toward the interoperability of multiple heterogeneous RDBMSes. Although most database vendors support SQL, there are differences in syntax, functionality, schema, and data type. For example, some vendors support decimal numbers, while others don't. Also, there are differences in how tables and columns are supported.

Gateways

Most vendors who address the problem of interoperability do so through gateways. For example, a 4GL developer can write gateways so that his or her programming toolset works with different RDBMSes. Conversely, a database vendor can write gateways so different 4GLs work with that particular database. The drawback is that a separate gateway has to be written for each client and server in use (see figure 2). Thus, if you are working with four clients and four servers, gateways must be written for every device (number of clients x number of servers). Also, users can't transparently access data from each RDBMS being addressed.

Another alternative is to develop a technical specification, to be adopted by the industry, that will enable SQL software interoperability and portability of SQL applications. In the above example, instead of multiple gateways, only one gateway would be needed for each client

continued

*Veitek AIX i860 PS/2 Sun-4
IBM RT Extended DOS Am29K
SCO ANSI C MS-DOS Ultrix
IBM 370 RISC i486 Motorola
Sun-3 UNIX System V SPARC
ANSI C Pascal Intel 386 DEC
VAX Sun386i OS/2 Solbourne*

MetaWare.

The only compiler you need.

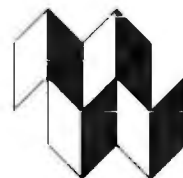
The industry is full of new technologies, fast chips, and cutting-edge platforms. Professional developers know that superior code quality and portability is more than a luxury — it's a matter of survival.

They've come to trust MetaWare as the essential source for reliable and robust development tools.

MetaWare's High C and Professional Pascal give demanding programmers an edge with state-of-the-art global optimizations. Accurate and informative diagnostics cut turn-around time by identifying potential problems early in the development cycle.

Join serious developers such as Autodesk, Intel, Phar Lap, and IBM — companies who trust MetaWare to provide quality tools for the industry's latest directions.

MetaWare[®]
INCORPORATED



*Compiler Products for
Professional Software Developers*

High C[®] • Professional Pascal[™]

2161 Delaware Ave. • Santa Cruz, CA • 95060-5706 • 408/429-6382 • Fax 408/429-9273

MetaWare and High C are registered trademarks, and Professional Pascal is a trademark, of MetaWare Incorporated. Other names are trademarks of their respective companies.
© Copyright 1990 MetaWare Incorporated

Circle 118 on Reader Service Card

and server (number of clients + number of servers).

Vendors doing notable work in this area include Gupta Technologies, Oracle, Ingres, Sybase, Teradata, and Information Builders. All these companies provide interoperability among their systems on different hosts, both for heterogeneous hardware and homogeneous database software. These vendors tend to use private protocols that prohibit them from exchanging data using SQL tools. Gupta, Oracle, Ingres, and Teradata provide import/export of data with DB2 and IMS, again using proprietary tools.

IBM's LU 6.2 is another protocol for remote server invocation, sending and receiving data, client/server authorization/authentication, transaction management, and maintenance services. Developed in the early 1980s, it is widely used in IBM mainframe environments.

The SQL Access Group is not competing with the standards organizations or individual companies. It is basing its technical specification on ANSI SQL, ISO/RDA, and ISO SQL, as well as on emerging guidelines from consortia like X/Open. The group has taken the work of

the standards organizations a step further. For example, in ANSI SQL, many areas were left user-definable (e.g., column length and table name lengths). The SQL Access Group is bringing definitions and conventions to the ANSI and ISO standards work by contributing to the syntax and communications protocols the two organizations have developed.

The SQL Access Group is developing a technical specification to accomplish the interoperability and portability of SQL RDBMSes and application tools. The technical specification, which was completed last spring, is vendor-independent, not a proprietary implementation of an individual company's product offering. A benefit of the specification is that it will allow 4GL vendors to build, package, and market software independently of back-end RDBMSes. Conversely, RDBMS vendors will be able to package and market database servers independently of front-end vendor applications.

When the SQL Access technical specification is implemented, users will be able to mix and match the clients and servers that best suit their applications, and to access data from multiple hetero-

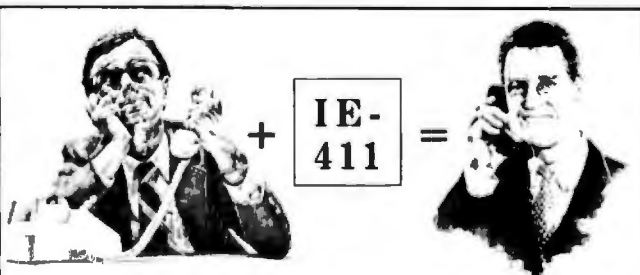
geneous databases without building multiple gateways.

SQL Evolution

Client/server computing is changing information management, and SQL will continue to play a major role in bringing data closer to the user. As the SQL standard evolves, through the efforts of individual vendors and consortia, users will have access to more information and the ability to interoperate across multiple heterogeneous RDBMSes.

Clearly, we are in an information revolution, and a major challenge facing the industry is to achieve true SQL portability. By achieving it, the industry will enable users to mix and match RDBMSes and application tools from multiple vendors, giving them more choices and, hopefully, fewer gateways and easier access to information. Through this, the industry will experience true "open" computing in the database area. ■

Robert J. Crutchfield, a former journalist, is a consultant to the SQL Access Group in Long Beach, California. He can be reached on BIX c/o "editors."



IE-411 is a MS-DOS PC/XT/AT-based voice messaging system that allows you or your company to dynamically maintain a voice information database. It features:

- ✓ Automatic answering of telephone line with call transferring capabilities;
- ✓ Quick, clear voice prompts that guide a caller to the information and messages they need and want;
- ✓ Multiple user access to information from any touch tone telephone;
- ✓ Remote configuration of system parameters and voice information;
- ✓ Software that is clear, simple and to the point.

Call or write for our Infopack and catalog of our other specialty hardware/software products:

- Solid state disk drives • XT/AT BIOS source code in C
- Custom database design • Software security products

PC, XT, and AT are registered trademarks of International Business Machines Corporation. All other product or brand names are trademarks of their respective holders.

Intelligent Exact Engineering

1115 East Ridge Road, Suite 231 (219) 844-4689
Griffith, IN 46319

A LIFETIME OF PROTECTION



Tripp Lite's GOLD SEAL Warranty protects your ISOBAR® and protected equipment for their lifetime.*

The ISOBAR® is the most advanced surge suppressor available. Only ISOBAR® has:

- Isolated filter banks to protect equipment from interfering with each other
- "Cascade Circuitry," which allows you to choose the level of protection you need for all your equipment
- All-metal construction provides superior line noise and RFI/EMI filtering

UL 1449 APPROVED; as low as 330 volt let-through; meets UL 1283 for noise suppression and isolation



500 N. Orleans St.
Chicago, IL 60610-4188
EST. 1922 (312) 329-1777
Fax (312) 644-6505

*Call or write for full details.

"THE POWER PEOPLE"

b11009-1

MEMORY UPGRADES



WE ACCEPT PURCHASE ORDERS FROM UNIVERSITIES,
QUALIFIED FIRMS AND GOVERNMENT AGENCIES.

WE ACCEPT INTERNATIONAL ORDERS

3 day International delivery available via Federal Express or DHL!

CALL (714) 588-9866 OR FAX 24-HOURS A-DAY FAX (714) 588-9872



WE WILL BEAT ANY ADVERTISED PRICE

IBM PS/2 MEMORY

Models 30-286 Exp. Board 1497259	
512K Kit 30F5348	\$54.00
2MB Kit 30F5360	\$179.00
Models 70-E81/121, 55SX, 65SX	
1MB 6450603	\$99.00
Models 70-E81/121, 502, 55SX, 65SX	
2MB 6450604	\$189.00
Models 55SX, 65SX, 34F3077 & 34F3011	
4MB 34F2933	\$585.00
Model 70-A21	
2MB 6450608	\$199.00
Model 80-141	
1MB 6450375	\$145.00
Models 80-111/311	
2MB 6450379	\$259.00
Models 80-A21/A31	
4MB 6451060	\$659.00
All Models 70 and 80	
2-8MB Board w/2M	
6450605	\$499.00
2-14MB Board w/2M	
34F3077	\$599.00
4-16MB Board w/4M	
34F3011	\$999.00
Models 50, 502, 55SX & 60	
2-8MB 1497259	\$699.00

LASER PRINTER MEMORY

Hewlett-Packard LaserJet IIP & III	
1MB 33474B	\$129.00
2MB 33475B	\$179.00
4MB 33477B	\$339.00
Hewlett-Packard LaserJet II & IID	
1MB 33443B	\$129.00
2MB 33444B	\$189.00
4MB 33445B	\$345.00
Apple Laserwriter II and II/NTX	
1MB M6005	\$89.00
4MB M6006	\$349.00
IBM Laser 4019 and 4019e	
1MB 1039136	\$209.00
2MB 1039137	\$375.00
3.5MB 1038675	\$489.00
Canon LBP-8II, 8IIR, 8IIT	
1MB S63-1300	\$129.00
2MB S63-1880	\$189.00
4MB Part # N/A	\$345.00
Epson EPL6000	
2MB IBS401	\$375.00
4MB Part # N/A	\$745.00

APPLE MEMORY

Apple Macintosh SE, SE30, II, IIfx and Iix	
1MB Kit M0218	\$95.00
2MB Kit M0219	\$145.00
Apple Macintosh IIfx	
4MB Kit M0252LL-A	\$285.00
16MB Kit Part # N/A	\$1445.00
Apple Macintosh IIfx	
4MB Kit M0376LL-A	\$319.00
16MB Kit Part # N/A	\$1450.00

ZENITH MEMORY

Zenith Z-386/Z-286/333 & 33E	
1MB ZA36/3800ME	\$99.00
4MB ZA3800MK	\$579.00
Zenith Z-386/2025 & 33	
2MB ZA3600MG	\$189.00
Zenith Z-386 SX	
2MB Z-605-1	\$267.00

COMPAQ MEMORY

DeskPro 286-E 386-20/206/25	
1MB 113131-001	\$139.00
4MB 113132-001	\$385.00
DeskPro 386/16	
1MB 113646-001	\$139.00
4MB 112534-001	\$385.00
DeskPro 286N, 386N and 386SX and 20	
1MB 118688-001	\$105.00
4MB 118690-001	\$589.00
DeskPro 386N, 386SX and 20	
2MB 118689-001	\$189.00
DeskPro 386-33, 486-33 & SystemPro	
2MB 115144-001	\$200.00
8MB 116561-001	\$1899.00
DeskPro 386-20e and 25e	
1MB Board 113644-001	\$225.00
4MB Board 113645-001	\$569.00
DeskPro 386S	
1MB Board 113633-001	\$225.00
4MB Board 113634-001	\$569.00
DeskPro 386/16 (Populate in this order)	
1MB Kit 108071-001	\$165.00
1MB Board 108069-001	\$369.00
2MB Board 108069/71-001	\$579.00
4MB Board 108070-001	\$1049.00
8MB Board 108070/72-001	\$1499.00

AST MEMORY

Premium Workstation 286/386SX	
Bravo 286	
512K Kit 500510-010	\$59.00
Premium Workstation 286/386SX	
Bravo 286	
Advantage Premium /2	
2MB Kit 500510-002	\$169.00
Premium 386C and 386-16	
1MB Kit 500510-007	\$95.00
4MB Kit 500510-008	\$349.00
Premium 386-20	
1MB Kit 500510-003	\$129.00
4MB Kit 500510-004	\$369.00
Bravo 386-SX	
2MB Kit 500510-002	\$179.00
4MB Kit 500510-008	\$349.00
Premium 386-33 & 486-33	
Premium 386-25 & 386SX-16	
Premium 486-25T/25TE/25/25E	
1MB 500718-002	\$95.00
Premium 486	
2MB 500718-004	\$342.00

First Source International can customize special configurations according to your AST memory needs, call for details!

HEWLETT-PACKARD MEMORY

Vectra QS/16S and ES/12PC	
2MB Kit D1354A	\$175.00
Vectra QS/16S	
1MB Kit D1540A	\$89.00
4MB Kit D1542A	\$349.00
Vectra QS/20PC, RS/25PC and 20C	
1MB Kit D1640A	\$105.00
4MB Kit D1642A	\$349.00
Vectra 486 PC	
1MB Kit D2150A	\$104.00
4MB Kit D2151A	\$592.00
Vectra 486PC and 386/25 PC	
8MB Kit D2152A	\$1199.00
Vectra 386/25 PC	
2MB Kit D2381A	\$266.00

LAPTOP MEMORY

TOSHIBA

Model 1000SE/EX	
1MB	\$329.00
2MB	\$469.00
Model T1200SE	
2MB	\$249.00
Model T1600	
2MB	\$249.00
Model T3100E	
2MB	\$249.00
Model T3100SX	
2MB	\$249.00
4MB	\$689.00
Model T3200SX	
2MB	\$249.00
4MB	\$689.00
Model T5100	
2MB	\$249.00
Model T5200, T5500	
2MB	\$249.00
8MB	\$1300.00

COMPAQ

Portable 386	
1MB Kit	\$325.00
4MB Extension Brd	\$1049.00
4MB Expansion Brd	\$1049.00
Portable III	
512K Kit	\$69.00
2MB Kit	\$325.00
Portable LTE 286	
1MB	\$189.00
2MB	\$269.00
SLT-286	
1MB	\$239.00
4MB	\$1325.00
SLT-386	
1MB	\$325.00
2MB	\$495.00

ZENITH

SuperSport 286 & 286E	
1MB	\$189.00
2MB	\$449.00
SuperSport SX	
2MB Alpha	\$649.00
2MB Beta	\$549.00

NEC

ProSpeed 286	
1MB	\$289.00
4MB	\$900.00
ProSpeed 386	
2MB	\$450.00
8MB	\$2250.00

APPLE

Apple Macintosh Portable	
1MB	\$299.00
2MB	\$875.00
3MB	\$1330.00
4MB	\$1750.00

FIRST SOURCE WILL NOT BE UNDERSOLD!

EXPANSION BOARDS

All BocaRam Boards shown include PrintSpooler and Ram Disk software.

BocaRam/XT

Up to 2MB of expanded memory for any IBM PC, XT, AT and 8-bit PC bus compatibles running at CPU speeds up to 12MHz. LIM/EMS 4.0 compatible. Uses 256Kx1 Dram.

Order Now: SIMXT00 \$119.00

with 2MB: SIMXT02 \$279.00

BocaRam/AT

Up to 2MB and upgradeable to 4MB for IBM AT and 16-bit compatibles running at CPU speeds up to 16MHz. Provides conventional expanded and/or extended memory. LIM/EMS 4.0. Uses 256Kx1 Dram.

Order Now: SIMAT00 \$129.00

with 2MB: SIMAT02 \$269.00

BocaRam/AT Plus

Up to 8MB for any AT or 16-bit compatible machines running up to 33MHz. Offers conventional expanded and/or extended memory, provides a maximum of 2MB LIM/EMS 4.0. Uses 1x1 Dram.

Order Now: SIMAT80 \$179.00

with 2MB: SIMAT82 \$399.00

BocaRam 502

Up to 2MB zero-wait-state expanded and/or extended memory board designed for IBM PS/2 Models 50, 50Z, 60, and true MCA compatibles. Uses 1x1 Dram. OS/2 compatible.

Order Now: SIMMC20 \$155.00

with 2MB: SIMMC22 \$290.00

Orchid 16/32

Up to 8MB, zero-wait-state for PS/2 Models 50, 50Z, 60, 70, and 80 which fully support 16 and 32-bit memory access. Includes 1 serial and 1 parallel port plus a free serial cable. LIM EMS 4.0 and OS/2 compatible. Uses 256K and 1MB SIMMS.

Order Now: SIM1603-90 \$299.00

SIMMS

IBM TYPE

4Mx9-80	\$410.00	1MX1-12	\$6.50
1Mx9-12	\$69.00	1MX1-10	\$7.00
1Mx9-10	\$73.50	1MX1-80	\$7.50
1Mx9-80	\$79.00	1MX1-70	\$8.00
1Mx9-70	\$89.00	1MX1-60	\$8.50
256x9-12	\$20.00		
256x9-10	\$23.50		
256x9-80	\$26.00	256KX4	
256x9-60	\$35.00	256KX4-12	\$6.85
		256KX4-10	\$7.00
		245KX4-80	\$7.20

APPLE-MAC

4Mx8-80	\$335.00	256KX1	
1Mx8-12	\$61.00	256KX1-12	\$1.85
1Mx8-10	\$65.00	256KX1-10	\$2.00
1Mx8-80	\$68.00	256KX1-80	\$2.20
256x8-12	\$23.40	256KX1-70	\$2.50
256x8-10	\$24.00	256KX1-60	\$3.50
256x8-80	\$24.70		
		64KX4	
		64KX4-12	\$2.30
		64KX4-10	\$2.40
		64KX4-80	\$2.60
		64KX1	
		64KX1-15	\$1.10
		64KX1-12	\$1.70
		64KX1-10	\$1.90

AVAILABLE

SIPPS AND STATIC COLUMN

AVAILABLE

WE ARE "THE ONLY SOURCE!"

TOLL FREE FROM ANYWHERE IN THE U.S. OR CANADA!

ORDER NOW: 1-800-535-5892

TERMS AND CONDITIONS

- ✓ NO SURCHARGE ON MC OR VISA
- ✓ Terms: MC, Visa, AmEx (Add 4%), COD, Cash, Net 30 days on purchase orders from qualified firms.
- ✓ 20% Restocking fee on all non-defective returns & refused orders. RMA # required.
- ✓ Manufacturers part numbers are for your convenience, all products third party.
- ✓ PRICES AND AVAILABILITY SUBJECT TO CHANGE.

First Source International, Inc.

36 Argonaut, Suite 140

Aliso Viejo, California 92656

Tel. (714) 588-9866

FAX (714) 588-9872

Order Desk Hours:

Monday thru Friday 8:00-5:00

Saturday 10:00-3:00

Please use our 24 hour-a-day voice mail or FAX!

WHY SHOULD YOU BUY FROM F.S.I.?

- ✓ We will meet or beat any advertised price!
- ✓ Limited Lifetime Warranty available
- ✓ All products guaranteed 100% compatible in form, fit and function or your money back.
- ✓ Advanced replacement available on defective returns.

WE ARE "THE ONLY SOURCE!"

PLEASE SEND ALL P.O.'S AND MAIL ORDERS TO:

First Source International, Inc.

P.O. Box 3676

Laguna Hills, CA 92653



Pretty.



*Mission Critical Workstation 1448.
9 option slots and 2 drive bays.*

A PC that looks good in your office won't look good for long out in the plant.

Heat murders microprocessors. Dust decimates disk drives. Vibration victimizes video cards.

Any or all can wreck your entire operation.

Texas Microsystems line of rugged, reliable ISA Bus products and systems are specifically engineered for those brutal industrial environments that eat pretty PCs for breakfast.

To ensure maximum reliability we design and manufacture from scratch practically everything that goes into our systems, like passive backplanes which we pioneered for microcomputers in 1983. These backplanes accommodate a full complement of convenient, plug-in components, all compatible with IBM®. They're why our Mean Time To Repair (MTTR) is a phenomenal 10 minutes.

You won't find passive backplanes — or lower MTTR — in any of the leading office PCs.

We also build industrial-strength option cards to handle

myriad functions, in addition to our 286, 386™ and 486™ CPU cards in a full range of processor speeds. Our CPU card designs use Very Large Scale Integrated circuits and programmable array logic devices to reduce component counts by 50-60% which enhances reliability and resistance to physical stress. Ultimately, the design contributes to our remarkably long Mean Time Between Failures (MTBF): 70,000-100,000 hours, calculated against the MIL Standard Handbook 217E.



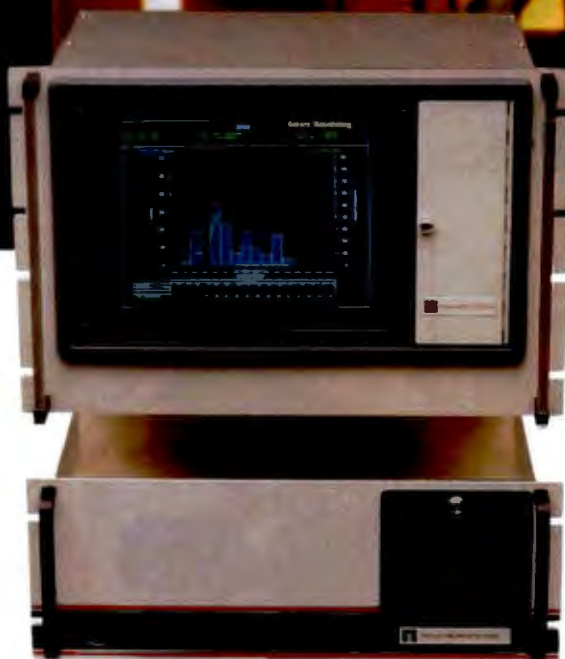
*Ultra-fast 32-bit (80386) AT[®]
equivalent CPU board B386S.
Available at 16, 20, 25, 33 MHz*

You won't find that kind of card selection — or MTBF — among the leading PC makers.

You won't find them torturing their systems like we torture ours, either. Not only do we perform extensive "shake, rattle and roll" tests on each new design, we pretest all our systems before they leave our dock. We burn them in at 55°C/131°F for 48 hours straight just to make sure they can take the heat at your plant.



*Mission Critical Benchtop 2003.
10 option slots and 2 drive bays*



Pretty tough.

What's more, we shock-mount our disk drives to stand up to vibrations surpassing Richter scale proportions and we use only high-reliability power supplies that can go 100,000 hours MTBF.

With all that reliability designed into our products, is it any wonder that we guarantee better support than the other leading PC makers? Every system we offer comes with a full one-year, on-site warranty. Theirs don't. We also offer a toll-free number for technical and sales information, a regional network of sales engineers, engineering support for systems integration and a guarantee to meet shock specs. Of the lead-

ing PC makers, Texas Microsystems has the longest history of design using Intel microprocessors: 15 years in all. You'll find our systems hard at work in harsh operating environments at 70 of the Fortune 100 companies.

Granted, the leading office PCs may be prettier than ours, but our industrial-strength systems are designed to be more reliable. That reliability makes our systems look a lot better where it really counts:

Your production line .



*Mission Critical Rack-mount 2001.
10 option slots and 3 drive bays.*

It's- No- Comparison			
	Texas Microsystems	COMPAQ	IBM PS/2
Passive Backplane	Yes	No	No
100,000-hour MTBF power supply	Yes	No	No
Shock-mounted disk drives	Yes	No	No
Maximized MTBF	Yes	No	No
Positive pressure, filtration	Yes	No	No
Operation at 55°C/131°F	Yes	No	No
48-hour burn-in at 55°C/131°F	Yes	No	No
Maximum expansion slots available	14	5	5
1-year, on-site warranty	Yes	No	No
Toll-free support number	Yes	No	No
Regional sales support	Yes	No	No
"Shake, rattle and roll" testing	Yes	No	No

For technical or sales information, call

1-800-627-8700



Texas Microsystems, Inc.

© 1990, Texas Microsystems, Inc. "Mission Critical Micro" is a trademark of Texas Microsystems, Inc. Other trademarks mentioned are registered, trademarked or service marked by their respective manufacturers.

Circle 191 on Reader Service Card

PERISCOPE® IV

New
Version
5

THE *Real* REAL-TIME SOURCE-LEVEL DEBUGGER

With Periscope Model IV, you can debug your software while it runs at full speed, something *no* software-only debugger can do.

You can also examine the execution history of a hardware interrupt in Periscope IV's real-time trace buffer, something *else* no software-only debugger can do.

When The Going Gets Tough... Periscope IV helps you debug most any program, but is specially designed to debug programs that software-only debuggers can't. Model IV users use it to debug TSRs, ISRs, device-drivers, DOS, BIOS, communications software, real-time data acquisition programs, multitasking software, network soft-



runs on most any 80286 or 80386 at speeds up to 25MHz.

The new Remote Debugging feature lets you use Periscope IV to debug programs running on IBM PS/2s and compatibles. The optional Plus board keeps Periscope from using any of the lower 640K, so Periscope can't be overwritten and doesn't use the memory your program needs.

You can try Periscope IV for ten days at no charge before you buy it. Call our toll-free number for details.

Periscope IV prices range from \$1995 for a 16 MHz 80286 system to \$2395 for a 25MHz 80386

FREE
10-day
Evaluation

MAKING THE MICRO-TO-MAINFRAME CONNECTION

In addition, the PC can support one of two modes: control unit terminal or distributed function terminal. CUT is simpler but more limited; it supports only one simultaneous mainframe session. DFT supports multiple simultaneous mainframe sessions. A PC with an attached printer can usually emulate an IBM printer as well.

Some IBM minicomputers (e.g., the System/3X) emulate a 5250 terminal rather than a 3270; this requires different hardware and software. However, more recent IBM minicomputers (e.g., the AS/400) support 3270 terminal emulation as well.

Gateways

Until a few years ago, the only way you could provide 3270 terminal emulation was to take the following three steps: Install an adapter card into each PC that might require mainframe communication, string cable from each PC to the mainframe, and run terminal-emulation

You'll need
*a communications
scheme so that the PC
and mainframe can talk
to each other.*

as half that of an individual link. Factors that can affect gateway performance include the type of PC that you use for the gateway itself, the speed between the gateway and the mainframe (a 4-mega-bit-per-second Token Ring link provides better performance than a 9600-bps modem link), the amount of traffic on the LAN, and the amount and type of data being transmitted to the mainframe.

ler itself communicates with the mainframe via a special kind of high-speed modem called a synchronous modem. (The more standard kind of modem used by PCs is called an asynchronous modem.) The cluster controller communicates over the modem by means of a protocol called synchronous data-link control. The mainframe communicates with the modem via a front-end processor. Stand-alone PCs can also communicate with mainframes via a synchronous modem, SDLC, and a front-end processor.

Another way that PCs can communicate with remote mainframes is by using an asynchronous ASCII connection. This method uses the more typical asynchronous modem and is best suited for users who don't require a great deal of mainframe communication. In this method, the mainframe needs an additional device called a protocol converter, which converts the asynchronous transmission to synchronous for communication with the mainframe.

configuring a large number of PCs is tedious and requires more mainframe resources. Some organizations do both: They individually configure some PCs (perhaps those that are used the most or that are used for different functions), and they create a pool of mainframe sessions that other users can share.

Talking the Mainframe Talk

In the same way that LANs require both adapter cards and network operating-system software to function, micro-to-mainframe communication has both hardware and software components. If you just want your PCs to act as terminals to the mainframe, all you need is terminal-emulation software. If you wish to write programs for the PCs that communicate with programs on the mainframe, you need additional software.

The type of software that organizations use depends on what kind of application programming interface they want for the mainframe. There are three kinds of APIs, which require increasingly more programming on the mainframe side than the one before it.

The first type is High-Level Language API (HLLAPI). With software that supports this interface, you can write applications that communicate with mainframe applications as though they were terminals. The mainframe applications don't need to be modified to communicate with the PC applications. You would use this type of interface for programs that transfer files between the PC and the mainframe.

In earlier software releases, IBM also supported Entry-Emulator HLLAPI. This provided a subset of HLLAPI and was designed for use with smaller, simpler LANs. EEHLLAPI is no longer available.

The second type of API is Server-Requester Programming Interface (SRPI). With software supporting this interface, you can write applications that treat the mainframe as a server by communicating with relational databases on the mainframe. However, to provide this function, the mainframe also requires another type of software, Enhanced Connectivity Facility (ECF). This type of interface is used for programs that extract data from a mainframe database.

The third type of API is Advanced Program-to-Program Communication. APPC differs from the other two APIs. In other types of communication, the mainframe "master" transmits and receives data from a PC "slave." With APPC, the mainframe and the PC are peers, and either one can request infor-

mation from the other. You would use this type of interface for client-server applications, where both the PC and the mainframe do some of the processing. However, to support APPC, you must write programs on the mainframe; you cannot use the existing applications that were written for dumb terminals.

APPC also uses a different type of communications protocol than the other two APIs. While HLLAPI and SRPI can communicate with the mainframe by using 3270 protocols, APPC uses a type known as Logical Unit 6.2 (LU 6.2).

LU 6.2 supports peer-to-peer communication on the hardware level; APPC provides it on the software level. However, the two terms—APPC and LU 6.2—are often used interchangeably.

Another term often associated with APPC is System Network Architecture. IBM is attempting to migrate its users toward a certain group of strategic communications protocols; it uses the term SNA to refer to these protocols. APPC/LU 6.2 are in SNA; 3270 communications protocols are not.

The Software Connection

The type of software you need depends on the APIs you choose and what operating system your PCs run. For example, many vendors offer 3270 terminal-emulation software for use with MS-DOS and OS/2. This software generally supports HLLAPI and other basic programming interfaces. If you want to support APPC, you need additional DOS software.

IBM recommends that OS/2 users who want both 3270 terminal emulation and support for APPC should move to OS/2 Extended Edition. Extended Edition includes a communications manager that provides both of these functions. Another advantage of Extended Edition is that it supports Ethernet LANs as well as Token Ring networks.

The two major vendors for PC communications hardware and software are IBM and Digital Communications Associates. These vendors provide products like 3270 terminal-emulation boards, terminal-emulation software, and gateway hardware and software. But more than a dozen other vendors also provide some subset of these products.

At present, Extended Edition/Communications Manager is available only from IBM. However, IBM announced in November 1989 that it would make its Communications Manager functions available to other vendors for incorporation into their products. IBM has not yet said how or when it will do this.

Some organizations wish to make their

micro-to-mainframe programs user-friendly, yet don't have time to rewrite the entire application. Many vendors have released products that let you develop icon- and menu-driven interfaces for their applications without requiring changes in the mainframe application.

Futures

At this point, IBM and the marketplace are pushing users toward communications methods that take advantage of the PC's intelligence (e.g., Token Ring connections and APPC) for writing new applications. The new crop of client-server OS/2-based applications demonstrate the value of this method.

Moreover, in response to user demand, IBM is beginning to support types of communication other than those it has developed itself. For example, OS/2 Extended Edition supports Ethernet LANs as well as Token Ring networks.

IBM has said that it will support Open Systems Interconnection protocols, which are intended to be used by all vendors to let you set up heterogeneous networks of computers. In addition, IBM is already beginning to support TCP/IP, a set of older communications methods that many vendors support and many products provide now.

On the other hand, the mainframe isn't likely to go away. While new micro-to-mainframe communications possibilities are opening up, the huge installed base of mainframe applications will guarantee that older terminal-emulation protocols and the applications that support them will continue to be used for the foreseeable future. ■

Editor's note: For more information on micro-to-mainframe communications, contact Attachmate (13231 Southeast 36th St., Bellevue, WA 98006, (800) 426-6283 or (206) 644-4010) and ask for the "Evaluator's Guide to 3270 Micro-Mainframe Products." Although Attachmate produces its own line of 3270 products, most parts of this guide are fairly bias-free and do a good job of presenting the information.

ACKNOWLEDGMENT

Thanks to Bob Spaziano, consulting support representative for LANs of IBM's telecommunications system support center, for providing some of the information in this article.

Sharon Fisher is a San Francisco-based freelance writer specializing in computer communications. She can be reached on BIX as "sharonfisher."

Largest Variety of Templates Available And The Most Inexpensive!

At present, FuncKey Enterprises has 36 color-coded templates for 70 of the most popular PC software programs, in BOTH 10 key and 12 key versions. We are continually updating the templates so that you always get the latest version of a program, plus older versions on one template. The major software manufacturers (Borland, Ashton-Tate, SPC, Microsoft, Dac-Easy, etc.) provide us with advanced copies of new releases, so that FuncKey always has the largest selection of low-cost, current program templates. The background color ink is formulated to diffuse light and reduce glare. The thin profile (only 12/1000 of an inch thick) lets you stack several templates on the keyboard for quick changes between programs. The removable reference card shows shortcuts, speed keys, and other useful conventions. FuncKey templates are excellent training tools or handy for occasionally used programs. **Best of all, a 10 key template is only \$2.98 and a 12 key template is only \$3.98.**



For More Information Please Call Your Local Dealer Or

**FuncKey
Enterprises**
(817)482-6613

DON'T WORRY, USE HLLAPI

Cooperative applications development that involves both microcomputers and mainframes draws on the strengths of each

Mike Fichtelman

One of the biggest surprises of the last decade, at least to IBM, was the phenomenal success of the IBM PC. IBM's original sales projections for the PC indicated that only about a quarter-million of the little machines would be sold. Of course, these projections may have been skewed by IBM's interest in mainframe computers—IBM makes a 60 percent profit on every mainframe. Therefore, just about everything that IBM does, makes, or sells is traditionally geared toward bolstering the sale of mainframes.

