DECEMBER 1991 THE LATEST WINDOWS WORD PROCESSORS Page 53

BYTE

A McGRAW-HILL PUBLICATION

Exclusive!

Intel and IBM Team Up on Multimedia

Page 177

Better Windows Than Windows?

OS/2 2.0

Firsthand Report on IBM's New 32-bit Operating System

MULTIMEDIA

Inside Apple's QuickTime Page 189

Multimedia at Work Page 153

LAB TESTS

15 Presentation Graphics Packages for DOS, Windows, and the Mac

PLUS

- Sun's Low-Cost Workstations
- Zenith's new Mastersport Notebook
- Lab Report: 6 Fax Servers
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Introducing Lotu

It's everything a Windows spreadsheet was meant to be.

After listening carefully to what our customers were looking for in a Windows™ spreadsheet, we developed Lotus® 1-2-3® for Windows with three goals in mind.

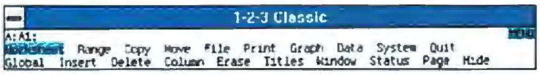
First, make it a full-fledged Windows application.

Second, introduce innovations that deliver a perfect balance of power and simplicity.

And third, make it fully compatible with all of the earlier versions of 1-2-3 that millions of 1-2-3 users are familiar with.

Well, we've done all this. And a whole lot more. Which, no doubt, is why 1-2-3 for Windows was awarded Byte Magazine's *Best New Windows Application* at Comdex/Spring '91.

For starters, the most exciting part of 1-2-3 for Windows is its SmartIcons,™ an innovative "one-click" approach for automating common spreadsheet tasks and fine tuning your working



Push the slash key and you'll have instant access to the familiar 1-2-3 menu which will appear in a window on your screen.

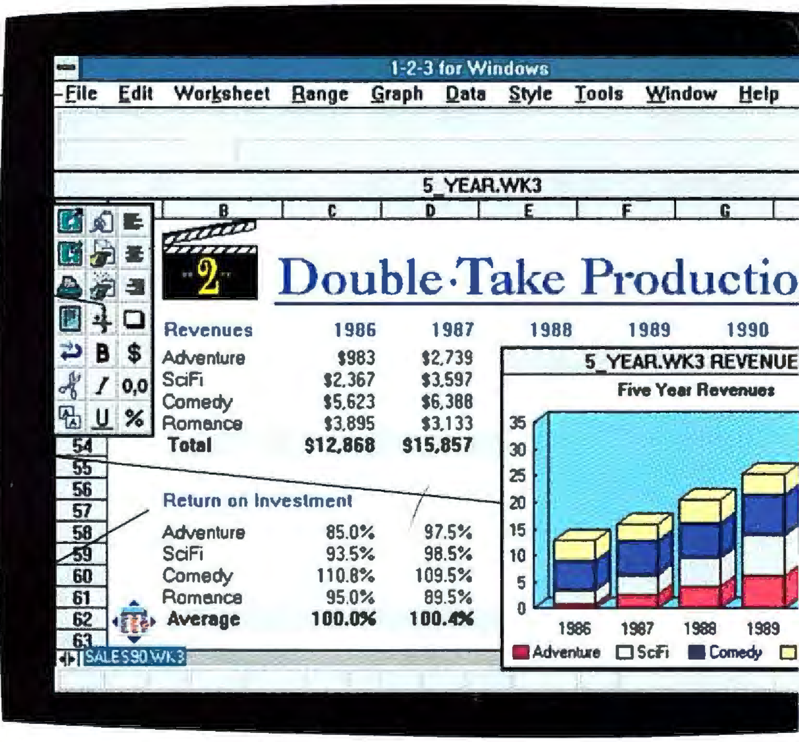
environment for even greater productivity. You'll also find these SmartIcons in all our Windows products, including Ami Pro™ 2.0, our award-winning word processor.

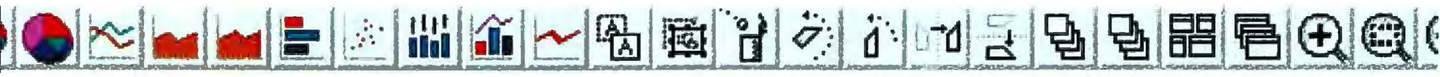
You'll feel right at home with our true Windows interface. And you can easily integrate your spreadsheet data with other Windows applications.

Our palette of customizable SmartIcons can be sized and placed anywhere on your screen.

Our interactive graph gallery means you can preview and select by example a wide range of chart and graph types.

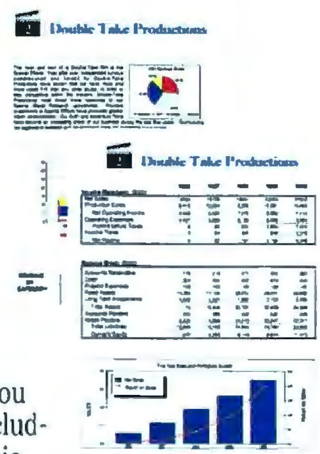
The program includes Adobe Type Manager® (ATM),® the leading scalable font manager, for outstanding spreadsheet publishing and presentation options.





ıs 1-2-3 for Windows.

With our "zoom in," "zoom out" and fast print preview features, you can refine and perfect your work before you print. Which means your output will always be just what you want it to be. Without any surprises at the printer.

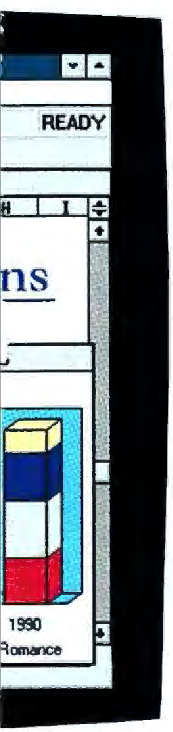


Unlike the Toolbar™ in Microsoft* Excel, 1-2-3 for Windows actually lets you create your own icons for the tasks that are unique to you.

And yes, 1-2-3 for Windows fully exploits the Windows environment. Which means it includes pull down menus, dialog boxes, sizable windows, mouse support, full DDE support and everything else you'd expect in a true Windows application.

What's more, with its interactive graph gallery, you can select by example a wide range of graph types, including true 3D graphs in bar, line, area, stacked bar and pie.

Of course, when you're ready to print, your results will be nothing short of perfection. And thanks to its Auto Compress feature, you can easily make an entire report fit on one page.



Beneath it all, you'll have the complete power of 1-2-3 at work for you. Including 3D worksheets, Solver goal-seeking features and external data access through DataLens.*

And finally, to make the move to Windows a simple one for 1-2-3 users, we've included the 1-2-3 Classic* commands in the program. Where, at the push of the slash key, the familiar 1-2-3 menu will appear, fully functional, on screen. So 1-2-3 for Windows offers you complete file, style, macro and keystroke compatibility with all of the previous versions of 1-2-3.

So see why Lotus 1-2-3 for Windows is more than a great Windows spreadsheet. It's everything you've been looking for in one.

And now, you can upgrade from your current version of 1-2-3 to 1-2-3 for Windows and get both 1-2-3 and Ami Pro 2.0 for just $199.* A suggested retail value of $645. For a free auto demo, or to order your upgrade directly from Lotus,** call **1-800-TRADEUP, ext. 6374.**

These SmartIcons give you "one-click" shortcuts for your most frequently used tasks, such as opening and saving files and printing.

Use them for a variety of activities, from simple functions like auto-summing ranges to more powerful analytical tasks, such as accessing Solver.

SmartIcons give you easy access to Windows functionality like cutting, copying and pasting to and from the clipboard.

Virtually any formatting task you need to do, including pasting one cell's style to a range of cells, is just one click away.

SmartIcons make it incredibly easy to arrange your worksheets in three different views: tile, cascading and 3D perspective.

Click this and you'll create charts and graphs automatically. Then the icon palette will change to provide SmartIcons that enhance your graphs.

Run and de-bug macros, select macro keywords, or create your own customized icons for your macros.

1-2-3 for Windows

Lotus

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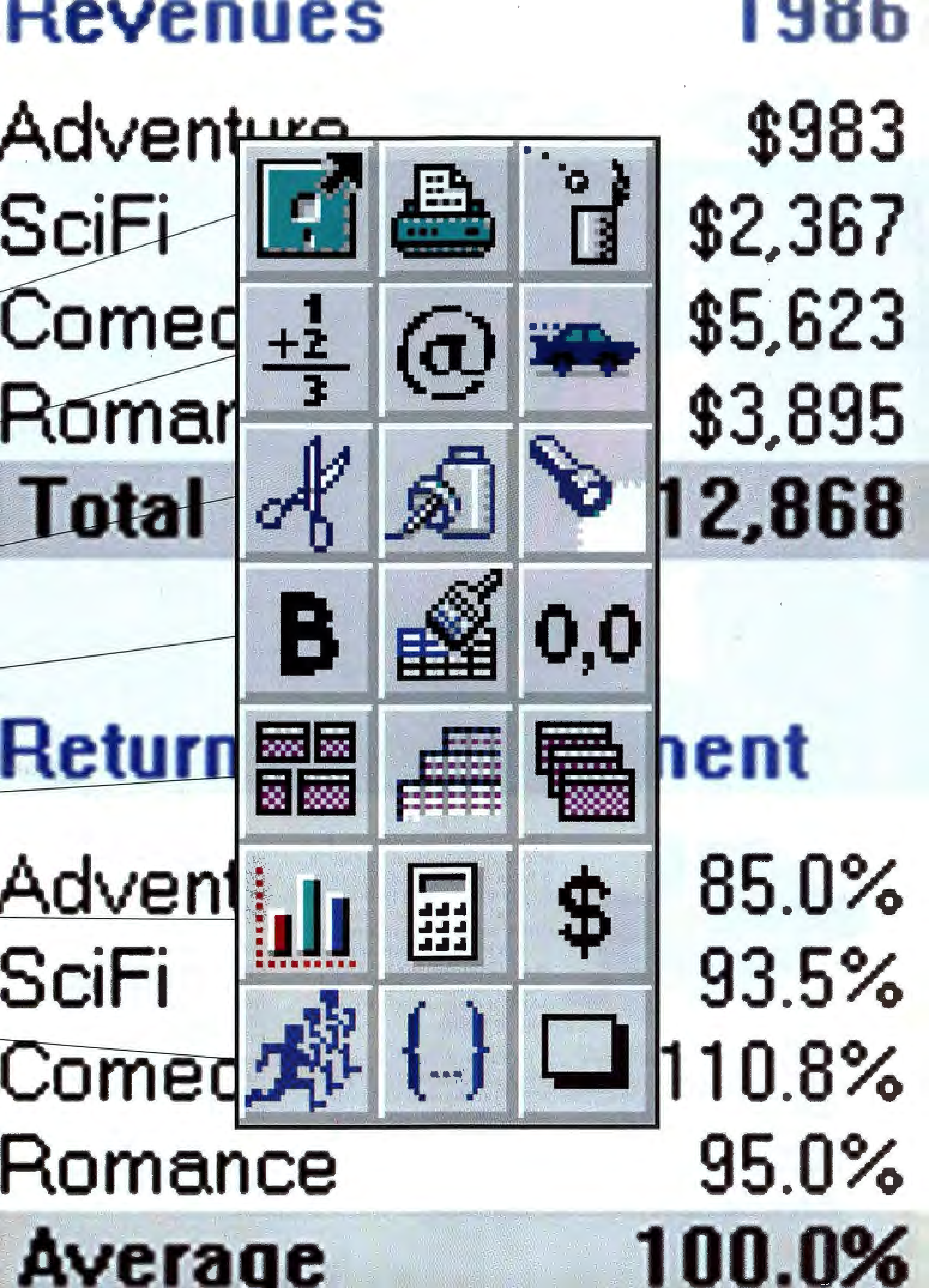
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Total EISA Expansion Slots	**8**	7
Hard Drives	Two 210-MB, <15ms	Two 210-MB, <19ms
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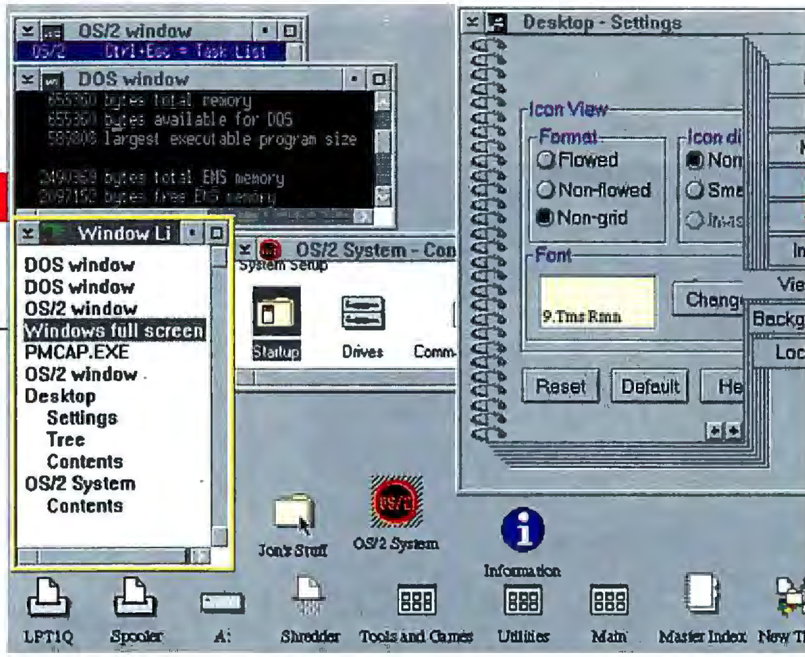
December 1991 Volume 16, Number 13



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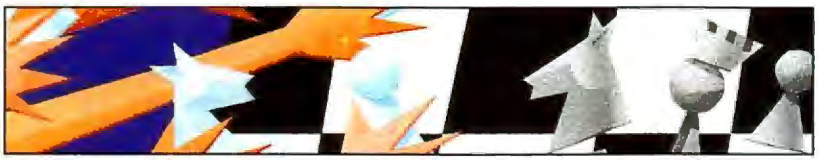

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OPINIONS

INSIDE BYTE

REGIONAL SECTION begins after page 84

BYTE Topic Index and Author Guide

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 368), you can identify articles by type, subject, title, author, or product discussed.

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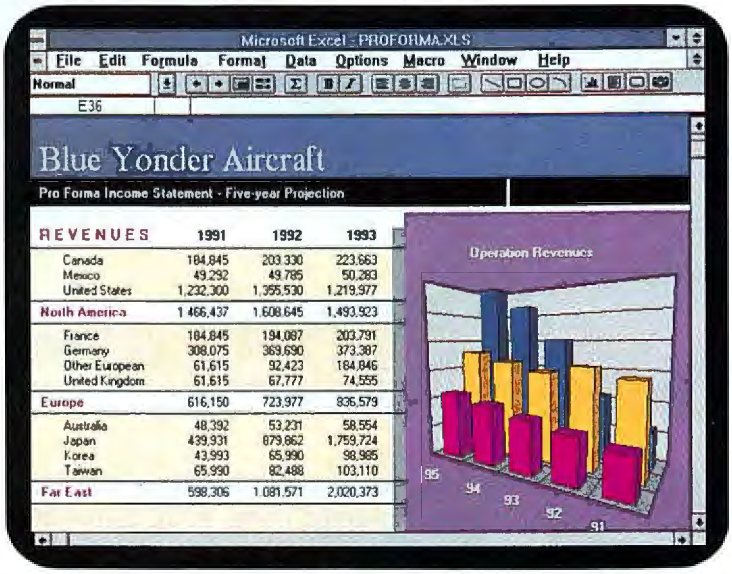
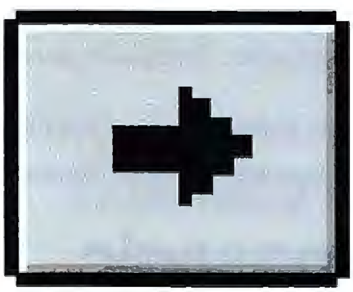
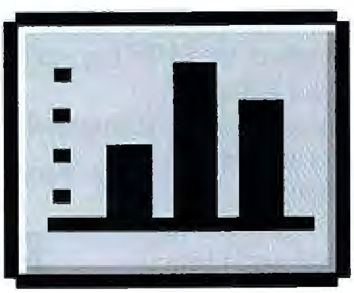
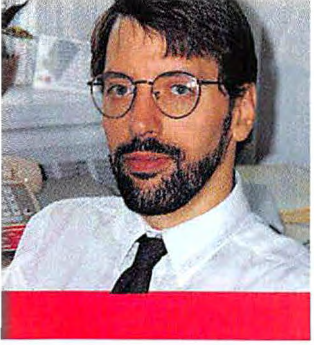


Create an instant report: hit the outlining arrow to collapse or expand your worksheet, showing as much or as little detail as you need to. Then create a chart in one step, display it right on the worksheet, and voilà—what you see on-screen is what you get at the printer.

Just a point and a click do the trick: charting, format changes, macros, you name it.







EDITORIAL

MICHAEL NADEAU

Why Windows Needs OS/2

OS/2 has always had its supporters: developers, corporations, and individual end users who saw its potential as a well-integrated applications environment. It appears that with version 2.0 that potential will be realized. Based on our experiences with a beta version, OS/2 2.0 is a well-designed operating system that runs both DOS and Windows as advertised—and better.

Competition between IBM and Microsoft will make both OS/2 and Windows better products

This is news worth cheering about, even if—especially if—you are a Microsoft Windows fan. Two strong companies competing fiercely to develop a 32-bit operating system ensures that OS/2 and Windows New Technology (NT) will evolve rapidly in response to one another and that end-user concerns will be quickly addressed.

A quick look at the historical record bears this out. When Microsoft's Excel and Borland International's Quattro spreadsheet packages were first released, Lotus 1-2-3 looked drab in comparison. Lotus was forced to upgrade its product with features similar to or better than those of its competitors. Other examples exist in almost every major software and hardware category. Innovation drives the computer industry, and competition drives innovation.

Big Enough for Both

Looking for a winner between the two, therefore, is pointless because they need each other. Each will offer unique features; each will have its own loyal following. The Windows applications base has quickly built up to critical mass, but OS/2's ability to run DOS and Windows applications within its 32-bit Presentation Manager shell provides an appealing upgrade path. The market is big enough for both of them.

Competition among 32-bit PC operating systems will not only step up the pace of innovation, but the better products that result will increase overall demand. IBM and Microsoft will vie for dominance on the marketing front, as well, with promotional blitzes. This will increase visibility exponentially for both products, whetting the public's appetite to a greater degree than either of them could singly.

The Intel-based PC market needs the energy this contest will generate, too. Apple's System 7.0, Motif, and high-end operating systems on other platforms are encouraging DOS and Windows users to defect. But more important, applications will be demanding more and more from the operating system.

Multimedia, for instance, appears unstoppable. The 16-bit environments today are only barely capable of running applications with multimedia features in a meaningful way. It's not just a performance issue; current PC operating environments treat sound and video as an afterthought. Both Windows and OS/2 will eventually have to integrate multimedia capabilities, not treat them as appendages.

And operating systems will have to become more sophisticated in how they allow applications to interact and share data with one another. Microsoft's Object Linking and Embedding application programming interface is a good start, and the market will demand better over time.

Preparing for the Future

What's at stake here is the long-term viability of the installed base of applications software. Completely new system platforms are already being planned to replace the PC. This should happen sometime within the next few years. The plans currently allow these next-generation PCs to run both Windows and OS/2 applications, but their primary operating systems will be new and, presumably, more powerful.

When these new system platforms finally become available, businesses will want to have options that give them some flexibility in making the transition to them. The applications base for these new operating systems will no doubt build slowly, and replacing the existing software investment immediately will not be appealing anyway.

Before the new systems arrive, IBM and Microsoft have the opportunity to build OS/2 and Windows into stable, robust environments that will let users make the transition at their own pace. The sense of urgency that comes with competition between the two will only help ensure that they meet that goal.

Farewell

The usual author of this column, Fred Langa, has left BYTE for another publishing opportunity. We wish Fred luck in his new venture and thank him for his four years as Editor in Chief of BYTE.

—Michael Nadeau
Executive Editor
(BIX name "miken")

Borland's Turbo Pascal for Windows What you need to go the distance

Turbo Pascal® for Windows is the easy way to get into Windows application development *and* go as far as you want. Because Turbo Pascal for Windows gives you *twice*

	Visual Basic	Turbo Pascal for Windows
Visual interface editing	Yes	Yes
Object-oriented language	No	Yes
Compiled	No	Yes
Built-in assembler	No	Yes
Extensible	No[1]	Yes
Create DLLs	No	Yes
Reference to API	No	Yes
Resource compiler	No	Yes
Help compiler	No	Yes
Speed (Sieve)	20.21 sec.	1.65 sec.
Space (Sieve)	5429 bytes[2]	1156 bytes

[1] Visual Basic can only be extended by writing Dynamic Link Libraries in C, C++ or Pascal.
[2] Visual Basic requires a runtime Dynamic Link Library of 272K.

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Get the critics' choice!

Turbo Pascal for Windows goes the distance with the critics, too! David Gerrold in *PC Techniques* (July–August 1991) says, **"If I had to pick one killer 'app' for Windows, I'd pick Turbo Pascal for Windows."** *Windows and OS/2 Magazine* states, **"The speed of the compiler is a pleasure to experience."** (Sept. 1991). *InfoWorld* proclaims, **"Turbo Pascal sets the standard for Windows programming. The ObjectWindows library makes (it) extremely easy to use."** (June 3, 1991).

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Criterion	**Score**
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Language extensions	Excellent
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Documentation	Excellent
Ease of learning	Very Good
Ease of use	Excellent
Error handling	Very Good
Support	
Support policies	Very Good
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Turbo Pascal for Windows received one of the highest scores ever in InfoWorld, outperforming Visual Basic.

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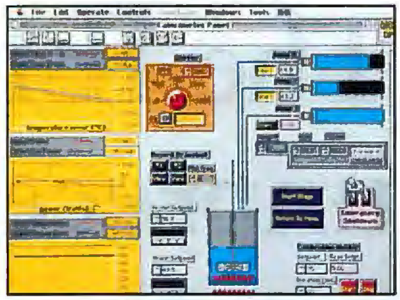
Analytical Chemistry



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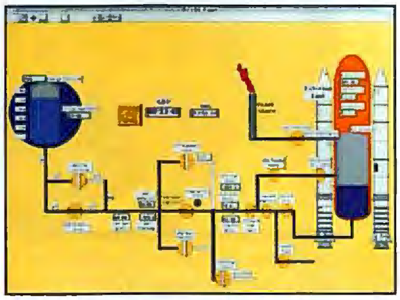

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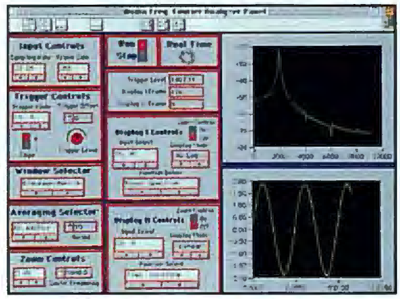

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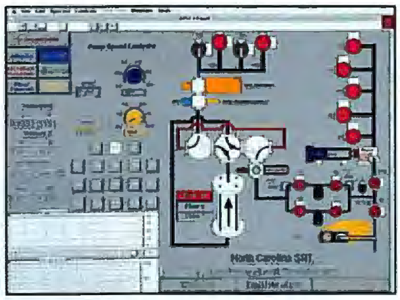

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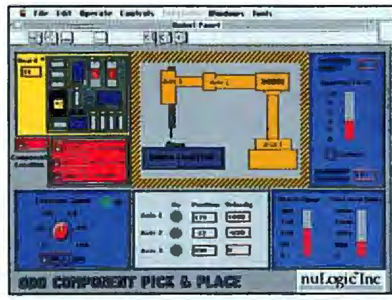

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Vice President
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"Our On-line Banking system has been in production for more than 12 months—500,000 transactions a day—without a single code failure. And we had very few enhancements to do. Our users got what they needed the first time out."

Mark Quinlan
Senior Programmer/Analyst
Huntington National Bank

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Executive Vice President
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"The strengths of the IEF are clear-cut. One obvious quality advantage is that application changes are made to diagrams, not code. This ensures ongoing integrity —the specification always matches the executing system."

Paul R. Hessinger
Chief Technology Officer
Computer Task Group

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Giorgio Sorani
Division Head – MIS
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Venkat (Vinnie) Tiruviluamala
Director, CPC/CPPC Information Systems
SONY Corporation

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Mogens Sorensen
Chief Consultant
Nykredit (Denmark)

op information systems with uctivity and maintainability.

The success of Texas Instruments CASE product is proven—in the field.

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Study shows zero code defects.

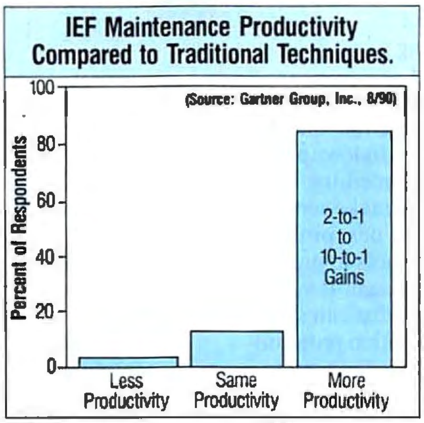
The quality of IEF-developed systems is remarkable. In recent CASE research by The Gartner Group, application developers were asked to report the number of abends they had experienced. (An "abend" is a system failure or "lock-up" caused by code defects.) *IEF developers reported zero defects—not one abend had occurred in IEF-generated code.*

Maintenance productivity gains of up to 10-to-1.

In this same study, developers were asked to compare IEF maintenance productivity with their former methods. Of those responding, *more than 80 percent had experienced gains of from 2-to-1 to 10-to-1.* (See chart.)

Specifications always match the executing application.

With the IEF, application changes are made to diagrams, not code. So, for the life of your system, specifications will always match the executing application. The Gartner Group research showed that *all* IEF users who reported making application changes made *all* changes at the diagram level.



Developers were asked to compare IEF maintenance to former methods. Of those responding, more than 80% reported productivity gains of from 2-to-1 to 10-to-1.

Mainframe applications can be developed and tested on a PC.

With our new OS/2 toolset, you can develop mainframe applications, from analysis through automatic code generation, on your PC. Then, using the IEF's TP monitor simulator and the diagram-level testing feature, you can also test these mainframe applications without ever leaving the PC.

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The IEF has generated applications for IBM mainframe environments (MVS/DB2 under TSO, IMS/DC, and CICS) since early 1988. Soon you'll be able to develop systems in OS/2 and then automatically generate for other platforms. DEC/VMS, TANDEM and UNIX are scheduled for availability in 1991. More will follow. We are committed to increased environmental independence in support of the Open Systems concept.

We are committed to standards.

IEF tools and IEF-generated code will comply with standards as they emerge. We will adhere to CUA standards and to the principles of IBM's AD/Cycle and DEC's COHESION—and we will support Open Systems environments centering around UNIX. In any environment, the COBOL, C and SQL we generate adhere closely to ANSI standards. Our presence on standards committees helps us keep abreast of ANSI and ISO developments affecting the CASE world.

Full-service support.

Of course, our technical support, consultancy, training courses, satellite seminars, and other informational assistance will continue apace. We also offer re-engineering and template services. This full-service support will remain an integral part of the IEF product.

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TEXAS INSTRUMENTS

LETTERS

Languages That Work


BEYOND DOS

CLASS CONFLICT

I enjoyed Louis J. Cutrona Jr.'s "Class Conflict" (September). Like Cutrona, I also found the kludge in Turbo Pascal for Windows that fixed the problems he demonstrated concerning Windows and C++.

The fascinating thing in this little puzzle is the way a supposedly general-purpose language—C++ or Borland's object-oriented Pascal—is unable to cope directly with another general-purpose system, the fairly garden-variety GUI of Windows. Of course, the very next thing that happens is the language is changed, which is the effect of these elaborate library features. But I want a language that works (i.e., one like the old unincremented C language). True, a C Windows program is complex, but it's still in C and something I know, not a language-of-the-week cobbed up to make somebody's object programming model fit the next problem.

Please understand, I'm not one who wants to program everything in binary machine language. If you have a usable high-level interface to Windows that can spare me the agony of programming the application programming interface directly, I'm all for it. Just don't try to convince me it's the next language for everyone.

J. G. Owen
Fort Salonga, NY

Only 64 Bits

Your article on 64-bit microprocessors ("64-bit Computing," September) did not mention a major application area in which wide data paths provide an advantage: object recognition. In a sense, this is the graphics problem in reverse.

Feature extraction involves massive numbers of comparisons. A 64-bit microprocessor determines where or if a particular binary value has a match. The performance improvement of the processors will be a function of the number of comparisons that can be made simultaneously.

In the most extreme case, this is a content-addressable memory, but such memories are not necessarily easy to load, and that may be overkill when there is a large number of short comparison tables. In a situation where a set of comparison registers and corresponding destination address registers must be loaded, even 64 bits at a time may be paltry.

In some cases, 64 bits seems marginal. It would be better to be able to load and store four 32-bit floating-point values simultaneously. However, there is still a material performance advantage in the 64-bit architecture.

Meredith Norman Poor
San Antonio, TX

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. Letters two pages in length or under have a better chance of being published in their entirety. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send letters via BIXmail c/o "editors."*

Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

What's in a Name?

The authors of "The Hungarian Revolution" (August) discussed a program-variable naming convention. The reasons they gave for using such a convention were to "get around the limitations of a language" and "help communicate additional information about a variable" to a reader. They neglected to point out that the benefits obtained by embedding type information in names are available from modern programming languages like C++ without having to resort to programmer-enforced, and therefore error-prone, conventions.

Good compilers are better than programmers at keeping track of type information, and good languages offer more appropriate constructs than name encoding for conveying information about program items. Ironically, the technique used by C++ compilers for keeping track of type information is similar to the one described by Simonyi and Heller. It would be a shame if your readers were left with the impression that their convention, which mimics on paper what is best done by computer, is truly revolutionary at this point.

Tim Peierls
Mineola, NY

Checking Grammar Checkers

Howard Eglowstein's report on grammar and style checkers was interesting and informative ("Can a Grammar and Style Checker Improve Your Writing?," August).

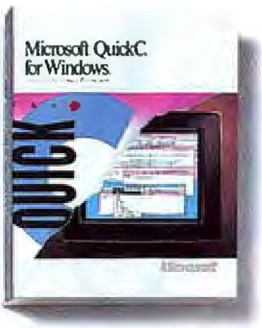
I've been using Grammatik IV for DOS in hopes of eliminating errors in punctuation and other minor errors, and I've also been somewhat disappointed. It rarely says anything at all about my punctuation, which is my main reason for using it. I, too, find it frustrating when Grammatik points out nonexistent errors in perfectly good text. The worst to date was when it recently told me "three hundred," in the phrase "close to three hundred pounds," was a verb.

Grammatik is a useful tool, but I agree with Eglowstein that a user shouldn't put too much faith in it.

David Phelps
St. Louis, MO

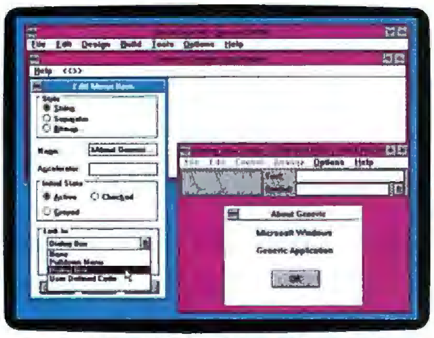
Heroic Teaching

In reading Bonnie J. Djouadi's "How to Be a Hero" (September), I found myself agreeing with all but one point. She recommends having users write down the steps when learning a new procedure. This may work well in a classroom environment when users are away

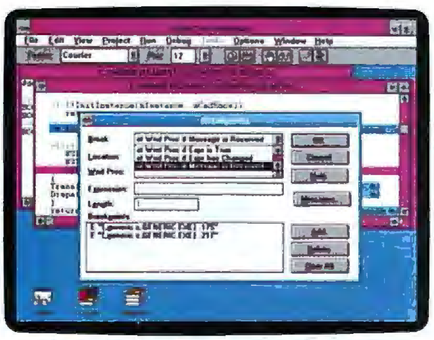


MICROSOFT SOFTWARE DEVELOPMENT TOOLS

Graphic proof that developing Windows apps is now easier.



Use QuickCase:W to draw the graphical elements of your Windows program, from menus and dialog boxes to cursors and icons. Then, let QuickCase:W generate commented expert-level C source code for the design that you've created.



QuickC for Windows supports a wide range of breakpoint types, from breaking at a location to breaking on a Windows procedure when a message is received.

Take a look at Microsoft® QuickC® for Windows™.

It's Windows-hosted, so you can edit, compile, and debug inside a single environment. Click on the Toolbar™ to choose frequently-used functions, from changing fonts to setting breakpoints. Workspace templates let you save your screen layouts, so you can reload them quickly from another session.

Plus, a remarkable tool known as QuickCase:W lets you create every element in your user interface with a few strokes of a mouse. Then it automatically generates the C source code you need.

All of which lets you create more applications. And more kinds of applications: C programs that call Windows APIs, graphical front-end programs for FORTRAN and COBOL, and C DLLs for other programs.

We suggest a visit to your Microsoft dealer. Because with QuickC for Windows, seeing is believing.

Key Features

- Windows-hosted integrated development environment including an editor, compiler, and debugger.
- All you need to write a Windows-based program.
- QuickCase:W generates source code from your program design and regenerates the code if you change the design.
- Wide range of breakpoint support, including breaking at a location, breaking when an expression has changed, and breaking at a Windows procedure when a message is received.
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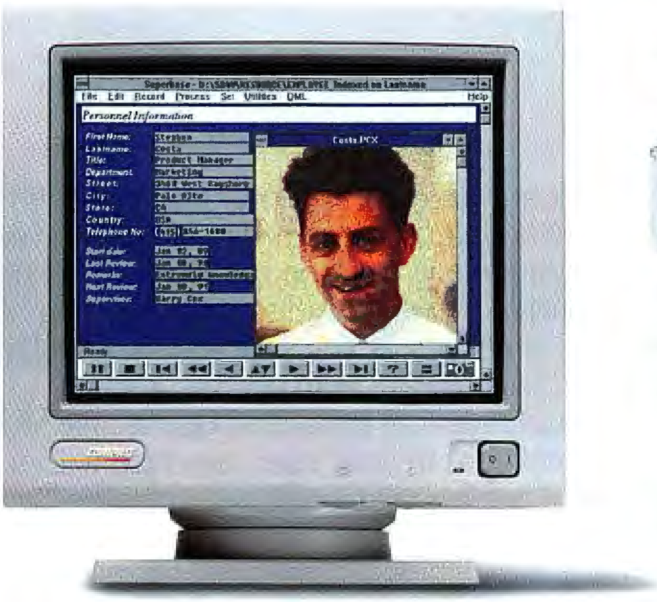
- Syntax highlighting in editor.
- Customizable tools menu allows you to run any Windows or DOS* program from within the QuickC for Windows environment.
- QuickWin library for converting well-behaved C programs for DOS to Windows programs.
- Generates Windows Executables, Windows Dynamic Link Libraries, QuickWin Executables for the Windows environment, and MS-DOS® Executables.

PROGRAMMER'S TIPS

- *To rebuild your character-based DOS applications to run under the Windows environment, select the "QuickWin EXE" Project type in the Options menu.*
- *Use the new and improved Dialog Editor to quickly and easily design dialog boxes for your programs.*

Microsoft

About the only t can't contain is y



Imagine this.

A Windows™ database that can handle virtually any data type.

It's called Superbase® 4 from Software Publishing Corporation. With it, the development possibilities are, well, thought provoking.

Consider bar coding. The state of the art in inventory control. Start thinking creatively and anything's fair game. A high-security prison, for example, uses Superbase 4 to handle the toughest inventory control problem anywhere. Keeping track of their prisoners.

Or how about video? Through DLL you can store still shots from a full-motion video camera. So you can monitor remote locations in real time.

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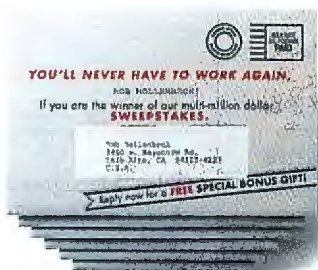
What's more, any photographic or graphic image can be included in any data file. So you can dress up product catalogs. Personnel records. Insurance claims files. Or anything else you can think of.

MICROSOFT WINDOWS Version 3.0 Compatible Product

And through DDE you can even pull in more familiar business accessories. Like maps, graphs, charts, and spreadsheets.

But don't think for a minute that this versatility comes at the expense of raw power. Superbase 4 is fast. It lets you include an unlimited number of characters in any text field. And supporting SQL, it easily connects with some formidable databases—SQL Server, Oracle, Sybase, dBase, and DB2, among others.



In fact, Superbase 4 already manages a direct mail database containing over one million records. It could handle a lot more.

A stock market ticker. A ticket sales network. You know, big stuff.

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from the keyboard. However, my experience has been that if users write down the steps, rather than listening and absorbing the reasons for the steps taken, they will rarely progress past following the steps written on that piece of paper. And if the paper is ever lost, users are lost with it.

I prefer to have users sit at the keyboard and actually perform each step as I explain the reason for each one. I try to make sure that they understand what is happening and why they are doing each step, as it relates to the desired end result. Once the entire procedure has been executed the first time, users can then write down the steps without my dictating them. If they can do that, there is a much better chance of their understanding the overall procedure, rather than simply remembering the individual steps.

Hal Scoggins
West Columbia, TX

The DOS Attitude

It is rare to encounter a point of view that is as totally wrong as that portrayed in Marshall Brain's "The X Attitude" (July).

Far from disregarding the then-available hardware, the X Window System was designed for a specific hardware environment. This environment consisted of a lightly loaded network that connected weak graphics workstations with stronger servers, usually minicomputers. The environment was heterogeneous (i.e., stations and servers were not necessarily manufactured by the same company).

The environment called for a windowing system that placed the computational load on the server rather than the station. The network was fast and lightly loaded, so communication was not a problem. No use was made of special graphics features in the stations (since there were so many makes that some were sure to be missed). So: Put everything you can in the application/server and out of the station. Result: X!

Workstations have grown so fast since then, and networks have become so loaded, that this design has become a bad joke. For example, an event must go through the network every time the pointer moves between menu entries, even if these entries are not selected, just so the current entry will always be highlighted! Imagine a Cray driving a Sun this way. Furthermore, the application can use only the simplest graphics operations, even if the station knows how to perform graphics wonders. Did you know that there is no such thing as rotated text in X? Not even a 90-degree rotation. The way a Bézier curve is drawn in X could drive anybody to tears. And Brain wonders why the Mac does better?

And why was this klutz adopted as "the world's windowing system"? "Because," as Hillary said about Mount Everest, "it was there." Why design a proper system, and have 10 companies argue about which is best, and wait years for ANSI/ISO to wait until the market decides, and whatnot, when you can simply buy the tapes (dirt cheap or even free) from MIT and have it run tomorrow? So it's goodbye, Sony News.

I think of this design philosophy as "the DOS attitude." Its central tenet is that "it's gotta work." While DOS is the best example of this attitude, X comes in a close second.

Oren Ben-Kiki
Tel Aviv, Israel

Stifling Cryptology

In "True Data" (September), Peter Wayner gives a fascinating account of the present state of computer cryptology. What he fails to mention is that the main impediment to the science of cryptology and its advancement in computer protection is an arm of the U.S. government. The highly secretive National Security Agency has used all its resources to stifle the dissemination of research on this topic for fear that it will not be able to break code keys when intercepting information. This is the reason why software packages such as the Norton Utilities, which uses cyphers to protect data, cannot be exported overseas unmodified.

Michael A. Stickel
Quincy, MA

The OOP Wave

I write large applications that involve some knowledge representation. After coaxing traditional languages and shells much as I would a lazy mule, I decided to join the C++ and object-oriented wave. Here's a quick summary of my first few hours of study: polymorphism, inheritance, encapsulation, instantiation, abstraction, iterative inferencing, auto-dependency, constructors, destructors, manipulators, classes, entities, and slots.

Objects are here to stay, and I'm glad. But I'd like to utter a warning: The hype and jargon now being slung around over object-oriented languages is exactly like the stuff that brought AI into disrepute in the 1980s. As my English teacher once said, "If you can express your ideas in clear, consistent language, they will live on after you." C++ code is revolutionary due to its very powerful implementations of polymorphism, inheritance, encapsulation, and overloading. C++ code is flexible and reusable. Which statement will still ring true in 2001?

Michael R. Will
Ontario, Canada

FIXES

- In "Managing the LAN" (July), the correct name of XcelleNet's product should have been the XcelleNet Remote Applications Management (X/RAM) System. The company is located at 5 Concourse Pkwy., Suite 200, Atlanta, GA 30328.
- The correct telephone numbers for Datapoint Corp. (September Resource Guide) are (512) 593-7000 and (800) 733-1500.
- The introductory price for MetaWare's 32-Bit Windows Application Development Kit (October What's New, page 70) is $495. The price is valid for 90 days after MetaWare releases the kit. ■

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PC Magazine Editors' Choice September 13, 1988

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Highlights

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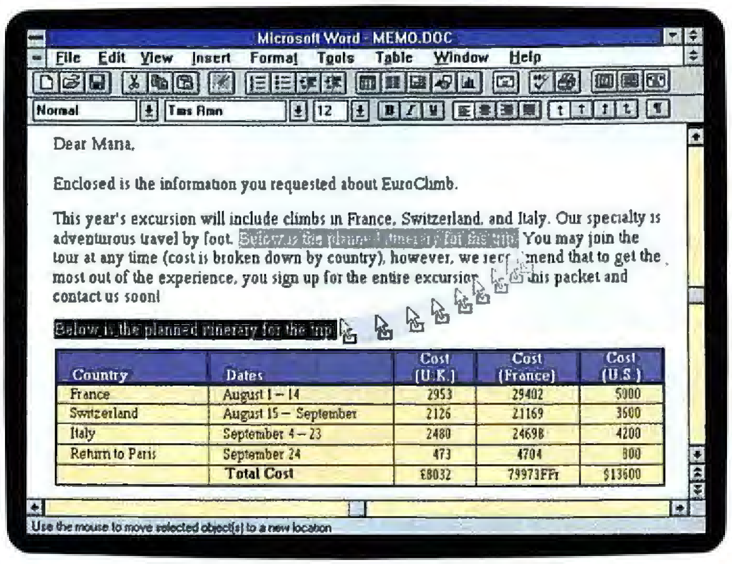

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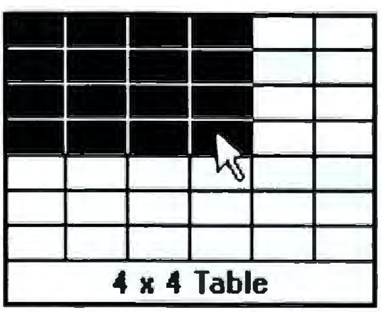
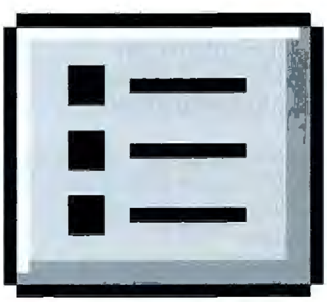


All it takes is one click on the Toolbar and presto, instant tables.



Click this Toolbar button and get instant bullets.

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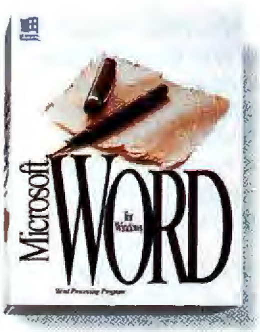
Click here for automatic envelopes. *Click here to print your work.*

Click here to make charts. *Click here to check spelling.* *Click here to zoom in.*

Introducing new Word for Windows 2.0.



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NEWS

MICROBYTES

MCC's Hybrid Super/Semiconductor Could Lead to Faster Memory

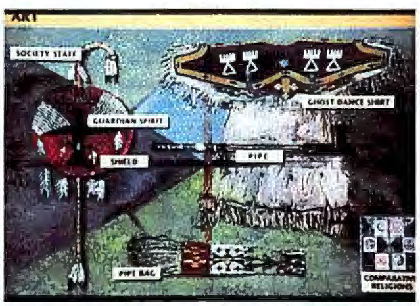
Researchers at Microelectronics and Computer Technology Corp. (Austin, TX) have patented a tiny amplifier that could bridge the gap between superconductors and semiconductors and lead to new, faster forms of computer memory. The patent, issued to MCC researchers Harry Kroger and Uttam Ghoshal, describes a very low-power, high-speed amplifier that measures less than 10 by 10 microns. The device amplifies the voltage levels of superconductors to levels useful to semiconductors, an increase from several millivolts to hundreds of millivolts and beyond.

The MCC scientists have placed many of these voltage amplifiers on a single chip, resulting in a superconducting/semiconducting hybrid. Researchers hope to develop, among other things, "memories that have lower power than DRAMs and faster speeds than SRAMs," says Kroger.

Superconductors communicate signals at very high speeds and allow electricity to pass through them with little or none of the resistance that constricts the flow of electricity in conventional conductors. However, they can't amplify signals as efficiently as semiconductor devices. To create their superconductor/semiconductor amplifier, MCC researchers combined a superconducting transistor with a CMOS transistor to form a circuit. "What's described in the patent is basically a high-gain CMOS amplifier," Kroger explains. "We need only a small input from a superconducting device to cause the CMOS amplifier to do its thing and create a big voltage.

"There are bottlenecks in semiconductor memories, and you certainly have a big play for improving the sensing of that information by using superconductors," Kroger says. "You may be able to address the memory site faster if you use superconductors."

—Jeff Bertolucci



Recognizing that good hardware is nothing without good software, IBM is becoming a provider of multimedia content on CD-ROM and laser disc. The company has helped develop a series of titles that take advantage of digital video and audio to explore American history. Columbus: A Journey to Discovery *attempts to document his historical voyages from several perspectives. IBM and codeveloper Synapse Technologies have packed about 150 hours of mixed-media material onto one disc and wrapped it up with an interface that lets you easily navigate from one topic to another. As part of its "illuminated books" project, IBM has digitized the Native American classic* Black Elk Speaks. *Could the Sioux sage have foreseen that his memoir—part autobiography, part cosmological treatise—would someday live on a thin platter read by a laser beam?*

NANOBYTES

Xing Technology (Arroyo Grande, CA) is working on a **software-only MPEG decoder** that will let PC users play back moving pictures without adding new hardware. The technology is for people who want to distribute video data in a compressed form that can then be decoded on a PC, said company president Howard Gordon. In its current implementation, the software, which runs under Windows, can play back video at 24 to 30 frames per second, with a resolution of up to 320 by 240 pixels, Gordon said. □

Open mail: **Lotus** is offering its **Open Messaging Interface** as a standard means of allowing E-mail applications to work across different platforms. OMI, which Lotus is putting into the public domain, will give developers a set of common messaging functions. **IBM** plans to build OMI technology into future versions of OS/2. **Apple** plans to support it in future versions of System 7.0. □

Canon says that it has come up with a **new type of LCD** that's 100 times faster than thin-film LCDs. The first monochrome version of the new ferroelectric LCDs has a resolution of 1310 by 960 pixels; a color version has a resolution of 1280 by 1024 pixels. □

IBM officials have been talking a lot about **digital media** in the home. Going beyond talk, the computer maker has signed a pact with Rogers Cable TV, Ltd., the biggest cable company in Canada, to test new technologies for sending images, audio, and text over fiber-optic lines. IBM says that the experiment, to run in Toronto, will help "define the technologies required to support interactive multimedia applications." □

Guidelines For Safe Shopping...

GATEWAY2000

...In The Wilds Of The C

omputer Industry.

Don't Fall Prey To High Prices.

The computer industry is a treacherous wilderness of sorts. In it you'll find dense thickets of confusing jargon. Swamps of advertising claims laced with quicksand to suck you in. And hungry predators hunting for prey. To prevent you from becoming a delicious lunch for one of them, we've prepared the Gateway 2000 pictorial survival guide for shopping in this wild kingdom.

Guideline #1 – Don't fall prey to high prices. A number of PC manufacturers would have you believe a computer with their brand name is worth hundreds, even thousands of extra dollars. Is there intrinsic value in a name? The wily wilderness shopper knows that real value is a combination of features, performance, quality, service, company stability and price. The system that compares favorably in all of these categories is the best buy.

As you might expect, we think Gateway 2000 offers the best buy on the market. But don't take our word for it. Do the comparisons and see for yourself.

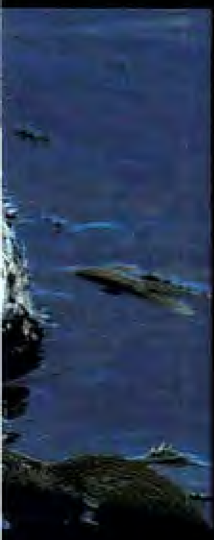
Beware Of Those Who Would Turn Their Backs On You.

Guideline #2 – Beware of those who would turn their backs on you. We've been in this industry for six years and we've seen a lot of PC manufacturers come and go. In the direct market channel, starting a business is easy. Staying in business is not. It's survival of the fittest, and the only companies that grow and prosper are those with an abiding commitment to quality and service and the financial strength to back it.

In the wilds of the computer industry, the savvy shopper studies the company as closely as the product. Is the company strong and successful? What do customers say about the company's commitment to quality and service?

With annual revenues in excess of $600 million and an enviable balance sheet, Gateway's strength is indisputable. Our success is demonstrated monthly when we ship over 25,000 Gateway systems to individuals and corporations.

Concerning the quality and service questions, we're feeling a little left out. J. D. Power and DataQuest did not include Gateway in their recent, highly touted surveys. In surveys which include Gateway, we consistently rank at or near the top. We're proud of our service record, but not satisfied. That's why we continuously invest in people, training and equipment to serve you better. The quest for improvement is a never-ending journey at Gateway 2000.



Just Relax And Get A Gateway!

Guideline #3 – If you don't want to worry about guidelines #1 and #2, just get a Gateway and you can relax.

Gateway 2000 holds a unique position in the wilds of the computer industry. The industry giants with their inflated prices live high on a mountain. At the foot of the mountain is the valley of the clone-makers where prices are great but quality and service are sometimes questionable and business is shaky. The outstanding little companies quickly grow and move up on the mountain where they raise their prices. This is the pattern of nature in the industry.

But Gateway 2000 lives all alone on a ridge at the base of the mountain overlooking the valley. You see, Gateway was one of the outstanding little companies that quickly grew – but refused to move up on the mountain. Our solitary outpost on the ridge allows us to give you the best of both worlds: mountain quality, service and stability at valley prices.

In the wilderness of the computer industry, take refuge in the simple value you get from Gateway 2000.

GATEWAY2000

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

GATEWAY 2000'S SANCTUARY OF VALUE

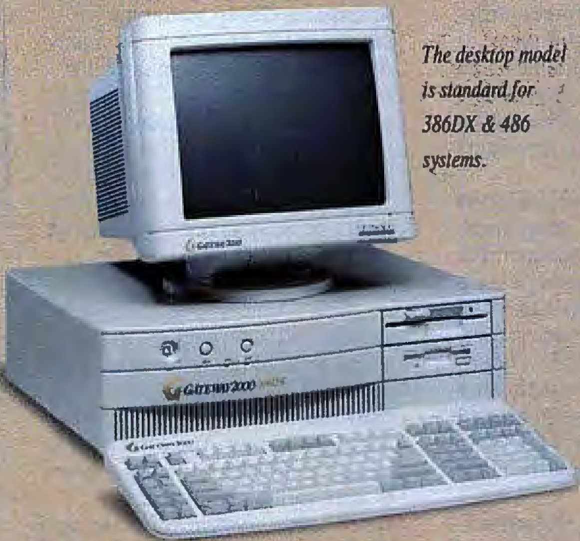
286/16, 386SX/16 & 386SX/20 systems come in a mini desktop model.

Mini Desktop Systems

Our 286 and 386SX systems come in a compact, mini desktop model that's just 4.25 inches high, 16.25 inches wide and 16 inches deep. These systems feature a custom-designed, integrated motherboard to create a more reliable system. To give you plenty of room for expansion in a small footprint computer, we integrated the diskette drive controller, the video chip set and the I/O card on the motherboard, leaving five 16-bit slots open in the standard configuration. The mini desktop models also have a standard mouse port (PS/2 compatible), leaving two serial ports open.

Desktop Systems

Standard configurations for Gateway's 386 and 486 systems include all the features you want for optimum performance with the latest software. You don't have to study our configurations to figure out what's missing. All systems have plenty of RAM, two diskette drives, high capacity, fast and reliable hard drives, super fast 16-bit VGA graphics with 1 MB RAM and 1024 x 768 non-interlaced color monitors. It's all there – for an unbelievably good price. 386DX and 486 systems come standard in a desktop model. Our tower model with a 220 watt power supply is available as an option for an additional $100.



The desktop model is standard for 386DX & 486 systems.

New 33 MHz 486 EISA

If you've been waiting for an affordable EISA system, your wait is over. With a 340 MB SCSI drive and 32-bit EISA SCSI controller, Gateway's 33 MHz 486 EISA system is incredibly priced at only $3895.

Peripherals

We sell and support a complete line of competitively priced, quality name-brand peripherals, including laser and dot matrix printers, modems, tape backups and coprocessors. Sorry – we sell peripherals and components only with the purchase of a system, or separately only to owners of Gateway 2000 systems.

The tower model is an option for 386DX & 486 systems.

The Extras – That Don't Cost Extra At Gateway

- One-year warranty on parts and labor
- Replacement parts shipped quickly via overnight shipping at no charge
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- Lifetime toll-free technical support from the service organization that won PC World's Service Excellence Award
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- C.O.D. terms and major credit cards honored
- Net 30-day credit terms and leasing options available to qualified commercial customers
- MS DOS 5.0 is standard; versions 4.01 and 3.3 are available at no extra charge
- The programmable AnyKey keyboard is standard; a 101-key keyboard is also available at no extra charge
- Software diskettes and comprehensive hardware and software manuals provided
- Canadian customers – our 800 number is toll-free from Canada and systems (excluding monitors and keyboards) are now duty-free!

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (Central Time)
Service Hours: 6am-Midnight Weekdays, 9am-2pm Saturdays (Central Time)

Infolio, priced below $2000, early next year.

Infolio provides built-in applications residing in ROM, including a text editor for notes, a sketchpad for drawings, a scribbler pad for capturing cursive handwriting, an address book/organizer, and a handwriting recognition module complete with trainer. Infolio also incorporates a "data transfer framework" to facilitate the transfer of data to and from host machines such as PCs, Macs, and minicomputers.

—Ellen Ullman

New Chips Will Help Bring Video into PCs

Two new ICs from Cirrus Logic and Brooktree could simplify the job of interfacing personal computers to standard video formats such as NTSC and PAL. The chips will likely show up first on add-in cards but might someday be built onto the motherboards of "video-ready" or multimedia PCs.

Converting analog video signals into the RGB format used in computers, or vice versa, typically requires add-in cards. Boards from companies such as VideoLogic, New Media Graphics, and TrueVision will digitize video and put it into a window on the screen, while cards such as the Willow Peripherals VGA-TV convert RGB output to NTSC for display on a TV or storage on a VCR.

The new video ICs do much of the same. Although there will still be demand for the high-end features of some add-in cards, these chips could make adding basic video support to PCs much less expensive and space-consuming.

The CL-Px0070 Video Window Generator, from the Pixel Semiconductor subsidiary of Cirrus Logic, integrates the functions of six chips into one. The chip requires an external device, such as the Philips Digital Decoder chip set, to digitize composite video and split it into its YUV components. But after that the Px0070 takes over, performing the YUV-to-RGB color space conversion, deinterlacing the picture, and scaling it to fill a window of any size. Input to the Px0070 could also come from a digital video decompression device like the C-Cube JPEG (Joint Photographic Experts Group) chip.

Cirrus says that the chip's continuous image scaling operates independently on the *x* and *y* axes and is accurate to a single pixel. Horizontal scaling uses true linear interpolation rather than "pixel dropping," resulting in a less jaggy image.

The part is slated to be available soon, at an OEM price of $55 each. Cirrus says that it expects as many as six Mac add-in board makers to announce products using the chip in early 1992.

Brooktree, a leading supplier of RAM D/A converters for desktop computers, has tackled the other end of the video I/O problem: The new Bt858 is a single-chip video encoder that accepts RGB or YUV input and puts out studio-quality composite NTSC, PAL, or S-VHS video. The system designer needs to supply only a digital and a synchronizing signal, and the Brooktree part will correct for varying pixel ratios and frequencies, the company says.

Available now in sample quantities, the Bt858 sells for $67 in quantities of 100. For "corporate quality" applications that don't demand studio-grade output, Brooktree will sell a lower-cost version of the chip called the Bt855.

—Andy Reinhardt

Stereo Chip Cuts Cost of Computerized Sound

A stereo sound chip from Crystal Semiconductor (Austin, TX) could cut the cost of high-quality sound in multimedia systems by combining 16-bit stereo A/D and D/A conversion with digital signal processing, microphone and headphone outputs, and several other functions. Crystal's new CS4215 chip, priced at about $30, replaces several components handling audio.

The 4215 is not a sound generator. Instead, it lets computers store and play back high-quality sound produced by other sources. To store or manipulate sounds in a computer, the analog audio input has to be converted to a digital signal. For output, the digital information has to be converted back to analog. The 4215 can run from 8 to 48 kHz on 16-bit samples. Marketing manager Brad Fluke says that varying the frequency gives performance ranging from voice-telephone-quality up to CD-quality sound. The 4215 also can compress and decompress the digitized signal. Other digital-signal-processing features include filters for antialiasing and output smoothing.