Despite IBM's predilection for mainframes, sales of PCs grew far beyond the original projection. People all over the world, in homes, offices, and factories, are using PCs to do just about everything that a "real" computer can do. In fact, the balance has shifted so dramatically that last year sales of PCs eclipsed sales of mainframes for the first time.

The reasons for this are simple. Given a choice between a mainframe terminal and a personal computer, people will almost always choose the latter. A personal computer is under your control. Response time and per-

formance are usually excellent, because you're not competing with hundreds of other users for the machine's attention.

Personal computers are also easier to use. Applications can be built using virtually endless levels of help screens, windows, and other techniques that make using the application more intuitive.

These kinds of things can't be done on a mainframe without enormous expendi-

ture and effort. It's like giving people a choice between a black-and-white TV and a color TV. Just as most people will take the color TV, most people will take a personal computer over a mainframe terminal.

In the mid-1980s, IBM began to realize that mainframe sales were ebbing away to the less profitable but enormously popular PC. But wait a second. What about all that information on the mainframe, all those huge data files? What about the tremendous investment that companies all over the world have made in mainframes and mainframe data communications networks?

To keep the PC people in the game, protect customer investment, and salvage its bread-and-butter business, IBM began to produce alternatives that were needed to provide connectivity between PCs and mainframes. Enter Systems Application Architecture (SAA).

You don't SAA

PCs weren't the only reason for IBM's sagging sales. Another culprit was IBM's disjointed product line. IBM produces a large portfolio of software products that run on

continued



a plethora of hardware platforms. IBM's product picture is so big that its own staff has trouble getting a handle on it; forget about the customers. Customers were having some problems integrating these products because of dissimilar protocols, file structures, operating systems, naming conventions, user interfaces, and so forth.

Meanwhile, competitors like Digital Equipment were promoting tightly integrated product lines that allowed users to port applications unchanged (theoretically) from a microcomputer to a mainframe and back again. This approach permitted the development of systems that distributed the work load across platforms, allowing different machines to do the part of the work that each did best.

IBM confronted the problems of personal (distributed) computing and its fragmented product line by announcing SAA in 1987. SAA is an attempt by IBM to pull everything it produces under a single umbrella of standardization.

SAA is not a product, but rather a set of guidelines that IBM and third-party vendors will adhere to in order to provide both users and vendors with the benefits that usually come from standardization. Along with SAA, IBM also announced the PS/2 family of microcomputers, the OS/2 operating system, and the Micro Channel architecture. These hardware and software components form part of

SAA is a great idea, but it won't happen overnight, and it won't come cheap.

Needless to say, SAA is an ambitious proposition. It's a great idea, but it won't happen overnight, and it won't come cheap. The chronic delays and relatively high cost associated with the development and implementation of IBM's first SAA application, OfficeVision, underscore this fact.

Hello, HLLAPI

The High-Level Language Application Programming Interface (HLLAPI—pronounced “ha-lap-pee”) is a valuable programming tool. HLLAPI lets programmers develop applications that deliver what SAA only promises. It can quickly, easily, and relatively inexpensively produce cooperative-processing applications between PCs and mainframes that draw on the strengths of both: PCs are great for fast, friendly user interfaces; mainframes can't be beat for storing and retrieving gigabytes of information reli-

ated; this dedicated approach was replaced by the 3278/3279 coax adapters. These adapters can be purchased for both the PC and Micro Channel buses.

The emulation software changed as well. The 3270PC control program gave way to two different programs. The full-blown workstation program provides support for four mainframe sessions, a PC session, and a lot of other features. The stripped-down version is called the 3270PC entry-level emulation program. The entry-level program provides one mainframe and one PC session; it meets the requirements of most users.

Various terminal-emulation products provided access to mainframe applications. Some even provided file transfer between the PC and the mainframe, but they weren't really programmable. With the introduction of HLLAPI, IBM has provided a mechanism for effectively controlling the interaction between the PC and the mainframe.

HLLAPI is exactly what the name purports: an interface to the low-level functions of the terminal-emulation program that can be accessed by applications written in a high-level programming language like C or Pascal. These functions are invoked in the typical manner of the particular programming language, by linking the application program with a language interface module (LIM).

DON'T WORRY, USE HLLAPI

Keystrokes can be sent to the mainframe, automating the actions of a human operator. The mainframe display can be searched, tested for an update, copied to a file, or sent to the printer. Data can be

entered into a mainframe CRT form or extracted and processed by another PC program.

In addition to these and other presentation services, HLLAPI provides func-

tions that perform support tasks, such as session status generation, connecting to and disconnecting from the mainframe, and system reset. The table provides a list of all the HLLAPI functions, as well as the function codes and a brief description of each.

HLLAPI FUNCTIONS

HLLAPI functions are executed by passing the function number as an argument to the TSR program's interface function, HLLC.

Function	Function number	Description
PRESENTATION SERVICES		
Connect presentation space	1	Establish connection.
Disconnect presentation space	2	Break connection.
Query cursor location	7	Find the cursor.
Query field attribute	14	E.g., is current field highlighted?
Search field	30	For presence of specified data.
Find field position	31	Locate a specified field.
Find field length	32	Get the length of a field.
Copy field to string	34	Move field contents to a string.
Copy string to field	33	Move string contents to a field.
Copy OIA	13	Move 3270 operator information area to a string.
Copy presentation space	5	Copy entire mainframe display to

Across the Great Divide

The primary problem that I encountered when I began exploring HLLAPI was a dearth of information. IBM provides documentation on all the functions in a terse manual, and the functions just weren't intuitive. Once I started to build a library of the functions in C, however, it was relatively simple to combine the functions to satisfy a variety of requirements.

Since a picture is worth a thousand words, I've included listing 1 as an annotated example of a program that uses HLLAPI. The program is short, but it ties together several important HLLAPI



See the Future.

The ideal 16-inch ergonomic monitor for professional graphics and business applications.

Maximum performance for CAD/CAM, spreadsheets, databases, WYSIWYG word processors and desktop publishing. Designed for PCs and Macintosh II.

1024 × 768 resolutions. Supporting the new, higher refresh rate of 70Hz and above for a flicker-free display. No distortion. Sharply focused. Bright images across the entire screen.

An anti-static, non-glare screen. Low magnetic radiation. No interference between two monitors separated by a mere six inches, for dual-display applications.

Microprocessor-controlled configuration for your applications, memorizing size and position of the screen settings you prefer.

Other monitors compete against the standards.
FLEXSCAN® sets them.

NANAO®

NANAO USA CORP.

23510 Telo Ave., Suite 5
Torrance, CA 90505 USA
Phone (213)325-5202
Fax (213)530-1679

Circle 224 on Reader Service Card
(RESELLERS: 225)

FLEXSCAN 9080i

16" (15V), 0.28mm-dot pitch CRT
1024 × 768 Super high resolution with 70Hz
high refresh rate
Scan Frequency: Automatic Adjustment
H: 30-64KHz V: 50-90Hz
VGA, 8514/A and Mac II Compatible

Attention U.S. BYTE Subscribers

Watch for the next **BYTE DECK** mailing that will be arriving in your mailbox soon!

Use this as a fast, convenient tool to purchase computer products and services. It's loaded with essential hardware and software products that you should be aware of when making your buying decisions...and it's absolutely **FREE!**



If you have a computer product or service, and would like to reach 275,000 influential **BYTE** magazine subscribers, please give Ed Ware a call today at (603) 924-2596.

Here's what a **BYTE Deck** advertiser has to say:

*"Ten years ago we advertised in the very first **BYTE Deck**—the number of sales leads we received was enormous! The **BYTE Deck** was so successful for us, that we have continued to use it over the past ten years!"*

Lisa Tarpoff
Marketing Manager
Heath Company
Benton Harbor, MI

BYTE DECK

DON'T WORRY, USE HLLAPI

Listing 1: *BYTEAPI.C, a little HLLAPI program.*

```
#include <stdio.h>

/* HLLAPI parameters */
int  API_FUNC, API_LEN, API_RET;
char API_STRING[255];

/****** HLLAPI DECLARATIONS *****/
void connect__host();
void disconnect__host();
void pause (int API_LEN);
void receive__file ();
void reset__system();
void search__pres(char *API_STRING,int API_RET);
void send__key(char *API_STRING);
void wait();

main()
{
    reset__system ();           /* initialize HLLAPI TSR program */
    connect__host();           /* connect to mainframe presentation space */

    /* perform the log-on process */
    puts("Logging On To Mainframe VM System");
    send__key ("@C");          /* clear the screen */
    wait();                    /* wait until mainframe is ready for input */
    send__key ("LOGON userid@E"); /* enters user ID */
    wait();
    pause(20);                  /* pause for 20 half-seconds */
    send__key ("password@E"); /* enters the password */
    wait();

    /* search the presentation space for the signal from another user */
    /* ID that it is time to download the file */
    strcpy(API_STRING,"OK TO PROCEED"); /* move search string to string parameter */
    API_LEN = 0;                /* initialize length parameter */
    /* loop until the search string is found in the presentation space
       ( as long as API_LEN = 0 or until a key is hit */
    while ( API_LEN == 0 && !kbhit() )
    {
        clrscr();              /* clear the PC screen */
        puts("Searching Presentation Space For Message To Proceed");
        search__pres(API_STRING,1); /* invoke the search function */
    }

    /* when the signal is received, begin download process */
    puts("Proceeding To Download File From Host");
    disconnect__host ();       /* must disconnect before receive */
    /* invoke the receive function with parameters for the PC filename,
       the mainframe filename, file type, and mode; convert the file to ASCII;
       carriage return/linefeed marks the end of records */
    receive__file("GLFILE GENERAL LEDGER * (ASCII CRLF)");
    connect__host();           /* reconnect to mainframe presentation space */
    send__key ("@C");          /* clear the screen */
    wait();

    /* send a message to the other user ID that the file has been downloaded */
    send__key ("MSG otherid GL FILE RECEIVED @E");
    wait();

    /* reinitialize and exit */
    reset__system ();
    exit(0);
}

/* Connect to Host Session*/
void connect__host ()
{
    API_FUNC = 1;              /* function code */
    strcpy(API_STRING, "E" ); /* connect to session E */
    API_LEN = 1;               /* length of string is 1 */
    /* call Language Interface Module */
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
    if (API_RET != 0)          /* handle the return code */
    {
        puts("Warning : could not connect to Host. ");
        printf("Return Code : %d\n",API_RET);
        return;
    }
}

/* Disconnect from Host Session*/
void disconnect__host ()
{
    API_FUNC = 2;
}
```

continued

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."

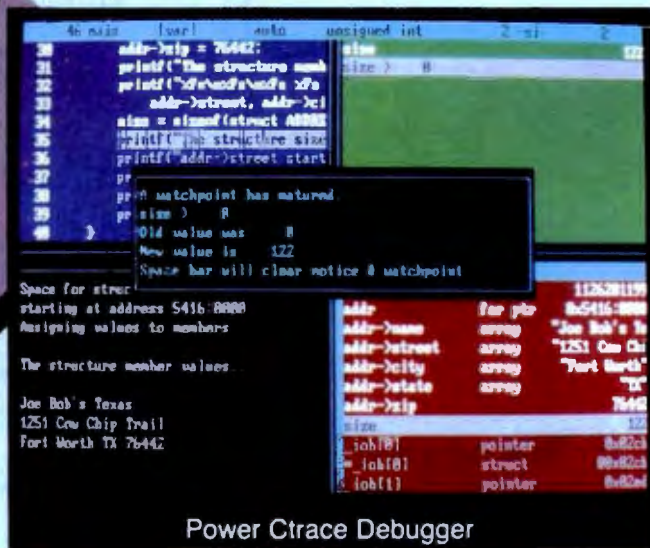
Stephen Davis
PC Magazine, September 13, 88 (Review)

"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)



Power Ctrace Debugger

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

O rder 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 _____	
Paying by: <input type="checkbox"/> Money Order <input type="checkbox"/> Check	
<input type="checkbox"/> Visa <input type="checkbox"/> MC <input type="checkbox"/> AX <input type="checkbox"/> Discover	
Card # _____	
Card Expiration Date _____	
Computer Name _____	Disk Size <input type="checkbox"/> 5 1/4" <input type="checkbox"/> 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"/> BCD Business Math (\$10.00)	\$ _____
Add Shipping (\$5 USA - \$20 Foreign)	
Texas Residents add 8% Sales Tax	
Total amount of your order \$ _____	

Circle 125 on Reader Service Card



Subscription Problems?



We want to help!

*If you have a problem with your **BYTE** subscription, write us with the details. We'll do our best to set it right. But we must have the name, address, and zip of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.*

BYTE

Subscriber Service
P.O. Box 555
Hightstown, NJ 08520



```
HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
if (API_RET != 0)
{
    puts("Warning : could not disconnect from Host.");
    printf("Return Code : %d\n",API_RET);
    return;
}

/* Pause for host event, APILEN in half-seconds */
void pause (int API_LEN)
{
    API_FUNC = 18;
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
}

/*Receive File*/
void receive_file(char *API_STRING)
{
    API_FUNC = 91;
    API_LEN = strlen(API_STRING);/*length of API string*/
    API_RET = 3; /*receive.com located on c: drive*/
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
    if (API_RET != 3)
    {
        puts("Warning : could not receive file.");
        printf("Return Code : %d\n",API_RET);
    }
    else
    {
        puts(" ");
        puts("File Received.");
    }
}

/* Reset System */
void reset_system ()
{
    API_FUNC = 21;
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
}

/*Search presentation space*/
void search_pres(char *API_STRING,int API_RET)
{
    API_FUNC = 6;
    API_LEN = strlen(API_STRING);/*length of API string*/
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
    if (API_RET != 0)
    {
        puts("Warning : Could not find string in presentation space.");
        printf("Return Code : %d\n",API_RET);
    }
}

/* Send Key*/
void send_key (char *API_STRING)
{
    API_FUNC = 3;
    API_LEN = strlen(API_STRING);/*length of API string*/
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
    if (API_RET != 0)
    {
        puts("Warning : could not send keystrokes.");
        printf("Return Code : %d\n",API_RET);
        return;
    }
}

/* Wait for mainframe to catch up */
void wait ()
{
    API_FUNC = 4;
    HLLC(&API_FUNC,API_STRING,&API_LEN,&API_RET);
}
```

the HLLAPI TSR program using reset system. It's the safe thing to do and re-sets everything to default values. Next, connect to the mainframe presentation space. The send key function clears the screen and enters the log-on ID. Certain keystrokes are preceded by an @ sign, such as @C (the Clear key) and @E (the Enter key). These are known as *atten-*

tion/interrupt keys because they initiate some kind of action on the part of the mainframe system.

Next, use pause to let 10 seconds pass and let the mainframe session catch up before entering the password. The difference between pause and wait is subtle. The wait function waits until the

continued

Group scheduling with online notification -- in 1.4 KBytes!

CaLANDar provides group scheduling of appointments and tasks, a group mail/notebook facility and the industry's best RSVP and notification system.

■ NOTIFICATION & ACCESS

On-line notification and "hot key" access to all of CaLANDar's features - without exiting from your application programs - even GRAPHICS programs! And one computer can monitor up to 10 schedules.

■ TINY RAM OVERHEAD

CaLANDar's full function TSR occupies 1.4 KBytes of main memory on systems with EMS - less than 7 KBytes w/o EMS. The pop-up only mode occupies less than 4 KBytes. And when used with "high loaders" it occupies 0 bytes of main memory!

■ SCHEDULE RESOURCES TOO

We treat people like people and resources like resources. And our Resource Manager facility provides extended control for the people who are responsible for corporate resources.

■ SENSIBLE REPORTS

CaLANDar provides several useful printouts - like our Daily Organizer, which help you organize your daily, weekly and monthly activities.

■ ON-LINE NOTIFICATION

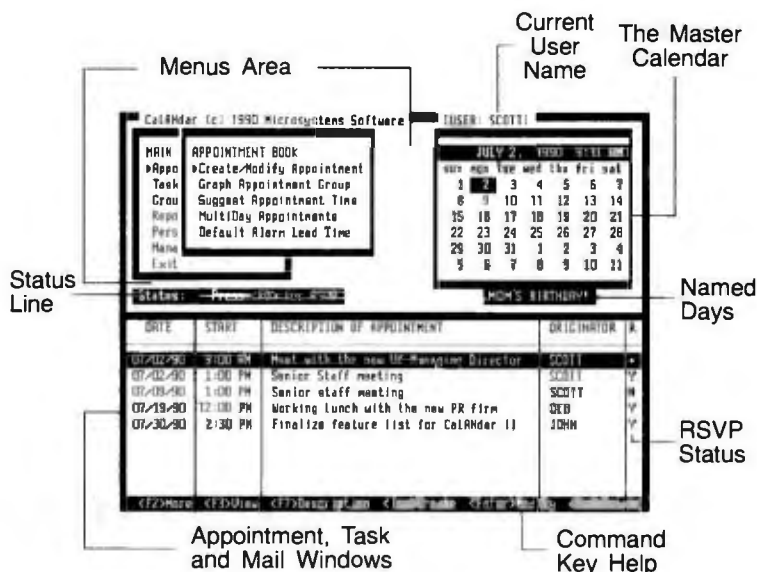
For new appointments, tasks and mail, RSVPs, appointment time and Quick Reminder.

■ PEOPLE GROUPS

CaLANDar's groups make it easy for you to maintain both system-wide and personal lists of people. When creating an appointment, task or mail, simply select a group name. CaLANDar will automatically notify each member of the group.

■ RESOURCE GROUPS/POOLS

CaLANDar supports system-wide and local resource groups and pools. Resource groups include resources which are frequently used together. Resource pools are groups of similar resources. When you select a resource pool for an appointment, CaLANDar automatically assigns one of the resources within the pool.



FREE DEMO

For more information and a free demo copy - call, write or FAX today. Or call our BBS to down-load your demo copy ... TODAY!

VOICE: 508/626-8511

FAX: 508/626-8515

BBS: 508/875-8009

CALANDAR™

A Microsystems Software **TeamWORKS** Product

Microsystems Software, Inc.

600 Worcester Road Framingham, MA 01701

CaLANDar and TeamWORKS are TMs of Microsystems Software.

communication line is no longer busy; this doesn't necessarily mean that the previous action you requested has been completed. The pause function waits for the length of time you specify.

To find out when it's safe to start the download, the automated operator will repeatedly search presentation space until it detects the notification string "OK TO PROCEED," or until somebody presses a key. Obviously, the notification string could have been anything. Please be aware that there are more sophisticated (and more complicated) ways of handling this kind of notification detection.

Once the automated operator gets the OK to continue, the download process begins. However, you must first disconnect from the presentation space; this is mandatory. The receive file function accepts the following parameters for receiving a file from a VM mainframe system: the PC filename (GLFILE), the VM filename (GENERAL), the VM file type (LEDGER), the VM file mode (*), and the conversion parameters (ASCII CRLF). When the file has been downloaded, reconnect to the presentation

space, clear the screen, and send a message to the other virtual machine saying that the file was received.

If you examine the functions themselves, you'll notice that they are modular. They can be mixed as necessary to create the desired result. There could have been other functions added to make this application more robust.

Once you've written your HLLAPI application program, you must compile it and link it with the appropriate LIM. In the case of C, there are three LIMs. For the small, medium, and large memory models, use HLLC_S.OBJ, HLLC_M.OBJ, or HLLC_L.OBJ, respectively.

The following is a batch file implementation that could be used to compile and link the BYTEAPI program using Turbo C.

```
REM compile and link byteapi.c
      using turbo c
tec -IC:|tc|include -LC:|tc|lib
      byteapi.c hllc_s.obj
```

To execute BYTEAPI, first run the terminal-emulation program from the DOS command line: C> pc3270 for the entry-

level program, and C> indc1pl for the workstation program. Next, execute the IBM HLLAPI program: C> EEHLLAPI for the entry-level version, and C> HLLAPI for the workstation version. Finally, execute the application program: C> BYTEAPI. That's all there is to it.

Take a Mainframe to Lunch

The ways in which you can use HLLAPI are limited only by your imagination. You needn't stretch too far to see the potential of a PC database that uses HLLAPI to pass data back and forth between a mainframe database and a PC database, or a PC front end to a mainframe-based application that provides a graphical user interface, or perhaps an expert-system shell that invokes a HLLAPI program to perform mainframe problem determination and resolution without human intervention.

All kinds of things are possible. Get your SAA the inexpensive way...start today. ■

Mike Fichtelman is the systems planning officer at EAB in New York, New York. He can be reached on BIX c/o "editors."

ABC Flowcharter for Windows

"Simply the easiest way to document procedures."



ABC Flowcharter™ makes drawing and editing flowcharts easier than ever. It's loaded with features that help you make and edit charts in a fraction of the time needed with other flowcharting or drawing programs.

ABC Flowcharter's advanced link feature lets you break complicated procedures into smaller, more manageable steps. Just click on a shape to display a sub-chart or procedure. It's that easy.

Ask your dealer for a demonstration or call 1-800-227-0847 for more information. See for yourself why ABC Flowcharter is quickly becoming the standard flowcharting tool for the Fortune 1000. Retail price \$295.

Roykore™

2215 Filbert St.
San Francisco, CA 94123
415-563-9175

ADDING VALUE TO YOUR DATA

*Whatever way you choose to share data,
the process is essential*

George Bond

Data sharing is one of those phrases whose fuzziness masks the immense value of what it describes. Its meanings and uses span a wide range. Moving data from one computer to another is so central an issue that it is impossible to overstate its importance.

Data sharing can mean slipping the answers to today's quiz to the kid across the aisle in an elementary-school history class. Or it can refer to the National Oceanic and Atmospheric Administration computer's pulling weather data from sensors and broadcast gear in a satellite miles above the earth and feeding it into a network that your local TV weatherperson uses to prepare the 6 p.m. report.

In down-to-earth, real-world terms, data sharing can mean maintaining a central file of procedures and functions for use by a programming team, the pooling of mortality statistics by insurance companies, or providing a statewide master card catalog for libraries.

You can even share data with yourself by cutting and pasting between applications, doing mail merges, importing

information, or using Dynamic Data Exchange (DDE) procedures. You can share data with others through something as simple as a null modem (or a peer-to-peer, zero-slot LAN).

Despite its importance, the world of data sharing is far from robust. The lack of hardware and software standards has caused enough problems to drive many users back to their isolated PCs after ten-

tative and often unsuccessful attempts to talk with the world. Users have needlessly rekeyed millions of characters instead of having them read from a file.

Thousands and thousands of people use databases, telephone directories, and accounting systems that don't really meet their needs. They do so because it takes too much work to manually transcribe years of data from an old program

to a new and improved one. What follows is a discussion of basic ways that you can share data and of what tools are available that you can use today.

Footpower Transfers

The "sneakernet" is the simplest way to share data between one computer and another. You store data on a floppy disk in computer A, remove the disk, carry it to computer B, insert it in a disk drive, and read it. It is simple, fast, and cheap.

Of course, this method of sharing data assumes that both computers use compatible disk formats and sizes (your PS/2 will have problems reading a disk from your DEC Robin). It also assumes that the programs that generate the data are compatible (for

continued



example, WordStar 4.0 is not happy trying to digest a raw WordPerfect 5.1 file). If you experience compatibility problems, there are solutions.

When all your data is stored in ASCII, all is well on the network. Of course, not everything is stored in ASCII. PageMaker stores data one way, dBASE another, and SuperCalc a third. WordPerfect 5.1 stores its data differently than WordPerfect 4.0. An early Lotus worksheet is different from a current Lotus worksheet.

There are several ways to deal with this problem. When you're working with Microsoft Windows applications, you can use DDE to move data around automatically. Smart clipboards, such as the ones in Windows and Desqview, can handle data from diverse programs and do the necessary conversion. Many programs now have very good import/translation programs built in. Excel, for example, can read files generated by many other spreadsheet programs. Most of the major word processors can read each other's files. And dBASE formats have become a virtual lingua franca of databases.

Slide-in, Slide-out Data

The Bernoulli Box, an early, removable-media, high-capacity disk drive that was introduced a decade ago by Iomega, has become a dependable data-sharing medium. It uses removable high-capacity disks protected by a hard shell. Bernoulli Boxes are available in both 8- and 5¼-inch formats and operate with most microcomputers. The 5¼-inch drives can be mounted internally. The 8-inch drives are available with capacities of 10 megabytes and 20 MB, and the 5¼-inch units are available with 20 MB and 44 MB. A Bernoulli Box can read data recorded on any other Bernoulli Box of the same size.

Photo 1: One way to share data is with a removable hard disk system like this Sysgen 45-MB device. With a setup like this, you can snap out the disk pack, plug it into another system, and use the information somewhere else.

Removable hard disk drives are another option. These devices are like standard hard disk drives, but they come in two parts: a docking section installed in the computer, and a separate disk pack (see photo 1). You can unplug the disk portion from the docking section and plug it into another computer.

In other words, you could work on a spreadsheet all day at the office, store it on a removable hard disk drive, and, at

T
ape
storage uses recording
tape instead of floppy
disks to store or
transfer information.
The principle is
the same, but the
medium is different.

the end of the day, snap out the disk and cart it home. After dinner, you could plug it into the docking socket in your home computer and continue working. Or you could ship it across the country so your partner in Boston could check your work before submitting it to the bank to document your qualifications for a loan. Such widely known manufacturers as Plus Development, SyQuest, and Sysgen, as well as lesser-known vendors like Axonix and Mega Drive Systems, are offering removable hard disk subsystems.



Dis and DAT

Tape storage, a variant of the sneakernet, uses recording tape instead of floppy disks to store and/or transfer information. The principle is the same, but the medium is different. Tape is available in three configurations: cassette, cartridge, and open-reel.

As a computer-data medium, cassettes are unreliable and difficult to use. A caveat: If you are considering using cassettes to transfer your data, discuss your needs with someone who owned a Tandy Model I with a cassette drive.

Digital audio tape (DAT) recorders modified for data use are beginning to show up on the market. You will find them handy for backing up LANs, because they have advantages such as their capability to store more than a gigabyte of data on a cartridge about the size of a standard audiocassette.

However, DAT devices are expensive—about \$2000 and up. If all you want to do is share data, they aren't very cost-effective. But if you're interested in this technology and can justify the expense, they're available from Jasmine Technologies, GigaTrend, and Tallgrass Technologies.

Generally, traditional magnetic cartridge tapes and drives make a lot more sense. They are available in several form factors and are growing in popularity as backup devices for small-computer hard disks. These drives are relatively inexpensive and compact. You can install them internally in many PCs, saving valuable desktop space.

The cartridges themselves are inexpensive, small, and easy to store. They are available in capacities of up to 320 MB (data compression techniques are generally used to attain such higher-capacity figures). Standards for this type of cartridge have been set and adopted by the industry. They are published by the Quarter-Inch Cartridge (QIC) committee, but not by ANSI, the International Standards Organization (ISO), or any other internationally recognized standards organizations.

The granddaddy of data-tape systems is open-reel. This is a configuration, usually called "9-track," that stores data at 800, 1600, 3200, or 6250 bits per inch on a ½-inch tape in nine parallel tracks. The data is read nine tracks at a time, making data transfers very fast.

Nine-track drives are common on mainframes, and you can install them on most PCs. They are more expensive than cartridge systems, and because they use large reels, they also present storage

continued

It's easy to see why LANtastic™ PC Network sales have skyrocketed — enough for 39th in *Inc* Magazines "Inc 500".

Linking anywhere from two to 300 PCs, it lets users share disks, files, databases, programs and printers. So they zoom through their days by replacing time consuming legwork with a few simple keystrokes.



And while LANtastic was designed to turbocharge productivity, it was also designed to fit comfortably inside limited budgets. For as little as \$252* per PC — software and adapters — it delivers a hefty price-performance payload: Disk caching to boost speed. E-mail to cut paper trails. Security to stop space invaders. Audit trails to track network



activity. Multiple printer sharing. Voice mail options. Just to name a few.

So whether you run LANtastic AE-2 Ethernet adapters, LANtastic 2Mbps adapters or others, you get a tremendous amount of LAN bang for the buck.

No wonder LANtastic sales have skyrocketed making it not only an Editors' Choice but a people's choice as well.

Call 602-293-6363 and join LANtastic's growing crowd.

 ARTISOFT

Why the PC network with the smallest RAM has made us the 39th fastest growing private company in America.



Circle 217 on Reader Service Card

*Based on manufacturer's suggested retail price for a 10-computer LAN using LANtastic 2Mbps adapters. Cost is slightly higher for smaller networks. ©1990 ARTISOFT LANtastic is a trademark of Artisoft.

BERNOULLI BOXES

Iomega Corp.
1821 West 4000 South
Roy, UT 84067
(801) 778-1000
Inquiry 1079.

CARTRIDGE TAPE SYSTEMS

Colorado Microsystems
800 South Taft Ave.
Loveland, CO 80537
(303) 779-1532
Inquiry 1080.

Mountain Computer, Inc.
360 El Pueblo Rd.
Scotts Valley, CA 95066
(408) 438-6650
Inquiry 1081.

Sysgen, Inc.
556 Gibraltar Dr.
Milpitas, CA 95035
(415) 490-6770
Inquiry 1082.

COMPUTER-TO-COMPUTER DIRECT CONNECTION

Fifth Generation Systems
10049 North Reiger Rd.
Baton Rouge, LA 70809
(800) 873-4384
(504) 291-7221
Inquiry 1083.

Traveling Software, Inc.
18702 North Creek
Pkwy.
Bothell, WA 98011
(800) 662-2652
Inquiry 1084.

DAT DRIVES

GigaTrend, Inc.
2234 Rutherford Rd.
P.O. Box 4298
Carlsbad, CA 92008
(619) 931-9122
Inquiry 1085.

Tallgrass Technologies
11100 West 82nd St.
South Overland Park, KS
66214
(913) 492-6002
Inquiry 1086.

MODEMS

Eurolink Corp.
17130 Dallas Pkwy.,
Suite 160
Dallas, TX 75248
(214) 248-2931
Inquiry 1087.

Hayes Microcomputer Products, Inc.
P.O. Box 105203
Atlanta, GA 30348
(800) 635-1225
Inquiry 1088.

Microcom
500 River Ridge Dr.
Norwood, MA 02062
(800) 822-8224
(617) 551-1000
Inquiry 1089.

USRobotics, Inc.
8100 North McCormick
Blvd.
Skokie, IL 60076
(800) 342-5877
(708) 982-5010
Inquiry 1090.

ZOOM Telephonics, Inc.
207 South St.
Boston, MA 02111
(800) 631-3116
(617) 423-1072
Inquiry 1091.

9-TRACK TAPE SYSTEMS

Contech Computer Corp.
P.O. Box 153
Tarzana, CA 91356
(818) 343-6505
Inquiry 1092.

Flagstaff Engineering
1120 Kaibab Lane
Flagstaff, AZ 86001
(602) 779-3341
Inquiry 1093.

Overland Data
5600 Kearney Mesa Rd.
San Diego, CA 92111
(800) 729-8725
Inquiry 1094.

REMOVABLE DISKS

Axonix
1214 Wilmington Ave.
Salt Lake City, UT 84106
(800) 866-9797
Inquiry 1095.

Data Technology Corp.
500 Yosemite Dr.
Milpitas, CA 95035
(408) 262-7700
Inquiry 1096.

Plus Development Corp.
1778 McCarthy Blvd.
Milpitas, CA 95035
(800) 826-8022
(408) 434-6900
Inquiry 1097.

TELECOMMUNICATIONS SOFTWARE

Datastorm Technologies, Inc.
P.O. Box 1471
Columbia, MO 65205
(314) 443-3282
Inquiry 1098.

DCA/Crosstalk Communications
1000 Alderman Dr.
Alpharetta, GA 30201
(800) 241-4762
(404) 442-4000
Inquiry 1099.

Forbin Project, Inc.
P.O. Box 702
Cedar Falls, IA 50613
(319) 232-4516
Inquiry 1100.

Future Soft Engineering, Inc.
1001 South Dairy
Ashford, Suite 101
Houston, TX 77077
(713) 496-9400
Inquiry 1101.

problems. But if you need to exchange data with a wide variety of computers, 9-track may be the way to go. Most 9-track drives can read tapes written by other drives at the same density. Some 9-track vendors are Flagstaff Engineering, Overland Data, Contech, and Qualstar.

Peer-to-Peer Data Sharing

The simplest way to share data is by stringing a wire between the computers' RS-232C ports (using a "null modem"). Null modems really aren't modems at

all. They are simply cables that have some of their connector pins cross-wired. For example, pin 2 at the sending computer may be tied to pin 3 at the receiving computer. Sender pin 6 may become receiver pin 20. The actual configuration depends on the serial ports involved.

Getting two computers to talk to each other over a null modem used to be a challenge—to say the least. You had to make your own cable, configure a serial port, and write or diddle software to get

the computers to communicate. However, the advent of the laptop computer has changed all that.

The need to move information on a regular basis between portable and desktop computers created a sizable market for software and hardware to handle this job. Although such programs were designed for laptop-to-desktop connections, they also work with desktop-to-desktop connections. These programs often include hydra-headed cables that connect to just about any port on a PC,

and they are a breeze to configure.

LapLink, Brooklyn Bridge, and File Shuttle are examples of available products in this market. Some of these transfer programs have become so sophisticated that they are virtually a LAN for a pair of computers; besides doing all the error checking needed to transfer both text and binary files, they allow you to use remote printers and disks. Unlike a full-featured LAN, however, these programs operate in a master/slave configuration. When you are using a disk on the remote computer, that computer cannot be used from its keyboard.

Plugging into the World

The next step up from a null-modem connection is a real, physical modem connection. Although you lose speed with a real modem, you gain distance. Null modems have a limit of 50 to 100 feet for serial connections and about 12 feet for parallel connections.

Null-modem serial connections allow data transfers at speeds exceeding 115K bytes per second; parallel connections allow for much faster transmission. Consumer modem speeds top out at 19,200 bps. But real modem connections can span continents and oceans if necessary (as long as the modem on the receiving end is compatible with that on the sending end).

The two basic types of external modems are *acoustic-coupled* and *direct-connect*. Acoustic modems make no permanent connection with the telephone system. Instead, they use transducers that press against a telephone handset's mouthpiece and earpiece.

Acoustic couplers don't handle high data speeds well. They are mostly relics today, but they still have some valuable uses. For instance, if you're stuck in a hotel room where the telephone cable is anchored into the wall the way Excalibur was anchored into the stone, acoustic couplers are essential. A 300-bps transmission through electronic earmuffs on the phone is better than no transmission at all. And technology is changing things, as usual. For example, a new modem from Eurolink comes with an acoustic coupler that the company says supports speeds of up to 4800 bps with MNP level 5 data compression.

You can obtain both external or internal direct-connect modems. External modems have one or two phone jacks and one serial connector. You plug a phone cord into one of the jacks in the modem, and the other end into the telephone wall outlet, just as you would plug in a phone. The jacks are generally RJ-11 and accept

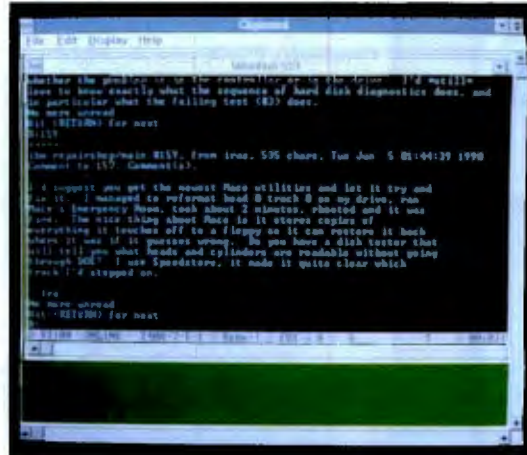


Photo 2: One way of sharing data is on a BBS. Shown here is a screen from BIX, which has several hundred different interactive conferences covering a huge variety of subjects.

a standard Bell Telephone extension cable. Often, the modem has a second jack to allow connecting a telephone to the line. Internal direct-connect modems also come as self-contained cards that fit into a bus slot and provide their own serial connection.

The slowest standard modem these days operates at 300 bps. I've seen these modems advertised for as little as \$25, and selling for \$2 to \$5 at swap meets. Unless you're on an absolutely rock-bottom budget, don't bother with them. Get at least a 1200-bps modem (\$50 to \$100) or, better yet, a 2400-bps unit (\$75 to \$200). If you need to move large amounts of data, consider 9600-bps or faster modems (\$600 and up). The 1200-bps modems are probably the most common today, but as prices fall, 2400-bps units are catching up fast.

Both the acoustic and direct-connect modems require a serial card that you can configure as a communications port on your computer. COM1 and COM2 are the most common, but you can often use COM3 and COM4 as well.

There are some amazing telecommunications software packages on the market today—public domain and shareware as well as commercial. You really have to look hard to find a bad one. You may find an interface you don't like, but the program is likely to do what it says it will do, and do it well.

Sophisticated packages like Crosstalk for Windows and DynaComm can support DDE while running in the background and can feed numeric data directly into an Excel spreadsheet. Kermit, a public domain program, can interact with everything from mainframes to microcomputers. With shareware programs (e.g., Telix, Qmodem, and Procomm) that include command languages, you can automate much of your telecommunications activity. If you choose other

software (e.g., Remote2 and Carbon Copy), you can set up one computer as a host and control it remotely from another computer. For example, you could run Remote2 on your office desktop while you travel and have access to all your files from the field.

Data telecommunications with on-line systems may be the best way to share data. No one knows for sure how many public computer BBSes exist today, but estimates for the U.S. alone begin at 6000 and go as high as 15,000. Most of these are free services run by individuals or companies.

Their content ranges from civil rights, freedom-of-the-press, and National Rifle Association gun policy support to product support. There are specialized BBSes for pilots, doctors, health-food fanciers, Buddhists, channelers and mystics, children, senior citizens, members of Alcoholics Anonymous and other 12-Step groups, and science fiction fans. You name it...there's probably a BBS group somewhere that addresses issues that interest you. Thousands of megabytes of text and program code are available for the price of a phone call.

Many commercial BBSes exist as well. Among those that provide information at moderate prices are BIX, CompuServe, GENie, Delphi, Dow Jones, and a dozen or so others (see photo 2). High-end services that cost \$25 per hour and up (e.g., Nexis and Dialog) provide specialized information on demand. This may be the ultimate in data sharing. When you use one of these services, you literally have the collected wisdom of the world sitting in data banks waiting for you to drop by and collect it. ■

George Bond is a communications consultant with more than 20 years' experience and a cofounder of BIX. You can reach him on BIX as "gbond."

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



662 Wolf Ledges Parkway
Akron, OH 44311

PC-AT is a trademark of IBM Corporation.

Eight Serial Ports One Board

Quatech's ES-100 provides eight RS/232 serial ports in a single AT slot. RJ-11 modular connectors. 16450 UARTS are standard. Optional buffered 16550 UARTS. PC-AT, ISA, or EISA compatible. Priced below \$500! Quantity Pricing Available!

Call for our PC Interface Handbook:
1-800-553-1170



662 Wolf Ledges Parkway
Akron, OH 44311

PC-AT is a trademark or
registered trademark of IBM Corp.

RS-422/RS-485 Boards for AT, Micro Channel

RS-422/RS-485 asynchronous serial communication boards from Quatech! 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



662 Wolf Ledges Parkway
Akron, OH 44311

PC-AT, Micro Channel, and PS/2 are trademarks or registered trademarks of IBM Corp.

Circle 240 on Reader Service Card

Circle 241 on Reader Service Card

Circle 242 on Reader Service Card

Synchronous Communication Boards for AT

Quatech 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



662 Wolf Ledges Parkway
Akron, OH 44311

PC-AT and PC are registered
trademarks of IBM Corp.

Communications Data Acquisition



"PC-AT (ISA) Interfaces"



"PS/2 Micro Channel Interfaces"



Phone: (216) 434-3154 • FAX: (216) 434-1409
TELEX: 510-101-2726

PC-AT, PS/2 and Micro Channel are
registered trademarks of IBM Corporation.

Digital I/O Board

Single-slot Quatech 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



662 Wolf Ledges Parkway
Akron, OH 44311

LabTech Notebook is a trademark of
Laboratories Technologies Corp.

Circle 243 on Reader Service Card

Circle 244 on Reader Service Card

Circle 245 on Reader Service Card

Joystick Adapter for PS/2

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



662 Wolf Ledges Parkway
Akron, OH 44311

IBM, Micro Channel, PS/2, PC-XT, AT,
and Game Control Adapter are trademarks
or registered trademarks of IBM Corp.

2 parallel, 2 serial, 1 board

Quatech DSDP-402 for PC-AT has two parallel ports, and two serial ports for any combination of RS-232, 422, and 485 communication. DSDP-100, two parallel and two RS-232 ports, available at lower cost.

For order info, call:
1-800-553-1170



662 Wolf Ledges Parkway
Akron, OH 44311

Wave Form 20MHz - 32K \$1290

The WSB-100 Wave Form Synthesizer Board from Quatech has the best set of numbers in the market. With speed to 20MHz and a 32K memory at \$1290, it's making waves in more ways than one. The WSB-100 is also a star performer as a digital pulse/word generator with the optional digital module.

Call for our free
PC Interface Handbook:
1-800-553-1170



662 Wolf Ledges Parkway
Akron, OH 44311

Circle 246 on Reader Service Card

Circle 247 on Reader Service Card

Circle 248 on Reader Service Card

BYTE

PRODUCT SHOWCASE

■ BUYER'S MART

■ BYTE BITS

■ PRODUCT SPOTS

■ MICRO PRODUCT CENTER

■ CATALOG SHOWCASE



THE BUYER'S MART

A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

Effective January 1, 1990.

RATES: 1x—\$590 3x—\$550 6x—\$525 12x—\$475 24x—\$450

Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must

furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Brian Higgins at 603-924-3754.

ACCESSORIES

RADIOACTIVE?

Plot it on your PC with THE RM-60 RADIATION MONITOR. Serial or printer port. Detects: ALPHA • BETA • GAMMA • X-RAY. MicroR: 1000 times the resolution of standard geiger counters. Excellent for tracking RADON GAS. Find sources. Plot: • Background • Cosmic Rays • Clouds • Foods. Call/Write for PC MAGAZINE review • TSR • GM Tube. VISA/MASTER Phone orders. Not satisfied? Full refund.

Tel: (302) 655-3800

Aware Electronics Corp.

P.O. Box 4299, Wilmington, DE 19807 \$149.50

Inquiry 701.

ACCESSORIES

DOZENS USEFUL PROGRAMS

IBM compatible, In ASCII, 5 1/4 disk, practical • educational. **CATEGORY FINANCIAL:** Prog's for wages, retirement pay, invest/mortg's, taxes, buy vs lease, inflation, etc. **CATEGORY PRINT:** Filesort/find/print addresses in diff ways, forms-tables, printer control & capability, etc. **CATEGORY GRAPHICS:** Little green men run/g over screen, filing • retrieving pictures, xy-drawing & grids, etc. \$29 for 1 category, \$39 for 2, \$49 for all 3 (\$52 prog) Cheque/M.O./M.C. (number • expiry date) — Catalog \$2

L G M SYSTEMS

P-Box 983, Guelph, Ont. Canada N1H 6N1 (519) 821-6344

Inquiry 706.

BAR CODE

LABELING SOFTWARE

On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 18 text sizes to 3" readable at 100'. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39. File Input & Scanned logos/symbols (PCX)—\$279. Other programs from \$49. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St. Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

BIG SAVINGS ON RIBBONS!

Get 50 better-than-new ribbons for each one you buy with our new Wet Ribbon Re-inker. Easy to use. Fits most cartridges. Printer safe. Satisfaction Guaranteed.

SPECIAL OFFER! CALL TODAY!

BLUE RIBBON INK, LTD.

3773 Cherry Creek North Drive, Suite 500
Denver, CO 80209

(800) 477-3465 (303) 377-4695

Inquiry 702.

HEWLETT PACKARD

Buy — Sell — Trade

Laser Jet II/III Color Pro (7640)
Genuine HP 2 Mag/4 Mag HP-7550A
Desk Jet Draft Pro DXL/EXL
Rugged Writer Draftmaster III
Electrostatic Plotters C1600 (D Size)/C1601 (E Size)
Science Accessories Corporation Sonic Digitizers
36" x 48" (2750) 60" x 72" (3175)

T. E. Dasher & Associates

4117 Second Ave S., Birmingham, AL 35222
Phone: (205) 591-4747 Fax: (205) 591-1108
(800) 638-4833

Inquiry 707.

BAR CODE READERS

For PC, XT, AT, & PS/2, Macintosh, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—\$399. Top rated in independent reviews. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St. Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

CUT RIBBON COSTS!

Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one inker! For crisp, black professional print since 1982. You can choose from 3 models: Manual E-Zee Inker — \$39.50
Electric E-Zee Inker — \$94.50
Ink Master (Electric) — \$189.00
1000s of satisfied users. Money-back guarantee.

BORG INDUSTRIES

525 MAIN ST., JANESVILLE, IA 50647

1-800-553-2404 In IA: 319-987-2976

Inquiry 703.

ARTIFICIAL INTELLIGENCE

NeuralWorks Explorer

NeuralWorks Explorer is a neural net tutorial that provides the novice user with a method of learning neural net theory as well as an environment in which to build practical real time applications such as targeted marketing, stock prediction, process control and more. PC and MAC. Price \$199. Visa/MC accepted.

NeuralWare, Inc.

412-787-8222

Inquiry 708.

PORTABLE READER

Battery-operated, handheld reader with 64K static RAM. 2x16 LCD display. 32-key keyboard. Real-Time-Clock. Wand or laser scanner. Program prompts and data checking through its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Doubles as On-Line Reader. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St. Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

80C31 DEVELOPMENT BOARD

Space for 32k EPROM, 2k SRAM, 8 Bit Latched Outputs, RS232 Serial Port, 12 I/O Lines, 5V Only, All CMOS. USE FOR DEVELOPMENT OF ALL MICROCONTROLLER-BASED PROJECTS. Currently used as the controller for the following plug-on boards: Keyboard & LCD Interface, Serial Cartridge Storage Module, Thermal Label Printer, Dot Matrix Label Printer, Serial Data Converter, Remote Scoreboard, and many more! JUST \$109 with EPROM or \$99 Without EPROM

CUSTOM FIRMWARE AVAILABLE

COMPUTER ADVICE

515 Calle San Pablo, Camarillo, CA 93012

805-482-2002 FAX: 805-389-3679

Inquiry 704.

muLISP® 87 for MS-DOS

Fast, compact, efficient LISP programming environment. muLISP programs run 2 to 3 times faster & take 1/2 to 1/3 the space of other LISP's. 450 Common LISP functions, multi-window editing & debugging, flavors, graphics primitives, lessons & help, demo programs, comprehensive manual.

Soft Warehouse, Inc.

3615 Harding Ave., Suite 505, Honolulu, HI 96816
(808) 734-5801

Inquiry 709.

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

417-A Ingalls St. Santa Cruz, CA 95060
(408) 458-9938 (800) 345-4220

COMPANION AND EXTENDER

Place a keyboard and monitor up to 600' from your CPU with EXTENDER and COMPANION products. Keep a second Keyboard/Monitor at the CPU with COMPANION. Supports MDA, CGA, EGA, VGA, PS2. Uses single 1/2" cable.

Prices start at \$149.00 for EXTENDER and \$219.00 for COMPANION 25 ft. unit complete.

CYBEX CORPORATION

2800-H Bob Wallace, Huntsville, AL 35805

205-534-0011 International Fax #205-534-0010
See our ad on page 130

Inquiry 705.

The Knowledge Engine:

Hypermedia for the rest of us!

The Knowledge Engine is an icon-driven, object-oriented hypermedia program for MS-DOS computers. Much more than a HyperCard clone, The Knowledge Engine allows even non-programmers to create breathtakingly powerful hypermedia applications simply by "pointing and clicking." Features include: full graphics support for CGA, EGA, VGA, Super VGA, and 8514A; PCX file support; memory-resident graphics snapshot program; graphics painter; animation editor; powerful programming language; and much more. A runtime library allows The Knowledge Engine to be embedded into Microsoft and Turbo C programs. Only \$495 for MS-DOS. Versions also available for UNIX and AS400. Demo disk \$25.

Software Artistry, Inc.

3500 DePauw Blvd., Suite 1100, Indianapolis, IN 46268
Phone: (317) 878-3042 Fax: (317) 876-3258

Inquiry 710.

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

2190 A Regal Parkway, Eubank, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

THE BUYER'S MART

BAR CODE

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 SOFTFOITS

AMERICAN MICROSYSTEMS

2190 A Regal Parkway, Eubank, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

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

Inquiry 711.

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 712.

LabelSoft®

LABELING & BARCODING SOFTWARE

- WYSIWYG label design • scalable font • Eight popular barcodes, variable densities, ratios, heights
- Imports/exports data; includes built-in data base • Menu-driven batch creation/printing • Lines, reverse, rotation, increments • Dot matrix, laser, thermal printers • PC's & compatibles • \$259 and up

PERRYSBURG SOFTWARE CORPORATION

P.O. Box 748, Perrysburg, Ohio 43551
Phone (419) 874-8502 Fax (419) 874-9313

Inquiry 713.

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost-effective data entry. They emulate your keyboard, so scanned data looks just like it was typed in! Choose from stainless steel wand, laser gun, card slot reader, and magnetic stripe scanner. Also, powerful Bar Code and Text printing software. Great warranty. Generous dealer discounts.

Seagull Scientific Systems

15127 N.E. 24th, Suite 333, Redmond, WA 98052
206-451-8966

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 95051/(408) 980-1880
800-666-4BAR FAX: (415) 623-1372

Inquiry 714.

BASIC CLIP MUSIC

300 Songs & Sounds + 180 Pg. Book

Besides being a fun jukebox, *The ENTER-tainer* teaches DOS, BASIC, bar file & display tricks. Many exciting musical projects! It's geared for beginners, yet teaches pros how to run music behind QB or C apps. Source code, no royalties. Money-back guarantee. 3.5" or two 5.25" disks. Needs BASIC 2.0 or later. \$29.95 + \$3.50 s&h (Europe, Canada & Mexico s/h=\$7, others=\$11, 1st class air) For fast VISA/MC orders - call

(800) 727-4140 Price soon going up to \$45!

PDI Music Software, 1511 48th St., Boulder, CO 80303 (303) 440-4140

Inquiry 715.

BRAILLE

BRAILLE PUBLISHING

Whether you have occasional word-processed memos or full-length textbooks, a Duxbury Translator enables conversion to properly contracted and formatted braille. The choice of professional publishers worldwide since 1975, Duxbury software for MSDOS, Macintosh, Unix and other systems supports: English Braille and Computer Braille (bidirectionally), Textbook Format, French, Spanish, Arabic, and others.

Duxbury Systems, Inc.

435 King St., P.O. Box 1504, Littleton, MA 01460 USA
508-486-9766

Inquiry 716.

BUSINESS OPPORTUNITIES

PRIME SPACE SOUTHERN NH

- 50% Below current market includes HEAT & TAXES
- AIR CONDITIONED • AMPLE PARKING • up to 46,000 S/F on floor • upgraded building (floor now occupied by SCI) • Ideal for LT MFG/Distribution Center
- Has 10,000 S/F Finished Executive Offices • Loading Docks, High Ceilings • Great Central Location

ONE DOW COURT, INC. MANCHESTER, N.H.

(603) 625-8933 (603) 625-8337

Inquiry 717.

FREE \$\$\$

There's no such thing but if you want to work at home a minimum of 9 hrs per week, own a computer and printer, the public needs you. \$695 investment that can make \$300 first week part-time, \$800+ full time GUARANTEED. Our national organization offers an enjoyable lifetime career with great repeat business. No selling, travel or exp. req.

FAMILY SERVICES

1406 E. 14th St., Des Moines, Iowa 50316
1-800-288-7437

Inquiry 718.

CABLE CONVERTERS

Cable TV Converters

Attention Cable Viewers

Jerrold, Zenith, Oak, Hamlin, Scientific Atlantic, Tocom, and many others.

BEST PRICES!! • 1-800-826-7623

Visa, American Express, MasterCard

B&B INC., 4030 Beau-D-Rue Dr., Eagan, MN 55122

Inquiry 719.

CAD

Electro-CAD \$99

Designed specifically for schematics and double-sided board layouts, Electro-CAD produces high quality board images on standard dot-matrix printers up to 11 by 15 inches. Virtually instantaneous screen updates, rubber-banding, user definable images, and many other features make Electro-CAD the best tool for the job or your money back.

Call us for more information and fast delivery

AEROUX Engineering

32 West Annapamu Suite 228, Santa Barbara, CA 93101
(805) 662-9655

Inquiry 720.

CAD/CAM

P-C-B ARTWORK MADE EASY!

Create and Revise Printed-Circuit-Artwork on your IBM or Compatible

- Menu Driven • Supports Mice
- Laser Printer Artwork • Libraries

Requirements: IBM or Compatible PC, 384K RAM, DOS 3.0 or later
LAYOUT • AUTO-ROUTER • SCHEMATIC
\$99.00 ea DEMO PKG \$10.00

PCBoards

2110 14th Ave South, Birmingham, AL 35205
(205) 933-1122

Inquiry 721.

CD-ROM

CD ROM PLAYERS FOR AS LOW AS \$499.00

Alde offers Chinon player, cable, card, and DOS extensions bundled with a disc at lowest prices. Alde carries a complete line of CDROM titles. Write, call or fax for complete product information.

ALDE PUBLISHING INC.

Box 1190, Glen Lake, MN 55345
800/727-9724 (Voc) 612/934-2824 (Fax)

Inquiry 722.

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 723.

CD ROM, Inc.

CD-ROM, WORM, MAGNETO-OPTICAL DRIVES, CD-ROM DISCS
FOR IBM AND MAC, OPTICAL CONSULTING SERVICES

- PUBLISHING • DISTRIBUTION • NETWORKING
- QUALITY PRODUCTS AND SERVICES AT COMPETITIVE PRICES
FREE CATALOG

TEL. 303-231-9373

1667 COLE BLVD., SUITE 400, GOLDEN, CO 80401
FAX: 303-231-9581, CIS: 72007,544
VISA/MC/AMEX/GOV T. PGs

Inquiry 724.

BIRDS COME TO LIFE

Listen & feel Audubon's *Birds of America* come to life. Full color lithographs, detailed descriptions, and now sound. Imagine... hearing birds as you see them. Now available on CD-ROM, for only \$99. Sherlock Holmes, Shakespeare & medical journal titles available, both PC & Macintosh versions. Software licensing for CD-ROM publishers. Call today.

CMC ReSearch, Inc.

7150 SW Hampton #120, Portland, OR 97223
800/262-7668

Inquiry 725.

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 726.

THE BUYER'S MART

CD-ROM

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.

3933 Spicewood Springs Rd., E-100, Austin, TX 78759
512-346-7887

Inquiry 727.

COMMUNICATIONS

C COMMUNICATIONS TOOLS!

Don't spend months developing and debugging the communications part of your application. *C Communications Toolkit* makes it fast and easy!
XMODEM, XMODEM-1k, YMODEM, YMODEM-g, Kermit, VT100, VT52, ANSI, FAX support, flow control and lots more.
Full source, 99.9% C. 600-page manual.
ONLY \$149.95

Magna Carta Software, Inc.

P.O. Box 475594, Garland, TX 75047
TEL (214) 226-6909 FAX: (214) 226-3086 BBS: (214) 226-8088

Inquiry 728.

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 729.

COMPUTER INSURANCE

INSURES YOUR COMPUTER

SAFWARE 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 730.

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 28Mb Mitsubishi disk drive, choice of 1.2 or 1.44Mb 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 731.

GET RESULTS

Advertise your computer products in
THE BUYER'S MART

Call Brian Higgins
for more information

603-924-3754

Inquiry 732.

CROSS ASSEMBLERS

CROSS ASSEMBLERS/SIMULATORS

New unique full-function simulators for the 8096 and 80C196 controllers, featuring ALL MODES of interrupts, plus the HSI, HSO, and A/D functions.

We also support the 80484/9, 8080/85, 8051/52, and Z80 controllers with excellent, reasonably priced Cross Assemblers and Simulators

Lear Com Company

2440 Kipling St., Ste 206, Lakewood, CO 80215
(303) 232-2226 FAX: (303) 232-8721

Inquiry 733.

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 734.

CROSS DISASSEMBLERS

PROFESSIONAL PC SOFTWARE

• CROSS-DISASSEMBLERS

Analysic Automatic Label Generation

• CROSS-ASSEMBLERS

Relocatable, Macro, Universal Linker • Librarian

• C CROSS COMPILERS

• SOURCE TRANSLATION UTILITIES

Support for Intel, Motorola, Zilog, TI, RCA

Order Today: (408) 773-8465

LOGISOFT

P.O. Box 61929, Sunnyvale, CA 94066
FAX: (408) 773-8466

Inquiry 735.

DATA CONVERSION

CONVERTING YOUR DISKETTES? ENTRUST THEM TO US!

2500 Word Processor & Computer formats, 3 1/4", 5 1/4", 8" Disk, Mag Tapes, Mag Cards, Cartridges & Cassettes, Custom Conversions, Programming & Applications Development

DISK DUPLICATION

OCR SCANNING SERVICES

HIGH VOLUME LASER PRINTING

Call us for Quality, Best Prices and Quickest Turnaround Time

COMPANY COMPENDIA, INC., 55 E. Washington St., #237, Chicago, IL 60602 TEL 312-418-8771 FAX 312-418-1390

Inquiry 736.

DATA RECOVERY

CRASHED?

Your valuable data can be recovered!

• 95% success rate • Fast turnaround

• Servicing Novell, DOS, Macintosh, Unix, Xenix, OS/2, Bernoulli and more!

ONTRACK DATA RECOVERY, INC.

Keeping you in business is our business

1-800-872-2599

Inquiry 737.

DATA/DISK CONVERSION

BILLIONS OF BITS CONVERTED!

Disk Interchange Service Company specializes in transferring files between incompatible computers. Our direct disk-to-disk conversion service is fast, efficient, and cost effective.

Disk Interchange Service Company

2 Park Drive • Westford, MA 01886 (508) 692-0050

Inquiry 738.

DATA/DISK CONVERSION

QUALITY CONVERSIONS

to or from virtually

ANY TAPE OR DISK FORMAT!

Horan Data Services converts over 2000 formats incl. 9-track tape, 3480 Cartridge and 8", 5 1/4" or 3 1/2" diskettes. All densities & most operating systems supported. Formats include EBCDIC, ASCII, databases, spreadsheets, and dedicated or PC word processors.

Call 1-800-677-8885

Hours 8:00 AM to 5:30 PM Eastern Time
817 Main Street, Third Floor, Cincinnati OH 45202

Inquiry 739.

IBM PC ◀ TO ▶ HP FILE COPY FASTER EASIER TO USE

Update version uses windows: Call for free demo! IBM PC <10> 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 740.

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) Convert

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) 448-0313 Fax (403) 448-0315

Inquiry 741.

DISASSEMBLERS

80x86 .EXE/.COM to .ASM

• Accurately reconstruct, study & modify [84K+] 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 file. Commented BIOS calls/DOS functions. SEGMENT/PROC/other vital pseudo-ops

PC-DISnDATA (5 1/4" disk & manual) \$165

PRO/AM SOFTWARE

220 Carigan Road, Centerville, OH 45459
(513) 435-4480 (9 A.M.-5 P.M. EST M-F)

Inquiry 742.

NO Source? ... NO Problem for DISDOC PROFESSIONAL

Automatically Disassembles EXE, COM, BIN, SYS, PGM files and ROM or RAM memory with interactive ability to change code, data or comments online. Disassembles 8086 to 80486 with no file size restrictions. Built in utility program EXE Unpacker, for unpacking packed files and BIO's Admission for disassembling BIOS's are included.

To order call (800) 336-1981 or into (203) 953-0238

Or write:

RJSWANTEK INC.

178 Brookside Rd., Newington, CT 06111

* Only \$249.95

MC/VISA accepted

Inquiry 743.

THE BUYER'S MART

DISK DRIVES

BEST BUY!!!

HD Kits for AT: Drive, Controller, Ribs & Cables

40MB - MFM	- \$ 339
85MB - RLL	- 459
80MB - MFM	- 689
150MB - ESDI	- 1099

NEW, ONE YEAR WARRANTY

jb TECHNOLOGIES, INC.

5105 Maureen Lane, Moorpark, CA 93021

(805) 529-0908 Fax (805) 529-7712

Inquiry 744.

FAX COMMUNICATIONS

FaxReply™

FaxReply is a 24-hour automatic telephone fax document retrieval system for your PC. Callers are guided to desired information using touch tone entries in response to voice prompts. After entering in their fax phone number and making selections, FaxReply will dial and deliver the requested information immediately or during any time frame you specify. Access can be password protected and the number of documents limited if desired. System messages can be re-recorded in your own voice and language. Call us regarding other fax applications. To order, hear demo, or to request more information call

(614) 870-3838

Versicom Communications®

1115 Wimbeldon Boulevard, Columbus OH 43228

Inquiry 750.

HARD DRIVE REPAIR

HARD DISC DRIVES

Sales • EXCHANGE • Repair

Trade in your defective drive for NEW, with FULL WARRANTY!

TREMENDOUS SAVINGS!

TECHNICAL SUPPORT OF COURSE!

Large Inventory Hard and Floppy Drives

jb TECHNOLOGIES, INC.

5105 Maureen Lane, Moorpark, CA 93021

(805) 529-0908 Fax (805) 529-7712

Inquiry 756.

FLOW CHARTS

WINDOWS FLOWCHARTER

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) 683-5767 FAX: (303) 689-4889

Inquiry 751.

DATA RECOVERY

SALES of new, remanufactured and removable disk drives

FULL TECHNICAL SUPPORT

ROTATING MEMORY SERVICE

1508 Dell Avenue, Campbell, CA 95008

(408) 370-3113

Inquiry 757.

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 746.

GRAPHICS

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 752.

HARDWARE

FREE CATALOG

Protect your computer power from black-outs, brown-outs, audio/video hash and surges! Complete line of low-cost Emergency Power Supply units, Line Conditioners and Surge Suppressors prevent damage and loss of valuable data. Prevent errors, malfunctions and false printouts! Send for money-saving catalog today

INDUS-TOOL

730 W. Lake St., Chicago, IL 60606

Phone 312-648-2191

Inquiry 758.

ENTERTAINMENT

WHERE ADULTS COME TO PLAY! ACCESS LA! BBS

• Designed for Adult modem users • Low cost local access numbers covering 850 cities! • Live online chat with other users! • Large software file library! • "Bulletin board" style Forum! • Interactive online games! • Matchmaker dating database! • And much, much more 24 hours a day! We also can provide your company with national BBS services. Call (818) 358-0938 for details!

Information and Signup By Modem

(818) 358-6968 (312/24 Baud, 8/NH, Must be over 18) Voice Information (818) 357-9570

Inquiry 747.

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. \$35.00 Postpaid. Call or write for free catalog.

LINDLEY SYSTEMS

4257 Berwick Place, Woodbridge, VA 22192-5119

(703) 590-8890

Inquiry 753.

FREE INTERFACE CATALOG

Interfaces for IBM compatibles. Digital I/O (8255) and Analog input 8 bit resolution (0-255). Control relays, motors, lights, measure temperature, voltage. Sample interconnect circuits, BASIC programs, and I/O map are included.

John Bell Engineering, Inc.

400 Oxford Way, Belmont, CA 94002

(415) 592-8411 9am to 4pm Pacific Time

Inquiry 759.

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]

Chaos Manor 1990 User's Choice Award

BYTE 4/90, p 62

Toyogo, Inc. The Leader in Computer Go.

PO Box 6, Dept. Y, Kanoeche, HI 96744

(808) 254-1166 or 1-800-TOYOGO-9

Inquiry 748.