—Rick Cook

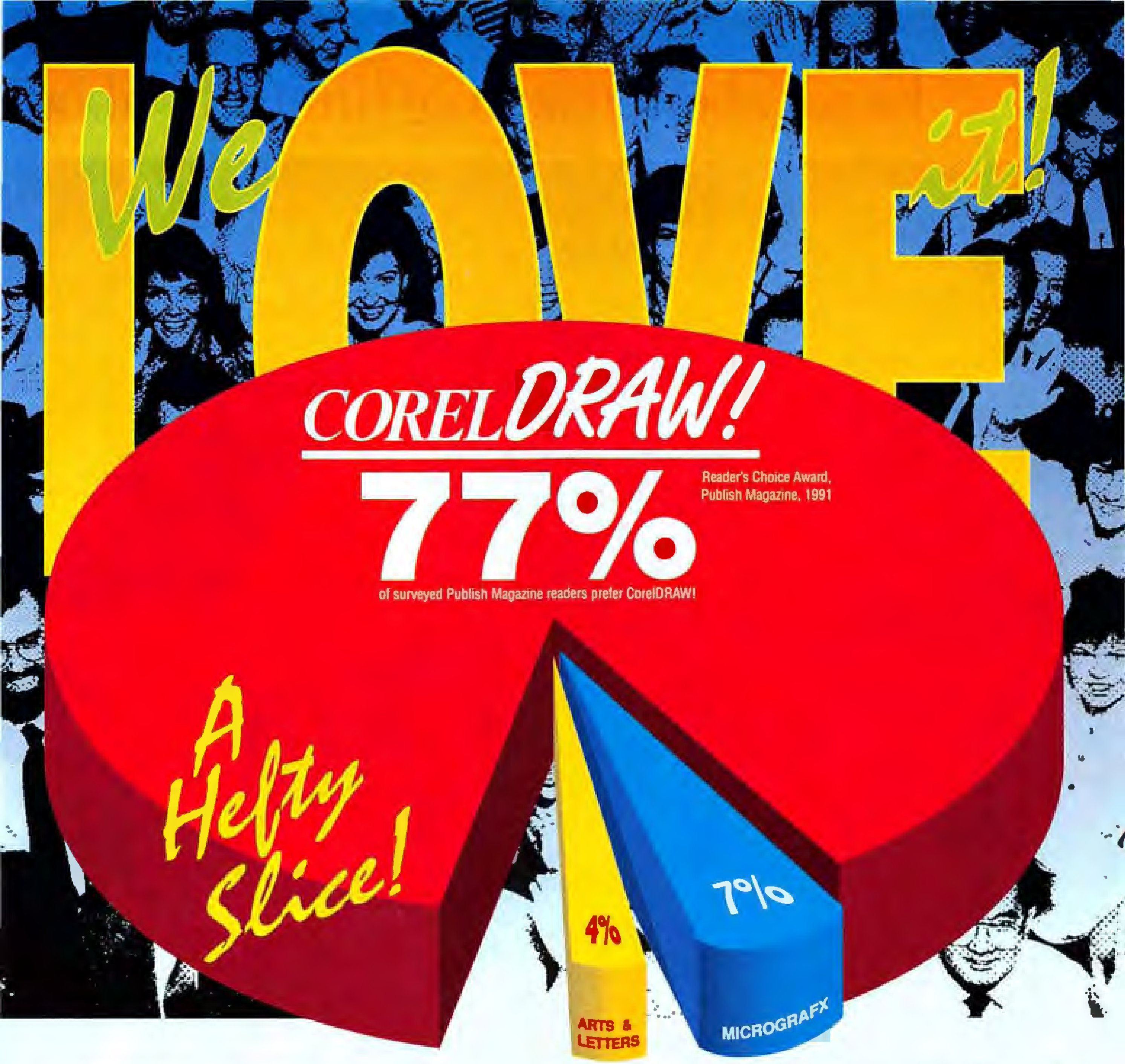
NANOBYTES

Another major brand has adopted Advanced Micro Devices' 25-MHz 386SX chip. **Grid Systems** (Fremont, CA) says that it picked the **Am386SX** for a new desktop computer primarily because of its faster clock speed. A 20-MHz SX doesn't have enough zip to handle GUIs, multitasking, and mixed media, a Grid official said. The Grid 325sc sells for $2599 with a 120-MB hard drive. □

Lead Technologies (Charlotte, NC) says that its new Lead Compression card, for IBM PC compatibles, extends Joint Photographic Experts Group technology to **squeeze still images** by as much as 255 to 1. Lead developed its own "extended ratios" compression algorithm. Company president Rich Little said that the card can shrink a file by up to 180 to 1 and still produce an image that looks as good as one run through the usual JPEG ratio of 20 to 1. The card costs $1995. □

Radius will use **Apple**'s digital-video technology to produce a presentation product targeted at "the **business side of video**." Radius has rights to use Apple's "Touchstone" technology, which consists of application-specific ICs, source code, system software, and 24-bit "convolution technology" that eliminates flicker in NTSC output. Radius plans to build a NuBus board for sending NTSC-quality output to videotape. The board will permit users to plug their VCRs into the Mac and output "anything on the Mac" to videotape. □

Tatung's Science & Technology subsidiary (San Jose, CA) has introduced the **lowest-priced** color SPARC RISC workstation yet. Prices for the 20-MHz micro Compstation start at $4290 for a diskless model with a 15-inch color monitor. If you add a 207-MB hard drive and 8 MB of RAM, it costs $4990. About the closest competitor in terms of price is Sun's ELC, but that's with a monochrome monitor. □



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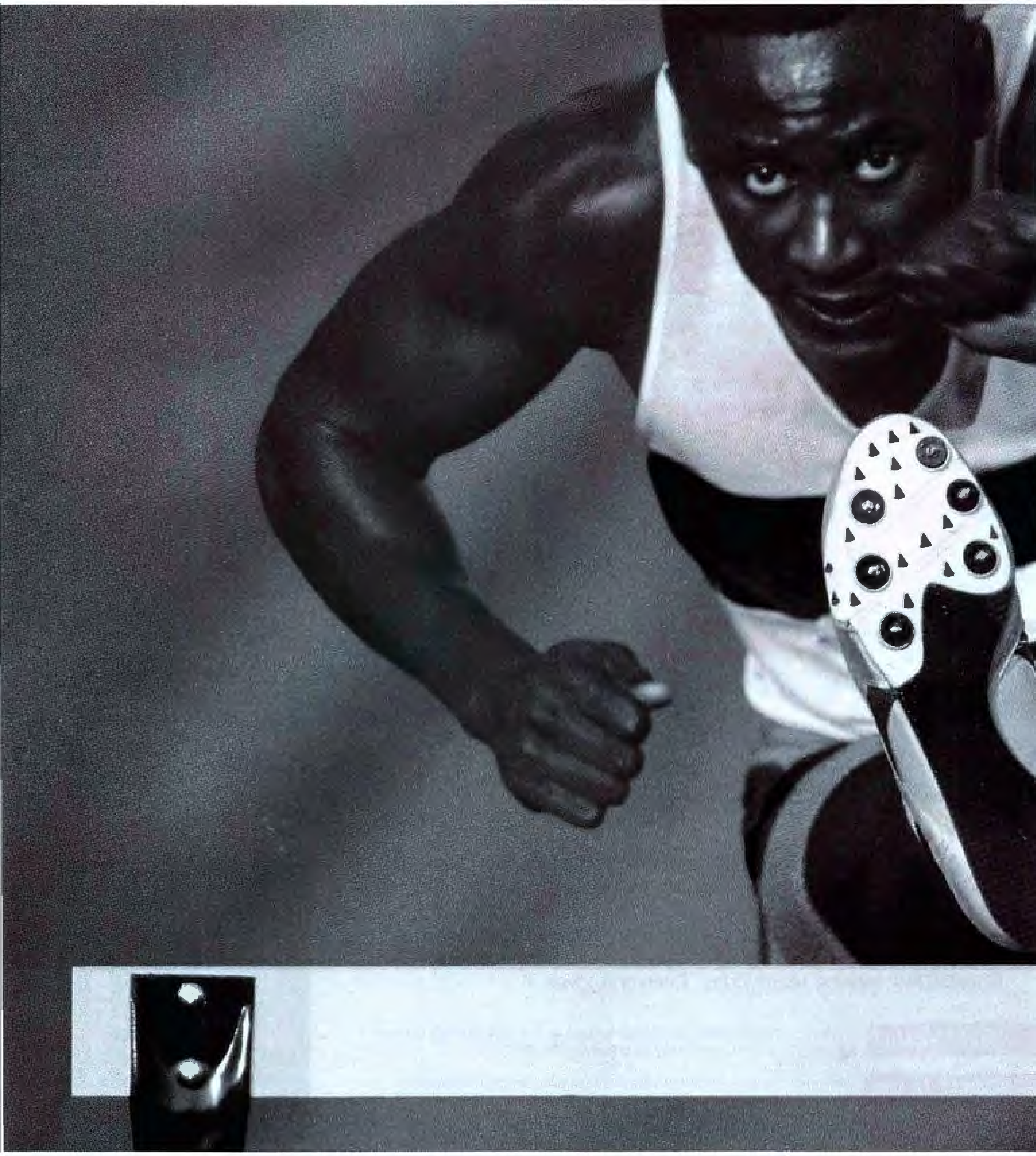

NEWS

MICROBYTES

Double Your Clock Speed, Double Your Fun

Intel has developed a new technology for doubling the internal clock speed of its 486 and 486SX processors. The clock doubler will boost the speed of the CPU (e.g., revving a 25-MHz processor up to 50 MHz) and thus improve overall PC performance without requiring big changes to the rest of the system. "The CPU runs at twice the speed of the memory system, and AC timing is unchanged," said Paul Otellini, vice president of the Microprocessor Products Group at Intel.

Letting the rest of the system still operate at half the speed of the CPU means PC designers don't have to build in expensive components and high-speed DRAM to get a significant performance boost, and they don't have to worry about high temperatures and emissions, Intel officials said.

Intel has been encouraging manufacturers of 486SX systems to build in a slot that will accept the new chip, allowing for a plug-in performance upgrade that's similar to snapping in a math coprocessor. With existing 486 designs, the upgrade will involve swapping in the pin-compatible chip, but at times it will involve some timing and BIOS changes, Intel concedes.

The clock doubler, manufactured using Intel's three-layer-metal submicron process, is not official yet, but it will be sometime next year, Intel said. It will be applied to all current speeds of the 486SX and DX, although a 50- to 100-MHz model is still up in the air. Company officials would not disclose pricing, but they did say that by 1993, the accelerated chips will cost about $500.

—D. Barker

Adobe Shows Document Across Platforms

Adobe Systems' John Warnock has been preaching about the need for easily moving documents from one kind of computer to another without losing the style and format. At the recent Seybold Computer Publishing conference, Warnock demonstrated the cross-platform technology Adobe has been hinting at. He showed a Mac II, a Windows PC, a Next computer, and a 640-KB DOS machine all displaying the same document, a complex image of the front page of a newsletter. The kicker: Each system was working with the same file, built from a page-description language based on PostScript. Each system was running an interpreter that used Adobe's MultiMaster font technology, which automatically scales type to make it fit in a specific space, while retaining the type's width and weight characteristics.

Adobe also disclosed its Type 1 Coprocessor, a chip that the company says will speed up text rendering by as much as 25 times faster than current printer controllers. The chip is basically Adobe's Type Manager implemented in silicon. Depending on how it's used, it will speed up font rasterization in printers or on-screen. The coprocessor should show up in products next year.

—Kenneth M. Sheldon

The Pen Is Mightier Than the PC When It Comes to Data Collection

It might look like a computer, but it's not. It's a data collection "peripheral." That's how PI Systems (Portland, OR) describes its new pen-based machine called Infolio. The company sees the pen system as an addition to existing hardware, not unlike a bar code reader—a specialized device for the input of data in real time.

Infolio is a clipboard-size machine weighing under 3 pounds with battery. The pen-based system runs for 15 hours on six standard AA batteries or on nickel-cadmium rechargeables, a battery life PI Systems measures in "one or two shifts." Infolio is built around the Motorola MC68331 32-bit processor and MC68HC705 power management microcontroller. The system has 1 MB of ROM for the operating system and base applications; half a megabyte of static RAM for maintaining system state; and three slots for PCMCIA 2.0–compliant cards, which can be used as SRAM or ROM for user data, customization modules, and applications. The monochrome screen, made by Sharp, provides 640- by 480-pixel resolution; both backlit and reflective screens are available. PI Systems expects to start volume shipments of

NANOBYTES

Starlight Networks (Mountain View, CA) is working on hardware and software for zapping mixed **digital media** around **on a network** in real time. The company sees a need for new kinds of servers to handle multimedia but says that its products will "coexist" with today's LANs. □

Portable Energy Products (Scotts Valley, CA) has designed a thin, flat, lightweight **battery** that could be a good fit in notebooks and other portable computers. The Planar Energy Cell, a lead-acid battery, weighs about half a pound and is just a little more than 3 inches wide, about 5.5 inches long, and only 0.332 inch thick. The device could fit in places cylindrical nickel-cadmium batteries can't, the company says (e.g., under a keyboard). □

Seen that Levi's 501 Jeans ad—the one with the jumpy, comic-book-style pieces of clip-art faces, telephones, and pieces of a U.S. map? It was done by FCB/San Francisco using a **Mac IIfx**. □

Composer Quest from **Dr. T's Music Software** (Needham, MA) is one of the new titles geared to work with **Multimedia PCs**. The interactive CD is a learning tool that covers musical artists from the seventeenth to the twentieth centuries. You can click on Duke Ellington and get a lesson on the jazz genius or find out what things were like back when Mozart was the Elvis of his generation. □

Intel's 860 processor has been used mostly in high-horsepower graphics cards, but **Okidata Microsystems** (Marlborough, MA) has built its new line of RISC workstations and servers around the chip. The Okimicrosystems 7300 systems run an Okidata version of Unix System V release 4 called Okix and support the X Window System, OSF/Motif, and Open Look. Prices range from $8000 for a diskless model up to nearly $40,000 for a fully loaded configuration. □

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Epson to Build New LCD into Color Notebook

Epson America's upcoming color notebook computer is the first to use a new screen technology developed in Japan by Seiko/Epson. Called metal-insulator-metal (MIM), the patented technology is a new twist on the active-matrix designs of other color LCDs.

Like a thin-film-transistor panel, which backs up each pixel with one or more transistors for rapid switching and sustained power levels, Epson's new MIM panel has a miniature diode behind every pixel. MIM uses only two or three photo masks, and the metal layers used to etch the diodes can be sputtered onto the LCD glass. The color panel measures 9 inches diagonally and will support 256 colors from a palette of 4096.

Although the 7.9-pound color notebook Epson showed at Comdex was a prototype, the final version is expected to use a 25-MHz 386SL, include 4 MB of RAM, and sell for roughly $8000.

Epson wouldn't say how much the display alone might cost. For now, Epson is the only company with MIM technology, but it may license the patents to others.

—Andy Reinhardt

Future Macs to Have Built-in DSPs for Sound and 3-D Graphics

Macs of the future are likely to have digital signal processors built in to handle voice synthesis, image rendering, and three-dimensional graphics. At the MacWorld Expo Toronto, Rick Lefaivre of Apple's Advanced Technical Group showed a video clip demonstrating a DSP being used to rotate a 3-D wireframe object and simultaneously generate four synthesized music pieces.

Apple is working on specifications for 3-D modeling, rendering, and file formats so that the interchange of 3-D objects will be possible, Lefaivre said. The easy use of 3-D graphics "would require some 3-D graphics hardware on the Mac motherboard," he said. A DSP is a likely candidate to offer 3-D hardware support.

Apple is examining how to provide a distributed operating-system kernel beneath the Mac interface, Lefaivre said. The Mac OS is being evaluated as to its scalability and portability. *Scalability* means that the interface would be easily adaptable to computers of any size, from desktop models to "hand-held Macs." Of course, portions of the Mac OS would be ported to IBM's PowerPC RISC chips, or to other CPUs.

—Tom Thompson

NT, SCO Desktop Previewed on R4000

Microsoft recently gave the first public "technology demonstration" of Windows NT running on the Mips R4000 processor. Although the upcoming operating system looks in many ways like Windows on top of DOS, the demonstration system, with its multitasking windows—one showing a clock, one showing Bézier curve support, one a multiple-threaded graphics program, one a command-line window, and so on—resembled a Unix environment.

Even the outline of the NT architecture is reminiscent of Unix. NT, like Unix, is based on a small, machine-dependent kernel surrounded by more extensive, machine-independent operating-system services. Like the X Window System, NT uses a client/server model to abstract system services. However, while X uses the client/server idea to generalize graphics processing and networking, Windows NT goes one step further.

NT offers what might be called "API servers"—a layer of the operating environment in which multiple applications subsystems can be running at the same time. Microsoft says that it will support three subsystems: Windows (for 32-bit Windows programs and, via emulation, 16-bit Windows and DOS programs), Posix 1003.1 (Unix specification), and OS/2 1.3 and 2.0. With all three subsystems in place, programs written to these different application programming interfaces (APIs) can all be running simultaneously. However, support for multiple APIs still remains a promise; this NT feature has not been shown publicly.

The Santa Cruz Operation (SCO) has demonstrated a prototype of its Open Desktop for the Mips R4000 chip. Based on OSF/Motif, the Desktop GUI shows icons of available services and applications. ■

—Ellen Ullman

NANOBYTES

QIC tape drives and media will be able to hold **100 gigabytes** by the end of the 1990s, says **3M,** the company that invented the quarter-inch cartridges. According to a 3M official at the DataStorage91 Forum, 3M plans to migrate QIC tape backup drives and media up to a 100-gigabyte capacity before the end of this decade. QIC tapes can now store up to 1.35 gigabytes and are backwardly compatible with drives storing as little as 20 MB. 3M and other QIC supporters had disclosed plans to boost QIC's capacity to 12 gigabytes, but apparently they've got new technologies that will surpass that. □

SynOptics, Cisco Systems, and **SunConnect** have formed a joint development relationship to build a "network architecture" that will combine routing systems and intelligent hubs under the aegis of one network management system. The goal of this alliance is an integrated hardware/software solution with one of the worst names of the year: the RubSystem. Scheduled for 1993, the RubSystem is designed to be a high-level architectural solution to the problem of large, complex networks. □

Apple has signed a development and licensing agreement for technology that **recognizes cursive handwriting.** The computer maker will be working with **ParaGraph,** a Soviet company that is also working with Microsoft and is rumored to be negotiating with several other major hardware and software vendors. ParaGraph is based in Moscow but has a U.S. office in Boulder, Colorado. □

A new interface card from Apple will let Mac users plug into the ISDN. The computer maker says that it is the first NuBus interface card available in North America for connecting Macs to basic-rate ISDN. The $1099 card implements the CCITT ISDN basic rate interface and supports a standard analog DTMF telephone. ■

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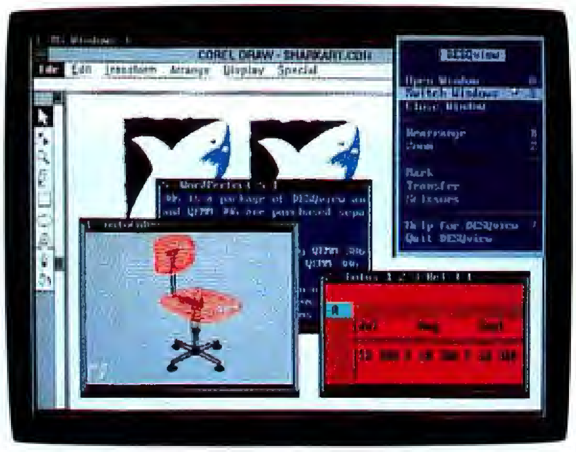

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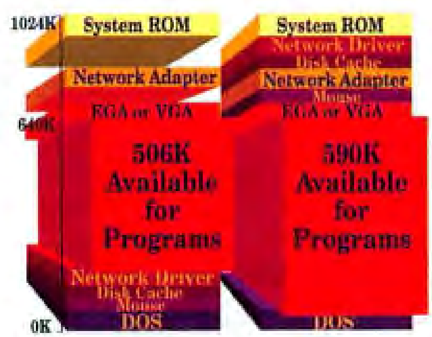

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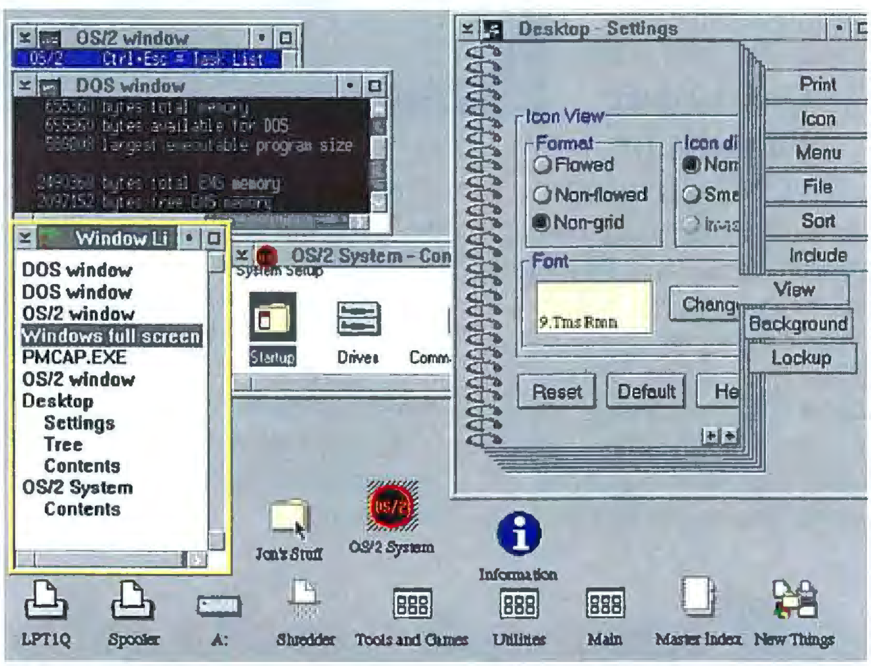
OS/2 2.0: A Pilgrim's Journey

JON UDELL

The latest incarnation of "the operating system of the 1990s" finally delivers on some promises

In the April 1990 BYTE, I wrote the following: "I've seen the system that I want to install on my 386 PC. It's OS/2 2.0."

I wrote those words nearly two years after making the pilgrimage to Redmond to see the first preview of the 32-bit, multiple-DOS-box version of OS/2. Since then, OS/2 has been on a roller coaster ride. Windows 3.0's huge success prompted Microsoft to rethink its plans for a next-generation operating system. As Microsoft shifted gears and announced that it would build its own New Technology (NT) operating system, IBM responded by seizing control of OS/2 development and raising the ante. Announcing extra features that were never contemplated by Microsoft—full virtualization of DOS (including device drivers), support for protected-mode DOS and Windows applications, a 32-bit rewrite of the Presentation Manager (PM) graphics engine, and a radically new graphical shell—IBM committed itself to a truly Herculean task.



In OS/2's new GUI, the Workplace Shell, you can freely arrange objects representing programs, documents, and printers on the desktop or in a hierarchy of folders. Objects can expose multiple views simultaneously; the Window List tracks and switches among the views. A new kind of control, the spiral-bound notebook, helps organize dialog boxes and documentation.

As IBM's self-imposed year-end deadline draws near, most of the pieces are in place. Although there's much work yet to be done, I'm happily using OS/2 2.0 to write, illustrate, program, and telecommunicate.

IBM bills the new system as an "integrating platform," and that's just what it is. The machines on which I've installed version 2.0 run three very different flavors of software: 16-bit OS/2 applications, real- and protected-mode DOS programs, and Windows 3.0 applications.

The fourth—and most potent—variety, 32-bit OS/2 software, waits in the wings. A number of leading OS/2 developers are porting their programs to version 2.0's flat memory model, and IBM has publicly shown early versions of several of these. Yet there aren't as many 32-bit PM applications in the pipeline as OS/2 2.0's long gestation might warrant. In part, that's because Microsoft's infamous Software Development Kit, which cost developers $2600, never worked very well. (IBM recently released its own compiler for version 2.0 development, and Borland, Digitalk, Jensen & Partners International, and Watcom all plan to offer alternative programming tools.)

Mostly, though, last year's OS/2 developers have become—often reluctantly—this year's Windows programmers. With third-party Windows extenders available today and Microsoft's 32-bit Windows for NT expected next year, OS/2 2.0 isn't likely to attract a large following solely on the strength of its 32-bit PM. Instead, IBM has staked version 2.0's fortunes on the claim that it will be "a better DOS than DOS, a better Windows than Windows." My judgment? I think it could be a better DOS for most purposes, and a better Windows in certain respects.

The Host with the MOST

Even the most partisan OS/2 users occasionally need to boot plain old DOS. One of OS/2 2.0's nicest features solves the multiple-boot problem cleanly and effectively. When you install the system, you can use FDISK to create a special 1-MB primary partition that holds the Multiple Operating System Tool. The rest of the disk can comprise two more primary partitions (one of which will be C) and an extended partition, which in turn can hold multiple logical drives D and following. MOST can select an operating system from one of the primary partitions or any of the logical drives.

To make this concrete, I've got an 800-MB Systempro drive array carved up into two primary partitions (MOST and C) and four logical drives. MOST, in the active partition, boots with a menu from which I select DOS, which lives in C, or one of several different beta versions of OS/2. Version 2.0's ability to boot from a logical drive, coupled with MOST and an enhanced FDISK, makes the black art of multiple booting a snap.

Let Me Count the DOS Boxes

Like Windows, OS/2 2.0 supports windowed and full-screen DOS sessions. You can switch between the two modes by way of the settings menu, although Windows' handy Alt-Enter trick won't work. (Unfortunately, you *can't* switch between windowed and full-screen OS/2 sessions.) Cut-and-paste between windowed sessions works much as in Windows. One nice enhancement (for both DOS and OS/2 windows) is the ability to change fonts. I've never liked the elongated EGA-style DOS windows that Windows presents, and I now much prefer one of the squarer styles that version 2.0 offers.

As advertised, OS/2 2.0 delivers EMS, Extended Memory Specification (XMS), and DOS Protected Mode Interface (DPMI) services to its DOS boxes. I'm running FoxPro 2.0 in one session, and it's working about as well as under pure DOS. That's great news for me, because I depend on the program but could barely use it in the conventional-memory-strapped and EMS-less OS/2 1.x DOS box. While XMS services are available, my usual XMS clients—Virtual Control Program Interface-oriented programs like the extended versions of FoxPro and Borland C++—can't use them. Why? OS/2 2.0 rightly refuses to support VCPI. To do so would compromise the system's integrity.

Happily, there's an alternative: DPMI. I wrote a protected-mode DOS program (using Borland C++ and Phar Lap's 286|DOS-Extender) that uses OS/2 2.0's DPMI services to allocate megabytes of memory. Not many DPMI-compliant DOS programs are available today—Lotus 1-2-3 release 3.0 is one notable example—but now that the DOS-extender toolkits all support DPMI (they need it for Windows compatibility), it's sure to dominate very soon.

How much conventional memory do DOS boxes get? It depends. I'll first distinguish between internal virtual DOS machines and external VDMs. An internal VDM—the default DOS box—sees about 633 KB because the support code runs in protected mode outside the DOS address space. An external VDM, which boots a normal DOS kernel from a DOS partition or from an image file made from a DOS-bootable floppy disk, sees less RAM—about 589 KB. (You should be able to high-load DOS in this situation, but that wasn't working yet.)

Both VDMs can load real DOS device drivers (I've done this successfully) and offer upper memory block support so you can high-load TSR programs (so far, I have made this work only with internal VDMs). Internal VDMs are smaller and faster for normal use, but they do not maintain all the DOS data structures needed to support, for example, block device drivers. So I've been able to run NetWare and communicate with a CD-ROM drive only by way of an external VDM.

That it's possible at all is a *huge* win, of course. Network and CD-ROM access through ordinary DOS mechanisms is a godsend for OS/2. There are OS/2 drivers—I'm running OS/2 1.x network, display, and tape device drivers under version 2.0. When available, I'll always prefer systemwide over DOS-box-specific device support. Thanks to an alpha version of Novell's OS/2 NetWare requester, all my OS/2 *and* DOS sessions see the network. But OS/2 drivers are hard to come by, while there's a DOS driver for every gadget under the sun. Windows, built atop DOS, inherits that critical software base.

Now OS/2 can, too—with an important twist. An errant DOS driver can bring Windows to a screeching halt; OS/2 calmly traps the error without skipping a beat. OS/2 2.0 virtualizes DOS sessions well enough that I was able to run two VDMs connected to NetWare through the same Tiara card. Fair warning: What I've seen so far is proof of concept only. What worked for a Tiara card in a Systempro didn't work for a Western Digital or NE2000 card in a Swan. I'm encouraged, but I can't predict how comprehensive version 2.0's DOS device support will ultimately be.

OS/2 Does Windows

The OS/2 installation regime has grown to more than a dozen high-density floppy disks and, like Windows' Setup, turns graphical once the kernel loads. As you watch the filenames roll by, you'll see why all the disks are needed. Along with OS/2's files come the likes of COMMAND.COM, HIMEM.SYS, PROGMAN.EXE, and SYSTEM.INI. It's not déjà vu: You're really installing DOS, Windows, and OS/2 all at once.

While the DOS components are modified for OS/2 2.0's VDM environment, the Windows pieces are (with a few key exceptions) the same ones you get in a retail Windows 3.0 package. OS/2 2.0 runs Windows in a VDM, and Windows in turn runs Windows applications in standard mode. How? Windows applications are DPMI clients, and the Windows kernel, a DPMI server, normally gives them access to extended memory. OS/2 is also a DPMI server, and IBM has tweaked the Windows kernel to make it a client of OS/2's DPMI services while at the same time a server for Windows applications.

When you launch Windows under OS/2 2.0, you land in a full-screen Windows desktop running PM. From OS/2's perspective, you switch to and away from a Windows session just like any other full-screen DOS or OS/2 session. On the Windows desktop, unmodified Windows 3.0 applications run—and multitask—normally. There's no DOS box available, but that's no problem because OS/2 handles

THE FACTS

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NEWS

FIRST IMPRESSIONS

the DOS multitasking much better than Windows can.

The clipboard has been tweaked to communicate with PM, so I was able to copy an icon from Visual Basic's icon editor to the Windows clipboard, switch to OS/2, and paste it into OS/2's new icon editor from the PM clipboard. A Dynamic Data Exchange server, intended to carry DDE message traffic between Windows and OS/2, wasn't working yet. Because Windows owns the screen, you can run your high-resolution display driver in the Windows session even if you don't have an equivalent driver for PM.

Windows can't run in enhanced mode, nor in general does it need to. OS/2 provides Windows' two key enhanced-mode features: paged virtual memory and DOS multitasking. Some Windows applications do require enhanced mode. These are the "extended" Windows applications (e.g., Objectworks 4.0) that use 32-bit flat-model memory. But the vast majority of today's Windows 3.0 programs—and all the ones I've tried—will run under OS/2 2.0. What about Windows 3.1? IBM says it will go into OS/2 as soon as Microsoft ships it.

Better than Windows? Well, a great many people use Windows as a DOS multitasker, and in that respect OS/2 2.0 clearly is a better Windows. Even though the Windows 3.1 beta version cleans up the unrecoverable applications error problem, I'm able to crash it at will by poking random data into the unprotected DOS memory that supports the whole show. Version 2.0's VDMs don't suffer that problem.

If you compare a Windows application on DOS to a Windows application in a VDM, things get more complicated. Obviously, a VDM can't run faster than naked DOS on the same hardware. OS/2's advanced virtual memory and file subsystems might offset that (version 2.0 includes a speedier file-allocation-table file system as well as the High Performance File System).

In the first cut at Windows support—what I'm running now—the Windows memory manager sees the DPMI memory OS/2 provides as physical RAM. That works fine on my 12-MB Systempro, but poorly on a 4-MB Swan because Windows' memory ends up in the OS/2 swap file. IBM is working hard to make Windows get more mileage out of OS/2's memory manager. That tactic will require more surgery on the Windows code IBM licenses from Microsoft, but it could improve matters dramatically by the time of OS/2 2.0's release.

The Shell Game

The version of the Workplace Shell I received (see the screen) was very much a work in progress. It's more Mac-like than Windows, the old PM shell (still available in version 2.0, by the way), or the Unix GUIs, in that objects nest within objects arbitrarily. Unlike on the Mac, though, the object hierarchy isn't a view of the file system, but rather a logical view of references to data files, programs, print destinations, and document sets. Each object can open onto multiple windows. You open a folder's "icon" view to display its contents, or its "settings" view to change its fonts, colors, or other properties.

The spiral-bound notebook shown in the screen is a handy new metaphor that's used extensively for both dialog boxes and system documentation. The Window List tracks all active windowed tasks. While IBM's public demonstrations have shown a variety of drag-and-drop shell operations (e.g., launching programs and printing and discarding files), I couldn't explore these capabilities fully in the early version of the shell I received.

As I write these words a few months before IBM's deadline, I'm awed by what has been accomplished and by what still needs doing. Can the 32-bit rewrite of PM's graphics engine, smarter Windows memory management, the Workplace Shell, and smooth integration of the DOS, Windows, and OS/2 parts of the system possibly happen in time? I doubt all these wishes will come true by December 31.

Will that make OS/2 2.0 a failure? Hardly. OS/2 has always appealed to individuals and corporations that value an advanced, reliable operating system. Unfortunately, we had to jettison much of our DOS/Windows baggage to reap those benefits. Version 2.0 promises to do what OS/2 should have done from the start: embrace the family of lesser PC operating systems and provide a smooth upgrade path. Ultimately, it's not just a better DOS or a better Windows that I want, but a better system. I think that's what OS/2 2.0 will be. ■

Jon Udell is a BYTE senior technical editor at large. He can be reached on BIX as "judell."

GRA

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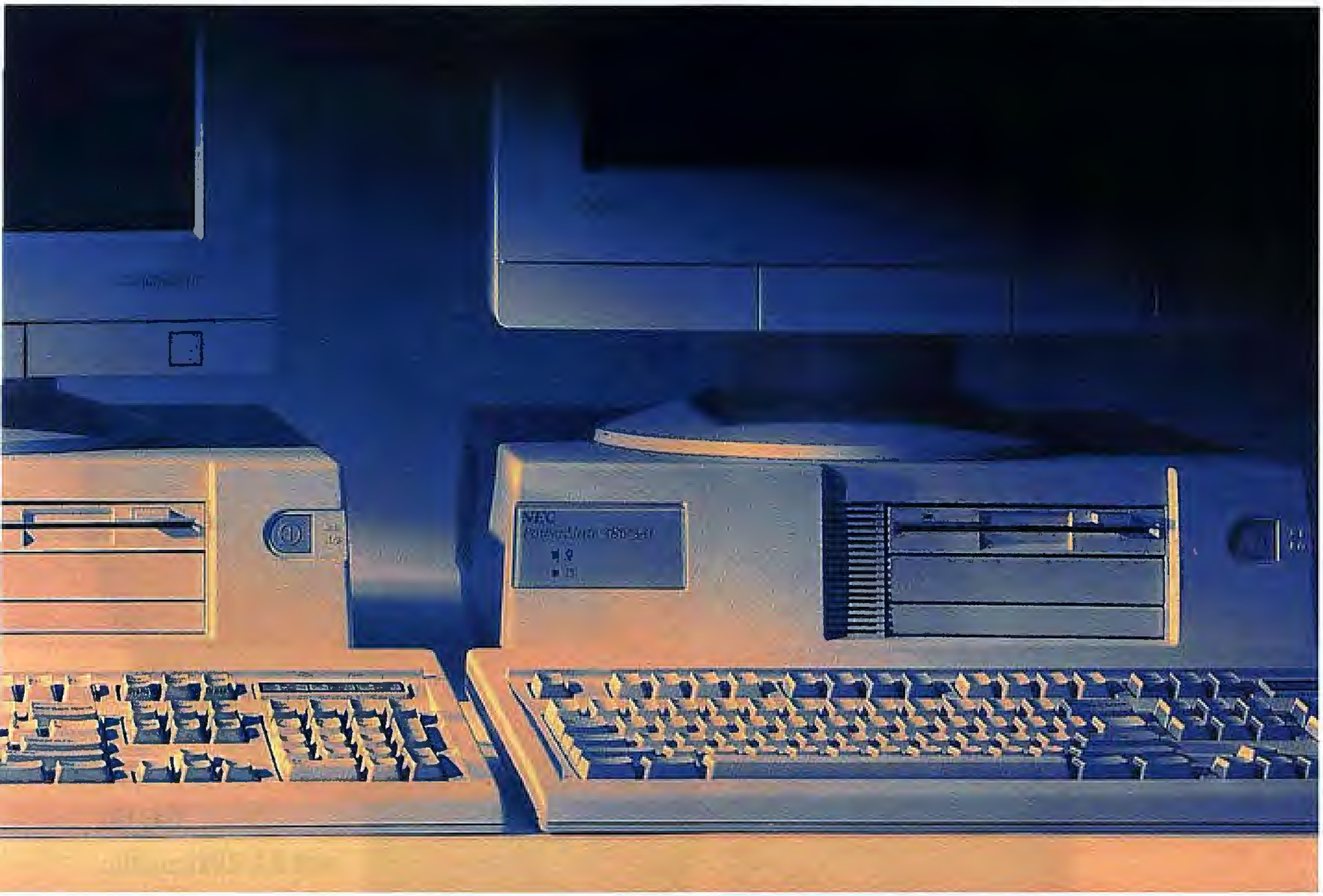

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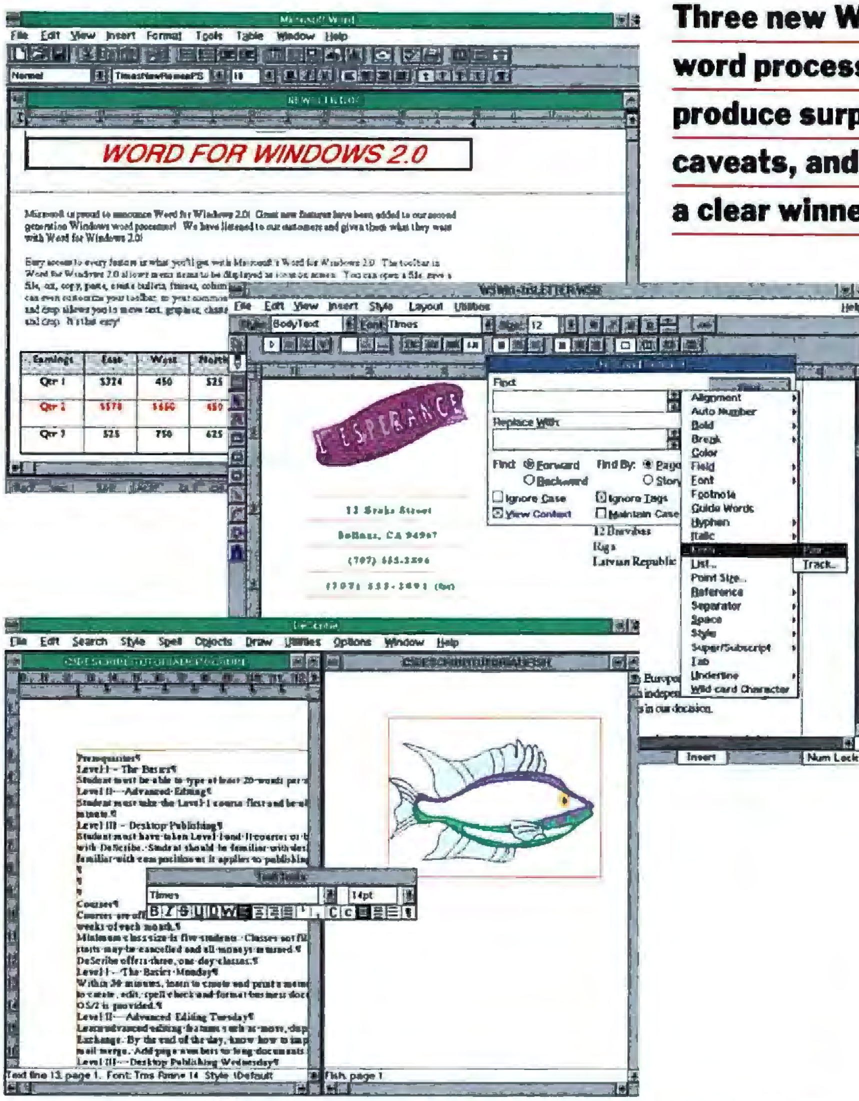
Putting Words to Windows

STAN MIASTKOWSKI

Three new Windows word processors produce surprises, caveats, and a clear winner

In the Great Windows Applications Sweepstakes, the arena of word processing is where the action is these days. We've come a long way from the days of simple editors. I took a look at beta versions of three new Windows word processors: Microsoft's Word for Windows 2.0, DeScribe Word Processor 3.0, and WordStar for Windows.

A year and a half after Windows 3.0 hit the shelves, these applications push Windows to its limits. The news is both good and bad: good because all three do amazing things with words and pictures; bad because of steep learning curves, feature confusion, and the heavy hardware resources that are needed to truly take advantage of all the bells and whistles in these packages.



Word for Windows 2.0 *(top),* **WordStar for Windows** *(middle), and* **DeScribe Word Processor 3.0** *(bottom) represent three similar approaches to the next generation of word processors. Yet all three retain their own individual personalities.*

Icons Everywhere

The most common trait of all three packages is what might be called "iconitis." Word for Windows 2.0 uses an enhanced and much-improved version of the icon bar that was first seen in Excel and is becoming universal in Microsoft applications. WordStar for Windows uses a similar approach, adding a vertical line of drawing icons down the left side of the screen. Of the three programs, DeScribe 3.0 has the unique icon approach: a minimal movable box of most-used icons that the company calls a "floating island." It's similar to the SmartIcons that Lotus uses in Ami Pro.

Perhaps I've become jaded by my old character-oriented word processors, but I still have problems with lots of icons. Instead of typing in well-remembered commands, I find myself stopping and having to study the icons to figure out what I want to do. Too often, it derails my train of thought. But I'll grudgingly admit that icons are in—for better or worse.

Even though all three packages go by the moniker of word processor, it's difficult to think of them as simple tools for putting words to the screen and then printing them. The line between word processors and full-fledged desktop publishing packages is now irrevocably blurred. The three packages can be used to produce full-fledged finished publications complete with pictures, graphs, and fancy typesetting. And therein lies another problem: All three suffer from "creeping featuritis." Each has hundreds and hundreds of features that I couldn't even begin to cover in these two pages.

Microsoft Forges Ahead

It's humbling and frightening to consider the hours and resources that Microsoft put into Word for Windows 2.0. The company walked the fine line between keeping familiar features and making changes that make the package easier to use. I have to admit that I've never been much of a Word fan. But with version 2.0, my opinion has changed.

Too often, the human interface of a software package is designed by the developers with little thought given to how people actually use a package. For this incarnation of Word, Microsoft spent thousands of hours doing both formal and informal usability testing. It shows. Word for Windows is indeed a complex package, but it's eminently usable. Menus and icons change depending on what you're doing, and textual hints supplement icons and menu choices. Help functions are a mix of text and easy-to-grasp graphics, and color is carefully used to highlight choices.

Word for Windows 2.0 is chock-full of useful touches, like the envelope icon that finds and captures the address in a letter and either prints an envelope immediately or saves it in an attached file. There are also extensive file management tools, a full-fledged drawing program and graphing utility that pop up from icons, and even a readability utility that tells you the grade level of your precious prose.

DeScribe Downgrades to Windows

DeScribe is a small company with its own unique agenda. The DeScribe Word *Publisher* (it's since been named the DeScribe Word Processor) was first developed for OS/2. It was advanced and ahead of its time. When market realities changed, the company switched course, with the distinctive result that DeScribe 3.0 is a product that has already gone through several iterations. Since Windows doesn't use threads (which dramatically speed up applications), I wasn't surprised to find that DeScribe's Windows version is a little slower than the OS/2 version (which is on the same set of disks). But subjectively, it's still a hair faster than the other packages that I looked at.

Of the three packages, DeScribe remains the quirkiest, but not so much that it stands distinctly apart from the other two. While its feature set is generally equal to those of its competitors, DeScribe still goes its own way in a number of cases. It has the cleanest-looking screen, but at the same time you can easily customize the look and feel to your particular preferences. If you root for the underdog and like to fiddle with the interface, DeScribe is the package for you.

It's Back

WordStar is the word processor that won't die. I'm dating myself when I mention my nostalgia remembering that the CP/M version was my first serious word processor and one that I used for years. The company rested on its laurels for many years while the market rushed past it, and it's been trying to catch up ever since. Make no mistake: WordStar for Windows is a powerful and full-featured word processor. However, what struck me is that it's basically a hodgepodge of features available in other packages. Of the three, its "featuritis" makes it the most difficult to learn to use. But at the same time, this very richness of features makes it most suitable for serious desktop publishing–type work.

WordStar for Windows also has its idiosyncrasies. For example, if you really can't part with those odd Control-key combinations of the original WordStar, you can switch them on in the Windows version. (I swore off them years ago.)

Which One's Which?

Problems common to all three packages are that they're disk space and hardware resource hogs. I have to shake my head when I look at my lean-and-mean 32-KB ASCII editor (which I use for lots of my writing) and compare it to the nearly 12 MB of disk space that Word for Windows takes up.

The hardware problem is much more serious; in fact, it's a major drawback. On my 33-MHz 386 with a fast hard drive and a high-resolution video RAM card, the speed of all three packages was just barely acceptable. I found myself continually switching into the draft mode that all three have to get acceptable speed. On a 20-MHz 386SX machine with a standard VGA display, all three packages were unacceptably slow in WYSIWYG mode.

Each of the three packages sells for $495. That's not an inconsequential piece of change, but it's in the ballpark for today's advanced applications. Word for Windows 2.0, DeScribe Word Processor 3.0, and WordStar for Windows are all feature-rich word processors that will do a more-than-competent job of producing eye-popping documents. However, of the three, Word for Windows 2.0 is the clear winner by a large margin. It's a groundbreaking Windows application that does the best job I've seen of making an advanced application truly easy to use. I've used hundreds of Windows applications, and Word for Windows 2.0 is the first one that makes me want to retire my character-based word processor. ■

Stan Miastkowski is BYTE's senior editor for new products. He can be reached on BIX as "stanm."

THE FACTS

Word for Windows 2.0
$495

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 1213 on Inquiry Card.

DeScribe Word Processor 3.0
$495; additional users on network, $350

DeScribe, Inc.
4047 North Freeway Blvd.
Sacramento, CA 95834
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(916) 646-1111
fax: (916) 923-3447
Circle 1214 on Inquiry Card.

WordStar for Windows
$495

WordStar International, Inc.
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Novato, CA 94949
(800) 227-5609
(415) 382-8000
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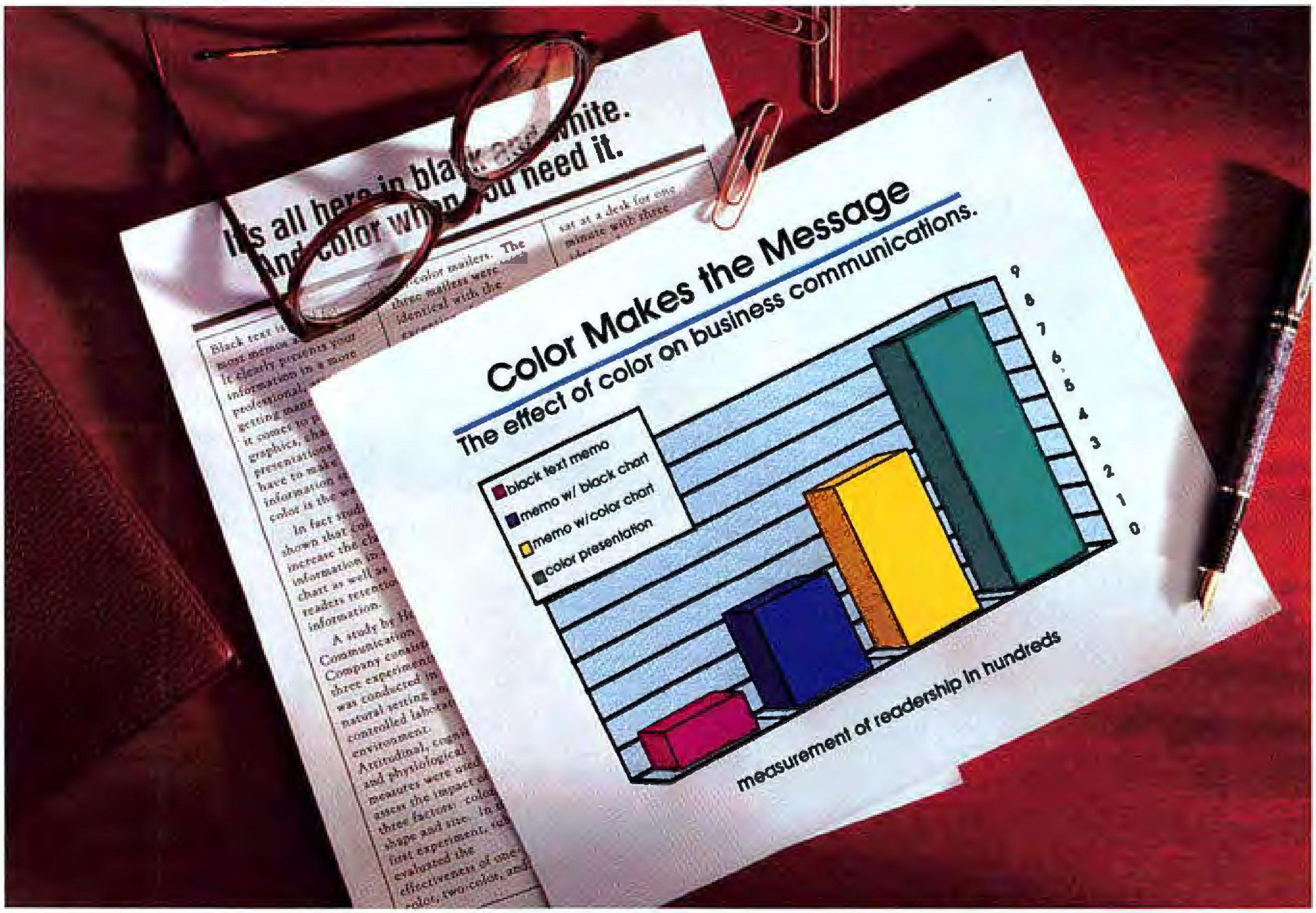
What's the business world coming to?



Now all users, Macintosh and PC, can get their hands on some color without giving up great black and white. Hewlett-Packard makes it all possible with the DeskWriter C printer for Macintosh and now the HP DeskJet 500C for DOS and Windows applications. Impressive black and white. And thousands of colors. For only $1,095.*

The best features of HP's DeskJet 500 black and white printer haven't changed. You'll still get the crisp, clean, laser-sharp output. The 300 dot-per-inch resolution. And you'll still have all the built-in, scalable fonts and graphic capabilities that can make such a difference in your documents and presentations.

Take all that, add a nearly endless choice of attention-getting colors, and your users have one very valuable partner. One that's a pleasure to work with. You just plug, play, and print. On plain paper or transparency.

With the DeskJet 500C and DeskWriter C, Hewlett-Packard introduces a colorful new generation to its family of inkjet printers. A family that stands for affordable quality. Quality that's backed by a three-year warranty.

*Suggested U.S. list price. †In Canada, call 1-800-387-3867, Ext. 2757. **Offer valid through January 31, 1992. No purchase necessary; void where prohibited.

Affordable color. The HP DeskWriter C printer for the Mac.

And the HP DeskJet 500C for PCs.

Only $1,095 each.

So when others ask you what's new, tell them to get ready for a splash of color. For more interesting graphs and charts. For impressive cover pages and for compelling overhead presentations. All for $1,095.

If you'd like to see some sample output from the DeskJet 500C or DeskWriter C, call **1-800-752-0900, Ext. 2757.**† Or visit your nearest authorized HP dealer and sign up for a chance to win a Caribbean cruise for two.** Color has finally arrived.

HP Peripherals
When it's important to you.

HEWLETT PACKARD

Circle 66 on Inquiry Card.

NEWS

FIRST IMPRESSIONS

Nanao Sets a New Standard

To get the most out of today's graphics-intensive environments and applications, you need hardware to match. Slow-as-molasses GUIs have made users realize that graphics are a major bottleneck. There's a raft of fast high-resolution cards available, but the last and most important link in the chain is the screen that displays the graphics.

After uncounted hours in front of the computer each week, a new eyeglass prescription every year, and tired eyes, I had about given up on finding a suitable monitor. My search is over. The **Nanao FlexScan T560i** is far and away the best monitor I've ever seen, and I don't make comments like that lightly.

Nanao isn't a high-profile name in the monitor market yet, but the T560i is sure to make it one. Based on a specially modified Sony Trinitron II CRT, the T560i is a 17-inch display—perfect for displaying high-resolution graphics at a readable size. It will flawlessly handle anything that you can throw at it, up to a 1280- by 1024-pixel noninterlaced display with a 70-Hz flickerless refresh.

From the well-designed microprocessor-based controls to the case and connectors, the T560i shows careful design and top-quality construction. It's a Cadillac of monitors, and, more important, it's one of the few monitors that conform to the strict new Swedish-government MPR II guidelines for electrical and magnetic radiation.

Besides relying on my subjective impressions of relaxed eyes at the end of the day, I also tested the T560i using Sonera Technologies' DisplayMate utility, which puts displays to a rigorous test. The T560i is the only monitor I've seen that passed the test flawlessly.

At a price of $2699, the T560i isn't inexpensive. You can find comparable-size displays for less, but if you work with graphics and value your eyes, this new Nanao monitor is the obvious first choice. The T560i is a groundbreaking product that sets a whole new standard for displays. The eyes have it.

—Stan Miastkowski

THE FACTS

Nanao FlexScan T560i
$2699

Nanao USA Corp.
23535 Telo Ave.
Torrance, CA 90505
(800) 800-5202
(213) 325-5202
fax: (213) 530-1679
Circle 1216 on Inquiry Card.

Presentation Power in a Friendly Package

The beta version of **Harvard Graphics for Windows** arrived here like a rookie phenom after a great spring training: under the spotlight of high expectations. Its forerunner was rated by the BYTE Lab as the best of the DOS presentation programs (see this month's Solutions Focus). The Windows version does not disappoint. This is a very capable program, and it doesn't have too much stuff.

There's not enough room to cover all the features of this complex package, so I'll focus on its most impressive aspect: It's easy to use. This is one of the nicest things you can say about presentation software, which essentially tries to squeeze an audiovisual department into a set of floppy disks.

The real test of ease of use is this: Can you get work done without having to slog through 500 pages of documentation? With Harvard Graphics for Windows, you can. I was able to compile a basic slide presentation in a day.

You basically start out with a blank slide and add the material you want: titles, body text, tables, charts, graphs, logos, and so forth. Your "canvas" can be within the slide editor or an outliner. You work with text just as you would in a graphical word processor or desktop publishing program, picking the font and size you want beforehand or easily changing it as you go along.

Software Publishing has managed to bring its winning DOS program into the Windows environment without sacrificing capabilities or elegance. Considering that the deadline for a presentation is usually yesterday, the only component missing is a time machine. ■

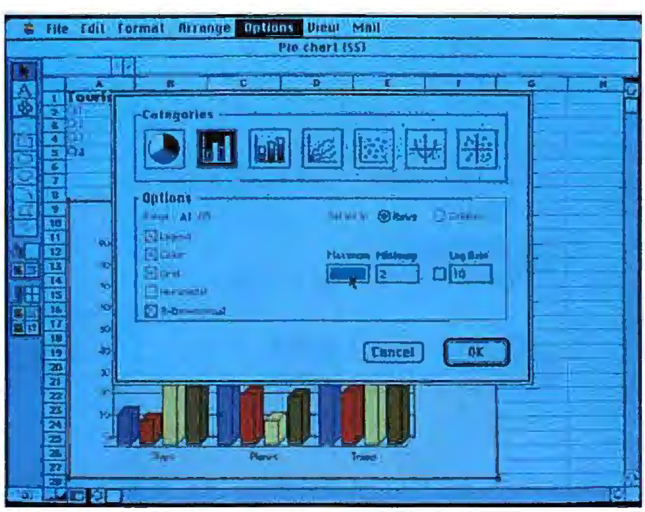
—D. Barker

THE FACTS

Harvard Graphics for Windows
$595; upgrade from Harvard Graphics 3.0, $50

System requirements:
IBM AT or compatible with Windows 3.0 and at least 2 MB of RAM.

Software Publishing Corp.
3165 Kifer Rd.
Santa Clara, CA 95051
(408) 986-8000
Circle 1217 on Inquiry Card.



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America's best hardware *plus* America's best software. You simply can't go wrong! Call us now at 800-423-5891.

The Eclipse-SL Takes a New Path

A 6-pound notebook computer based on the 20-MHz 386SL processor, the Eclipse-SL comes with 2 MB of RAM, expandable to 8 MB. It has a 1.44-MB floppy drive, a 20-MB hard drive, 64 KB of cache memory, a backlit VGA-compatible LCD, and an 84-key keyboard featuring a key mouse from Key Tronic. The unit ships with DR DOS 5.0 in ROM.
Price: $2995.
Contact: MicroWorld Corp., 3610 North 44th St., Suite 250, Phoenix, AZ 85018, (602) 381-8433; fax (602) 381-8445.
Circle 1271 on Inquiry Card.

The Eclipse-SL is based on Intel's SL chip.

Braille in a Pocket Computer

BrailleMate, a pocket computer for visually impaired people, has a braille keyboard that uses a built-in editor, enabling you to write into solid-state memory. The 1-pound unit acknowledges input with a speech synthesizer and an electronically operated braille cell. BrailleMate can store up to 128 braille pages. Credit-card-size memory cards fit into the bottom of the computer for extended memory.

You can enter information in braille abbreviations and have it print in full text using the computer's serial or parallel port. Material stored in Grade 2 braille is automatically retranslated to text for printing on a hard-copy braille or ink printer.
Price: $1595.
Contact: TeleSensory, 455 North Bernardo Ave., Mountain View, CA 94039, (800) 227-8418 or (415) 960-0920; fax (415) 969-9064.
Circle 1272 on Inquiry Card.

High Power and Easy Upgrades

The backplane technology of the 486B/50 desktop computer lets you upgrade without changing drives and add-in cards or unplugging internal devices. The system is designed for CAD/CAM design automation, scientific analysis, and database processing.

Features include 2 MB of RAM (expandable to 16 MB on the CPU), one serial and two parallel ports, built-in Super VGA capability, an Intelligent Drive Electronics controller, six 16-bit expansion slots, and DOS 5.0. The unit supports OS/2, Unix, Xenix, and NetWare.
Price: $3999.
Contact: Copam USA, 45875 Northport Loop E, Fremont, CA 94538, (415) 623-8911; fax (415) 623-8551.
Circle 1273 on Inquiry Card.

Unix on a 486 EISA

The Aegis 486 EISA-bus computer, targeted at Unix users, includes a fault-tolerant, multiuser I/O system that supports 128 devices and is expandable to support 512. Its 64 KB of second-level cache (expandable to 256 KB) enhances the 8-KB on-chip cache and FPU. It has a SCSI mirroring hard drive controller with caching and 1 MB of RAM (expandable to 32 MB) and a 300-MB tape backup unit.
Price: $23,650.
Contact: Ensure Computing Systems, 6030/E Dawson Blvd., Norcross, GA 30039, (404) 729-9900; fax (404) 729-8028.
Circle 1274 on Inquiry Card.

The Aegis fault-tolerant system for Unix.

Plenty of Pizzazz in This 386SX

The Model 325SXT 25-MHz 386SX offers a lot for a little. Configured with 2 MB of RAM that is expandable to 16 MB, the unit has one parallel and two serial ports, six expansion slots, and a 512-KB VGA board. It also features a 105-MB hard drive, 3½- and 5¼-inch floppy drives, and a 1024- by 768-pixel Super VGA monitor. It includes a mouse, DOS 4.01, and Windows 3.0.
Price: $1995.
Contact: Bell Computer Systems, 6615 Valjean Ave., Van Nuys, CA 91406, (800) 922-1126 or (818) 909-3501.
Circle 1275 on Inquiry Card.

Laser Printer from Alps

Alps America's 16-ppm, 300-dpi Alps LSX1600 has a noise level of less than 55 dB. Designed for use on LANs and in other workgroup environments, the printer has two built-in paper bins and an integrated envelope feeder that lets you print letterhead, plain paper, and an envelope with just one request.

The printer is LaserJet Series II compatible and can be upgraded for PostScript compatibility by adding an optional cartridge. With 24 built-in fonts, the printer also supports Hewlett-Packard soft fonts and font cartridges. Its 1 MB of memory is expandable to 7 MB.
Price: $3295.
Contact: Alps America, 3553 North First St., San Jose, CA 95134, (800) 825-2577 or (408) 432-6000; fax (408) 432-6035.
Circle 1276 on Inquiry Card.

The laser Alps LSX1600 works quietly on LANs.

Make CD-ROMs from Tape

The Personal Rom-Maker is a CD-ROM premastering and backup system for 386 PCs. You can produce ISO-9660- or Hi-Sierra CD-ROM-formatted output on a 4-mm DATA/DAT tape and then send the tape to a replication plant to be duplicated as CD-ROMs. The system's emulation capabilities test the user application before it masters and replicates it. The package includes the necessary software, a SCSI card, and a DATA/DAT drive. The system requires a PC running DOS with at least 1 MB of extended memory.
Price: $7000.
Contact: JVC Information Products Co. of America, 19900 Beach Blvd., Suite 1, Huntington Beach, CA 92648, (714) 965-2610; fax (714) 968-9071.
Circle 1277 on Inquiry Card.

Stand-Alone OCR Scanner

ReadStation, an integrated, stand-alone optical-character-recognition scanner, includes an automatic document feeder, a dedicated computer, and OCR software. The unit accepts word processing, spreadsheet, and database files, and its LCD control panel offers one-touch operation. It uses Caere's OmniPage page-recognition software.

You can use ReadStation as a stand-alone unit to scan documents into the scanner's 4 MB of memory and then copy them to disk in DOS, Macintosh, or Unix format using the built-in 3½-inch floppy drive. Alternatively, you can connect ReadStation to a host PC via its RS-232 or RS-422 serial port interface and send files directly to the PC.

When in read mode, ReadStation automatically ignores or removes graphics. When operating in graphics mode, it saves images in TIF format.
Price: $5495.
Contact: Umax Technologies, Inc., 2352 Walsh Ave., Santa Clara, CA 95051, (800) 562-0311 or (408) 982-0771; fax (408) 982-0776.
Circle 1278 on Inquiry Card.

Optical Drive for the Mac

The Infinity Optical 3½-inch half-height drive uses single-sided optical disks with a capacity of 128 MB. The rewritable optical drive rotates at 3000 rpm for a data transfer rate of 625 KBps, has an average seek time of 40 ms, and is compatible with the Mac Plus and better Macs.
Price: Drive, $2195; cartridge, $89.
Contact: Peripheral Land, Inc., 47421 Bayside Pkwy., Fremont, CA 94538, (800) 288-8754 or (415) 657-2211; fax (415) 683-9713.
Circle 1279 on Inquiry Card.

The Infinity Optical drive transfers data quickly.

Print Two Sides on Your Desk Printer

Two-sided printing is standard for the Xerox 4213 Laser Printing System. The desktop system also is designed so that you can replace your own dry ink, developer, and photoreceptor cartridges.

With 300-dpi resolution at speeds of up to 13 ppm, the Xerox 4213 can print up to 45,000 pages per month. The printer supports applications running on remotely connected mainframes and minicomputers, as well as on PCs in workgroups and LANs.

Standard emulations are the HP LaserJet Series IID and Xerox Escape Sequences. PostScript emulation is optional. Emulation switching is available from the user interface or the host computer. Input trays are computer controlled.
Price: $4795.
Contact: Xerox Corp., P.O. Box 24, Rochester, NY 14692, (800) 332-2092.
Circle 1280 on Inquiry Card.

The ZEOS® '386 SX

Now 20 MHz Only $2295!

Notebook.

16 MHz Only $1995!

"THE HOTTEST DEAL ON THE NOTEBOOK MARKET"—PC MAGAZINE

"King of the Hill... Sensational... The best price-performer ... Astonishing value ... The number one contender..." The praise goes on and on. Winner of PC Magazine's Editor's Choice Award *and* PC World's Best Buy Award, the experts love the ZEOS Notebook. And you'll love it too. Because as PC Magazine said, the ZEOS Notebook is simply "the hottest deal on the notebook market."

INCREDIBLE DESKTOP FEATURES IN A NOTEBOOK.

Pick your power. Choose our '386SX-16MHz version or go for the incredible new ZEOS '386SX-20MHz version. Combine that with our high speed hard disk, built in 1.44MB floppy drive, VGA and more—you've got the greatest notebook going at any price!

Look closely at the details. Like our crisp 10" VGA display. The ultimate in sparkling clarity featuring advanced fluorescent backlighting for vivid VGA graphics. And then the drives.

Two drives are better than one! First, you're getting our whisper quiet high speed, high capacity hard disk. Then we've built in an industry standard 1.44 Megabyte, 3.5 inch floppy as well. And we don't stop there.

DETAILS MAKE THE DIFFERENCE!

For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. Or, you can use the optional charging stand if you wish.

Either way, you're sure to appreciate our light weight snap-in, snap-out battery packs. They're so light and easy to use, you can easily take an extra one with you on those really long trips. Plus, you can get even more life out of a single charge by using our programmable power management system. Hour upon hour of Notebook computing power!

CONNECTIVITY TOO!

Your new ZEOS notebook is a great connectivity tool! Using our optional built-in 2400 baud MNP Class 5 modem, connectivity buffs will find themselves logging on at every turn.

And speaking of connectivity, we've kept the I/O easy to use too. Because unlike many of the others, your new ZEOS notebook has the same industry standard port connectors you'll find on your larger desktop system. Serial and Parallel ports; even an external VGA connector. Completely compatible!

ZEOS 24 HOUR A DAY SUPPORT.

Don't forget your new ZEOS notebook is backed by the best Technical and Sales support in the industry, 24 Hours a Day. We're always here to help, *any time* of the day or night. And we don't stop there either.

Your new notebook is also backed by our 30 Day Absolute Satisfaction Money Back Guarantee and One Full Year Limited Warranty. You're going to be very satisfied. We don't just say it. *We guarantee it.*

ORDER YOUR OWN ZEOS NOTEBOOK NOW!