IMAGE CAPTURE BOARD

Capture images from any VCR or Camcorder. Resolution up to 512 x 480 pixels, 65,536 colors or 256 shades of grey. Images saved in GIF, PCX, TIFF formats and more. For XT/AT/PS2. Includes user friendly software and user's guide. One year warranty. VGA required. Can capture from live video (eliminates need for expensive digital video). Ideal for Desktop publishing, CAD, Animation, and Pictorial Databases.

\$749

VISA/MC/AMEX/C.O.D.

PEGA Micrographics

PO Box 713, Westerville, OH 43081, (614) 885-1007

1-800-477-PEGA

Inquiry 754.

HARD DRIVE REPAIR

Beat the cost of replacement!

10% Off Discount **REPAIR** Coupon 10% Off

HARD DISC AND FLOPPY DRIVES

FULL WARRANTY PROTECTION

Fast Turnaround • Data Recovery

jb TECHNOLOGIES, INC.

5105 Maureen Lane, Moorpark, CA 93021

(805) 529-0908 Fax (805) 529-7712

Inquiry 755.

HARDWARE COMPUTERS

EMBEDDED SYSTEMS COMPUTERS

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 real-time 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 SC81 I/O Plug-on board for PCS or SBC with SCSI, floppy, 56K baud serial, 16-bit parallel ports, and software drivers. Forth s/w included. C also available. Ideal for embedded real-time control, data acquisition, robotics, and signal processing.

SILICON COMPOSERS INC. (415) 322-8783

208 California Avenue, Palo Alto, CA 94306

Inquiry 761.

Win \$10,000 CASH Prize

In WORDLOK Puzzle Contest!

Each contestant's goal is to obtain the highest scoring word puzzle solutions. Easy-to-use solution software for IBM/compatibles is provided free of charge to all entrants. Winner receives \$10,000 Cash Prize!

Virtual Solutions, Inc.

4925 University Dr NW, Suite 179-211, Dept. 1a

Huntsville, AL 35816

Inquiry 749.

THE BUYER'S MART

HARDWARE/COPROCESSOR

DSP32C PC/AT COPROCESSOR BOARD

- 25 MFLOP 32 bit Floating point DSP:
- High speed NUMERICS and GRAPHICS
 - 640K DUAL PORTED on-board memory
 - 32 bit parallel and serial I/O headers
 - 15 ms 1024 point FFT from high level C
 - Assembler, monitor, and math libraries
- Base board and ALL software \$950, 640K \$300

SYMMETRIC RESEARCH

15 Central Way #9, Kirkland, WA 98033
(206) 828-6560

Inquiry 762.

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 763.

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 764.

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, Round Brook, NJ 08805

Phone: 201-469-7678 (Fax: 201-469-7544)

Hours: 9am/10pm 7 days Worldwide sales

Inquiry 765.

New Laptop Products for:

- Palmtops: Atari Portfolio, Pocket
Notebooks: Compaq LTE, NEC-UL, Tandy 100/102,
Tandy 1100, TI-M12, Toshiba SE/XE, Zenith-MS
PC-Laptops: All major brands and models

Accessories: Auto Adapters, Batteries, Carry Cases, Keypads,
Peripherals: Portable Printers, Hard Disks, 360K/1.2M Drives,
Keyboard Covers, Modems, Barcode Wands, Laptop Software, etc.

For a free newsletter & catalogue, please call or write:

ULTRASOFT INNOVATIONS INC.

1 Transborder Drive, PO Box 247, Champlain, NY 12919
Tel: (514) 487-9293 Fax: (514) 487-9295 9-8 EST
Canadian Orders & Dealer Inquiries are Welcome

Inquiry 766.

LAPTOP PERIPHERALS

TOSHIBA LAPTOP ENHANCEMENTS

FAX/MODEMS: 9600/2400 bps, software, acoustic port
MODEMS, INTERNAL: 2400 bps, acoustic or serial port
MODEM, DEDICATED: 2400 bps (T1200, T1600, T3200SX)
SERIAL I/O CARDS: RS232, RS422, SCSI, HPIL, Barcode
BATTERY PACKS: 12V external battery + vehicle adapter

Contact us for more information:

PRODUCT R&D Corporation (Call).

805/546-9713, Fax: 805/546-9716

Inquiry 767.

228 Fall 1990 • B Y T E IBM Special Edition

MEMORY BOARDS

S.S.T. MEMORY UPGRADES

IBM PS/2

2MB module—Model 50, 70 \$230

2-8MB expan bds—Model 55, 70 \$520

COMPAQ

4MB module—DESKPRO 386/20E, 25, S \$460

4MB expan brd—DESKPRO 386/20E, 25, S \$540

8MB single slot module—SYSTEMPRO \$1600

H P LASER JET

2MB upgrades \$229

1-800-688-8993 5 YR. WARRANTY

Inquiry 768.

MEMORY CHIPS

PRICE MEETING & BEATING!

GRAMS

64K x 1-12, 10

64K x 4-80

256K x 1-15, 12, 10, 80, 70, 60

256K x 4-80

1MEG x 1-10, 80, 70, 60

INTELCYRIX/IT MATH CO'S

60287-8, 10

80387-SX, 16, 20, 25, 33

CALL DRAM COMPANY (800) 488-DRAM

PO Box 590127 • S.F., CA 94159 (415) 398-2987

SIMMS/SIPPS

256K x 9-10, 80, 70, 60

1MEG x 8-10, 80, 70, 60

1MEG x 9-10, 80, 70, 60

4MEG x 8-80

4MEG x 9-80

PS/2 TYPE SIMMS

Model: 30 288

Model: 50, 55, 60, 70, 80

Inquiry 769.

MOUSE DRIVES

MOUSE DRIVERS

We have developed great new inexpensive Menuing and Mouse Drivers for Lotus 1-2-3 2.01 & 2.2, WordPerfect 5.0 & 4.2, dBASE III+ & IV, WordStar 5.0, 5.5, & 6.0, Turbo C & Pascal, PlanPerfect 5.0 and MultiMate Advan. II. Others to follow shortly. All are simple-to-use and make traversing your application a snap! Each driver is \$40.00. Call or send your order to:

Mostly Mice Software, Inc.

125 Gates Ave., Montclair, NJ 07042

1-800-926-6873 (1-800-92 MOUSE)

Inquiry 770.

MULTILINGUAL APPLICATIONS

DTP/WP/Forms and Sign Making

Apple MAC & IBM PC Available languages: Russian, E. European, Turkish, Greek & Indian. It's a DA on MAC, works with virtually any application program. It's a TSR on PC, for GEM based graphical WP, PoFORM & Ventura in WYSIWYG. Keyboard remapping utility. Postscript, dot matrix, deskjet & laserjet fonts. Vinyl cutting sys. for sign making for any of the languages. Prices start at \$250, demo \$25. MCV/vis

Solustan, Inc.

378 Hillside Ave., Needham MA 02194

Ph: 617-449-7886 Fax: 617-449-7750

Inquiry 771.

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! Certified by Intel and Micro Devices

Free Brochure: 916/477-7481
California Scientific Software

Inquiry 772.

PROGRAMMERS' TOOLS

HYPERINTERFACE™ II

Menu Creator™ — An interactive WYSIWYG editor to generate a menu-driven user interface for your software
Screen Creator™ — An interactive WYSIWYG editor for quick and easy screen design and a screen database manager for your software
Advanced Library — Extended capability for data entry for your programs. FORTRAN, Pascal, C, BASIC supported.

Avanpro Corp.

PO Box 969, Pacific Palisades, CA 90272

(213) 454-3866

Inquiry 773.

PROGRAMMERS' TOOLS

WINDOWS TEXT EDITOR

SPEEDIT is a professional level text editor available for Windows 3.0, PM & XWindows as a true windows application. Also DOS, OS/2, UNIX & MPE character versions. Includes user customization, DDE, regular expressions, language sensitivity, keyboard macros, multiple file access; compilation & testing from within.

BRADFORD BUSINESS SYSTEMS, INC.

23151 Verdugo Drive, Suite 114, Laguna Hills, CA 92653
TEL (714) 859-4428 FAX (714) 859-4508

Inquiry 774.

PD/Shareware Libraries

Massive collections of files for PC professionals only: 66 disk Dbase language, 17 disk AutoCAD \$99.50 44 disk Ventura/DTF \$79.50 31 disk C, 23 disk TPascal, 17 disk 123, 14 disk ASM, 30 disk WordPerfect, 24 disk Novell, 26 disk DOS, 35 disk games, Windows \$49.50 Indexed with search program and ZIPed to minimize disk count. 30 day money back guarantee.

EMS

(301) 924-3594

4505 Buckhurst Ct.
Olney, MD 20832 USA

Fax: (301) 963-2708

Inquiry 775.

Bsupport for Btrieve®

The "Norton Utilities" for Btrieve users
Bedit: DISPLAY, UPDATE, COPY, and DELETE
EXPORT SDF to dBASE & LOTUS RECOVER damaged files
Edit/Insert using Data Dictionary
Bbug: TSR Btrieve debugger. Displays info in pop-up window.
Brun: BUTIL replacement with Run-Time and C source
Bedit/Bbug: \$120 Brun: \$150 VISA/MC/COD/PO

800/359-2721 FAX: 517/887-2366

Information Architects, Inc.

PO Box 4184, East Lansing, MI 48826-4184

Inquiry 776.

For QuickBasic programmers

SMART^{menu} plus SMARTOOLS cuts your development time by more than 60% by giving you an integrated user interface that easily configures to your applications. Dialogues boxes, pop-up & pull-down menus, as well as "fill the form" type entries. For QB 4.0 or later. Libraries, tools & manual are \$99 + S&H.

KALTEK

PO Box 2166, Martinez, CA 94553 (415) 370-1920

Inquiry 777.

Dazzle Your Users...

by including a full-featured pop-up calculator with memory, a 100-line scrollable tape and more in your application. Takes minutes and costs as little as \$395 with no royalties. Demo disk and manual \$5.00. Specify language.

Liaison Systems, Inc.

PO Box 82720, Kentmore, WA 98028

(206) 486-4996 — 30-day money back guarantee

Inquiry 778.

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 779.

THE BUYER'S MART

PROGRAMMERS' TOOLS

SPEED FORTRAN DEVELOPMENT AND CUT MAINTENANCE COSTS

FORTRAN—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.

3340 Marble Terrace, Colorado Springs, CO 80906
(719) 527-1384

Inquiry 780.

PUBLIC DOMAIN

15 FULL DISKS — FREE SOFTWARE FOR IBM COMPUTERS

TRY US! 15 5 1/4" or 8 3/4" disks full of our best sellers—FREE! Games, Business, Education, Graphics, Utilities, Finance, Desktop publishing, more.

PAY ONLY \$5.00 FOR SHIPPING SATISFACTION GUARANTEED!

INTERNATIONAL SOFTWARE LIBRARY ORDER TODAY — CALL

since 1985 (619) 942-9998
Visa & MasterCard accepted

Inquiry 781.

325 MEGABYTES Virus Free Share Ware

Desktop/Systems/Educators. Instant IBM Shareware Library for your Customers, use group or Students. Distributed in 25 Megabyte increments on HD 1.2M 4 diskettes. \$39.00 for first 25 Megabytes then add \$40.00 for each 25 Megabyte increment.

Add \$3.00 postage for each 25 Megabyte increment.
Add \$4.00/25 Meg increment for 1.44 diskettes.
Orders Only: 1-800-876-8496
Info/Tech: 1-405-524-5233

SHARE-NET

POB 12388, Okla City, OK 73157

No Surcharge for Visa/MasterCard
We gladly accept PO's from Educational/Fed/State Agencies.

Inquiry 782.

\$\$ SAVE YOUR CASH \$\$ AAA RATED IBM SHAREWARE

FREE 150+ PAGE DISK CATALOG
FREE 5 OUTSTANDING UTILITIES
FREE DISKETTES—LOWEST PRICE
300+ NEW PROGRAM SELECTIONS

SOFTHOUSE INTERNATIONAL

3515 Pecan, Irvine, CA 92714

1-800-441-1079 24 hours—7 days

Inquiry 783.

SDK85 (8 bit) and SDK86 (16 bit)

NOW AVAILABLE ONLY FROM URDA, INC. which has an exclusive, world-wide, manufacturing and marketing license from Intel, Inc. The URDA SDK85 and SDK86 educational trainers and microprocessor development systems are now furnished fully assembled and boxed with manuals. Call URDA, Inc. for new low prices and delivery schedules. Other 8, 16 and 32 bit systems are available.

Phone URDA, Inc.

1-800-338-0517 or 412-683-8732

Inquiry 784.

REPAIR SERVICES

PRINTER PROBLEMS!

Pinhead problems and ribbon problems are the chief causes of printer failure. MATRIX can rebuild any dot matrix pinhead to perform like new. Apple, Epson, Okidata, IBM, Panasonic etc. can be repaired quickly and with a 6 month warranty. Pinhead and ribbon prices start at \$55 and \$4 each respectively. Please call or write to us for pricing and a copy of our bulletin "How to triple the life of your Printer".

MATRIX PRINTER SERVICES, INC.

13033 Pond Springs Road, Suite 201, Austin, Texas 78729
Phone 512-331-5154 FAX 512-331-1460

Inquiry 785.

SCHEDULING

SCHEDULE PLUS

REDUCE SCHEDULING TIME UP TO 90%!

Automatic Scheduling • Rotations • Priority • 24 Hour • Holiday Vacation • Overtime • Banquet/Meeting • Financial Reports • Schedule Listings •

Several versions to meet your needs:
Basic, Advanced, Restaurant, Law Enforcement, Casino, Telemarketing, Customizing Available. Working Demo includes Manual. \$25

CYCLESOFT INCORPORATED

2816 E 125th St. • Burnsville, MN 55337
Call 612-884-8738 or FAX 612-880-8828

Inquiry 786.

SECURITY

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 Mastering
- FREE Demo Disk

STOPVIEW™

Quite
Simply
The Best
Ways To
Protect
Your Valuable
Software Investment

BBI COMPUTER SYSTEMS • (301) 871-1694
14105 Heritage Ln. Silver Spring, MD 20906 FAX: (301) 480-7545

Inquiry 787.

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 408-779-6162 or 1-800-344-2545
Int'l: 2886 Baggaard, Denmark Phone +45-44403322 Fax -44440722

Inquiry 788.

RID YOUR SYSTEM OF VIRUSES FOR EVER VIRUSAFE™

The most effective anti-virus system available
■ Recognizes over 110 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) 888-1408

Inquiry 789.

COPY PROTECTION

The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invaluable 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 94085
FAX (408) 773-1405

Inquiry 790.

SOFTWARE MARKETING

The "Software Success Reference Book (1987-1988)" is a MUST READ if you want to market your software products successfully. Written by David H. Bowen, publisher of Software Success™, the monthly newsletter on successfully running a software business, the Reference Book is a 268-page guide, organized by topic. Covers Lead Generation, Promotion, Pricing, Distribution, Support, etc. Only \$25. Check or Credit Card (Visa/MC/AEX).

100% Money Back Guarantee

Software Success

PO Box 9006, San Jose, CA 95157
(408) 446-2504 FAX (408) 255-1098

Inquiry 791.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORDINVENTORY
- ACCOUNTS RECEIVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

\$99 ea + S&H

DATAMAR SYSTEMS

4876-B Santa Monica Ave
San Diego, CA 92107 (619) 223-3344

Inquiry 792.

SOFTWARE/BUSINESS

StaffMinder™

Staff Administration Software — A must for all managers! Named for its inherent ability to "keep an eye on your staff," StaffMinder™ handles the following:

- Attendance tracking and analysis
- Vacation planning and scheduling
- Skills inventory
- Salary review and bonus tracking
- Compliance reporting
- Employee information

StaffMinder™ provides numerous informative reports. Free aerial mouse included with each order. Simple point and click interface allows for easy implementation. Source code available. List price \$395. Ask for details on current special pricing!

NEXT GENERATION SOFTWARE

Suite 1445, 3340 Peachtree Road, Atlanta, GA 30326
CALL (800) 966-0707

Inquiry 793.

SOFTWARE/ENGINEERING

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
Midnight Engineering

Midnight Engineering

111 E. Drake Rd., Suite 7041, Fort Collins, CO 80525
303-491-9092

Inquiry 794.

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

PO Box 1717, Stow, Massachusetts, USA
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 795.

TUTSIM™, USA's #1 Program for Linear and Non-Linear Continuous System Simulation now has

PERSONAL Prices for PERSONAL Use: \$129.50! Full Featured 999 block program, full text and examples. An analog computer in your "IBM compatible".

Until March 1991: \$67.50 + \$5 S&H + (in CA) State Tax. (Same program as our \$595 professional version)

TUTSIM Products, 200 California Ave., #212,

Palo Alto, CA 94306; (415) 325-4800

Personal TUTSIM is not licensed for corporate use, government agencies, or classroom instruction. No PO's, COD's. No fooling!

Inquiry 796.

SOFTWARE/GEOLOGICAL

GEOLOGICAL CATALOG

Geological software for log plotting, gridding/contouring, 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

THE BUYER'S MART

SOFTWARE/GRAPHICS

SEGS 2.1 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 16,000 points each

Advanced Micro Solutions

3817 Windover Dr. 405-340-0897
Edmond, OK 73013 800-284-3381

Cellular Automata

Want to explore an entirely new way to compute? With Autodesk's Cellular Automata Lab and your IBM® PC, creating dazzling animations, simulating complex physical systems, exploring massively parallel computation, and experimenting with artificial life is just the beginning. CA Lab™ is your passport to the frontiers of computing. Includes a 250-page introduction to cellular automata by award-winning author Rudy Rucker \$59.95

Autodesk, Inc.

2320 Marinship Way, Sausalito, CA 94965
(800) 223-2521

Inquiry 797.

QuickGeometry CAD/CAM Developer's Kit

Third party and custom developers: get your products to market sooner—eliminate 90% of development time and expense

Just call functions for: reading and writing DXF files, vectorized geometry display for any graphics resolution, geometric operations (rotate, scale, move, copy, mirror, intersect, etc.) for lines, arcs, ellipses, NURB splines. C source available for MS/DOS, Macintosh, UNIX, VAX, other.

Call (617) 828-5217 today for free info or to order.
Building Block Software, PO Box 1373, Somerville, MA 02144

Inquiry 798.

FRACTAL GRAFICS

is a radical new drawing program for your PC. Create breathtaking images and scientific models interactively with your mouse. Add dramatic effects to any PCX image. On-line tutorial, extensive Guidebook, and 200+ hands-on examples help you use and understand fractals and Chaos. Only \$79. FREE Brochure!

Cedar Software

R1 Box 5140, Morrisville, VT 05661
(802) 888-5275

Inquiry 799.

RAINDROP™

FAST, compact Print Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 6 kbyte. 14 video graphic standards. Scale, rotate, colorize and more. 'CALL' from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library \$44.95+\$3 s/h.

ECLECTIC SYSTEMS

8106 St. David Ct., Springfield, VA 22153
(703) 440-0064

Inquiry 800.

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 Proprietary, Epson LQ/FX, Toshiba, HP Laserjet, Okidata 290/39x, Hercules/CGA/EGA/VGA \$64 check/m o / VISA/MC

Fplot Corporation

24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 801.

SOFTWARE/GRAPHICS

GRAPHICS PRINTER SUPPORT

AT LAST! Use the PtiSck 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 \$59.95

Jewell Technologies, Inc.

4740 - 44th Ave. SW, Seattle, WA 98116
(800) 359-9000 x527 (206) 937-1081

Inquiry 802.

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program

GRAFATIC: screen routines \$135
PLOTMATIC: plotter driver 135
PRINTMATIC: 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 803.

GRAPHIC TOOLS LIBRARY

XGLIB: Very fast. Window/vp. Thick lines & arcs. Figure drawing, splines. Plots and charts. User coordinates. Text scale, rotate. Mouse functions. Screen print from function call and TSR utility. All functions work in Super VGA modes. Supports modes up to 800x600x256 and 1024x768x16. \$195. Most "C", Pascal, Fortran, MS Basic 4.0-7.1.

NOVA INC.

2500 W. Higgins Road, #1144 CALL 708-882-4111
Hoffman Estates, IL 60195 FAX 708-882-4173

Inquiry 804.

IMAGE TOOLS LIBRARY

PCXIO: Source Library avail. in "C" or Assembler for fast read/write & display of PCX files at any point on screen or memory. Examine headers, palettes, compress data and clip images. Greyscale & Color Mapping. Read image files created in non-compatible graphic modes. Readable, easily modifiable \$295.

NOVA INC.

2500 W. Higgins Road, #1144 CALL 708-882-4111
Hoffman Estates, IL 60195 FAX 708-882-4173

Inquiry 805.

SOFTWARE/LANGUAGES

DRUMA FORTH-83

Break the 64K barrier without speed/price penalty. Powerful, attractively priced, 83 Standard.

- IBM® automated memory management
- Full OS interface, extensive utilities
- On-line documentation, ASCII/block files
- Other products: windows, modules, profiler
- IBM PC/XT/AT including 386 compatibles

FREE learn/utility disks with purchase

DRUMA INC.

6448 Hwy 290 East E103, Austin, TX 78723
Orders: 512-323-5411 Fax: 512-323-0403

Inquiry 806.

FINAL LIQUIDATION!!

IBM® Compilers, SAVE UP TO 80%!

Title	Retail Sale
COROL V2.0 (3 1/2" & 5 1/4")	\$900 \$100
Prof. FORTRAN V1.3 (3 1/2" & 5 1/4")	\$795 \$ 90
C Compiler (3 1/2" or 5 1/4")	\$395 \$ 50
BASIC Compiler V2.0 (3 1/2")	\$495 \$ 50
Macro Assembler V2.0 (3 1/2" or 5 1/4")	\$195 \$ 40
VISA, MC, Check accepted, S and H fee \$10 per order	

THE COMPUTER PLACE, INC.

12105 Darnestown Rd. #9A Tel: (301) 330-6016
Gaithersburg, MD 20878 Fax: (301) 926-3415

Inquiry 807.

SOFTWARE/LOTTO

PC-LOTTO Club BBS

1-604-479-7189

Winning numbers, Wheeling, Shareware or registered copy of PC-LOTTO ver. 2.84 and PC-LOTTOprint (Print official Bet Slips on your printer)

Lottoware

870 Giadiola Ave., Victoria, B.C. Canada V8Z 2T6
voice 604-479-8536

Inquiry 808.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^j = \sum_{k=0}^n [x_k^{j+1} \binom{n}{k}] + \left\{ \frac{1}{U} \frac{F}{G} \frac{dy}{dx} \right\}$$

- 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 809.

DERIVE® A Mathematical Assistant

Makes math more inspiration and less perspiration! Combines the power of computer algebra with 2D & 3D plotting and a friendly menu-driven user interface. Does equation solving, calculus, trigonometry, vector & matrix algebra, and more. Derive requires a PC compatible computer & 512K memory.

Soft Warehouse, Inc.

3615 Harding Ave. Suite 505, Honolulu, HI 96816
(808) 734-5801

Inquiry 810.

SOFTWARE/SCANNERS

Optical Character Recognition

PC-OCR® software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Canon, Panasonic & most other scanners. Supplied with over 20 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. From \$99. Check/VISA/MC/AmExp/CCD

Essex Software Publishing, Inc.

P.O. Box 391, Cedar Grove, NJ 07009
(201) 783-6940

Inquiry 811.

INCREDIBLE OCR

A total solution to all your OCR needs. Recognizes many common text typefaces, and can quickly learn most others. Supports all the major word processors. Faster and more accurate than systems costing twice as much. Amazingly it works with virtually every brand of hand-held scanner, most full-page scanners, and all PC/fax boards. More than 15,000 satisfied users.

All for only \$184 including shipping*

*International include \$25 for airmail shipping
Check, money order, VISA, MC, and COD accepted

PAI OCR

811 Tucker Street, Raleigh, NC 27603
800-782-5542 FAX: 919-828-5196

Inquiry 812.

SOFTWARE/SCIENTIFIC

DI-GRAPH™

Scientific Plotting Package for IBM PC's. Hi-res, 2D, 3D, Contour, Polar, Smith chart, - ASCII - HPGL files, Greek/Super-sub - Microsoft Word/WordPerfect, Epsan & Laserjet II printer, HP pen plotter, others. Basic/8086 \$119.95 or \$169.95 incl. source

DI-MAN™: FAST Protected mode FRACTAL GRAPHICS IBM486/386/387/2MB-VGA \$299.95/\$49.95 source

DAMASKOS, Inc.

Box 469, Concordville, PA 19331 - 215-358-0200

Inquiry 813.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

FREE CATALOG 800-942-MATH

MicroMath Scientific Software
Salt Lake City, UT 84121-0550
Look for our ad on page 124.

Inquiry 814.

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
PO Box 678 — Zephyr Cove, NV 89448

Inquiry 815.

SOFTWARE/UTILITIES

Duplicate Disks Fast!

DiskDupe duplicates, formats and compares disks amazingly fast—up to 20 disks an hour! Its unique RELAY feature lets you quickly duplicate lots of master disks effortlessly. And you can protect your masters by storing disk images on your hard disk. Also supports high-density formats—plus a whole lot more! \$79 + S/H, Money Back Guarantee.

Micro System Designs, Inc.
1309 El Cortado Blvd., Lafayette, CA 94549
(415) 944-9994 Order today!

Inquiry 816.

SOFTWARE/VOICE

MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development Toolkit for Pascal or "C" 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, RHETOREX, VBX \$599, WATSON \$99, Visa/MC. Now available: Fax Tool Kit.

ITI Logiclel

1705 St. Joseph E, Suite 4, Montreal, PQ, Can. H2J 1N1
(514) 861-5988
We can also write your Voice Response application programs.

Inquiry 817.

STATISTICS

STATISTICAL SOFTWARE PACKAGE

Complete statistics package, menu driven with comprehensive user's guide. Options include full edit capabilities, probability analysis, major statistical indicators, confidence intervals, regression analysis, ANOVA and forecasting. Ideal for research, education and financial analysis. Import/Export ASCII. \$125.

SOFTWARE SYSTEMS, Attn: Larry Jones
2612 St. Regis Lane, Virginia Beach, VA 23456
(804) 455-7085

Inquiry 818.

TERMINAL EMULATION

TEK 4207/4105/4014 Emulation

PC-PLOT-V is a complete communications program which includes file transfer, script files, VT-100/200 emulation plus Tektronix graphics terminal emulation. Supports COM1-4 plus support for DECnet, NETBIOS, U-B Net1. Graphics screenprint \$225. Free Catalog.

MicroPlot Systems Co.

1897 Red Fern Dr., Columbus, Ohio 43229
614-882-4786 614-882-3399 (BBS/FAX)

Inquiry 819.

UNINTERRUPTIBLE POWER

HOW TO PROTECT YOUR COMPUTER And Make It Last Longer

FREE money-saving literature tells you how to protect your computer and make it last longer with an uninterruptible power supply. 500VA through 18KVA models from the world's largest manufacturer of single-phase UPS.

Best Power Technology, Inc.

PO Box 280, Necedah, WI 54646
Toll-Free (800) 356-5794, Ext. 3880
Telephone: (608) 585-7200, Ext. 3880
See our Ad on page 236

Inquiry 820.

UTILITIES

A Difference That Must Be Seen! Diff, it™

△ Unlimited file sizes △ Configurable compare algorithm
△ Scrollable split screen display △ Display in ascii or hex
△ 25, 43 and 50 line display modes △ Command line interface
△ Pop-up menu interface △ Line, Word and Hex compare
△ Difference output to a disk file △ Batch file drive-able
Requires IBM PC or 100% compatible, 148KB memory, DOS 2.0 or higher, floppy or hard disk. 30 day money back guarantee. \$129.95

Double R Software, Inc.

Rd1 Fifth Ave., Valley Forge Manor, Phoenixville, PA 19460

Inquiry 821.

0 K Ram Menu Systems Batch'in

Batch'in helps you write professional batch file menu systems with sub-menus and full color screens for ANSI.SYS. Convenient for experts, easy enough for complete novices. Only \$40.00!

MC LEBER ENTERPRISES VISA

(309) 693-0634 Box 9281 Peoria, IL 61612-9281

Inquiry 822.

COPY AT TO PC—BRIDGE-IT 3.5

"CPATPC" RELIABLY writes 360KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape backup. Only \$75.00 + S/H.
"BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 3 1/2" 720KB 44MB drives for PC/XT/AT without upgrading DOS/BIOS. Only \$39.00 + S/H.

BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT

\$129.00 + S/H VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS

655 Sky Way Suite 220, San Carlos, CA 94070
1-415-593-8777(CA) 1-415-593-7675 (FAX)
1-416-855-1993 (CANADA) 1-800-523-8777
0908-260-188 (UK) 4711 4020 (FRG)

Inquiry 823.

UNIX under DOS !!!

Get the Feel & Power of UNIX

Include awk, cb, cp, diff, ed, find, grep, ls, make, move, mv, rm, sed, sort & 17 others. All V.3 and BSD 4.3 options included. Thorough documentation.

THE BERKELEY UTILITIES \$200.00 order now 800-542-0938

OPENetwork

POWER TOOLS FOR POWER USERS

215 Berkeley Pl (B-2), Brooklyn, NY 11217

See our ad on page 20

Inquiry 824.

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.

QUAID SOFTWARE LIMITED

45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

UTILITIES

COPYWRITE

Copy/Write
Removes
Copy Protection
No more diskettes,
manuals or
codewheels

US \$75

1000's of products copied.

QUAID 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.

Guaranteed to work! The following packages are available:

PCAD	\$199.00	CADKEY	\$199.00
MICROSTATION	\$99.00	PERSONAL DESIGNER	\$199.00
MasterCAM	\$250.00	SmartCAM	\$250.00
TANGO PCB	\$99.00	CADVANCE	\$99.00

PLUS SHIPPING AND HANDLING

PHONE (204) 669-4639 FAX (204) 668-3566

VISA AND MASTERCARD Welcome

SafeSoft Systems Inc.

191 Kyrilstone Way, Winnipeg, MB, Canada, R2G 3B6
See our ad on page 234

Inquiry 825.

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 826.

VOICE MAIL/AUTO ATTENDANT

Complete PC CAM™ Users!

Upgrade to a 4-line Voice Express™!

This system picks up where the CAM leaves off with these added features:

- All lines share the same files
- Supervised call transfer options
- File structuring capabilities
- System messages re-recordable
- Selectable recording quality
- Automatic time-based changes
- Order entry & survey capabilities
- Expandable in multiples of 4

To order, hear demo, or to request more information:

Call (614) 870-3838

Versicom Communications®

1115 Wimbeldon Blvd., Columbus, OH 43228

Inquiry 827.

WORD PROCESSING

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 828.

DuangJan

Bilingual word processor for English and: Armenian, Bangali, Burmese, EuroLatin/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 19149-1806
(215) 331-2748 FAX: (215) 331-4188

Inquiry 829.



AutoCAD® Users



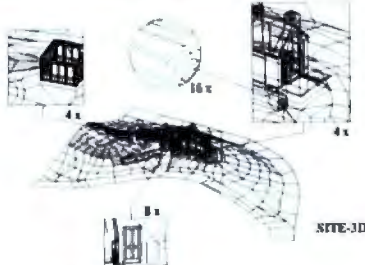
YOU NEED THIS UTILITY!!! FastBreak™

FastBreak™ - Cookie-cut, hatch, 'break' and/or 'trim' thousands of AutoCAD® entities: 3DFACES, 3DPOLYLINES, 3DLINES, SOLIDS, TRACES, ARCS, CIRCLES, LINES, POLYLINES, exploded SURFACES, MESHES, and 3D-CONSTRUCTION... and ALL within seconds in a single 'window' or 'crossing' point and pick.

YES! YES! YES! - 3DFACES, SOLIDS, TRACES, surfaces, splines, 3D-meshes, and any 2D or 3D-construction can be broken and/or trimmed using FastBreak™!!!

AutoCAD® will not break or trim 3DFACES and other 3D-construction.

FastBreak™ can do the job - quickly, accurately, and reliably in any UCS. The drawing shown is SITE-3D.DWG with four enlarged insert clips added. All four inserts were made on a 386-PC using FastBreak in less than two minutes!!!



ClipView™ - is integrated into FastBreak and performs *Automatic* clipping or trimming of the above entities to create inserts. Options include: Box or Bubble boundaries, Inside or Outside (makes a hole) trim, and borders.

FastBreak™ and **ClipView™** are integrated into DOS executable code, run interactively in AutoCAD shells from 256K, use fast block binary database, virtual memory paging, user friendly AutoLISP® interface, and perform FAST, FAST, FAST in any AutoCAD Rel. 9 through Rel 10-386.

FastBreak™ and **ClipView™** are licensed in a single user package. Contact your dealer or buy direct (credit or money order, for UPS Next Day add \$6. shpg. fee) from:

BZ Technical

P.O.Box 10, Bothell, WA 98041

Phone: 206/258-1568 or FAX: 206/487-1357

Retail price: \$399.⁹⁵ Demo: \$25.⁰⁰

NOT Copy protected, NOT AutoLISP® encrypted, FULL documentation, technical support, 3.5" and 5.25" media.

"Quality software development located near the home of MICROSOFT® in Bothell's High Technology Corridor."

AutoCAD and AutoLISP are registered trademarks of Autodesk Inc. FastBreak and ClipView are trademarks of BZ Technical



COMPUcom

9,600-38,400 bps MODEM+FAX...\$279

NOW you can afford a **SPEEDMODEM**. Raw speed of 300 - 9600 bps and 4:1 data compression push throughput up to 38,400 bps. Dynamic Impedance Stabilization - provides robust performance on noisy telephone circuits. A 9600 bps send/receive, full-featured FAX is included on the same card. Total communications capability—only \$279. It comes with a 30-day money back guarantee and a 5-year warranty. **BYTE** magazine said our 2400 bps modem was "a real deal"...well we've done it again... our **COMBO** - is setting a new standard for value and performance. See for yourself... *3/89p.102

(408)732-4500 **CALL NOW 800 ACT ON IT** (800)228-6648

9-Track? Just call us.

It doesn't get any easier than this. A wide variety of PC-9-Track tape subsystems are available to you by phone, including tape drives, cards, and software:

- DOS, UNIX, XENIX, PICK, NOVELL Support
- 486, 386, 286 & PS/2 Compatible
- Menu-Driven Software
- 2 Year Warranty on Controller Cards
- 800, 1600, 3200, 6250 bpi
- 24 Hour Delivery
- Excellent for Hard Disk Backup

We invented the first PC-9-Track controller ten years ago, and have been on top ever since with the world's best selling cards. It's easy to find out why: just call us.

1-800-PC-9TRAK*

OVERLAND DATA

5600 Kearny Mesa Rd. San Diego, CA 92111

*1-800-729-8725 US & Can. • 1-619-571-5555 • FAX 1-619-571-0982



48 CHANNEL 25MHz LOGIC ANALYZER



PA480 \$1595 + POD PRICE

***New WINDOWS 3.0 Compatible Software**

- 48 Channels @ 25 MHz x 4K word deep
- 16 Trigger Words/16 Level Trigger Sequence
- Storage and Recall of traces/setups to disk
- Disassemblers available for: 68000, 8088, 8086, 6801, 6811, Z80, 8085, 6502, 6809, 6303, 8031.

**NCI □ 6438 UNIVERSITY DRIVE
HUNTSVILLE, AL 35806 • (205) 837-6667**

Quality Hard Drive Repair

- 7-10 Working Days
- 6-month Warranties
- 1-year Warranty on Refurbished Drives
- 24-hour Turn-around Time Available

We Specialize in Data Recovery
As well as Buying & Selling Hard Drives

AT Portable Computer

Gas Plasma 286

- 286 12 MHz Clock Speed
- 1 Meg RAM Memory
- 360K "A" Drive
- 1.44 Meg "B" Drive
- 20 Meg Hard Drive
- 1:1 Interleave Controller



\$1695

OR:

386 SX Gas Plasma Portable

Same as above except with 1.2

Meg Floppy and 40 Meg Hard Drive

\$2195

Is your old PC too slow? Don't replace it!!!
Upgrade it to a true 286. 12 MHz AT for as low as
\$399, installation included. Give us a call!!!

404-366-1600

H&W Micro Labs

528-C Forest Parkway • Forest Park, GA 30050

MEMORY UPGRADES

5 YEAR WARRANTY! - FREE DELIVERY!

IBM PS/2 & LaserPrinter

2MB Module Model 80's	\$CALL
2MB Module	
Mod. 70-E61;-121	\$185
Mod. 70-A21;B21;A61;B61	\$300
2-8MB Exp Boards	\$CALL
Models 50, 60, 70 & 80	
1, 2, 3.5MB Memory Boards	\$CALL
LaserPrinter 4019 & 4019e	

Toshiba Laptops

2MB Upgrades	\$CALL
Models 1000SE, 1600, 3100e,	
3100SX, 3200SX, 5100, 5200	

Apple Mac & NTX

4MB Memory Kit	\$CALL
Macintosh IIfx	
Laser Writer II/NTX	
1MB Memory Kit	\$173
Laser Writer II/NTX	

COMPAQ Memory

DeskPro 386/20,25,20e,25e	
1MB Add-On Module	\$153
4MB Add-On Module	\$387
DeskPro 486/25,386/33, SystemPro	
2MB Module (386, 486, SP)	\$336
8MB Module (486, SP)	\$2000

PORTABLES

1, 2MB Modules - LTE/286	\$CALL
1, 4MB Module - SLT	\$CALL

HP LaserJet Memory

1MB Upgrade - II; IID; IIP; III	\$182
2MB Upgrade - II; IID; IIP; III	\$CALL
4MB Upgrade - II; IID	\$CALL

NEC Memory

1-2MB Memory Board	\$311
PowerMate SX Plus	
1, 2MB Memory Upgrades	\$CALL
ProSpeeds 286, 386	

Apple, AST, AT&T, DEC, Dell, Epson, NEC, SUN, Zenith, Others

SIGMA DATA

Scytheville Row • P.O. Box 1790 • New London, NH 03257

Call for latest pricing

TOLL FREE: (800) 446-4525

NH (603) 526-6909 FAX (603) 526-6915

Established - 1980

A COMPLETE 386 SYSTEM

WITH VGA COLOR AND 40 MB HARD DRIVE

\$1,449

- Intel 80386SX-16 MHz CPU
- 1 MB RAM Expandable to 8 MB
- 40 MB Hard Drive
- VGA Color Monitor (.31) and 16-bit Card
- 1.2 MB Floppy
- 2 serial, 1 parallel
- 101 Keyboard
- Case with power supply
- 2 Year Warranty



Other systems with the same configuration:
286-12: \$1,199 / 386-20SX: \$1,599 / 386-25: \$1,899 / 386-33: \$2,349
All upgrade options are available

SPECIAL SALE

LAPTOP SPECIAL

286 LAPTOP \$1499

- 1 MB RAM
- 20 MB Hard Drive
- 1.44 MB Floppy
- LCD, CGA Display
- Serial, Parallel Ports
- Battery Pack
- AC adapter

386SX LAPTOP \$2599

- 1 MB RAM
- 40 MB Hard Drive 25 ms.
- 1.44 MB Floppy
- Paper White VGA Display
- Serial, Parallel Ports
- Battery Pack
- AC adapter



Prices subject to change without notice. Quantities are limited.

Both Laptops include: FREE MS-DOS, 1 year warranty

Call for special sale on 286, 386 & 486 Mother Board and other components.

First Computer Systems, Inc.

3951 Pleasantdale Road, Suite 224, Atlanta, GA 30340

Tel. (404) 441-1911 Toll Free (800) 325-1911 Fax (404) 441-1856

Santa got his wish...

Caller ID+Plus!

*The Complete Caller Identification
and Contact Management System*

Because your business needs to be well organized but retain a personal touch, you need Caller ID+Plus. Know who is calling before you answer. Instantly display caller records. Record notes on each contact. Memory resident. Import/export data.

For more information contact:

Rochelle Communications, Inc.
8716 N. Mopac, Suite 200
Austin, TX 78759

Call: 1-800-542-8808

Outside U.S.: +1-512-794-0088

See us at COMDEX Booth B1536



MEMORY UPGRADES

IBM PS/2, APPLE
AST, COMPAQ
HEWLETT PACKARD
ZENITH, SUN MICRO
STANDARD SIMMS
LAPTOP MEMORY
(NEC, TOSHIBA, APPLE, COMPAQ)
LASER PRINTER MEMORY
(HP, CANON, TEC ENGINE)
NO RISK, BEST PRICE, BEST QUALITY

**ADD ON
TAMERICA**

A DIVISION OF ROHM CORPORATION
433 N. MATHILDA AVE. SUNNYVALE, CA 94088
TEL (408) 746-1580 FAX (408) 746-1583

1-800-292-7771

Circle 10 on Reader Service Card

9 Track Tape Subsystem for PC/XT/AT/386/PS2



\$1995 for 1600/3200 BPI
\$4995 for 1600/6250 BPI
\$6995 for 800/1600/3200/6250 BPI
CALL 1-800-289-4TAPE

Laguna Conversion Systems
1401 South Pacific Coast Highway
Laguna Beach, CA 92651

Circle 113 on Reader Service Card

Hardware Locks Getting you Down??

Software programs that will
eliminate the need to use
hardware locks. Don't wait for
your lock to fail, get stolen or
become lost,
ORDER YOURS TODAY!!

Tango PCB \$ 99.00 PADS \$ 99.00
CadKey 99.00 PCAD 199.00
MasterCam 250.00 SmartCam 250.00
Microstation 99.00 MaxRoute 99.00

PH: (204)669-4639 FAX: (204)668-3566

SAFESOFT SYSTEMS

191 Kirlystone Way
Winnipeg, MB
R2G 3B6
Canada



Circle 167 on Reader Service Card

VOICE MAIL MONEY-MAKER

Generate hundreds of dollars
monthly in your spare time
by installing a BigMouth
voice mail card and our
menu-driven software
package in your own
IBM-clone computer.

Press 1 for sales,
2 for customer
support, 3 to speak
to a Live
operator...

Use it to rent voice
mailboxes and pocket
pagers, advertise
mail order products,
operate a pay-per-
call audiotext service
using credit cards, passwords,
or a nationwide 900 number

Add the optional Goldmine module and your BigMouth will
automatically generate outbound telephone calls to friends,
existing clients, or new business prospects for sales and
telemarketing purposes.

Your BigMouth arrives complete with all software, external
speaker, third-party peripherals directory, a detailed
installation manual and start-up guide

ID# 1840 Bigmouth \$299.00 ID# 1841 Goldmine \$99.00
Entrepreneurs Toolkit \$25.00 (credited on future purchases)



24-Hr Info & Order Hotline
1-800-283-4759

Reseller & OEM Inquiries Welcome

DemoSource

8646 Corbin Avenue • Nonbridge, CA 91324

Trademarks belong to their respective companies.
Check state regulations before using Goldmine

Circle 58 on Reader Service Card

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for SEPT 9, 1989

OUTSIDE OKLAHOMA NO SALES TAX

DYNAMIC RAM			
4M Board for hp LJ's w/2MB			\$175.00
SIMM 2M IBM PS/2 Model 70			225.00
SIMM 1M AST Prem386/33Mhz			150.00
SIMM 1Mx9	80 ns		63.00
SIMM 256Kx9	100 ns		22.00
1Mbit	1Mx1	60 ns	11.95
1Mbit	1Mx1	80 ns	6.50
41256	256Kx1	80 ns	2.95
41256	256Kx1	100 ns	2.15
41256	256Kx1	120 ns	1.95
4464	64Kx4	100 ns	2.25
41264*	64Kx4	100 ns	5.95
EPROM			
27C1000	128Kx8	200 ns	\$17.50
27512	64Kx8	200 ns	7.25
27256	32Kx8	200 ns	5.50
27128	16Kx8	250 ns	3.75
STATIC RAM			
62256P-10	32Kx8	100 ns	\$7.50
6264P-12	8Kx8	120 ns	4.50

OPEN 6 DAYS, 7:30 AM-10 PM SHIP VIA FED-EX ON SAT.

SAT DEL ON
FED-EX ORDERS
RECEIVED BY
2400 S. Peoria Ave
BEGGS OK 74421
No minimum order. Please note: prices subject to change!
Shipping, insurance extra, up to \$1 for packing materials.

Circle 124 on Reader Service Card

REPAIR YOUR OWN IBM PC, XT, AT or Clone

With Professional

TROUBLESHOOTING FLOWCHARTS

And TECHNICAL TIPS

These are the documents that your
Computer Serviceman
does NOT want you to have!

Send only \$6.95 plus \$1.50 postage
and handling per set to:
A & M Enterprises
Box 2712, Waterloo IA 50704
IOWA RESIDENTS ADD 4% TAX

Circle 8 on Reader Service Card

EZ-WRITER (E)EPROM MULTIPROGRAMMER

Best Portable (E)EPROM
Programmer Money Can Buy.



Models from
\$495.

☆ Made in USA

- 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 40-Pin Devices
- Model K3/C3, easy 3 key Operation

BYTEK

Corporation

800-523-1565

FL: (407) 994-3520

Fax: (407) 994-3615

CA: (408) 437-2414

Telex: 4998369BYTEK

Circle 34 on Reader Service Card

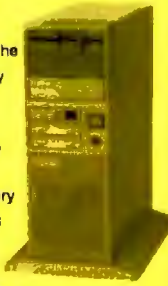
PCS 486 WORKSTATION

FAST! Landmark 155 MHz
Norton SI 101
Power Meter 15.2 MIPS

- Intel 80486 25/33 MHz processor
- 8K internal/64K ext. cache
- 4 Mbytes basic memory
- 1.2 Mbyte 5 1/4" floppy

Options

- 25/33 MHz Weitek 4167 co-processor
- Up to 16 Mbytes memory
- Hard disk—100 Mbytes to 1 GByte
- Removable hard disk
- Non-stop power supply



PROFESSIONAL
COMPUTER
SYSTEMS (408) 263-0222

550 Valley Way, Milpitas, CA 95035

Circle 153 on Reader Service Card

33 MHz Single Board Computer

Landmark 58.7 MHz



Norton SI 45.9
Power Meter 8.1 MIPS

- Intel 80386 25/33 MHz processor
- Intel 82385 25/33 MHz cache controller
- Optional 25/33 MHz co-processor
- Up to 32 MB page mode memory
- 8 MHz I/O speed
- Phoenix/AMI/Award/Quadtel BIOS
- Passive backplane with seven expansion slots



PROFESSIONAL
COMPUTER
SYSTEMS (408) 263-0222

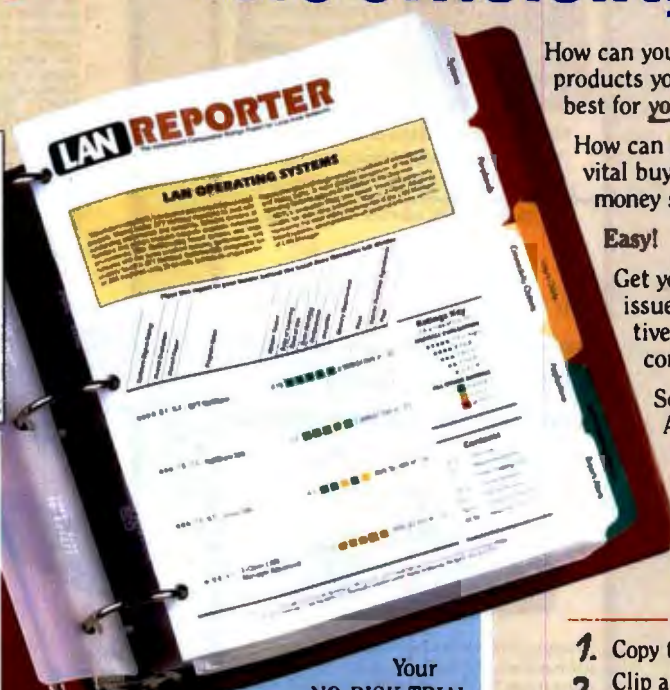
550 Valley Way, Milpitas, CA 95035

Circle 154 on Reader Service Card

We refer to
NSTL publications as
the 'Consumer Reports'
of PC computing

Steven Boyle, Manager
MIS Technical Support
Virginia Employment
Commission

Now, build a more effective, more efficient, network...



LAN Reporter's NO-RISK GUARANTEE!

If you're not happy
with your first
issue, you owe
nothing. Plus if,
at any time during
the year, you feel
LAN Reporter is not
for you, we'll send
you a refund for the
unfulfilled portion
of your subscription.

Your
NO-RISK-TRIAL
subscription includes:

- 12 issues of *LAN Reporter*
- 12 supplemental issues of *Buyer's Alert*
- 4 quarterly indexes
- 1 FREE binder with dividers for storing it all

LAN Reporter covers it all for you.

• SQL servers • 486 servers • file servers
• bridges • multiuser databases • routers
• token ring adapters • arcnet adapters •
ethernet adapters • multiple servers •
E-mail • network monitoring • network
backup • diskless workstations • low-end
LAN operating systems • and more . . .

. . . we test all leading products in all
product categories. Independently.
Methodically. And as thoroughly as
possible.

Then we tell you which products
deliver the usability, compatibility,
and expansion capabilities you need
for your network.

Packed cover to cover with test results and product ratings.

Don't expect ads, feature articles or
fancy pictures in *LAN Reporter*. Count

on getting an easy-to-read, easily
accessible format with lots of
charts, tables and ratings, including:

Front Cover Summary

Right up front you'll see a roundup
of the issue's test results.

Product Reports

Quick reading summaries of each
individual product's strengths and
limitations that can save you time,
money and trouble right now —
and down the road.

Versatility and Performance Charts

No more last minute surprises. *LAN Reporter* tests and verifies every
single product feature and identifies
products that will work best for your
specific applications.

Buyer's Alert

Concise, late-breaking reports on
emerging technologies and tests of
updated and upgraded products —
all included with every issue of
LAN Reporter.

How can you be absolutely sure which networking
products you read about in this magazine are
best for you?

How can you minimize your risk when making
vital buying decisions and reduce the time and
money spent on research?

Easy!

Get your hands on *LAN Reporter*. Issue after
issue, it brings you independent, compara-
tive ratings information based on our
comprehensive, real-world product testing.

So you can buy with more confidence.
And build more effective, more efficient
networks.

See yourself. Try your first issue FREE.

3 easy ways to order...

1. Copy this page and FAX to 1-215-941-9950
2. Clip and mail coupon to NSTL, Box 1000,
Plymouth Meeting, PA 19462
3. Call toll-free 1-800-223-7093

Respond
today for FREE issue and no-risk-trial subscription!

☒ **YES** rush me a FREE issue of *LAN Reporter*,
and enter my no-risk trial subscription

for 12 additional issues of *LAN Reporter* plus 12 issues
of the *Buyer's Alert* supplement for \$185—a savings of
\$110 off your regular rate of \$295. If I'm not 100%
satisfied, I'll owe nothing and the first issue is mine
to keep.

- ☐ Bill company ☐ Bill me
☐ Check for \$185 enclosed. (Make payable to NSTL)
☐ Charge to ☐ MasterCard ☐ VISA ☐ American
Express

Acct. No. _____

Expiration Date _____

Signature _____

Name _____

Title _____

Company Name _____

Phone No. _____

Street Address _____ (Needed for quick order processing)

City _____ (No. P.O. Boxes)

State _____ Zip _____

MAIL TO: NSTL, Box 1000, Plymouth Meeting, PA 19462

Offer valid in U.S. only. Prices subject to change without notice.

NSTL NATIONAL SOFTWARE TESTING LABORATORIES
Publishers of *Software Digest* and *PC Digest Ratings Reports*
A Division of Datapro Research Group ■ Plymouth Corporate Center, Plymouth Meeting, PA 19462

\$5900



DIGITAL FM TELEMETRY

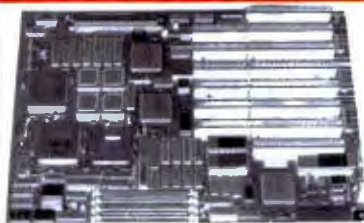
Ideal for ECG, physiology, etc.
6 channels, for PC/AT compatible.
Adaptable interface.
Dual antennae, digital error check.

CME Telemetry

554 Parkside Dr., Waterloo, Ont.
519-886-8440 Fax 519-886-8442

Circle 41 on Reader Service Card

486/25MHz GIANT MEMORY Series



GM Series Expands to 32Mb On-Board
64K External Cache/Expand to 128K
TEXAS INSTRUMENT 486 Chip-Set

SX, 386/33, 486/33 Cache GM SERIES... Call

(800)627-6998/SALES

(713)589-7100/INFO

HOMESMART COMPUTING

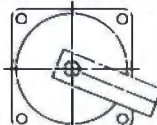
VISA • M/CARD • AMX • COD

Circle 99 on Reader Service Card

COORDINATED MOTION CONTROL

Indexer LPT™

- Powerful
- Easy To Use
- Economical \$199



- ☐ Software easily converts printer port into multi axis step motor controller.
- ☐ Use IBM type personal computer to control movement of cameras, positioning stages, valves, robotics, optics, custom plotters, machine tools, or other motion or positioning applications.
- ☐ Accepts 'plain English' commands from any language or program that can write to a file including BASIC, C, Pascal, spreadsheet and database macros, high level laboratory software, and even from DOS batch files! HPGL converter available.
- ☐ Full functions for up to six axes including step, direction, reduced current, power, limit switches, home, acceleration, position tracking, line drawing and more.
- ☐ Super Manual covers everything. Easy to read. Easy to use. Numerous examples.
- ☐ Why fight with RS-232 and cryptic commands AND pay \$500 or more per axis?

Inquire about Indexer LPT today!

Ability Systems Corp.

1422 Arnold Ave. Roslyn, PA 19001 (215)657-4338

Circle 9 on Reader Service Card

DOS IN ROM!

ALWAYS WAITING
FOR A PROMPT?
SPEED UP WITH
MVS ROM DRIVE!
-BOOT 0.1 SEC
-1/2 SIZE CARD
-ANY POMS, DOS
-LANE CONTROL
64K... \$95
380K... 200
1.44M... 300
MVS
(508) 792 9907



8088 SINGLE BOARD COMPUTER

PC ON A CARD!
1. DEBUG ON PC
2. TEST SBC RAM
3. BURN EPROM
-BATTERY SOLAR
-5YR WARRANTY
-62 PIN PC BUS
-2PAR, 3SER, RTC
-LCD/KBD PORTS
MVSBC1... \$95
MVSBC2... 60
PC CABLE... 50
PC CARD... 85



Circle 115 on Reader Service Card

HELLO, MY NAME IS PHRED



At last, your PC can talk! Phred is completely self-contained, and connects to any PC-compatible with a simple RS-232 serial cable. Program Phred to say anything — anytime! High quality voice synthesizer, built-in speaker, even a headphone jack. Includes manual and demo disk.

Give your computer a voice of its own.

Only \$395.00 (Includes shipping)

Voice Demo Cassette - \$10.00 (Applies towards purchase)

Send cheque or money order to:

Aiello Engineering

26 Willow St. N.

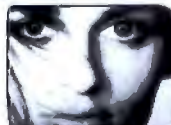
Acton, Ontario,

Canada L7J 1Z7

For more information, call (416) 853-4014

Circle 11 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



HRT

HIGH RES TECHNOLOGIES

P.O. BOX 76

LEWISTON, N.Y. 14092

PHONE 416-497-6493

FAX 416-497-1988

Circle 98 on Reader Service Card

9-Track Tape For Your IBM PC/XT/AT/PS-2™

Read 1600 bpi 9-track tapes from a micro, mini or mainframe in EBCDIC or ASCII as mirror image or by individual files.

Use the 2000 PC™ for disk backup, data interchange or archival storage.

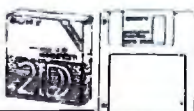
PC/XT/AT/PS-2 are trademarks of IBM.
2000 PC is a trademark of Digi-Data



DIGI-DATA CORPORATION
8580 Dorsey Run Road
Jessup, MD 20794-9990
(301) 498-0200
800-782-6395
FAX (301) 498-0771
First in Value

Circle 64 on Reader Service Card

SONY DISKETTES 10/Box



3.5" DS/DD 1MB \$.82 ea
3.5" DS/HD 2MB \$1.53 ea

3.5" DS/DD 1MB \$.59 ea
#SB-2DD 50/ pack Sony logo on shutter

**NEW Sony Digital Data Tapes
(4mm & 8mm) Call for price.**

1-800-258-0028

Call for free 60 page catalog!

Min. order \$25.00. S&H: FOB Grand Rapids MI.

COD: add \$5.50. MI residents + 4% tax.

Prices subject to change.



Precision Data Products™

P.O. Box 8367

Grand Rapids, MI 49518

616-698-2242 FAX 616-698-9047

Circle 152 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. 500 VA to 18 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. 1878

(608) 565-7200, ext. 1878

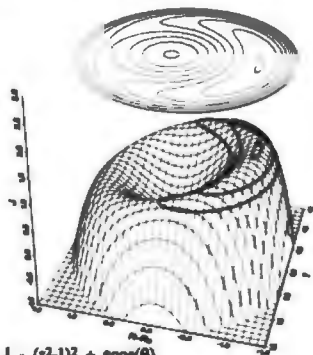
Circle 23 on Reader Service Card

GraphiCTM

"gives you all the C language routines you need to write an impressive scientific graphing program of your own. Highly recommended.*"

— PC Magazine

Orbits correspond to $J = \text{constant}$ contours



IBM® PC (with source code) \$395

Circle 169 on Reader Service Card

Macintosh® (no source code) \$295

Circle 170 on Reader Service Card

Licensed for personal use only

VTEK-HPTM 1.0

New!

**DEC® VT220/102/52
& Tektronix®
4010/4014/4105
Terminal Emulator
for IBM® PCs**

Circle 171 on Reader Service Card

VTEK-HP has added full VT220 emulation to VTEK

New High Performance features:

- TIFF export
- Color PostScript® and viewable EPS
- HP-GL/2TM and PaintJet XLTM support
- Full national character set support
- Telephone dialer
- faster and uses less memory
- requires '286 or '386 and VGA/EGA

VTEK-HP \$245 VTEK \$195

Scientific Endeavors
508 North Kentucky Street
Kingston, TN 37763 USA
(615) 376-4146 FAX:(615) 376-1571

BYTE BACK ISSUES FOR SALE

	1987	1988	1989	1990
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Inside the IBM PCs				

☐
Issues
Available

Rates (postage and handling included):

1987-'90 BYTE Issues	\$6.00*	BYTE 1988 Index	\$4.00
BYTE '83-'84 Index	\$4.00	1985 Inside The IBM PCs	\$4.00
BYTE 1985 Index	\$4.00	1988 Inside The IBM PCs	\$6.00

*June 1988 (Benchmarks) \$3.00

*December 1988 \$3.00

The above prices include postage in the US. 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 payment to:

BYTE Back Issues, One Phoenix Mill Lane, Peterborough, NH 03458 (603) 924-9281

☐ Check enclosed Charge: ☐ VISA ☐ MasterCard

Card # _____

Exp. Date _____

Signature _____

Name _____

Address _____

City _____

State _____ Zip _____

All orders must be prepaid. Please allow four weeks for delivery.



PS/2 model 30/286-30 meg	1795
PS/2 model 50Z/286-60 meg	2395
PS/2 model 55SX/386SX-60 meg	3295
PS/2 model 70/386-120 meg	5595
PS/2 model 80/121-120 meg	NEW

*** Monitor Extra ***



Compaq 286E-40 meg	2150
Compaq 386/20E-100 meg	4150
Compaq 386S-100 meg	3595
Other Models	CALL

*** Monitor Extra ***

Macintosh

Mac SE/30-40 meg	3195
Mac IICX-80 meg	4595
Mac Portable-40 meg	4795
Other Models	CALL

*** Keyboard & Monitor Extra ***

LOW PRICE LEADER

SINCE 1983

LAPTOP

Compaq LTE/286-20	2975
Sharp 286/40	2490

CALL FOR OTHER BRANDS

LAPTOP ACCESSORIES

Memory	
1 meg Toshiba 1000SE	325
2 meg Toshiba 3100SX	390
2 meg Toshiba 3200SX	399
2 meg Toshiba 5200	415
1 meg Compaq SLT	390
Modems	
2400 Int. for Laptops	225



Everex System 1 1995

Everex Step 286/12 - 1meg
40 meg VGA card and monitor

Everex System II 2495

Everex Step 386SX - 2 meg
40 meg VGA card and monitor

Everex System III 5395

Everex Step 386/33 - 4 meg
150 meg VGA card and monitor

* CALL FOR MODELS & CONFIG *

AGI Computer

AGI 386SX-1 meg	1695
40 meg VGA card and monitor	



AST 386SX - 2 meg	2395
40 meg VGA card and monitor	

CALL FOR OTHER MODELS

DISKS

DYSAN 5 1/4 HD / 3 1/2 HD	13/26
MAXELL 5 1/4 HD / 3 1/2 HD	12/25
Min. 10 Boxes Order	

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

Intel Coproducts

8087-3	105
8087-2	145
80287-8	225
80287-10	249
80387-16	395
80387-20	425
80387-25	495
80387-33	599

SOFTWARE SPECIALS

dBase IV	455
Wordperfect 5.1	260
Aldus Pagemaker	495
Ventura Publisher	525
Clipper	435
WordStar 5.5	150
EasyExtra	40



NOVELL
Authorized
Dealer

SPECIALS

HP Scan Jet	1425
HP Paint Jet	965
Lotus Ver. 3.0	355
Kodak 150P	370
Complete Fax Board	499
Okidata 391	625
Epson LQ1050	660
Panasonic 1124	319
HP-7475 Plotter	1595
SummaGraphic	365

LASER PRINTERS

HP Laser IID	2750
HP Laser 2P	995
HP Laser III	1695
Panasonic 4450	1395
Brother HL-8-E	1895
Nec LC 890	3195
Toshiba Laser 6	1095

MONITORS

Nec Multisync IIA	499
Nec Multisync 3D	599
Magnavox EGA	339
Nec Multisync 5D	2350
Samsung EGA	359
Sony 1302	619

PACIFIC DATA PRODUCTS

P. Page II	459
P. Page IIP	365
P. 1-2-4 Mem II	159
P. One Meg IIP	180
P. 25 in One III	325
P. Headlines	245

LAN BOARDS

8 bit Arcnet	110
16 bit Arcnet	220
8 bit Ethernet	190
16 bit Ethernet	275
8 port Active Hub	325
Token Ring Card	399
Tokenhub 4-port	355
Call for other LAN Accessories	

MODEMS

Everex 2400 Int/Mnp	179
Hayes 2400B	315
Hayes 9600B	875
USRobotics Hst/Dual	1150
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-F 9-6
S 10-6

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

DYNAMIC RAMS

4Mx9	80ns	\$365.00
PS2	2M 604/608	\$165.00
1Mx9	80ns	\$ 59.00
1Mx8	80ns	\$ 55.00
256x4	100ns	\$ 5.75
✓ 1Mx1	100ns	\$ 5.50
✓ 41464	100ns	\$ 2.75
✓ 41256	120ns	\$ 2.15
51258	80ns	\$ 3.45
4164	120ns	\$ 1.85

* For quantity discount, high speed parts, SFP, Please Call!

■ NATH. COPROCESSORS	3237	1707018	\$ CALL
80387-33	30MHz	\$540.00	\$255.00
80387-28	25MHz	\$435.00	\$194.00
80387-20	20MHz	\$350.00	\$180.00
80387-16	16MHz	\$305.00	\$153.00
80387-10	10MHz	\$260.00	\$135.00
	■ V-20	80MHz	\$65.00

I.C. EXPRESS

15142 Valley Blvd. City of Industry, CA 91744
Customer service: (818) 333-8891 FAX: (818) 336-1238

ORDER: (800) 877-8188 (Mon-Fri 9-5 PST)

CALL FOR CURRENT PRICES & VOLUME DISCOUNTS

Prices shown for cash. MasterCard/VISA add 3%, those are subject to change.
Minimum order \$10.00 Shipping & Handling: UPS Ground \$6.00 Air \$7.00 (1 lb.)
ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

EZ-ROUTE VERSION II



SCHEMATIC TO PCLAYOUT \$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

SILICON VALLEY VALUES!



Motherboards for AT Upgrades

486-25	11.1MIPS	\$2190
386-33	8.3MIPS	1075
386-25	4.6MIPS	599
386SX	3.7MIPS	329

Also:
Barebones & Systems
Call for Quote

NASCENT
Technology Inc.