You can order your own ZEOS Notebook *right now.* Simply pick up the phone and give us a call now at 800-423-5891. Larger hard drives, carrying cases and more are also available! At last, a full featured notebook that lets you compute anywhere. You're going to love it!

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NOW. YOUR COMPLETE '386SX-16 NOTEBOOK! VGA, 20MB HARD DRIVE, 1.44MB FLOPPY AND MORE. LIGHT AND LOADED! INCREDIBLE.

ONLY $1995!

20MHz ONLY $2295!

- '386SX-16 or '386SX-20.
- 1MB DRAM, expandable to 3 or 5MB.
- 20MB High Speed HDD.
- Built in High Density 3.5" 1.44MB floppy drive.
- High resolution VGA display. Fluorescent backlit 640x480, 32 grey scales. Bright and clear!
- Removable quick charge NiCad battery. Two hour plus battery life typical, more using Programmable Power Management!
- Quick charge or trickle charge using included AC power adapter.
- Extra battery packs and external charging stand available.
- 82 key keyboard. True 101 key emulation.
- Industry standard Serial and Parallel Ports.
- VGA port for external VGA color display. Great for demos!
- Total system weight 7 lbs. with battery.
- 30 Day Absolute Satisfaction Money Back Guarantee and ZEOS Customer Satisfaction Package.
- One Full Year Limited Warranty.
- 24 Hour a Day Toll Free Technical Support, 365 Days a Year.

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MasterCard, VISA, Discover, Am Exp, Z-Card and COD.
Open 24 Hours a Day, 365 Days a Year!

ZEOS INTERNATIONAL, LTD.

Be a Master of Design

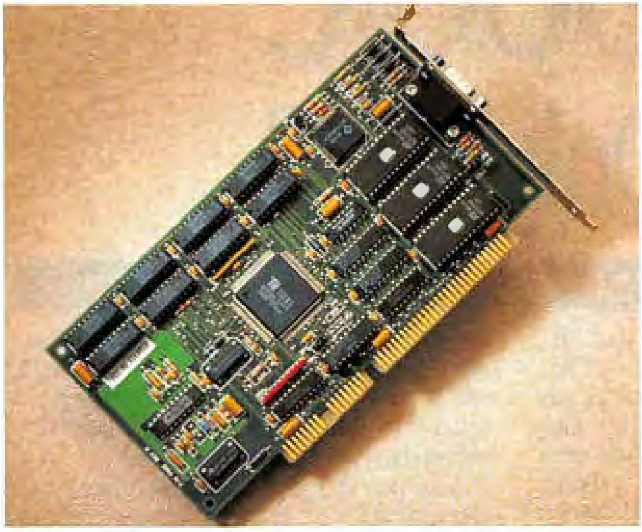
A high-resolution VGA board for work in AutoCAD and Windows 3.0, the Design Master VGA includes AutoMate/Pro Display List software for AutoCAD 386 release 11, AutoShade 2.0, and AutoDesk 3D Studio, as well as VMI True View, an image-viewing application for Windows 3.0. The board supports more than 100 text modes, including 132-column display, and has a 72-Hz refresh rate.

With 1 MB of memory, the 16-bit Design Master VGA uses VMI's Render-Ready technology and on-board Sierra Hi-Color DAC to support up to 32,768 colors at up to 800- by 600-pixel resolution. Based on the Tseng ET4000 chip, the board works with VESA and 8514/A applications and includes drivers for GEM, Ventura Publisher, Lotus 1-2-3, WordStar, and WordPerfect.

Price: $495.

Contact: Vermont Microsystems, 11 Tigan St., Winooski, VT 05404, (802) 655-2860; fax (802) 655-9058.

Circle 1281 on Inquiry Card.



The Design Master VGA gives high resolution in many modes.

Support for XT and Extended AT Interrupts

The PCIO board provides a Centronics parallel port and a serial port that supports XT and extended AT interrupts. The I/O board is PC compatible.

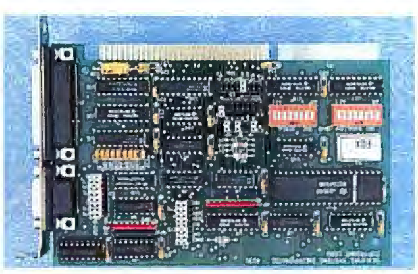
The parallel port features include user-selectable addresses of LPT1, LPT2, and LPT3 via DIP switches, an individually selectable interrupt level, the capability to share interrupts with other interrupts, and a jumper that lets the port operate bidirectionally.

The serial port features include the ability to address the port as various COM addresses, an individually selectable interrupt level, and the ability to determine the serial port interface via jumper selection. Additionally, interrupts can be shared with other interrupts.

Price: $199.

Contact: Sealevel Systems, Inc., 102 West Main St., Liberty, SC 29657, (803) 843-4343.

Circle 1282 on Inquiry Card.



The PCIO board has an individually selectable interrupt level.

Sing Along with Your PC

A sound-enhancement board for PCs, Sound Master II comes with a complete set of software applications. Included is PC-Lycra, which lets you compose your own music; input can be via the keyboard, a mouse, or a MIDI keyboard.

Sound Master II supports voice-recognition software and is packaged with the Voice Master Key program, letting you create macro files holding up to 64 voice-activated macros that you can use in most applications. The Voice Master Key is trained to recognize the speaker's voice and respond with a set of user-defined keystrokes. The program can be kept in resident memory while you access applications such as word processors and databases.

Price: $229.95.

Contact: Covox, Inc., 675 Conger St., Eugene, OR 97402, (503) 342-1271; fax (503) 342-1283.

Circle 1283 on Inquiry Card.

Watch TV on Your PS/2

The Super TV Tuner for PS/2 systems lets you pop up a menu to select any of 122 U.S. cable or broadcast TV channels. The tuner demodulates the incoming signal into pure NTSC, which can drive an IBM M-Motion or VideoLogic DVA-4000 board for live digital video in a window on the monitor. You can scale the window; adjust hue, saturation, brightness, and contrast; and control the sound concurrently with other applications in other windows.

Price: $495.

Contact: New Media Graphics Corp., 780 Boston Rd., Billerica, MA 01821, (508) 663-0666; fax (508) 663-6678.

Circle 1284 on Inquiry Card.

Speed Up Your Mac Classic

The Classic Performer accelerator board can speed up your Mac Classic by 92 percent to 96 percent, according to Harris Laboratories. The board consists of a 68000 processor running at 16 MHz and fits over the original 68000. An optional math coprocessor is available.

Price: $299.95; math coprocessor, $149.95.

Contact: Harris Laboratories, Inc., 7379C Washington Ave. S, Edina, MN 55439, (800) 783-3726 or (612) 941-2948; fax (612) 941-3515.

Circle 1285 on Inquiry Card.

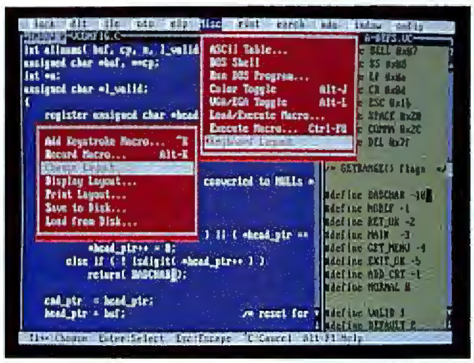
The new multi-mode VEDIT PLUS is the only text editor you will ever need!

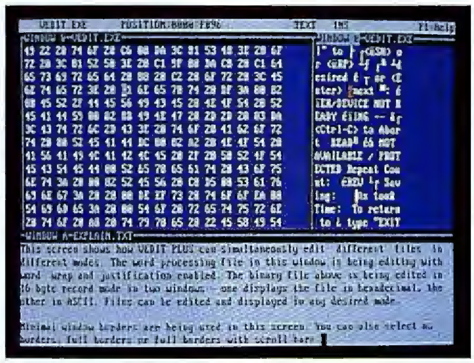
The most powerful text editor for program development and text processing

- **Drop-down menus, mouse support**
- **Columnar blocks, regular expressions, undo**
- **Also VEDIT for $69, VEDIT Jr. for $29**

The fastest text editor for mainframe, CD ROM and other huge files

- **Edit up to 2 Gigabyte text, binary, mainframe files**
- **Edit in ASCII, EBCDIC or Hexadecimal**
- **Emulate Wordstar, Word Perfect, Brief, vi, others**





The new VEDIT PLUS is today's finest programmer's editor. Small (80K) and lightning fast, it is written entirely in assembly language. VEDIT PLUS is the only programmer's editor that can edit *any* text or binary file you will ever encounter.

Incredibly, VEDIT is over 20 times faster than other editors on just a 3 megabyte file. When editing multi-megabyte files, only VEDIT has the speed to get the job done.

Benchmarks in 3 Meg File	VEDIT	Brief	Sage
Save and continue	52 sec	3:52 min	1:47 min
Load, modify, save, exit	21 sec	49 sec	1:38 min
Block-column copy (40x200)	2 sec	30 sec	2 sec
Delete one column in file	9:58 min	1:50 hour	1:03 hour
60,000 search & replace	3:18min	1:44 hour	1:32 hour

The extensive compiler support runs popular compilers and also your favorite linkers, debuggers and Make from within VEDIT. It even integrates tools from different vendors. When shelling to DOS, VEDIT swaps itself and TSRs out of memory, giving you as much as 620K of available memory for compiling the biggest programs. Only VEDIT gives you the advantages of a powerful editor with the convenience of an integrated environment.

VEDIT PLUS has every advanced feature you might expect. Simultaneously edit numerous files, split the screen into windows, search/replace with regular expressions. Automatic indent, block indent, parentheses matching and block operations by character, line, file or column speed program development. Word wrap, paragraph formatting, justification, centering and many printing options are ideal for text processing.

VEDIT PLUS has the most powerful macro programming language of any editor. It eliminates repetitive editing tasks and lets you create your own editing functions. It includes testing, branching, looping, user prompts, keyboard input, string and numeric variables, complete control over windows plus access to hardware interrupts, memory and I/O ports. Source level debugging helps you develop new macros quickly and easily.

Until now, few PC text editors could even begin to handle huge mainframe, CD ROM, postscript, plotter output and other multi-megabyte files. The new VEDIT PLUS, with its unique virtual memory management, handles them all effortlessly.

Edit in ASCII, EBCDIC or Hexadecimal modes, or split the screen for any combination of modes. File modes support DOS text, UNIX text, binary and many fixed length record formats.

VEDIT PLUS

DOS	QNX
XENIX	FlexOS
UNIX	IBM 4680

An intuitive user interface with drop down menus, hot keys, mouse support, optional scroll bars, context sensitive help, point and shoot file selection, 1000 level undo and unlimited keystroke macros make VEDIT PLUS easy to use, easy to learn. And it can emulate the keystrokes of almost any editor you already know.

Everything in VEDIT PLUS is configurable. The keyboard layout, the screen colors, the way control characters, long lines and window borders are displayed, and much more, is all configured with easy to use menus.

Confidently order your copy of VEDIT PLUS today; it comes with a 30 day money-back guarantee. VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT PLUS - DOS single user license: $185; DOS network 5 user license: $295; UNIX/XENIX, QNX, FlexOS/IBM 4680 single CPU license: $285. Site license pricing is available.

24-Hour Bulletin Board

A fully functional demo version of VEDIT PLUS and a shareware version of VEDIT Jr. are available on our BBS at 1-313-996-1304.

Toll Free: 1-800-45-VEDIT (1-800-458-3348)
Telephone: (313) 996-1300, Fax: (313) 996-1308
Mail: P.O. Box 1586, Ann Arbor, MI 48106

Greenview Data

Circle 35 on Inquiry Card.

Scanner Tests Network Wiring

Next Scanner uses an expert-system architecture to simplify the process of certifying new and existing network wiring. After you enter information on cable and network type into the hand-held tester, it automatically determines what tests are appropriate and runs them. Next, it compares the test results to a table of expected results for that network type and indicates whether the cable will support the application. If the cable fails the test, the scanner indicates why.

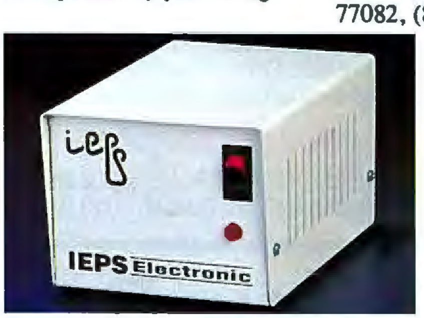
The Next Scanner certifies whether new or existing wiring will support Ethernet, 10Base-T, 4- and 16-Mbps token-ring, and ARCnet network applications. You can instantly determine if you can use existing 4-Mb token-ring cabling for 16-Mb token-ring systems.
Price: $3495; cable management software, $395.
Contact: Microtest, Inc., 3519 East Shea Blvd., Suite 134, Phoenix, AZ 85028, (602) 971-6464; fax (602) 971-6963.
Circle 1286 on Inquiry Card.

After testing network wiring, Next Scanner compares the results to a table and indicates if the cable will support the application.

Protect Your Computer from Your Printer

Lasermatch protects your computer from your laser printer by preventing low-voltage spikes generated by the printer from migrating into the computer. The unit's transformer-based design supplies 12 amps of power and lets the Lasermatch absorb high- and low-level spikes, dissipating them as low-grade heat.

When you use a stand-alone computer with Lasermatch, you plug the computer into the unit. When you use the unit with a LAN, you plug the printer into it.
Price: Two-outlet unit, $179; four-outlet unit, $185.
Contact: IEPS Electronic, Inc., 11391 Meadowglen, Suite F, Houston, TX 77082, (800) 882-8285.
Circle 1287 on Inquiry Card.



Lasermatch works with stand-alone PCs or on a LAN.

Windows and DOS Run Remotely

The modem remote-control software Close-Up 4.0 supports Windows 3.0 and DOS 5.0, letting you remotely run multiple Windows and multiple DOS applications simultaneously, full-screen or windowed. The software lets you remotely install Windows, start a long file transfer in a background Window, and monitor the transfer while the person using the remote PC continues to work in a foreground Window. The program supports Windows in standard, real, and 386 enhanced modes.

Version 4.0 lets you use a mouse to paint, click, and draw in real time on remote PCs. Other features include a 200 percent increase in file transfer speed, memory requirements as low as 34 KB, the ability to use extended memory and be loaded into high memory, and compatibility with memory managers 386Max, QEMM-386, and EMM386.
Price: $440 (TSR Support/ACS, $245; foreground program Customer/Terminal, $195).
Contact: Norton-Lambert Corp., P.O. Box 4085, Santa Barbara, CA 93140, (805) 964-6767; fax (805) 683-5679.
Circle 1288 on Inquiry Card.

Do Parallel Processing on Your Mac

The Paratech Solutions TMac is an external hardware platform for developing and hosting transputer parallel systems. Hosted over the SCSI bus, the unit leaves your Mac's internal slots free. Iserver support lets you use Inmos tool sets for Occam, C, and FORTRAN on the attached network. Four links are available on the rear connector, which, with the TMac subsystem, let your Mac control large transputer networks.

The TMac runs at 20 MHz and has a 700-KBps transfer rate to the host. It has either 1 or 4 MB of DRAM and zero-wait-state memory.
Price: $1299 to $1699.
Contact: The Saelig Co., 1193 Moseley Rd., Victor, NY 14564, (716) 425-3753; fax (716) 425-3835.
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THE MOST USE
TO COME ALONG

A few months ago we brought you the world's most useful computer—the Toshiba T2000SX.

That computer symbolized what we call "the next generation in personal computing." A computer that not only allows you the freedom to work where, when, and how you want to. But is so precisely engineered—from its superior keyboard to its easy-to-read VGA screen—that you'll actually enjoy using it.

Well, thanks to the incredible speed of modern technology, here we are once again.

This time to present the new Toshiba T2000SXe.

FUL COMPUTER SINCE FEBRUARY.

THE E STANDS FOR EXTRA POWER.

Like the T2000SX, the T2000SXe weighs a minuscule 6.9 pounds, it boasts a 386SX processor, and it supplies up to 60 MB of hard disk storage space. But, and here's the news, the T2000SXe gives you a bigger dose of speed (20MHz) and more memory (2-10 MB RAM).

Of course, the T2000SXe also offers Hypertext, a VGA screen, full modem capabilities (including available cellular and fax accessories), full-size sculpted keys on its keyboard and a host of additional benefits that make other notebooks look more like memo pads.

After testing eight of the top notebook computers on the market, Byte Magazine said, "Buy the Toshiba T2000SX." Wait'll they try the T2000SXe.

A LONGER LASTING BATTERY.

The most useful computer isn't of much use if its battery doesn't last long.

That's why the T2000SXe, like the T2000SX, is armed with a Nickel Hydride battery. Nickel Hydride is proven to deliver 22% more power per ounce than the NiCad batteries found in other portable computers. In fact, according to Byte magazine, the battery on Toshiba's T2000SX lasted well over three hours on a 90-minute charge. Outlasting every other notebook they tested and lasting twice as long as some.

To get even greater battery life, the T2000SXe offers Toshiba's highly acclaimed AutoResume. A special feature that allows you to shut your computer down and start up precisely where you left off. Without the hassle of rebooting, restarting applications and reloading files.

NOW THERE ARE EVEN MORE CHOICES.

At Toshiba, we've always believed that no one computer is right for everyone. That's why we've also added a more affordable notebook to our line called the T2000. Featuring a 12MHz, 286 processor, it's designed for people who don't need all the power of the T2000SX or the T2000SXe.

If you'd like to learn more about the world's most useful notebook and portable computers, please call us at **1-800-457-7777.**

Well, that's the latest. Three incredible notebooks that fit your needs, your briefcase and now your budget.

Isn't technology wonderful?

In Touch with Tomorrow
TOSHIBA

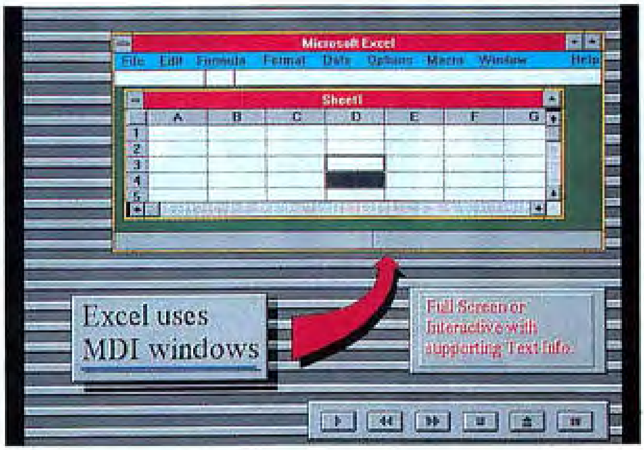
Circle 153 on Inquiry Card.

Six Windows and OS/2 Utilities

To help you showcase the features of your Windows 3.0 and OS/2 Presentation Manager (PM) applications, The Stirling Group developed DemoShield, a demonstration toolkit. It is one of six toolkits offered by the company to help you develop professional programs for the platforms.

With DemoShield, you can create program demos and tutorials. Built-in pointers and tools let you highlight the important features of your application. A Director feature lets you rehearse your script while using other tools to enhance the demo.

Other toolkits include InstallShield, which lets you create graphical installation programs for your application; TbxShield, for adding toolbox controls to your application; DbxShield, for implementing the logic behind your application's dialog boxes; MemShield, a memory management library; and LogShield, for adding session recording and playback facilities.
Price: DemoShield: Windows version, $495; PM version, $595. TbxShield, $295 each version. All others, $395 or $595.
Contact: The Stirling Group, 127 East Main St., Roselle, IL 60172, (708) 307-9197; fax (708) 307-9340.
Circle 1290 on Inquiry Card.



DemoShield lets you embed a live copy or working model of your program to let end users learn about features as they work in the application. Here a live copy of Excel is running.

HIFFL Saves You a Year of Programming

With the new Halo Image File Format Library, you can save yourself about a year's worth of programming effort in adding support for popular graphics and imaging file formats, Media Cybernetics says. Available for DOS compilers and Windows as a dynamic link library, HIFFL lets your application read and write bit-mapped image files in TIF, PCX, BMP, and CUT formats.
Price: DOS version, $249; Windows version, $349.
Contact: Media Cybernetics, Inc., 8484 Georgia Ave., Silver Spring, MD 20910, (301) 495-3305; fax (301) 495-5964.
Circle 1291 on Inquiry Card.

Transaction Processing Toolkit for Unix

The On-Line Transaction Processing Toolkit, called iTran, has eight software tools based on C and C++ for Unix. The toolkit simplifies and accelerates the development of distributed transaction processing solutions under AT&T's Unix Systems Lab's Tuxedo System/T transaction manager.
Price: $10,000 and up.
Contact: Independence Technologies, Inc., 42705 Lawrence Place, Fremont, CA 94538, (415) 438-2000; fax (415) 438-2034.
Circle 1292 on Inquiry Card.

GIS Toolkit for the Mac

TerraView, a programmer's toolkit for developing mapping applications, is now available for the Mac. The program, which also comes in versions for DOS, Windows, and Unix, lets you write applications using Pascal, C, and other languages without having knowledge of complex cartographic constructs. TerraView is optimized for rapid retrieval and display of spatial data accessed from magnetic and CD-ROM media.

The toolkit supports such data types and classification systems as ETAK, USGS, and TIGER/Line. TerraView functions support standard mapping projections, including Mercator and Polyconic, and coordinate systems, such as longitude/latitude and most state plane coordinate systems.
Price: $3495.
Contact: TerraLogics, Inc., 114 Daniel Webster Hwy. S, Suite 256, Nashua, NH 03060, (603) 889-1800; fax (603) 880-2022.
Circle 1293 on Inquiry Card.

New Actor Adds Database Access

Database access is a key component to The Whitewater Group's new version of Actor, which lets you write, test, and debug Windows applications in Windows. The Object Graphics 1.1 graphics class library, included with the professional version of Actor 4.0, supports device-independent bit maps, arbitrary scaling of images, and palette support with animation. Version 4.0 also includes ObjectWindows, the class library for fast interface development.

Actor 4.0's dynamic link libraries provide access to Paradox, dBase, and Excel files. An optional DLL provides access to SQL Server, DB2, Oracle, and OS/2 Extended Edition Database. A mechanism called *protocols* implements safe multiple inheritance by keeping all shared code in one location, eliminating unexpected dependencies.

Actor 4.0 Professional includes the Whitewater Resource Toolkit.
Price: Actor 4.0, $249; Actor 4.0 Professional, $495; optional database DLL, $395.
Contact: The Whitewater Group, 1800 Ridge Ave., Evanston, IL 60201, (708) 328-3800; fax (708) 328-9386.
Circle 1294 on Inquiry Card.

Programmer's

Q+E Database Library

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

List: $399 Ours: $ 209

FAXcetera# 2625-0001

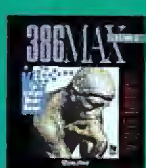
GUI Windows Programmer Toolkit

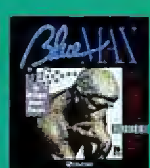
3-in-1 C/C++ Screen Designer and Code Generator, complete any screen design and generate C/C++ and all other files in minutes. ObjectTable C/C++ source code utility, multi-column, edit table, including column title, attribute, row number, and data validation. DynamicObject C/C++ source code of screen designer, a module allows users to customize the screen at the run-time.

3-in-1 C++	List: $259	Ours: $229
ObjectTable C/C++	List: $299	Ours: $269
DynamicObject C/C++	List: $259	Ours: $229

FAXcetera# 3107-0002

386MAX® & BlueMAX™





Qualitas' new memory managers feature SmartMemory™, Automatic Reordering, an integrated graphical interface, disk cache, and system analyzer to give you more memory with better performance than any other memory manager. 386MAX 6 also features ROMsearch™ and VGASwap™. BlueMAX 6 features BIOS Compression technology form IBM PS/2s.

CALL FOR SALE PRICES TODAY!

FAXcetera # 1888-0006

WindowsMAKER Professional 3.10

The fastest way to create Windows applications in C. Generates the Windows .EXE with fully commented source and production files. No royalties. Point and click to define user interface. Preview your design to instantly test look and feel. Make changes on the fly without compiling. Custom code is preserved during code generation. Supports C++. True Visual Programming in C. Highly recommended.

List: $995 Ours: $795

FAXcetera #2602-0003

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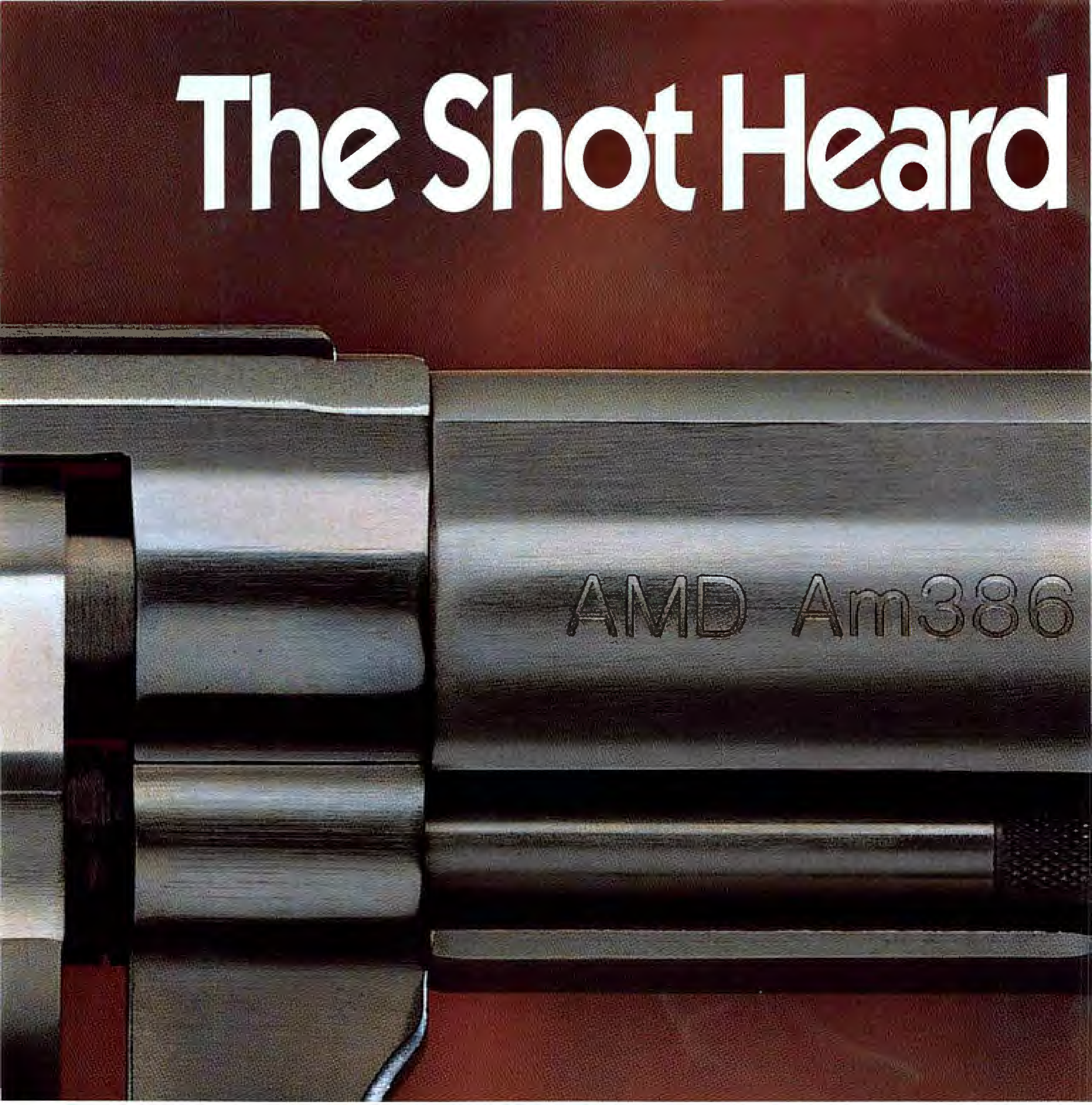
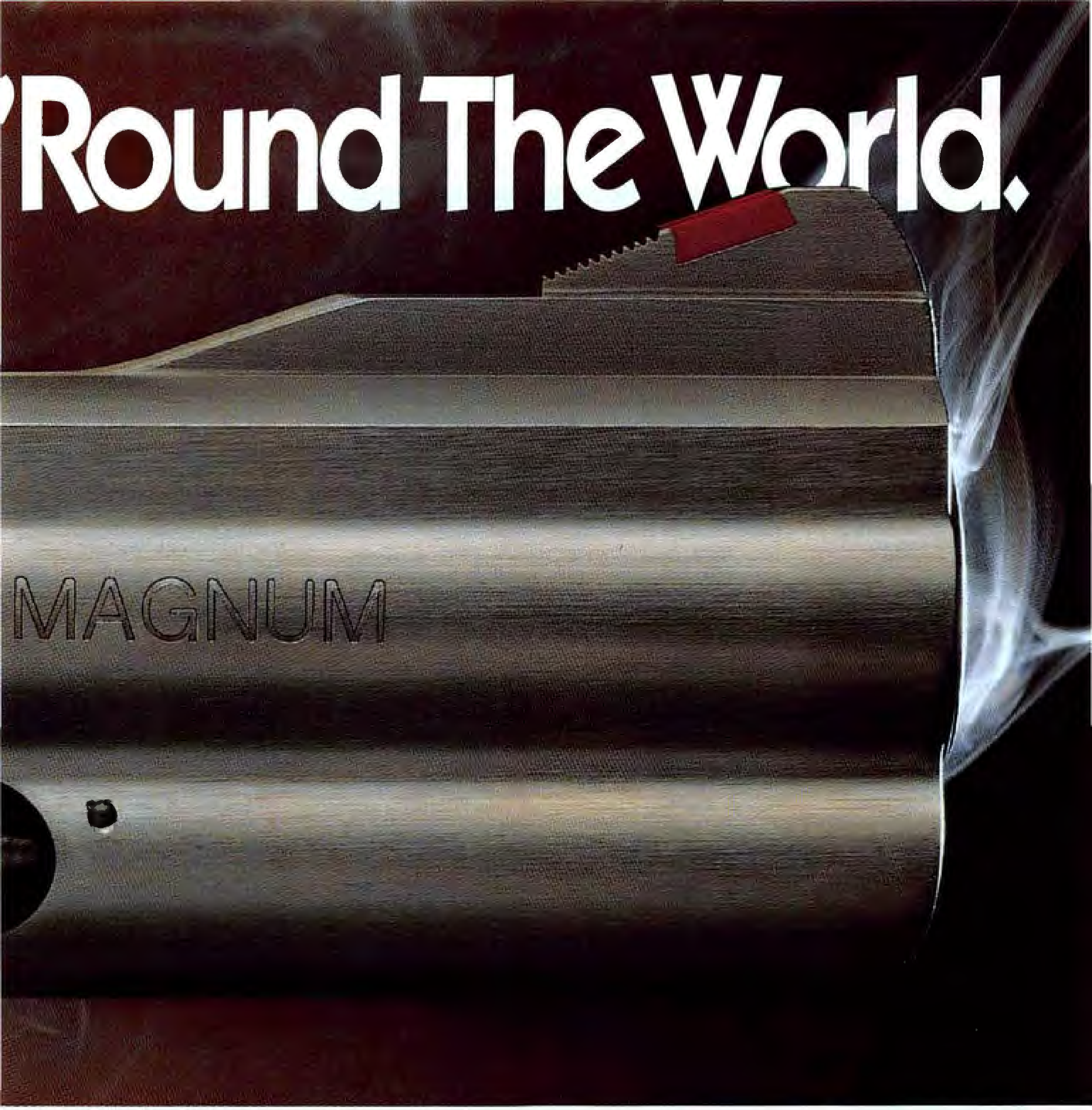


AMD Introduces The Am386™ Microprocessor.

You say you want a revolution? We've got your ammunition: The Am386 microprocessor. And it stands for the same principles you value most—higher speeds, longer battery life, better price-performance, and the freedom to choose your own vendor.

The Am386DXL-40 microprocessor shatters the 33MHz 386 speed barrier with a genuine, 40MHz, plug-in replacement. Which means you can easily offer the fastest 386 system available.

Thanks to its truly static operation, the Am386 microprocessor family uses very little power. So you can expect battery life up to 5.5 hours under normal working conditions with our 25MHz, low-power Am386SXL-25 CPU.



And the price you pay for such freedoms is small, and getting smaller. Because we've brought back aggressive learning curve pricing, anticipating at least a 20% price reduction each year for our Am386SXL-25 CPU.

What's more, the Am386 microprocessor family is available today, available in quantity, and available to everyone.

In truth, it's *the microprocessor for the masses.*

So call AMD today at **1-800-222-9323.**

And start a revolution of your own with the Am386 microprocessor.

Advanced Micro Devices

"We're Not Your Competition."

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Data Acquisition to the Hilt on Windows 3.0

Snap-Master for Windows, a data acquisition, analysis, and graphing program, lets you define custom test instruments that duplicate and even surpass the capabilities of conventional test instruments while operating at the maximum speeds of your A/D hardware. HEM Data says the program can handle up to 400,000 samples per second.

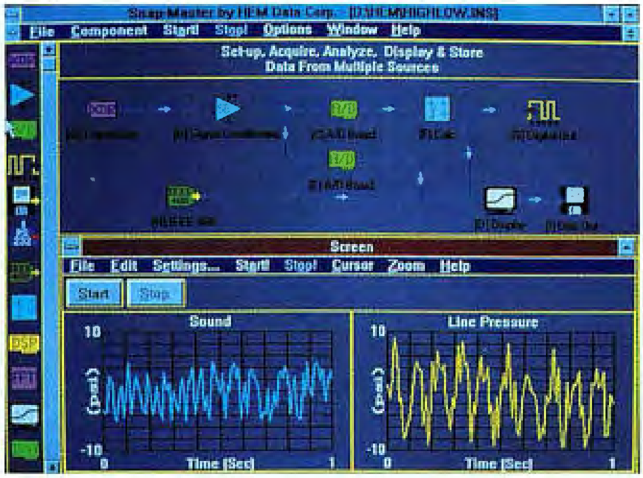
Snap-Master for Windows can control sensors, transducers, actuators, and signal conditioners as part of the data acquisition system.

To create a test instrument, you define the flow of data through the test system using a flowchart. Graphical icons represent each element of a test instrument (e.g., A/D, Display, or Disk In). Dialog boxes define the details of each icon, including channel settings. The program reduces setup time by performing group operations on similar channels.

Price: $995.

Contact: HEM Data Corp., 17336 12 Mile Rd., Suite 200, Southfield, MI 48076, (313) 559-5607; fax (313) 559-8008.

Circle 1300 on Inquiry Card.



Snap-Master for Windows lets your PC operate as a data acquisition and control system, digital storage oscilloscope, strip-chart recorder, frequency spectrum analyzer, waveform analyzer, or meter.

Organize Your References and Bibliography

EndNote Plus for the Mac, the database manager that can store, manage, and search for bibliographic references while automatically creating a bibliography for your technical documents, is now available in a PC version. Not only can EndNote Plus for the PC store up to 32,000 records and generate bibliographies in many journal styles, the new version offers a QuickFind (full-text index) feature for quickly locating records in a file with thousands of references.

EndNote Plus can build a list of cited works automatically by scanning your document for in-text citations. It then builds a bibliography using the information that you've entered or imported into your database.

With EndNote, you can access the database as you work within your word processor. Once you've created a paper with a bibliography, EndNote lets you copy and format it with different styles of bibliographies and citations.

Price: $249.

Contact: Niles & Associates, 2000 Hearst St., Suite 200, Berkeley, CA 94709, (510) 649-8176; fax (510) 649-8179.

Circle 1301 on Inquiry Card.

Analyze Medical Images on the Mac

A new modular system for visualizing medical diagnostic images lets you view, measure, enhance, and analyze medical images on the Mac. With MedVision, you can take an image from an MR, CT, PET, or SPECT scanner and accurately and quickly perform image analyses previously done on film. MedVision is modular, letting you add capabilities for specific medical applications, Evergreen reports. The program works with Evergreen nine-track tape drives, which start at $7800.

Price: $895.

Contact: Evergreen Technologies, Inc., Diamond Farms Office Park, 849-M Quince Orchard Blvd., Gaithersburg, MD 20878, (301) 948-1800.

Circle 1302 on Inquiry Card.

Molecules and Chemistry Times Three

The ISIS/Draw chemical drawing program recognizes a chemical structure as a molecule, not just a collection of lines and letters. The program's drawing tools approach structures and reactions as a chemist would and know how bonds should fuse as you build a structure with templates.

ISIS/Draw runs on the Mac, the PC with Windows, and the Hewlett-Packard 9000 Series 300 and 800 running HP-UX.

Price: $495.

Contact: Molecular Design, Ltd., 2132 Farallon Dr., San Leandro, CA 94577, (415) 895-1313; (415) 352-2870.

Circle 1303 on Inquiry Card.

The Chem-X molecular visualization, database, and computational program for Unix workstations is now available for 386- and 486-based PCs.

Price: $4000.

Contact: Chemical Design, Inc., 200 Route 17 S, Suite 120, Mahwah, NJ 07430, (201) 529-3323; fax (201) 529-2443.

Circle 1304 on Inquiry Card.

OpenMolecule, a molecular modeling program for Sparcstations, provides 3-D graphics capabilities for dissecting, displaying, and measuring complex chemical structures. The program runs under Open Look.

Price: $4995.

Contact: Andataco Computer Peripherals, 9550 Waples St., San Diego, CA 91921, (800) 334-9191 or (619) 453-9191; fax (619) 453-9294.

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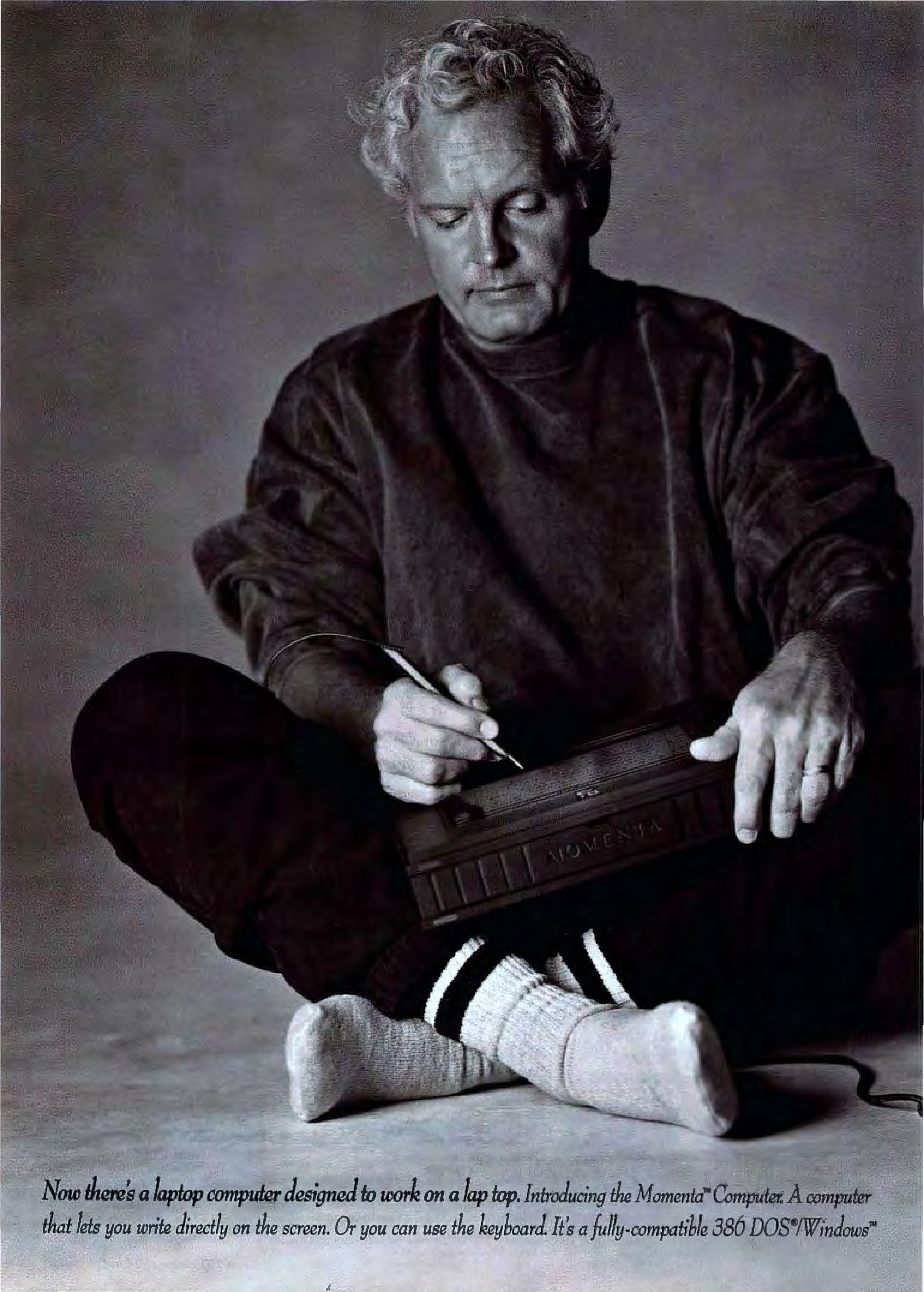
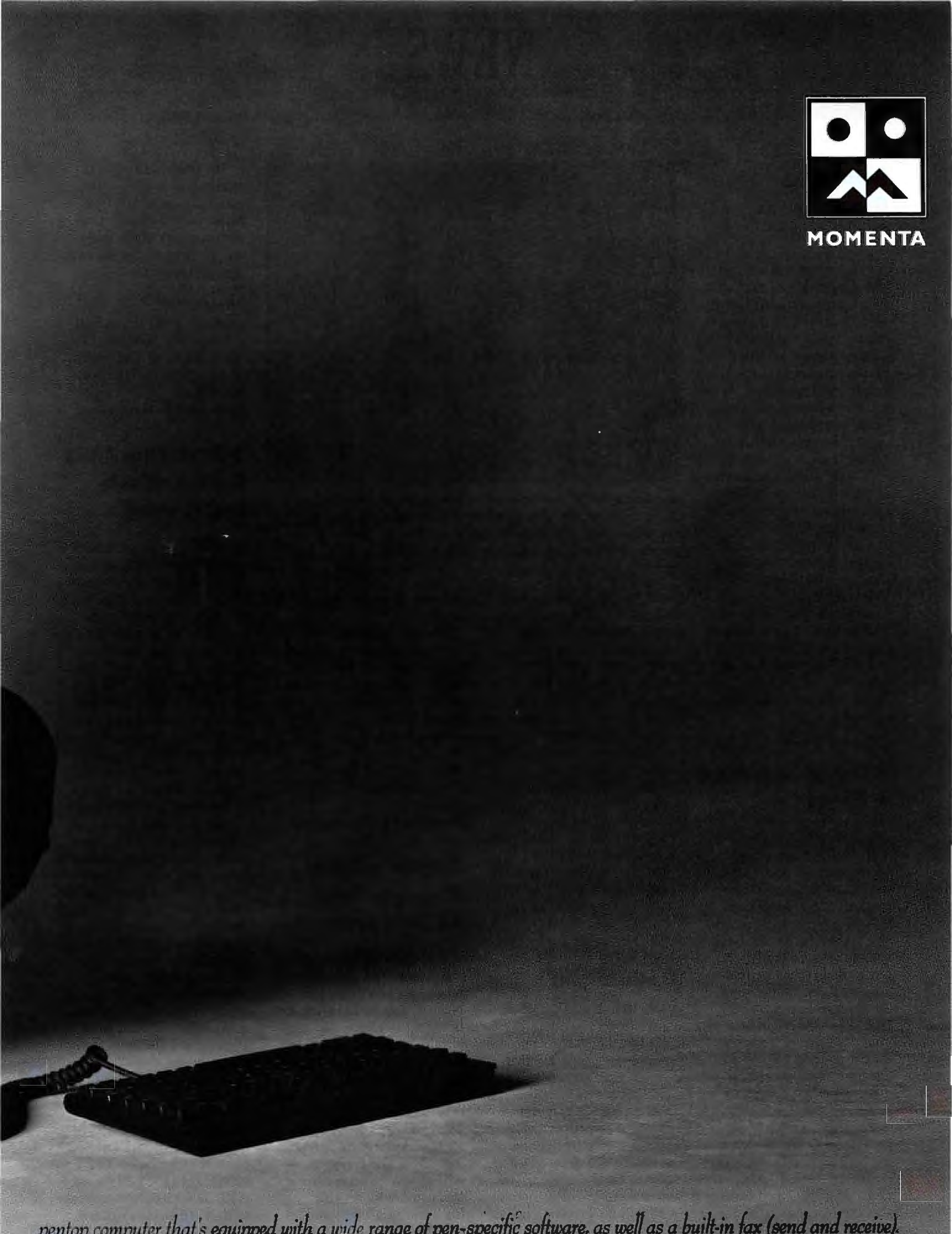

MOMENTA
Now there's a laptop computer designed to work on a lap top. Introducing the Momenta™ Computer. A computer that lets you write directly on the screen. Or you can use the keyboard. It's a fully-compatible 386 DOS®/Windows™


MOMENTA

Scientific Graphing for the Mac

SigmaPlot, the scientific graphing tool for the PC, is now available for the Mac. SigmaPlot lets you choose from graph types such as scatter and line graphs, quality control graphs, and pie charts. Specialized axis scales include linear, semi-log, log-log, natural log, probability, probit, logit, and reverse.

The program's data sheet of 32,000 rows by 16,000 columns supports a range of mathematical functions. You can define equations of up to 25 parameters and 10 independent variables.

Price: $395.

Contact: Jandel Scientific, 65 Koch Rd., Corte Madera, CA 94925, (800) 874-1888 or (415) 924-8640; fax (415) 924-2850.

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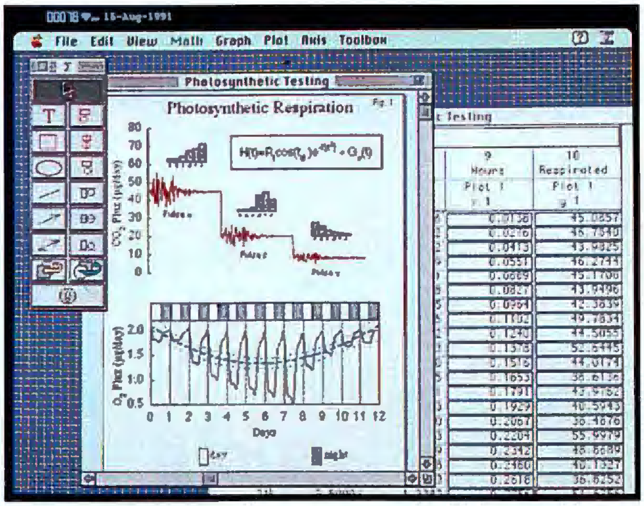

Jandel says that, unlike business presentation programs, SigmaPlot for the Mac offers error bars, curve fitting, axis breaks, regressions, multiple axes, confidence intervals, quality control lines, and other scientific features.

Batch Language, Printing Improved in EasyPlot

A new version of EasyPlot offers improved batch language, printing capabilities, and new analysis features and graph types. EasyPlot 2.2 provides scientific data viewing, analysis, and plotting for the PC. A batch-mode interface lets you run the scientific data program from command files. With the batch language feature, you can use the program as a graphing and analysis front end for any system that gathers or generates data.

Printing enhancements include push-button switching between landscape and portrait modes, 40 percent faster printing speed than previous versions, and support for the Hewlett-Packard LaserJet III and color dot-matrix printers.

New analysis tools include weighted curve-fits, surface integrals, and the ability to use equations to generate error bars. New graph types include reverse-axis plots that place the minimum data values at the top of the graph.

Price: $349; 10-user license, $1240.

Contact: Spiral Software, 15 Auburn Place, Brookline, MA 02146, (800) 833-1511 or (617) 739-1511; fax (617) 739-4836.

Circle 1307 on Inquiry Card.

Curve-Fitting Options and Direct Plotting

RPlot, the technical plotting program that lets you view and compare ASCII data sets from the DOS command line, now offers curve-fitting options, including cubic spline interpolation and nonlinear least-squares fitting. You can use the new curve-fitting options with RPlot's graphing options or as a stand-alone utility.

Version 2.0 also comes with source code to a C language interface, letting developers incorporate RPlot within a program.

Price: $149.

Contact: RSoft, Inc., 345 Riverside Dr., Suite 2G, New York, NY 10025, (212) 666-0959; fax (212) 666-3962.

Circle 1308 on Inquiry Card.

EnPlot's Data Mapping Gets a Fine-Tuning

EnPlot 3.12, the Windows 3.0 application that takes your raw data, analyzes it, and makes presentation-quality charts and graphs, now gives you finer control over your final output. Once EnPlot is done sorting, smoothing, and otherwise converting your data, you can use its new tools to control which fonts, font sizes, and text sizes will appear on your graphs. You can use longer title lines and axis labels and import bit-mapped graphics.

The program supports semi-log or log-log scales with grids on or off, tick marks in or out, and more. It performs automatic scaling, permits multicolor overlays, and prepares 3-D plots.

Price: $399.

Contact: ASM International Center for Materials Data, Materials Park, OH 44073, (216) 338-5151; fax (216) 564-7846.

Circle 1309 on Inquiry Card.

3-D Visions Adds Data Analysis to Graphing

Stanford Graphics for Windows offers more than 160 types of graphs to choose from, including high-end business and financial technical styles such as bubble charts, multidimensional pie-bar charts, and surface and contour plots. You can also choose from an assortment of scientific and statistical styles such as 2-D and 3-D scatter plots, logarithmic and probability plots, and histograms.

Stanford Graphics incorporates data analysis into a sophisticated graphing program. The program uses its Data-Link technology with Windows' Dynamic Data Exchange and Object Linking and Embedding capabilities to provide seamless interconnectivity. You can link data from Excel, Word for Windows, and Lotus files to a graph that changes as the data shifts, and vice versa. With Real-Time Data Rotation, you can visualize complex data relationships in real time.

Price: $495.

Contact: 3-D Visions, Inc., 2780 Skypark Dr., Suite 175, Torrance, CA 90505, (213) 325-1339; fax (213) 325-1505.

Circle 1310 on Inquiry Card.

486/33 Features

80486 33MHZ 32 bit INTEL CPU
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AMI BIOS with Extended CMOS Setup
256K Static RAM Cache
8 Expansion Slots (ISA 16 bit)
14" SuperVGA Color Monitor, 1024x768, .28mm dot
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		ESDI/EISA 32-bit Controller	add $795

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Circle 552 on Inquiry Card (RESELLERS: 553).

Windows CAD Gets Smarter

Intelligent cursors, group selecting, and greater customizing—these new features of Drafix Windows CAD 2.0 let you accomplish commonly performed operations more quickly and add more precise editing control than previous versions.

The intelligent cursor gives you constant snap-mode information (e.g., which snap mode is selected), and it indicates which input is required next. The new version adds icons for immediate access to most drawing, editing, and display functions that you'd normally execute from the menu.

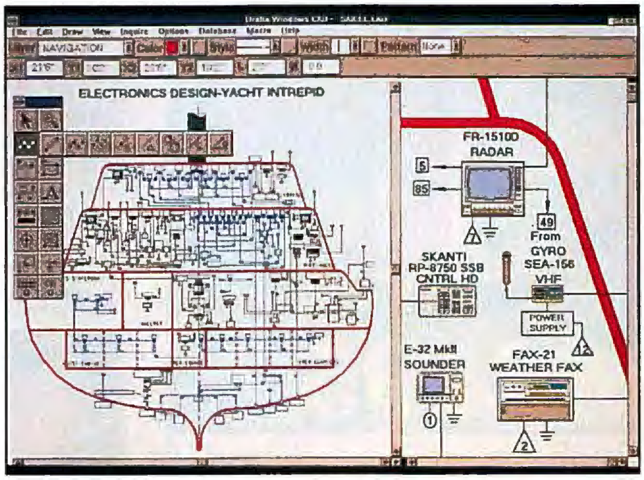
The program lets you select multiple objects using a combination of geometric, graphical, and database attributes.

The Drafix Graphics Language and a new macro editor let you create and assign on-screen buttons to quickly access a macro.

Price: $695.

Contact: Foresight Resources Corp., 10725 Ambassador Dr., Kansas City, MO 64153, (800) 231-8574 or (816) 891-1040; fax (816) 891-8018.

Circle 1000 on Inquiry Card.



Drafix Windows CAD 2.0's new CAD edit bar shows geometric information of the last item drawn or any item selected in the drawing and makes it available for editing. If you select an arc, the edit bar shows its center coordinates, radius, and starting and ending angles. You can change the arc by typing in a new value.

Symbol Libraries for AutoCAD

The SDS AutoCAD Symbol Libraries are designed to lessen your workload by providing more than 2200 predesigned symbols in more than 80 libraries. The libraries include mechanical and architectural symbols for bolts, electrical schematics, cabinets, and many others.

Price: $199.

Contact: Bracken International, 465 West 200 North, Logan, UT 84321, (801) 752-6230; fax (801) 752-0718.

Circle 1003 on Inquiry Card.

Seven AutoCAD Utilities in One Program

CADmagic offers seven utilities for AutoCAD release 11, including a file manager, text editor, fence tool for object selection, and programmable calculator. An AutoCAD system variable editor lets you organize system variables according to functionality to allow quick reference.

CADmagic's parametric editor lets you automate repetitive operations. A drawing history manager is also included.

Price: $50.

Contact: Haestad Methods, Inc., 37 Brookside Rd., Waterbury, CT 06708, (800) 727-6555 or (203) 755-1666; fax (203) 597-1488.

Circle 1002 on Inquiry Card.

Vellum for the Iris

Ashlar Vellum, the program that combines CAD with the Drafting Assistant expert-system technology, is now available for the Silicon Graphics Iris 4D family. The Drafting Assistant automatically pinpoints and aligns geometry as you draw, eliminating the need to remember and execute complex and tedious steps.

After you sketch the basic shape and alignments of a drawing, the Integrated Parametrics feature automatically adjusts the drawing to match your specified dimensions.

Price: $1995.

Contact: Ashlar, Inc., 1290 Oakmead Pkwy., Suite 218, Sunnyvale, CA 94086, (408) 746-1800; fax (408) 746-0749.

Circle 1001 on Inquiry Card.

Design Your Own Landscape

Design Your Own Home, Landscape, the latest addition to Abracadata's Design Your Own Home series, lets you draw complete landscape plans, place plants and other objects, and create shopping lists. After you draw a top view of your property and place trees, shrubs, fences, and other objects on the map, you can switch to any of four side-view perspectives. You can use the program's drawing tools to customize the side views or create brand-new objects.

Design Your Own Home, Landscape is available for the PC, the Mac, and the Apple II.

Price: $99.95.

Contact: Abracadata, Ltd., P.O. Box 2440, Eugene, OR 97402, (503) 342-3030.

Circle 1005 on Inquiry Card.

ViewPort + Lets You Control Who Sees What

ViewPort+, a CAD viewing utility, has been enhanced to let you control the level of detail users can see at any given workstation. CADman says ViewPort+ 3.0 lets you view drawings in as few as 2 seconds on a minimum PC.

You customize ViewPort+ 3.0 using an optional toolkit that also lets you link ViewPort+ 3.0 with word processing, desktop publishing, and spreadsheet programs.

Price: $595 to $795; toolkit, $1495.

Contact: CADman Corp., 19700 South Vermont Ave., Suite 100, Torrance, CA 90502, (213) 515-1289; fax (213) 329-0469.

Circle 1004 on Inquiry Card.

Arabic Word Processing for Windows 3.0

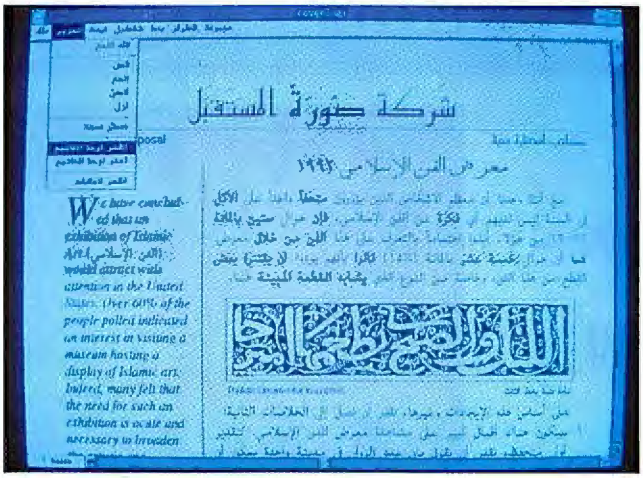
AlKaatib International 1.1, a new version of the Arabic multilingual word processor for Windows 3.0, supports templates that save you from repetitive formatting of regularly used documents (e.g., fax cover sheets and letters). The program, which supports WYSIWYG editing, is compatible with the Adobe Type Manager and lets you select any Arabic font size from 6 to 200 points. A Show Markers command lets you see what formatting features are used in a document.

Other features include support for bidirectional text entry, multiple columns, graphics integration, border drawing to create tables, and multiple fonts.

Price: $495.

Contact: Eastern Language Systems, 39 West 300 North, Provo, UT 84601, (801) 377-4558; fax (801) 377-2200.

Circle 1032 on Inquiry Card.



AlKaatib International 1.1 for Windows 3.0 supports bidirectional text entry, multiple columns and fonts, graphics integration, border drawing, and other features.

Speak Out and Fight Apathy

Speak Out, a letter-writing package, has more than 3000 names of top public officials, searchable by name, title, nation, state, office, or agency, and by a variety of keywords that you assign. Sample letters for expressing your views are included with the package.

Examples of keywords that you can search for include environment, drugs, poverty, taxes, tobacco, and education. You can add information for local officials.

Price: $49.95.

Contact: Speak Out Software Co., P.O. Box 272705, Houston, TX 77277, (800) 437-7325 or (713) 664-1005; fax (713) 961-4438.

Circle 1033 on Inquiry Card.

Optimize and Simulate Circuits

Electrical Engineering Software, developer of circuit-simulation and -optimization programs for Unix, now offers PC-Opt+, a circuit optimizer and simulator that runs on the PC. The program complements PC-based circuit simulators (e.g., PSpice and Intuspice) by letting you optimize any circuit you can simulate and simulating across AC, DC, and time domains.

If a frequency response is not correct or a digital cell isn't fast enough, PC-Opt+ will find component values that do not meet the target (if they can be found). The program accepts standard Spice netlists, and for circuit simulation, it is netlist-compatible with PSpice.

PC-Opt+, a circuit optimizer and simulator that runs on the PC, shows the results of an optimization run. Here it has taken the specification (the white and green crosses and triangles) and optimized a bandpass filter circuit to meet the target.

Price: $1695.
Contact: Electrical Engineering Software, Inc., 4675 Stevens Creek Blvd., Suite 200, Santa Clara, CA 95051, (408) 296-8151; fax (408) 296-7563.
Circle 1030 on Inquiry Card.

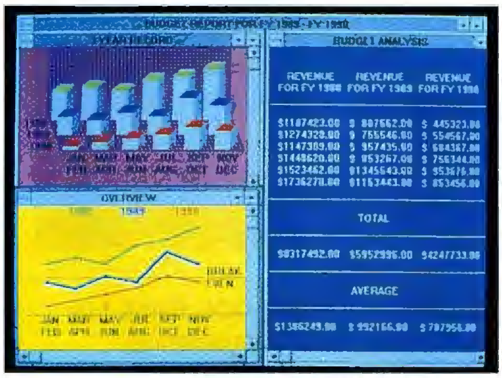
A Programmable PC Calculator

MP-Genesis, a program that solves complex mathematical problems in trigonometry, algebra, statistics, and other disciplines, lets you input your own expressions, formulas, and conversions in any field or language. You can do this if the characters are suitable to the keyboard. MP-Genesis lets you define your own formulas.

Three types of audit trails are made available to the program: the on-screen trail, the printout, and the audit trail.

Price: $149.50.
Contact: Racine Technologies, P.O. Box 477, Alpine, CA 91903, (619) 445-3692; fax (619) 445-1845.
Circle 1031 on Inquiry Card.

Only one programming language lets you cross develop for Windows 3.0 and MS-DOS without rewriting code. Introducing GFA-BASIC.



GFA-BASIC for Windows

GFA-BASIC for MS-DOS

```
main
PROCEDURE main
  set_database
  bar_graph
  line_graph
  budget_a
  stop_program
RETURN
> PROCEDURE set_database
> PROCEDURE bar_graph
```

With GFA-BASIC you use the same commands and functions whether you are developing for Windows 3.0 or MS-DOS.

GFA-BASIC gives you a simple, but powerful, language for developing sophisticated, state-of-the-art Windows 3.0™ and MS-DOS™ applications. Write a program with either the DOS or Windows version of GFA-BASIC and port it to the other platform, maintaining a common look and feel.

One set of source code

Both versions of GFA-BASIC include 500 system and mathematical commands and functions to facilitate software development. At the same time, common commands and functions enable you to develop and maintain a single set of source code for each program.

Simplifies GUI development

Another 400 commands and functions in the Windows version simplify the development of a complete GUI interface, including clipboard, DDE, DLL's, and dialog boxes. And, you don't need any additional libraries or the SDK.

In the DOS version, a subset of the same commands and functions lets you bring Windows-like programs to AT- and XT-class PCs without using any additional tools.

Bind in existing routines

What's more, routines you've already developed in C or Assembler can be bound into a compiled GFA-BASIC program. And, GFA-BASIC supports arrays larger than 64K as well as the use of EMS in DOS.

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Both Windows and DOS version	$ 790.00	**$ 395.00**

Add it all up and you have a very low-cost, easy-to-use structured language for developing Windows and MS-DOS applications[1]. To see for yourself how powerful GFA-BASIC is, just ask for our free demo disk. Call 1-800-766-6GFA, or write GFA Software Technologies, Inc.; 27 Congress St.; Salem, MA 01970; Fax (508) 744-8041.

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[1]UNIX and OS/2 versions of GFA-BASIC available in 1992.
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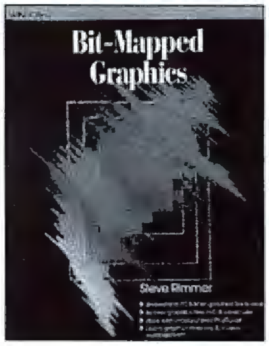

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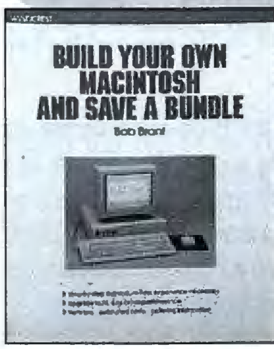

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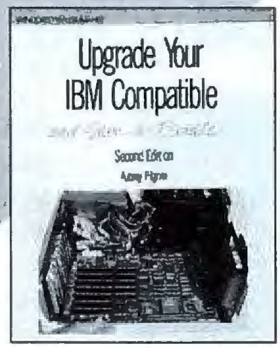

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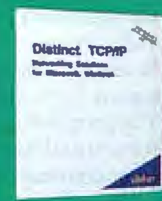

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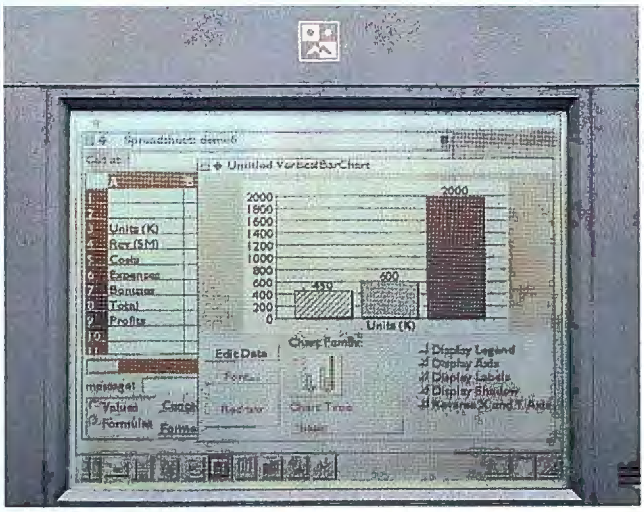
A Spreadsheet for the Pen

PenCell, a spreadsheet developed exclusively for pen-based computing and currently bundled on the Momenta system, is designed for mobile computing. The program gives you instant visual feedback as you enter commands and supports undo and redo commands. PenCell lets you directly manipulate spreadsheets using the pen.
Contact: PenWare, Inc., 4040 Moorpark Ave., Suite 209, San Jose, CA 95117, (408) 249-7004; fax (408) 249-0336.
Circle 1295 on Inquiry Card.



PenWare created the PenCell spreadsheet for mobile managers. PenCell is currently bundled with Momenta's pen-based laptop. Versions of PenCell are planned for other pen-based systems.

Two Competitors for Quicken

CashBiz, for home and cash-based business accounting on your PC, helps you keep track of your personal finances while having the features necessary to manage a small, cash-based business, M-USA says. CashBiz can balance your checkbook automatically, track your credit cards, monitor home mortgage payments, and prepare a statement of assets, liabilities, and net worth.

The program offers an address book, automatic phone dialing, and a notepad with basic word processing features such as cut, copy, and paste. An electronic calculator is also included. CashBiz can generate cash-flow, balance-sheet, income-statement, aging, and other reports. It also comes with a built-in facility for exporting files to spreadsheet, database, tax preparation, graphics, or word processing programs.
Price: $49.95.
Contact: M-USA Business Systems, Inc., 15806 Midway Rd., Dallas, TX 75244, (800) 345-4243 or (214) 386-6100; fax (214) 404-1957.
Circle 1296 on Inquiry Card.

Browsing or updating your address book in CashBiz is easy, because you can call it from anywhere in the program.

Microsoft's new Money package doesn't support double-entry accounting but suffices for personal money management or the running of a small firm. The program can automatically log expenses entered in one category to another, based on how they are entered. A SmartReconcile capability helps you find mistakes when balancing a checkbook.
Price: $69.95.
Contact: Microsoft Corp., 1 Microsoft Way, Redmond, WA 98052, (800) 426-9400 or (206) 882-8080.
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No More Searching on Microfiche

Microbank's PC and WORM (write once, read many times) based data storage retrieval system uses optical technology, LANs, and Windows 3.0 to replace the need to search for reports stored on paper or microfiche.

Microbank's Storfiche software catalogs, indexes, and writes data from your host transaction files or print spools to an optical disk. The system can store up to 1.2 gigabytes of data on a single optical disk.
Price: $16,900 and up.
Contact: Microbank Software, Inc., 80 Broad St., New York, NY 10004, (212) 363-5600; fax (212) 363-5891.
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Delrina Eliminates the Paper Chase

A new program for companies stuck somewhere between the paperless office and the old way of processing forms on paper goes beyond simply scanning form outlines into electronic format. PerForm Tracer uses what Delrina calls "optical forms recognition" to recognize objects on a form as lines, boxes, and combs so that once the scanned form is in electronic format, you can customize it and use it with other PerForm programs to create a front end to your database.

Once you've scanned in the form, you use Delrina's other programs to use the electronic information. With PerForm Pro, you can add intelligence and links between the form fields and dBase-compatible applications so that data from completed forms can automatically update a database. With PerForm Data Merge, you can generate reports.
Price: PerForm Tracer, $495; PerForm Pro Designer & Filler for Windows, $495; PerForm Pro Filler for DOS, $199; PerForm Pro Filler for Windows, $199; PerForm Pro Filler for GEM, $199; PerForm Data Merge, $49.
Contact: Delrina Technology, Inc., 1945 Leslie St., Don Mills, Toronto, Ontario, Canada M3B 2M3, (416) 441-3676; fax (416) 441-0333.
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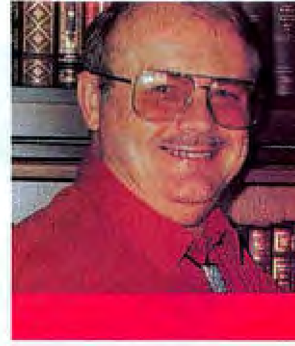


JERRY POURNELLE

THE REVOLUTION CONTINUES

A dozen years ago, I pointed out in this column that the small computer would pose an intolerable dilemma for the U.S.S.R. Either they would have to fall behind in military and economic capabilities by stifling the computer revolution, or they would lose control of their population by introducing the means for the free exchange of ideas. Fortunately, the masters of the Evil Empire didn't pay attention. They opted for the computer revolution with the hope of controlling it: that didn't work.

The Evil Empire is dead, and we helped kill it. Of course, that doesn't usher in the millennium. The world will still have plenty of problems. There remain irredentist movements, nationalisms and partisanships, nuclear-armed remnants of the empire. But for the first time in my children's memory, there is no one with the power and the incentive to launch a massive attack on the U.S. We may yet have nuclear weapons explode in anger, but the threat of the massive central war that could bring an end to civilization is already fading like a nightmare. *Deo gratias.*

WORMS, Tapes, and Backup

I began writing with computers in 1977. Shortly after I did, one of the planetary probes reached Saturn. I had managed to persuade the Jet Propulsion Laboratory to invite some science fiction writers to watch the encounter. The result was that a number of the major writers were in Los Angeles for a week. Naturally, I had a party to show off my new computer.

In those days, I was writing with old Ezekial, the CompuPro CP/M Z80 now on display in the Smithsonian. That was a primitive system, but it worked, and I turned out a lot of text on Zeke. Most of my colleagues were impressed, and about a dozen bought computers: some got Apple IIs, six or eight bought copies of Zeke, a few (in spite of my pleading) got commercial systems that have since died, like the Exidy Sorcerer, or the Epson QX-10 with Valdocs.

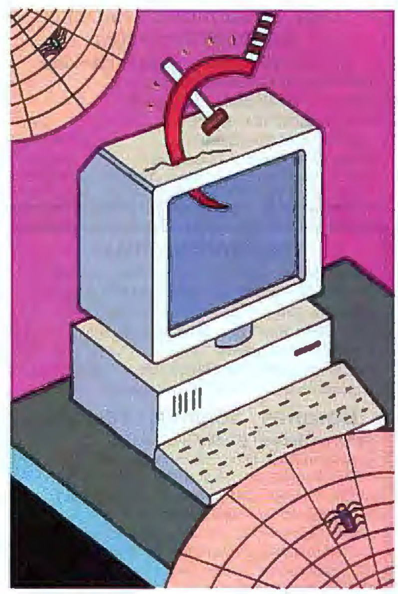
Then there was Frank Herbert. Frank was fascinated by my computer, but he didn't think it was good enough. Frank generally wrote several drafts of his books. And he liked to save copies of every draft. I didn't see that as a problem. In those days, I did very little on-screen editing. My practice then was to write a draft, print it out, edit it on paper, enter the edits into the machine, and start over. As a result, I had copies of each draft of a story.

"No," he said. "I want to save it all, automatically."

Apparently, he wanted to save nearly everything he did, including false starts at paragraphs and sentences. I can't imagine why. You can sort of do that on paper, if you're not too vigorous in crossing out false starts, but most people don't pay much attention to them. Indeed, Mr. Heinlein taught me to obliterate any crossed-out text on the theory that it would confuse the typesetter.

In any event, although you can do that now with WordPerfect, the task was too much for the technology of the late 1970s and early 1980s. Frank retained an engineer to design the ideal system, and he made the fundamental error of giving his designer nearly unlimited time and funding. The result was predictable: Frank never got a satisfactory computer. He even wrote a popular-press book about small computers—but he wrote it on a Selectric typewriter. I'm not sure if he ever did convert to computers before he died. I am certain he never got a system that saved all his work.

You shall know the truth, and the truth shall make you free



He could have one now. All he'd need is a WORM (write once, read many times) drive such as the Duette System 6 from Maximum Storage or the Pioneer DE-S7001 dual-purpose external optical disk drive I've written about before. Log your word processor to that, save early and often, and you'll have it all, because when you write a file to a WORM drive, you do not overwrite files of the same name. The WORM software changes the current directory entry so that only the latest file appears. But all WORM software has a method for looking back to past versions of a file and retrieving whichever one you want. Moreover, in the several years that WORM drives have been available, no one has reported any deterioration in the readability of the information stored on them.

In a word, WORM drives look like the ultimate in backup storage. You don't have to be quite as fanatic as Frank Herbert was: you can save daily or hourly. In any event, all versions are kept, and for all practical purposes, they're kept forever.

continued

ILLUSTRATION: STEVE TURK © 1991

If you're really serious about the value of your files, you should strongly consider a WORM drive as primary backup. There's nothing like having a copy of every version of a program. There seems to be a law that the instant you discard the last copy of one program version, you'll discover you need some routine deleted from the current version and present only on the erased version. . . .

However, there is a problem: WORM drives are expensive, and so are the storage media, about $100 for a gigabyte. Any rational system for backup and storage will, sooner than you like, completely fill a WORM disk cartridge. I tend to do a lot of testing, so perhaps I use them more than most people, but I have an astounding collection of filled-up WORM cartridges dating back several years. Most contain files I'll never want to look at again. While they don't take up much space, I have part of a cabinet filled with them.

If you're serious about the value of your files, you should consider a WORM drive.

Catalogs

Most WORM programs do not make a catalog of the files stored on the cartridge, but you can get programs that will catalog as they archive files. PC Librarian will not only make catalogs, and records of what you have stored where, but will also compress the files, so you can get considerably more on a WORM cartridge. PC Librarian is primarily intended for use with a network and a big hard drive or tape. It reserves a large block of a hard disk or other medium for archives.

Doubtless other programs will do much the same thing, but PC Librarian is very good at it and easy to use. And it will work with a WORM drive. Moreover, besides compressing the file, PC Librarian will either copy or move that file to the archive, meaning that if you are through with a file, it won't be cluttering up your hard disk.

The problem, of course, is that you have to *use* PC Librarian: you can't just save the file and forget about it. You enter PC Librarian and have an orgy of saving, filing, and cataloging, but those aren't the sorts of things you would do every day; at least I don't, which means that I can't rely on the program for backups.

Erasable WORM

There's another option: Maximum Storage, whose WORM drives I have been using for years, has the new Duette System 6, a dual-purpose optical disk drive that will accept either WORM or read/write (R/W) optical cartridges. In that it's similar to the Pioneer DE-S7001. However, the technology is quite different: Maximum Storage uses phase-change technology to write to the optical disk drive, which means that it doesn't have to erase before writing. This is said to make it about twice as fast as the DE-S7001. It ought to be very stable, too, possibly even more stable than a standard WORM drive.

The WORM cartridges for the Duette System 6 work more or less the way the old Maximum Storage WORM cartridges did. The software is simple to use, and it's possible to retrieve any version of any file you've ever put on the cartridge, presuming that you can find the exact version you want.

The innovation comes when you use a rewritable optical cartridge. Maximum Storage furnishes two versions of R/W software: DOS files, which turn the system into just another very large hard drive, and the MAXSYS file system, which operates exactly the same as it would if the cartridge were a true WORM (i.e., when you write to the disk, it doesn't overwrite previous versions of the file, but preserves them for possible later retrieval).

This means that you can store everything on the optical disk drive, and later you can peel off what's important, scrub the cartridge, and start over. Whether that's a good idea isn't totally clear to me. The other day I went back through a stack of WORM disks looking for a letter I'd written four years ago. I found it, too. But I do wonder if I might not have erased that cartridge if that had been possible. Anyway, the Duette System 6 does have that option.

I'll have more on the Duette System 6 another time. I've only just got software that lets it run with DOS 5.0, and I have not run extensive tests. Next week, I'll start up my batch files to transfer 150 MB of data onto the Duette, back to a hard disk, and then overwrite them onto the Duette again, and so forth, for a few weeks. I did that to the DE-S7001 with no problems. Now it's the Duette's turn. More when I have results.

continued

Palindrome

Jim Gast, vice president of Palindrome, is an information preservation fanatic. Get him talking about networks and archiving, and you will learn a very great deal, as I found when he visited Chaos Manor.

It began when Jim came to the Los Angeles area to visit a site where my son Alex had installed a Palindrome Network Archivist (NA) backup system. Alex then brought Jim over to Chaos Manor, ostensibly to install a smaller version of the system here.

The Palindrome system comes in two parts: a physical backup mechanism and the NA software. The physical system can vary. In our case, it's a Future Domain SCSI card and a small (smaller than a shoe box) Palindrome tape drive that uses digital audiotapes. We installed the Palindrome controller card in a big Cheetah 486 with an enormous (800-MB) Siemens hard drive driven by a Perceptive Solutions caching controller. This is very much overkill: as Jim Gast kept saying, we could just as easily have used an old 286, or even an IBM XT, as the archive's network server.

That's true enough, but it would require that we change the way we do networking around here. At the moment, I've got a LANtastic card in the Cheetah 386/25 I use as my main writing machine. The Cheetah runs Desqview, and the LANtastic network is available in every window; I can access CD-ROM drives across the network. In particular, I can get at the Pioneer Minichanger CD-ROM drive. On the other hand, my Cheetah is not a network server: I can send files from it, or get files off other machines, but my own files aren't accessible to remote stations.

The Palindrome software, on the other hand, will archive everything it sees as a normal disk drive. But that means it won't archive anything from my Cheetah 386/25 because the network server doesn't see my machine's hard disk. I could change that, and one day I probably will, but I didn't want to revamp the system without thinking it through, so I wasn't going to do it in sudden haste.

The temporary solution, then, was to use the network server's Siemens hard drive. I built a batch file called SENDIT.BAT, which uses XCOPY with the /M option to copy every new file over to the D: partition on the network server's Siemens drive. This XCOPY operation runs in Desqview's background. I'm running it even as I write this. Thus, when it's done, I'll have backed up everything from my system to the network server's hard disk. In addition to that backup, my Cheetah 386/25 has dual Maxtor hard drives in a mirror configuration, meaning that everything written to one of those hard disks gets automatically written to the other. Furthermore, my primary machine is connected to a Clary uninterruptible power

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–Sean Fulton, UNIX Today!, November 26, 1990

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supply. Between the Clary UPS and the mirroring, I have almost the ultimate protection against hardware failure.

"So," I said to Jim Gast, "while I admit that most businesses, large or small, aren't likely to have quite the computer resources I have, why should I be interested in Palindrome? Don't I have the ultimate backup system?"

"No. It's safe against hardware failure, none safer, but it's not foolproof against operator error. Suppose you erase a file? Overwrite one you wanted to keep? And suppose your house burned down? You don't have any off-site backup at all."

All of which was true. Of course, I could remedy that by installing the DE-S7001 on the network server and archiving on that—but this would mean recopying already-archived files every time I changed WORM cartridges. Keeping track of what was on which cartridge, and when I should rotate them, would be a colossal pain. So. "All right," I said. "Let's set up your system."

That turned out to be fairly easy. Our biggest problem was changing addresses so the tape drive and LANtastic would work in the same machine without address conflicts. Once that was done, it was time to make some backups—except that we had only one tape. I was eager to test this system by making a tape copy of every important file in Chaos Manor and getting a complete tape set off the premises. I couldn't do that with only one tape. Fortunately, this is southern California, and it was only 11:30 at night. Tower Records is open until midnight.

While Jim and Alex continued to add other machines to my network, Roberta and I went to Tower Records to get a digital audiotape. The one tape Jim had brought was for a computer, and it was marked "60," meaning 60 meters. The tapes at Tower Records marked "60" clearly didn't have as much tape on the reel as my "60" did. Eventually I figured it out: in the audio stores, the tapes are marked in minutes of recording, which is apparently at a pretty fast clip, since the audio "120" turns out to be what the computer tape company meant by a "60." That settled, I bought half a dozen 120-minute tapes at about 10 bucks each. Each of those tapes will hold a gigabyte, meaning that we are at a penny a megabyte for permanent storage. Not bad.

I brought the tapes home, and we started the archive operations. Palindrome's NA software is fast, efficient, and easy to use. It can be set up to do automatic archiving or to work under manual control. Either way, it grabs off every new file it can find. NA considers files to be identical only if their dates, times, sizes, and filenames are identical. Otherwise, it makes a copy. As it makes copies, it builds a database from which you can extract a full catalog of your archived files. Needless to say, that database is itself backed up onto the tape.

So far, so good. NA also keeps track of how long you've used the tape, and from time to time it asks you to put in a blank tape so it can make a new backup; it also nags you to take one of the old tapes and store it off-site. Eventually, it will warn you to bring that tape back in so it can be recycled, but it will do that only after demanding that you take another tape offsite to replace it.

There's considerably more to NA, including tools to let you simply dump stuff onto a tape (for sending elsewhere), erase and reformat tapes, tension the tapes, and so forth. The manuals are complete and easy enough to read. Palindrome's technical support is good. I did run into a couple of glitches. LANtastic opens files and keeps them open when you're using the network, while NA wants to handle open files in a special way. However, as a result of a minor problem I had with this, Jim Gast and some of the LANtastic people at Artisoft got together to make a fix that will be shipped before you read this, so that shouldn't be a problem.

I also had a minor difficulty when I decided to dump a bunch of stuff from a WORM cartridge to a Palindrome tape without cluttering up the Palindrome database. The Palindrome software didn't like that much, and it had to be fooled by letting it see the WORM disk and taking access away from it again: a peculiar procedure I won't describe because you're unlikely to want to dump a WORM onto a tape. Anyway, Jim Gast says they'll write a new command into NA to handle it more directly.

Amazingly, those were the only glitches. Otherwise, this runs smooth as silk. It will reach across the network to archive any disk drives it finds out there. It archives the local files. It tells me the name of the tape and nags me if I insert the wrong tape. It watches for files you never use and asks you what to do about them. And more.

All told, this is one heck of a backup system. Highly recommended.

MEMORY.PIG

I have two Cheetah 486 systems. One, the 486/33, is used as the network server because, as I explained, it has a large enough hard drive to hold the primary backup copies of everything on the Cheetah 386/25 that I actually work with. The other, the 486/25, is the main Windows machine. It's also the system Larry Niven prefers when we're working on books. It's fast, and with the Perceptive Solutions controller, it can save big text files so quickly that half the time Larry saves them a second time, not believing they were saved the first time around.

We had no trouble installing LANtastic on the Cheetah 486/33. However, when we went to install it on the 486/25, we first got the message that some other software was using the interrupt request (IRQ) we needed. That's no problem: LANtastic lets you change the IRQ in software. That cured the IRQ problem, but then the software couldn't find the LANtastic board. No matter where we addressed that board, the software would not see it. It didn't take long for that to get frustrating.

It took two days to figure it out. What was happening was caused by the VGA board. The 486/33 has a Sota board and works just fine. The 486/25, on the other hand, had a different brand that grabs every bit of loose memory between 640 KB and 1 MB. It doesn't need that memory, and indeed can't even use it, but it grabs it just the same. I have since found out that a number of video boards, some well known, all seem to have in video ROM a program that ought to be named MEMORY.PIG.

The solution to the problem was to change video boards. Fortunately, just about the time I figured that out, we got new boards from ATI Technologies. I put one of those in, and LANtastic worked on the first try. More on the ATI boards next month.

Farewell, Good and Faithful

We shipped back the Arche Legacy 386/33 last week. It had served us well, but we had to make room for some more machines, including an Arche Legacy 486/33.

This was one of the first Legacy 386/33 systems Arche Technologies made. It worked fine, but it had an annoying problem: sometimes it wouldn't boot until I hit the Reset button. I'd turn on the power,

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TEXAS INSTRUMENTS

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and only later notice that the machine hadn't really come up. It also came with a mediocre tape drive.

Otherwise, it was a great machine. A few months after I got it, Arche sent some new ROM BIOS chips; installing them fixed the boot hang-up. Legacy 386/33s are now shipped with no tape drive. If you want to archive to tape, get NA and be done with it. If NA is too expensive, Colorado Memory Systems makes good tape drives and software. Try that.

Once we'd replaced the ROM BIOS, the machine was fast and very reliable, so reliable that for a year it was the official Chaos Manor test-bed. Intel's people installed a Satisfaxion coprocessor. Microsoft's people installed a test version of DOS 5.0, and sure enough, I found a bug. The Arche Legacy had a switch to cut the speed from 33 MHz to 8 MHz. I used to play Wing Commander at the slower speed. When we installed DOS 5.0, the machine wouldn't run at 8 MHz. I reported that to Microsoft, and in less than a week we had a new test version of DOS 5.0 that worked fine at any speed.

All told, the Arche Legacy 386/33 was used to test LANtastic, beta and final versions of DOS 5.0, DR DOS 5.0, Wing Commander, Railroad Tycoon, Windows 3.0, trackballs, mice, the Sound Blaster, the Pioneer Minichanger and DE-S7001 daisy chain, the newest Norton Commander, and a whole bunch of software. Worked fine for all that. Arche advertises their machines as "quality first"; from my experience with them, I can say I believe that. Recommended.

SpeedStor

For years I've been recommending SpeedStor if you need software to diagnose, tune up, or install a hard drive. SpeedStor will do complete media analysis to find bad sectors, low-level formatting, partitioning, and just about anything else you would want to do to a hard drive. My son Alex swears by it.

Unfortunately, a couple of years ago Storage Dimensions took SpeedStor off the retail market. The program was available only with Storage Dimension hard drives. Since SpeedStor was the best thing around, this was unfortunate for people who had other drives.

I am pleased to say that Storage Dimensions is once again offering SpeedStor in a stand-alone package. They've also greatly improved the user interface and have set things up so that most times you only have to insert the hardware, boot up, put in the SpeedStor floppy disk, and issue the command INSTALL. SpeedStor will then do everything to get your hard drive running properly.

SpeedStor has a lot of options for fine-tuning drives. Most of you will never need those options, but it doesn't hurt to have them. SpeedStor will handle ESDI, RLL, SCSI, and MFM drives that I know of, and probably any others. Get SpeedStor and you'll never have to use the evil FDISK again. Highly recommended.

Learning C++

Since they burst on the scene with Turbo Pascal lo these many years ago, Borland International has expanded well beyond languages. Some of their ventures have done well in the market, and some, like Traveling Sidekick, were good ideas that didn't quite make it. But for the most part, when there's a choice between Borland and another company's product, you want to give Borland very serious consideration. They've left a few orphans—I don't know anyone who uses Sprint any longer—but for the most part their record

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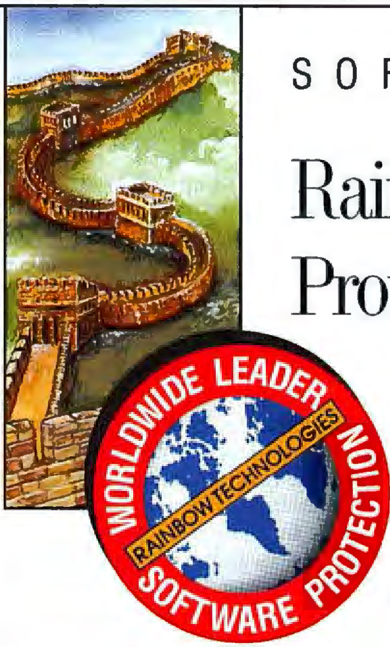

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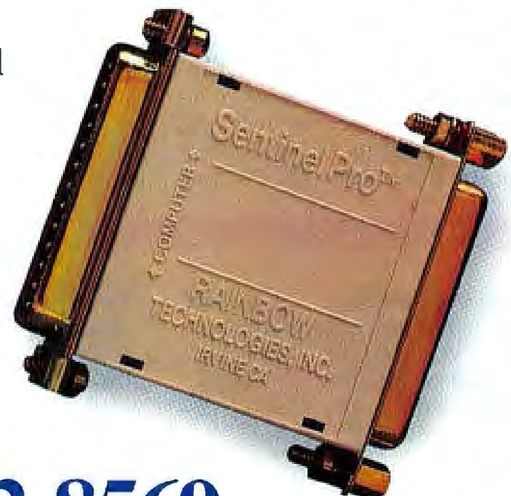

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of update and support is excellent. Quattro Pro is, in my judgment, right there among the best of the spreadsheets, and Paradox is the clear choice if you need all the power of a full relational database.

For all that, Borland began as a language house, and they haven't forgotten that. They've kept Pascal up to date. They tried their best to make Prolog a viable language. I wish they'd done a Modula-2, and I wish even more that they'd bring out a version of Niklaus Wirth's newest, Oberon, unlikely as that is. But even without that, Borland kept the faith: they've done their best for rationally structured languages.

I say all that as preliminary because it's also the case that Borland has done a very great deal to keep my least favorite language alive and well. It's no secret that I am no great fan of C. I believe that C is responsible for a lot of very bad code, and yes, I know you can write bad code in any language. But I'll repeat what I've said before, if there's a big program with known but unfixable bugs, that program is very likely to have been written in C.

I do not believe I know of five cases in which a large C program has been maintained and expanded by anyone but its original author: if the author vanishes, the new programmer will often reverse-engineer and rewrite large parts of the old code, rather than try to figure out how the originator did it. Or so I am told. In any event, C is a language to be used by people who program nearly every day, not by sometime programmers like me.

Now, though, we have C++, which everyone tells me is going to fix many of the problems of C. C++ is "C with Objects" and is based on a simulation language developed in, I believe, Norway some years ago. It has generated a great deal of interest. I'm not qualified to judge. But people I trust tell me that knowing C++ is very worthwhile if you're programming for a living or want to.

I don't know C++. But if I decide to learn it, I know how I'll do that. I'll get private lessons from David Intersimone of Borland.

You can, too. You don't have to be a published columnist. All you need is Borland's new The World of C++, which consists of two videotapes with David Intersimone, disks of programs, and a rather dense book that isn't too useful without the videotape. The combination, though, is the best introduction I've ever seen to any complex language.

In addition to this package, you'll need a C++ compiler. Naturally, Borland hopes you'll use Borland C++ and Applications Frameworks, which includes ObjectWindows and Turbo Vision, but, in fact, any will do, including one that will work for Windows or Unix. If you're working with a machine that doesn't run DOS, you will, of course, have to type in the programs yourself or use some kind of linkage to your Mac.

continued

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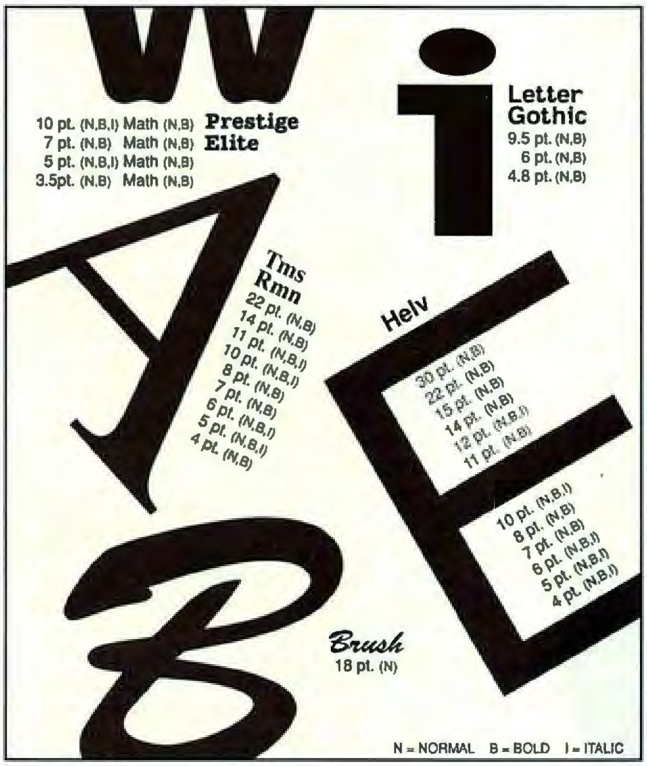

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If you're really interested in learning C++, get this. If you simply want to know more about the language, persuade your users group to buy a copy and show the videos at meetings.

They tell me that C++ is part of the wave of the future. This is one way to get onboard.

Winding Down

I'd meant to look at Desqview versus Windows this month, but I'm out of space. The shareware of the month is BG-Math, which is available from Bob Gearhart; it's not as sophisticated as Mathematica or MathCAD, but it's an extremely good math package to help kids learn algebra. It's fast and simple to use.

The book of the month is *Leftism Revisited* by Erik Von Kuehnelt-Leddihn (Regnery Gateway, 1990). Written as the left was losing its control of Europe, this presents the religious conservative analysis and criticism of "leftism" in all its aspects, "from De Sade and Marx to Hitler and Pol Pot." I doubt that any American can read this book without disagreeing with a substantial part of it, but it is the best case for European conservatism you will find in print.

The game of the month is Rules of Engagement, a new module in the Omnitrend games series published by Mindcraft. Good space opera. You're in control of a ship whose control screens look remarkably like those in *Star Trek: The Next Generation.*

The computer book of the month is one published by Howard Sams, *Best Book of Microsoft Windows 3.0*, one of a huge number of books that are available on the subject; I haven't read them all, but I can recommend this one. On that subject: if you get Windows, get Symantec's Norton Desktop for Windows. You will not regret it.

Next month, Desqview versus Windows, a spreadsheet for those who hate spreadsheets, and some Windows applications. Now I'm off to celebrate the fall of the Evil Empire. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

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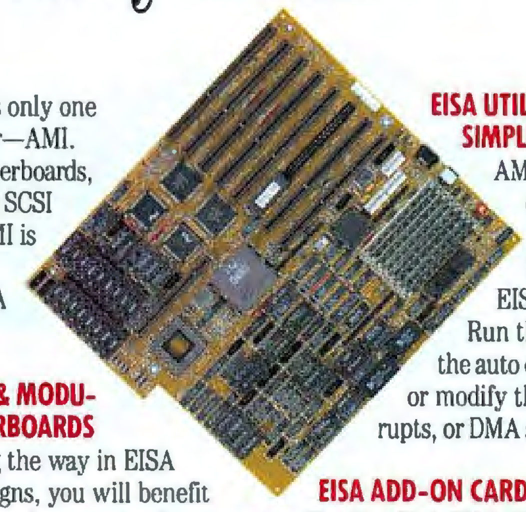

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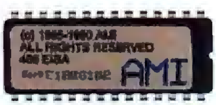

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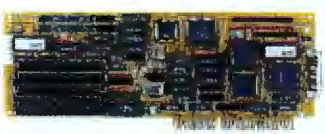

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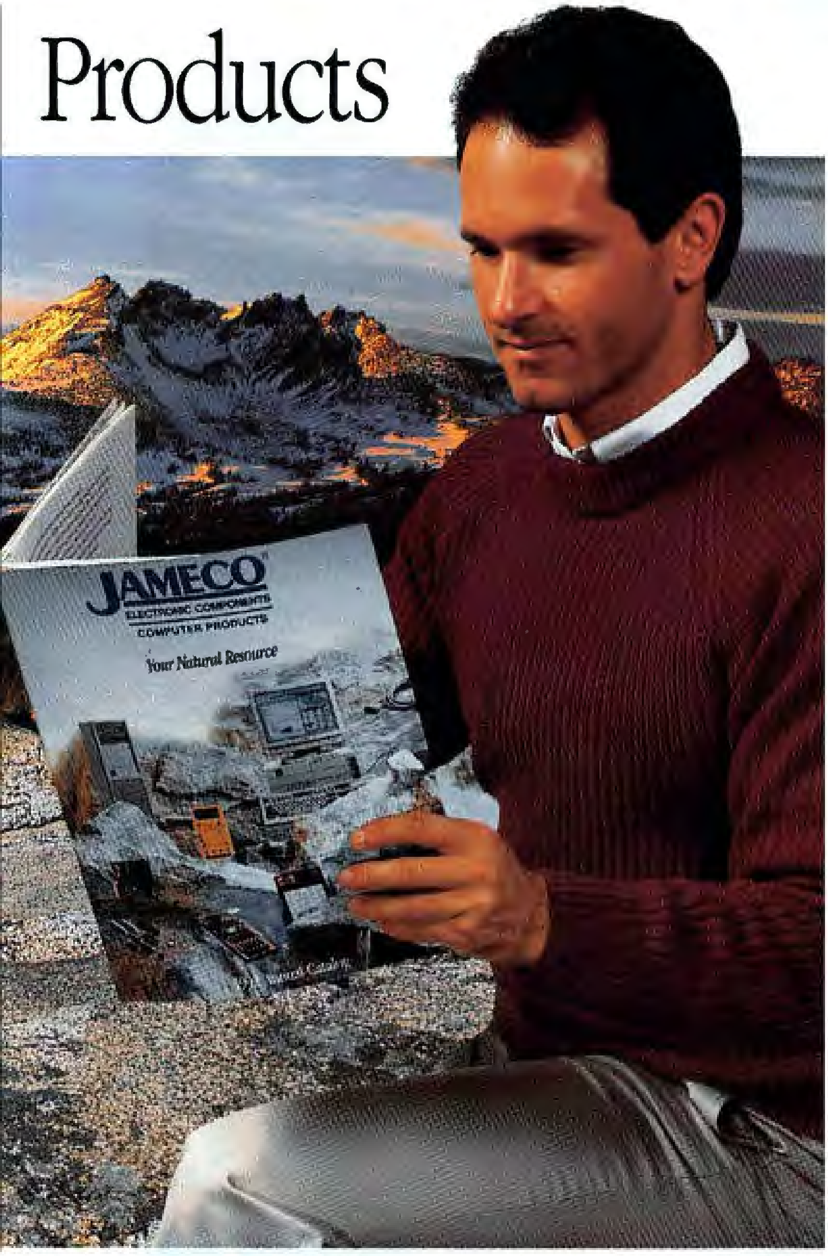

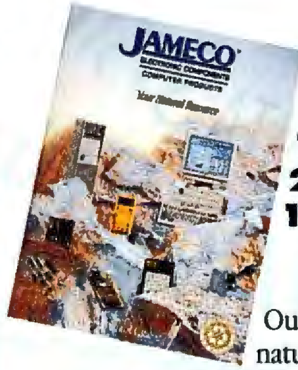

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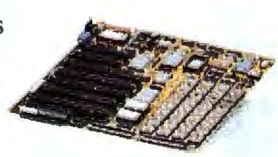

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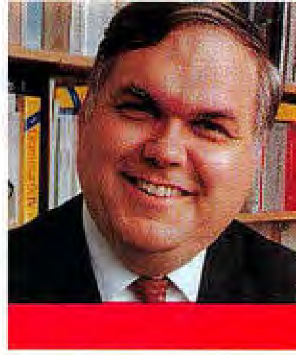

WAYNE RASH JR.

BEYOND FILE SHARING

Well, you've finally done it. You've taken the plunge and installed a LAN. Or maybe you already had a LAN and are reading along in hopes that you might find out what else you can do with one. As you've probably figured out by now, there's a lot more to LANs than just file sharing.

What else can you do? Well, you can store and retrieve images, access vast quantities of information, communicate with the world, fax documents, and talk with your coworkers. You can also expand on these capabilities by setting up your organization so that you form electronic teams assigned to accomplish a specific purpose, even to the point of creating an organization that can form and reform as needed to meet the requirements of the business of the moment. In short, you can use your network, and some of the equipment that you can attach to your network, to rework the way you do business.

Sending Stuff to Other Users

One of the first add-ons to networks that I usually get asked about are fax servers. The Castelle FaxPress was among the first of these. It is a stand-alone device that appears to the LAN as if it were a workstation, and to your fax software as if it were an attached fax card. You can use this fax server with several software packages, including a few E-mail packages that will create fax messages to people not on the LAN when you address E-mail to them.

I first ran across the FaxPress in actual use when I was in Honolulu last year doing a seminar for NetWare Users International. While I was there, I visited with Les Iczkovitz at Unified Micro Solutions and looked at the fax server he had installed on his company's LAN. UniMic uses the fax server heavily in its support program for its LAN customers. Because it's not dependent on using a scanner in a fax machine, the documents arrive clear and crisp, looking almost as if they had been laser-printed rather than faxed.

The FaxPress was introduced three years ago, and since then, interest in fax servers has exploded. Now there are many fax servers, most of which are cards that mount in a workstation, and accompanying software. A few cards, notably the Intel Satisfaxtion board, work with software from several different vendors. If you want to find out more about these fax servers, see my review "Network Fax Servers Come of Age (Slowly)" on page 226.

Fax servers are handy gadgets for use on a LAN, because they allow several users access to a valuable resource. They also tend to improve productivity, since users can send faxes without leaving their desks. This does, of course, eliminate the single most important source of interoffice communication, since the fax machine has replaced the water cooler as a place for exchanging gossip.

There are more serious disadvantages to the network fax servers. You can only send an electronic image or file, which means that if you want to send an existing document, you'll have to scan it into your computer first. Receiving faxes can also be a problem. Most fax servers either send all faxes to a specific printer or dump the electronic fax image into an administrator's file area. Both require someone to distribute the faxes, usually the administrator. The distribution requirement means that there is a possible area of compromise for faxes that contain sensitive information. This can be overcome by automatic routing systems, such as direct inward dialing, but most products don't have that yet.

LAN add-ons provide new capabilities and improve productivity

Still, fax servers can help justify the investment in your LAN simply because they do help productivity and because they produce better results, at least for sending faxes. For companies that produce a lot of faxes, this difference alone can make the LAN pay for itself.

Serving BIX

Sometimes you don't want to send a fax. After all, if you only need to send a message, there's no real reason to prepare a nice-looking document, make a long-distance call, and create a fax for the person on the other end to deal with. In cases where a simple message will do, plenty of electronic communications services are available that support E-mail. These services can include fairly simple systems such as BIX, as well as more complex X.400 routing systems, such as those provided by MCI Mail.

These remote communications servers can work in a

ILLUSTRATION: DANIEL BAXTER © 1991

couple of ways. One is as a simple asynchronous communications gateway, and another is as a gateway into a network, such as an X.25 gateway. A LAN can support either (or both) of these devices and, in doing so, can give you access to a variety of services in the outside world.

One of the nice things about these gateways to the outside world is that they can be fairly simple to arrange. If you're using a recent version of Novell NetWare, for example, you can set up a simple asynchronous server with an existing serial port and software such as PC Anywhere IV/LAN or Procomm Plus LAN. Of course, if you need more capability than a single serial port, you can also use something like Novell's WNIM+ board that includes four serial ports.

In most cases, the software that you use with your asynchronous server will let you use your LAN workstation to dial services outside of your LAN, as well as give you a way to dial into your LAN from outside. This means that you can call into your LAN from home and check your E-mail on the weekend. It also means that you don't have to drive to the office just to use the office LAN, a capability that can improve morale along with productivity.

The ability to use asynchronous communications as a shared LAN resource is also handy. Since many users can share a few modems, most companies don't mind buying high-end hardware, such as V.42-bis modems. You can log onto BIX and zip through a download in record time. Of course, for some offices, there are significant sources of information at the other end of the phone line. Networked law offices are finding that their LAN-based asynchronous server can give the entire firm access to WestLaw and Lexis, and stockbrokers can check up on the information on-line in the Dow Jones News/Retrieval Service. Access to these information sources makes the business more productive and again helps justify the expense of installing and running the LAN.

Spitting Image

One of the nice things about a LAN is that it can provide for centralized storage of images. Exactly what sort of images you can find on the LAN depends on what you're set up for, but three kinds of images are the most common: drawings, documents, and captured versions of displayed images.

Document images are usually stored on optical disks and are simply pictures of paper that have been scanned. For the most part, they replace microfilm. Captured images are much the same thing, although they usually started out as a video image or an image produced by a software package. CAD images are really vector information downloaded from a central file server and re-created on the workstation screen.

One easy and inexpensive way to have image access is through a CD-ROM server, such as those from Meridian Data. A CD-ROM server is a computer that can have as many as 10 CD-ROM drives online at any time. LAN users can access any or all of these, just as if the drives were attached to the users' workstations. This is particularly useful for organizations that keep a central store of images as a part of their corporate databases.

Of course, you don't need to restrict your CD-ROM server to images. Many CD-ROMs contain no image data, but instead are collections of specialized information provided by database companies or others that have found ways to market megabytes of information along with specialized retrieval software. In fact, you can

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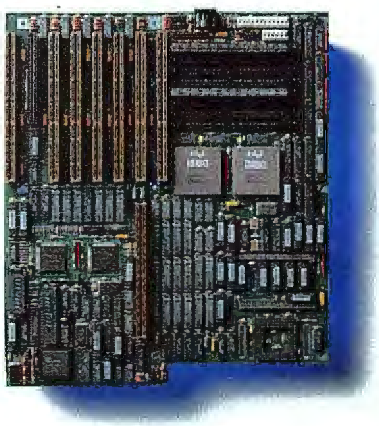

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use something like Jaeger and Waldmann's International Telefax Directory in your CD-ROM server so that you can look up numbers to use with your fax server.

The nice thing about CD-ROM servers is that you can set things up so that each drive on the server looks like a local CD-ROM drive to your computer. There are problems, though. The CD-ROM industry is still not standardized, so you can end up with some conflicting software as you move among drives, and you're very likely to find completely different user interfaces on each CD-ROM. This is one area where a common, Windows-based interface would help a lot. Maybe Microsoft's multimedia extensions can provide relief in this area.

Printed Image

All these images are nice to look at, but sometimes it can be a lot more useful if you have a way to print them for later use. Printing really isn't a problem on a LAN, provided you aren't fussy about where you locate the printer. With some LANs, you're stuck with printers attached to the file server. With other LANs, you'll have to use a workstation as an entry point for network printing, or you'll have to dedicate a personal computer to act as a LAN printer server. All these methods work, but they all have problems: They are wasteful of resources, and they are frequently slow. They may also be inconvenient for users.

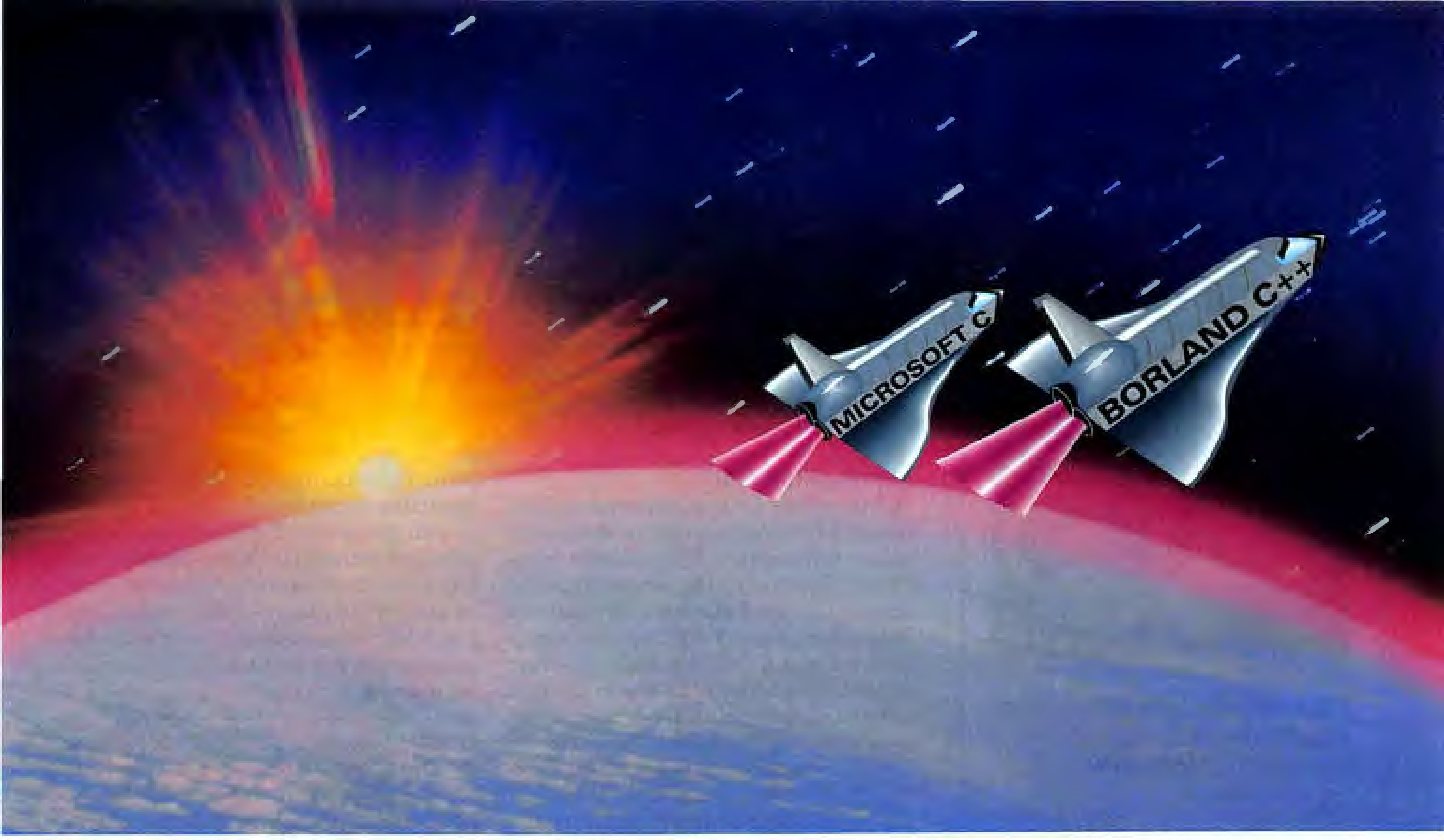
Over the last year or two, several manufacturers have developed an alternative method of hooking a printer to the LAN, at least as long as it's a Novell LAN. Microtest was the first to develop a LAN printer server with its LANport product. This was followed by Intel's nearly identical NetPort. Both of these devices are small boxes that you could attach to the printer with a Velcro strip, and they can run two or three printers if they are nearby. Unfortunately, they can't handle the encrypted passwords of Novell NetWare version 3, which was a major problem for many users. Still, they work well, and more important, they're cheap enough that LAN administrators don't mind buying them in large numbers, considering the fact that the self-contained devices effectively replace a personal computer and a network interface card.

The problem with encrypted-password support was solved by Castelle, whose LANpress printer server also proved to be very fast. This is one product that really blows away earlier performance problems with LAN printing. Like the LANport and the NetPort, the Castelle product is self-contained and connects directly to a Novell LAN. Castelle also makes a new type of printer server for network use called the JetPress, which works like the LANpress, except that it mounts in the expansion slot of a Hewlett-Packard LaserJet printer. The internal mounting arrangements mean that the JetPress can work only with a single printer rather than the four printers supported by its sibling, the LANpress.

Serving You Right

The applications that I mentioned here are the most common in a business environment. In fact, you can do nearly anything with your data on a LAN that you might want to do. Want to control your coffee pot or your air-conditioning with a LAN? Sure, you can do that, but most businesses don't.

On the other hand, the availability of servers to do things like send and receive faxes, communicate with distant computer users, and ship pictures around the company certainly makes life more productive for the users. These are all things that can be done with a stand-alone PC, but often their productivity enhancement is



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so limited that it simply doesn't make good business sense.

With a LAN and the proper business environment, the capabilities I've discussed here can make excellent business sense. They can improve productivity and morale, and provide capabilities that your company didn't have before. In other words, they're well worth the money.

Leaving Stuff Out

Shortly before I wrote this column, I received a fax from a reader in France objecting to the content of my column on remote connectivity. The writer suggested that the fact that I discussed Ethernet and Token Ring but not ARCnet was somehow nefarious, and that I was ignoring what he apparently believed was the most important protocol of those commonly available. The suggestion is hogwash.

In the first place, I was discussing hardware that was not available in an ARCnet version. Because of that, it made no sense to discuss ARCnet. In addition, the old 2.5-Mbps version of ARCnet is simply outmoded. ARCnet does have a significant installed base, but that's mostly because it was cheap. That's ended, now that Ethernet, which moves data at four times the speed of ARCnet, costs about the same to install as ARCnet.

More important, ARCnet is simply too slow in a world that must deal with massive spreadsheet files and with Windows executables that are simply huge. As a matter of fact, 10-Mbps Ethernet and 16-Mbps Token Ring are beginning to look a little stretched when faced with the massive increase in file size that accompanies Windows.

Fortunately, there is hope. ARCnet is available in a 20-Mbps version that's compatible with earlier versions of the software. Fiber Distributed Data Interface is becoming somewhat affordable, especially with the advent of a version for copper wire and the availability of plastic fiber. I'm not so much ignoring ARCnet because of lack of familiarity—I use an ARCnet LAN every day—but because it's rapidly becoming irrelevant for all but the smallest users. ■

Wayne Rash Jr. is a contributing editor for BYTE and a principal and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He is coauthor of two books for business network users: The Executive Guide to Local Area Networks *and* The Novell Connection. *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.

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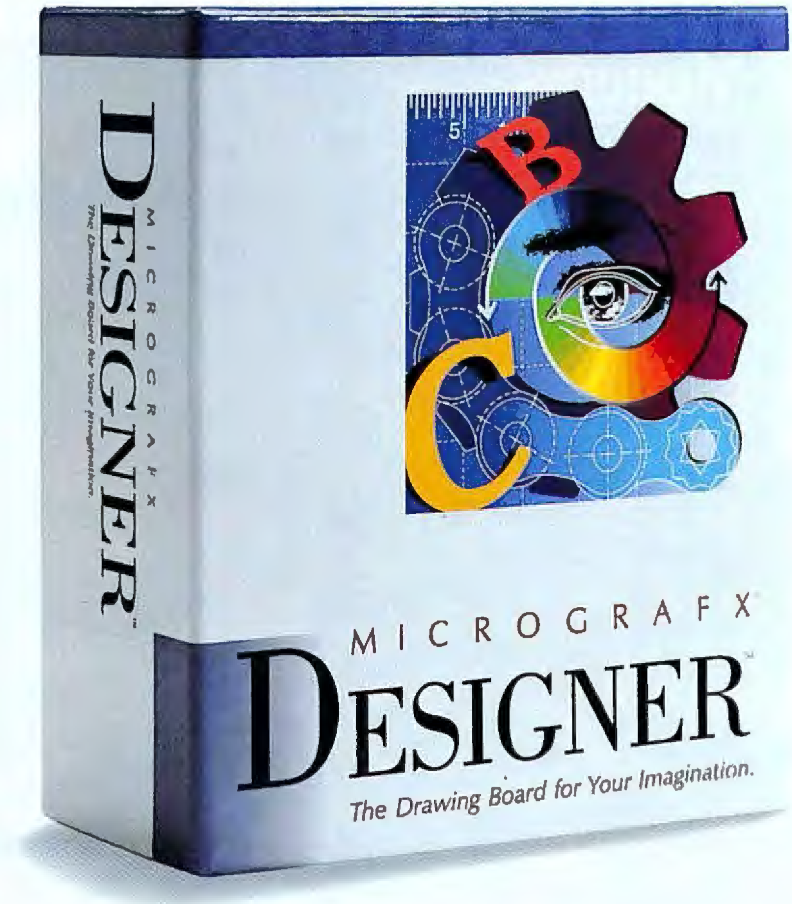

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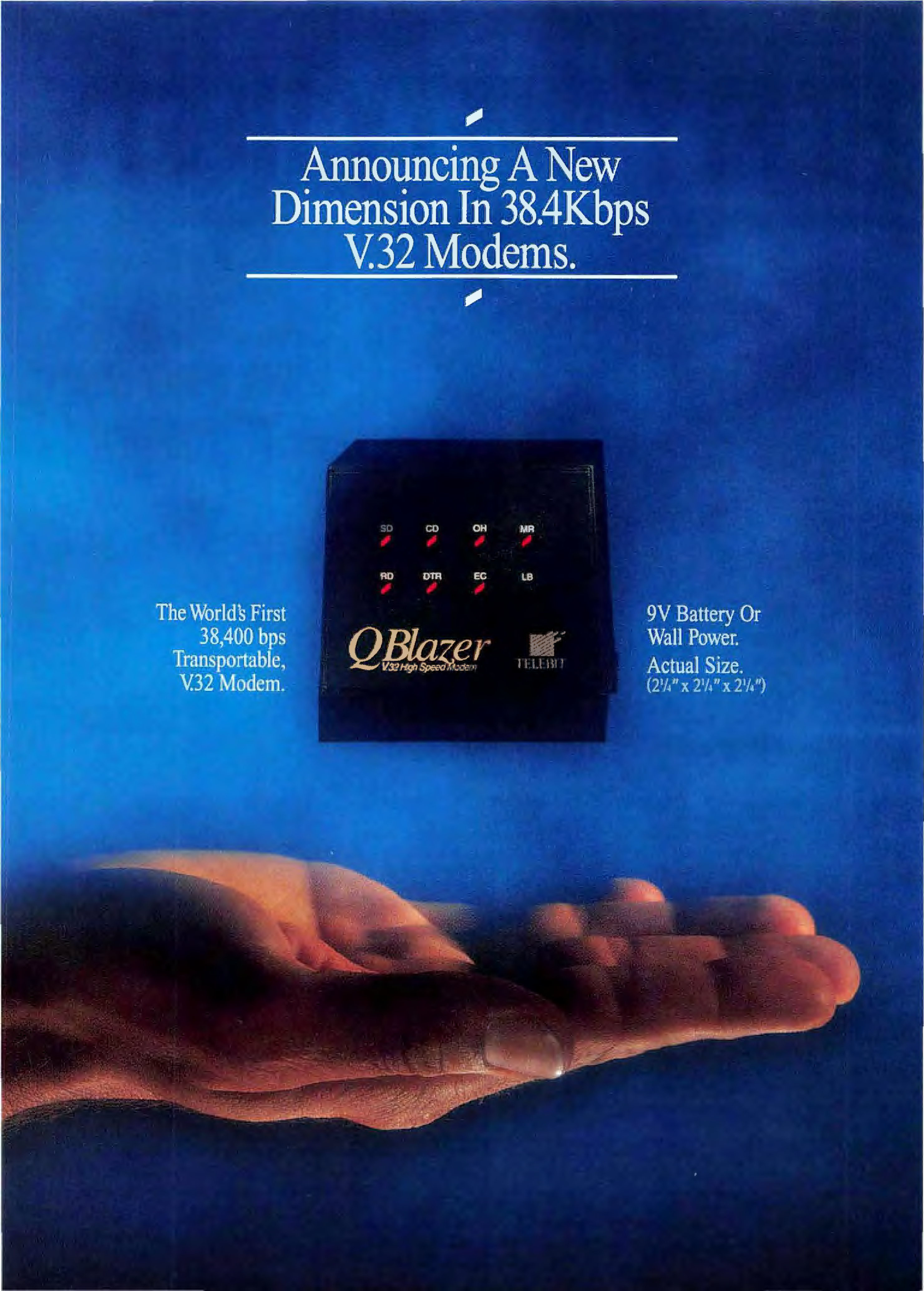
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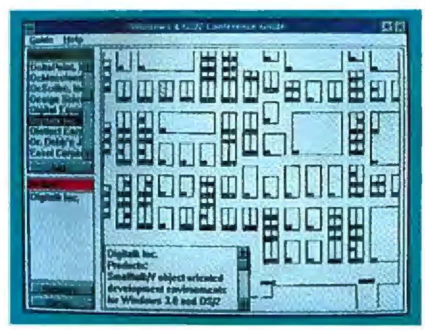
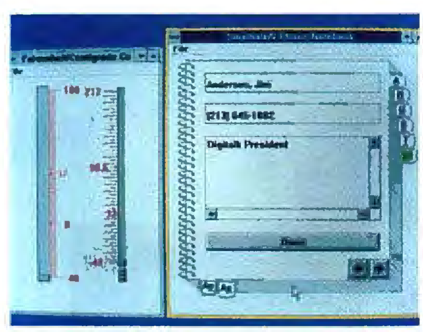
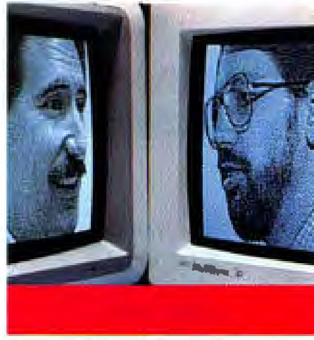


This Smalltalk/V Windows application captured the PC Week Shootout award—and it was completed in 6 hours.



Smalltalk/V PM applications are used to develop state-of-the-art CUA-compliant applications—and they're portable to Smalltalk/V Windows.



B Y T E columnists, staff, and contributors debate the issues

What's Wrong with Unix?

Roundtable is a forum in which BYTE editors, columnists, and contributors debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX, where you can participate in the round.table conference.

ELLEN ULLMAN: At the risk of opening the proverbial can of worms (picture me smiling, *not* fishing), will someone tell me just what is the big objection to Unix? I don't understand the animosity toward Unix. For me, it has a coherence (an elegance, almost) that I don't see in other operating-system designs. DOS 5.0, with its modes and memory management schemes, looks like the sort of retrofit kludge that any self-respecting programmer would be ashamed of. Windows, likewise. The coherence is missing. And it sounds like multimedia extensions, pen extensions, and so on will just make it worse.

ANDY REINHARDT: I think the basic problem with it is that Joe and Joanne user simply don't need it, if what they're used to doing is cranking out form letters from WordPerfect or throwing together a few slides in Harvard Graphics. Why upgrade to something so scary, with awful-sounding commands like awk and grep, when you can have pretty little color pictures on a Mac for $1200?

MARTIN HELLER: Unix has been updated a lot—by every Tom, Dick, and Harry with a computer since Dennis Ritchie could fit the whole distribution on one RK05 pack. Consequently, there are a million different Unix variants, and almost all of them are bloated beyond recognition (speaking as someone who last saw Unix in the flesh in the PDP-11 RK05 days).

TOM YAGER: True, it does get confusing when there are multiple choices on a single platform (like Intel-based PCs), but generally, a large part of Unix's strength is the huge number of people and companies that have contributed to its development. Unix is unique among the operating systems in that it is a melting pot of good ideas, taken from college students and multi-billion-dollar corporations alike.

It's true that all this innovation is scattered across various versions of Unix. But both AT&T and the Open Software Foundation are working to combine the best features of the available Unixes into a single operating system.

Does that mean that Unix is perfect? Hardly. Only now are vendors starting to realize that ease of use and administration are issues that need to be resolved before Unix can enjoy widespread commercial success. Creating simple front ends for Unix use and administration isn't hard; it's just that few companies saw a need to invest the time and effort before. The next several months will see some breakthroughs in this area, and vendors will adjust their offerings to account for the fact that most users, with their desktop or deskside individual systems, are their own system administrators. Another problem has been packaging: Nobody has come up with an inexpensive, run-time-only Unix that can be used as an application platform. Open Desktop from The Santa Cruz Operation fills most of the bill, but DOS buyers, accustomed to spending $100 tops for the latest version of DOS, still balk at the price.

DON CRABB
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MARTIN HELLER
Contributing Editor

LARRY LOEB
Consulting Editor

STAN MIASTKOWSKI
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ANDY REINHARDT
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JON UDELL
Senior Technical Editor at Large

ELLEN ULLMAN
News Editor

TOM YAGER
Technical Editor, BYTE Lab

ULLMAN: OK, Unix is far from perfect. But do you know a better operating system? One that is not either too small (DOS) or too big? As a systems programmer, for me the issue was the ability to do what I needed to get done. I had interprocedure communications, signals, semaphores, and pipes. I had a high-performance file system. True multitasking. All the things we are waiting for in PC platforms.

It seems that most of the objections to Unix are religious. It's too bad that early Unix devotees were evangelistic about the operating system—once the adherents were religious, the detractors were free to be religious as well.

JON UDELL: All that's wrong with Unix is that it hasn't been sufficiently well commoditized—not for the dominant Intel platform, but not really anywhere else either, although Sun and Next are getting close. In principle, there's no reason in the world why Unix can't be made more easily user-installable and user-maintainable than it is. In practice that hasn't happened, so the first step is a doozy.

That's a shame because, so far as I can tell, once you're over the hump all kinds of things (e.g., networking, E-mail, and multiuser applications) sort of just fall into place. DOS/Windows looks easy because even my own father can manage to install it and use it.

But then, when you try to layer on the networking, E-mail, and multiuser applications, that illusion of ease of use melts away—things just keep getting harder to do. The hope for OS/2 2.0 is that it'll strike a balance between these extremes: easy to get started with, but capable of real growth.

ULLMAN: The "problem" of Unix has always been the administrator. Every place I've ever worked had one or more. Remember, Unix is industrial-strength. It should be compared not with DOS but with something like System/38 (AS/400) or VMS or perhaps VM. Systems designed for multiuser commercial use need administrators and systems programmers. There's nothing wrong with that fact, per se.