356 S. Milpitas Blvd.
Milpitas, CA 95035 (800) 899-1889

Circle 104 on Reader Service Card

Circle 17 on Reader Service Card

Circle 129 on Reader Service Card
(RESELLERS: 130)

SPEECH MASTER

Automated Speech Control Software
for the Information Age

NEW FOR THE 90s

SpeechSoft, maker of the most sophisticated speech systems, presents

"The top four speech applications integrated into one full-featured, high-performance software package."

SPEECH MASTER requires no programming, sets up quickly, and is easy to use. Its low price lets you afford the benefits of speech automation.

DIALOGIC hardware 1 to 24 lines, same low price.



AUDIOTEX VOICEMAIL ATTENDANT OUTCALL

\$ 895

Unconditional 30 day money back guarantee. The sensible, no-risk way to buy speech software.

**SPEECH
SOFT**

WE MAKE SPEECH HAPPEN

(201) 461-8117 Fax-8145
1605 John Street
Fort Lee, NJ 07024

There is a Difference. Lifetime Free Updates

EP-1
\$349



A programmer is not just another programmer. That is why BP Microsystems is committed to bringing our customers the highest quality programmers at an affordable price. A good example of this commitment is the EP-1 EPROM Programmer. The EP-1 supports virtually every 24- or 28-pin E/EPROM. And, all of our programmers include lifetime free software updates and an unconditional money back guarantee.

BP MICROSYSTEMS

1-800-225-2102

(713) 481-9430

Circle 31 on Reader Service Card

There is a Difference. Lifetime Free Updates

EP-1140
\$895



A programmer is not just another programmer. That is why BP Microsystems is committed to bringing our customers the highest quality programmers at an affordable price. This commitment is evident in our EP-1140 E/EPROM programmer supporting thousands of 24, 28, 32 and 40 pin devices. A 32-pin model, EP-1132, is available also for \$695. And, all of our programmers include future chip support at no charge and an unconditional money back guarantee.

BP MICROSYSTEMS

1-800-225-2102

(713) 481-9430

Circle 32 on Reader Service Card



Introducing ITR VISION Software

\$695.00
Special Offer

The Software Solution To Image Compression

- IBM Compatible MS-DOS 3.0 or Higher
- Uses EMS 3.2 or above to Handle Large Images
- Variable Compression—Up to half a bit per pixel
- No Extra Hardware Needed
- Uses High Resolution TGA Files
- Includes Proposed JPEG Standard Compression Modes

CALL NOW TO ORDER

1-800-966-4487

MAJOR CREDIT CARDS ACCEPTED

Circle 108 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 101 on Reader Service Card

BLACKJACK COMPUTER



The ultimate card-counting weapon, operated under complete concealment within the casinos. CPU, "magic" shoes, I/O switches, sensors, power supplies, extensive training and support provided. Win consistently with the latest generation of the technology every casino fears the most.

Contact
(714) 865-1191

Circle 27 on Reader Service Card

OVERSTOCKED BELOW DEALER COST SALE

1Meg Memory Chips...\$4.95 Letter Quality Daisy Wheel Printer...\$149 40Meg Seagate ST251-1...\$269

"We guarantee lowest pricing on Seagate, Everex, Panasonic, DTK Systems, Samsung, all memory expansions, and many more name brand products. Also, NEVADA COMPUTER specializes in over stock, discontinued, excess, liquidation, bankrupt, etc. INVENTORIES, of which we purchase large quantities under dealer cost and offer to you at a fraction of everybody elses pricing. Savings up to 90% off! All new with at least 90 day warranties."

COMPAG

Description	Equip. Compag	Part #	Model #	Your Low Price
1MB Add-on Module	113131-001	386/20/25/20/286E		179 ⁰⁰
1MB Add-on Module	113646-001	Deskpro 386S		189 ⁰⁰
4MB Add-on Module	113132-001	386/20/25/20/286E		359 ⁰⁰
4MB Add-on Module	112534-001	Deskpro 386S		499 ⁰⁰
1MB Memory Exp Bd	113644-001	Deskpro 386/20e		299 ⁰⁰
1MB Memory Exp Bd	113633-001	Deskpro 386S		309 ⁰⁰
4MB Memory Exp Bd	113645-001	Deskpro 386/20e		799 ⁰⁰
4MB Memory Exp Bd	113634-001	Deskpro 386S		799 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		399 ⁰⁰
4MB Upgrade Bd	106070-001	386/16		1299 ⁰⁰

HP LASER JET II, III, HP 4 & III

1Meg	134 ⁰⁰	2Meg	189 ⁰⁰	4Meg	339 ⁰⁰
HP II	1049 ⁰⁰	HP LASER JET II	1499 ⁰⁰	HP III	1799 ⁰⁰

All memory boards expandable to 4 Meg. Specify Machine

EVEREX

RAM 3000 DELUXE Up to 3 Meg (EMS) 4.0 OS/2 Back up base memory and expanded and/or extended memory Uses 256K D-RAM	99 ⁰⁰
RAM 8000 Up to 8MG capacity/support to base extended or expanded memory in any combination Fully compatible with Lotus, Intel, Microsoft, EMS 4.0 EEMS Supports Multi-Tasking and DMA Multi-Tasking in hardware software configurable (no dip switches to set) Full 16MG window for future expansion Zero wait state, uses 1MG D-RAM	199 ⁰⁰
RAM 10000 Up to 10 MB extended or expanded memory Compatible with Lotus, Intel, Microsoft, EMS 4.0 Uses 1 MB D-RAM	179 ⁰⁰

MEMORIES...

Description	120NS	100NS	80NS	60NS
256 x 9 IBM	19 ⁰⁰	29 ⁰⁰	33 ⁰⁰	59 ⁰⁰
1Meg x 8 Apple	85 ⁰⁰	95 ⁰⁰	99 ⁰⁰	—
1Meg x 9 IBM	—	64 ⁰⁰	69 ⁰⁰	99 ⁰⁰
4Meg x 9 IBM	—	—	399 ⁰⁰	499 ⁰⁰

INTEL COPROCESSORS

8 Bit	32 Bit
8087 5MHz or less	80807-15 16MHz
8087-2 8MHz	80387-20 20MHz
8087-1 10MHz or less	80387-25 25MHz
80287 6MHz	80387-33 33MHz
80287-8 8MHz	80387-SX
80287-10 10MHz	218 ⁰⁰
80287-12 Laptop	80287-XL

BOCA AT PLUS

16 BIT MEMORY BOARD FOR 286, 386 AT	
OK-8Meg Board + 4.0 LIM Compatible + New 5 Year Warranty	
• Conventional Expanded and Extended Memory	
• Supports DOS, OS/2, LIM/EMS & EEMS	
• Operates with CPU Speeds to 33 MHz	
OK — 129 ⁰⁰	2 Meg — 269 ⁰⁰
4 Meg — 389 ⁰⁰	8 Meg — 649 ⁰⁰

ZENITH

386/25/33 1 Meg	109 ⁰⁰	Super 1 Meg	359 ⁰⁰
2 Meg	299 ⁰⁰	Super 286 4 Meg	1199 ⁰⁰

IBM PS2 (BOARDS & MODULES)

Description	Equip. IBMPS2	Part #	Model #	Your Low Price
512K Upgrade	30F 5348	30F286		59 ⁰⁰
2MB Upgrade	30F 5360	30F286		189 ⁰⁰
1MB Module	6450603	70-E61 & 121		104 ⁰⁰
2MB Module	6450604	70-E61 & 121		199 ⁰⁰
2MB Module	6450608	70-A21		209 ⁰⁰
1MB Mem Board	6450375	80-041		149 ⁰⁰
2MB Mem Board	6450379	80-111 & 311		319 ⁰⁰
2MB Exp BMB	6450605	70/80		599 ⁰⁰
4MB Module	34F 2933	70/80		599 ⁰⁰
2MG Module	6450572	70 & 80		449 ⁰⁰
4MG Board	6451060	80-A21 & A31		699 ⁰⁰
2-BMG Board	1497259	50-55 & 60		499 ⁰⁰

RAM CHIPS

Description	150NS	120NS	100NS	80NS	70NS
64 x 4	1 ⁰⁰	1 ⁰⁰	2 ⁰⁰	—	—
64 x 4	1 ⁰⁰	2 ⁰⁰	3 ⁰⁰	3 ⁰⁰	—
256 x 1	1 ⁰⁰	1 ⁰⁰	2 ⁰⁰	2 ⁰⁰	4 ⁰⁰
1 Meg x 1	—	8 ⁰⁰	5 ⁰⁰	5 ⁰⁰	13 ⁰⁰

TOSHIBA

2MG Card Toshiba Portable T1600	298 ⁰⁰
2MG Card Toshiba Portable T3100SX	298 ⁰⁰
4MG Card Toshiba Portable T3100SX	798 ⁰⁰
512K Card Toshiba Portable T3100e	148 ⁰⁰
2MG Card Toshiba Portable T3100e	298 ⁰⁰
2MG Card Toshiba Portable T3200SX	298 ⁰⁰
4MG Card Toshiba Portable T3200SX	698 ⁰⁰
3MG Card Toshiba Portable T3200	498 ⁰⁰
2MG Card Toshiba Portable T5100	298 ⁰⁰
2MG Module Toshiba Portable T5200	298 ⁰⁰
3MG Module Toshiba Desktop T8500	348 ⁰⁰

CANON FLATBED SCANNER D-12F

- 300 DPI • 16 Secs per page • 32 Level Gray Scale
 - 1 year warranty • Ready to go interface card and cable included
- List 1595 Your Price 499⁰⁰
- OPTIONS: OCR 199⁰⁰ PC Paint By 2-Soft 165 79⁰⁰
Sheet Feeder (also works with HP) 299⁰⁰

SALE SALE SALE

WHILE SUPPLIES LAST — WITH 1 YEAR WARRANTY



FAX MODEM CARD BY XEROX

- Automatic Group III Digital Fax • Background operation
 - Send text, screen images, scanned pages
 - Hayes compatible module built on • Fax 9600/7200/4800/2400
 - Software - telephone cord • New, factory sealed
- List 695 Your Price 149⁰⁰

WANGTEK TAPE BACKUPS

- 6.5MB per minute
 - Wangtek 5099EN24 drive
 - Wangtek 8 bit QIC80 controller
 - Software • Menu driven
 - DC600 cartridge • Easy installation
- List 999⁰⁰ Your Price 399⁰⁰
- 40MB backup works off floppy controller

DAISY WHEEL PRINTER

- 14CPS Letter Quality
- Manufactured by Silver Reed
- IBM Centronics Parallel Interface
- New 90 day warranty

List 1149⁰⁰ Your Price 149⁰⁰

FULL PAGE SCANNER BY AT&T

- IBM Interface & Cable
- PagePower Software
- A complete draw: Scan/fax packages
- 200DPI • Automatic Sheet Feeder

List 999⁰⁰ Your Price 299⁰⁰

MODEMS

- MANUFACTURED BY ZOOM PC 2400 MC INTERNAL MODEM**
- Fully Hayes Compatible • Monitor Speaker with Volume Control
 - 2400/300 Baud Transmission Rate • Addressable COM 1,2,3,4
 - Compatible with IBM PC, XT, AT and Compatibles
 - Full Duplex Operation • Complete with ProComm Software
 - Two Year Manufacturer's Warranty • Auto Dial/Auto Answer
- List 199⁰⁰ Your Price 79⁰⁰ Each

2400 BAUD EXTERNAL MODEM List 299⁰⁰ Your Price 99⁰⁰

EVEREX MODEMS

EV-923 EverCom 12 300/1200 bps Bitcom Software	69 ⁰⁰
EV-941 EverCom 24 2400 Baud Int. Bitcom Software	139 ⁰⁰
EV-945 External 2400 Baud	199 ⁰⁰
EV-942 2400 PS2	199 ⁰⁰
Level 5 MNP	Add 39 ⁰⁰

FLOPPY DRIVES

360K 1/2 Ht 5 1/4	59 ⁰⁰
1.2 Meg 5 1/4	79 ⁰⁰
720K 3 1/2" Drive w/5 1/4" mounting	89 ⁰⁰
1.44 Meg 3 1/2" Drive w/5 1/4" mounting	89 ⁰⁰
360K Tandem TM100-2 Full Ht (The original IBM)	89 ⁰⁰

We also carry Sony, Teac & others Please Call

POWER SUPPLIES

- IBM DIRECT REPLACEMENT**
- 150 WATT XT Comp. • UL Appr • 110/220V input switch • 4 drives 49⁰⁰
 - 200 WATT AT comp • UL Appr • 110/220V input switch 89⁰⁰

SAMSUNG MONITORS

12" Amber w/tilt & Swivel Base	89 ⁰⁰
14" Color 640 x 200, 16 colors	209 ⁰⁰
14" EGA 640 x 350, 64 colors/31	369 ⁰⁰
VGA 800 x 600 Multisync Compatible	449 ⁰⁰
14" VGA Demo looks new, 31 Dot Pitch	284 ⁰⁰

EVEREX VIDEO CARDS

EGA EV659, 640 x 350, Auto Switch	99 ⁰⁰
VGA Viewpoint 16 Bit 256 Exp 512k	179 ⁰⁰
NCC VIDEO CARDS	
MonoGraphics (Hercules Compatible) with Par Port	29 ⁰⁰
Color Graphics (Hercules Compatible) with Par Port	39 ⁰⁰
Mono Card Text Only	9 ⁰⁰
VGA Card 1024 x 768 (256K Exp 512K)	109 ⁰⁰
STB mono/color card	29 ⁰⁰

SEAGATE HARDDRIVE

ST125-0	20mb 40msec 3 1/2"	AT KIT	XT KIT
ST125-1	20mb 28msec 3 1/2"	\$249	\$299
ST138-0	30mb 40msec 3 1/2"	\$269	\$319
ST138-1	30mb 28msec 3 1/2"	\$289	\$339
ST225	20mb 65msec	\$309	\$359
ST238R (RL)	30mb 65msec	\$199	\$249
ST251-1	42mb 28msec	\$219	\$279
ST227R-1 (RL)	42mb 28msec	\$269	\$339
ST4096	65mb 28msec	\$339	\$389
ST4144 (RL)	80mb 28msec	\$549	\$599
	120mb 28msec	\$649	\$699

XT kits include cables, software (over 32MB) controller
AT kits include cables, rilla, software (over 32MB)

HARDDRIVE SPECIALS

10 Meg 80 Mil Sec	89 ⁰⁰	20 Meg 60 Mil Sec	159 ⁰⁰
40 Meg 40 Mil Sec	229 ⁰⁰		

CONTROLLERS

8 Bit WD Controller	FOR HARDDRIVES	59 ⁰⁰
16 Bit WD Controller 2:1	109 ⁰⁰ 16 Bit Everex HD/Floppy 1:1	59 ⁰⁰
	FOR FLOPPYS	
Super Floppy Controls 1:2, 360K, 720K & 1:4 Drives		69 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.

• WE ACCEPT INTERNATIONAL ORDERS

• WE ALSO PURCHASE EXCESS INVENTORY—FAX OR CALL

• NO SOFTWARE RETURNS

*APPLIES TO ADVERTISED PRICES IN THIS MAGAZINE ONLY

NO SURCHARGE FOR MC/VISA/AE

TERMS:

MC • VISA • CDD CASH • NET

Purchase Orders from Qualified Firms

Personal Checks • CDD add \$3.00

20% Restocking Fee on Returns Within 15 Days

No Refunds After 30 Days

ALL PRICES FINAL



1000 Nevada Hwy. • Unit 101
Boulder City, NV 89005

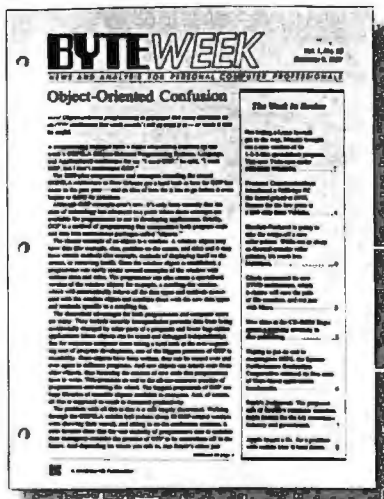
SE HABLE ESPANOL



SHIPPING: (min \$25) UPS

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 _____

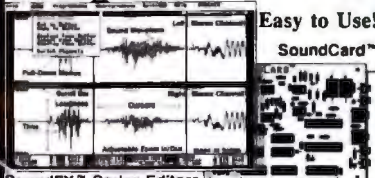
☐ MasterCard ☐ VISA
☐ Check enclosed ☐ Bill me

Card # _____
Exp. _____
Signature _____

BYTEWEEK

One Phoenix Mill Lane
Peterborough, NH 03458

SuperSound™



Easy to Use!

SoundCard™

SoundFX™ Series Editors™

IBM PC DIGITAL VOICE / SOUND
from \$29 (play only) to \$469 (top stereo rec. / play)

Quality Software / Hardware
- in use worldwide!

30 Day Money-Back Guarantee If not Satisfied

- JUST LIKE HAVING A TAPE RECORDER IN A PC.
- Fastest, easiest Editors with the most features for the price.
- Quick, simple hardware / software installation
- Use for Animal / Human communications research
- For Business: Training, Slide Shows, Works with Grap, GBC
- For Engineering: Function Gen, Clear Voice Alarms, Storage Scope
- For Fun: Create Your Own Music, Mix, Boost up Sounds, Alter Your Voice

Orders 800-986-4411 by Silicon Shack FAX: 408-374-4412

5120 Campbell Ave. #112, San Jose, CA 95130.

Technical: 408-446-4521

Ask for FREE PRODUCT CATALOG of IBM-PC sound products.

Developers: Ask about TurboSound - PC voice sound engine

* TurboSound, SoundFX, SoundCard, and SoundEdit are trademarks of Silicon Shack Ltd. Other product names are trademarks of their manufacturers.

Circle 174 on Reader Service Card

UNIPRO,

the PC/XT/AT/386 based universal programmer/tester programs PROMs, EPROMs, EEPROMs up to 4MB and 32-bit wide, PALs, PLDs, GALs, EPLDs, PEELs, and Micro Controllers. JEDEC file compatibility and Test Vector verification allow the use of most popular PLD compilers. The unit also tests TTL/CMOS Logic ICs and Dynamic/Static RAMs. 40-pin Gold ZIF socket, built-in protection for short circuit and over current, high speed parallel interface to the PC, and menu-driven software are included at \$585.



XELTEK

764 San Aleso Ave.
Sunnyvale, CA 94086
TEL: (408) 727-6995 • FAX: (408) 727-6996

Circle 215 on Reader Service Card

MOTION CONTROL

The RTMC16 Card and Software Package digitizes and plays back free-form motion on up to 16 axes at a time. Use the Graphic Move Editor to "sweeten" joystick moves, or create complex moves directly on-screen with curve-fit and curve-drawing.

- Non-Cartesian Robotics
- Remote Manipulators
- Animated Puppets
- Special Effects
- Realtime Contouring
- Perfect Repeatability
- 16 Quadrature Joystick Inputs
- 16 Step & Direction Outputs
- 254 khz Pulse Streams

IBM Card and Software: just \$1,295.00

Kuper Controls

11200 Montgomery NE Suite 8
Albuquerque, NM 87111
505-263-5949 FAX: 505-298-3272

Circle 112 on Reader Service Card

Get on the PC BUS



ROM or Disk based AT Systems
Cards \$299, Systems \$399

It's easy to run your compatible applications on our single board computer! Develop code on a PC, and follow our ten easy steps to place your .exe files and DOS in ROM.

CPU Card: V50 CPU, 8086 Code Compatible
1 MB Ram, 256kB Rom, 4 5" x 7"
5 Serial Ports, CMOS (2 watt)

Expansion: Backplanes for PC/AT cards
Piggyback card with: Floppy,
SCSI, Printer, and Keyboard ports

Software: BIOS, Utilities, Monitor, & Source code



303-444-7737 fax 303-786-9983
655 Hawthorn Ave., Boulder CO 80304

Circle 111 on Reader Service Card

LOGIC,

the universal PLD programmer supports extensive library of industry-standard logic types, including latest EPLDs, PLAs, GALs, FPLs, and PEELs. The pull-down menu driven software accepts JEDEC files from most PLD

design softwares. The full screen editor for Fuse Maps and Test Vectors is included at \$395. Tango-PLD, the logic design software generates JEDEC files by schematic entry, logic minimization, logic simulation, and design compilation at \$495.

LOGIC and Tango
PLD are bundled
for \$745.



XELTEK

764 San Aleso Ave.
Sunnyvale, CA 94086
TEL: (408) 727-6995 • FAX: (408) 727-6996

Circle 216 on Reader Service Card

TWIX PC CASH REGISTERS NEW MODELS, LOW PRICES



- NEW 3011/12 "REGISTER HEADS": Receipt printer, register keyboard, cash drawer & monitor in a sleek package for hook-up to a XT/AT or PS-2.
- NEW 3041 "REGISTER TERMINAL": TV950 terminal emulation for multi-user oper. systems with built in controls for drawer, receipts, scanners & more.
- NEW 3081 "REGISTER COMPUTER": Standalone "AT" compatible whard & floppy drives, 1 MB Ram
- NEW "TWIX ADVANTAGE" RETAIL POS Software: Advanced features, network, scanner interface.

TWIX INTERNATIONAL CORP.
4401 S. BROADWAY, ENGLEWOOD, CO 80110
(303) 789-5333 FAX (303) 788-0670

Circle 211 on Reader Service Card

Nashua



Authorized Distributor: Magnetic Media Division



Canon LBP-4 LASER BEAM PRINTER

OUR PRICE IS SO LOW THAT THE MANUFACTURER WOULD BE VERY UPSET IF WE WERE TO PUBLISH IT. SO WE CAN ONLY SAY "THE PRICE IS LOW & INCLUDES ONE TONER CARTRIDGE & UPS TWO DAY AIR DELIVERY"

CALL FOR PRICE

Diskette Connection

NORTHEAST & CANADA
1-800-451-1849
PO BOX 10247 WILMINGTON, DE 19850

SOUTHEAST
1-800-940-4600
PO BOX 4163 DEERFIELD BEACH, FL 33442

MIDWEST
1-800-654-4058
PO BOX 1624 BETHANY, OK 73808

WEST - HAWAII & ALASKA
1-800-621-6221
PO BOX 12396 LAS VEGAS, NV 89112

Minimum Order \$20.00 NO SURCHARGE on VISA / MC
COD orders add \$3.50 Shipping charges determined by
items and delivery method required by customer
(Prices are subject to change without notice)

FAX (405) 493-1598

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

Company, Page # Inquiry #

A

Acorn, 133
Adobe Systems, 89, 97 1146
Advanced Programming Institute, 161
Agilis, 63
Aldus, 89 1157
American National Television Standards Committee, 105
Anderson Consulting, 105
Apollo Computer, 137
Apple Computer, 89, 97, 133, 187 1151
Applied Optical Media, 105
Apricot, 133
Artisoft, 15 1110
Ashton-Tate, 133
AST Research, 133
Asymetrix, 41 977
AT&T, 51
AT&T Data Systems, 183
Atari, 133, 153, 161
Autodesk, 89
Axonix, 217 1095

B

Bank Street College, 105
Bethlehem Steel, 105
Bitstream, 97
Borland International, 63, 113, 133

C

C-Cube Microsystems, 63
CE Software, 89 1150
CEIT Systems, 105
Chicago Art Institute, 105
Chips & Technologies, 63, 153
Colorado Microsystems, 217 1080
Commodore Business Machines, 187
Compaq Computer, 63, 121, 153
Computer Presentations, 89 1148
Contech Computer, 217 1092
Crescent Software, 15 1106

D

Data General, 183
Data Technology, 217 1096
Data Viz, 89 1154
Datastorm Technologies, 217 1098
Dayna Communications, 89 1149
DCA/Crosstalk Communications, 217 1099
Digital Communications Associates, 203
Digital Equipment, 63, 133, 207
Digital Research, 193
Dolch, 153

E

Eclipse, 113
Entropy Engineering, 15 1113
Ergo Computing, 250 1075
Eurolink, 217 1087

F

Fifth Generation Systems, 217 1083
Flagstaff Engineering, 217 1093
Forbin Project, 217 1100
Format Software, 41
Fujitsu, 133
Future Soft Engineering, 217 1101

G

General Electric, 105
Geoclock, 15 1109
GigaTrend, 217 1085
Glockenspiel, 161
Groupe Bull, 133
Gupta Technologies, 37, 63, 193

H

Hayes Microcomputer Products, 217 1088
Headland Technology, 63
Headstart, 121
Hewlett-Packard, 63, 97, 161, 175, 193 851
Hitachi, 121
Honeywell Information Systems, 133

I

IBM, 51, 57, 63, 82, 105, 121, 153, 161, 169, 187, 193, 203, 207
IBM Research Labs, 193
IGC, 113
Information Builders, 193
Informix, 37, 193
Ingres, 193
Insignia, 137
Intel, 51, 63, 75, 97, 105, 113, 137
Interactive Systems, 51, 183
International Data, 153
International Standards Organization, 121, 193
Iomega, 217 1079

J

Joint Photographic Experts Group, 63

L

Locus Computing, 51, 113, 137
Lotus Development, 63, 133, 161, 193

M

Mac Trucks, 121
MetaWare, 250 1076
Metropolitan Museum of Art, 105
Micro Solutions Computer Products, 89 1155
Microcom, 217 1089
Micrografx, 97
Microport, 51
Microsoft, 37, 47, 57, 63, 82, 89, 97, 113, 121, 133, 161, 169 1159 1222
MIT, 161, 183
Mitsubishi, 133
Motorola, 51
Mountain Computer, 217 1081
Moving Pictures Expert Group, 105

N

NEC, 63, 153
NetFrame, 63
NeXT, 63
Nixdorf, 133
Novell, 57, 89, 133 1156
Nu-Mega Technologies, 137

O

Ohio State University, 41
Olduvai Software, 41
Olivetti, 133
Olmsted Brain Simulation Software, 15 1111
Open Software Foundation, 63, 183
Oracle, 193
Overland Data, 217 1094
Oxford Electronic Publishing, 15 1107

P

Phar Lap Software, 97, 113, 250 1077
Philips, 121, 133
Phoenix Technologies, 51, 113, 137
Plus Development, 217 1087
Poqet Computer, 153
PrairieTek, 153

Q

QMS, 175 852
Quarterdeck Office Systems, 47, 113, 183 1221

R

Rational Systems, 113
RCA, 105
Reflection Technology, 153
Remote Data Access Committee, 193

S

S3, 63
Schneider, 133
Schneider & Koch, 57
SemiDisk Systems, 15 1112
Sharp Electronics, 89, 121 1152
Siemens Information Systems, 133
Sintar Software, 15 1105
Soft-Logic Solutions, 137
Software Publishing, 63
Sony, 121
Spinnaker Software, 41 976
Standard Telephone and Cable, 133
Sun Microsystems, 51, 133, 137, 183
SuperMac Technology, 89 1158
Sybase, 193
Sysgen, 217 1082
Systat, 15 1108

T

Tallgrass Technologies, 217 1086
Tandem Computers, 193
Tandy, 51, 121
Tektronix, 175 853
Teradata, 193
Texas Instruments, 161
The Santa Cruz Operation, 51, 183
3Com, 57
Toshiba, 153
Traveling Software, 89, 217 1084 1153

U

Uniphoto Picture Agency, 105
University of Chicago, 41
USRobotics, 217 1090

V

Victor, 133
Video Electronics Standards Association, 161

W

Watcom Systems, 250 1078
WordPerfect, 89 1160

Z

Zenith Data Systems, 133, 153
ZOOM Telephonics, 217 1091

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.