LARRY LOEB: Unix reminds me of DOS a lot. They both are command-line interfaces that work well on an ASR-33 teletypewriter at 110 bps. They are both cryptic, and actions do not flow from instructions directly without your holding some sort of intermediary result in your head (let's see, what directory am I in, what modifiers exist for this call, where is the darn MAN page?).

It's a great way to keep programmers employed, though. For a long time, it was the only way to get several users on one computer. That's what it did—and it still does. I just think that we've outgrown the need to do that as much, and I haven't even started on the GUI aspects—or lack of.

ULLMAN: Hmmm. Can I try to separate the user-interface issue from the programming-interface issue? In its native state (without Motif/Open Look), Unix is cryptic to the end user, true. But to the programmer, interacting with the system calls, the system looks crystal clear; at least it does to me.

The user interface, the cryptic commands, the teletypewriter command line: Are these the main reasons for the Unix bad rap? If so, that objection is taken care of in the architecture itself. Just install another shell, one more to your liking.

Does it bother you that much that, as an individual, you're not an expert in everything the system has to offer? That you'd have to cooperate with some other people to get the job done? That you might really need the help of an administrator? Maybe this is what has created such heat against Unix: It's not a "personal" operating system. It was designed as a collegial operating system.

YAGER: I don't think you can reasonably separate the base operating system from the GUI layers that have been built above it. Workstations would have no market if it weren't for graphical interfaces. Unix GUIs aren't some recent development; they've been part of workstations since Apollo invented them more than a decade ago.

As for Unix being cryptic to use, hogwash. If you boil it down to DOS's command-line functionality (e.g., delete, rename, and run program), Unix is no harder to use than DOS. I didn't say "administer," and I hasten to point out that huge numbers of DOS users don't know how to format a floppy disk or hook two systems together. How difficult Unix is to use depends entirely on how much you ask it to do.

DON CRABB: Arguing that Unix isn't cryptic to use because it's no harder to use than DOS really ends up damning Unix with faint praise. Whoever said that DOS was easy to use? Memorizable, sure, but hardly easy to use. The fact is that like DOS, Unix is cryptic. Anyone who has written a shell script knows what I'm talking about. Unix shell scripts can make C++ seem like a voluptuous syntax by comparison.

But Unix's cryptic command structure isn't limited to shell scripts. The whole thing hangs on a series of two- and three-letter programs and scripts that made mnemonic sense to the AT&T and Berkeley engineers and computer scientists who built the thing to begin with. What was crystal clear to those folks is about as clear as mud to today's Unix users.

LOEB: The meat of the discussion really isn't about Unix as an operating system: It's about procedural versus event-driven programming. I (like everyone else here) started out doing procedural stuff: Get some input, do a routine, output a value. What the Mac has brought to the computing table isn't really its GUI—it's the first machine to institutionalize user event-driven styles of programming. An operating system that can't handle that is a dinosaur.

I concede the Swiss Army knife utility of Unix—a tool for darn near anything. But Unix and DOS remain operating systems that are procedurally optimized. They ignore the user until the process is ready to accept input. I see the future of programming as event-driven, not procedural.

YAGER: Again, I must disagree. Unix is a multitasking system, and programs that are not written in a single thread of execution are the ones that take best advantage of resources. At the lowest level, Unix is just loaded with signals, semaphores, and other hooks that dispatch registered procedures on the occurrence of a particular event. Moving up to networking, nearly all Unix applications are event-driven. TCP/IP services are registered with a "broker" that dispatches requests for services to the appropriate routines.

Remote procedure calls take it even a step further, permitting a single application to publish an unlimited number of individual functions that can be called from a remote system. Then there's X Window System, but I hope I don't have to argue its event-driven aspects. The reverse of your argument is true: Unix is optimized not for single-threaded, procedural programs, but rather for event-driven programs and procedures that don't surface until some event requires their attention.

STAN MIASTKOWSKI: I always have to chuckle at the high emotions involved in the discussion of operating systems. Whenever I start to have a religious feeling about an operating system, I remember two things: 1. End users don't give a darn what operating system is running. They just want to get a job done. 2. The "pie" is big enough that I firmly believe that there will be a place for Unix, DOS, OS/2, Mac, and probably one or two other operating systems that haven't been invented yet.

We keep getting back to the good old American sports analogy: There must be a "winner" and a "loser." The reality of it is that there will always be lots of winners. ■

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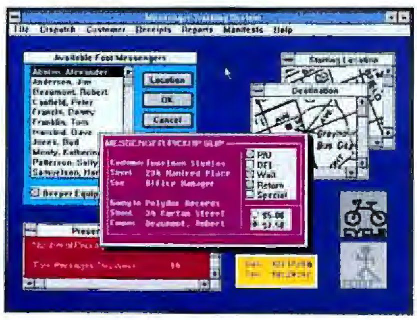

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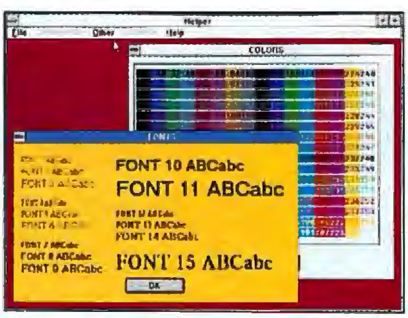

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FEATURE

Making the GUI Talk

New technology holds promise for blind and learning-disabled people who live in a GUI-oriented world

RICHARD S. SCHWERDTFEGER

More than 120,000 people in the U.S. are legally blind, according to figures put out by the American Foundation for the Blind in New York. In addition, the National Institutes of Health in Washington, D.C., states that 10 percent to 15 percent of the U.S. population have learning disabilities.

For some years now, to communicate with the sighted world, blind people have used computers via screen-reader systems (SRDs) that can access a physical display buffer of characters and orally present the information (see "Opening Doors for the Disabled," August 1990 BYTE). In the past few years, however, the widespread trend toward the development and use of GUIs has caused a multitude of problems for the visually impaired and some learning-disabled people. The advent of GUIs has made it virtually impossible for blind people to use much of the industry's most popular software and has limited their chances for advancement in the now graphically oriented world.

The coming of GUIs has left some SRDs with no means to access graphical information. GUIs do not use a physical display buffer, but instead employ a pixel-based display buffer. Fortunately, new technology is coming into existence to correct this problem. Companies are now enhancing SRDs to work by intercepting low-level graphics commands and constructing a text database that models the display.

Developers have created new screen-reader software and combined it with a common user interface. One prototype of this type of application is Screen Reader/PM from IBM. It is an enhancement of the original DOS Screen Reader that the company brought out four years ago. The research project has a current installed base of more than 40 beta-test sites.

With a system like this, the disabled user can maneuver a mouse over the display and use the keyboard or a separate keypad, and a voice synthesizer will actually describe an icon the GUI has displayed or the graphical text shown on the screen (see the photo). This new technology has alleviated many of the problems that GUIs created for blind and some learning-disabled users, and their future now looks much more promising. Recent technological developments are putting the computer back into the hands of blind and learning-disabled people.

Also spurring development of adaptive technology for the disabled are two new laws. An amendment to Public Law 506 (29 U.S.C. 794d) states that a company

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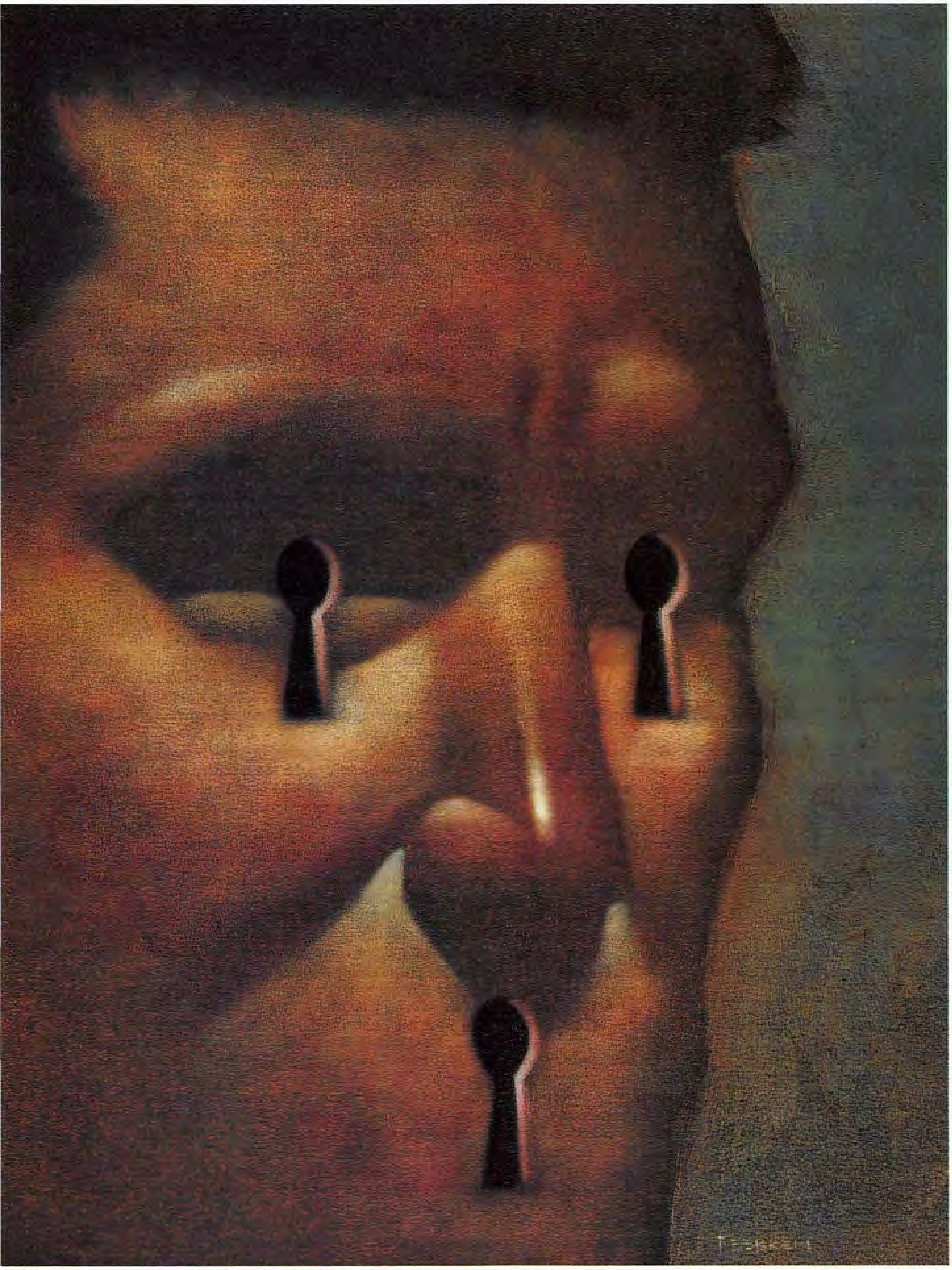

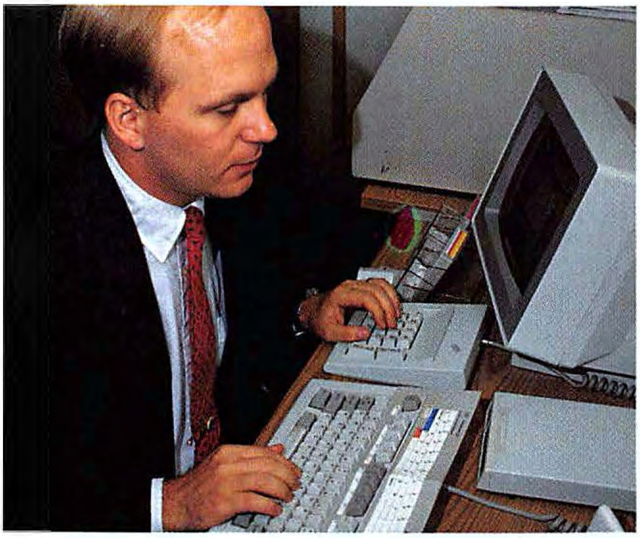

Screen Reader/PM comes bundled with a small keyboard, about the size of a numeric keypad. This keyboard plugs into the mouse port on any PS/2 computer and lets you control all aspects of the SRD.

can sell a product to the U.S. government only if that device is accessible to people with disabilities. The Americans with Disabilities Act, signed into law by President Bush in 1990, states, in part, that if your company has more than 25 employees, you must provide reasonable accommodation (including technology) in the form of job adaptations for the handicapped.

Taking the First Step

A package called OutSpoken is available that reads and vocalizes a GUI. It was designed and developed in 1989 by Berkeley Systems (BSI) for the Macintosh GUI. OutSpoken is a screen reader that communicates through voice synthesis with blind users as they move the mouse around the GUI and come in contact with text and graphical objects on the screen.

BSI realized that it had to construct a database that the screen-reader software could access. This database, called an off-screen model (OSM), is the conceptual basis for GUI screen readers that vendors are developing today. The advent of OutSpoken was a significant breakthrough for the blind community.

Other companies and software developers are considering how to use this new technology to make their systems accessible to the disabled. I will define what an OSM is, how it is created, and how SRDs can access and use it. The information in this article is based on my work on the Screen Reader project at IBM's T. J. Watson Research Center in Yorktown Heights, New York.

BYTE ACTION SUMMARY

GUIs have stifled, if not brought to a standstill, the use of computers by blind and learning-disabled people. New technologies, such as a graphics-based speech package from IBM, are evolving that may restore the independence computers once provided. Here's a preview of a ground-breaking development in adaptive technology.

Off-Screen Model

An OSM is a database reconstruction of what is visible on the screen and also what is not visible on the screen. A database must manage information resources, provide utilities for managing these resources, and supply utilities to access the database. The resources the OSM must manage are text, off-screen bit maps, icons, and cursors.

Text is obviously the largest resource the OSM must maintain. It is arranged in the database relative to its position on the display or to the bit map on which it is drawn. This situation gives the model an appearance like that of the conventional display buffer. Each character must have certain information associated with it: foreground and background color; font family and typeface name; point size; and font style, such as bold, italic, strike-out, underscore, and width.

Merging text by baseline (i.e., position on the display) gives the model a physical display buffer appearance with which current SRDs are accustomed to working. Therefore, to merge associated text in the database, the model combines text in such a way that characters in a particular window have the same baseline. Each string of text in the OSM has an associated bounding rectangle used for model placement, a window handle, and a handle to indicate whether the text is associated with a particular bit map or the display.

GUI text is not always placed directly onto the screen. Text can be drawn into memory in bit-map format and then transferred to the screen. It can also be clipped from a section of the display and saved in memory for placement back onto the screen later. An example of this is a drop-down menu: Text in the area to be overlaid by the menu is transferred to memory and later tranferred back onto the screen when the menu is deleted.

The operation required to transfer bit maps is called a BitBlt, or bit block transfer. GUIs use BitBlts for speed. For example, in a drop-down menu, it is much faster to transfer the pixels cut from the screen back onto the screen than to have the application redraw or "paint" that portion of the screen from scratch.

Icons are pictorial representations of an idea or object. In the GUI, icons represent many things, ranging from programs that are currently running to objects that receive user input to perform a specific action (e.g., a push button or check box). Icons are read, identified, and then stored as single text images or as completely separate, nontext entities.

People who are blind need to be able to use icons the way they use text—in other words, they need to be able to hear a verbal description of each icon. When an application is designed without a provision for keyboard access to particular icons, the blind user needs a mouse to locate the icons. A screen-reader application must be able to track mouse movements, match their positions with OSM icons, and vocalize the associated icon names. The OSM must also provide cursor information so a screen reader can vocalize the user's cursor position on the display.

In windowing systems, more than one application can be displayed on the screen. However, your keyboard input is directed to only one active window at a time. But each active window is often made up of many child windows. The applications cursor is placed in at least one of these child windows. The OSM must keep track of a cursor's window identification (i.e., handle) so that when a window becomes active, SRDs can determine if it has a cursor and vocalize it. An SRD cursor is the area on the display where the next potential action will occur or where users can enter their next text. An example of a cursor is the

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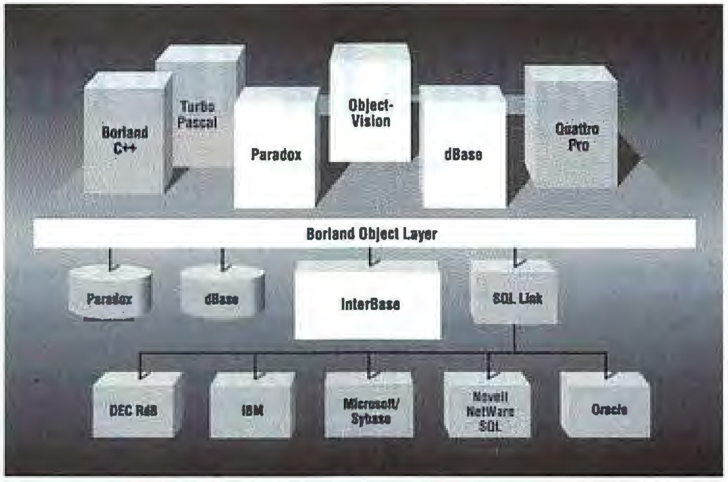

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Hearing Graphics for the First Time

Joseph J. Lazzaro

As computers become more graphically oriented with each new product release, vendors must forge tools so that blind people can access image-intensive systems. Screen Reader/PM may be the instrument with which visually impaired and learning-disabled people gain equal access to the GUI.

As a computer user who is blind and responsible for adapting job sites for a state and federally funded computer access project, I have tested nearly every screen-reader system (SRD) on virtually every text-based computer platform. Until now, most systems have been mute in graphical environments (see "Windows of Vulnerability," June BYTE).

But new technology has surfaced that may help the visually impaired and learning disabled to operate in a GUI-oriented world. Screen Reader/PM from IBM is a breakthrough speech package. The company sent me a system and gave me the chance to check out a beta version of the software.

I evaluated Screen Reader/PM's capabilities using an IBM PS/2 Model 70 equipped with 4 MB of memory, a 70-MB hard drive, and an Accent stand-alone voice synthesizer from Aicom (San Jose, CA). Screen Reader/PM also works with other synthesizers on the market, so you can choose the voice unit that best suits the application at hand.

Installation is relatively easy. It involves copying the speech software to an appropriate subdirectory and rewriting the CONFIG.SYS and STARTUP .CMD files. I had to connect the voice synthesizer to one of the serial communications ports—a trivial job, to say the least.

Screen Reader/PM comes bundled with a small keyboard, about the size of a numeric keypad. This keyboard plugs into the mouse port on any PS/2 computer and lets you control all aspects of the SRD. There are keys for reading lines, words, and characters, as well as commands for reading entire windows. Once I completed the installation, I cranked up the software, which gave a voice to OS/2 and Presentation Manager.

When the synthesizer came to life, I was amazed to find that, for the first time, I could actually use an IBM-based graphics-based system. As I moved the arrow keys, the synthesizer crisply verbalized each highlighted menu selection. I found Screen Reader/PM to be quite responsive, with little or no lag time between keystrokes and verbalizations. This is very important for a speech program, as a sluggish package would slow down productivity.

When I began further exploring the external keyboard, I discovered a dedicated help key that gave me verbal verification of every key in the system. This keyboard has both positive and negative implications. It prevents conflicts with applications that seize control of the main keyboard, an occasional problem with terminal-emulation hardware and software. But blind users who are more comfortable keeping their hands firmly fixed on the home row to control voice functions may at first find the use of a secondary control board slow and painful. I was pleased to find that you can bypass this external keyboard and use the numeric keypad on the main keyboard if you wish; this is a feature that will satisfy a wide range of speech users.

All in all, I found the system fast and responsive, although there are a few rough edges in the current beta version. This is to be expected, especially when you consider that Screen Reader/PM is the first graphics-based speech package for the family of IBM computer platforms.

The program lives up to its claims—to allow blind people equal access to the OS/2 and Presentation Manager GUI, as well as to a host of programs running under OS/2. Screen Reader/PM may also help learning-disabled users who have difficulties with graphical representations of text.

According to IBM, OS/2 2.0 will be able to run Windows applications; this may eventually give blind and learning-disabled people access to that graphics-based environment. I think Screen Reader/PM will evolve into a stable and highly reliable access package, one that will provide many disabled users with the freedom the coming of the GUI almost took away.

Joseph J. Lazzaro is the cofounder of Talking Computer Systems in Cambridge, Massachusetts. He is writing a book on assistive technology for the American Library Association and is project director for the adaptive-technology program of the Massachusetts Commission for the Blind. You can reach him on BIX as "lazzaro."

blinking insertion bar in an editor or the rectangular highlighting text in a menu of options.

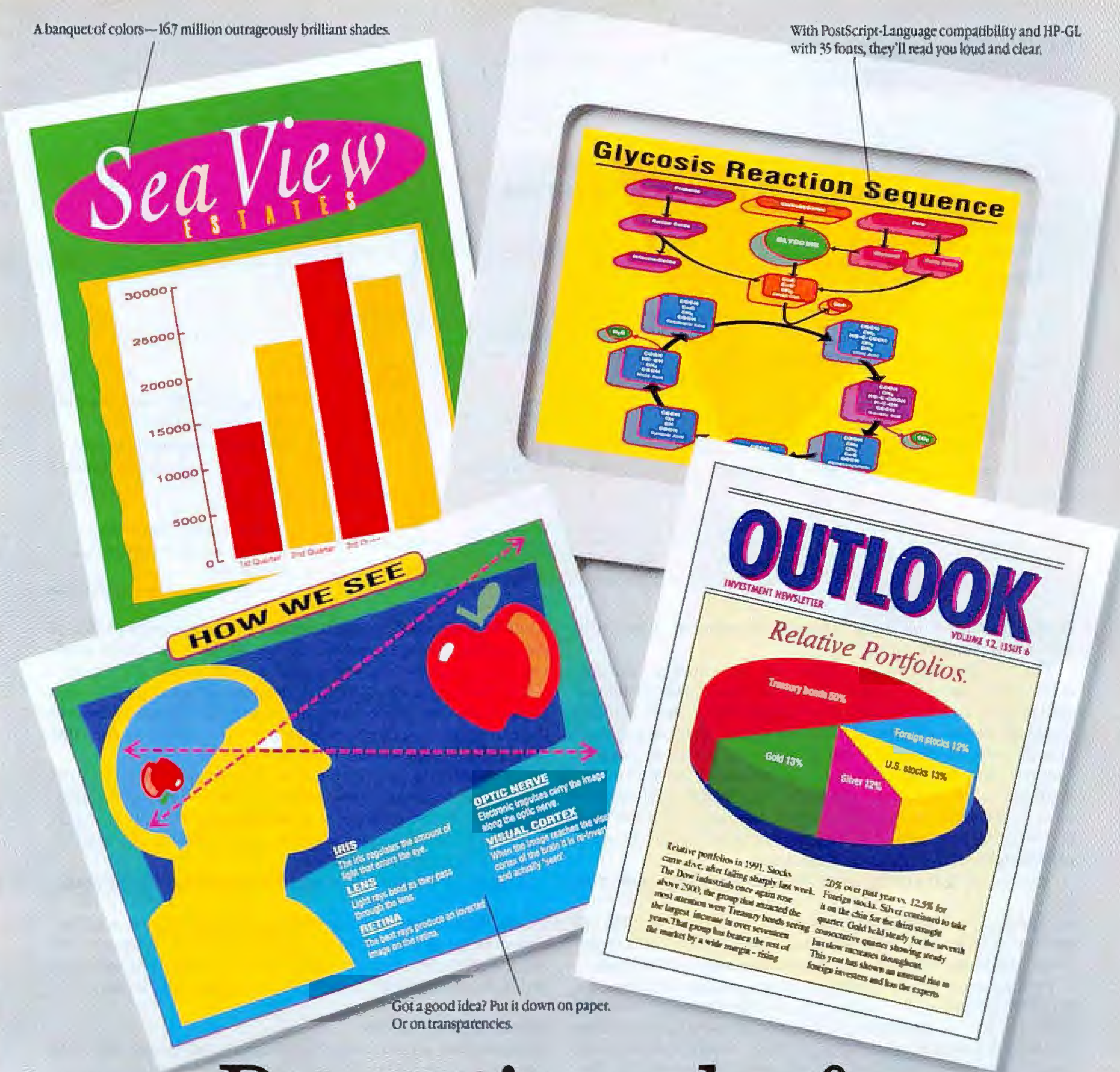
The OSM must keep track of the cursor's screen position, dimensions, the associated text string (i.e., speakable cursor text), and string character position. If the cursor is a blinking insertion bar, its character position is that of the associated character in the OSM string. In this case, the cursor's text is the entire string.

A wide rectangular cursor is called a selector, since it is used to isolate screen text to identify an action. Examples of selector cursors are those used for spreadsheets or drop-down menus. The text that is enclosed within the borders of the selector is the text that the screen reader would speak.

Construction Toolkit

Now, I'll build a toolkit of utility functions that you can use for constructing and maintaining the resource information.

The software performing the display reconstruction is driven from low-level GUI graphics functions. Therefore, with some exceptions, OSM utilities used to construct and maintain the model appear like operations being performed by the graphics engine. These operations are performed on text or database



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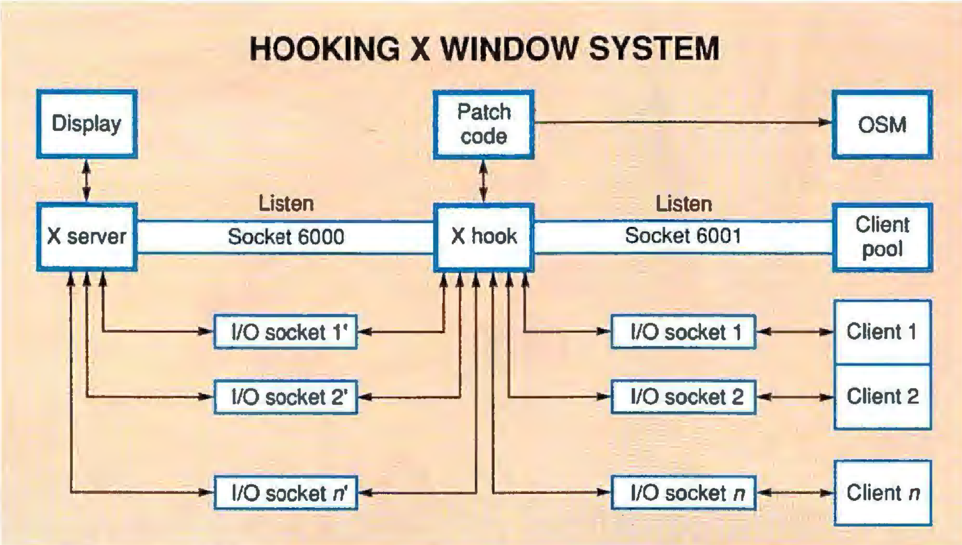


To build an off-screen model, you must hook low-level graphics commands to call the patch code that constructs the model. Here, the screen reader uses the X client/server relationship to hook low-level graphics commands.

representations of bit maps, cursors, or icons, as opposed to pictures or actual bit maps.

The utilities required to handle text are clipping, erasure, text merger, and text transfer. These tools must handle icons as well as text. Developers do not normally worry about clipping text to the windows in their GUI applications. Text running outside the window must be clipped off by the low-level graphics routines, and the code constructing the model must also perform the same operation. Therefore, the model must provide tools to clip the text to the clip region supplied by the software constructing the model. This region is represented by an array of rectangles defining the visible domain.

You can use text-erasing tools when placing one window over another or when you reduce the size of a window. You can use text-merger tools when you combine text with other text having the same handle and screen baseline. Simply put, text is merged into an OSM bit-map representation using common baselines.

Performing a BitBlt requires tools to transfer functions for text and cursors—for example, if you are moving a window from one part of the display to another, or when text that was previously drawn to a memory bit map is transferred to the screen. Therefore, tools are also required for moving text between the visible display portion of the database and the nonvisible off-screen portion where OSM representations of bit maps are stored.

System Dependent

Now, on to building the model. The construction code, called the *patch code,* is operating-system dependent, because specific patch-code function calls are patched or hooked in with a subset of the low-level graphics calls. The calls to hook are those that draw text; perform BitBlts; save bit maps to display card memory; restore bit maps from display card memory; select and unselect bit maps for drawing; delete bit maps; map display buffers to windows; draw rectangles, boxes, borders, and regions; and update cursors.

For each of these graphics calls, you have a corresponding patch function call. The job of these patch functions is to directly mimic the low-level calls by performing the same operations on the model. For instance, the instruction `drawtext` would draw text on the screen as well as merge text into the model.

How you hook these calls depends on the GUI system architecture. X Window System is based on a client/server model. X applications (clients) communicate with the X server by sending and receiving messages over a socket (see the figure). When the X server initializes, it creates a socket that clients use to establish new connections and returns the socket address to the calling environment. When a new client starts, it uses that socket address to connect to the X server.

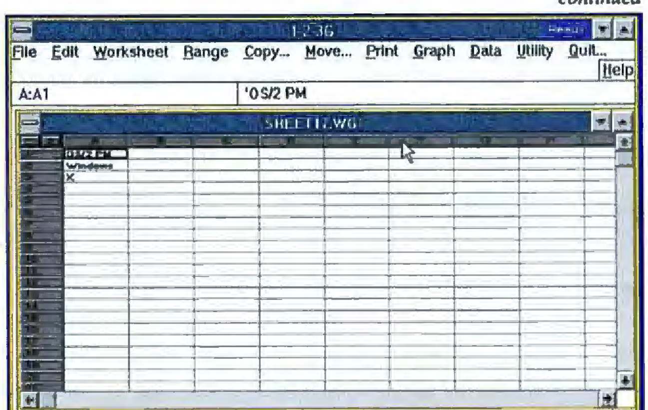
To establish a new connection, the client connects to the socket and receives a new socket to use for communication. When the X server accepts a connection, it receives a new socket connected only to the new client, leaving the original socket open for new connections.

SRD patch software intercepts this communication by changing the socket address that clients use to connect to the X server. New clients use the modified socket address and connect directly to the screen reader instead of the X server. The SRD then connects to the real X server on behalf of the client and manages all socket I/O between the client and server.

Screen Reader's View

Regarding the screen reader's interface to the model, the OSM must notify the SRD of cursor changes and window updates.

continued



In this Lotus 1-2-3/G spreadsheet, the view is the spreadsheet itself. The blind user has the option of looking at a subset of the view or a viewport (e.g., column 1). The cursor is at OS/2 PM.

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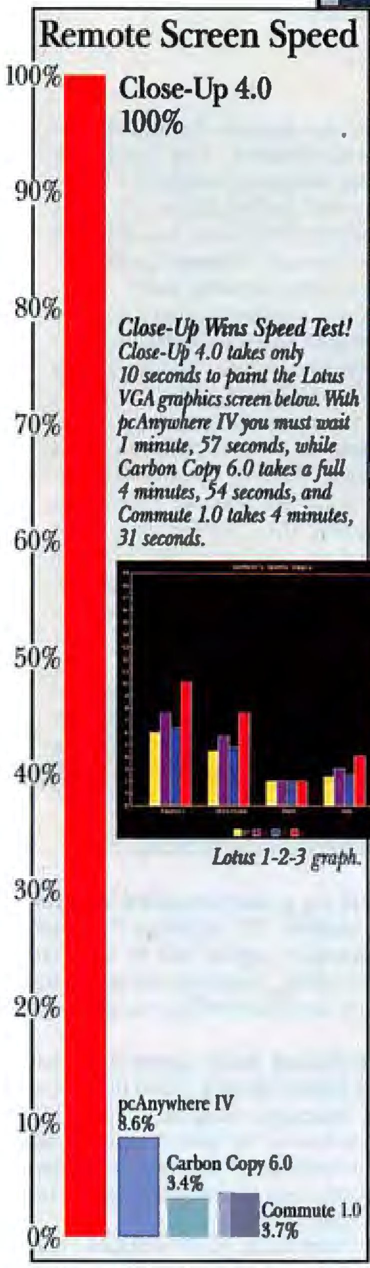

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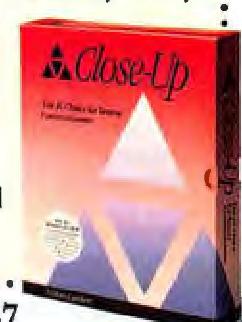

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Chaotic Progress

Janet J. Barron

Suppose that, for some reason, society confined you to a self-contained world and tagged you as "disabled" or "handicapped." Although your mental capacities were OK, you couldn't travel around unaided or get a job to support yourself. With the advent of the microcomputer and devices that let it speak, however, you qualified for a job, and life changed for the better.

Then along came the GUI, a technology that quickly became popular and pervasive in the enabled world (see "Windows of Vulnerability," June BYTE). But because it couldn't talk, you began to wonder if you'd have to return to the kind of isolated existence you knew before GUIs. It was a pretty scary thought.

Now organizations and people have begun to develop ways to provide access to the GUI. And therein lies the most recent good news regarding adaptive technology. "Talking" graphics are on their way. Enhanced screen readers will allow those disabled people who were almost shut out of the computing environment by the GUI's coming to do their jobs and keep up with the changes in technology.

For a good while now, several companies have been working in the field of adaptive technology (e.g., Berkeley Systems of Berkeley, CA, and Dragon Systems of Waltham, MA). Also among the organizations involved in these efforts are the University of Wisconsin's Trace Research and Development Center and Johns Hopkins University's Applied Physics Laboratory in Laurel, Maryland. As a result of increased activity in assistive technology, some great things are happening.

Ten years ago, Johns Hopkins held a competition to motivate people to create innovative computer technology to help the disabled. The competition was very successful, and many of the ideas entered in the contest have become mainstream products and programs used by people who may be blind, deaf, learning disabled, developmentally disabled, or physically disabled. The computing world has changed dramatically in the past 10 years. So Paul Hazan, the Johns Hopkins project director who directed the first national computer search, is doing it all over again this year.

This year's contest is cosponsored by the National Science Foundation and MCI Communications. Besides the top prize of $10,000, numerous other awards and recognitions include smaller amounts of money, computers, and certificates. Winning entries will be exhibited at the Smithsonian Museum in Washington, D.C., in February. The main payoff, however, won't be the money or the other prizes. It will be new and innovative technology developed to help disabled people actualize their potentials.

The Trace Center works in several areas to address the communication needs of people who are nonspeaking and have other severe disabilities. Much of the work at Trace is directed toward

Cursor changes and window-update notifications are performed either by setting flags, in the case of polling, or by various means of interprocess communication (IPC) on multitasking systems.

OSM change notifications result in the SRD's referring to the OSM to check for important updates. Therefore, the SRD software writer needs to reduce the OSM viewing area to a particular application or window. This area of the model is called a *view*, and a subset of this view is called a *viewport*. OSM software must provide tools to set up and maintain views and viewports.

An example of the way you use views and viewports is the Lotus 1-2-3/G spreadsheet shown in the screen. To construct a view of the spreadsheet, the SRD must pass the OSM the spreadsheet's bounding rectangle and all window identifications composing the spreadsheet. The OSM then extracts all view text and sorts it by baseline. The user then might ask the SRD to isolate a specific spreadsheet column for ease of use. Upon such a request, the SRD vocalizes each column (i.e., viewport) entry.

Turning On the Lights

Here's an example of how text drawn by an application GUI program is spoken by a screen-reader program. First, an application uses a standard application programming interface call to draw "Hello World" in an OS/2 Presentation Manager (PM) window. The application could use a function called `WinDrawText` to place the text in the window. The `WinDrawText` function results in a low-level graphics engine call to `GreCharStringPos`. For `GreCharStringPos`, there is a corresponding call to the patch-code function `OsmCharStringPos`, passing it the same parameters.

PM is very helpful in providing many query functions needed to build an OSM node before placing it into the model. The construction code uses functions such as `GreGetClipRects` and `GreQueryFontAttributes` to obtain clipping and font information. When the necessary information is acquired from the `Gre` functions, the patch code then determines the text colors by performing its own color mixing.

Next, a database node is constructed. OSM utilities create the node; add the font, color, spacing, text, and text bounds; and clip the node to the region. If the text is still visible, a window handle is retrieved from PM and placed in the node. Finally, OSM utilities are used to merge the text into its proper place in the database—in this case, the visible (displayed) portion.

After the text is merged into the OSM, the SRD is notified. Assuming that "Hello World" is in the current view, on the next keystroke command, the blind user could hear the SRD speak what is in the window. If "Hello World" were the only text to be displayed in the window, the user could program the SRD to speak it automatically on update.

studying ways in which nonspeaking and physically impaired people can converse and write using high-technology aids. Trace scientists are also researching and establishing standards for the control mechanisms used to operate computers, communication devices, and home environmental controls, and are investigating ways to make computers and other electronic equipment more accessible to disabled people.

Gregg Vanderheiden is director of the Trace Center and a specialist in assistive technology. Early on, Vanderheiden realized that blind and learning-disabled computer users lacked ways to access GUIs. Since then, he has devoted a great deal of his time and efforts to making GUIs accessible to the disabled.

Also working in the area of technology for disabled people is Joe Lazzaro, project director for the adaptive-technology program at the Massachusetts Commission for the Blind. His full-time job is trying out technological devices and matching and fitting them for disabled people so that they can obtain jobs and become self-sufficient.

Joe writes for BYTE (see "Opening Doors for the Disabled," August 1990 BYTE), is a whiz-bang computer programmer and user, and is finishing up a book devoted to the subject of adaptive technology. Because he is legally blind, this subject is important to him—adaptive technology actually did open up his world. Now, because of computers, he can help others become enabled.

One man whom Joe and technology have helped become productive is Dennis, who is blind and wheelchair-bound, is missing fingers and a leg, and has other complications caused by diabetes. Joe's first adaptation for Dennis was speech output for MultiMate on his DOS-based computer.

Because Dennis's job is as a counselor (ombudsman) to help disabled people obtain services and get help, he must make phone calls and write effective formal letters to service companies and vendors. He must also prepare reports regarding clients and contacts that go to his supervisors once a month.

Because of Dennis's missing fingers, speech capabilities for his computer are not all that he needs. Joe is considering providing a program for him called Dragon Dictate by Dragon Systems. To use an application such as a word processor or a database, Dennis would load his software by speaking verbal commands into a desktop microphone. Then he could dictate rather than type his letters and documents and use verbal commands to edit, format, and access and control the information.

The new technology will double Dennis's output almost immediately. And as he grows more proficient with this type of technology, he can expect a four- to fivefold increase in his productivity. With a system such as Screen Reader/PM, Dennis would also have access to the GUI to produce a pictorial representation by job of all the clients he deals with across the state. For instance, he could import his client database into his spreadsheet and produce a pie chart or other type of graph.

According to government figures, 25 million Americans are disabled. Two laws have recently been passed that, besides indicating concern for the quality of life of people who are disabled, have significantly stimulated new work in adaptive technology (see the main text).

Because of these new laws and the efforts of those who are tweaking technology, many formerly disenfranchised people are finally reaping benefits from using computers that open the world of the enabled to the world of the disabled. But, as Richard Schwerdtfeger says in the main text, there is still much to do.

Janet J. Barron is a BYTE technical editor for State of the Art/Features. You can contact her on BIX as "neural."

Twisting Screen Readers' Arms

This is a good time to discuss the effects of making the current screen readers work in the new GUI system environment. Modifying current screen readers to accommodate the new GUI software is no easy task. Most of these systems run under DOS as TSR programs. Unlike DOS, leading GUI software operates in multitasking environments where applications are running concurrently. The SRD performs a juggling act as each application gets the user's input.

Since an SRD is a new multitasking application itself, it must use forms of IPC, like queues. PM and Windows use message queuing so that windows can receive keyboard and mouse input and communicate between other windows. A program remains dormant most of the time, until it receives a message.

Operating systems like OS/2 provide for multiple full-screen sessions as well as a GUI. Due to the protected-mode environment of systems like OS/2, SRD developers must now write device drivers to access the protected full-screen display-buffer memory of non-GUI applications.

With macros or a full-profile language used by current fully functional SRD systems, you can program how each application is read to the user. The blind user or the SRD developer must write profiles to employ multitasking constructs and be able to distinguish GUI constructs like window classes for various system and application controls.

Writing new profiles for these systems will require major rewrites to the existing software base and is a hair-raising experience. If you resize the window, text or child windows within the frame may disappear. The writer can't always count on the text or icons remaining in the window.

Capabilities and Shortcomings

With the new technology, screen readers will be able to work with most popular GUI software packages. These include the new GUI versions of Microsoft Word and Excel or Lotus 1-2-3 for Windows and PM—any application that relies mainly on text or icons.

The new screen-reader world still won't be a utopian one. The disabled will have problems with packages such as CorelDraw, which draws pictures as well as text. It includes no way to describe the pictures to the blind user. Disabled people will also have trouble with other packages that cannot tell them the location of graphical images on the screen. In addition, some software packages construct screen text from lines rather than from fixed fonts. In this case, the application performs the drawing instead of placing a fixed font on the screen. Access to this text requires that character recognition be built into off-screen models.

What Else Is Needed?

To fully exploit the new technology, developers should make OSM libraries accessible to the public. Access to an OSM would allow screen-reader developers to tailor their systems to people with learning disabilities. As an example, a modified screen reader could say "file disposer" rather than "wastebasket" for the Macintosh GUI, an enhancement that would help learning-disabled people who have problems translating symbolic representations into meaning.

Other screen-reader companies will want to develop their own OSMs. Developing the hook code for AIX or PM is a very large undertaking. Therefore, GUI systems should provide hook facilities that allow applications to intercept the low-level graphics calls and construct their own OSMs.

Release of this new software and promulgation of the new laws will motivate computer companies to develop more accessible systems. But there is still much more to be done.

Sneak Preview

For the past year, I have been part of a project team whose goal is to convert IBM's Screen Reader for DOS to Screen Reader OS/2 and PM. In particular, I've been involved in developing PM's OSM.

Commenting on the destiny of Screen Reader/PM, IBM's Jim Thatcher, research staff member and project manager, says, "Currently, Screen Reader for PM is an IBM Research Division prototype being used on the job by more than 40 people in IBM and other companies. It hasn't yet been determined whether or not it will become a product. However, we are demonstrating it at major conferences, including The World Congress on Technology in Washington, D.C., this month, and it is entered in the Johns Hopkins National Search for Computing to Assist Persons with Disabilities." (See the text box "Chaotic Progress" on page 126.)

IBM's Screen Reader/PM is the first fully functional SRD for a GUI. It is fully programmable. Project team members have completely rewritten the profile access language to accommodate PM and OS/2 multitasking constructs. Screen Reader/PM automatically switches profiles as the blind user switches between applications, either on the PM GUI or in full-screen sessions.

The group is also porting Screen Reader/PM to AIX and X. Screen Reader/AIX is to be the first GUI screen reader for a Unix-based system. With this software, the blind user will also be able to work with Motif. Development of Screen Reader/AIX marks the beginning of a portable OSM between two large multitasking operating systems.

Berkeley Systems is rewriting OutSpoken for Windows 3.0 and developing a portable OSM called the GUI Access Toolkit. This toolkit will make it possible for third-party developers to create and market new access software for Windows and the Macintosh without having to develop their own OSMs.

These efforts forecast a new era of independence for the visually impaired community. For the first time, blind and visually impaired people will be able to work with multitasking systems. They will be able to perform tasks such as formatting a disk and running a spreadsheet calculation while they are logged onto a mainframe and listening to the daily announcements in a window.

With software like IBM's Screen Reader/AIX, blind people will be able to use workstations. This access will open many new jobs now unattainable by visually impaired people. ■

Richard S. Schwerdtfeger is an independent software consultant specializing in OS/2. He is working with the Screen Reader/PM development team at IBM's T. J. Watson Research Center in Yorktown Heights, New York. You can reach him on BIX as "rschwer."

Whither xBase?

The foremost applications development language for the microcomputer derives its vitality from aggressive competition

MARC SCHNAPP

The birth and growth of Ashton-Tate's dBase II typified the glory days of personal computer software publishing in the early 1980s. dBase II was the product of creative design thinking and astute marketing. There was no dBase I, but calling it dBase II lent a sense of maturity to the newborn package.

Wayne Ratliff, a developer at Jet Propulsion Laboratories, built dBase II as a programmable CP/M data management system intended to handle extracurricular office matters. It was the age of garage entrepreneurship.

Although xBase started as a monolith, it isn't one now. Many xBase products are available today, including the father of them all, the dBase series—originating from Ashton-Tate and now published by Borland. Others include FoxBase and FoxPro from Fox Software (Perrysburg, OH), xBase for Windows from Borland International (Scotts Valley, CA), Clipper from Nantucket (Los Angeles, CA), Arago Quicksilver and dBXL from Wordtech Systems (Orinda, CA), Force from Sophco (Boulder, CO), dBFast/Windows from Gensoft Development (Bellevue, WA), and Recital from Recital Corp. (Danvers, MA).

In August, Borland bought out Ashton-Tate. Borland was already developing a Windows xBase product; it will be interesting to see how it meshes both product lines. Marrying some of the best minds of the language business with powerful database tools could be a winning combination.

The Component Parts

The prime elements of xBase are the data model, the data file formats, and the applications development language. xBase products are not relational. The relational model yields sets of data that use the primary key as their means of access; classic xBase accesses data one record at a time. xBase includes nonprocedural query constructs to yield data sets—traditionally the least efficient means of yielding data. dBase II offered no built-in support for one-to-many relationships and limited user access to two tables at a time. Today's xBase implementations support one-to-many relationships, multiple parent-child relationships, and outer joins. But claims of relationality would seem to be more the result of entrepreneurial zeal than of reality.

Lacking the fundamentals of a relational architecture, xBase has never provided assurance of referential integrity. Should you remove a parent record (e.g., an invoice summary), xBase has no means of automatically cascading the deletions to child records and updating the primary keys for those child tables. dBase IV acknowledges the problem by making multiple-table views read-only.

Referential integrity protections for xBase must be implemented programmatically. With the anticipated market growth of database servers, the solution will undoubtedly appear at the back end.

Probably the most enduring file format of DOS is xBase's DBF. It consists of a binary file header followed by fixed-length ASCII field data. The header holds the total record count, update date, field names and sizes, and data types.

However, xBase's greatest strength lies in its applications development language. It has evolved significantly over time and offers sufficient depth to avoid deficiencies in the data model.

The xBase Language

The xBase applications development language inherits most of the field data types that the databases support.

continued

BYTE ACTION SUMMARY

Fathered by Ashton-Tate's dBase II, xBase is a generic term for dBase-inspired products. Defining that term is another story. Some features are shared by all comers, but many are specific to individual implementations, and the permutations and combinations of features are as varied as the product names.

- *Character* contains alphanumeric data. dBase IV allows up to 1-KB strings.
- *Numeric* holds up to 19 bytes, including positions for the sign and decimal point.
- *Logical* is for Boolean values.
- *Date* is stored internally as an 8-byte string, YYYYMMDD. Date fields and variables can be used in calculations.
- *Memo* is a variable-length field. A 10-byte pointer containing the location of the memo record in an associated memo file is stored in the DBF (e.g., if CUSTOMER.DBF is created with a memo field, xBase creates an associated file for the contents of the memo). dBase III, III Plus, Clipper, Arago, and FoxBase Plus memo files use the DBT extension, while FoxPro uses its own FPT format. Although Clipper has no memory-variable data type corresponding to memo, its string-variable maximums of 64K bytes provide an adequate vessel for memo data.
- *Float* is a numeric field. It is actually an Ashton-Tate compatibility measure intended to retain the floating-point math of dBase III Plus. Numeric fields (and numeric-type memory variables) in dBase IV use binary-coded decimal. Arago supports float fields but uses floating-point math for float and numeric field types. Clipper has not adopted float.
- *Picture* is fully implemented in FoxBase+/Mac and dBFast/Windows. FoxPro shows a picture field, but it's not yet available to users.

Most xBase products support multidimensional arrays. Clipper 5.0 has the most intriguing array implementation, permitting array elements to point to other arrays. Clipper leads with array-handling functions, with FoxPro 2.0 in close pursuit.

Variable and field names in xBase are up to 10 characters long and must begin with an alphabetic character. The symbols may include digits and underscores. Owing to dBase's interpretive looseness, you must not use keywords as field or variable names. Arago supports symbol names of up to 32 characters. The xBase language is insensitive to case in symbol names.

xBase includes branching logic, procedural commands, and a standard library of functions. Under dBase II, xBase was a command-driven language augmented by hard-coded conversion and system functions. Because a high proportion of dBase users worked interactively at the dot prompt, the language also had its share of nonprocedural commands. Among other tasks, these commands can print fields and delete records.

The language comes with a primitive set of control structures: DO...WHILE, IF...THEN...ELSE, and DO...CASE...OTHERWISE. Unlike C and Pascal, xBase CASE statements test for independent conditions, not varying instances of a single variable. As soon as xBase encounters a valid condition, it executes the code within the CASE statement and then drops completely out of the block. Clipper, FoxPro, and Arago implement variants on the classic FOR loop.

The xBase language also contains several variable-scoping directives. A *public* variable is globally available anywhere in the application. A *private* variable is not visible to modules above the one that declares a variable, but it is available to lower-level routines. Clipper 5.0 adds two notable lexically scoped variables. A *local* variable is visible only within the module in which it's created. It expires when that module is no longer executing. And a *static* variable is visible only within the module in which it's created. Its current value is maintained when the module is no longer active.

dBase II was an interpreter. With the notable exception of Force, xBase language conventions still bear the marks of interactive features: loose typing and macros. Unlike languages designed for compilation, xBase supports variable typing by

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XBASE PLATFORMS

The companies shown provide xBase products for the platforms listed.

Platform	Company
DOS	Borland (Ashton-Tate), Fox, Nantucket, Wordtech, Sophco
Windows	Gensoft, Borland[1], Fox[1], Nantucket[1]
Macintosh	Ashton-Tate, Fox
Unix, Xenix	Borland (Ashton-Tate), Recital, Wordtech, The Santa Cruz Operation (FoxBase)
VAX/VMS	Borland (Ashton-Tate), Recital
MVS	Computer Associates[2]

[1] Announced but not shipping.
[2] Announced in 1989 but prospects unknown.

context. Unlike BASIC, the xBase language needs no suffixes to signal the data type. Some people consider this flexible, while others see it as disastrous. It's entirely possible to step all over yourself by changing data types on the fly. xBase won't complain unless you stir up a data type mismatch.

A popular aspect of the xBase language has been its macro-expansion capability. By first assigning a string to a variable, the xBase run-time interpreter could be forced to expand the string's contents. Before Clipper, macros were used for array simulation. In addition, xBase is modular and includes the ability to pass parameters. It can also create larger files with discrete modules (identified by the PROCEDURE identifier). User-defined functions are available to return values to calling routines. UDFs are especially useful when placed in line with nonprocedural xBase code. The result looks clean and upholds the tenets of structured programming.

xBase's language is weak on querying and strong on application building. xBase has not been immune to the siren song of Structured Query Language, but there has been an edgy relationship between the two. With the release of FoxPro 2.0 in mid-1991, SQL is no longer a flash in the pan. The underlying FoxPro database engine is speedy, and Fox Software added its Rushmore technology, which is a bit-mapped indexing technology that facilitates common query types. To effect multi-table queries subject to Rushmore optimization, developers must use SQL. It's not that FoxPro banishes xBase code—it's that xBase code doesn't resolve to set logic.

Borland's entry with a Windows product for xBase developers will leverage the company's SQL requester technology. As Borland assimilates Ashton-Tate, a cleaner, faster dBase IV should emerge. Borland also acquires the Interbase server technology; it, too, provides SQL connectivity.

A vital characteristic of xBase has been the active market of third-party products—a result of the large user base. Documentation tools, report makers, code generators, and even file-repair utilities are broadly available. xBase has been too formidable a market force to stand still—it's sprouting up on multiple hardware and operating-system platforms (see the table).

As the market has fragmented, with language dialects becoming increasingly distinctive, publishers of DBMSes are

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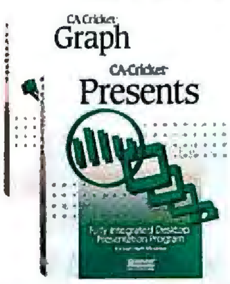

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releasing products of broader scope. dBase IV, FoxPro, and Arago include code generators. The third-party market is likely to shrink as a result.

The Evolution of xBase

Nantucket has played the leading role in improving the xBase language. Clipper introduced arrays, control structures, variable scoping, flexible multiple-table links, and the VALID clause—a means of testing data integrity at the field level.

While xBase has supported mixed-language development of sorts from the start (dBase II permitted PEEKs and POKEs), Ashton-Tate's implementations required run-time loading of separate binary files. Coupling and error handling are awkward. Clipper, on the other hand, offers a well-defined interface for C and assembly language modules. You can pass parameters to and from these non-xBase modules.

While Nantucket has been a responsible party in the fragmentation of the xBase language, the inclusion of a preprocessor also gives Clipper a tool to make it the Great Conciliator. It not only adopts the `#define` constants and conditional compilation features that C programmers take for granted, but it also adds constructs for creating custom commands.

Borland promises to accelerate the pace of innovation. It will bring object-oriented language extensions to xBase as it has to Pascal. Attaching a method to a Windows push button is only one step away from today's xBase PROCEDURE.

With Borland in the xBase world, multiple-language support will take on added meaning. Using Borland C++ or Turbo Pascal for Windows, you can create specialized dynamic link libraries that xBase for Windows can use.

Borland offers a preprocessor that draws on the company's C compiler experience. Using a subset of standard C called Tiny C, you can insert #c and #cend directives in xBase code. Tiny C supports `type` and `typedef` declarations, C expressions, prefix and postfix operators, and bitwise operations.

Current Directions

xBase derives its vitality from aggressive competition. It's also the victim of that same force. When Ashton-Tate was slow to enhance dBase, entrepreneurs on the periphery began to leapfrog the market leader.

FoxBase Plus appealed to those who sought a faster, better dBase. The earliest Clipper customers wanted to be able to compile their dBase III Plus applications and bypass paying royalties to Ashton-Tate. It was fairly simple to port an application you had previously written using dBase III Plus. And perhaps you'd be tempted to use a few of the enhancements found in your newly adopted product.

The transition is not so smooth nowadays. Unlike COBOL or C, there's no arbiter for xBase language standards. An abortive effort to establish such a standards committee crumbled under hints of legal action from Ashton-Tate. The company had traditionally claimed the language as its own and viewed a standards effort as an incursion into its intellectual property. Thus, *xBase* is a simply generic term that describes the realm of dBase and dBase-inspired products.

Competitive tactics work effectively to set up exit barriers for those contemplating adopting a different xBase product. Once when Ashton-Tate released a product, its competitors responded with a new baseline. That resulted in a de facto standard. Nantucket would introduce a valuable new feature, and Fox was likely to acknowledge that same construct. No longer.

The struggle for xBase has been to keep pace with the slicker look of today's popular software packages. Wordtech opened the battle with a set of character-based windowing commands.

continued

Easy Access

With the rapid acceptance of GUIs on a variety of platforms, more flexible, less hierarchical interfaces are becoming the rule rather than the exception. This trend is gradually emerging in the xBase world with character-based versions of GUIs. Vendors of products like dBase, FoxPro, Clipper, dBXL, and Quicksilver are noting the schism between the polished look of commercial windowing programs and the prosaic xBase language applications.

Systems Application Architecture is IBM's plan to bridge the company's assortment of CPUs and operating systems and to unify applications across the IBM spectrum. IBM specifies four components for SAA.

The Common Programming Interface portion prescribes the languages (C, COBOL, and FORTRAN) that IBM will support across platforms. The Common Communications Support component proposes methods of transferring information among machines. The Common Applications section, if implemented, will be available on various CPUs. And then there's the Common User Access (CUA) component.

CUA is the one component of SAA that has already put down roots. The goal is to replace a wide variety of software interfaces with some guidelines for consistency. IBM's OS/2 development partnership with Microsoft has paid off at least with visibility for CUA.

Although Presentation Manager delivered the first CUA-compliant operating system, many people feel that OS/2 is not yet ready for prime time. However, Windows 3.0 offers a virtually identical interface. As a result, CUA is winning an enormous user base.

Once you master a CUA application, it takes less effort to learn each subsequent package. IBM offers three reasons why CUA results in enhanced productivity. Physical consistency means coordinated hardware design across product lines; semantic consistency means that you can reasonably expect certain sequences and actions to cause certain results; and semantic consistency also provides known elements, each with its own meaning and purpose.

For example, in CUA-compliant interfaces, pressing a push button invokes direct action, while checking a check box indicates that you're selecting a feature. CUA advocates a paradigm shift—designing an object-action strategy for the user interface. Applications permit you to focus on the data, giving you the feel of directly manipulating information as you create the final product.

CUA always places its information on panels. Each panel constitutes discrete frames of related information. Word processing packages with their many text-styling options use these panel dialog boxes to great effect.

Database applications benefit, particularly in the design of ad hoc queries. Through the common interface, the application can present you with all the data elements, operators, values, and Boolean operators you might need to use. While traditional xBase code dictated multiple passes through menus, CUA designs require fewer passes, thus promoting a flatter access system.

CUA objects map neatly to data selection. Selection fields, with their ability to display scrolling lists from arrays or data files, enable you to identify valid options quickly, promoting table-driven designs. Check boxes offer a vivid metaphor for Boolean values, and choice fields quickly present all the finite values for a data-entry field. With a solid applications development language and a highly usable front end, database applications using CUA-compliant interfaces will bring greater productivity to both users and developers.

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dBase IV validated the concept while establishing the language standard (one that Wordtech's Arago adopts faithfully). FoxPro amplifies on the theme, adding full-fledged mouse support and user-sizable windows.

Nonprocedural interactive tools become more significant than language features. Both FoxPro 2.0 and Borland's forthcoming Windows product make major inroads into applications design and development. FoxPro offers screen painter and report facilities. dBase for Windows includes graphical approaches leveraging Borland's object-oriented R&D. Arago Quicksilver and dBXL offer character-based implementations of the Common User Access interface paradigm (see the text box "Easy Access" above).

xBase could benefit significantly from an active data dictionary, ensuring that every application accessing the data would play by the same rules. Field-level picture masks, validation, prompts, error messages, help text, and labeling information could simplify screen design immeasurably. The ability to identify primary and foreign keys and the relationships between tables could lead to referential-integrity features. Recital and Emerald Bay offer such features, but other, more well-known xBase products need them badly.

A Giant Leap for xBase

xBase has become a polyglot product category. As the foremost development language for the microcomputer, its prestige is substantial. It straddles two eras: that of the TTY device with primitive command languages and that of the graphical environment with object-oriented programming techniques.

Can xBase make the leap into the twenty-first century? So far, it has shown impressive progress. The release of FoxPro 2.0 and the entry of Borland into the xBase market are promising signs of what's to come. And Borland's buyout of Ashton-Tate offers interesting possibilities. "For many years, we have maintained that command sets as functional items should be promoted as open standards, and our commitment is to make the dBase commands an open standard for the benefit of all software users," says Borland CEO Philippe Kahn. xBase has demonstrated resilience in its first decade. Perhaps a standard language core may usher it through the next 10 years. ■

Marc Schnapp is the founding president of the Professional Association of Database Developers. He is a technical communications specialist and an xBase applications developer and trainer. He can be reached on BIX c/o "editors."

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FEATURE

CLASSIC LANGUAGES, PART 4

APL

Despite its unique symbols and narrow focus, this language is still finding new applications

DORIS APPLEBY

APL, an acronym for "A Programming Language," suggests simplicity itself. It was intended to capture the ideas and notations of mathematics where *simple* connotes elegance and parsimony of detail. To those who are comfortable with APL's symbols and methods, the language is a joy to use. My introduction to it occurred during a stay at Yale as a visiting fellow in statistics from 1980 to 1981. Francis Anscombe was developing interactive techniques for conducting exploratory data analysis, and we all got to try out his APL programs and devise our own.

What a difference from the FORTRAN, PL/I, and BASIC we knew at the time! I could define a 3-by-3 matrix MAT with

```
MAT ← 3 3 ρ 4 6 0 3 2 2 1 3 4
```

The system returned

```
4 6 0
3 2 2
1 3 4
```

I found its inverse with

```
⌹MAT
```

returning the matrix shown in listing 1.

What's more, a regression line computed by the least-squares method could be determined with the single line of APL code

```
Y⌹X∘.* 0 1
```

where X and Y are vectors containing the *x* and *y* coordinates of a set of observations. If you had the right printer (and Yale did), you could print out the data points using equally terse APL code. And it was all interactive: no pink punch cards containing Job Control Language and blue ones with the program followed by white data cards. With APL, a computer suddenly became a miraculous assistant for exploring experimental data and building statistical models.

Programming in APL is the process of creating new functions, denoted by names. APL has a special character for doing this, ∇. If you want to define a function REG(X,Y) to compute the slope and *y*-intercept for a linear regression line, you write

```
∇R←X REG Y
[1] R←Y⌹X∘.* 0 1
[2] ∇
```

and call it for any two vectors X and Y of equal size with

```
X REG Y
```

A pair of values will be returned. Any data type can be returned by a function or be the value of any variable. APL is truly typeless, and any data is first class whether it is a number, character, string, vector, or matrix. But this programming flexibility is also the source of a problem in using APL: Since the type of each variable is determined dynamically (at run time rather than at compile time), APL has traditionally been an interpreted language. Thus, APL run-time speeds cannot compare with those of compiled code. Some implementers claim that the speed of numerically intensive programs may be enhanced dramatically by the use of a math coprocessor.

A deterrent to APL's popularity has been the special character set

BYTE ACTION SUMMARY

If you want to do complex mathematical operations in just a few keystrokes, the APL language is well suited to your needs, but it will require a modified keyboard. Nonetheless, APL is used by specialists throughout the world.

Listing 1: *The inverse of the matrix generated by* `MAT ← 3 3 ρ 4 6 0 3 2 2 1 3 4`. *The APL syntax for the inverse is simply* `⌹MAT`.

```
¯0.03846153846 0.4615384615 ¯0.2307692308
 0.1923076923 ¯0.3076923077 0.1538461538
¯0.1346153846 0.1153846154 0.1923076923
```

used to symbolize APL's functions. Formerly, a character ROM was required to produce these characters, but now all APL interpreters use software to generate them on any PC graphics display. Special keyboard layouts and sets of key decals are supplied with interpreters. When you write APL code, you make maximum use of its symbols. Many symbols represent monadic as well as dyadic functions (e.g., !3 is 3-factorial, while 3!2 returns the number of combinations of three things taken two at a time).

Other functions are built from any functions *f* and *g*, using three functional forms: *f*/ (reduction), ∘.*f* (outer product), and *f*.*g* (inner product). For example, `+/ 1 2 3 4` returns the sum `10`. Before leaving reduction, consider `-/ 1 2 3 4`, which returns `¯2`. This is because APL has two rules: The right argument of any function is the value of any expression following it, and the right-most function or specification that can be performed is performed first. The APL operator `-/` distributes the minus sign between each of the numbers following it. Thus, `-/ 1 2 3 4` is `1-2-3-4`. The first rule implies that each – extends over all the numbers to its right, and the second rule indicates that you evaluate from right to left. Thus, `-/ 1 2 3 4` represents `1-(2-(3-4))`, or `¯2`.

Early History

APL was designed by K. E. Iverson in the late 1950s, with *A Programming Language* (New York: John Wiley & Sons) appearing in 1962—the same year A. D. Falkoff published "Algorithms for Parallel Search Memories" (*Journal of the ACM*, vol. 9, p. 488). The *APL/360 User's Manual* (IBM Document GH20-0683-1), written by both Iverson and Falkoff, was not available until 1970. APL was conceived not as a language for programming computers but as a necessary tool for writing clear, unambiguous mathematical notation, which proved useful as a tool for writing clearly about data processing. APL's first major use was in describing the IBM/360 system.

Iverson used it throughout the 1960s in various university and high school courses, publishing an elementary functions text in APL in 1966. Although early work stressed communication between people, a fully implemented time-sharing system featuring special APL keyboards became available outside IBM in 1968.

During an APL session, three processors are active simultaneously: the one that executes the program, the system that manages libraries and the environment, and the user. APL includes a group of I-beam functions that link the first two; system commands link the last two; and two system functions, `[QUAD]` and `[QUOTE-QUAD]`, provide an interface between the user and APL itself. (Note: Some APL versions use different system functions.)

The first computer languages were machine languages, adhering to a computer's architecture more than to basic mathematical notions. High-level languages were then developed to translate machine instructions into more familiar algebraic notation. APL began with no deference to machine architecture and, in fact, existed as a paper-and-pencil language for about eight years before being implemented for computers. It is close to traditional mathematical and scientific usage. This, however, is another disadvantage APL suffers. Because many of its characters are not standard mathematical symbols, it is not widely accepted by the mathematics community, yet it is too mathematical for programmers who are accustomed to COBOL and FORTRAN.

An advantage of deferred implementation was that revisions could be and were easily made. According to Falkoff and Iverson, the guiding principles—in addition to simplicity—were practicality, uniformity (few and simple rules), generality (few general functions that could be combined to produce others), familiarity (conventional scientific notation), and brevity. Moreover, because no more than five people controlled APL's design, these principles were monitored and enforced during design and implementation. Among APL's advantages is ease of learning, resulting in a sense of programmer confidence. A good understanding of the language leads to extremely fast development of programs, which are frequently quite short. For example, a problem that required 19 lines of BASIC used only four lines in APL, while another showed one statement of APL replacing pages of BASIC (see "A Weaving Simulator," September 1982 BYTE).

An innovative device of APL is the *workspace*. During an APL session, all variable names and values and all defined functions are kept in a user's private memory, or workspace. This workspace can be named and saved using `)SAVE` *`spacename`* and recovered with `)LOAD` *`spacename`*. Thus, functions and data can be bundled together and one or more workspaces incorporated into another APL application.

In 1981, APL suffered a blow when IBM extended ASCII code from 128 to 256 characters. The new characters included foreign letters and graphics symbols but excluded 21 of APL's 34 special characters.

APL Today

So, just what is APL, and what is it used for? Falkoff states that it is a "tool to help people do what they want to do." It's a tool of thought for analysis and experimentation; it's a production tool for designing systems and prototypes as well as running applications; and it's a recreational tool for people who "get a kick out of thinking."

Although APL was originally thought of as a mathematical, array-oriented, nonprocedural language, its uses now are more in the commercial world of financial analysts, actuaries, scientists, and engineers. It is especially good for developing new products, making forecasts, doing simulations, and prototyping certain applications. It is not used, however, for high-volume transaction processing, where COBOL reigns supreme. STSC, a leading publisher of APL, claims that its APL*PLUS is used at 70 percent of the Fortune 100 U.S. companies, as well as in organizations like The Los Angeles Times that need to analyze large amounts of data quickly.

Among other applications, IBM's APL2 and APL2/PC are being used to implement logic-based AI systems and to write compilers and controllers for I/O devices, instruments, and tools. APL*PLUS and MultiAPL's APL.68000 have been used to develop "APL for Music," which includes computer-assisted music instruction, MIDI score editing, music theory, and analysis.

The acceptance of APL spans a broad spectrum of users. Even though it is a standardized language, it has never reached the status of heavily used languages like FORTRAN, COBOL, BASIC, and even Lisp.

A standard for APL was approved by the ISO in 1987 after a seven-year effort. This was unusual in that the standardization route ordinarily goes through the U.S. (ANSI) or British (BSI) institute first, with final approval granted by the international organization. The committee is now working on an Extended APL Standard that will include nested and heterogeneous arrays with both numeric and character elements.

continued

The standard is a formal model of an APL machine. An implementation conforming to this standard is a combination of computer hardware and software that processes APL code.

One such system appeared in Japan in 1984. It was a 6-pound laptop supporting both multiple users and multitasking and selling for $1450. Other systems are IBM's APL2 for the IBM 370 and its APL2/PC for the PS/2 Model 70, STSC's APL*PLUS II for the 386 machine, and Spencer's MultiAPL for the Motorola 680x0 microprocessor. Similarly, APL*PLUS is available on Unix RISC workstations such as the SPARC workstations and the IBM RISC System/6000. Dyalog APL has been around European Unix markets since 1982 and has recently become available in the U.S. for 386 machines. It reportedly combines the best features of other interpreters and adds new functions and operators. New APL interpreters make external C routines easily available.

Non-APL programs associated with APL are called Auxiliary Processors. For example, APL2/PC is packaged with several APs. One provides a FORTRAN link, another drives music programs, and another implements logic programming. There are presently dozens of APs, and some users are creating their own. Interfaces to Structured Query Language, DOS commands, graphics, database managers, and networks are also available in some products.

I.P. Sharp of Toronto, Canada, and STSC have shifted APL from the scientific to the commercial world, primarily through the addition of an integrated file system as well as powerful formatting and error-trapping facilities. To avoid the need for special characters, STSC provides alternative mnemonic functions. The J language, developed by Iverson and Roger Hui under the Iverson Software name, has among its features the use of ASCII characters. For example, `⍳5`, which returns `1 2 3 4 5`, is written as `i.5` in J.

Future Trends

As shown in the text box "APL in Parallel" below, APL programs contain implicit data parallelism. This is being exploited at IBM by Wai-Mee Ching and Dz-Ching Ju for the RP3 64-way

APL in Parallel

APL code can be greatly sped up by taking advantage of the parallelism that is inherent in many array operations. The two APL functions shown in listings A and B at the right appeared in a letter to BYTE entitled "APL Fibonacci" (see February 1988 BYTE, page 24). The function in listing A, FIBC, is a conventional implementation of the Fibonacci benchmark program, generating the first 24 elements of the Fibonacci sequence 100 times. (The Fibonacci sequence is (1 1 2 3 5 8 . . .), where each successive element can be found by adding the previous two.)

Listing A: *The APL for the function FIBC, which uses the standard algorithm for generating a Fibonacci series.*

```
 ∇ FIBC;CTR
[1] CTR←1
   ⍝ SET ITERATIONS COUNTER (CTR) TO 1
[2] L1:SEQ←1
   ⍝ SET INITIAL SEQUENCE (SEQ) TO 1
[3] L2:SEQ←SEQ, +/¯2↑SEQ
   ⍝ ADD LAST TWO VALUES OF SEQ, CATENATE TO SEQ
[4] →(24>⍴SEQ)/L2
   ⍝ CHECK TO SEE IF 24 NUMBERS HAVE BEEN DONE
[5] →(100>CTR←CTR+1)/L1
   ⍝ CHECK TO SEE IF 100 ITERATIONS HAVE BEEN DONE
 ∇
```

The function in listing B, FIBA, is more typical of APL style, generating 100 rows of 24 numbers simultaneously. FIBA ran 10 times faster than FIBC, comparing favorably with comparable compiled C code.

Listing B: *The APL for the function FIBA, which generates the Fibonacci series using an algorithm that takes advantage of the parallelism of APL. This function runs 10 times faster than FIBC.*

```
 ∇ FIBA
[1] SEQ← 100 1 ⍴ 1
   ⍝ SET INITIAL SEQUENCE (SEQ) TO 100 ROWS OF 1
[2] L2:SEQ←SEQ, +/100 ¯2 ↑SEQ
   ⍝ ADD LAST 2 VALUES OF SEQ, CATENATE TO SEQ
[3] →(24>¯1↑⍴SEQ)/L2
   ⍝ CHECK TO SEE IF 24 COLUMNS HAVE BEEN DONE
 ∇
```

The following is a line-by-line explanation of the FIBA code:

[1] 100 1 ⍴1 creates 100 unit vectors (⍴1), each containing a 1.

[2] L2: is a label. Evaluating from right to left, you take the last two elements of SEQ (¯2 ↑SEQ) and add them across all 100 rows, (+/100) catenating (,) the result onto SEQ. At first, each row does not have two elements, so APL appends a 0; that is, each row becomes (1 0) instead of (1). The original SEQ is replaced by the result (SEQ←<result>).

[3] Control branches to L2 (→) if the second coordinate of SEQ (¯1↑⍴SEQ) contains less than 24 columns. Otherwise, the program is terminated.

Deciphering the FIBC code is left as an exercise.

multiple instruction/multiple data (MIMD) machine, running the Mach operating system. Since RP3 uses a different architecture than platforms on which APL is implemented, the route is from APL to compiled C to RP3 code. Not all APL functions can be compiled, but the APL/C compiler includes enough to still be considered APL. Still other work is in progress at Morgan Stanley, a New York–based investment bank, which has developed super-high-performance APL interpreters on workstations.

Robert Brown, currently with Merrill Lynch, stated in 1989 that if APL implementers remain complacent, forces active in data processing might cause the retirement of APL as large companies standardize the work environment. "An overriding need for fast, workable solutions to problems remains a key asset of APL. Prototype-oriented users, armed with high-end PCs and workstations, are forming a new niche for APL. Vendors that have moved into this area have done well." Indeed, others believe that the trend toward distributed departmental computing will encourage the use of APL on high-performance workstations.

APL is much less used in education than it was in the 1960s and 1970s, although it still has ardent advocates. The extra equipment investment and lack of marketplace demand for APL programmers have discouraged most high schools and colleges from teaching APL or using it to develop mathematical ideas. However, a recent APL conference was more heavily attended by college faculty members than any in the last five years. Another development is the availability of a "shareware" APL interpreter, called I-APL (for international APL), designed for instructional use on many machines used in U.S. and European schools.

Even though IBM has done a feasibility study on generating a "portable" workstation APL2 with full code compatibility between the 370 family, the Intel microprocessor family, and the ROMP microprocessor used in the IBM RT PC computer, and even though it has encouraged research on an APL/C compiler for the shared-memory MIMD RP3 machine, APL is not included on its Systems Application Architecture list. SAA applications run on the VM, MVS, OS/2, and AS/400 architectures.

Lynne Shaw, chairperson of ACM/SIGAPL, is excited about the universal appeal of APL in an increasingly interdependent global marketplace. "APL code is the same from one country to another. This international appeal improves communication between cooperating specialists. Our next conference, slated for St. Petersburg in Russia, has as its theme 'The Language in Common.' This emphasizes the use of APL around the world."

But there are those who believe that APL is a dying language, even though it still attracts a group of enthusiasts—diminishing according to some, stable according to others. Bill Grey of IBM's Watson Research Lab borrows a phrase and says, "The rumor of APL's demise has been greatly exaggerated." ■

Editor's note: *Thanks to STSC for supplying the APL font for typesetting this article.*

Doris Appleby writes about mathematics, computer science, and pedagogy. She is also the chairperson of mathematics/computer science/information systems at Marymount College in Tarrytown, New York, and the author of Programming Languages—Paradigm and Practice *(McGraw-Hill, 1991). You can reach her on BIX c/o "editors."*

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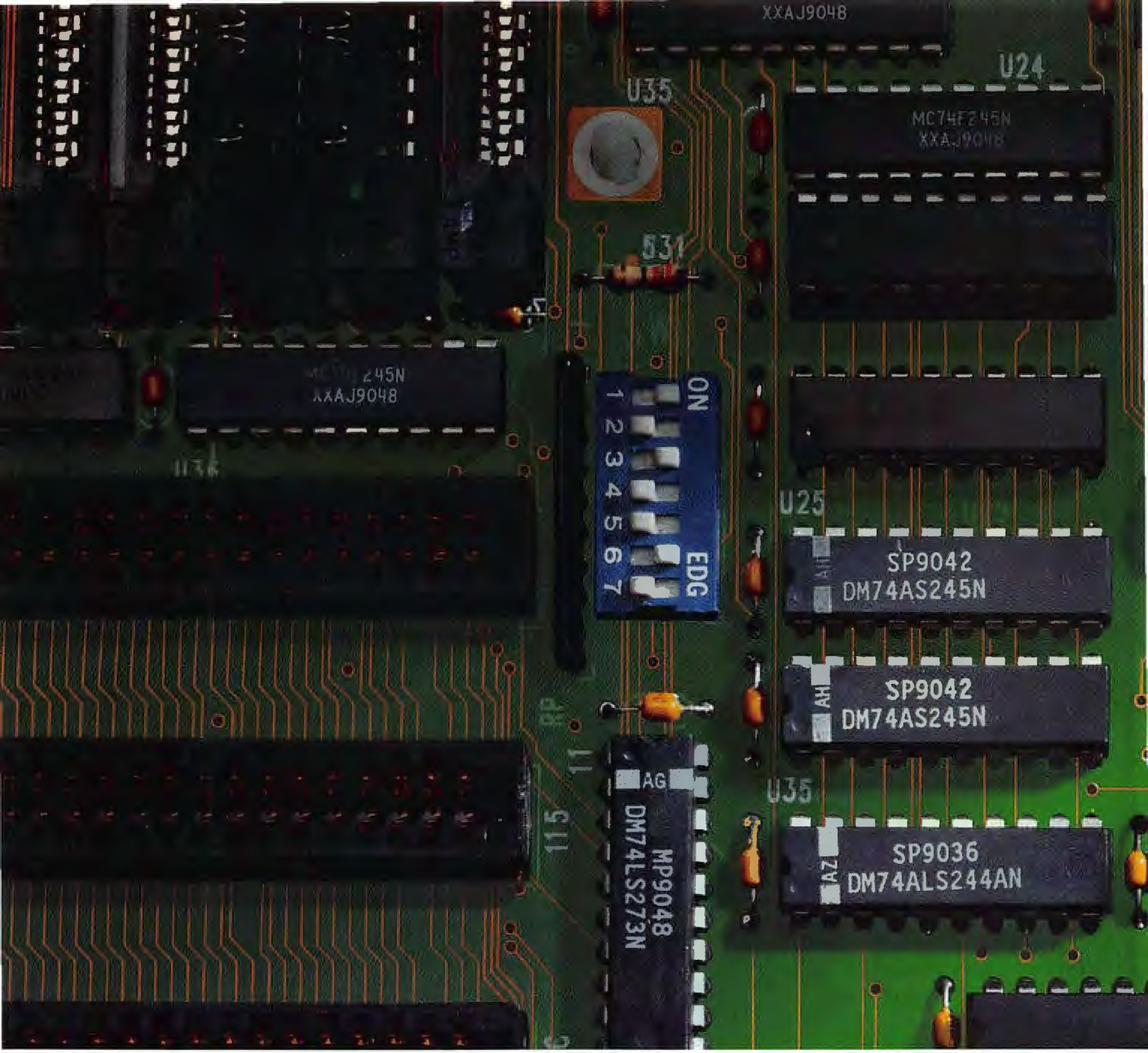

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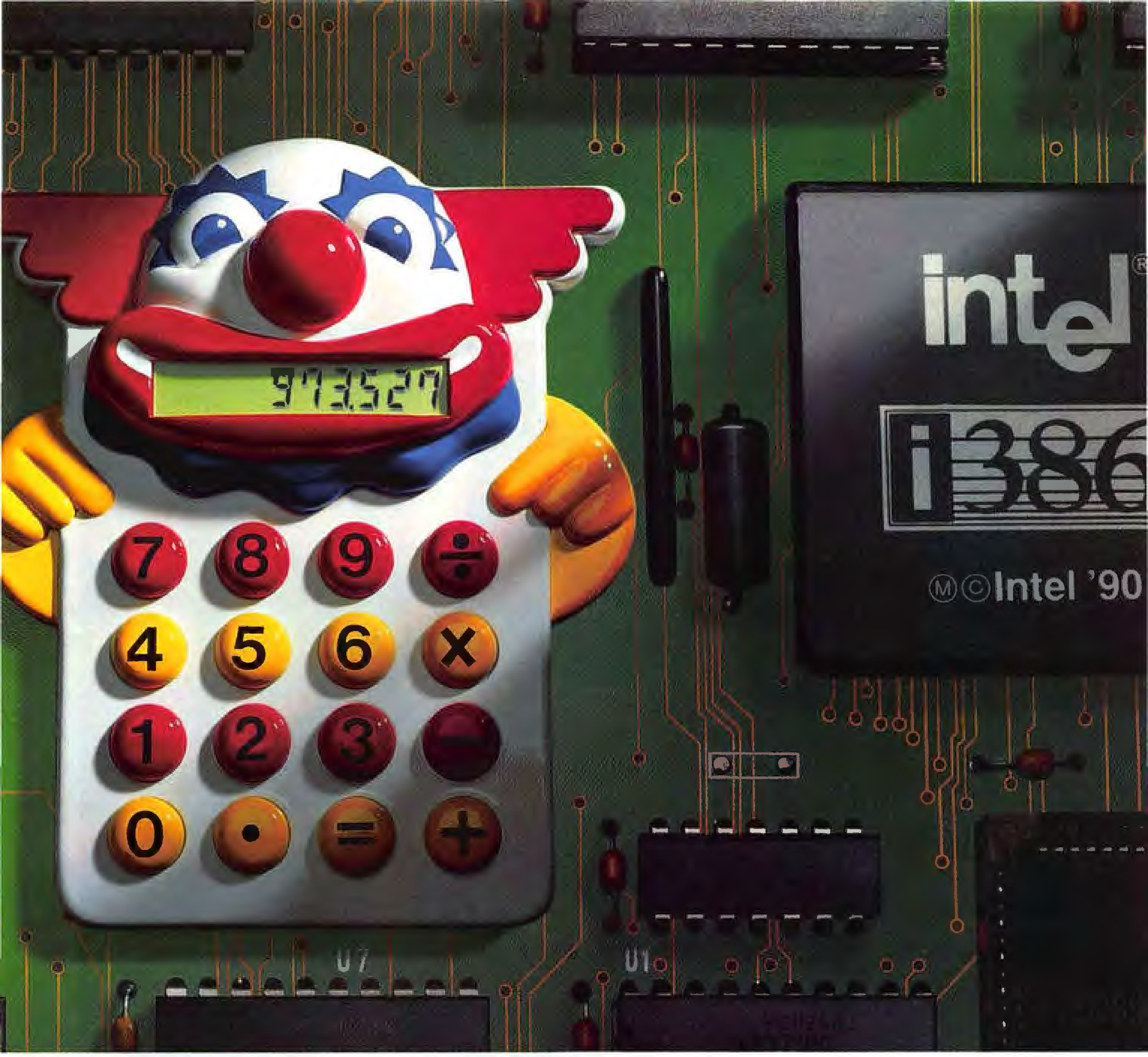

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MULTIMEDIA

SOLUTIONS ANTICIPATING A MARKET

Multimedia is widely proclaimed as the next revolution in computing, and rightly so. The potential effects of humanizing information are profound—so profound that the horizons of the discussion seem to recede with each new report. There's no question that someday multimedia will mean virtual reality, perhaps as convincing as the holodeck on TV's *Star Trek: The Next Generation* series.

The danger of dwelling on this vision of the distant future is that it distracts us from the more immediate and more important news. Desktop multimedia is about to cause a series of revolutions—not only in computing but in areas that computing has only lightly touched, if at all. Desktop multimedia is poised to deliver fundamental improvements in how we educate our kids, train our work force, and make our buying decisions. By the way, it's predicted that it will be the most popular human interface for our personal computers in a few years. Move over GUI, here comes "MMUI."

It's entirely appropriate that a future development of multimedia lives today on TV, because multimedia today *is* TV—TV combined with the personal computer. The idea of adding realistic images, full-motion video, and audio information to the personal computer's already potent array of graphics- and text-based presentation capabilities is exciting. But even more exciting is the new vision from leading developers of what desktop multimedia will be.

Although early development efforts were focused on the bare requirements of displaying a single video program on a computer's screen, the new vision is much broader. It supports the full spectrum of activities encompassed by multimedia program development: the digitizing, mixing, manipulating, and compressing of multiple channels of video and audio information. The new model for desktop multimedia, one that developers are now beginning to deliver, is nothing less than a full video-production studio.

In "Information's Human Dimension," Tom Yager, who oversees BYTE's Multimedia Lab, brings desktop multimedia into focus. He illustrates some of its uses in typical business presentations and introduces the concept of the desktop video-production studio. It's a concept you'll be hearing a lot of from now on.

But putting a production studio on the desktop requires that systems have a lot more computing power than is common now. It also means that applications developers must have a stable environment to work in.

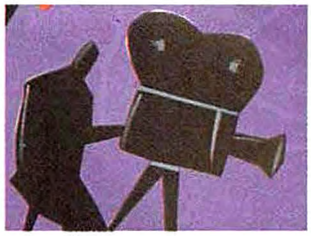
The massive infusion of specialized computing power required by real-time video processing is coming in the form of dedicated chips. In "Chips Deliver Multimedia," Yongmin Kim, a professor of electrical engineering at the University of Washington and director of its Image Computing Systems Laboratory, explores developments in multimedia processors.

The stable environment needed by multimedia applications and tool developers will be made possible by software and data standards. "Intel/IBM's Audio-Video Kernel" introduces an important advance toward the ability to run multimedia applications on multiple platforms. In the text box "IBM's Personal Multimedia System," BYTE news editor Andy Reinhardt provides a look at the way desktop systems are evolving to handle real-time video and sound. For a view of how digital multimedia will be processed by desktop systems, see the text box "Intel/IBM's New Multimedia Boards."

"Inside QuickTime," by BYTE consulting editor Peter Wayner, focuses on the multimedia extensions to System 7.0 that provide standard methods for Macs to handle video and sound data.

TV's worldwide popularity is our best indication of the persuasive power of the video medium. Let's hope that as this power comes to the computer community, we use it to better effect. Or is someone already planning our version of the sitcom?

—*John W. Donovan*
Senior Editor,
State of the Art/Features



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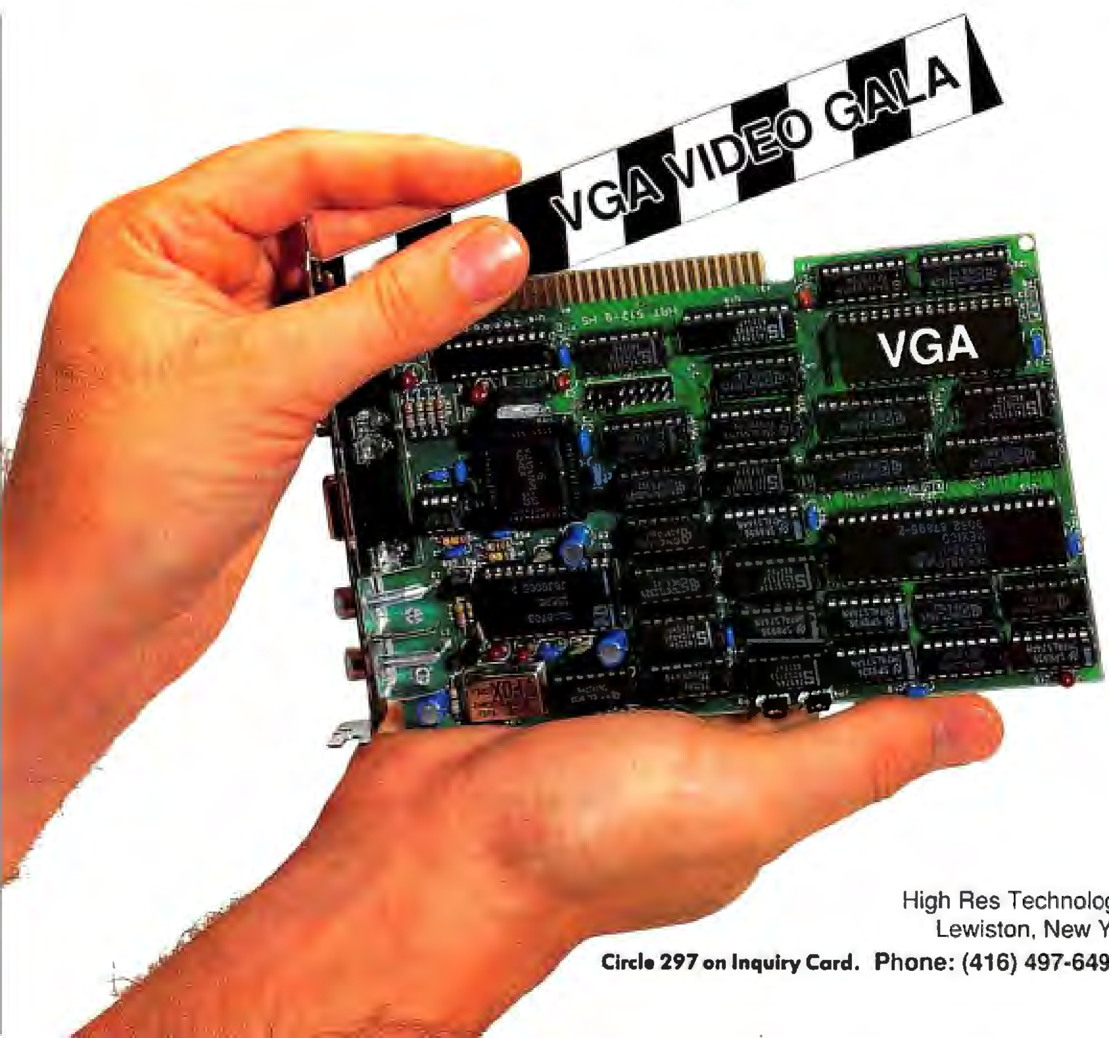

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INFORMATION'S HUMAN DIMENSION

Multimedia technologies can improve presentations today

TOM YAGER

Finding better ways to present information to others has occupied minds since humans began drawing pictures to augment spoken communications. Thousands of years before the advent of writing, humans relied on pictures and gestures to help others comprehend important information.

Although people have long sought ways to make better presentations, the definition of what *better* means has varied over the years. The current thinking is that *better* means a shorter path from a concept in one person's mind to comprehension of that concept in another person's mind.

The further hope is that if people can understand new concepts more quickly and thoroughly, their performance in intellectual tasks will improve. For anyone, better comprehension holds the promise of a richer fund of ideas and information. It is this fund that provides the raw materials on which the human mind—with its unique talents for associative reasoning, pattern discrimination, and intuition—performs its magic.

Prior methods of packaging information for improved presentation were limited by available media. Before the wide availability of computers, information was packaged in static forms, difficult or impossible to modify or update. As a result, economics forced presentations to serve the widest possible audience—a one-size-fits-all approach to information packaging. It simply wasn't practical to tailor a presentation to the unique needs of an individual.

The abilities of the computer to manipulate information and present it in a variety of forms has already begun to break

ILLUSTRATION JOHN NELSON © 1991

the monopoly of static media. Many universities and companies are focusing intense R&D efforts on finding ways to best develop these abilities, loosely gathered under the umbrella of multimedia.

However, the color, graphics, animation, and sound that are the visible manifestations of multimedia presentations are inherently exciting. They also provide much of multimedia's powerful human appeal. The degree of its appeal is clearly shown by the avid response of the general public to demonstrations of prototypes of multimedia technologies and applications.

Unfortunately, the nontechnical press has noticed and pursued the wide interest in multimedia, and they have covered multimedia with a fervor that is now threatening to strangle it. The nontechnical media's breathless enthusiasm for anything high-tech is clouding the status and potential benefits of multimedia, and that enthusiasm has led to tremendous confusion in the user community. Marketing departments have added to the confusion by using the term *multimedia* as a buzzword to describe everything from gadgets that let you watch TV on your computer's screen to graphical adventure games.

BYTE ACTION SUMMARY

Multimedia isn't as difficult to understand or use as some reports indicate. And developers have already created desktop solutions that can make today's routine presentations come alive.

Why Multimedia?

I'm often asked to define *multimedia*. I typically direct the questioner to look up the roots of the word. That is seldom necessary; it's easy to figure out the word's most obvious meaning. (The least complicated definition applies best to this infant set of technologies.) But is the ability to transfer information through more than one medium at a time any reason to invest in fledgling technologies?

Does anybody really need multimedia? Or, more important, do *you* need multimedia? For example, if you make formal presentations in business, you've probably been getting along nicely with flip charts, overhead transparencies, and attractively bound reports—why change now? The most compelling reason is that when you use older methods, chances are, most of your audience isn't absorbing as much information as they should, and some may not be paying attention.

The longer the presentation, the more people you'll lose. And the more information you present, the less the audience absorbs because you can't hold their interest. It's not your fault, and your audience isn't stupid or lazy; it has more to do with the way people are built. They see in color, focus on motion, and hear keenly. These are not incidental properties of the human machine. They are traits that originally kept us from being devoured, and they are now central to how we take in and process information.

Multimedia is, in part, about presenting information through more than one of the senses. Multisensory presentations speed and improve understanding, and they can hold an audience's attention.

The Power of Simple Ideas

Using technology to build a shorter and more efficient path to the brain isn't a new idea. Consider the case of a computer monitoring an assembly line. When it detects an error condition requiring immediate attention from an operator, the program could include a line in the message describing the condition on the log display, assuming the operator would be looking for such conditions. But most software designers know better than that. If you put spaces around the message, and perhaps asterisks on either end, it stands out from the rest of the log. That's a simple technique I call "spice"; it's just different enough from the ordinary to attract attention.

Put the error-message text in a different color—say, bright red—and you will really get their attention. That is the power of color: Our eyes are automatically drawn to objects that are a significantly different shade or hue than their backgrounds. Make that text blink, and you've added motion. Again, instinctively, we key in on motion, so the operator will probably get the message. But what if he's not looking toward the display at the time? That's easy: Make a sound that's different enough from the background noise to get him to look at the display. Apply a little creativity, and you can have a whole library of sounds, each one identifiable with a certain condition. Sound characteristics can be tailored to instantly instill anything from a mild diversion to outright panic. After a little training, an operator could judge from across the room the type and severity of the condition just from the sound generated to represent it.

The example I just related might seem far removed from what many consider true multimedia, but it's not. The operator's display—incorporating spice, color, motion, and sound—is, strictly speaking, a multimedia device. The objective is to get the operator's attention and to hold it long enough to make him understand the condition and formulate a response. Give that statement a bit of a twist, and it applies equally well to business and educational presentations: You want your audience to pay close attention long enough to understand the material.

The Gravel Factor

Somebody decided that if it tastes good it *can't* be good for you, and it stuck. To this day, some serious-minded people have trouble believing that information needs to be packaged. A room full of professionals, paid to attend a meeting, should be expected to digest facts however they are presented, or so common wisdom dictates. But the attention-getting potential of the visual aids used in most meetings make for the rough equivalent of serving gravel for dinner: You can pay your guests to sit at the table, but you can't make them eat. For all the understanding nods and muttered uh-huhs from your presentation's audience, you will be lucky if half of them are not mentally reviewing their stock portfolios or wondering if they left the iron on. That's bad enough when you're doing a progress report for your department, but that attention gap can kill you if you're trying to sell a product, win a contract, teach a new concept, or change people's minds.

Multimedia isn't about turning business and educational presentations into Oscar-winning material or spoon-feeding sugar-coated information to an audience of presumed dullards. It's about condensing a large amount of information and packaging it in a way that makes it more palatable and understandable.

Assuming you're interested enough in multimedia to look into applying it to your specific needs, a confusing array of choices lies ahead for you. Still or moving images, sound or no sound, video or not—there seem to be too many choices to make. It's a bit easier, though, if you take a brief look at some of the advantages offered by the various technologies contributing to computer-assisted presentations.

The type of solution you build, or have built for you, depends entirely on your priorities, the type of information being presented, and the type of presentation. Fortunately, one of the things you need to worry least about is your audience. While the material itself needs to be geared toward your audience's requirements, most forms of multimedia can be applied equally well for young and old, novice and veteran.

Hey, Big Spender

Too often, necessity drives us to make price the primary consideration. Multimedia technology, being fairly new to the general market, is still costly in some product categories. The least expensive class of multimedia products is directed toward building and presenting collections of still images to groups of people. It's the rough equivalent of the slide projector, but with several benefits.

First, these presentations come together very quickly with the high-quality tools available today. Data in its native form, such as spreadsheet and word processor files, can be massaged into colorful text and graphs and presented in minutes. Last-minute changes are not a problem: You can change the images or the order of the presentation on the fly, without waiting for slide processing or fumbling with rotary trays. The presentation is enhanced by rapid, random access to individual images, freedom from blurry or jammed slides, and printed output that guides you through the presentation. Replacing flip charts, slides, or overheads with computer-generated presentations certainly makes things run more smoothly. The presenter appears more in command of the material, and the audience won't be distracted by the click-clack of the projector or the fingerprints on your overheads.

The disadvantage of this simplest application of multimedia, and of multimedia in general, is that you must learn it. There are no tools that will build a presentation without your involvement, and this is one of the most common complaints. The more you want in your presentation, the more tools you must learn.

There is a merging process under way, and tools are appearing that combine the functions of several different multimedia programs in one box. But until these become the standard, producing multimedia presentations will require a combination of several tools. They're not hard to learn, but learning them is an investment of time that some people are not willing to make.

Start with Today's Technologies

A simple, ordered presentation of still images can be enhanced with the addition of captured video. Any live or taped video image can be frozen and stored on disk as a graphics file by various add-in cards, many of which are quite inexpensive. While digital cameras that store images directly on a medium compatible with computer input exist, a camcorder and a video capture board make for a less expensive, more versatile solution.

Computer-generated graphics are fine on their own, but digitized images add the impact of reality to a presentation. In addition to video input, some boards offer video output, making your computer's display signal compatible with the NTSC or PAL (European video) TV standards. In simple terms, with a video output board, you can use a regular TV (including the big ones on carts that most companies have rolling around these days) to show your presentation. You can also videotape your presentation so that it can be seen later by anyone with a VCR.

Even though inexpensive video input boards let you grab a snapshot of a moving image, the image won't be moving when you display it. There is no more sought-after, controversial multimedia capability than displaying moving images with a computer.

Full-Motion Video

The easiest method of adding full-motion video to a computer-based presentation is to have an external device generate the moving video, usually a videotape, laser disc, or live video. You pipe it into a special board that can display the video signal in a window on your system's monitor. This is easy, because the computer system hardly has to be involved. The board intercepts the video signal coming from your system's display card and sets aside some portion of the display area for the video window.

But the real power of video in a window comes when you give the computer some control over the external video device. For instance, a laser disc player is a random-access device. You can quickly find and display any segment of the recorded material under computer control. Software takes advantage of this and combines text and on-screen graphics with the video playback window to add commentary and other information that isn't part of the images recorded on the disk.

The ability to control the playback gives multimedia a powerful feeling of interaction that is only achieved when the presenter, or, more typically, the viewer, controls the path the presentation follows. That control might be asserted through a keyboard or mouse interface, via a touchscreen, or, indirectly, as part of a software-managed lesson plan.

External moving video, for its advantages, has some drawbacks. Laser discs are random-access devices, but the discs themselves are expensive to create. A new wrinkle has been added with the introduction of affordable computer-controllable VCRs. A videotape is much less expensive to produce than a laser disc, and the new class of VCR peripherals give the computer enough control to locate any segment of a program to within a second on a tape. Better units can seek as accurately as a laser disc player (to the individual frame), but not as quickly. Although videotape isn't suitable for applications that require fast random access, it fits perfectly into presentations that combine computer-generated material with the video, giving the VCR time between segments to seek to the next location.

The Digital Debate

For some, tape or disc is not the question. They believe that requiring an external device to supply moving video is the wrong approach. Having moving video processed by the computer and stored on a hard disk (and possibly transferred onto CD-ROM later for distribution) seems to make more sense. Random access

becomes *instant* access, and the ability to edit and rearrange the video material is enhanced by its existence in digital form. But as nice as it sounds, this approach has problems of its own that have yet to be solved: space and speed.

The smooth motion you're used to seeing on TV requires 30 distinct images per second. Each frame is built from an analog signal capable of representing an incredible range of colors. Unfortunately, both the rate of frames per second and the depth of color create serious problems for systems that turn video signals into digital data. Each frame of a typical video signal occupies well over a half megabyte on disk. Each second of digitized video occupies a minimum of 15 MB of storage. That's obviously unacceptable, not only because it limits the length of a disk-based video segment, but because it is impossible with current technology to move that much data from disk to display in a second. It's worse when you store the data on optical disk or CD-ROM, both of which offer excellent storage density but move data much more slowly than hard disks.

To solve these problems, proponents of disk-based digital video had to make some unavoidable compromises. By limiting the size of the image, reducing the frame rate, and trimming the number of colors, a single video frame can be reduced to less than 100 KB. That still adds up (1 MB or more per second), so various types of compression are then applied to bring the file size down even more. You wind up with an image that merely resembles the original. In the best case, you can barely tell the difference, but in the worst case, colors swim and movement is jerky. If you have the viewer sitting a reasonable distance away from a small image, the reduced quality isn't too much of a problem. On the other hand, if you're projecting the image onto a large surface, the shortcuts taken to squeeze the data become painfully apparent. Examined in detail, the images are too often fuzzy and jerky, degraded by compression and reduced frame rate.

While digital video technology certainly offers unique advantages, the cost is high. A common $4 VHS cassette can hold 2 hours of material with a visual quality that puts current digital video to shame. And comparing disk-based video to laser disc (or even Super VHS) output makes the digital version look even more sickly. That may change as technology advances, but while digital video developers scramble for ways to improve image quality and squeeze more data onto disk, costs are dropping for the computer-controllable VCRs and disc players. Recordable laser disc has entered the fray, too, lowering mastering and duplication costs for small quantities of disks.

But even given the severe limitations of current technologies, digital video has its place. It is very appropriate when used for short segments (like video annotation of spreadsheet data), for combination with other material on CD-ROM, and for other uses where image quality and heavy storage requirements aren't as important as rapid, easy access.

Desktop Video Production

All these solutions for combining computer-generated graphics with moving video are worthless unless you have the moving video in the first place. You can buy it, have it made for you, or make it yourself. The latter option has only recently become available to most of us, thanks mostly to a quiet revolution called desktop video. Until recently, only the

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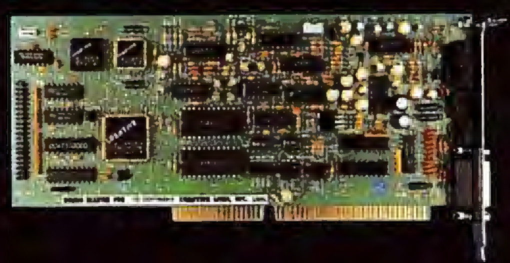

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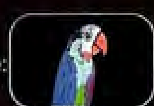

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well-heeled and daring built their own video-production facilities. Others were forced to pay hundreds of dollars per second of video (depending on the type of material) to production houses for even the simplest video pieces. Now leading-edge computer and video technologies can be combined to build a fully functional production facility for a fraction of what it cost five years ago, and for significantly less than even two years ago.

On the video side, advances in the precision of VCRs, lower costs for professional video equipment, and new high-quality video formats grant corporate communicators the power to create their own video material more affordably and with impressive quality. The advent of Super VHS and Hi8 video formats created a middle ground between consumer-level and professional equipment, and most of the excitement in new equipment centers around these two formats. Each has its own advantages, but most important, VCRs that support these formats offer incredible image quality at a greatly reduced price.

Unless you are a very good planner (and all your subjects are either inanimate or extremely cooperative), what you will have after shooting your live video is a mishmash of scenes. Some are good; some are embarrassing; but almost certainly, all are in the wrong order and lack titles and other useful graphics. That's where computers come in.

Anything you might want to do to edit and enhance video can be done affordably with equipment and software that exists today. With a computer's help, titles, logos, artwork, and even animation and special effects become rather an enjoyable exercise, and well within the reach of those who aren't artists or video experts. Desktop video production exemplifies what's best and most exciting about multimedia. It empowers ordinary people and opens pathways for communication that never existed before.

The Ears Have It

No discussion of multimedia would be complete without sound. For many, audio puts the "multi" in multimedia. The technology has advanced, and recently costs have declined significantly.

As with video, a middle ground between consumer-level and costly professional audio gear has been created. It is now possible to put up to eight tracks of high-quality sound onto an ordinary audiocassette and to have the movement of the tape placed under computer control. With that control, the audio can be perfectly synchronized to video, making the addition of music, sound effects, and voice-overs to a video's original audio track almost effortless. And digitizing audio to disk has proved quite manageable, bringing the advantages of random access and digital enhancement and editing to audio.

One area that frequently gets passed over in these discussions is music, but it can't be denied that practically every professionally produced presentation has it. A seemingly endless array of companies offer canned production music on CDs, and for those who are not musically inclined, these collections of short, original musical pieces are the only way to go. Most production music houses have collections to fit any mood or tempo, and the pieces are timed to standard lengths.

The other option involves investing in some musical equipment and doing your own production music. That is not as rough as it sounds; most companies have someone on staff who dabbles in music. With the software tools available today and the sophistication of even inexpensive electronic musical instruments, all it takes is a few chords and some creativity.

There are now several music software packages that have features intended for use by nonmusicians, and most of the better ones are capable of precisely synchronizing the music to video timing. When you create your own music, you do not need to worry about licensing (unless you use someone else's material), and you can ensure that the music reflects the proper mood and fits the allotted space.

Whatever you have to communicate, technology now stands ready to help you do it more easily and more effectively. In the battle to fix your audience's attention on your message, computers figure prominently in their ability to organize and present information in ways that would take much longer if done by hand.

You can already see evidence of the practical use of multimedia around you. In my office, I receive about two videotapes per month from companies with a point of view to sell, and I usually watch them. I have been pleased to note that not all of these videos hail from big companies with deep pockets.

Multimedia technology is being applied in classrooms, boardrooms, teleconferencing centers, teaching hospitals, and other places in which getting the message across is the most important thing. But then again, isn't it always? ■

Tom Yager is a BYTE technical editor. He oversees BYTE's Multimedia Lab. He can be reached on BIX as "tyager."

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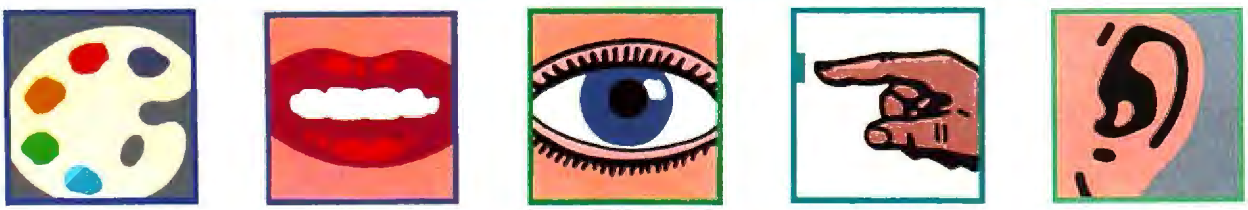

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CHIPS DELIVER MULTIMEDIA

Multimedia is the next wave in personal computing, and a host of high-performance chips are emerging to make it a reality

YONGMIN KIM

Multimedia is the hottest topic in the computer industry. But if this new era in personal computing is going to make it to the desktop, systems supporting it will require tight integration of hardware and software.

A steady stream of multimedia software soon promises to become a torrent, but the processors to handle multimedia's incredible demands for computing power are just appearing on the market in the form of dedicated multimedia chips. The most innovative semiconductor designers and manufacturers are racing to meet the hardware challenges of multimedia with advanced silicon and improved standards.

Multimedia chips can be grouped into two categories: fixed-function chips and programmable processors. Fixed-function chips are easier to design and manufacture, since each chip can be designed to perform only a single function or algorithm. For consumer and entertainment applications, fixed-function chips have a cost advantage over programmable processors because they implement only a limited number of functions.

On the other hand, programmable processors are more flexible than fixed-function chips. The same processor can be reprogrammed to perform different operations and can adapt to changes and upgrades in the standards.

Fixed-function chips for performing image processing, graphics, or filtering have been available for some time. Now, however, manufacturers are developing more highly integrated, higher-performance chips and chip sets tailored for specific multimedia applications. Some

of the first offerings are aimed at implementing video compression solutions, such as fixed-function chips from LSI Logic, SGS-Thomson, and C-Cube.

Chips are also available for multimedia delivery only (e.g., Compact Disc Interactive and Digital Video Interactive), but in this article, I'll concentrate on the chips that can perform both encoding and decoding of video and image data. These capabilities are generally seen as necessary for desktop applications.

Bunching Up Those Bytes

The most immediate obstacle in implementing a multimedia system has been the huge amount of data that needs to be captured, stored, processed, and transferred. Chips and systems are emerging to solve this problem. The largest volumes of data are generated by full-motion video applications; for example, a 10-second video clip that is digitized from a TV broadcast requires more than 200 MB of storage space.

BYTE ACTION SUMMARY

Multimedia chips require supercomputer-like computing power to support video compression standards, signal and image processing, and graphics. Using these new powerful multimedia chips, designers can build multimedia systems for PCs.

Not only is storing any more than a few seconds of such video data impractical, transmitting the data over conventional communications channels in real time is very expensive. Therefore, people continuously seek data-compression techniques, especially those related to image and video data, to reduce the storage and transmission requirements. Data compression is one of the most important and demanding operations necessary for multimedia systems.

It is necessary to expedite the development of compression hardware and to ease the exchange of compressed images among systems from different vendors. Thus, industry representatives have been (and are) developing several international standards for different applications. These include the Joint Photographic Experts Group (JPEG) standard for still-image compression, the Moving Pictures Experts Group (MPEG) standard for full-motion video compression, and the CCITT H.261 (also known as Px64) standard for video teleconferencing.

The JPEG and Px64 standards have been finalized. The date for the ISO balloting for MPEG was in November, and it may be two or more years before people adopt MPEG as an official international standard. But except for a few minor changes, the video-coding portion of the MPEG standard has been frozen since September 1990. It is reasonable to expect that there will be no more significant changes in the remaining phases.

Processing Power Is the Key

Many image-computing algorithms used in multimedia require substantial computing power. Consider the two-dimensional discrete cosine transform (DCT) used in a number of compression algorithms. It requires 896 additions and 1024 multiplications to transform a single 8- by 8-pixel image block, using a matrix multiply algorithm.

In a standard image format (e.g., 352 by 240 pixels used in the MPEG standard), there are 1320 (44 by 30) 8- by 8-pixel blocks. They require about 2.5 million arithmetic operations for a single image DCT. If real-time computation is required, say at 30 frames per second (fps), a processor must sustain 76 million operations per second. When color images are used, that figure either doubles or triples, depending on the color encoding method; thus, people are looking at hundreds of MOPS to perform just the DCT operations on full-motion color video.

Images with larger sizes, such as the CCIR 601 (720- by 480-pixel) format, require about four times more computing power. The MPEG and Px64 standards also use motion estimation and compensation techniques to exploit temporal redundancy between consecutive frames; for example, most video sequences do not jump from one frame to the other. Only a small amount of changes exist between these frames. By coding the difference instead of the whole image,

Quality vs. Quantity: The Compression Trade-Off

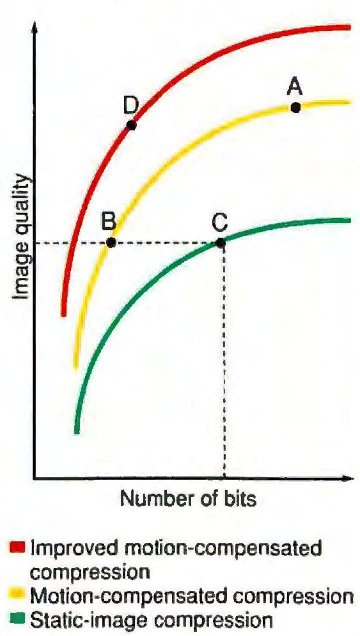
For images and other types of data (e.g., sound) that do not necessarily need exact reconstruction of the original, a *lossy* compression technique is often used to achieve high-compression ratio. Lossy is a classification of a group of compression techniques that sacrifice exact reproduction of data for better compression.

With lossy technique, once the original data is compressed, it can never be fully recovered. Only a close approximation can be made in the decompression stage. However, its use results in a much higher compression ratio than the lossless methods often used in data-file compression.

Lossy techniques are based on quantization of data values. Only a small number of bits are used to represent the data value. Obviously, the more bits that are used, the closer the approximation to the original and, thus, the better the image quality (see the figure).

The minimum number of bits needed for an acceptable image quality varies greatly depending on the application. In medical image compression, the reconstructed image should be as close to the original as is technically possible. This requirement leads to a rather low compression ratio (point A in the figure). On the other hand, high-compression ratio is the top priority in teleconferencing applications, even to the extent of sacrificing image quality (point B in the figure).

COMPRESSION TRADE-OFFS



In applications requiring good image quality, more bits are needed (point A). The number of bits can be reduced significantly if poorer image quality is acceptable (point B). JPEG-like compression requires about three times more bits than the MPEG compression that uses motion estimation and compensation (points B and C). In the upcoming MPEG algorithm, you can expect higher image quality at the same number of bits (points B and D).

Most motion video sequences exhibit temporal redundancy (i.e., they contain information that is repeated in many frames). This information can be processed in a way that reduces the number of bits encoded for each frame. You can take advantage of temporal redundancy to encode images of given quality with fewer bits than you would need if there were no redundancy among frames. The lower curve in the figure applies to Joint Photographic Experts Group–like algorithms where temporal redundancy removal is not incorporated.

The Moving Pictures Experts Group compression standard uses motion estimation and compensation techniques. The middle curve in the figure shows that in MPEG compression, a smaller number of bits can be used to achieve the same image quality. However, the MPEG standard does not specify which algorithms should be used in motion estimation and compensation. If developers use more advanced and smarter algorithms, the number of bits can decrease even more, as shown in the upper curve of the figure.

compression ratio can increase by a factor of 3 to 10.

This motion estimation and compensation step necessitates far more calculations than the DCT alone; thus, MPEG encoding will require three to four times more computing power than the decoding. You can safely expect that at least 1 billion operations per second (BOPS) of processing power will be required in any practical multimedia system to perform real-time image compression and image-computing operations.

Current RISC or CISC general-purpose processors are not capable of sustaining such high computing requirements. A multimedia system should use a separate processing unit to perform these compute-intensive operations.

In the beginning, most multimedia systems will be implemented as an adjunct to a host computer, usually a PC or workstation. Later on, they will be integrated directly into the host computer's motherboard. The multimedia system, therefore, should be capable of receiving multiple requests from the application software and performing all the necessary operations internally. This capability would free the host CPU for other tasks, such as database management or user-interface support.

The design of the data flow within the system requires careful attention because multiple external devices may be requesting real-time data transfers at the same time that the CPU needs to access main memory.

Things Are Looking Up

Every multimedia system for PC and workstation applications must have a

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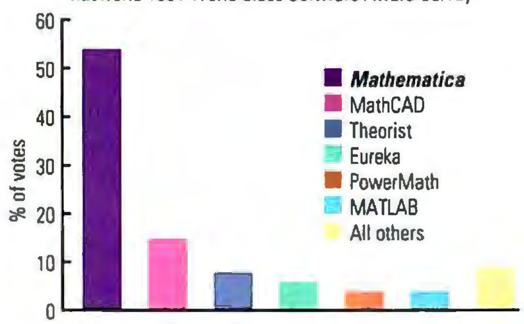

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programmable multimedia processor. If this processor has enough horsepower to perform all the different computing functions, it may be the only processing unit needed. Otherwise, auxiliary processing subsystems implementing specialized functions may be necessary to supplement the processor.

To date, programmable chips have had some disadvantages. Early semiconductor technologies had severely limited their computing power, and, thus, it was difficult for the chips to compete against their fixed-function counterparts in speed and price. However, as a result of continuous improvements in semiconductor technology, people are now seeing the introduction of a new generation of programmable processors with increased performance and enhanced features.

In the next few years, programmable processors will gain even more power. Then they will be able to meet the requirements in multimedia applications that, up until now, could only be fulfilled by fixed-function chips.

Programmable processors intended for multimedia applications will have many characteristics in common: multiple processors integrated in a single chip; individual processors incorporating extensive parallelism in time and space; large on-chip memory; integration of many functional units; extremely high bandwidth between CPU, memory, and I/O devices, and the capability of performing more than a billion operations per second.

Motion Estimation and DCT

SGS-Thomson focuses on producing processors to address the most demanding image and video compression requirements. The motion estimation processor (STI3220) uses a systolic array of 256 processors to perform a full-search algorithm on a 16- by 16-pixel block in a 31-by-31 window.

The company's Inmos division's IMS A121 is a pipelined processor computing an 8- by 8-pixel block DCT using the matrix multiplication method. It consists of two 8-by-8 matrix multiplication units, a transposition RAM, and clipping and rounding logic. SGS-Thomson also offers other DCT processors with varying features, such as multiple block-size operations from 4 by 4 pixels to 16 by 16 pixels (STV3200) and zigzag scanning integrated within the chip (STV3208).

JPEG Compression Chip

C-Cube's CL-550 was the first JPEG compression chip introduced in the market. This chip integrates a DCT/IDCT unit, quantizer, and variable-length coder for the JPEG coding and decoding. The compression ratio can be adjusted by modifying the contents of quantization and VLC tables.

CL-550's video-interface unit can accept pixels directly from a video source without the need for external line buffers, as the buffer is incorporated in the chip. Usually, several lines of pixels need to be stored in a buffer before the DCT processor begins its work on 8- by 8-pixel blocks. The CL-550 can perform the JPEG compression at up to 30 images per second. However, output bit rates will be much higher than (about 3 to 4 times) those of the MPEG.

The CL-550 provides a good example of the critical relationship between chips and standards. The original CL-550 was introduced before the finalization of the JPEG standard, and C-Cube had to develop a revised version, CL-550B, to conform to the standard. Next Computer first designed its Nextdimension board around the CL-550B. But development problems with the CL-550B delayed production, forcing the company to ship its boards without the C-Cube chip.

No semiconductor manufacturer will make the huge investment demanded by a sophisticated chip development project unless it has a stable standard as a design target. And few board or subsystem designers will attempt a complex design project until the chips are produced. So the availability of new multimedia hardware really hinges on stable standards.

C-Cube is now taking a different, more flexible approach in the development of its new MPEG decoder. It is making the chip adaptable via a microprogrammable architecture, to allow accommodation of any changes in the standard. A 32-bit microcontroller directs the flow of data between the VLC, the inverse DCT unit, and the frame reconstruction unit. By modifying the microcode, you can adjust the functionality of the chip to follow changes in the MPEG standard.

SGS-Thomson, LSI Logic, and many other companies are currently working on MPEG-related chips. Due to much higher computing requirements for the encoding process, however, single-chip MPEG decoding chips are expected to become available earlier than the encoders.

Multifunction Chip

The Vision Processor from Integrated Information Technology has an architecture that is optimized for image and video compression. To support various compression standards, the VP is programmable in microcode, which the host

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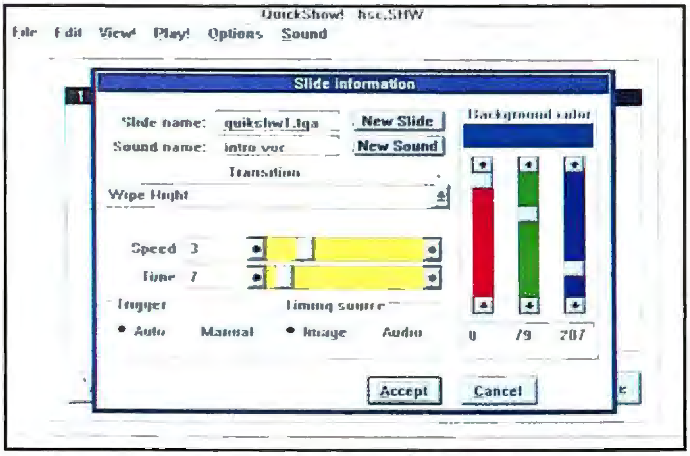

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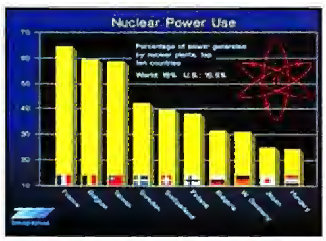

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computer can download into the VP. The VP can be directly controlled by the host processor in a JPEG compression system. However, in MPEG and Px64 systems, the VP requires a Vision Controller (VC), which includes high-speed pixel I/O ports, a microcontroller, VLC, and a buffered system interface to a host computer.

VC contains high-speed, data-routing logic, which, in combination with the microcontroller, manages the flow of the data for MPEG and Px64 compression and decompression. The VP incorporates extensive on-chip parallelism with four 16-by-16 multipliers and eight 16-bit ALUs that can be executed concurrently.

VP also integrates a RISC processor and 64 64-bit registers, as well as a large memory intended primarily for use in motion estimation. Together with the VC, the VP can sustain 30 fps in MPEG decoding, JPEG encoding and decoding, and Px64 decoding on standard image formats. However, the VP can sustain only 15 fps for Px64 encoding, and even less for MPEG encoding.

After the 750

Intel is developing the next generation of 750, codesigned with PictureTel. It may provide the major computing power for multimedia applications. According to Intel, samples of the 750-nextgen may become available in the second half of 1992. Using submicron technology, the 750-nextgen implements multiple execution units configured as single-instruction/multiple-data processors. This next-generation processor is expected to deliver about 1-BOPS computing performance.

The 750-nextgen will be programmable at the microcode level, and the object code is to be compatible with the current 750 Pixel Processor. Intel expects this processor to serve as a single-chip solution in MPEG compression and other image-computing tasks for PCs and workstations. The 750-nextgen can achieve real-time Px64 encoding *or* decoding at 30 fps, but not both at the same time.

The 750-nextgen is being developed to also perform MPEG decoding on standard image formats in real time. Intel plans to make various versions available as a family of processors. According to Intel, the high-end processor will be able to handle audio processing and special effects in addition to video encoding. The basic version will serve as an MPEG decoder.

Texas Instruments is also developing a highly programmable modular multimedia processor, as yet unnamed. Based on parallel processing with multiple processors, it is due to deliver computing power of over 2 BOPS. This processor is a good example of a programmable, next-generation approach.

MPEG vs. JPEG

Implementing an MPEG encoding processor is extremely complex. Therefore, some people believe that JPEG compression chips may also be used in full-motion video compression, even though JPEG will provide only about a third of the compression that MPEG can achieve (see the text box "Quality vs. Quantity: The Compression Trade-Off" on page 166). The interest in using JPEG in full-motion video processing stems largely from the fact that JPEG encoding and decoding chips are now available, while MPEG and Px64 decoding chips won't be available until 1992. Real-time MPEG encoders and Px64 codecs will be widely available about a year later, both in the form of fixed-function processors and programmable-parallel processors.

In some cases, MPEG encoding need not be performed in real time. Vendors may make available JPEG-to-MPEG conversion software, which you can use for applications that do not require real-time turnaround. When MPEG encoding chips are available, JPEG compression and its chips will be relegated to the area for which they were intended—desktop publishing, utilizing high-resolution static color images.

The introduction of real-time compression engines and high-performance parallel processors will bring the ability to encode and decode full-motion video using JPEG, MPEG, and Px64 standards. These programmable processors will become increasingly popular—although slowly at first, due to their cost. The demand for them will grow, because they will be able to perform JPEG, MPEG, and Px64 coding, as well as a variety of image-computing operations that are necessary for a flexible multimedia system.

A Moving Target

MPEG and Px64 standards are not without their shortcomings. During their development stages, the standards committees made several compromises in image quality to satisfy communications and storage media requirements. Although the image quality is reasonably good for their intended applications, in some areas, such as professional and broadcast-quality video, the image quality provided by these standards may not be acceptable.

As users become more sophisticated

and the digital video applications spread, they will demand far more enhancements and improvements. Then compression efforts will extend into higher-quality, higher-bandwidth standards. Future standards may be based on higher-resolution images such as CCIR 601, and they may even apply to high-definition TV technology.

Supporting Chips

Although a multimedia system's core is a specialized processor, any of these systems require a variety of supporting chips, including memory, A/D converter (ADC), D/A converter (DAC), and audio chips. Some companies may implement some of these functions within their upcoming multifunction chips, but in most cases, these functions will be delivered as external components that supplement multimedia processors.

Philips-Signetics is producing a digital video chip set that includes devices for video ADC, digital multistandard decoding (DMSD), digital encoding, color space conversion, and clock signal generation. Where older systems used analog circuitry to separate luminance and chrominance signals from composite video signal, the DMSD performs color decoding of NTSC or PAL signals in the digital domain. Line-locked (instead of burst-locked) sampling methods used in this chip enable orthogonal sampling to take place in three dimensions: horizontal, vertical, and time.

A digitized stream of composite video pixels from ADC is fed to the DMSD, which outputs another stream of luminance and chrominance pixels. The digital encoding function, which also includes DACs, acts in a manner exactly opposite that of the DMSD, taking in (digital) pixels in either RGB or YUV format and generating (analog) NTSC- and PAL-encoded signals, as well as an S-VHS version of the color standard.