Alphabetical Index to Advertisers

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
8 A & M ENTERPRISES	234	60 DIGIBOARD	49	114 LAHEY	104	248 QUA TECH, INC.	222
9 ABILITY SYSTEMS CORP.	236	61 DIGIBOARD	49	* MARK WILLIAMS CO.	23	159 QUARTERDECK	168
10 ADD ON AMERICA	234	62 DIGITAL DISTRIBUTING, INC.	28	115 MERRIMACK VALLEY SYS.	236	* QUARTERDECK	168(1-32)
11 AIELLO ENGINEERING	236	63 DIGITAL DISTRIBUTING, INC.	28	116 METAMEDIA SYSTEMS, INC.	58	180 RAIMA CORP.	39
12 ALADDIN	130	64 DIGI-DATA CORP.	236	117 METAMEDIA SYSTEMS, INC.	58	161 RAIMA CORP.	26
13 ALTEC TECHNOLOGY	36	65 DISKETTE CONNECTION	243	118 METAWARE	197	162 RAINBOW	74
14 AMERICAN POWER CONVERSION	48	66 DISTINCT CORP.	68	119 MICRO SOLUTIONS COMP. PROD.	146	163 RAINBOW	74
15 AMERICAN SMALL BUSINESS	93	67 DISTRIBUTED PROCESSING	128	120 MICROMATH SCIENTIFIC SFTWR.	124	164 RAINDROP SOFTWARE	68
217 ARTISOFT	219	68 DISTRIBUTED PROCESSING	128	121 MICRONICS	21	165 ROCHELLE COMMUNICATIONS	233
16 ARTIST GRAPHICS	165	69 DTK COMPUTER, INC.	112	122 MICROPRESS	178	166 ROSE ELECTRONICS	61
17 A.M.S.	240	70 DTK COMPUTER, INC.	112	123 MICROPRESS	179	210 ROYKORE	216
20 BAY TECHNICAL ASSOCIATES	167	* EASTRIDGE TECHNOLOGY	30	124 MICROPROCESSORS UNLTD.	234	167 SAFESOFT SYSTEMS	234
21 BAY TECHNICAL ASSOCIATES	167	71 EMERSON UPS	96	222 MICROSISTEMS SOFTWARE, INC.	215	168 SANTA CRUZ OPERATION	115
22 BELL ATLANTIC	159	72 EMERSON UPS	96	223 MICROSISTEMS SOFTWARE, INC.	215	169 SCIENTIFIC ENDEAVORS	238
23 BEST POWER TECHN., INC.	236	221 EVENT HORIZONS	126	* MICROWAY	CIV	170 SCIENTIFIC ENDEAVORS	238
24 BETTER SOFTWARE	40	73 EVEREX SYSTEMS	34,35	125 MIX SOFTWARE	213	171 SCIENTIFIC ENDEAVORS	238
25 BETTER SOFTWARE	40	74 FAIRCOM CORP.	50	126 MONOLITHIC SYSTEMS CORP.	54	172 SHECOM COMPUTERS, INC.	192
26 BITSTREAM	181	75 FIRST COMPUTER SYS. INC.	233	224 NANA0	211	173 SIGMA DATA	233
* BIX	156	76 FIRST COMPUTER SYS. INC.	233	225 NANA0	211	174 SILICON SHACK LTD.	243
* BIX	194	77 FIRST SOURCE INT'L	199	127 NANTUCKET	127	18 SIM WARE	166
27 BLACK JACK COMPUTER	240	78 FIRST SOURCE INT'L	199	129 NASCENT TECHNOLOGY, INC.	240	19 SIM WARE	166
28 BLACKSHIP COMPUTER SYS.	108	79 FLAGSTAFF ENGINEERING	120	130 NASCENT TECHNOLOGY, INC.	240	175 SN'W COMPUTERS & ELECTRONICS	104
29 BLAST/COMM. RESCH. GROUP	152	80 FLYTECH TECHNOLOGY, INC.	33	131 NATIONAL INSTRUMENT	CIII	176 SPECIALTY SOFTWARE	160
30 BLAST/COMM. RESCH. GROUP	152	81 FTG DATA SYSTEMS	66	132 NCI	232	177 SPEECHSOFT	240
31 BP MICROSYSTEMS	240	82 FTG DATA SYSTEMS	66	133 NCI	232	178 SPSS	171
32 BP MICROSYSTEMS	240	219 FUNCKEY ENTERPRISES	208	134 NEC INFORMATION SYSTEMS	67	180 STATSOFT	145
33 BRIGHTBILL-ROBERTS	131	83 GALACTICOMM, INC.	2,3	135 NEVADA COMPUTER	241	196 STEPSTONE CORP.	66
* BUYERS MART	224-231	* GATEWAY 2000	40A-H	136 NISCA, INC.	123	181 STORAGE DIMENSIONS	125
* BYTE BACK ISSUES	236	84 GENERIC SOFTWARE	12,13	* NSTL	235	182 STORAGE DIMENSIONS	125
* BYTE CARD DECK	212	85 GENERIC SOFTWARE	12,13	137 OMNITEL, INC.	17	183 SUPERSOFT, INC.	70
* BYTE SUB MESSAGE	166	86 GEOCOMP CORP.	136	138 OPENNETWORK	20	187 TANGENT	19
* BYTE SUB SERVICE	214	87 GEOCOMP CORP.	136	139 OPTICAL PUBLISHING, INC.	60	188 TATUNG	27
34 BYTEK COMPUTER CORP.	234	88 GLENCO ENGINEERING, INC.	101	140 OPTICAL PUBLISHING, INC.	60	189 TELEPHONE PRODUCT CTR.	237
* BYTEWEEK/NEWSLETTER	242	89 GREENVIEW	18	* ORACLE	67	190 TEXAS INSTRUMENTS	157
35 BZ TECHNICAL	232	90 GROUNDHOG GRAPHICS, INC.	68	141 OVERLAND DATA	232	191 TEXAS MICROSYSTEMS	200,201
36 CACHE COMPUTERS	147	91 GROUNDHOG GRAPHICS, INC.	68	142 OWL INTERNATIONAL	109	* TEXAS MICROSYSTEMS	200A-B
37 CADRE TECHNOLOGIES	9	92 GROUP 1 SOFTWARE	38	143 PACIFIC DATA PRODUCTS	119	192 THE PERISCOPE CO.	202
38 CAPITAL EQUIPMENT CORP.	20	93 GROUP 1 SOFTWARE	38	144 PACIFIC DATA PRODUCTS	119	193 THE PERISCOPE CO.	202
39 CINCINNATI TIME	148	94 GTEK, INC.	141	145 PARA SYSTEMS	25	194 THE SOFTWARE LINK	117
40 CINCINNATI TIME	148	95 GTEK, INC.	141	146 PATTON & PATTON	22	195 THE SOFTWARE LINK	117
* CLEO COMMUNICATIONS, INC.	59	96 G.W. COMPUTERS, INC.	136	147 PC POWER & COOLING, INC.	71	197 TOUCHBASE SYSTEMS, INC.	16
41 CME TELEMETRIX	238	220 HARD FACTS	209	148 PC POWER & COOLING, INC.	71	198 TOUCHSTONE SOFTWARE CORP.	24
* COMPUADD	104A-D	97 HAUPPAUGE COMP. WORKS	11	149 PERCEPTIVE SOLUTIONS, INC.	132	199 TOUCHSTONE SOFTWARE CORP.	24
* COMPUADD	138A-D	98 HIGH RES TECHNOLOGIES	238	150 PHAR LAP SOFTWARE	89	200 TRANS ERA CORP.	55
42 COMPUCOM	232	99 HOME SMART COMPUTING	238	151 POPKIN SOFTWARE	103	201 TRANS ERA CORP.	55
43 COMPUTER PERIPH., INC.	188	100 HOOLEON	118	152 PRECISION DATA PRODUCTS	236	203 TRIPP LITE	198
44 COMPUTER SERVICE SUP. CORP.	158	101 HOUSTON COMPUTER SERV.	240	153 PROFESSIONAL COMPUTER SYS.	234	204 TRIPP LITE	198
45 COMPUTERLANE	239	102 H&W MICRO LABS	233	154 PROFESSIONAL COMPUTER SYS.	234	207 TRI-STAR COMPUTER	14
46 CONTROL CORP.	52,53	103 IBM - PS/2	4	* PROGRAMMER'S SHOP	146,149	208 TRUEVISION, INC.	163
* COPIA INTERNATIONAL LTD.	179	104 I.C. EXPRESS	240	* PROGRAMMER'S SHOP	150,151	209 TULIN CORP.	128
47 CORESOFT	45	* INTELLIGENT EXACT ENG.	198	155 PROTECH MARKETING, INC.	31	210 TULIN CORP.	128
48 CTX INTERNATIONAL	174	105 I.S.C.	110,111	156 PROTECH MARKETING, INC.	31	211 TWIX INTERNATIONAL CORP.	243
49 CTX INTERNATIONAL	174	106 ISLAND SYSTEMS	128	157 QMS	43	* US ROBOTICS	56
50 CYBEX CORP.	130	107 ISLAND SYSTEMS	128	158 QMS	43	* VERMONT CREATIVE SOFTWARE	29
* DAMARK INT'L, INC.	116	108 ITR	240	240 QUA TECH, INC.	222	212 VIDEX	65
51 DATALUX CORPORATION	87	6 JDR MICRODEVICES	249	241 QUA TECH, INC.	222	213 VIDEX	65
52 DATALUX CORPORATION	87	7 JDR MICRODEVICES	249	242 QUA TECH, INC.	222	214 XEC PRODUCTS	64
53 DELL COMPUTER CORP.	CII,1	109 KADAK PRODUCTS	44	243 QUA TECH, INC.	222	215 XELTEK	243
54 DELL COMPUTER CORP.	72,73	110 KEA SYSTEMS	173	244 QUA TECH, INC.	222	216 XELTEK	243
55 DELL COMPUTER CORP.	72A-B	111 KILA SYSTEMS	243	245 QUA TECH, INC.	222		
56 DEMOSOURCE	234	112 KUPER CONTROLS	243	246 QUA TECH, INC.	222		
59 DFI	182	113 LAGUNA CONVERSION SYS.	234	247 QUA TECH, INC.	222		

* Correspond directly with company

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		MISCELLANEOUS		SOFTWARE SECURITY		IBM/MSDOS APPLICATIONS	
526	ADD INS	117	METAMEDIA SYSTEMS, INC. 58	136	NISCA, INC. 123	184	RAINDROP SOFTWARE 68
10	ADD ON AMERICA 234	139	OPTICAL PUBLISHING, INC. 60	212	VIDEX 65	218	ROYKORE 216
16	ARTIST GRAPHICS 165	140	OPTICAL PUBLISHING, INC. 60	213	VIDEX 65	178	SPSS 171
36	CACHE COMPUTERS 147	141	OVERLAND DATA 232	939		Miscellaneous	
38	CAPITAL EQUIPMENT CORP. 20	181	STORAGE DIMENSIONS 125	12	ALADDIN 130	47	CORESOFT 45
44	COMPUTER SERVICE SUP CORP 158	182	STORAGE DIMENSIONS 125	88	GLENCO ENGINEERING, INC. 101	142	OWL INTERNATIONAL 109
46	COMTROL CORP. 52, 53	181	TEXAS MICROSYSTEMS 200, 201	155	PROTECH MARKETING, INC. 31	177	SPEECHSOFT 240
60	DIGIBOARD 49	* TEXAS MICROSYSTEMS 200A-B		156	PROTECH MARKETING, INC. 31	946	
61	DIGIBOARD 49	209	TULIN CORP. 128	162	RAINBOW 74	IBM/MSDOS APPLICATIONS	
67	DISTRIBUTED PROCESSING 129	210	TULIN CORP. 128	163	RAINBOW 74	Word Processing	
68	DISTRIBUTED PROCESSING 129	932		167	SAFESOFT SYSTEMS 234	26	BITSTREAM 181
* GATEWAY 2000 40A-H		MISCELLANEOUS		940		86	GEOCOMP CORP. 136
94	GTEK, INC. 141	11	AIELLO ENGINEERING 236	SYSTEMS		87	GEOCOMP CORP. 136
95	GTEK, INC. 141	20	BAY TECHNICAL ASSOCIATES 187	13	ALTEC TECHNOLOGY 36	947	
98	HIGH RES TECHNOLOGIES 236	21	BAY TECHNICAL ASSOCIATES 187	28	BLACKSHIP COMPUTER SYS 108	IBM/MSDOS CAD	
99	HOME SMART COMPUTING 236	27	BLACK JACK COMPUTER 240	* COMPUADD 104A-D		15	AMERICAN SMALL BUSINESS 93
105	I.S.C. 110, 111	58	DEMOSOURCE 234	* COMPUADD 136A-D		16	ARTIST GRAPHICS 165
111	KILA SYSTEMS 243	83	GALACTICOMM, INC. 2, 3	* DAMARK INT'L, INC. 116		17	A.M.S. 240
112	KUPER CONTROLS 243	100	HOOLEON 118	53	DELL COMPUTER CORP. CII, 1	84	GENERIC SOFTWARE 12, 13
115	MERRIMACK VALLEY SYS 236	* INTELLIGENT EXACT ENG 198		54	DELL COMPUTER CORP. 72, 73	85	GENERIC SOFTWARE 12, 13
121	MICRONICS 21	132	NCI 232	55	DELL COMPUTER CORP. 72A-B	948	
* MICROWAY CIV		133	NCI 232	62	DIGITAL DISTRIBUTING, INC. 28	IBM/MSDOS COMMUNICATIONS	
126	MONOLITHIC SYSTEMS CORP 54	152	PRECISION DATA PRODUCTS 236	63	DIGITAL DISTRIBUTING, INC. 28	29	BLAST/COMM RESCH GROUP 152
129	NASCENT TECHNOLOGY, INC. 240	173	SIGMA DATA 233	70	DTK COMPUTER, INC. 112	30	BLAST/COMM RESCH GROUP 152
130	NASCENT TECHNOLOGY, INC. 240	174	SILICON SHACK LTD 243	76	DTK COMPUTER, INC. 112	58	DEMOSOURCE 234
137	OMNITEL, INC. 17	182	THE PERISCOPE CO. 202	76	DTK COMPUTER, INC. 112	66	DISTINCT CORP 68
148	PERCEPTIVE SOLUTIONS, INC. 132	193	THE PERISCOPE CO. 202	77	EVEREX SYSTEMS 34, 35	110	KEA SYSTEMS 173
153	PROFESSIONAL COMPUTER SYS 234	211	TWIX INTERNATIONAL CORP 243	75	FIRST COMPUTER SYS INC 233	222	MICROSYSTEMS SOFTWARE, INC. 215
154	PROFESSIONAL COMPUTER SYS 234	212	VIDEX 65	76	FIRST COMPUTER SYS INC 233	223	MICROSYSTEMS SOFTWARE, INC. 215
240	QUA TECH, INC. 222	213	VIDEX 65	80	FLYTECH TECHNOLOGY, INC. 33	949	
241	QUA TECH, INC. 222	933		97	HAUPPAUGE COMP WORKS 11	IBM/MSDOS GRAPHICS	
242	QUA TECH, INC. 222	MODEMS/MULTIPLEXORS		102	H&W MICRO LABS 233	22	BELL ATLANTIC 159
243	QUA TECH, INC. 222	20	BAY TECHNICAL ASSOCIATES 187	103	IBM - PS/2 4	* EASTRIDGE TECHNOLOGY 30	
244	QUA TECH, INC. 222	21	BAY TECHNICAL ASSOCIATES 187	105	I.S.C. 110, 111	221	EVENT HORIZONS 126
245	QUA TECH, INC. 222	39	CINCINNATI TIME 146	111	KILA SYSTEMS 243	90	GROUNDHOG GRAPHICS, INC. 88
246	QUA TECH, INC. 222	40	CINCINNATI TIME 146	172	SHECOM COMPUTERS, INC. 192	91	GROUNDHOG GRAPHICS, INC. 88
247	QUA TECH, INC. 222	42	COMPUCOM 232	187	TANGENT 19	106	ISLAND SYSTEMS 128
248	QUA TECH, INC. 222	43	COMPUTER PERIPH. INC. 186	190	TEXAS INSTRUMENTS 157	107	ISLAND SYSTEMS 128
172	SHECOM COMPUTERS, INC. 192	197	TOUCHBASE SYSTEMS, INC. 16	191	TEXAS MICROSYSTEMS 200, 201	108	ITR 240
176	SPECIALTY SOFTWARE 160	* US ROBOTICS 58		* TEXAS MICROSYSTEMS 200A-B		950	
208	TRUEVISION, INC. 183	934		207	TRI-STAR COMPUTER 14	IBM/MSDOS LAN	
927		MONITORS		214	XEC PRODUCTS 64	222	MICROSYSTEMS SOFTWARE, INC. 215
119	MICRO SOLUTIONS COMP PROD 146	48	CTX INTERNATIONAL 174	941		223	MICROSYSTEMS SOFTWARE, INC. 215
181	STORAGE DIMENSIONS 125	49	CTX INTERNATIONAL 174	UPS		951	
182	STORAGE DIMENSIONS 125	224	NANAO 211	14	AMERICAN POWER CONVERSION 46	IBM/MSDOS LANGUAGES	
209	TULIN CORP. 128	225	NANAO 211	71	EMERSON UPS 96	74	FAIRCOM CORP. 50
210	TULIN CORP. 128	134	NEC INFORMATION SYSTEMS 8, 7	72	EMERSON UPS 96	114	LAHEY 104
928		188	TATUNG 27	145	PARA SYSTEMS 25	118	METAWARE 197
HARDWARE PROGRAMMERS		935		147	PC POWER & COOLING, INC. 71	125	MIX SOFTWARE 213
31	BP MICROSYSTEMS 240	NETWORK HARDWARE		148	PC POWER & COOLING, INC. 71	169	SCIENTIFIC ENDEAVORS 238
32	BP MICROSYSTEMS 240	20	BAY TECHNICAL ASSOCIATES 187	203	TRIPP LITE 198	170	SCIENTIFIC ENDEAVORS 238
215	XELTEK 243	21	BAY TECHNICAL ASSOCIATES 187	204	TRIPP LITE 198	171	SCIENTIFIC ENDEAVORS 238
216	XELTEK 243	* CLEO COMMUNICATIONS, INC. 59		SOFTWARE		196	STEPSTONE CORP. 66
929		46	COMTROL CORP. 52, 53	APPLE/MAC LANGUAGES		* VERMONT CREATIVE SOFTWARE 29	
INSTRUMENTATION		50	CYBEX CORP. 130	942		IBM/MSDOS UTILITES	
41	CME TELEMETRIX 236	60	DIGIBOARD 49	APPLE/MAC LANGUAGES		24	BETTER SOFTWARE 40
131	NATIONAL INSTRUMENT CII	61	DIGIBOARD 49	943		25	BETTER SOFTWARE 40
930		94	GTEK, INC. 141	IBM/MSDOS APPLICATIONS		33	BRIGHTBILL-ROBERTS 131
KEYBOARDS/MICE		95	GTEK, INC. 141	Business/Office		37	CADRE TECHNOLOGIES 9
51	DATALUX CORPORATION 87	165	ROCHELLE COMMUNICATIONS 233	222	MICROSYSTEMS SOFTWARE, INC. 215	89	GREENVIEW 18
52	DATALUX CORPORATION 87	18	SIM WARE 166	127	MICROSYSTEMS SOFTWARE, INC. 215	98	G.W. COMPUTERS, INC. 136
81	FTG DATA SYSTEMS 66	19	SIM WARE 166	* ORACLE 67		106	ISLAND SYSTEMS 128
82	FTG DATA SYSTEMS 66	194	THE SOFTWARE LINK 117	* QUARTERDECK 188(1-32)		107	ISLAND SYSTEMS 128
101	HOUSTON COMPUTER SERV 240	195	THE SOFTWARE LINK 117	160	RAIMA CORP. 39	108	ITR 240
931		936		166	ROSE ELECTRONICS 61	150	PHAR LAP SOFTWARE 69
MASS STORAGE		PRINTERS/PLOTTERS		944		159	QUARTERDECK 168
64	DIGI-DATA CORP 236	157	QMS 43	IBM/MSDOS APPLICATIONS		* QUARTERDECK 168(1-32)	
79	FLAGSTAFF ENGINEERING 120	158	QMS 43	Scientific/Technical		161	RAIMA CORP. 26
113	LAGUNA CONVERSION SYS 234	937		9	ABILITY SYSTEMS CORP 236	180	STATSOFT 145
116	METAMEDIA SYSTEMS, INC. 58	PRINTER RIBBONS/SUPPLIES		146	PATTON & PATTON 22	183	SUPERSOFT, INC. 70

READER SERVICE

Inquiry No.	Page No.
198 TOUCHSTONE SOFTWARE CORP.	24
199 TOUCHSTONE SOFTWARE CORP.	24
200 TRANS ERA CORP.	55
201 TRANS ERA CORP.	55
953 OTHER APPLICATIONS	
<i>Business/Office</i>	
22 BELL ATLANTIC	159
92 GROUP 1 SOFTWARE	38
93 GROUP 1 SOFTWARE	38
* ORACLE	67
214 XEC PRODUCTS	64
954 OTHER APPLICATIONS	
<i>Scientific/Technical</i>	
120 MICROMATH SCIENTIFIC SFTWR	124
139 OPTICAL PUBLISHING, INC.	60
140 OPTICAL PUBLISHING, INC.	60
955 OTHER—CROSS DEVELOPMENT	
* MARK WILLIAMS CO.	23
138 OPENNETWORK	20
956 OTHER—LAN	
217 ARTISOFT	219

Inquiry No.	Page No.
957 OTHER—LANGUAGES	
74 FAIRCOM CORP.	50
188 SANTA CRUZ OPERATION	115
958 OTHER—UTILITIES	
66 DISTINCT CORP.	68
89 GREENVIEW	18
959 DESKTOP PUBLISHING	
122 MICROPRESS	179
123 MICROPRESS	179
143 PACIFIC DATA PRODUCTS	119
144 PACIFIC DATA PRODUCTS	119
186 ROSE ELECTRONICS	61
960 EDUCATIONAL/INSTRUCTIONAL	
* A & M ENTERPRISES	234
23 BEST POWER TECHN., INC.	236
* BYTE BACK ISSUES	238

Inquiry No.	Page No.
* BYTE CARD DECK	212
* BYTE SUB MESSAGE	166
* BYTE SUB SERVICE	214
34 BYTEK COMPUTER CORP.	234
* BYTEWEEK/NEWSLETTER	242
220 HARD FACTS	209
* NSTL	235
961 MAIL ORDER/RETAIL	
* BUYERS MART	224-231
35 BZ TECHNICAL	232
45 COMPUTERLANE	239
85 DISKETTE CONNECTION	243
77 FIRST SOURCE INT'L	199
78 FIRST SOURCE INT'L	199
104 I.C. EXPRESS	240
8 JDR MICRODEVICES	249
7 JDR MICRODEVICES	249
124 MICROPROCESSORS UNLTD	234
135 NEVADA COMPUTER	241
* PROGRAMMER'S SHOP	148, 149
* PROGRAMMER'S SHOP	150, 151
175 SN'W COMPUTERS & ELECTRONICS	104
189 TELEPHONE PRODUCT CTR.	237

Inquiry No.	Page No.
962 MISCELLANEOUS	
* A & M ENTERPRISES	234
219 FUNCKEY ENTERPRISES	206
102 H&W MICRO LABS	233
211 TWIX INTERNATIONAL CORP.	243
963 ON-LINE SERVICES	
* BIX	156
* BIX	194
221 EVENT HORIZONS	126
220 HARD FACTS	209
964 OPERATING SYSTEMS	
108 KADAK PRODUCTS	44
22 BELL ATLANTIC	159

* Correspond directly with company

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 Advertising Director, Two Prudential Plaza, 180 North Stetson Ave., Chicago, IL 60601, tel. (312) 616-3341
 Jennifer L. Bartel, Western Advertising Director, 14850 Quorum Drive, Suite 380, Dallas, TX 75240, tel. (214) 701-8496
 Liz Coymann, Inside Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-2518

NEW ENGLAND
 ME, NH, VT, MA, RI, CT, ONTARIO
 CANADA & EASTERN CANADA
 Dan Savage (617) 860-6344
 Mary Ann Goulding (603) 924-2664
 McGraw-Hill Publications
 29 Hartwell Avenue
 Lexington, MA 02173
 FAX: (617) 860-6999

EAST COAST
 NY, NYC, NJ, DE, PA
 Kim Norris (212) 512-2645
 Ariane Casey (212) 512-2368
 Patricia Payne (603) 924-2654
 McGraw-Hill Publications
 1221 Avenue of the Americas—
 28th Floor
 New York, NY 10020
 FAX: (212) 512-2075

SOUTHEAST
 NC, SC, GA, FL, AL, TN, VA,
 MS, AR, LA, DC, MD, WV, KY
 John Y. Schilin (404) 843-4782
 Patricia Payne (603) 924-2654
 McGraw-Hill Publications
 4170 Ashford-Dunwoody Road
 Suite 520
 Atlanta, GA 30319
 FAX: (404) 252-4056

MIDWEST
 IL, MO, KS, IA, ND, SD, MN,
 WI, NE, IN, MI, OH
 Kurt Kelley (312) 616-3328
 Mary Ann Goulding (603) 924-2664
 McGraw-Hill Publications
 Two Prudential Plaza
 180 North Stetson Ave.
 Chicago, IL 60601
 FAX: (312) 616-3370

**SOUTHWEST,
 ROCKY MOUNTAIN**
 CO, OK, TX,
 Alison Kencan (214) 701-8496
 Patricia Payne (603) 924-2654
 McGraw-Hill Publications
 14850 Quorum Drive
 Suite 380
 Dallas, TX 75240
 FAX: (214) 991-6208

NORTH PACIFIC: San Francisco, CA
**NORTHERN CA, OR, ID, MT,
 WY, NORTHERN NV**
 Roy J. Kops (415) 954-9728
 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) 879-0381
 Leslie Hupp (408) 879-0381
 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, SOUTHERN NEVADA**
 Alan El Faye (213) 480-5243
 Jonathan Sawyer (603) 924-2665
 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
 Jonathan Sawyer (603) 924-2665
 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

Catalog Showcase/Outserts
 Scott Gagnon (603) 924-2651
BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

BYTE Deck
 Ed Ware (603) 924-2596
BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

BYTE International Postcards
 Ellen Perham (603) 924-2596
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:

Uwe Kretschmar, European Advertising and Marketing Manager, BYTE Publications,
 McGraw-Hill Publishing Co., Wimbledon Bridge House, One Harfield Road, Wimbledon, London, SW19 3RU, England, Tel: 44 81 543 1234, Fax: 44 81 540 3833

GERMANY
 Uwe Kretschmar (44-81-543-6268)
UNITED KINGDOM
 Roz Weyman (44-81-543-6269)
 McGraw-Hill Publishing Co.
 Wimbledon Bridge House
 One Harfield Road
 Wimbledon, London SW19 3RU
 England
 Tel: 44 81 543 1234
 FAX: 44 81 540 3833
 TEL EX: 892191

BENELUX
 Frank Tanis
 Batenburg 103
 3437 AB Nieuwegein
 The Netherlands
 Tel: 31 34 02 49496
 FAX: 31 34 02 37944

FRANCE, ITALY
 Zena Coupe, Amanda Blaskett
 A-Z International Sales Ltd
 4 Ashmount Road, Hornsey Lane
 Highgate, London N19 3BH
 England
 Tel: 44 71 281 4116
 FAX: 44 71 281 8224

ISRAEL
 Dan Ehrlich
 Ehrlich Communication International
 P.O. Box 11297
 Tel Aviv 61112
 Israel
 Tel: (972) 3 449823
 FAX: (972) 3 5468168

JAPAN
 Masaki Mori
 McGraw-Hill Publishing Co.
 Overseas Corp
 Room 1528
 Kasumigaseki Bldg.
 3-2-5 Kasumigaseki,
 Chiyoda-Ku
 Tokyo 100, Japan
 Tel: 81 3 581 9811
 FAX: 81 3 581 4018

SWEDEN
 Media Marketing AB
 Karlbergsvägen 89A
 S-10031 Stockholm
 Sweden
 Tel: 46 8 301280

HONG KONG
 Stephen Marcopoto
 Seavex Ltd.
 903 Wilson House
 19-27 Wyndham St.
 Central, Hong Kong
 Tel: 852-868-2010
 Telex: 60904 SEVEX HX
 FAX: 852 810 1283

SINGAPORE
 Jocelyn Domingo
 Seavex Ltd.
 400 Orchard Road, #10-01
 Singapore 0923
 Republic of Singapore
 Tel: 65 734 9790
 Telex: RS35539 SEAVEX
 FAX: 65 732 3129

TAIWAN
 Anita Chen
 Acer TWP
 977 Min Shen E. Road, 1-4 Flr.
 Taipei 10581, Taiwan ROC
 Tel: 886 2 763 0052
 Fax: 886 2 765 6874

REQUEST FREE PRODUCT INFORMATION BY FAX

Just fax this page to 1-413-637-4343. Save time because your request for information will be processed *immediately*.

- 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 "E".
- 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 primary job function/principal area of responsibility? (Check one.)

- ☐ 1 MIS/DP
☐ 2 Programmer/Systems Analyst
☐ 3 Administration/Management
☐ 4 Sales/Marketing
☐ 5 Engineer/Scientist
☐ 6 Other

B. What is your level of management responsibility?

- ☐ 7 Senior-level
☐ 8 Middle-level
☐ 9 Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- ☐ 10 Yes ☐ 11 No

D. What operating systems are you currently using? (Check all that apply.)

- ☐ 12 PC/MS-DOS
☐ 13 DOS + Windows
☐ 14 OS/2
☐ 15 UNIX
☐ 16 MacOS
☐ 17 VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

- ☐ 18 1-25
☐ 19 26-50
☐ 20 51-99
☐ 21 100 or more

Inquiry Numbers 1-495

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121
122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143
144	145	146	147	148	149	150	151	152	153	154
155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176
177	178	179	180	181	182	183	184	185	186	187
188	189	190	191	192	193	194	195	196	197	198
199	200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231
232	233	234	235	236	237	238	239	240	241	242
243	244	245	246	247	248	249	250	251	252	253

Inquiry Numbers 496-990

496	497	498	499	500	501	502	503	504	505	506
507	508	509	510	511	512	513	514	515	516	517
518	519	520	521	522	523	524	525	526	527	528
529	530	531	532	533	534	535	536	537	538	539
540	541	542	543	544	545	546	547	548	549	550
551	552	553	554	555	556	557	558	559	560	561
562	563	564	565	566	567	568	569	570	571	572
573	574	575	576	577	578	579	580	581	582	583
584	585	586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603	604	605
606	607	608	609	610	611	612	613	614	615	616
617	618	619	620	621	622	623	624	625	626	627
628	629	630	631	632	633	634	635	636	637	638
639	640	641	642	643	644	645	646	647	648	649
650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671
672	673	674	675	676	677	678	679	680	681	682
683	684	685	686	687	688	689	690	691	692	693
694	695	696	697	698	699	700	701	702	703	704
705	706	707	708	709	710	711	712	713	714	715
716	717	718	719	720	721	722	723	724	725	726
727	728	729	730	731	732	733	734	735	736	737
738	739	740	741	742	743	744	745	746	747	748

Inquiry Numbers 991-1479

991	992	993	994	995	996	997	998	999	1000	1001
1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012
1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023
1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034
1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045
1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056
1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067
1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078
1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089
1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111
1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122
1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133
1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144
1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155
1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166
1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177
1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188
1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199
1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210
1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221
1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232
1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243

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

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

1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254
1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265
1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276
1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287
1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298

FREE PRODUCT INFORMATION

Want More Information About the Products Featured in this Issue? Use this Reader Service Card!

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 "E".

3

Print your name and address and mail.

Fill out this coupon carefully. PLEASE PRINT.

Name _____
 Title _____ () Phone _____
 Company _____
 Address _____
 City _____ County _____ Code _____

A. What is your primary job function/principal area of responsibility? (Check one.)

- ☐ 1 MIS/DP
☐ 2 Programmer/Systems Analyst
☐ 3 Administration/Management
☐ 4 Sales/Marketing
☐ 5 Engineer/Scientist
☐ 6 Other

B. What is your level of management responsibility?

- ☐ 7 Senior-level ☐ 9 Professional
☐ 8 Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- ☐ 10 Yes ☐ 11 No

D. What operating systems are you currently using? (Check all that apply.)

- ☐ 12 PC/MS-DOS
☐ 13 DOS + Windows
☐ 14 OS/2
☐ 15 UNIX
☐ 16 MacOS
☐ 17 VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

- ☐ 18 1-25 ☐ 21 100 or more
☐ 19 26-50 ☐ 20 51-99

IBM
IRSE009

Inquiry Numbers 1-493

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

Inquiry Numbers 494-986

494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510
 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527
 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544
 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561
 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

Inquiry Numbers 987-1479

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 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241
 1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258
 1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275
 1276 1277 1278 1279 1280 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292
 1293 1294 1295 1296 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309
 1310 1311 1312 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326
 1327 1328 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343
 1344 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360
 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377
 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392 1393 1394
 1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408 1409 1410 1411
 1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 1426 1427 1428
 1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445
 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462
 1463 1464 1465 1466 1467 1468 1469 1470 1471 1472 1473 1474 1475 1476 1477 1478 1479

BYTE

TNT MAILFAST
 FRG/BOS/700252/MOI
 P.O. Box 66
 Hounslow
 TW5 9RT
 England

PLACE
POSTAGE
HERE

FREE PRODUCT INFORMATION

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 "E".

3

Print your name and address and mail.

Want More Information About the Products Featured in this Issue? Use this Reader Service Card!

PLACE POSTAGE HERE

BYTE

TNT MAILFAST
FRG/BOS/700252/MOI
P.O. Box 66
Hounslow
TW5 9RT
England

Fill out this coupon carefully. PLEASE PRINT.

Name _____

Title _____ Phone _____

Company _____

Address _____

City _____ County _____ Code _____

A. What is your primary job function/principal area of responsibility? (Check one.)

- ☐ 1 MIS/DP
☐ 2 Programmer/Systems Analyst
☐ 3 Administration/Management
☐ 4 Sales/Marketing
☐ 5 Engineer/Scientist
☐ 6 Other

B. What is your level of management responsibility?

- ☐ 7 Senior-level ☐ 9 Professional
☐ 8 Middle-level

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

- ☐ 10 Yes ☐ 11 No

D. What operating systems are you currently using? (Check all that apply.)

- ☐ 12 PC/MS-DOS
☐ 13 DOS + Windows
☐ 14 OS/2
☐ 15 UNIX
☐ 16 MacOS
☐ 17 VAX/VMS

E. For how many people do you influence the purchase of hardware or software?

- ☐ 18 1-25 ☐ 21 100 or more
☐ 19 26-50 ☐ 20 51-99

IBM

IRSE009

Inquiry Numbers 1-483

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

Inquiry Numbers 494-888

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

Inquiry Numbers 887-1479

887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 1003
1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020
1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037
1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054
1055 1056 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071
1072 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088
1089 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104 1105
1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120 1121 1122
1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136 1137 1138 1139
1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151 1152 1153 1154 1155 1156
1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167 1168 1169 1170 1171 1172 1173
1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190
1191 1192 1193 1194 1195 1196 1197 1198 1199 1200 1201 1202 1203 1204 1205 1206 1207
1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224
1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241
1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258
1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275
1276 1277 1278 1279 1280 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292
1293 1294 1295 1296 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309
1310 1311 1312 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326
1327 1328 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343
1344 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360
1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377
1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392 1393 1394
1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408 1409 1410 1411
1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 1426 1427 1428
1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445
1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462
1463 1464 1465 1466 1467 1468 1469 1470 1471 1472 1473 1474 1475 1476 1477 1478 1479



JDR Microdevices®

2233 BRANHAM LANE, SAN JOSE CA 95124

- BUY WITH CONFIDENCE FROM JDR!**
- 30-DAY MONEY BACK GUARANTEE
 - 1 YEAR WARRANTY
 - TOLL-FREE TECH SUPPORT



TI MICROLASER™ —FAST, AFFORDABLE AND EXPANDABLE!

EXPANDABLE PRINTER HAS TEXAS INSTRUMENTS QUALITY AND RELIABILITY IN A COMPACT SIZE! UPGRADEABLE TO 4.5MB AND POSTSCRIPT® • 300 DPI • 6 PPM OUTPUT • 250 SHEET DRAWER

• MANUAL FEED • 40 ENVELOPE AUTO FEED • 5MB RAM BASE UNIT • EMULATES HP LASERJET II

MICROLASER \$1495.00
MICROLASER-PS \$2495.00
 WITH 35 FONT POSTSCRIPT® AND 1.5MB RAM

TEFAX—FAX, COPIER, SCANNER, PHONE & PRINTER

• G3/G2 FAX MACHINE • 8.5" SCAN WIDTH • 200 DPI SCANNER • SAME SIZE COPIER • FAX SOFTWARE FOR IBM & MAC • AUTO FAX SEND

TEFAX \$995.00

**JDR'S AN AUTHORIZED EPSON
DEALER—CALL US FOR QUOTES**



CITIZEN 200GX COLOR PRINTER

CITIZEN EXPANDS 9-WIRE TECHNOLOGY TO THE CUTTING EDGE! OPTIONAL COLOR KIT PROVIDES VIVID COLOR OUTPUT UNRIVALED IN ITS PRICE RANGE!

• 5 RESIDENT FONTS • 240 X 216 DPI • 213 CPS DRAFT MODE: 40 CPS LETTER QUALITY • PARALLEL INTERFACES • 8K PRINT BUFFER

CTZ-200GX \$199.95
CTZ-200GXCOLOR COLOR ON COMMAND KIT \$59.95

KODAK DICONIX 150+ PORTABLE PRINTER

THE PERFECT COMPANION FOR YOUR LAPTOP OR OUR CARRY-1 PC! WEIGHS 5LBS AND MEASURES JUST 6.5" X 11" X 2.1"

• QUIET NON-IMPACT INK-JET TECHNOLOGY
 • UP TO 180 CPS • DRAFT, NLQ, QUALITY AND CONDENSED MODES • USES CUT-SHEET OR CONTINUOUS FORM PAPER
 • SUPPORTS EPSON FX-80 & IBM PROPRINTER COMMANDS

DICONIX-150 \$399.95

FUJITSU COLOR PLOTTER
 COMPACT PLOTTER • HP7475A COMPATIBLE • 025MM RES
FPG-315 \$799.00



INTRODUCING THE AMAZING CARRY-1 BOOK SIZE PC

\$299⁹⁵

THIS HIGH PERFORMANCE 8088-BASED COMPUTER COMPETES WITH FULL SIZE PC'S STAND IT UPRIGHT. SIT IT UNDER A MONITOR—ITS COMPACT SIZE IS THE PERFECT SOLUTION FOR A CROWDED DESKTOP. A COST-CONSCIOUS SCHOOL DISTRICT OR A CONVENIENT TRANSPORTABLE HOME COMPUTER

- 10MHz/4 77MHz 8088-1 CPU
 - AMI BIOS ASSURES COMPATIBILITY
 - 256K RAM EXPANDABLE TO 640K
 - BUILT-IN CGA, MGA DISPLAY ADAPTOR
 - BUILT-IN SERIAL, PARALLEL AND GAME ADAPTORS
 - BUILT-IN 3.5" 720K FLOPPY DRIVE
 - WORKS WITH ANY STANDARD KEYBOARD
 - INCLUDES CARRYING CASE, POWER ADAPTOR, MINI UPRIGHT STANDS
- CARRY-1** \$299.95
CARRY-1B \$399.95
 ENHANCED VERSION INCLUDES 2 FLOPPY DRIVES (720K) AND 640K RAM
- CARRY-1K** 82 KEY CARRY-1 KEYBOARD \$49.95



ADD 425 FONTS WITH 1 CARTRIDGE!

\$349⁹⁵

NEW SUPERSET™ HAS THE CAPABILITIES OF THESE CARTRIDGES: PDP'S™ 25 IN ONE™, HP'S MASTERTYPE™, PROCOLLECT™, HP'S MICROSOFT™ CARTRIDGE, HEADLINE FONTS & 18 PTS AND JETWARE'S 12/30 • FOR HP LASERJET SERIES II, IIP, III AND PCL COMPATIBLE • PRINTER DRIVERS FOR WORDPERFECT, MS WORD, MS WINDOWS, EXCEL, PAGERMAKER, WORD, AMI PROFESSIONAL, VENTURA PUBLISHERS, WORDSTAR AND LOTUS 1-2-3

SUPERSET

RAM CARD FOR HP LASERJET

• FOR HP LASERJET II PRINTERS • USER EXPANDABLE TO 1/2/4MB (0K INSTALLED) • USES 1MB 120 NS DRAMS

MCT-RAMJET \$89.95
MCT-RAMJET-P \$89.95
 1/2/4MB FOR IIP, USES 1MB DRAMS

OUTSTANDING SOFTWARE VALUES

THE NORTON UTILITIES \$69.95
SPINRITE \$79.95
QA PLUS \$89.95
P.C. TOOLS \$99.95
DESQVIEW 386 \$149.95
QEMM-386 \$39.95
VGA DIMMER \$29.95
QUATTRO-PRO \$359.95
PARADOX 3.0 \$469.95
TURBO C++ \$199.95

COLOR HAND SCANNER!

- 400 DPI 16-COLOR DITHER MODE
 - 200 DPI 16-SHADE GRAYSCALE
 - TRUE 400 DPI MONO MODE
 - 3 SWITCH-SELECTABLE 64-SHADE DITHER PATTERNS
 - SCAN EXERCISER SOFTWARE AND ZSOFT PAINTBRUSH VI PLUS
- CHS-400** \$599.00



DFI LOW COST ETHERNET CARD

- 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



NEW PRODUCTS FROM



PROMETHEUS



9600 BAUD V.32 MODEM WITH SEND/RECEIVE FAX

\$699

THIS NEW EXTERNAL MODEM IS V.32 AND V.42 COMPATIBLE. THE EMERGING 9600 BPS STANDARDS PLUS IT NOW HAS FULL GROUP 3 FAX SEND AND RECEIVE CAPABILITY. THIS MACHINE TRANSFORMS YOUR PC INTO A COMPLETE PERSONAL INFORMATION CENTER

- 9600/4800/2400/1200 BPS DATA MODEM
 - CCITT V.32, V.42 ERROR CORRECTION COMPATIBLE
 - MNP-5 ERROR CORRECTION AND DATA COMPRESSION FOR THROUGHPUTS UP TO 19200 BPS
 - 9600 BPS GROUP III SEND AND RECEIVE FAX
 - INCLUDES PRO-COMM COMMUNICATIONS SOFTWARE
 - INCLUDES FAX-IT FAX SOFTWARE
 - 2 YEAR WARRANTY
- PRO-96EF**

INTERNAL FAX MODEM

\$229⁹⁵

- 2400/1200/300 BPS DATA MODEM
 - 9600 BAUD SEND/RECEIVE FAX CAPABILITY
 - 8088, 286, 386 COMPATIBLE CARD
- PRO-MAXI**



MINI 2400 BPS MODEM WITH SEND ONLY FAX

\$139⁹⁵

THIS TINY EXTERNAL MODEM PACKS A BIGGER PUNCH THAN YOU'D EXPECT! NOT ONLY IS IT A FULL FUNCTION 2400 BPS DATA MODEM BUT IT ALSO OPERATES AS A SEND-ONLY FAX AT A REMARKABLY LOW PRICE!

- 2400/1200/300 BPS DATA MODEM
 - CCITT V.22/V.22BIS, BELL 103/212A COMPATIBLE
 - 4800 BPS GROUP III SEND ONLY FAX
 - MEASURES JUST 6.25 X 3.8 X 2 INCHES
 - 8 STATUS LEDS
 - INCLUDES PRO-COMM COMMUNICATIONS SOFTWARE
 - INCLUDES FAX-IT FAX SOFTWARE
 - 2 YEAR WARRANTY
- PRO-EFXM**

MINI-MODEM WITH 9600 BPS FAX-SEND SPEED
PRO-EFXM96 \$169.95

2400BPS MINI MODEM

\$119⁹⁵

AS ABOVE BUT WITHOUT FAX CAPABILITY
MCT-24E



2400 BPS MNP ERROR CORRECTING MODEM

\$249⁹⁵

AN ECONOMICALLY PRICED EXTERNAL MODEM THAT NOW INCLUDES MNP-5 ERROR CORRECTION AND DATA COMPRESSION CAPABILITY

- 2400/1200/300 BPS DATA MODEM
- CCITT V.22/V.22BIS, BELL 103/212A COMPATIBLE
- DATA COMPRESSION BOOSTS THROUGHPUT UP TO 4800 BPS
- 8 STATUS LEDS
- AT COMMAND SET COMPATIBLE
- AUTO DIAL AND AUTO ANSWER
- 2 YEAR WARRANTY

PRO-24EMNP

PRO-24E EXTERNAL 2400 BAUD MODEM-NO MNP \$149.95

INTERNAL MNP MODEM

\$189⁹⁵

PLUG-IN CARD MODEM HAS SAME FEATURES AS ABOVE MODEL. FOR 8088, 286/386 COMPUTERS

PRO-24MNP

PRO-24I INTERNAL 2400 BAUD MODEM-NO MNP \$99.95

TERMS: Minimum order \$10.00. For shipping & handling include \$4.00 for ground and \$5.50 for air. Orders over 1 lb. and foreign orders may require additional shipping charges. Contact our Sales Dept. for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sales. A full copy of our terms is available upon request. Items pictured may only be representative. JDR, the JDR logo, JDR Microdevices, and the MCT logo are registered trademarks of JDR MICRODEVICES, INC.

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)

ORDER TOLL-FREE 800-538-5000

Copyright 1990 JDR MICRODEVICES

KEY
CODE
#10

DOS UNBOUND: USES OF PROTECTED MODE

DOS UNBOUND: USES OF PROTECTED MODE

DOS UNBOUND: USES OF PROTECTED MODE

COMPANY INFORMATION

Ergo

1 Intercontinental Way
Peabody, MA 01960
(508) 535-7510
Inquiry 1075.

MetaWare, Inc.

2161 Delaware Ave.
Santa Cruz, CA 95060
(408) 429-6382
Inquiry 1076.

Phar Lap Software

60 Aberdeen Ave.
Cambridge, MA 02138
(617) 661-1510
Inquiry 1077.

Watcom Systems, Inc.

415 Phillip St.
Waterloo, Ontario,
Canada N2L 3X2
(519) 886-3700
Inquiry 1078.

small program shown in listing 2. When it is in real mode, it peeks at the BIOS timer count located at 0040:006C, but when it runs in protected mode under the Phar Lap DOS extender, it produces the following message:

```
C:\PHARLAP>run386 ticks
Abnormal program termination:
Memory protection fault CS:EIP =
000C:0000000C.
```

at 000C: 00000000C; what instruction does that correspond to?

```
0002      xor ax,ax; AX = 0
0005      mov fs,ax
0007      mov eax,0000046cH
000c      push fs:[eax]
```

Note that loading 0 into FS (one of two additional segment registers on the 386) did not cause a GP fault. You use selector 0 to create null pointers in protected mode. Loading these pointers is always legal; however, if you try to dereference one, it causes a GP fault. That's what happened with PUSH FS:[EAX]. Furthermore, an equivalence between 0040:006C and 0000:046C was assumed, and this doesn't hold in protected mode.

So how can you peek at memory location 0040:006C? You often hear statements like "you can't do that in protected mode." But rather than take these as injunctions, you should just regard them as problems to solve. Obviously, you *can* execute data in protected mode: otherwise, how would executables ever get loaded and executed? Likewise, there must be some way to peek at arbitrary physical memory locations: otherwise, how could anyone write graphics code?

There are several ways to read the BIOS data area at real-mode segment 40h. Phar Lap executables (whether run under the Phar Lap or the Ergo DOS extender) provide a protected-mode selector, 34h, that maps to the first megabyte of physical memory. (Note how the entire DOS address space occupies a tiny portion of one 32-bit protected-mode selec-

an executable alias selector for a data segment or a writable data selector to a code segment. You can call a real-mode service (software interrupt or far call) not transparently handled by the DOS extender (e.g., NetBIOS or undocumented DOS calls like INT 21h AH=52h). Or you can query virtual-memory statistics. These APIs are quite small, but they're proof that you don't need 500 functions to provide a powerful API.

Future Directions

Now is a good time to get into 386 development. There is healthy competition between the two major 32-bit C compiler manufacturers, MetaWare and Watcom. The new release of Watcom's compiler includes not only the first source-level debugger for 32-bit DOS extenders, but also a superb execution profiler. Micro-soft itself finally has a 32-bit C compiler (C 5.2) targeted for OS/2 2.0. Several C++ compilers are available for 32-bit DOS. Meanwhile, the entire DOS extender "industry" is working together in a committee with Microsoft and others to put together the DPMS specification. Windows 3.0 incorporates the DPMS specification, and OS/2 2.0 is expected to. Perhaps it will even find its way into a future version of MS-DOS itself.

All these developments should ensure a long life for 32-bit DOS applications, and they should ensure that the 386 won't remain a code museum for ancient 8088 code. Now is the time to stop finding workarounds for limitations that the 386 is only pretending to have. ■

Their 20MHz 386 System Alone: \$6354.
CompuAdd's NEW DX Success Kit: \$1995.
And The Deal Gets Better...



- CompuAdd 320 system and monitor
- 40MB hard drive
- FREE Panasonic printer
- FREE mouse
- FREE Windows 3.0
- FREE MS-DOS 4.01

We Give You A FREE Printer And More!

CompuAdd's NEW DX Success Kit \$1995

**320 System Alone Was \$2259.
Save \$263 And Get The Printer And
CompuAdd Windows 3.0 FREE!**

CompuAdd answers your demands for affordable 386-powered systems — and goes one better with the NEW CompuAdd DX Success Kit.

The 320 system alone was \$2259. Now you save \$263 and, in effect, get a FREE Panasonic KX-P1180 printer — a \$179 value! Add to that, a FREE CompuAdd mouse plus FREE software worth over \$230, and you have a deal that appeals to the shrewdest Executive.

The NEW DX Success Kit gives you the power of our 20MHz 386 system with the convenience of our popular "plug-and-go" kits. FREE CompuAdd Windows 3.0 and FREE CompuAdd MS-DOS 4.01 come pre-loaded on your hard drive, so your system is ready to go right out of the box!

With the 320 at the heart of your kit, you have power for the most demanding tasks — detailed spreadsheets, complex databases, desktop publishing and even CAD/CAM. Compatible with OS/2 and Novell operating systems as well as MS-DOS and SCO XENIX, the 320 also makes an excellent network file server or powerful workstation.

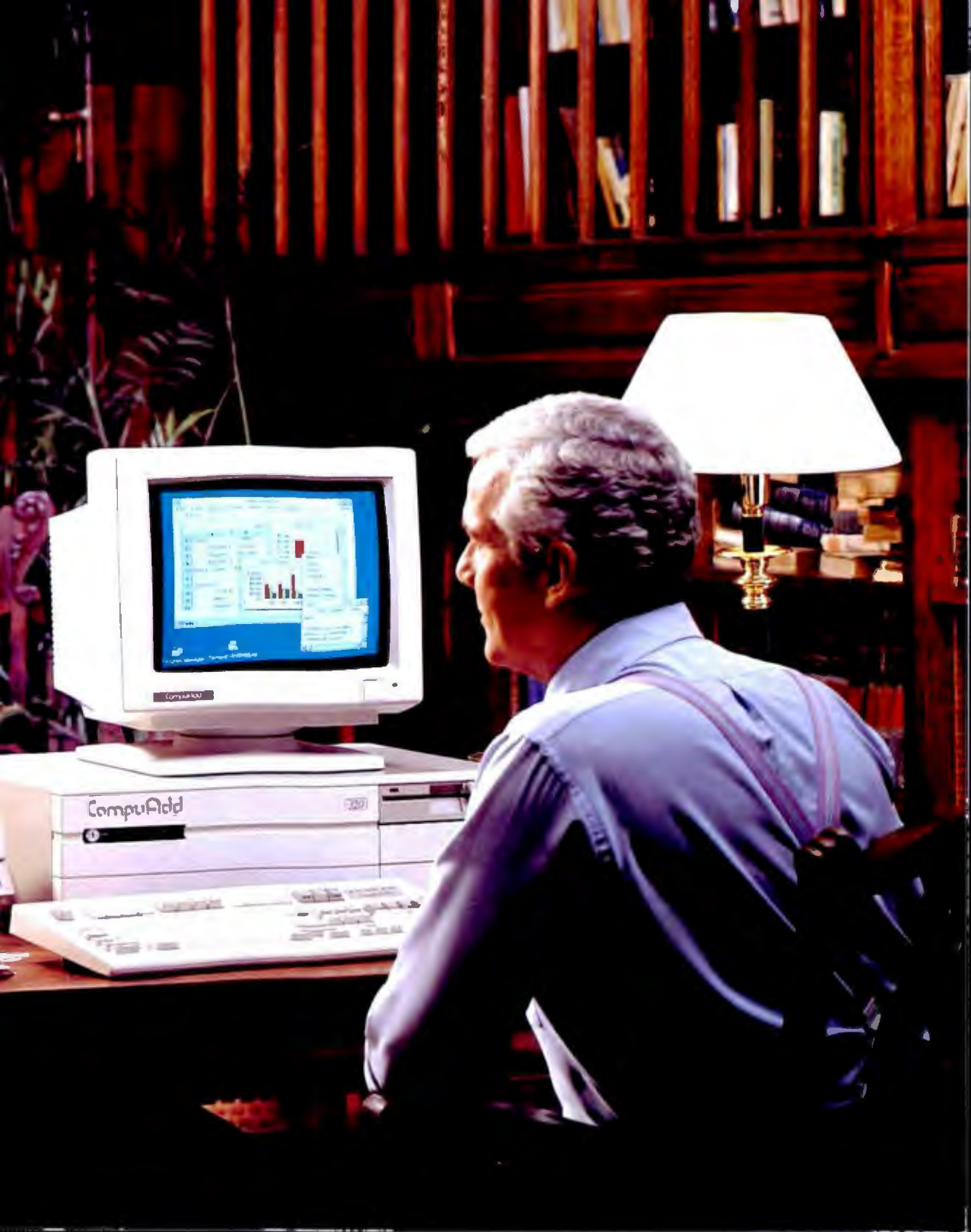


CompuAdd NEW DX Success Kit features:

80386 microprocessor running at 20MHz
1 MB DRAM expandable to 16MB
0 wait-state cache memory
40MB (28ms) hard drive
5.25" 1.2MB or 3.5" 1.44MB diskette drive
Dual diskette controller
Dual IDE hard drive interface
Six 16-bit and two 8-bit expansion slots

Five 5.25" half-height drive bays
Built in parallel and two serial ports
High performance monitor and graphics adapter
FREE! Panasonic KX-P1180 printer
FREE! CompuAdd mouse
FREE! CompuAdd Windows 3.0 preloaded
FREE! CompuAdd MS-DOS 4.01 preloaded

Part Number 66674



The Panasonic KX-P1180 printer that comes with your NEW DX Success Kit is a 9-pin Near-Letter-Quality printer. Chosen *PC Magazine* Editor's Choice in November 1989, the Panasonic printer is a \$179 value -- yours virtually FREE when you buy CompuAdd's NEW DX Success Kit.

Look for us at Comdex
Exhibit Booth N3250

*Get 386 Power, Kit
Convenience and CompuAdd Value!*

Call 800-766-7646

CompuAdd[®]
Customer driven. by design.[™]

CompuAdd DX Success Kit

Kit price: \$1995 (66674)

CompuAdd responds to your demands for full 386 performance and power with the NEW DX Success Kit. Run Windows 3.0 plus all the latest 386-

based software or your favorite 286 applications. The DX Success Kit combines our full profile CompuAdd 320 with all these extras: a Panasonic KX-P1180 printer, a CompuAdd serial mouse, CompuAdd Windows 3.0 and MS-DOS 4.01. Step up the ladder to the DX Success Kit.



CompuAdd 333

CompuAdd designed the 333 Tower and Full Profile systems with "hot slots" — expansion slots optimized to boost data transfers with CompuAdd's HardCache ESDI controller and Hi-Rez VGA card. Get maximum speed enhancement for minimum cost.



- 80386 microprocessor running at 33MHz
 - 4MB DRAM expandable to 16MB
 - 0 wait-state cache memory
 - 5.25" 1.2MB or 3.5" 1.44MB diskette drive
 - Six 16-bit and one 8-bit expansion slots
 - Four half-height front access and five half-height internal 5.25" drive bays (Full Profile has three half-height front access and two half-height internal 5.25" drive bays)
 - FREE CompuAdd serial mouse
 - FREE CompuAdd Windows 3.0 and MS-DOS 4.01
 - CompuAdd 333
- Tower base system: \$2775 (66656)
Full Profile base system: \$2595 (66665)

CompuAdd 425

Based on the revolutionary Intel i486 microprocessor — the "mainframe on a chip" — the CompuAdd 425 delivers astonishing performance. And it's compatible with all your favorite 286 and 386 applications.



- 80486 microprocessor rated at 25MHz with internal 8KB cache and floating point processor
- 4MB DRAM, expandable to 8MB using SIMMs (supports 1, 2, 4, 5 and 8MB on motherboard, full 16MB on system bus)
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 80MB hard drive
- Three 16-bit and two 8-bit expansion slots
- 16-bit video graphics adapter
- CVGA monitor
- FREE CompuAdd Windows 3.0 and MS-DOS 4.01
- FREE CompuAdd serial mouse
- System Price: \$4995 (66652)

**CALL TODAY! or
visit a CompuAdd
Superstore for these
savings.**

800-766-7646

Hours Monday - Friday 7:00am to 7:00pm CST

We accept MasterCard, VISA, money orders, certified checks and personal checks (please allow ten days for processing). CODs (\$50 minimum order), company and institutional purchase orders (minimum initial purchase \$500, thereafter \$50), and wire transfers.
Please add 2% to all purchases for shipping and handling (minimum \$3, shipping outside the continental United States will increase cost). Add 8% for shipping and handling to APO/FPO addresses (minimum \$10). AZ, CO, CT, DC, FL, GA, IL, IN, KS, LA, MA, MD, MI, MN, MO, NC, NE, NJ, NM, NY, OH, OK, PA, RI, SC, TN, TX, UT, VA, and WI residents, please add appropriate local sales tax. Thirty-day money-back guarantee does not include return freight or shipping and handling. Opened software, videotapes, and other consumables are nonrefundable. All return items must be accompanied by a return merchandise authorization (RMA) number. Prices and product descriptions are subject to change without notice. CompuAdd is not liable for damage due to omissions or typographical errors. Call 800-666-1872 for a copy of CompuAdd's complete warranty.

- 80386 microprocessor running at 20MHz
- 1MB DRAM expandable to 16MB
- 0 wait-state cache memory
- ROM shadowing into faster DRAM
- 40MB (28ms) hard drive
- 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Dual diskette controller
- Dual IDE hard drive interface
- Six 16-bit and two 8-bit expansion slots
- Five 5.25" half-height drive bays
- Built in parallel and two serial ports
- High performance monitor and graphics adapter
- 80387 math coprocessor support
- Real-time clock/calendar
- MS-DOS, OS/2, SCO UNIX/XENIX, and Novell compatible
- 101-key enhanced keyboard
- FREE Panasonic KX-P1180 9-pin Near-Letter-Quality printer
- FREE CompuAdd mouse
- FREE CompuAdd Windows 3.0 and MS-DOS 4.01

Think Technology, Think CompuAdd

CompuAdd®

Customer driven, by design.™

12303 Technology, Austin, Texas 78727
Fax: 512-335-6236
Telex: 763543 COMPUADD AUS

Technical Support: 800-999-9901
Outside US: 512-258-5575
Canada: 800-837-3266

Order BYTE Program Listings on Disk!



BYTE listings are available on disk if you want to compile or read the complete source code listings of programs. BYTE listings are available from December 1985 to the present at the prices stated on the adjacent order form.

Call Toll-free 800-258-5485
(in N.H. 603-924-9281)

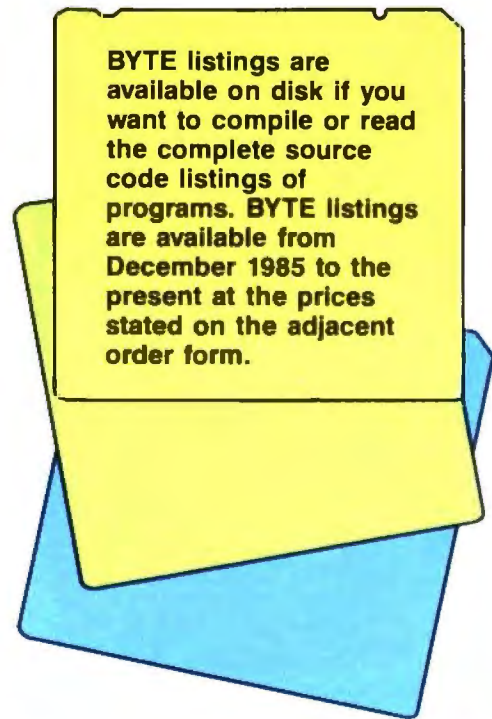
BYTE on Disk

One Phoenix Mill Lane
PO Box 809
Peterborough, NH 03458-0809

PLACE
POSTAGE
HERE

Order BYTE Program Listings on Disk!

BYTE listings are available on disk if you want to compile or read the complete source code listings of programs. BYTE listings are available from December 1985 to the present at the prices stated on the adjacent order form.



Call Toll-free 800-258-5485
(in N.H. 603-924-9281)

FOR DIRECT ORDERING CALL TOLL-FREE: 800-258-5485

Call: M-F, 8:30 a.m. to 4:30 p.m. Eastern Time; (603-924-9281 for N.H. residents). *For credit card orders only.*



ORDER FORM: To place your order, fill out the card and mail.

PLEASE COMPLETE IN FULL

Name _____

Address _____

City _____

State _____ Zip _____

County or Parish _____ Country _____

Credit Card # _____ Exp. Date _____

Signature _____ Date _____

Please allow 6-12 weeks for delivery.

IBM

5¼ Inch: <input type="checkbox"/> IBM PC	3½ Inch: <input type="checkbox"/> Apple Macintosh <input type="checkbox"/> IBM PS/2	• Please indicate the issue date below. If you are beginning an annual subscription, note the starting issue. BYTE Program Listings Month _____ Year _____ <input type="checkbox"/> Check enclosed <input type="checkbox"/> MasterCard <input type="checkbox"/> VISA <input type="checkbox"/> U.S. funds enclosed (If ordering from outside the U.S. please remit in U.S. funds drawn on U.S. bank. Thank you.)
IN USA/Single Month (1 disk) <input type="checkbox"/> BYTE Listings \$10.95 <input type="checkbox"/> BYTE Listings \$11.95		
IN USA/Annual Subscription (13 disks) <input type="checkbox"/> BYTE Listings \$89.95 <input type="checkbox"/> BYTE Listings \$99.95		
OUTSIDE USA/Single Month (1 disk) <input type="checkbox"/> BYTE Listings \$13.95 <input type="checkbox"/> BYTE Listings \$14.95		
OUTSIDE USA/Annual Subscription (13 disks) <input type="checkbox"/> BYTE Listings \$109.95 <input type="checkbox"/> BYTE Listings \$119.95		

BYTE





*Mission Critical
Rack-mount 3014:
14 option slots,
5 drive bays and a
95-130 VAC, 47-440
11z power supply,
pictured with a
model 1005R EGA
monitor (optional)*



BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 2484 HOUSTON, TEXAS

POSTAGE WILL BE PAID BY ADDRESSEE

Texas Microsystems, Inc.
10618 Rockley Road
Houston, TX 77099

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



**Want more than just another pretty face? Send the card.
Or call 1-800-627-8700.**

Name _____ Title _____

Company _____ Phone _____

Address _____ City _____ State _____ Zip _____

Are you a ☐ VAR ☐ Consultant ☐ Government Purchaser ☐ Corporate Purchaser ☐ DP/MIS Purchaser ☐ End User

Type of Business _____

Type of Operating Environment/Application _____

1 How many PCs does your company plan to purchase?

Timeframe: ☐ Within the next month ☐ Within three months ☐ Within six months

Quantity: _____

2 What type of configuration are you interested in?

☐ Rack-mount workstation ☐ Benchtop workstation ☐ Tower system ☐ Cards _____

3 Which processor do you require in your system?

☐ 286-based systems ☐ 386-based systems ☐ 486-based systems ☐ Other _____

4 What operating system would you use? _____ 5. How many expansion slots do you need? _____

6 Do you need assistance developing specifications? ☐ YES ☐ NO

7 What specifications are most important to your application?

☐ Mean Time Between Failures ☐ Mean Time To Repair ☐ Heat _____ ☐ Dust _____ ☐ Shock _____ ☐ Other _____

8 What type of custom configuration do you need? _____

© 1990, Texas Microsystems, Inc. "Mission Critical Micro" is a trademark of Texas Microsystems, Inc. Other trademarks mentioned are registered, trademarked or service marked by their respective manufacturers.

Put LabWindows to Your Test



LabWindows® INSTRUMENTATION SOFTWARE **A+**

Data Acquisition

GPIO
Plug-in Boards
VXI
RS-232

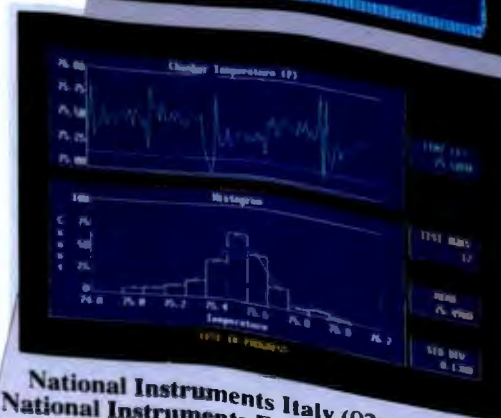
Data Analysis

Digital Signal Processing
Statistics
Curve Fitting
Array Operations

Data Presentation

File I/O
2D Plots
Real Time Strip Charts
Printer and Plotter Output

- ☒ ☐ True False
- ☒ ☐ Industry standard Microsoft C, QuickC, and QuickBASIC development tools for data acquisition and instrument control.
- ☒ ☐ Instrument drivers for over 100 GPIO, VXI, and RS-232 instruments.
- ☒ ☐ Integrated support for plug-in data acquisition boards.
- ☒ ☐ Powerful analysis library for real-time data processing.
- ☒ ☐ Extensive graphics library for creating full-color displays on printers and plotters.
- ☒ ☐ Code generation and debugging tools for faster program development.
- ☒ ☐ Software development tools for production test and ATE systems.



LabWindows...making industry standard programming languages work for you in data acquisition and instrument control.

NATIONAL INSTRUMENTS®
The Software is the Instrument®
6504 Bridge Point Parkway
Austin, TX 78730-5039
Circle 131 on Reader Service Card

National Instruments Italy (02) 4830 1892
National Instruments France (1) 48 65 33 70
National Instruments Switzerland (056) 82 18 27
National Instruments United Kingdom (06) 35 523 545
Nihon National Instruments K.K. (Japan) (03) 788 1921

**Call for a FREE Demo Disk and Catalog
(512) 794-0100 • (800) 433-3488 (U.S. and Canada)**

Discover Parallel Processing

Quadputer™

The Microway Quadputer is the world's most popular PC Transputer development environment. It can be purchased with two to four Transputers and one to four megabytes of RAM per processor. The Quadputer runs all the popular Transputer development software, all of which is available from Microway. It is compatible with our Monoputer™ which provides 1 to 16 megabytes of RAM and a single T800, our Videoputer™ which comes in VGA and higher resolution versions and is powered by a memory mapped pair (T800 and 34010), and our Linkputer™ whose cross bar switching network can dynamically link up to 32 Transputers. Finally, all Microway Transputer products can be used with our Number Smasher-860 to provide out-of-this-world numeric performance!

For more information, please call 508-746-7341.

Microway

The World Leader in PC Numerics

Corporate Headquarters, Research Park, Box 79, Kingston, MA 02364

TEL 508-746-7341 • FAX 508-746-4678

U.K. - 32 High St., Kingston-Upon-Thames, 081-541-5466 • Italy 02-74.90.749

Holland 40 836455 • Germany 069-75-2023 • Japan 81 3 222 0544

Number Smasher® 860

The highest performance coprocessor card to ever run in a PC, Number Smasher-860 delivers up to 80 million single precision floating point operations per second at 40 MHz and produces over 10 Linkpack megaflops. The board comes standard with an ISA interface, two Transputer Link Adaptors that allow it to interface with a Microway Quadputer or Videoputer, your choice of our NDP Fortran, C or Pascal for the 80860, plus 8 megabytes of high speed memory.

NDP Fortran-860, C-860 and C++-860

Microway NDP 860 Compilers make it easy to recompile your favorite mainframe, 80386 or PC application for the 80860. The resulting code runs on our XTEND-860™ environment under DOS, UNIX or XENIX.