To perform the D/A conversion for high-resolution displays, Brooktree came up with a true-color DAC chip, the Bt 463 RAMDAC. This chip contains three lookup tables for color palette and three DACs, and it provides support for shared lookup table operations used in the X Window System. Bt 463 takes in 24-bit RGB pixels in a 1-to-1, 2-to-1, or 4-to-1 multiplexed format, enabling a direct connection of data pins to video RAM (VRAM) chips, which run much slower than the DAC chip. Although some of the earlier chips had triple DACs on one chip, none had the capability to accept 24-bit true-color pixels at 170 MHz, a rate that is high enough to drive monitors with screen resolutions of up to 1600 by 1200 pixels.

When there are two streams of video pixels—one coming in from a video ADC and another going to a video DAC—their data paths to the frame buffer can become a bottleneck. However, with specialized video memory devices, such as Micron's new triple-port VRAM chips, each pixel stream can access the frame buffer asynchronously.

Regular VRAM chips have one random-access data port and one serial data port. To these, Micron has added another serial data port. Therefore, the triple-port VRAM chips can perform two separate serial transfers concurrently. The VRAM chips can receive incoming pixels from an ADC through one serial port while they are sending out pixels to a DAC through another port. These transfers are performed independently of each other.

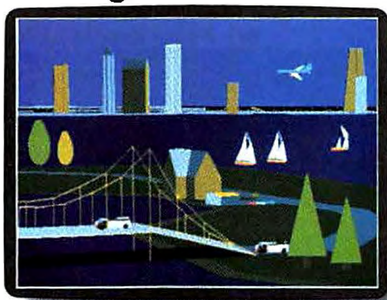
Chips for Audio

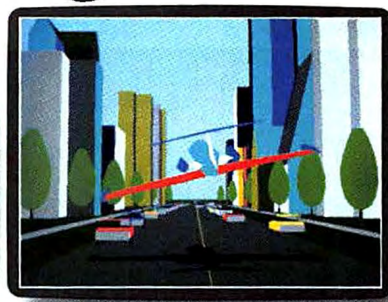
A number of audio ADC and DAC manufacturers are trying to integrate as many functions as possible into their new products. Analog Devices is developing a stereo codec with sigma-delta ADC and DAC in a single chip. In addition, the AD 1849 contains on-chip analog filters; programmable gain and mute control; μ-law/A-law conversion facilities for audio-data compacting and expanding; and a serial interface to processors.

The chip takes in stereo audio signals from line-level or microphone-level input pins. Two stereo line-level outputs and one monospeaker output are also available at the external pins. Each of these five channels can be independently muted. Since AD 1849 contains most of the essential features of the audio interface, you can implement a complete audio section of the multimedia system with only one chip. However, AD 1849 does not provide any computing power necessary to support data compression (e.g., audio coding in the MPEG standard).

Although compression will remain one of the key multimedia technologies, success in compression chips will not directly lead to success in multimedia chips. It is necessary for the chip manufacturers and system integrators to master other significant associated technologies to maintain a presence in future multimedia markets. ■

Yongmin Kim is a professor of electrical engineering at the University of Washington in Seattle, where he is also the director of the Image Computing Systems Laboratory. He has published more than 120 technical papers in the imaging area. You can contact him on BIX c/o "editors."





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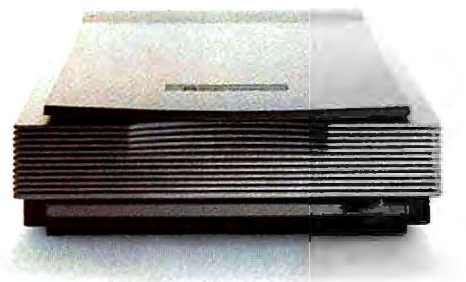

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INTEL/IBM'S AUDIO-VIDEO KERNEL

Multimedia's new horizons demand a new model. A joint development of Intel and IBM has defined such a model, as well as an architecture that supports it.

JOHN W. DONOVAN

The progress of multimedia developments to date has been largely along the lines of single-point solutions. Simply meeting the technical challenges of displaying video sequences on a computer's screen was enough for early developers. But the future of multimedia applications, especially on the desktop, demands that developers have a broader path mapped out for them. And in the world of developers, a clearly mapped path is paved with standards.

A joint development effort of Intel and IBM addressed the need for comprehensive vision of desktop multimedia. The effort then defined a set of standard methods and an architecture for building desktop multimedia systems. The results of the joint effort are a new real-time audio-video software kernel, called AVK, and a new generation of multimedia processing boards, called ActionMedia II, for personal computers. AVK provides a low-level programming interface that is designed to integrate smoothly with multimedia programming interfaces, such as IBM's and Microsoft's Media Control Interface and Apple's QuickTime (see "Inside QuickTime" on page 189).

The New Model for Desktop Multimedia

Early approaches to desktop multimedia were aimed at delivering full-motion video and audio information on a personal computer. The model they followed was essentially a VCR attached to a PC, allowing recording and playback of a single video program with limited control of sequence, format, and data. This

EXCLUSIVE

IBM's Personal Multimedia System

Andy Reinhardt

October was the month of multimedia. First came the formal unveiling of the initial wave of Multimedia Personal Computer machines, which run Microsoft Windows 3.0 with Multimedia Extensions and sport a CD-ROM drive and stereo audio. Then, just before Comdex, IBM revealed its answer to the MPC: a version of the PS/2 Model 57, upgraded to support sound, CD-ROM, and high-resolution graphics—and running not just Windows but also OS/2.

IBM's first personal computer designed specifically for multimedia is called the PS/2 Ultimedia Model M57 SLC. It's based around a new, higher-performance version of the 386SX, developed and manufactured by IBM in conjunction with Intel. The 386 SLC chip runs at the same 20-MHz clock rate as an off-the-shelf 386SX but offers performance as much as 88 percent faster, IBM says. The higher speed is due to optimization of frequently used instructions and the addition of an on-chip 8-KB data and instruction cache similar to that used in the Intel 486.

IBM's first PC designed specifically for multimedia has a CD-ROM drive, an XGA graphics adapter, and an audio capture/playback adapter with a MIDI port.

To make the machine "multimedia," IBM has added a CD-ROM drive, an XGA graphics card, and its own M-Audio Capture and Playback Adapter, which provides 16-bit A/D and D/A conversion, a MIDI port, and musical sounds. The system does not include a video-capture board for converting NTSC or PAL analog video input from a camera, VCR, or videodisk player into RGB. It also doesn't have the capability to output a computer-based presentation to videotape or a TV monitor. However, boards that perform these functions are available from IBM or third parties.

The system also doesn't offer digital video support as a standard feature, but its Micro Channel bus slots will accept IBM's new ActionMedia II cards, which implement Intel's DVI technology (see the main text). By adding video conversion or DVI boards to the Model M57 SLC, you can use it for various video authoring or playback applications.

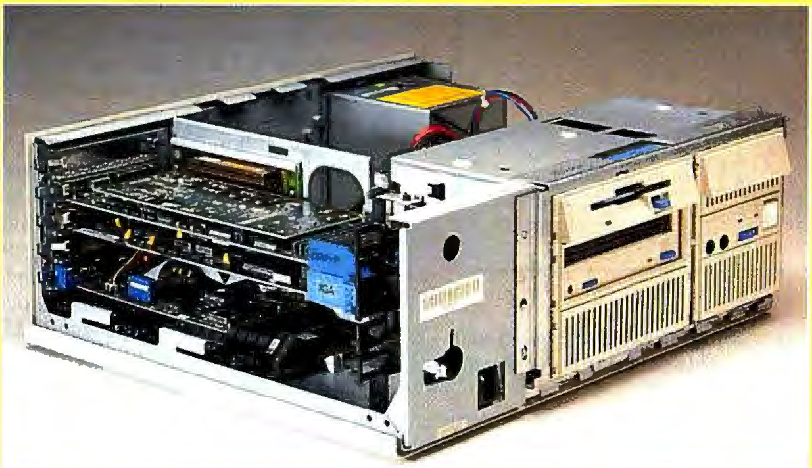
The Model M57 SLC uses the same chassis and enclosure as IBM's Model 57, announced last June. The new 386 SLC processor sits on a small daughterboard that plugs into the 387 socket on

model was adequate for some uses (e.g., computer-based help applications) that handle video files as if they were on a physical tape. But it is not up to the demands of more advanced applications, such as video conferencing or multimedia E-mail, which require a more sophisticated conceptual model.

The new model for desktop multimedia is the video production studio. This model resulted from extensive consultations with multimedia applications developers and producers of video and audio program material. The functions they wanted in a multimedia system were no less than those found in a typical video production studio. But the power of present and future multimedia processing hardware made the model a reasonable one for desktop systems.

Such a far-reaching model holds a host of implications for multimedia systems. First, it implies that applications developers will need sophisticated tools to mimic the functions that today's video studio provides in dedicated (and expensive) hardware. Second, applications developers want the same creative freedom they might find in a real video studio, as provided by a wide range of available tools. Finally, multimedia applications have as large a potential audience as possible; therefore, multimedia program material should be compatible with as many playback (delivery) systems as possible.

In computer-industry terms, these implications spell third-party support. The AVK development team extended the requirements model to include support of multiple platforms for applications development and delivery. They defined a low-level software interface that would handle real-time video and audio information and work with different operating systems. And they defined it to be extendable in a way that lets applications and tool developers create additional



With the addition of a DVI-based ActionMedia II board, the system can provide playback of digital video applications.

the system motherboard and disables the existing 386SX. If you want to install a 387 coprocessor, there's a socket for it on the daughterboard. (The 386 SLC is also available as a $780 upgrade option for regular Model 57 systems, but it's not possible to convert them to multimedia machines, because the M57 has a special front panel with a volume control knob and an enhanced speaker.)

The system ships with 4 MB of RAM, expandable on the motherboard to up to 16 MB, and four Micro Channel bus slots, three of which are available for add-ins. The graphics subsystem is IBM's new XGA standard; with 1 MB of video RAM, the Model M57 SLC supports 1024- by 768-pixel resolution with 256 colors, as well as normal 640- by 480-pixel VGA.

For storage, the Model M57 includes a 2.88-MB high-capacity floppy drive and an 80-MB SCSI hard drive. There are one empty drive bay and five available SCSI addresses. The built-in CD-ROM player has an average access time of 380 milliseconds and a sustained data throughput of 150 KBps; it supports the CD-ROM XA standard, an extension to CD-ROM that permits audio and data to be interleaved. (IBM calls this CD-ROM II.)

The system also ships with a PS/2 mouse, a 101-key Enhanced keyboard, manuals, DOS 5.0, Windows 3.0 with Multimedia Extensions, and OS/2 2.0. Multimedia extensions to OS/2 are expected to be available in 1992, IBM says. A CD-ROM disc included with the system gives demonstrations of programs such as Asymetrix ToolBook, MacroMind Action, and Authorware Professional.

IBM will use the term *Ultimedia* for a whole line of multimedia-capable computers that the company plans to introduce in the future. It's a safe bet that this machine, based on the entry-level 386SX-architecture CPU, will be the bottom of the line, since IBM has said that it considers 32-bit Micro Channel bus machines to be a minimum platform for multimedia use. With a suggested list price of somewhere near $6000, the Model M57 isn't exactly inexpensive, but IBM promises that further integration of the audio and graphics technologies—and their eventual migration to the motherboard—will someday make multimedia an everyday capability.

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functions without losing backward compatibility.

The Production Studio Model

A real video production studio is built to handle multiple channels of video and audio information at the same time. These channels are recorded, processed, mixed, rerecorded, played, and combined into a single program by a variety of equipment designed for each of these functions. The digital production studio model is composed of a similar collection of functions performed by a group of subsystems that operate on multiple streams of digital video and audio information (see figure 1).

In the digital model, a collection of related streams forms a *group*. Analog I/Os can be thought of as *channels*, and streams of data from input channels are routed to output channels by making *connections*. Individual streams can be mixed together or sent to an effects processor to be altered in some way. The complete digital production studio is conceived as comprising an analog device interface, a display manager, a sampler, a stream manager, an effects processor, and an audio/video mixer.

The analog interface provides connections to a variety of analog I/O devices, such as laser disc players, cameras, and VCRs. These connections are physical, each attached directly to some external device, and are defined as unidirectional (either an input or an output). Each channel carries a single stream of information. All analog inputs are converted to a digital format at the system interface; likewise, data routed to outputs undergoes D/A conversion. All data within the system is handled in digital form.

The display subsystem handles the display of visual information on the computer's screen. It permits mixed data types, such as full-motion video and still images, to be displayed simultaneously

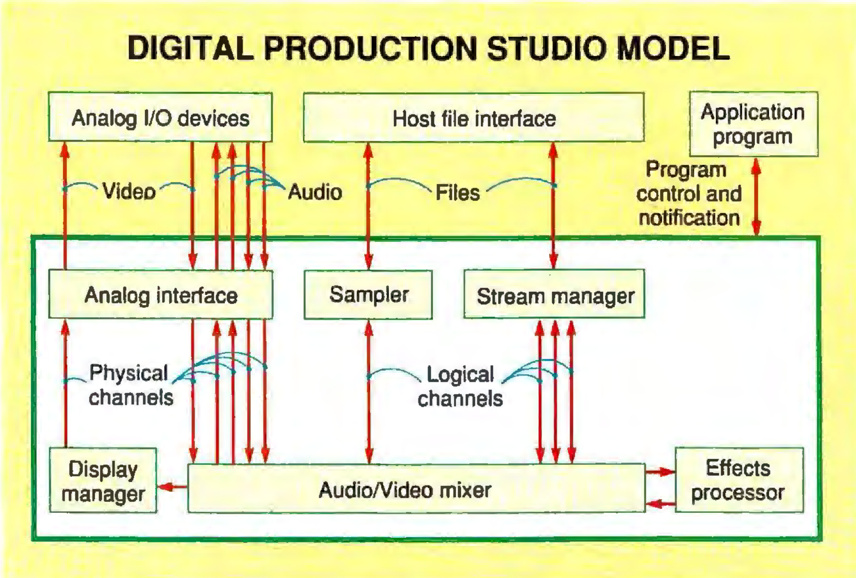


Figure 1: *The essential functions of a real video production studio are embodied in this conceptual model of the digital production studio. This model was the starting point for the development of the AVK architecture.*

on the screen (see figure 2). The mix of information displayed on a screen can be thought of as your view of the data, and more than one view can be defined on the system. The display subsystem lets you create and select views for display. You can change the views to monitor different combinations of the data.

The sampler is the digital equivalent of the sampling synthesizers found in audio studios. These transform a sample of an analog sound into digital data that can be manipulated to achieve a variety of effects, such as varying its pitch. The sampler treats video information in this manner, capturing a frame of image data as a visual sample to be further processed by the system.

The stream manager controls the flow of digital data to or from some storage device, such as a hard disk, CD-ROM, or LAN. Digital data flows through logical channels that are controlled by the stream manager. These channels are not necessarily mapped to a single physical device. For example, a single digital data file may contain interleaved video and audio information. The stream manager routes the appropriate data to the correct logical channels so that video information flows through one channel and audio information flows through another. Logical channels are bidirectional and can be used for I/O.

The effects processor can manipulate image and audio data and add computer-generated graphics to images. For example, the tint and brightness of different sequences can be matched on a frame-by-frame basis, or the volume of multiple audio sources can be balanced. In addition, the effects processor can convert images from one bit-map format to another.

The mixer provides high-level control of the digital production studio through mechanisms for assigning input streams to output channels. It permits mixing multiple input streams to create new composite output streams. For example, for audio information, this would allow mixing separate recordings of guitar, bass, drums, and vocals into a single recording. For visual information, it would allow displaying a narrator's face as an inset to a window that displays the video sequence that is the subject of the narration. The mixer provides controls for some manipulation of video data, such as cropping, scaling, and adjusting for tint, brightness, contrast, and saturation.

BYTE ACTION SUMMARY

A new set of software- and systems-level standards developed by IBM and Intel addresses the full spectrum of desktop multimedia applications. The new approach is designed to operate across multiple platforms, in different operating systems, and with future multimedia hardware advances.

The AVK Architecture

The digital production studio model guided the development of the AVK system software. The project had adopted as its goals that the AVK would be portable to multiple platforms and operating environments, support windowing environments, be able to expand as the power of available hardware grew, and minimize reliance on the host CPU. The architecture was able to avoid dependence on a host for processing by relying instead on high-performance multimedia processors. At present it's based on Intel's 750B processors (the 82750PB Pixel Processor and the 82750DP Display Processor), but it's also capable of accommodating future, higher-performance processors.

The AVK system architecture is built in layers (see figure 3). The lowest layer is called the *microcode engine*, because it includes a set of microcode routines for the 82750PB processor; for example, a routine called DoMotion manages decompression tasks and buffers, and another routine, called CopyScale, copies and scales video images in real time into the display buffer.

The next layer is the Audio/Video driver, which encapsulates the details of the ActionMedia II hardware. The AVD interface provides functions for accessing the multimedia board's local video RAM, setting display formats for the 82750DB, and loading microcode functions from VRAM into the 82750PB's on-chip instruction memory. This last function is key to AVK's ability to accommodate new features and algorithms. The AVD acts as the interface for the audio subsystem and the video-capture card.

The third layer is the Audio/Video library. This is the layer that provides most of the features described in the digital production studio model. It supports the specialized data types needed for manipulating video and audio. These data types are generalized into streams that are then collected together into groups. A *group* is a collection of streams that need to be controlled synchronously with functions (such as play, stop, or pause) that operate on the groups. The AVL implements these functions in addition to the read and write data functions for capture and display data buffers. This layer also provides control over the attributes of these data types—for example, as functions for adjusting the volume of an audio stream or the tint of a video stream. This layer is essentially platform independent and so can be easily ported to other hardware and operating environments.

The AVL includes a set of functions that manage VRAM, format bit maps, and generate and manage command lists. A *command list* is a set of microcode functions and their parameters. These lists can be built in memory and then scheduled for execution by the 82750PB as a group. In the case of the effects processor, each microcode function can be thought of as an effect. Adding a microcode function to a command list is essentially the same as installing an effect on the effects processor. Command lists can be active for a single image or for a video stream. If a list is active for a video stream, it will be executed on every frame until it is replaced or canceled.

There's one more layer that is needed to link the architecture to an operating environment. It's an environment-specific application programming interface (API) that performs two critical functions for AVK. It reads and writes data into the host file system and integrates AVK into the host windowing environment. Because these functions need to be optimized to a specific environment, they are defined as being outside the AVK architecture to maintain its portability.

Two examples of an API that can be implemented on top of AVK are the Media Control Interface, as defined for Microsoft's Windows 3.0 with Multimedia Extensions, and Apple's QuickTime. Because AVK was designed to be independent of both the API and media formats, it will easily port to emerging standards, such as those being developed by the Interactive Multimedia Association. It is also architecturally independent of specific compression and decompression algorithms and will easily accommodate new algorithms as they are developed.

An Interface Based on Objects

The AVK interface was developed by identifying and abstracting a number of objects with their associated behaviors and attributes (see figure 4). Objects are at the heart of AVK operation; they are the means of implementing the functions defined in the digital studio model. For example, the analog interface subsystem is implemented in AVK as a collection of two objects, the AVK Session and the AVK Device. Calls to these objects start up AVK, define communications with the application, allow query of device capabilities, and open and close the DVI device within an AVK application session.

The function of a mixer in the studio model is provided by a single object, called a Connector, that accepts data flow, optionally manipulates the data, and sends the data to a destination. Connectors allow rectangular regions, referred to as *boxes*, to be defined for the source and destination bit maps. Boxes can be resized and relocated in real time to provide good system responsiveness in windowing applications.

Data Flow in AVK

AVK implements a three-layered buffered data structure that provides for simultaneous execution of multiple tasks; for example, compressed data is input from a storage device by an input task that loads it into a compressed data buffer. A decode task then decompresses the data and loads it into a decompressed bit-map array buffer. Individual bit-map arrays are then processed by a copy/scale task and sent to the display buffer, where a display task accesses them and sends them to the screen.

continued

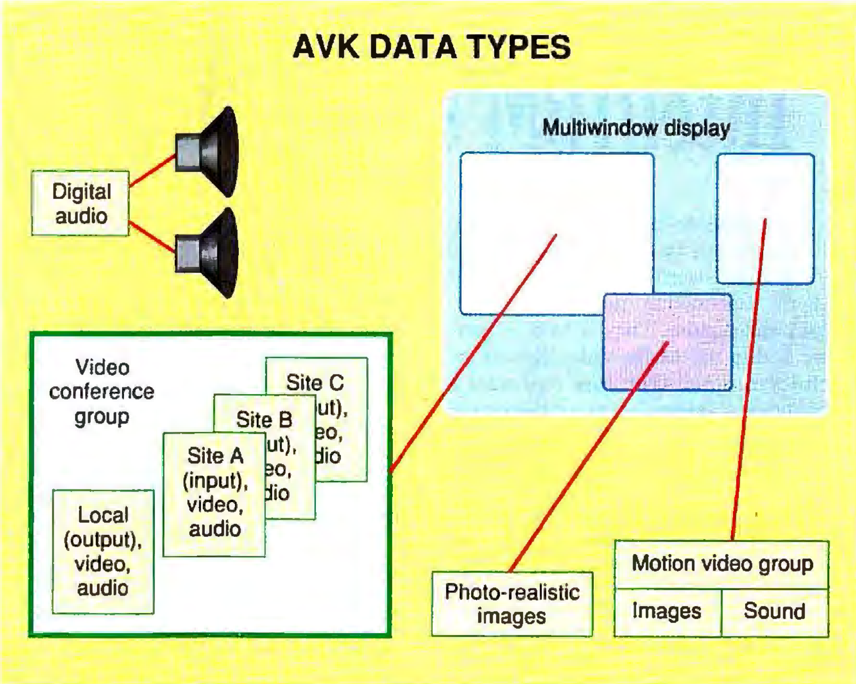


Figure 2: *Multimedia systems will be required to work with a variety of data types. The AVK architecture is designed to accommodate multiple visual data types and to permit multiple views of the data.*

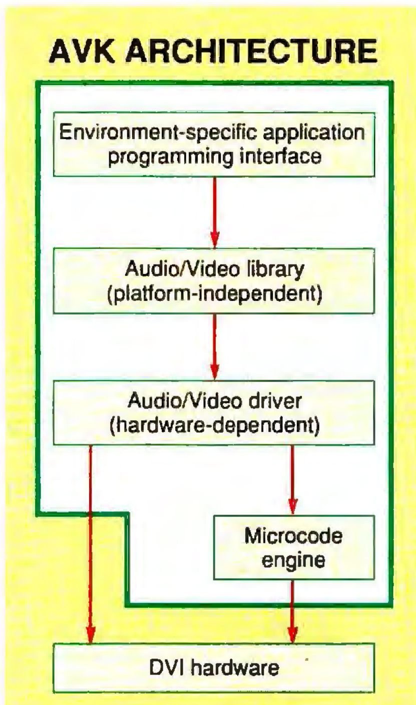


Figure 3: *AVK's layered architecture has been organized for portability across a variety of APIs, platforms, and hardware. While it supports Intel/IBM's ActionMedia II boards, it is also available for license to other OEMs.*

Intel/IBM's New Multimedia Boards

ActionMedia II is a set of option boards for Micro Channel- and ISA-based systems that provide full-motion digital video playback and capture. They're built to operate within the Audio-Video Kernel architecture and therefore represent a hardware implementation of the digital production studio model. The boards are based on Intel's DVI B series processors, the 82750PB Pixel Processor and the 82750DB Display Processor.

The boards perform A/D and D/A translations on all signals at the interface between the desktop system and external analog-based audio and video equipment. All data is processed within the system in a digital format.

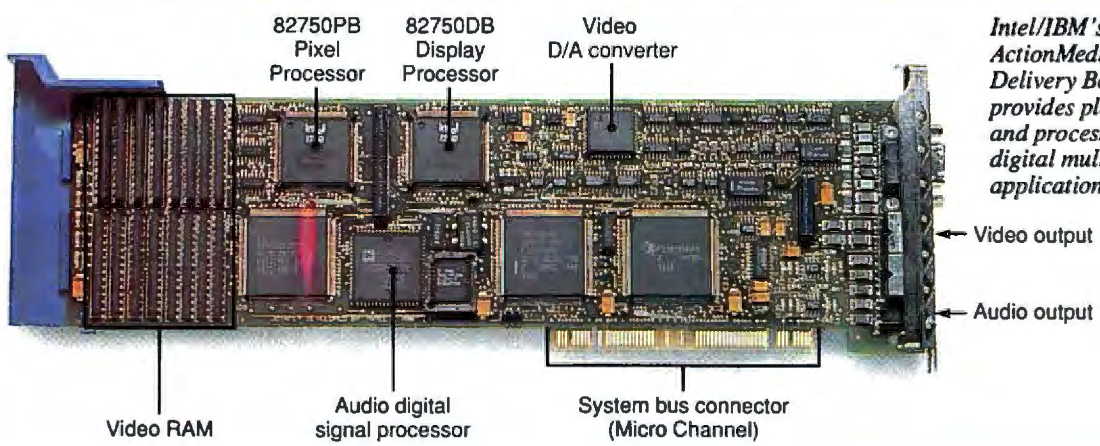
The following list describes a playback operation on the ActionMedia II Delivery Board. (For video-capture operations, the ActionMedia II Capture Module is required. This module attaches as a daughterboard to two connectors on either version of the Delivery Board.)

- The digitized video and audio data stream is accessed from a CD-ROM through a SCSI connector. In the Micro Channel version, the digital data flows through the board's Micro Channel connector (the ISA version has its own SCSI connector).
- The compressed data stream is passed to a data buffer in video RAM to await the availability of a bit-map buffer into which it can be decompressed. The ActionMedia II boards are configured with 2 MB of VRAM and permit expansion to up to a total of 4 MB of VRAM.
- When a compressed frame and a free bit-map buffer are both present, the 82750PB calls a decompression algorithm from its on-chip instruction RAM. The interleaved stream of audio and video is separated into a single stream of video data and two streams of audio data (for stereo sound) by the stream-manager function programmed into the 82750PB.
- Decompressed image data is stored in a bit-map buffer in VRAM. Each pixel of the decompressed image is described by a luminance (i.e., brightness, symbolized by Y) parameter and two chrominance (color, symbolized by UV) parameters. The YUV images are stored as three separate bit maps in VRAM to achieve the fastest read/write efficiency between the 82750PB and VRAM and the fastest possible instruction execution. To maintain continuous motion, the pixel processor (operating at 25 MHz) decompresses the data for each frame in less time, on average, than it takes for the frame to be displayed. The effects of variations in frame processing times are canceled by subsequent synchronization operations.

The pixel processor is fully programmable and designed to process and integrate video data with other multimedia data in real time. Depending on what microcoded routines are loaded into its internal RAM, the processor can perform a wide range of algorithms for data compression, decompression, and special effects, such as panning, zooming, and windowing. Microcode routines can be changed on a frame-by-frame basis, or remain active for entire sequences of images.

The processor has a programmable core and several dedicated (hard-wired) function blocks. It uses these in parallel to execute up to six instructions simultaneously, giving it a processing power that's equivalent to a first-generation RISC processor running at 150 MHz.

- The 82750DB Display Processor retrieves the image data from the bit map and performs further processing, such as two-dimensional UV interpolation, on it. It then translates the image from YUV to RGB format, converts the digital values to analog signals through a video D/A converter, and generates CRT synchronization and control signals as needed. The current version of the 82750DB is available at rated clock speeds of up to 45 MHz, fast enough to handle Super VGA displays.
- Audio data is decompressed by an audio digital-signal-processor chip, synchronized to the video data stream, transformed into an analog format, and passed to the audio output stage.



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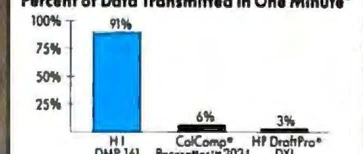

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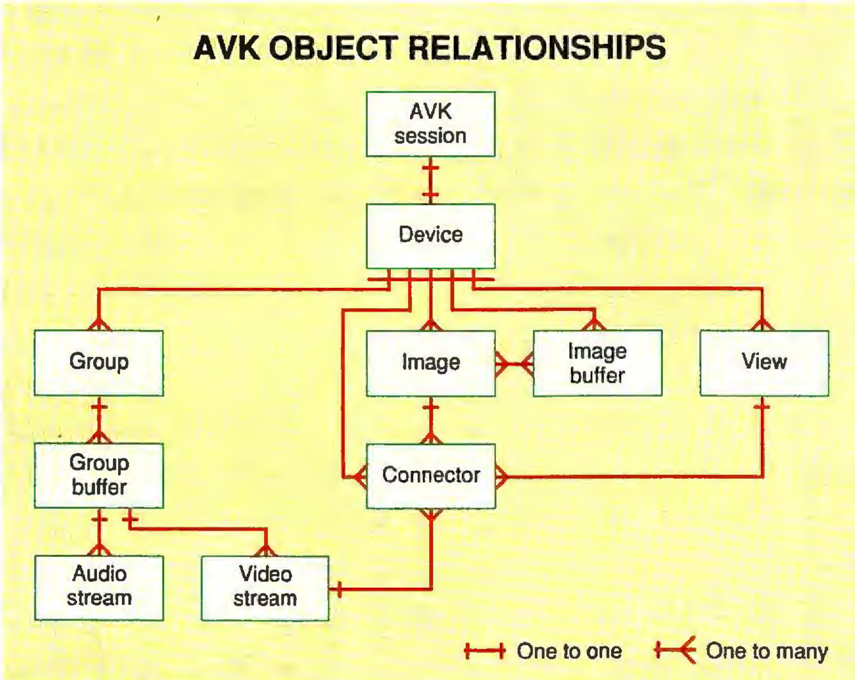

Figure 4: *The digital studio model was decomposed into a number of objects with their associated behaviors and attributes. These form the basis for the AVK interface and implement the functions described in the digital studio model.*

Task scheduling in AVK requires real-time response, a capability not provided by most operating systems found in desktop computers. The solution for AVK was to depend on the multimedia processor (the 82750PB, for now) to schedule all real-time tasks. Thus, on the ActionMedia II boards, the video-processor chip also schedules audio operations. The video processor schedules tasks through the microcode engine. For example, while video streams are being processed, DoMotion continuously loops between the master command-list-processing task and the buffer/stream processing task. For playback, the buffer/stream processing task looks for a frame of compressed data to be available and for a free bit map into which the data can be decompressed. When these conditions are both met, the buffer/stream processing task calls the appropriate decompression algorithm.

Video-Processing Algorithms

Under AVK, the 82750PB executes two types of video algorithms, Production Level Video and Real-Time Video (RTV). PLV refers to video that is compressed off-line, typically by a video-compression service organization, and that provides the highest achievable video image quality. PLV compression is performed on video frames without the time constraints of sending them to a display; therefore, it does not need to be performed in real time. The 82750PB can decompress images processed by PLV in real time.

RTV compression and decompression are performed by the 82750PB in real time and are tailored to the requirements of existing CD-ROM drives and broadcast-video frame rates. The drives can deliver data at 150 KBps, and broadcast (NTSC) video delivers images at 30 frames per second. Dividing one second of the CD-ROM's data rate (150 KB) by the number of frames per second displayed on the screen (30) yields an allowable data budget of 5 KB per screen for RTV processing.

To put this number in perspective, current off-line techniques used in PLV by Intel digitize each frame to a resolution of 512 by 480 pixels with a color depth of 24 bits per pixel, resulting in 720 KB of data per frame. PLV then compresses the frame data (but not in real time) to less than 5 KB of data per frame. RTV accomplishes the same level of compression in real time by trading off some degree of image quality.

Both compression techniques use *interframe coding*, which is similar to the method of the proposed Moving Pictures Experts Group standard. The technique stores information only on pixels that change between frames. A frame for which all the pixels are defined is called an *intraframe* and serves as an access point into the video data stream. Other frames are *predicted frames*, which are constructed from previous frame data. Only the data needed to change a frame into the next frame in the sequence is stored in the bit stream, enabling a tremendous reduction in the data rate required to achieve full-motion video.

Algorithms for Other Data Types

The 82750PB also provides several algorithms for processing still images. These include the DVI algorithms for compressing and decompressing 16-bit and 9-bit (subsampled) images, in addition to the Joint Photographic Experts Group standard for compressing and decompressing 9-bit (subsampled) images.

For the ActionMedia II series, audio algorithms are executed on an audio digital signal processor. These include Intel's ADPCM4E algorithm and the 8-bit PCM algorithm specified by Microsoft's Windows 3.0 with Multimedia Extensions.

AVK's data flow and object organization have been deliberately designed to allow future functional enhancements. When processor power and I/O bandwidth increase in future systems, AVK's architecture will permit the number of streams processed simultaneously to increase. By allowing the host to program its microcode engine, AVK can accommodate custom microcode for video effects and new image compression/decompression algorithms without requiring changes to the basic structure of the software. New or custom microcode can even be delivered on the same digital media as the multimedia program data.

Another real benefit of AVK is that multimedia program material needs only be developed once. It will play on any host system that supports AVK with no modification. And with the large storage capacity of CD-ROM drives, applications developers can include copies of the system-specific binaries for the nonmultimedia portions of the applications, letting a single CD-ROM run in any supported machine.

AVK is a real advance in the progress of multimedia. It puts a new set of applications development possibilities on the desktop. Now it's up to the applications and tool developers to deliver on these possibilities. ■

John W. Donovan is BYTE's senior editor for State of the Art/Features. You can reach him on BIX as "jwd."

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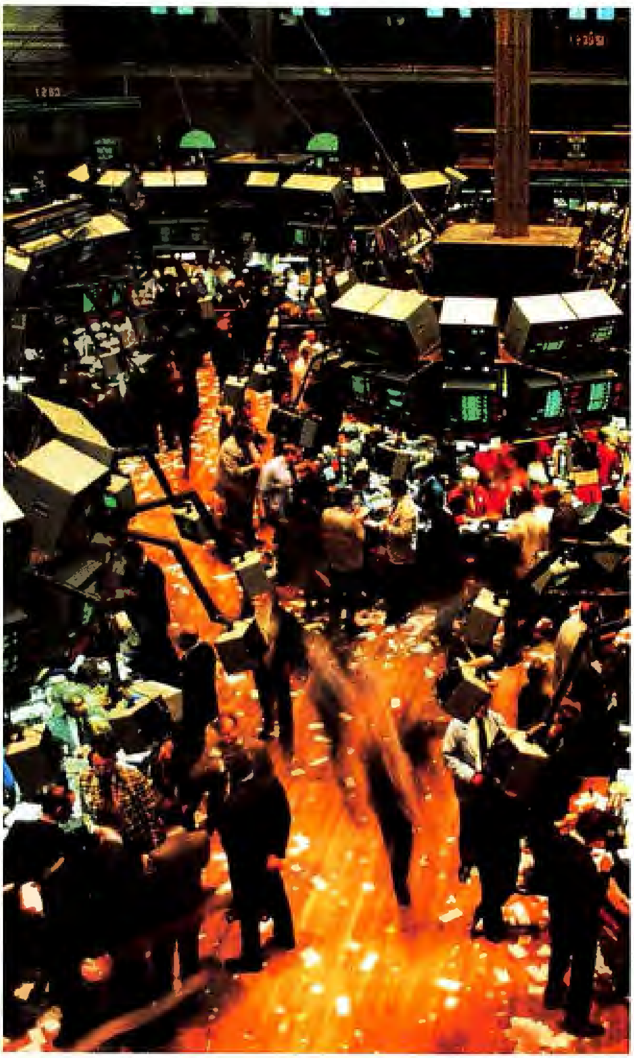

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INSIDE QUICKTIME

Apple's multimedia extensions for System 7.0 provide a standard mechanism for managing dynamic data

PETER WAYNER

The Macintosh has always enjoyed a well-deserved reputation for being easier to understand and use than other platforms. Its system software makes the Macintosh very accessible to anyone who needs to create and manipulate text and graphics information. Today, multimedia technology is bringing dynamic data—full-motion video and digitized speech—to desktop systems. To cope with these new forms of data, Apple has introduced a broad class of simple multimedia standards called QuickTime, which will make it easy to manipulate multimedia data and integrate multimedia technology into your working environment. QuickTime will take much of the hassle out of creating your next multimedia presentation or training application.

QuickTime is an extension of System 7.0, the latest version of the Macintosh system software, which was released last spring. By dropping the QuickTime icon into your System Folder, you make your Macintosh aware of a standard way of displaying, compressing, reexpanding, cutting, copying, and pasting multimedia data (e.g., color images, animation sequences, and sounds).

QuickTime is designed to insulate you from the complexities of multimedia applications. For example, you won't have to worry about which decompression algorithm to use when viewing an animation—QuickTime automatically calls the correct code. When developers start including QuickTime in their programs, you will be able manipulate multimedia data as easily as you manipulate pictures today. Apple has also extended its Human Interface Guidelines so developers

ILLUSTRATION: JOHN NELSON © 1991

can implement QuickTime's features in a consistent fashion.

Tracking Data

The core of QuickTime is contained in its support for two file formats. The first, a new format called Movie, is used to manage different forms of dynamic data. The Movie format consists of different tracks that begin and end at different times during a presentation. QuickTime synchronizes the playing of the tracks, and it makes sure that all data is decompressed and ready to flash on the screen or be sent to the sound chip at the right time. It acts as an electronic stage manager. So far, Apple has released two types of tracks—one for video and one for digitized sound—and it can add new types via hooks into QuickTime. Future possibilities for tracks include such robust synchronization protocols as MIDI and SMPTE. Eventually, Apple also plans to release the track interface so that developers can create their own track types.

The second QuickTime format is an extended version of the venerable PICT format, which was introduced with the first Macintosh. When applications cut and paste images, they use PICTs. The new extensions allow PICTs to be compressed, and they let you scan the contents of image files easily.

QuickTime's job is to maintain these specialized formats. It is divided into three sections: the Movie Manager, the Image Compression Manager, and the Component Manager. The Movie Manager makes sure the tracks are played in the proper sequence, and it relies on the Image Compression Manager to juggle the available compression algorithms.

BYTE ACTION SUMMARY

Multimedia applications require the management of time-dependent data. Apple's QuickTime introduces a track layer between your application and the multimedia data, which simplifies the display and synchronization of data. QuickTime also offers basic multimedia services, such as data compression and decompression.

Underneath these is a novel piece of software known as the Component Manager. The range of multimedia peripherals (e.g., microphones, video digitizers, hardware compression boards, and video boards) available for the Mac is wide indeed. The Component Manager lets an application determine the resources available on a machine by determining the capabilities of a machine rather than the specific configurations. Thus, a program says, "Give me the 24-bit video digitizer," and not "I know how to interface with the FooBaz Zooper 500 and the Grumster KittyPuff 210. Are there any out there on this bus?" Programs don't have to include device drivers for every possible attachment. This part of QuickTime should have broad use in many different applications.

The Movie Format

In a simple system for displaying animated presentations, the data file is just a set of screen images dumped onto a disk. The software calls up the images one after another, and it flips them on the screen. This low-budget approach may get the job done, but it is hardly the beginning of an easy-to-use system for creating or distributing multimedia.

Consider these problems: Cutting and pasting segments of video involves copying and moving large blocks of data—a very slow process. Pasting a 20-second cut may mean moving 20 MB of data. If you want to create a version of the presentation with a soundtrack in French or Japanese, you must copy the entire file and add the new soundtrack. To segue from one image to another, you have to splice different image streams together. These are just some of the frustrating limitations that arise when using a simple presentation platform.

The QuickTime architecture was designed to handle these problems by placing an intermediate abstraction known as the *track* between the raw data (called the media) and the presentation itself (referred to as a movie). A track is a routine for doing specific things with the data at a specific time; each movie contains one or more tracks.

When you start a movie, QuickTime first finds the data used by each track. If the data is compressed, it calls the Image Compression Manager to turn the data into a usable form. Then it starts each track at the right time. Notice that the data does not have to be stored with the movie. It is kept in separate media files. The movie file contains only the tracks, which themselves contain only the pointers to the media files, although you can copy the media data into a movie file to create a self-contained presentation.

QuickTime gives tracks a great deal of flexibility beyond simply specifying the starting and ending points of the media display. Each track has its own time scale as well as its own coordinates on the screen. You can program the tracks to display multiple segments on the screen at their own speed in their own positions at the same time. Moreover, you can specify the display of certain tracks at certain times to get different effects. (To get a feel for how you use tracks to control and synchronize a presentation, see the text box "On-Track Presentations" on page 192.)

QuickTime Compression

The greatest obstacle to the widespread use of animation and multimedia is storage limitations on personal computers. Pictures just take up too much room. One color image for a standard screen can easily take 400 KB of memory. A movie will use up 24 of these images in a second. At this rate, even a CD-ROM can only hold 67 seconds of full-screen animation. The solution is *image compression*, and Apple has made this one of the cornerstones of the QuickTime system.

In theory, the concept is simple. Images contain redundancy that can be squeezed out to save space. A large section of red that might take up 10 KB of disk space can be reduced to a small set of commands describing the size and color of the patch. If this is done everywhere on the image, the resulting file can be much smaller. The effectiveness depends on the variation in the image. The Japanese flag is very easy to compress, but it is difficult to save much space in a complex image, such as an overhead shot of Times Square on New Year's Eve.

Four basic parameters determine the usability of the various different algorithms for image compression. The first is the compression ratio that expresses the size reduction. Very efficient algorithms can reduce a simple picture by as much as 100 to 1. This is rare, however, and an average performance ranges from 5-to-1 to 10-to-1.

The second factor is speed. Some algorithms work much faster than others. Generally, the slower ones do a better job than the faster ones.

The accuracy of the algorithm is the third factor. Some decompression algorithms produce an exact duplicate of the original, and they are called "lossless." Others are known as "lossy" because

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On-Track Presentations

Imagine that you're a postdoctoral fellow at Deconstruction U., where you have a grant to create a multimedia presentation about popular American culture. The presentation will consist of images from various TV shows, cleverly juxtaposed to explore and reveal the barren nature of America. You begin with videotape of episodes of *The Brady Bunch*, *Miami Vice*, *Leave It to Beaver*, and *The Dr. Ruth Show*. You acquire digitized versions of the clips that you want using a VCR digitizer equipped with built-in QuickTime interfaces, which store the raw images in the correct QuickTime media format.

Without QuickTime, you'd have to cut and paste enormous quantities of data to achieve the juxtapositions you need, and you'd have to synchronize different events manually. QuickTime, however, lets you use *tracks* to manipulate and synchronize data. A track contains a list of pointers to the media and the time you want the system to "play" the media. One clever track might contain instructions to play 10 seconds of *The Brady Bunch* opening sequence, followed by 5 seconds of Crockett and Tubbs cruising through Miami.

In a separate sound-only track, you record your voice-over, perhaps with selections from Walt Whitman thrown in. Apple tries to make all its software international, and QuickTime is no exception. So, you could record another voice-over track in French, with some Rimbaud instead of Whitman.

The movie format lets you aggregate tracks into *alternate groups*. When you play a movie that contains tracks in an alternate group, you select the track you want to see. Thus, people could choose either the English-language track or the French track.

Only one track in each group can be played at a time, so there is no chance people will have to listen to French and English concurrently. Alternate groups are not limited to sounds. You can also create alternate video tracks. For example, you may want to leave excerpts from *Dr. Ruth* out of a presentation seen by squeamish members of Congress.

The format of a track specifies more than simply when to display particular data. You can also add clipping shapes and transformation matrices that convert the data into different positions or shapes in the final movie.

For example, you could ask the QuickTime manager to clip out a square full-face picture of Tubbs from a section of *Miami Vice* and superimpose it over the picture of his hair-alike Greg Brady in the opening credits of *The Brady Bunch*. The track would contain the starting point of the picture in the *Miami Vice* episode and the instructions for clipping out a square segment and then translating and scaling it so that it would appear in the upper left corner of the screen. When the movie was played, these would appear simultaneously.

Miami Vice is a faster-paced show than *The Brady Bunch*, and there probably isn't a clip in the whole series where Tubbs stands still for 20 seconds. Luckily, each track under QuickTime has its own relative time scale, so you can instruct the track controlling the picture of Tubbs to move slower than the track displaying the *Brady* opening.

Now that you've finished your opus, you need to package it so that everyone can view your brilliant riposte about American culture. Up to this point, you would have done all your work in a multimedia authoring system, such as Authorware Professional. You can also use this same software when showing the presentation to friends and colleagues. The movie format also lets you package the tracks with the data for more widespread distribution. In the future, word processors may be QuickTime aware, and you will be able to paste QuickTime movies into documents the same way you can paste pictures today.

Perhaps now you can see the advantages of the design of QuickTime. You don't have to repeatedly cut and paste images or store multiple copies of images and sounds. The media remains uncut on the disk so that anyone else can use it and you can reedit your presentation at any time. There is no need to waste disk space by making an uncut copy. The tracks contain all the timing information, so you don't have to try to synchronize things manually. If you store the files on a central file server, others will be able to produce their own presentations at the same time without making a lot of copies. Disk space is conserved; editing time is reduced; and the presentations are quite professional.

they cut corners to increase compression and lose some of the data contained in the original image.

The latter are designed so that the losses will have little effect on the final image. The red apple won't reappear as blue, but it may be grainier or have a much more homogeneous red surface. Image quality is the last and most subjective factor. Some of the problems of various lossy algorithms are documentable, but often people simply develop preferences for the qualities of certain algorithms and ratios.

Apple designed QuickTime with the future in mind. QuickTime has three built-in compression schemes as well as room for either Apple or third-party developers to add new algorithms.

The basic algorithm is the Joint Photographic Experts Group (JPEG) international standard, which is based on the discrete cosine transform. This mathematical approach models each segment of the image with several cosine functions.

The JPEG standard allows some information to be lost when there is a tiny amount of noise in the image, because it lumps large, similarly colored regions into one chunk. The quality is very good, and the compression ratios are generally impressive (about 10 to 1), but the algorithm is computationally expensive.

Compression using the JPEG standard can take 60 seconds on a Mac IIcx. This is acceptable for still images, but it is much too slow for full-motion video and animation. This fact will change in the distant future, when faster processors are available. When this happens, the compression system will be able to grow to include new systems to take advantage of these processors.

The other two built-in compression

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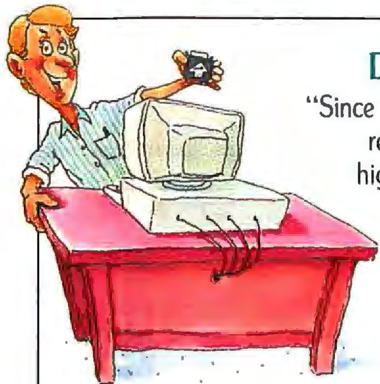

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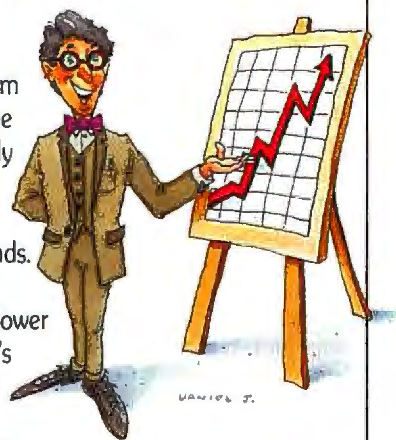

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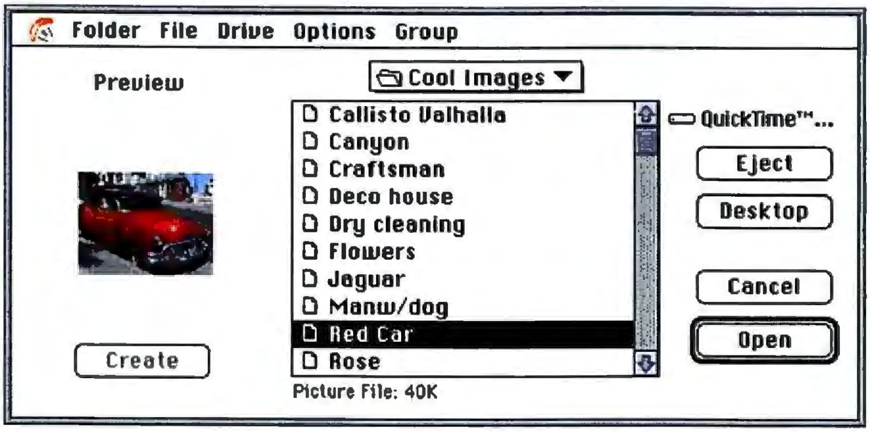

QuickTime provides a new file requester to handle the new PICT format. Applications can store a thumbnail sketch of a PICT image in the resource fork of the file. The file requester displays the sketch. Thus, you can get an idea of what a picture file looks like without having to load the entire file.

algorithms were designed by Apple to handle real-time video decompression. One works well for video images (its internal name was RoadPizza), and the other is tuned for the noise-free domain of computer-synthesized animation. Both processes do temporal as well as spatial compression: They look for redundancy between sequential frames of animation, and then they compress the repetition. The algorithms are simple, and they can run efficiently at video speed on a standard Macintosh. The documentation, for instance, reports that a Mac can practically display a 240- by 180-pixel image at 15 frames per second. The maximum compression of a video is 25 to 1, but average ratios are much less. They usually range from 5-to-1 to 6-to-1.

The differences between the compression techniques are largely transparent to the user and the programmer. Whenever you want to open up an image, the Image Compression Manager finds the proper decompression code and provides the decompressed image. In the future, more compression algorithms will probably be developed, and QuickTime can expand to hold them. There are already hardware implementations of the JPEG standard, and QuickTime will be able to take advantage of them.

The Component Manager

Apple will release the Component Manager in conjunction with QuickTime because it provides many necessary services for QuickTime. The Component Manager lets an application ask the system software for a particular solution; the system then provides the best solution available. When a QuickTime application asks for a JPEG decompressor, the system will check to see if it has a hardware board available to do the work. If it does, the system tells the application to call up the hardware; otherwise the system informs the application of the location of a software decompression routine.

The Component Manager can make value decisions and choose, for example, between the fastest or the most accurate decompression routine. Apple has designed a standard set of flags and values that specify the characteristics of a solution (e.g., a particular compression algorithm's speed or quality). These flags also describe the formats that an algorithm can handle, as well as any undocumented technical details, such as the pipeline latency. When the system starts up, the Component Manager assembles a list of the algorithms so that it can provide the best one for the particular job.

The Component Manager software is designed for use by all software. Software will be able to ask for either the fastest or the most accurate hardware/software combination installed in a host computer, and the Component Manager will provide the pointers to the best resource. The Component Manager should prove useful in many other areas (e.g., encryption or telecommunications).

The Interface Factor

Naturally, Apple issued a number of Human Interface Guidelines for programmers creating software that will utilize QuickTime movies and still pictures. It wants to ensure that every application sports a consistent and standard interface for manipulating movies and pictures.

Apple provides some of these ideas as standard Toolbox routines so that the developer needs to write only one line of code to solve simple problems. One of these standard interfaces is the Open File dialog box. Before QuickTime, this routine would just display a scrolling list of files and let you move from folder to folder. This list just held the name of the file, and that alone is often not very helpful.

Now the Open File dialog box includes a small image of the file when a picture or movie is currently selected. In movies, this image is stored as a particular one-frame track. Another track called a *preview* points to a 3-second section of the movie.

When you select a still photo, the new Open File dialog box displays a smaller version of the image called a *thumbnail* PICT (see the photo). The thumbnail is stored in the Resource Fork of the file by QuickTime-aware software, so the system doesn't have to open the entire image file and compute a little compressed version. This would take too long and make the previewing dialog box unusable.

The Human Interface Team also provides a standard movie controller with play, fast-forward, and rewind buttons. A scroll bar lets you scroll through a movie the same way you'd scroll through a document. The team was thinking ahead when it required a sound-muting button, because the software can be used in places where loud soundtracks are inappropriate. This standard movie controller is designed to be included in every QuickTime application.

Apple has also considered some of the more subtle interface issues that may cause problems for a user. Remember that a QuickTime movie can be a collection of pointers to other data files. What happens, then, if you copy a movie to another system without these basic data files? The Human Interface Guidelines suggest that the save boxes warn you of this possible danger and provide a way to save a complete version of the movie with all the necessary data embedded inside of it.

First Impressions

QuickTime was "introduced" in June, but don't look for it on dealers' shelves. You must be a certified developer just to look at the information provided with the beta release. By the time you read this article, QuickTime-aware software should be making its way into the world in new versions of multimedia programs, word processors, and drawing programs.

The adoption of QuickTime, however, doesn't mean that your Macintosh will have achieved multimedia nirvana. On my Mac II, the software was slow, although it was smooth and usable. The seamless execution is a tribute to Apple's engineering ability. The company has created good compression schemes that work well on older, slower machines. QuickTime, in fact, works on any color Macintosh, including the LC.

On the other hand, QuickTime makes it apparent that home computers are just not ready to edit a Hollywood production. Even when compressed at a 10-to-1 ratio, some images that I worked with still took up 40 KB of memory. Thus, you might be able to store 1000 of your home photos on a 40-MB disk at about 600 by 500 pixels of resolution—a far cry from the 150,000 much higher quality frames used in a feature film.

To illustrate the processing power and storage required for multimedia, consider the QuickTime demo that Apple distributes on a 1.4-MB floppy disk. The demo takes a few minutes to decompress before the speaker starts trumpeting and the movie begins. The accompanying animation is displayed on a small portion of the screen—about 100 pixels square. The movie—a NASA rocket disposing of a spent booster stage—is over in less than a minute.

Although multimedia on home computers seems a bit sluggish, this is almost certain to change in the future. Apple has made QuickTime open-ended so that it can grow as faster machines, cheaper memory, and next-generation CD-ROM drives arrive. Given the importance of solid yet flexible standards in any new technological area, you might say that QuickTime has arrived just in time. ■

Peter Wayner is a BYTE consulting editor and is working toward a Ph.D. in computer science at Cornell University. You can reach him on BIX as "pwayner."

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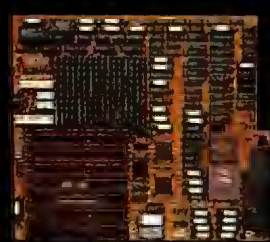

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fax: (818) 577-2426
Circle 1188 on Inquiry Card.

MacroMind, Inc.
(MacroMind Three-D: Mac)
600 Townsend St., Suite 310W
San Francisco, CA 94103
(415) 442-0200
fax: (415) 442-0190
Circle 1189 on Inquiry Card.

Pixar
(RenderMan and MacRenderMan: MS-DOS, Mac, and Unix)
1001 West Cutting Blvd.,
Suite 200
Point Richmond, CA 94804
(510) 236-4000
fax: (510) 236-0388
Circle 1190 on Inquiry Card.

Silicon Beach Software, Inc.
(Super 3D: Mac)
9770 Carroll Center, Suite J
San Diego, CA 92126
(619) 695-6956
fax: (619) 695-7902
Circle 1191 on Inquiry Card.

SoftImage, Inc.
(SoftImage 3D: Unix)
3510 Blvd. St. Laurent,
Suite 214
Montreal, Quebec,
Canada H2X 2V2
(514) 845-1636
fax: (514) 845-5676
Circle 1192 on Inquiry Card.

Thomson Digital Image
(TDI Explore: Silicon Graphics workstations; TDImage: IBM RISC System/6000/AIX)
1270 Avenue of the Americas,
Suite 508
New York, NY 10020
(212) 247-1950
fax: (212) 247-1957
Circle 1193 on Inquiry Card.

Visual Information Development, Inc.
(Presenter Professional 1.0: Mac)
16309 Double Grove
La Puente, CA 91744
(818) 918-8834
fax: (818) 918-9935
Circle 1194 on Inquiry Card.

Wavefront Technologies
(Dynamic Imaging System: Unix)
530 East Montecito St.,
Suite 106
Santa Barbara, CA 93103
(800) 346-9283
(805) 962-8117
fax: (805) 963-0410
Circle 1195 on Inquiry Card.

AUTHORING SYSTEMS

AimTech Corp.
(IconAuthor 4.0: Windows 3.0)
20 Trafalgar Sq.
Nashua, NH 03063
(800) 289-2884
(603) 883-0220
fax: (603) 883-5582
Circle 1196 on Inquiry Card.

Allen Communication, Inc.
(Quest: MS-DOS)
5225 Wiley Post Way,
Suite 140
Salt Lake City, UT 84116
(800) 325-7850
(801) 537-7800
fax: (801) 537-7805
Circle 1197 on Inquiry Card.

Asymetrix Corp.
(ToolBook Multimedia Resource Kit: Windows 3.0)
110 110th Ave. NE, Suite 717
Bellevue, WA 98004
(800) 624-8999
(206) 637-1500
Circle 1198 on Inquiry Card.

Authorware, Inc.
(Authorware Professional: Windows 3.0, Mac)
275 Shoreline Dr., Suite 535
Redwood City, CA 94065
(800) 288-8108
(415) 595-3101
fax: (415) 595-3077
Circle 1199 on Inquiry Card.

CEIT Systems, Inc.
(Authology: MultiMedia: MS-DOS)
4800 Great American Pkwy.,
Suite 200
Santa Clara, CA 95054
(408) 986-1101
fax: (408) 986-1107
Circle 1200 on Inquiry Card.

Commodore Business Machines, Inc.
(AmigaVision: AmigaDOS)
1200 Wilson Dr.
West Chester, PA 19380
(800) 662-6442
(215) 431-9100
fax: (215) 431-9156
Circle 1201 on Inquiry Card.

Edudisc, Inc.
(Mentor/MacVideo: Mac)
1400 Tyne Blvd.
Nashville, TN 37215
(615) 373-2506
Circle 1202 on Inquiry Card.

IBM
(Storyboard Live: Windows 3.0, OS/2)
Old Orchard Rd.
Armonk, NY 10504
(800) 426-2468
(914) 765-1900
Circle 1203 on Inquiry Card.

Meridian Data, Inc.
(VR Producer: MS-DOS)
5615 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-3100
fax: (408) 438-6816
Circle 1204 on Inquiry Card.

Network Technology Corp.
(MediaScript: MS-DOS, OS/2, Windows 3.0)
7401-F Fullerton Rd.
Springfield, VA 22153
(703) 866-9000
fax: (703) 866-9007
Circle 1205 on Inquiry Card.

Ntergaid, Inc.
(HyperWriter: MS-DOS)
2490 Black Rock Tpke.,
Suite 337
Fairfield, CT 06430
(203) 368-0632
fax: (203) 380-1465
Circle 1206 on Inquiry Card.

Tiger Media, Inc.
(Cats Meow: Sparcstation)
5801 East Slauson Ave.,
Suite 200
Los Angeles, CA 90040
(213) 721-8282
fax: (213) 721-8336
Circle 1207 on Inquiry Card.

V_Graph, Inc.
(VirtualVideo Producer 3.5: MS-DOS)
P.O. Box 105
1275 Westtown Thornton Rd.
Westtown, PA 19395
(215) 399-1521
fax: (215) 399-0566
Circle 1208 on Inquiry Card.

VideoLogic, Inc.
(M.I.C. System: MS-DOS)
245 First St.
Cambridge, MA 02142
(617) 494-0530
fax: (617) 494-0534
Circle 1209 on Inquiry Card.

Vision Imaging
(Media Master: MS-DOS)
10231 Slater Ave., Suite 112
Fountain Valley, CA 92708
(714) 965-7122
fax: (714) 965-7118
Circle 1210 on Inquiry Card.

Wonder Corp.
(Wonder Desktop Studio: MS-DOS)
51 Winchester St.
Newton Highlands, MA 02161
(617) 965-8400
fax: (617) 965-6817
Circle 1211 on Inquiry Card.

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ELVIS HAS BEEN SIGHTED. And you're rocking and rolling through a presentation on his life and times, thinking what a blessing it would be if your PC could sing and dance to his greatest hits. On CD, of course.

Introducing CDPC™ One-Stop Multimedia from Media Vision™

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What's the big deal about multimedia anyway, you ask? Well, for starters: sound, music and visuals enrich business presentations beyond your wildest expectations. Interactivity lets you tailor your communication, precisely—to fit each audience's specific interests. And features like CDPC's external volume control, built-in speakers and microphone make presentations a breeze.

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So, if you're playing games, or playing music, your PC can once and for all be heard. Loud and clear. PC games, for example, get so highly-fueled with sound, they're down right explosive. Characters come roaring to life. Plus, CDPC is Sound Blaster and AdLib compatible, helping you access virtually all your favorite software. Like Battle Chess, Wing Commander, Jones In The Fast Lane, you name it.

Regardless of whether you're scoring points or scoring music, the multi-source analog mixer gives you total control over the audio output. Also, CDPC is MPU-401 compatible. And offers a full orchestra at your command—with 4 operator FM synthesis that delivers 20 instrument sounds, simultaneously. That's entertainment!

MPC
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Windows For A Song. (And That's Not All.)

What's more, you get Microsoft® Windows™ graphical environment with Multimedia Extensions 1.0. FREE. Which means that you can begin opening windows to your multimedia world immediately. If not sooner.

Plus two FREE software applications! Jones In The Fast Lane by Sierra On-Line, the ultimate parlor game of the '90s. And Compton's Multimedia Encyclopedia, which contains twenty-six volumes worth of valuable information. And a whole lot more.

Altogether, that's over a $1000 worth of FREE software.

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Media Vision, 47221 Fremont Boulevard, Fremont, CA 94538. 510-770-8600, FAX: 510-770-9592

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THE PERFECT PITCH

The BYTE Lab evaluates 15 presentation packages that promise style and flair for your visual presentations

STANFORD DIEHL

A room full of people is waiting. It's now your turn to speak, impress these people, and sell them on your ideas. Skeptical eyes stare up at you. What those eyes demand—professionalism, a dynamic delivery, and subtle wit—is not nearly as intimidating as what they really expect: to be bored out of their minds. Your heart skips a beat. You feel beads of perspiration break out on your forehead. You're all alone.

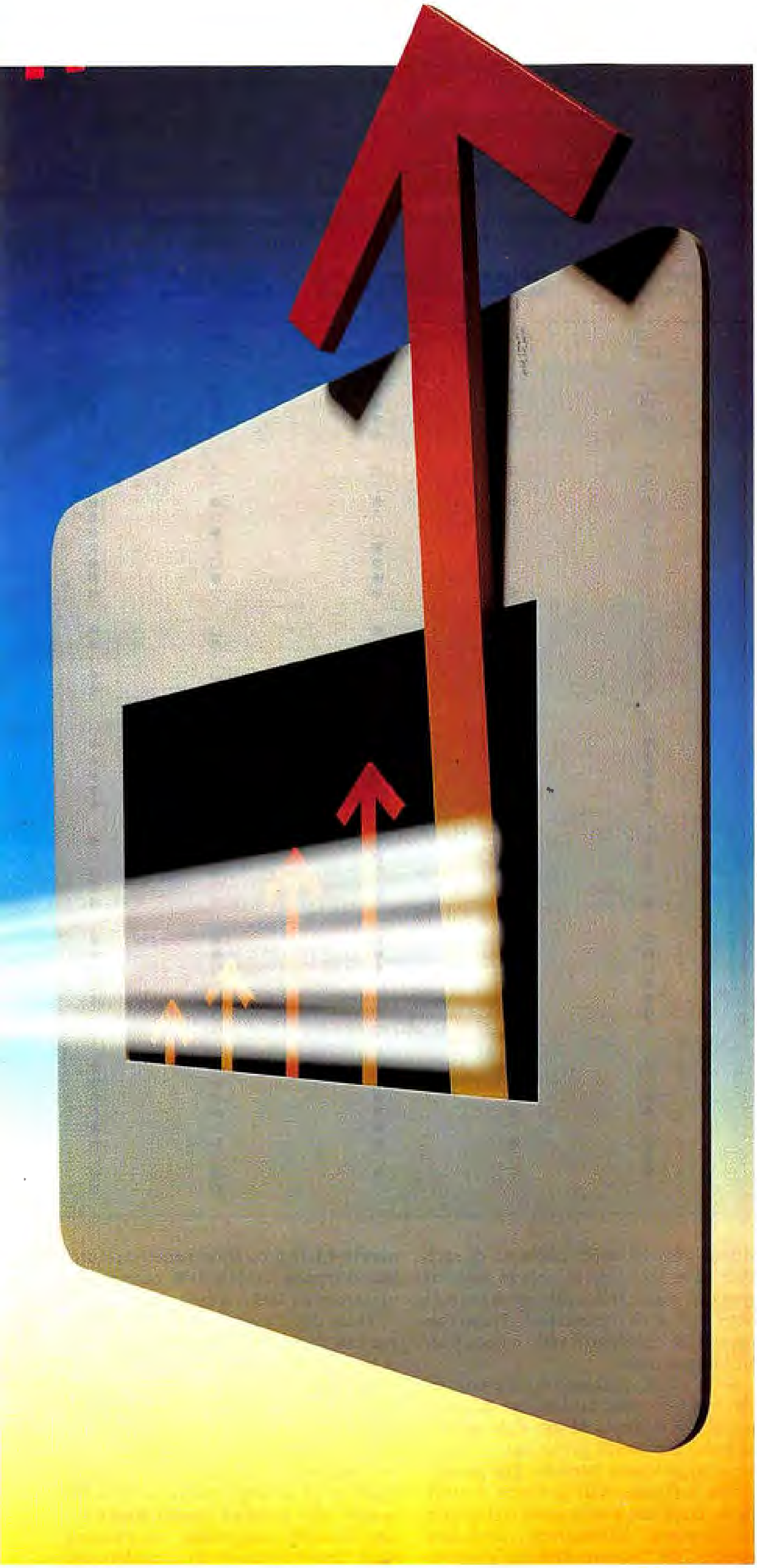
And yet, this is not the moment of truth. The real work came in the days leading up to your presentation. Only confidence built on solid preparation can cure the jitters and ensure a smooth delivery. As you introduce yourself, your first slide appears. The audience's eyes turn. A professional is at work. Cues start firing off in your head. You're not so alone after all. . . .

In the demanding world of business presentations, audiences have come to expect powerful visual aids. Information conveyed visually impresses in a way that oral communication alone cannot. Today's sophisticated presentation software can take some of the struggle out of the hard work of preparing slide shows. Best of all, the software can provide the tools you need to make shows that sparkle.

This month, the BYTE Lab takes a look at 15 of the top presentation packages available for Windows, DOS, and the Mac (see the text box "Mac Presentations: A Mixed Quartet" on page 216 for Mac-specific evaluations). The packages reviewed are Persuasion 2.0 (Windows and Mac), Applause II 1.5 (DOS), GraphShow 1.1 (Windows), CA-Cricket Presents 1.3 (Windows and Mac), Presentation Team 2.0 (DOS), Hollywood 1.0 (Windows), Freelance Plus 4.0 (DOS), Charisma 2.0 (Windows), PowerPoint 2.0 (Windows and Mac), Harvard Graphics 3.0 (DOS), More 3.0 (Mac), and DrawPerfect 1.1 (DOS).

Presentation software has come a long way in the past year alone. Windows 3.0 and the rise of the GUI account for much of that progress. With its heavy reliance on graphical elements, presentation software is a natural fit in the graphical environment of Windows and the Mac.

PHOTOGRAPHY ELLE SCHUSTER © 1991



BYTE ACTION SUMMARY

- **WHAT PRESENTATION SOFTWARE DOES**
  It provides all the tools for creating and managing visual presentations.
- **LIKES**
  The best products offer a wide range of features for producing dazzling output. Device support for slide service bureaus, film recorders, popular printers, and VGA screens gives professional presenters a complete choice of media.
- **DISLIKES**
  The full-featured programs are somewhat complex and require large amounts of disk space.
- **RECOMMENDATIONS**
  Harvard Graphics 3.0 delivers features and power that other DOS-based products can't match. If you run Windows, which is the better platform for presentation graphics, Persuasion 2.0 is the top product. For the Mac, pick More 3.0 for building good-looking presentations in a hurry; if you must have the maximum in artistic and creative control for Mac-based presentations, then choose Persuasion.

DOS Is Still in the Game

Many venerable DOS presentation products were being revised for Windows as this issue went to press, including Freelance Plus and Harvard Graphics. These and other Windows products from major software vendors should be on the shelves by the time you read this.

This is not to say, however, that the DOS-based products are dead in the water—far from it. In a readership survey BYTE conducted for this review, a majority of those responding said that they still used DOS-based presentation products rather than Windows packages. As reflected in the survey, Harvard Graphics dominates the PC market, and the release of version 3.0 demonstrates Software Publishing's commitment to the DOS platform.

Clearly, not all corporate users have standardized on Windows, and even the DOS-based packages have become more sophisticated and easier to use. It therefore seemed wise for me to evaluate the DOS-based presentation applications separately and select a top product for that category.

continued

PRESENTATION PROGRAM FEATURES

The best presentation packages offer an array of tools and utilities to create, manage, and display your presentations. (● = yes; ○ = no.)

	Aldus Persuasion 2.0	Ashton-Tate/Borland Applause II 1.5	Chartersoft GraphShow 1.1	Computer Associates CA-Cricket Presents 1.3	Digital Research Presentation Team 2.0	IBM Hollywood 1.0
Price	$495	$495	$259	$199	$495	$495
Platform	Windows/Mac	DOS	Windows	Windows/Mac	GEM (DOS)	Windows
Layout tools						
On-screen ruler	●	○	●	●	●	●
Grid	○	●	●	●	●	●
Customizable grid	○	●	●	●	●	●
Guidelines	●	○	○	●	○	○
Presentation tools						
Master page	●	○	●	○	○	●
Multiple master pages	●	○	○	○	○	○
Gradient background	●	●	●	●	●	●
Layered pages	●	○	○	○	○	●
Global color schemes	●	○	○	○	●	●
Outliner	●	○	○	●	○	●
Speaker notes	●	○	○	●	○	●
Audience handouts	●	○	○	●	●	●
Load multiple files	○	○	●	●	○	●
Slide-show tools						
WYSIWYG thumbnail sequencer	●	○	○	●	○	●
Slide title sequencer	●	●	●	●	●	●
Number of transitional effects	8	25	13	11	0	11
Overlay slides	●	●	●	○	○	●
Stand-alone run-time module	○	●	○	○	○	●
Charting						
Number of data graph types	9	37	36	9	7	11
Exploded pie	●	●	●	○	●	●
Combination	●	●	●	○	●	●
Tables	●	●	●	●	●	●
Organizational	●	●	●	○	○	●
Link to external worksheet	○	●	●	○	○	●
Text						
Scalable fonts	●	●	●	●	○	●
Text ruler	●	○	●	●	○	○
Rotate text	○	●	●	○	●	●
Search and replace	●	○	○	○	○	●
Spelling checker	●	●	○	○	○	●
Object effects						
Align	●	●	●	●	●	●
Group/ungroup	●	●	●	●	●	●
Step and repeat	●	○	●	●	○	●
Flip	●	●	●	○	●	○
Rotate	●	●	●	○	●	●
Blend	○	●	●	○	○	○
Crop	●	○	●	○	○	○
Import data formats						
ASCII	●	●	●	●	○	●
WMF	●	○	●	●	●	●
PCX	●	●	●	●	●	●
TIF	●	●	●	●	●	●
EPS	●	○	○	●	○	●
WK1	●	●	●	●	●	●
DBF	●	●	○	○	○	○
CGM	●	●	●	●	●	●
IMG	○	○	○	○	●	●

Professional Images

The best software in each of the three groups will help you create beautiful presentations (see the features table). You can generate text charts, data graphs, tables, organizational charts, and even freehand drawings. Master pages, gradient backgrounds, color schemes, and templates ensure the consistency of your presentation.

The best packages can also support the management of your slide show. With some, you can develop the presentation using an integrated outliner, which lets you carefully plan the sequence of your visuals and the major elements of each slide. You will also be able to spin off speaker notes and audience handouts from your slide presentation. These two steps alone can significantly reduce your preparation time.

Some of the packages bundle utilities that convert your slides into formats acceptable to major 35mm slide service bureaus. For small gatherings, you can use a large-screen monitor. The presentation software will produce a slide show, complete with transitional effects and overlays. Alternatively, projection screens like Ovation, Proxima's active-matrix LCD projection panel, can project computer presentation output with more than 24,000 colors.

These days, a good presentation package can do just about everything except offer a pat on the back when showtime is over and the deal is done. The benefit of the best presentation software is that you don't have to be an artist to generate professional slide shows, and that's an important point. In BYTE's reader survey, eight out of 10 respondents said that the people who conduct presentations are also directly responsible for creating them. Only 12 percent of our readers said

PRESENTATION PROGRAM FEATURES

Lotus Freelance Plus 4.0	Micrografx Charisma 2.0	Microsoft PowerPoint 2.0	Software Publishing Harvard Graphics 3.0	Symantec More 3.0	WordPerfect DrawPerfect 1.1
$495	$495	$495/$395	$595	$395	$495
DOS	Windows	Windows/Mac	DOS	Mac	DOS
○	●	○	●	●	○
●	●	●	●	●	●
●	●	○	●	●	●
○	○	●	○	○	○
●	○	●	○	●	○
○	○	●	○	○	○
●	●	●	●	●	●
○	○	○	●	○	○
○	○	●	●	●	○
●	○	○	○	●	○
○	○	●	●	●	○
○	○	●	●	●	○
○	○	●	○	●	●
○	○	●	○	○	○
●	○	●	●	○	●
14	11	0	9	24	42
○	○	○	●	○	●
●	○	○	●	○	●
11	8	10	7	10	8
○	●	●	●	●	●
●	●	○	●	●	●
●	●	○	●	●	○
●	○	○	●	●	○
●	●	●	●	●	●
●	●	●	●	●	●
○	●	●	○	●	○
●	●	○	●	○	●
○	○	●	○	●	○
●	○	●	●	●	○
●	●	○	●	●	●
●	●	○	●	●	●
●	○	○	●	○	○
●	●	○	●	●	●
●	●	○	●	●	●
○	○	○	●	○	○
○	○	●	○	○	○
●	●	●	●	●	●
○	●	●	○	○	○
○	●	●	●	○	●
●	●	●	●	○	●
○	●	●	○	●	●
●	●	●	●	●	●
●	○	○	●	○	○
●	●	●	●	○	●
○	○	○	○	○	●

they could count on an art department to produce visual aids.

Bringing It All Together

I created a presentation designed to test the basic capabilities of presentation software. The test included a title page that contained a simple logo stored in several graphics formats, including PCX, BMP, WMF, EPS, and TIF. I placed the logo and the date on the master page (when available in the individual package) or in the background so that it would repeat on each page. I then applied a suitable gradient background.

Other parts of my presentation were a multiple-level bullet chart, a pie chart with an exploded slice, two bar charts on a single page with annotations and a customized grid, a shaded table with ASCII-imported text, and an organizational chart. I generated the charts and tables using data imported from a Lotus 1-2-3 release 2.3 spreadsheet. Each package reviewed provides a unique mix of features for getting these elements down on paper and up on the screen. This mix determined how quickly I could create a presentation and how appealing the final result looked.

Throughout the test, I created lines, boxes, and ovals using simple drawing tools and placed the elements on the page using any special layout tools the package supported. A few tools proved especially useful. One element consisted of three overlapping ovals. The trick was to maintain the same vertical and horizontal spacing between the first and second and the second and third ovals. The best tool for this operation is called *step and repeat*. (Often, this function is also called *duplicate*, although that term can refer to simple copying.) Using the step-and-repeat feature, I could specify a vertical and horizontal offset when duplicating the ovals (i.e., objects). I then placed text inside the ovals and attempted to group all three ovals and the associated text into a single object. I could then move the entire set of objects as one complete unit.

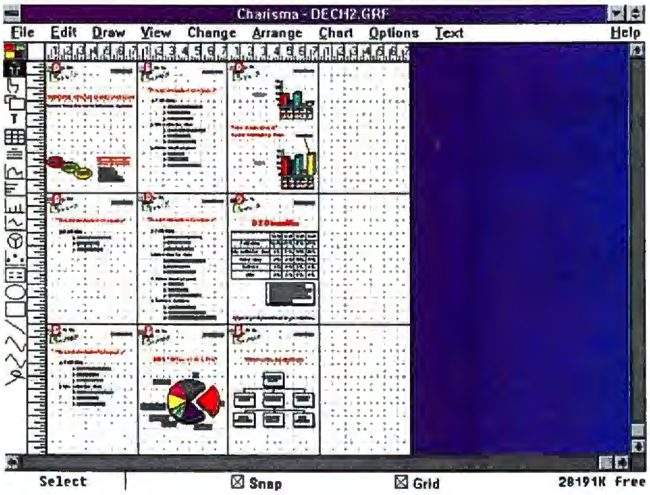
Presentation software can combine all your slides into an integrated slide show. You can set the order and duration for displaying each slide on-screen. The slides cycle automatically after a designated delay or change each time you click the mouse. A good slide-show utility will support a wide range of transitional effects. These effects determine the way in which one slide disappears and the next one appears. For instance, a *dissolve* will cause one slide to slowly fade away as the next slide in sequence appears on-screen.

An on-screen ruler aids almost any layout chore, as do guidelines and a grid. The ruler appears along both the horizontal and vertical margins of the page. The grid feature places a grid on the screen and lets you snap objects to both the horizontal and vertical lines of the grid. You can usually customize the grid by designating horizontal and vertical spacing. Guidelines provide you with a little bit more flexibility: You can drag a guideline across the screen, place it wherever you choose, and then line up objects on it.

Other useful tools apply special effects to objects. Such effects let you flip an object horizontally or vertically, rotate an object to a specified degree, or blend one or more objects. The blend tool (also called *evolve*) will automatically create all the intermediate objects necessary to change one selected object into another. For instance, if you selected a square and a circle, a set of objects would be drawn, each one with corners more rounded. The tool creates some interesting gradient effects and, in the case of Harvard Graphics, can even facilitate simple animation.

continued

WINDOWS PRESENTATION SOFTWARE



Screen 1: *Charisma lays your presentation out on a four- by three-page workspace. This structure was harder to work with than those of the other Windows-based products.*

Charisma 2.0

Micrografx Charisma is a powerful presentation package that has a steep learning curve. You can pull off sophisticated effects with its advanced capabilities, but it takes time to get used to Charisma's unique approach. The interface has rulers and a grid, and both are fully customizable. There are no guidelines, but a crosshair feature shows you exactly where your cursor is in relation to the horizontal and vertical rulers. There is no step-and-repeat feature.

The software offers some nice time-saving touches. You can add any command from the menu to the on-screen icon bar. This lets you position commonly used commands a mouse-click away. When you use a certain text style, Charisma places that style on the menu bar for simple selection the next time you need it. Despite these conveniences, the overall package design is confusing.

Charisma does not conform to the usual metaphor of individual slides making up a presentation. Instead, each file is composed of 12 pages in a four- by three-page grid (see screen 1). When I first created a presentation, I ordered the pages from left to right and then down. The correct order should have been down and then over. This mistake caused my slide show to run out of sequence. It actually seemed easier to make each slide a file, but since you can open only one file at a time in Charisma, this turned out to be more trouble than it was worth. In general, the design demands some effort before you get accustomed to it.

Once you do get the hang of Charisma, it rewards you with some impressive power. Its file support is unmatched. I found myself turning to Charisma when I needed to convert among different file formats. For instance, I imported my logo as a bit-map image (PCX) and exported it as Encapsulated PostScript. Charisma can also create an EPS file with a TIF preview attached to it. This lets you see your EPS files on-screen. With such top-notch file support, Charisma works well with other software you might use to build your presentations, such as sophisticated drawing packages and third-party slide-show utilities.

The graphing component was also excellent. I could do exactly what I wanted when it came to data graphs, including making pie slices separate components, changing numerical grids to a different range, and revising percentage labels for the pie slices. You select components of the graph (e.g., a pie slice) and move them independently. Charisma cannot create organizational charts, but the drawing features are strong enough to make up for it.

Charisma serves up a rich set of easy-to-apply templates to create word charts. The templates include many multilevel bullet charts, which are easy to edit and customize. Paragraph settings further enhance the power of text charting.

The slide-show component is somewhat difficult to use, but, again, you are rewarded with some powerful capabilities. Unlike other Windows packages, Charisma doesn't automatically place the active pages into a slide-show format; you have to add the slides manually. There are plenty of transitional effects and other tools for building the presentation, and Charisma makes up for slow slide-show performance by predrawing slides in memory.

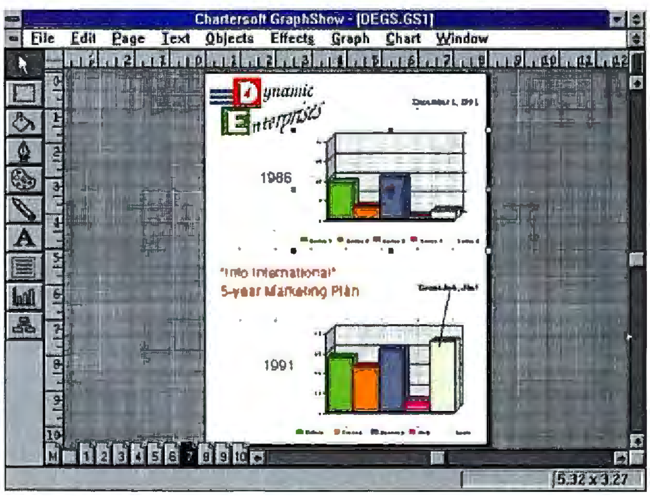
This is powerful software. Just be prepared to spend time learning the ropes. I think that Persuasion offers comparable power with a gentler learning curve.

GraphShow 1.1

While this review focuses on the market leaders, I simply couldn't overlook one newcomer: Chartersoft's GraphShow. This package, with its depth of features and a well-designed interface, stands up well against an imposing field.

My title page was a breeze to create in GraphShow, thanks to a strong set of drawing and layout features (see screen 2). The interface includes an on-screen ruler. A small line on the ruler shows the position of the cursor. You can also turn on a grid and customize it, but you can't set up guidelines. GraphShow will track an exact cursor position as well as report

Screen 2: *GraphShow boasts strong layout features. Note the on-screen ruler, grid marks, and object dimensions in the lower right-hand corner.*



the dimensions of a selected object.

The duplicate tool made it easy to place objects at equal intervals. In addition to letting you specify an offset, the duplicate dialog box lets you rotate a duplicated object to any angle. If that's not enough, GraphShow provides a complete set of alignment options to finish the design job. You'll find the standard set of drawing tools and effects to scale, rotate, flip, blend, and crop objects.

GraphShow does not support predefined text styles, but it does let you modify a full set of character attributes from a single dialog box. You can also assign paragraph attributes easily. This made it simple to create bullet charts: From the paragraph-style dialog box, you can define indents and spacing as well as select an assortment of bullet characters (or none at all) for the paragraph. Text charting automates the procedure, but you are limited to predefined formats.

GraphShow imported my Lotus 1-2-3 worksheet and generated some attractive three-dimensional graphs. You can reposition elements of the graphs (e.g., pie slices) by clicking and dragging them, but for some reason, you can't move data labels that way. Drawing an organizational chart was so easy I started wondering if Chartersoft had designed the software with my project in mind.

The slide-show facility did not support WYSIWYG thumbnails of the slides but used slide titles instead. I couldn't click and drag the titles to rearrange slides but could do it using cut and paste. The title sorter's strongest suit was a wide range of transitional effects, all easily selectable from a set of icons. Nevertheless, I would have liked to see WYSIWYG thumbnails in a Windows product.

The software has some weaknesses. It does not generate speaker notes or handouts. You can't create layered slides, but an overlay transitional effect makes this less of a problem. And there are a few signs of an immature product. For example, a check box for customizing the scale of a bar graph was not visible until I clicked on it. Also, I ran into an error when importing my Windows metafile.

Given the impressive performance of GraphShow as a whole, I think Chartersoft will iron out the kinks. This is a strong new entry in a brutal field of contenders. If you find yourself intimidated by the complexity of some packages, GraphShow is an easy-to-use alternative.

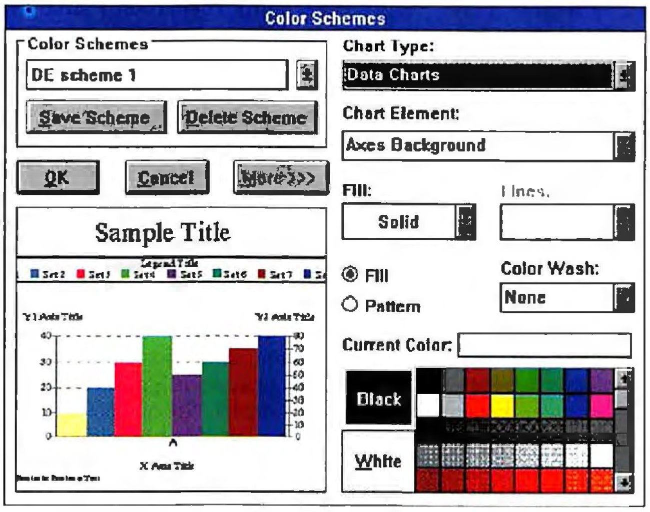
Hollywood 1.0

With Hollywood, IBM makes it even tougher to choose a Windows presentation package. In a single release, the company has packed in an impressive set of high-end features, including WYSIWYG sorting, master pages, layering, and an all-in-one formatting component called Color Schemes (see screen 3), which helps your slide show achieve a unified style.

Hollywood has a full complement of drawing tools. Layout operations are enhanced by an on-screen ruler, a customizable grid, and a display of *x,y* coordinates during drawing operations. The duplicate function is the most powerful one reviewed here. After selecting an object, you can align a duplicate with the original or select a precise offset.

But Hollywood doesn't stop there. You can select how many duplicates you want to produce and send each to a different layer of the page. You can scale subsequent duplicates to a percentage you define and even blend the duplicates from the same dialog box. The blend option lets you set the color of the final duplicate. Each intermediate duplicate is shaded a color between that of the original object and that of the final duplicate. For instance, if you select a red object and designate a purple color blend, each duplicate will have a little more blue added than the one before it.

My bullet chart was a snap to create using the integrated outliner. I could assign different sections of the chart to multiple layers or, easier still, call up the Layer dialog box and assign layering effects to the entire page. This includes such effects as progressive build, which automatically displays one bulleted item at a time instead of forcing you to speak in front of a single, static screen. The outliner also made it easy to create and edit organizational charts.



Screen 3: *With Hollywood's Color Schemes, you can set all your formatting options from a single dialog box and ensure a consistent look across multiple slides.*

To further facilitate text entry, Hollywood lets you define text styles. You can define font, point size, and whether the characters are roman, italic, or bold. Hollywood even lets you set line justification and text spacing. These styles are then readily available from the menu bar when you need to apply them to your text.

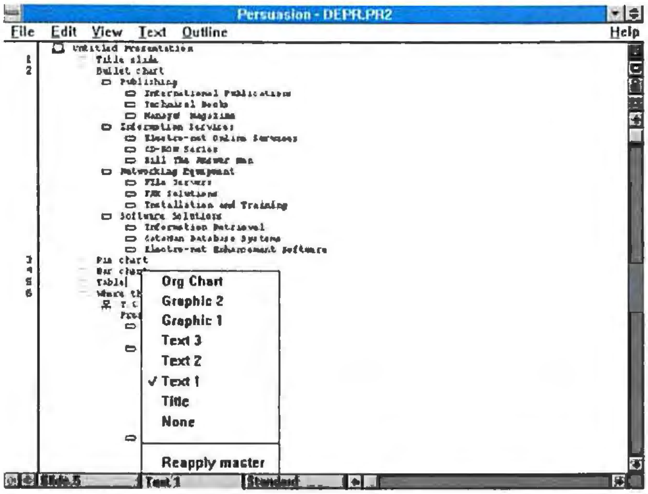
The entire format of a presentation can be set from the Color Schemes dialog box. This feature is somewhat complex but extremely powerful. It allows you to apply consistent formatting to every part of your presentation. You can set different attributes, such as color, line style, fill patterns, and font syles, for all elements of your presentation.

Although Color Schemes deserves credit for helping you ensure a consistent color mix across multiple pages, the tool is also a bit inflexible. It would be nice, for instance, to change the colors of a bar chart from the Chart Options box, but you can do this only from the Color Schemes menu.

The charting module, in general, is also fairly inflexible. I couldn't customize the axis on my bar chart, and once I placed the chart on the page, I couldn't select individual components, such as a legend or a label. Furthermore, I could move only the entire graph around the page.

Hollywood has a steep learning curve, but it stacks up well in terms of power and features. The layering options are simply unbeatable. And yet, when you look for that optimal mix of power, flexibility, and ease of use, Persuasion is still the one to beat.

continued



Screen 4: *Persuasion eases your design job with an outliner and multiple master pages. You can apply masters directly from the outliner view (as shown here).*

Persuasion 2.0

Aldus Persuasion combines the best of both worlds on a Windows platform. If you need to put together a simple demonstration quickly, Persuasion is intuitive and follows the basic rules of Windows. Later, if you want to add some fancier effects and exploit the full power of a sophisticated presentation program, Persuasion won't let you down.

Persuasion offers you all the amenities of a full-featured presentation package: an outliner, multiple master pages, a WYSIWYG sorter, and a bundled copy of Adobe Type Manager (ATM) to make sure your output looks great. You start from the outliner, mapping out the elements of your presentation (see screen 4). You can then apply a master template to each slide directly from the outliner module, or you can go to the master page and edit each master separately. Persuasion automatically applies the masters to the outline and generates a set of slides. If you don't like to proceed that way, you can build a presentation in the traditional way, working on each slide individually and ignoring masters altogether. Flexibility is certainly Persuasion's strongest asset.

Persuasion handled my project so easily it was almost embarrassing to use some of the other packages. First, I applied the logo and date to the background and then edited the master pages to conform to my specifications. Strong layout features assisted me when creating the title page. Persuasion supports an on-screen ruler and multiple guidelines. You can't customize the ruler or display a grid, but you can snap to the ruler, which works the same as a grid feature. Other design aids include alignment options and step and repeat. Special effects support rotation, flipping, cropping (i.e., cutting away parts of a graphic), and shadowing.

To create the bullet chart, I entered the text in the outliner. Persuasion has a template for master text charts, so I applied it to the page from the outliner. The specs weren't quite right, but that was no problem. I simply brought up the master page, selected the text master, and edited it to my liking. You can also create new masters from scratch.

Persuasion also supports multiple layers for each page. You can select objects on the page and apply them to different layers. The software then displays each layer in sequence during a slide show. This is a powerful feature that some of the best programs lacked.

The graphing component supplies the expected variety of chart types. Once I placed the charts on the page, I could move elements (e.g., pie slices, legends, and labels) around freely. Each piece of the chart is a fully independent object. This structure contributes to the program's impressive flexibility.

Using the same steps for creating other pages in the presentation, I entered the names for my organizational chart into the outliner and applied the "org" chart master page to it. That's all it took. I created my table by filling in the worksheet and selecting Table as the chart type. I was then able to change fonts as if the text had been entered with the text tool.

Persuasion doesn't have some perks, such as blending, and perhaps the biggest missing piece is a Color Scheme feature like Hollywood's. You can copy color schemes from other presentations, but Persuasion has no single dialog box for presentation-wide formatting. Still, considering what the package does offer, those complaints are minor. Persuasion can master almost any trick you ask of it. And if you run Windows and haven't bought ATM yet, an investment in Persuasion will improve the look of your presentations and that of your other Windows applications as well.

CA-Cricket Presents 1.3

Computer Associates' CA-Cricket Presents offers some impressive features, including a bundled outliner and strong layout tools. The package is the only one that provides a ruler, a grid, *and* guidelines to assist you in placing objects on the page. Both the ruler and the grid are customizable. The duplicate option lets you designate the number of objects to duplicate, as well as horizontal and vertical offsets for precise placement. CA-Cricket Presents throws in some additional drawing tools (i.e, diamond, polygon, and rhomboid) to go with the standard set of shapes.

The program does not support master pages, but it was easy for me to place my logo on the background page. Icons are available for placing date and page-number variables on the background as well. CA-Cricket Presents automatically generates speaker notes and handouts.

Making your way through the presentation is not easy, however. The usual scrolling tools aren't on the screen. You can use the "flip corner" for turning single pages, or you can call up the title sorter or the image sorter and double-click on a page to move there. Still, you'll miss the convenience of scroll bars, especially when you've zoomed in on a page and have no way to scroll around easily.

Navigating by way of the image sequencer brought up the first quirk I discovered in the product. The image sequencer displays a thumbnail view of each slide. Here you can copy slides, delete them, or move them around in your presentation: a valuable feature. However, when I double-clicked on an image to bring the page full-screen, the title of the thumbnail remained on-screen, right in the middle of the bar graph.

A similar bug kept creeping up when I used the text tool. A ruler would appear above the text-entry box. Nice touch. Sometimes, though, the ruler refused to go away. Other times the entire text-entry box would remain on-screen, sans text. I couldn't select the object to delete

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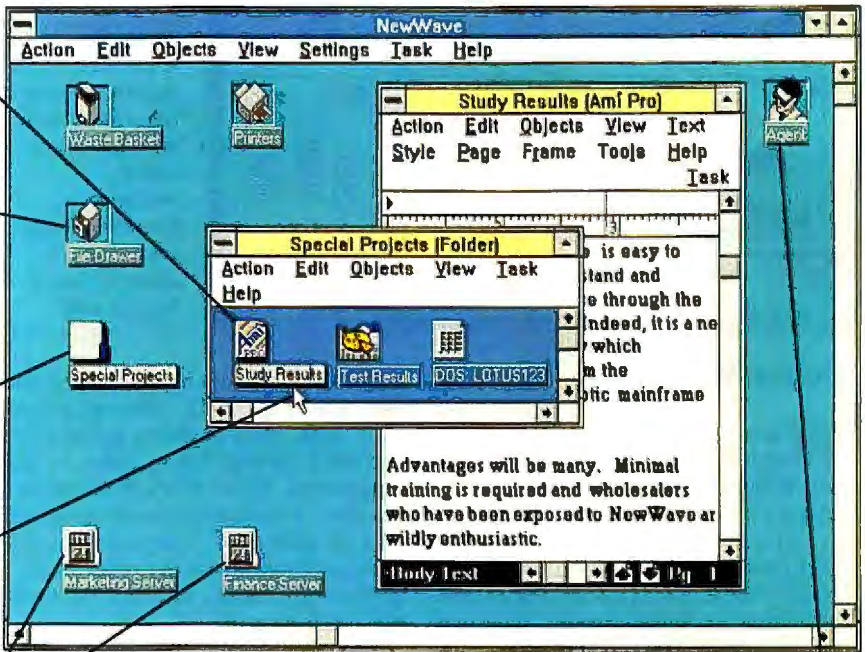

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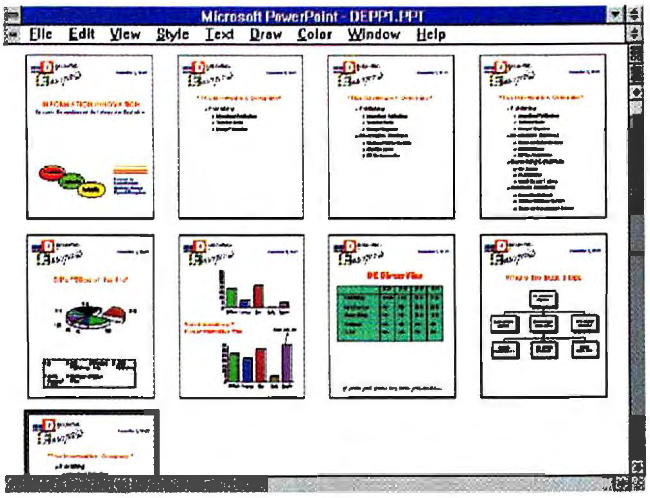
it, and it didn't go away even when the page was redrawn. That's too bad. The text tool is otherwise very powerful. Computer Associates says that version 1.4 will fix the text-entry problems. That release should be out when you read this.

The graph module was weak. Once I placed a graph on a page, I couldn't select individual elements—only the entire graph. I found no way to explode a pie slice, nor could I customize the axis of my bar chart to reflect a different numerical range than that provided.

Despite some attractive touches, CA-Cricket Presents seems to be an inflexible and even unstable product. With so many outstanding packages available, I can't recommend it.



Screen 5: *WYSIWYG sequencers give you a thumbnail overview of an entire presentation. PowerPoint lets you sequence slides by image or by slide title.*

PowerPoint 2.0

When it comes to managing slide shows, Microsoft PowerPoint excels. When it comes to data charting, Excel it is not. Microsoft apparently expects you to turn to its spreadsheet for your serious charting needs. If you don't have Excel or some other Object Linking and Embedding component (other than that packaged with PowerPoint), you must settle for weak charting features.

A slider knob on the right side of the PowerPoint screen makes it easy to page through slides. You can click on the up or down arrow to go through slides one at a time, or you can click on the slider knob and drag it to the slide you want. It's a nice design.

PowerPoint also has a WYSIWYG display of all the slides in your presentation (see screen 5). Here, you can preview your work, copy or delete entire slides, and even click and drag slides to rearrange them. If the WYSIWYG mode is too slow, you can do the same thing using only the slide titles. The package's slide-show component, on the other hand, is surprisingly weak, offering no transitional effects at all.

The package automatically generates handout pages and speaker notes. In addition to a slide master, there is a note master that serves the same purpose for speaker notes. PowerPoint does not support layered slides.

You can define your own text styles to include font, point size, type style (e.g., bold or underlined), and even text color. The newly defined style will then appear on the pull-down menu for easy selection. Line-spacing options are very flexible and really come in handy when you are building bullet charts. You can define spaces between individual lines and between paragraphs and apply the spacing characteristics to all levels of the text chart or to one selected level.

Finally, PowerPoint supports color schemes to further facilitate management of the slide show. The color scheme feature is not quite as powerful as Hollywood's, but it is easier to use. In PowerPoint, color schemes apply only to the colors used in the presentation and do not control other elements, such as text formatting.

PowerPoint's layout features come up short. While the program does support guidelines, only a single set is available: one horizontal and one vertical. There's a grid, but you can't make it visible or customize it. And you can't display an on-screen ruler except when placing text blocks. PowerPoint has no facility for step and repeat, and you can't align objects by simply selecting them—you have to do it manually using guidelines. Remarkably, there is no grouping function for combining a number of objects into a single object. In fact, you can't do any fancy stuff, such as rotating, skewing, or flipping objects and text.

PowerPoint is a solid, easy-to-use product. However, much of its strength derives from its Windows base. Other Windows products can perform the same tricks and then some. You'll be better off looking elsewhere.

DOS PRESENTATION SOFTWARE

Applause II 1.5

The interface in Ashton-Tate/Borland's Applause II supports three separate work areas. From the chart window, you enter data to a worksheet and generate data charts. You can then import the charts into the draw window and, once they're there, use an assortment of drawing tools to spruce up the page. The present window displays a table where you enter filenames, transitional effects, and other instructions for building slide shows. The interface is generally intuitive.

A customizable grid helped me position the elements on my title page, but there is no on-screen ruler or guidelines. There is no step-and-repeat function, either, so I had to place the overlapping ovals by trial and error. The program reports font sizes as a percentage of the screen, so you won't be able to use any standard font specifications, such as the ones I had designated for my project.

To create my bullet chart, I selected the text tool and entered the text from a window at the top of the screen. Then I changed fonts and added bullets from the option bar as I typed. I also created a bullet chart from the chart window even though I found the facility inflexible. If you follow the Applause II format, the process is quick and easy, but coming up with variations proved difficult.

I experienced no trouble importing my Lotus 1-2-3 data into Applause II. The data showed up in a worksheet. I simply highlighted parts of the data and assigned them to labels or data axes by clicking on the option bar. Once I was satisfied with the graph's looks, I

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Mac Presentations: A Mixed Quartet

Tom Yager

The Macintosh, long recognized as a graphics machine, is well suited to the role of building and showing business presentations. I evaluated four Mac presentation tools in the BYTE Multimedia Lab: Aldus Persuasion, Computer Associates CA-Cricket Presents, Microsoft PowerPoint, and Symantec More. Overall, I was mostly pleased by the quality of both the products and the presentations they produced.

More was the only Mac-specific package I looked at. It proved to be a surprisingly good tool for pulling together great-looking presentations in a hurry. More's strength is that it's less a presentation graphics program than an outline manager (the other Mac products uniformly read More outlines as input). Turning an outline into a slide show with More is pretty much a matter of switching views. For example, More can automatically create bulleted lists and other formats with a simple mouse-click.

Artful touches, like gradated backgrounds and drop shadows, are all within easy reach. I was able to create a beautiful color presentation from a fairly detailed outline in just a few minutes after breaking the seal on More. This isn't the best tool for creating presentations from scratch, but I can't think of a faster, more hassle-free way to organize and present your information.

The main article details the features and, in some cases, shortcomings of the multiplatform contenders: Persuasion, CA-Cricket Presents, and PowerPoint. When tested solely for their Macintosh performance, these packages ranged from excellent to frustrating to inoperable. The latter was PowerPoint, which wouldn't work with the TrueType fonts in the System 7.0 version of the Mac OS. There is a fix, which should be available by the time you read this, but I wasn't able to get the disks from Microsoft in time for this article. I'm forced to defer to the judgments contained in the main article about PowerPoint's overall quality.

One package I spent quite a bit of time with was CA-Cricket Presents. Compared to the other packages, CA-Cricket Presents doesn't create presentations as smoothly, owing, among other things, to some obvious program design flaws. For example, you can't resize text boxes by dragging their handles. Instead, you must bring up a mini-ruler and drag its margin maker off the end to enlarge the text box horizontally.

Even the interface has holes in it—selecting a text object and pulling up the Font dialog box brings that box up *empty*. None of the attributes of the selected object is reflected in the dialog box's entries. And while it's nice that the package lets you select from a number of output devices, the objects aren't resized to reflect the new layout.

In general, I found using CA-Cricket Presents to be more of a hindrance than a help. With such strong competition from the other players in the category, I can't recommend it.

Persuasion clearly proved to be the best Mac package, at least in terms of versatility. Like More, Persuasion has an outline tool to help you organize information. Where Persuasion really shines is, not surprisingly, in its graphics capabilities. This package is best suited of all for creating text, business graphs, and freehand drawings (or clip art) and combining them into an attractive presentation. Persuasion's considerable graphics power, in the hands of a creative (but not necessarily artistic) person, can produce stunningly appealing graphics.

As for choosing a favorite, I have to offer a split vote. For those who need to generate very high quality presentations in a hurry, I highly recommend More. Its rich array of effortless image-enhancement tools empowers even the most hurried professionals to build presentations that look as if they had taken all day to create.

If you want complete control over every element of your presentation, Persuasion gives you everything you need and then steps aside and lets you create. Graphically speaking, you can take a presentation further with Persuasion than with More. If you have the time and the inclination, I recommend it.

Tom Yager is the BYTE technical editor who oversees the Multimedia Lab. You can contact him on BIX as "tyager."

imported it into the draw window and added annotations. In the draw window, the graph is merely a drawn object. Applause II no longer tracks it as a data graph. To make changes, you must return to the chart window, make your edits, and import the graph again. This is tedious. Also, you must save the graph's data sheet as a separate file, or you won't be able to change the graph later.

Applause II includes welcome tools for producing tables and organizational charts. Again, you must save the chart data as separate files. Once you import the files into the draw window, the table or organizational chart becomes just another drawn object—no data is associated with it.

Overall, Applause II is a solid product, but it has neither the flexibility of some other programs nor the power of DOS-based Harvard Graphics. I recommend you wait and see what new owner Borland does with this product. An upgraded Applause II, infused with some of Quattro Pro's presentation and annotation features, could heat up competition among the DOS-based packages.

DrawPerfect 1.1

DrawPerfect, from WordPerfect, offers some impressive capabilities for a DOS-based product. For one thing, it doesn't fall short on support of graphics formats. It can import an acceptable range of files, including EPS, PCX, and TIF formats. The interface is well designed and largely intuitive, despite some reliance on the function-key operation familiar to WordPerfect users. The interface is annoying when you have to press the F7 key to complete certain operations

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(e.g., exiting text charts), but, for the most part, mouse support is well established in DrawPerfect.

The drawing tools are extensive. In addition to supporting various shapes, DrawPerfect lets you rotate an object and flip it horizontally or vertically. The package doesn't provide guidelines or a ruler, but it does have a customizable grid. DrawPerfect lacks a step-and-repeat function, but other tools support grouping and extensive alignment options.

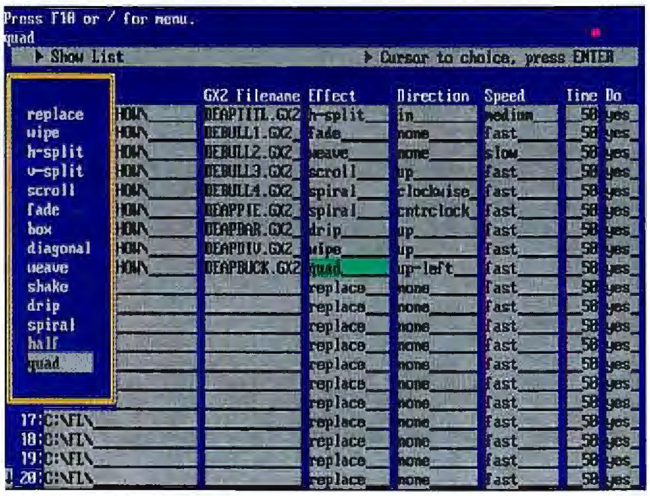
You can create bullet charts quickly and automatically, but it is difficult to make changes to the format provided. I couldn't find an easy way to create multiple levels of bullets, nor could I establish different text formats for different paragraphs in the chart. When a text format is applied to one part of the text chart, it affects all lines in the chart automatically. And if you want to leave a title or subtitle out of the text chart, you must put a blank line in its place. To its credit, DrawPerfect bundles an impressive array of fonts.

DrawPerfect is a strong offering for the DOS-based crowd.

The package has no special tabling features, nor does it have any tools for constructing organizational charts. The graphing component has some annoying limitations. I could not customize the scale of my bar-chart axis, and when I imported the Lotus 1-2-3 file, the data labels remained behind—I had to enter them manually. You can move data labels around freely, but when I moved labels on my pie chart, they sometimes got hidden under a slice of pie. It took some work to get everything looking exactly right.

DrawPerfect boasts a strong slide-show feature. It was easy to add, edit, and rearrange slides, as well as create a rich assortment of transitional effects. Best of all, the package has a run-time component for displaying slide shows independently. Another nice perk is the packaged screen grabber. All the DOS-based packages could use this (Windows has that capability built in).

There's a lot to like about DrawPerfect. If you can work around some inflexibilities, you should be able to come up with impressive presentations. This is a strong offering for the DOS-based crowd.



Screen 6: *To generate screen shows in Freelance Plus, you must first print your slides to a screen image. You then enter the filenames to a show list. A full range of transitional effects is available.*

Freelance Plus 4.0

Although Lotus's Freelance Plus remains a mainstay in the DOS-based presentation market, some of its competitors handle a few basic tasks more effectively.

Freelance has some nice layout features. The replicate function works as a step-and-repeat feature, and Freelance supports a customizable grid. You can snap to the grid vertically, horizontally, or not at all. The cursor position is constantly reported on-screen to help you place items and perform measurement tasks, such as drawing a line to a precise length. The ruler command is especially powerful in providing an exact measurement scale. By using the custom-size function, you can designate a line to represent a specified distance. This helps if you want to draw to scale. For instance, you can draw a 1-inch line and make it represent, say, 15 feet. All other lines will then conform to the ratio.

You create text charts from a form. After typing in headings and body text, you can change the specs (e.g., font, size, and color) from secondary forms. Each line of the text body has a text style associated with it, and you can customize these styles. I found it easy to create a secondary bullet line by designating a style, going to the Text Styles form, and selecting from different bullet types. Data charting works much the same way. A rich set of charting options provides plenty of flexibility once you find your way around.

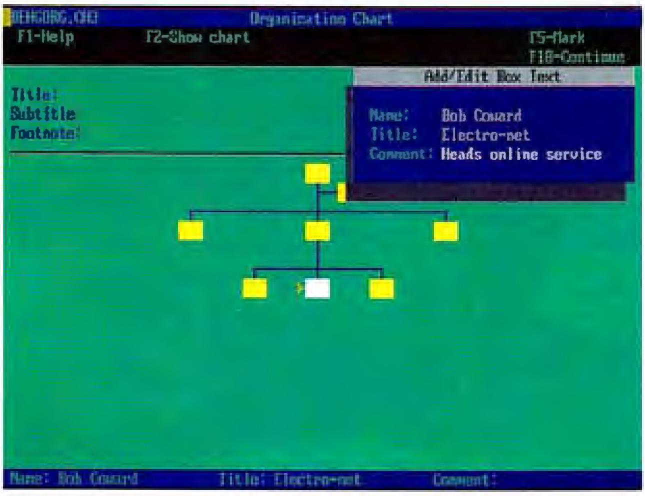
In general, Freelance is difficult to use. Navigating through directories requires multiple keystrokes, and mouse support is not very smooth. The product boasts some impressive capabilities, but its overall complexity detracts from the program's power.

A feature called Portfolio combines all your slides into a single presentation. You can then apply a single backdrop file to each slide in the Portfolio list. You can also move, copy, insert, and erase files from the list. Print options let you apply default options to a file or retain the options already saved in the file. This feature is not as powerful as a true global color scheme, but it can ensure consistency across a presentation. Freelance also comes bundled with the powerful GrandView outliner.

The slide-show component exposes the complicated structure of Freelance (see screen 6). You cannot simply select the drawings you have been busily creating. First, you must print the files to a screen image and then select the image. This cumbersome process is hardly what I would call intuitive. Freelance should let you designate drawing files and then do the print-to-screen function automatically.

Complexity and a manual interface combine to make Freelance a frustrating package to use. I found it to be difficult to learn, and it refused to do the little things that would make my work easier. There are too many powerful yet easy-to-use packages out there—including DOS-based products—for me to recommend Freelance.

continued



Screen 7: *Harvard Graphics makes it easy to create organizational charts. To edit an entry, you point to a box and use the function-key menus.*

Harvard Graphics 3.0

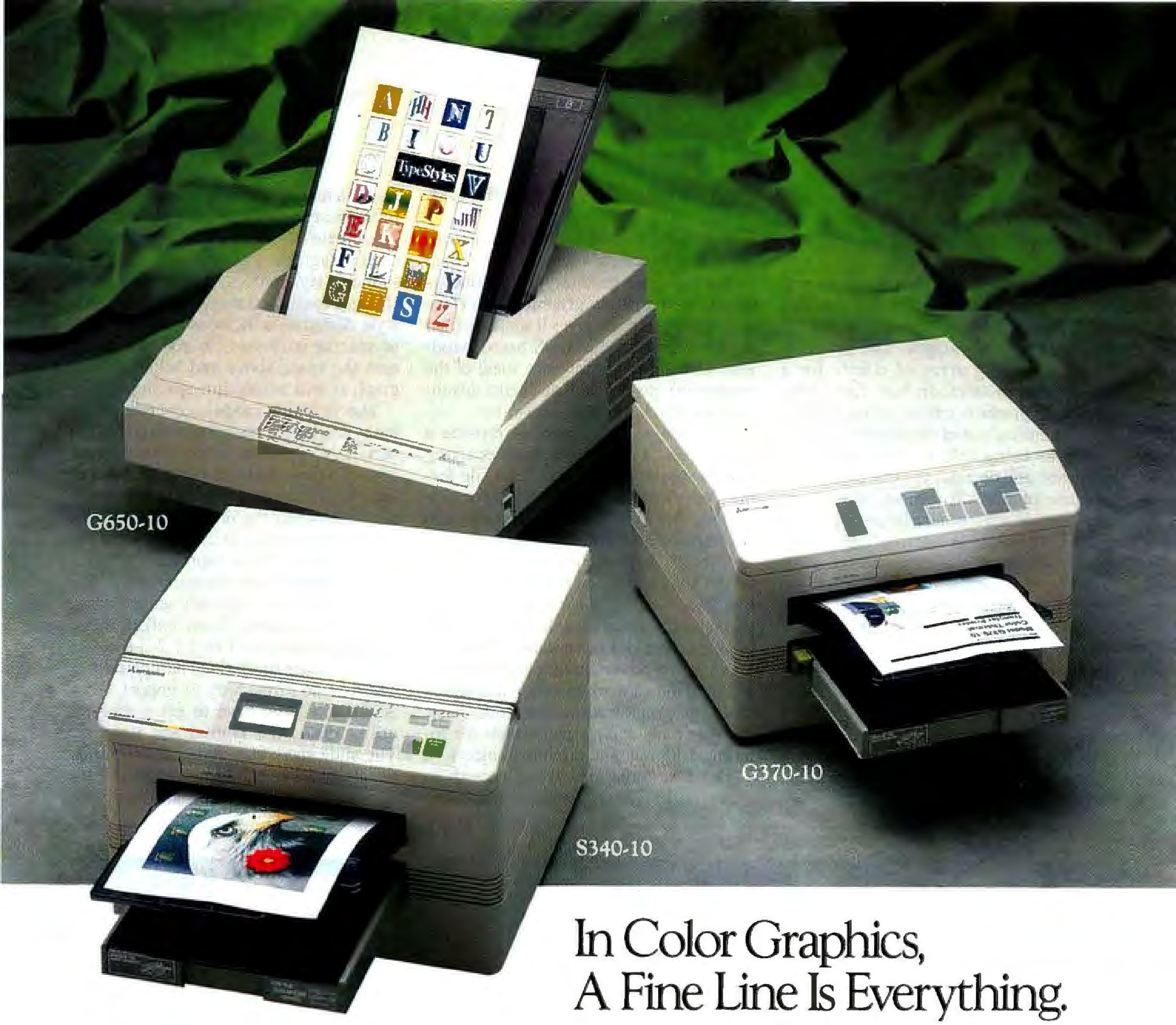
Software Publishing has been at the forefront of the presentation market for some time with its bellwether product, Harvard Graphics. The latest release builds on a solid DOS foundation and adds some nice touches that should continue to appeal to the product's substantial installed base.

Harvard Graphics offered enough layout features to make creating my title page an easy task. Although the program lacks guidelines, it can display a ruler and a grid. The grid is fully customizable, and you can set objects to snap to the horizontal or vertical axis, or both. The duplicate function (i.e., step and repeat) comes in handy. You can also select three or more objects and make the distance between them equal.

Making bullet charts is a breeze. You start in a work area, where you enter a title, subtitle, footnotes, and text body. Within the body, the first level of bullets is created automatically. By pressing Control-B, you can easily change the bullet character. To add a second level of bullets, you just move to the place where you want to put the secondary bullet and press Control-B. You can then set the font characteristics of the text and place the finished product in the draw window. At that point, you can add effects with the drawing tools. Unfortunately, this facility won't let you import longer, unformatted ASCII text blocks.

Harvard Graphics also supports a layering feature called auto-build. A series of charts is automatically created from a single chart so that specific items (e.g., bullets) appear one frame at a time.

Creating tables is even easier. You just enter the information in rows and columns and send it to the draw window. Do you need to make organizational charts? Harvard Graphics shows you a blank chart, and you just point to the boxes and enter the appropriate information (see



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screen 7). A pop-up menu lets you add and delete staff positions, move boxes, and work with an entire organizational group.

The program had no trouble importing various graphics images. And the fun really starts when you want to play around with the images. The program has a surprising array of effects for a DOS-based product. In fact, few of the Windows products can stand up to Harvard Graphics' set of object tools. In addition to being able to flip, rotate, or skew text and objects, you can evolve and animate objects. To evolve, you select, say, a small square and a larger oval. The program creates the intermediate images that transform the square into the oval. You can then use these images to achieve an effect of simple animation.

This new release should only solidify Harvard Graphics' position as a market leader. It was the only DOS-based product that didn't make me feel constrained as I built a presentation. It did what I wanted in a simple and intuitive way. This is the best DOS-based product and still a formidable competitor even in the Windows world.

Presentation Team 2.0

In the DOS-versus-Windows battle, Digital Research's Presentation Team stakes a middle ground. The product is based on a mature graphical interface (i.e., GEM), which gives it some distinct advantages over the DOS-based products. But the program lacks some of the impressive power and aesthetic advantages of Windows-based software.

Presentation Team doesn't provide a master page, but you can place recurring objects on the background. The file formats required for my logo were not supported, but the Hijaak file-conversion program comes bundled with the package, so that was not a problem.

The layout tools are helpful. Presentation Team supports a ruler and a grid, and both are customizable. A full set of alignment options is available. There is a duplicate menu option that looked promising but didn't work as a step-and-repeat tool. The program supports all the basic drawing tools and special effects for rotating, flipping, and grouping objects.

The text tools are strong enough to make bullet charts an easy task. You create a text region, and a ruler appears. From the ruler, you can change the margin, create tabs, and specify indents for each paragraph. Presentation Team also supports style names, which makes font changes easier and more consistent. The style designation includes a complete set of spacing attributes, so you can designate the space above and below a paragraph as well as interline spacing.

The graphing module covered all the bases needed for my presentation, but the module's operation is not always intuitive. To move an object (e.g., a label or legend), you have to click the left mouse button to select the object and then hold down both buttons to drag it around the screen. The software supports simple selection methods for changing fonts, patterns, and colors. The only setback came when Presentation Team balked when trying to import my Lotus 1-2-3 file.

Some other limitations hampered me. There is no direct way to import a raw ASCII file. You have to get a separate utility disk from Digital and use that. The slide show was especially limiting. Basically, you print the output to the screen. The program has no transitional

effects or other methods for customizing a slide show as a whole. You can edit, copy, delete, and rearrange slides from the sorter module, but it is based on screen titles, not on thumbnails.

While Presentation Team's interface shares some operational characteristics with the Windows-based products, the final output just doesn't measure up. A run-time version of the GEM interface comes bundled with Presentation Team, so if you are on a dedicated DOS-only platform, Presentation Team requires no additional investment to run.

The future of presentations on PCs is under windows.

The Envelope, Please

As you can see, the presentation graphics market boasts some impressive players. In general, the software is powerful, packed with features, and complete enough to prepare every aspect of your slide show. The DOS-based packages are hanging in, but even the successful players in that market—Harvard Graphics and Freelance Plus—are turning to Windows.

If your organization has not made a commitment to Windows, you still have some good choices. I liked Harvard Graphics best. On the other hand, if you are using Windows, you'll be best served by going with a Windows-based presentation package. Compared to DOS packages, the Windows products give you stronger management features (e.g., having all your slides together in one file) and better output results. In fact, if you've been thinking about investing in Windows, Windows-based presentation packages offer a compelling impetus to make the move. I think the future of presentations on the PC platform is under Windows.

It's tough to pick a single presentation package for Windows. There are some excellent choices out there, and the recent introductions of Hollywood and GraphShow make the decision even tougher. I really appreciated Hollywood and its depth of features and comprehensive color schemes. Yet in the end, Persuasion won me over. The program has the complexity of the best high-end packages and combines this power with elegant operation. You can start off with simple presentations and bring in more complex elements as you go along.

Persuasion came in the clear winner on the Mac side as well. This means that organizations running both platforms should consider Persuasion their only real choice. PowerPoint, another multiplatform contender, just doesn't have the features to measure up to Persuasion.

Keep an eye on the market, though. Future releases should start incorporating more elements of multimedia. This is a hot segment and shows no signs of cooling off. ■

Stanford Diehl is a testing editor for the BYTE Lab. You can contact him on BIX as "sdiehl."

COMPANY INFORMATION

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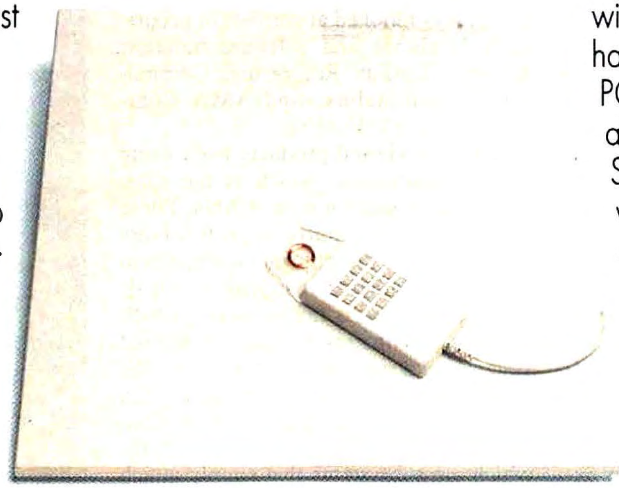

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HARDWARE

Network Fax Servers Come of Age (Slowly)

WAYNE RASH JR.

It would have been nice to tell you that the network fax server has come of age. As it turns out, only a couple of the ones I looked at have come of age. Still, there is hope. Despite the disappointing quality and design of some products, others show innovation and craftsmanship.

Fax servers are devices that you attach to your LAN to send faxes from a network workstation to any fax machine. Some fax servers also let you receive faxes at your workstation. The appeal, of course, is an end to excursions to a centralized fax machine and the inevitable waiting while coworkers finish sending jobs or while the machine receives incoming documents. Fax servers not only let you send and perhaps receive documents at your desk, they also automatically queue jobs so you don't waste time when the fax is busy. In addition, because you're not scanning the original documents, output quality with fax servers is typically superior to that of stand-alone machines.

Fax Server Choices

A fax server usually consists of an expansion card that mounts in a LAN workstation. The card becomes a server when you couple it with appropriate server software. To send faxes, each workstation must also run software that can assemble faxes from existing files, which might include graphics images, drawings, and ASCII text. Once the workstation software assembles the fax, it sends the document to the fax server directly or by depositing it into a shared file on the network file server.

Three of the fax server products in this review consist only of software: Intel's Net Satisfaxtion, SofNet's ShareFax, and Optus Software's FacSys. They are designed to work with third-party fax hardware, such as Intel's Satisfaxtion board, the Intel Connection CoProcessor, or the Hayes JT Fax. The software products adhere to the Communications Application Specification (CAS) developed by Intel and Digital Communications Associates. This specification allows hardware and software from different manufacturers to work together. The second category of fax servers I looked at consists of proprietary hardware and software bundles: Alcom's LanFax Redirector, GammaLink's GammaFax, and AMA Computers' SkyTek*Fax*Net.

All the reviewed products work using printer emulations, which is the most flexible approach for many LANs. These products work similarly to print servers except that you direct print commands to a fax board rather than a printer. An alternative method is fax gateways, which send fax documents through an E-mail system. Making up a subgroup of the printer emulators are stand-alone fax servers, such as the FaxPress from Castelle and the Faxcom from Biscom, which are subsystems that simply attach to the LAN and don't reside in a network workstation.

Living with Your LAN

To increase productivity in an existing work environment, fax servers must make the process of sending a fax both faster and easier than using a fax machine. The fax workstation software does this either by inserting itself into some common function, such as printing, or by being readily available, such as through a hot key.

Servers handle incoming faxes in one of several ways. Some software, including most of the CAS-compatible packages, relies on a fax administrator to route incoming faxes to recipients. All packages, except SofNet's ShareFax, provide for automatic printing on a network printer (the ShareFax doesn't provide for fax reception at all). But automatic printing of faxes is neither secure

BYTE ACTION SUMMARY

- **WHAT FAX SERVERS DO**
  They allow LAN workstations to send (and in some cases receive) faxes through a single machine attached to the network.

- **LIKES**
  The ability to send clear, crisp faxes from files on your LAN workstation.

- **DISLIKES**
  Difficult installation, deficient design, and error-prone software are characteristic of several of the reviewed products.

- **RECOMMENDATIONS**
  If you need fax server software to run with CAS-compatible fax hardware, choose Intel's Net Satisfaxtion. My pick of the proprietary hardware/software bundles is the SkyTek*Fax*Net, although it lacks some features some LANs may need. If you want inward routing offered by DID or DTMF and can handle the possibility of an extremely difficult installation, consider GammaLink's GammaFax.

- **PRICES**
  Alcom LanFax Redirector, $995
  GammaLink GammaFax CP board, $1095; GammaFax CPD, $1395; GammaNet software, $1295
  Intel Net Satisfaxtion, $799 (requires the $499 Satisfaxtion board or other CAS-compatible fax card)
  Optus FacSys, $995 (requires a CAS-compatible card)
  SkyTek*Fax*Net, $1880
  SofNet ShareFax for Windows, $995 (requires a CAS-compatible card)

nor productive because the documents rest in the printer's catch tray until someone claims them. Fax administrator routing is more secure, simply because fewer prying eyes see the documents, although the faxes are still visible to the administrator. Intel restricts the administrator's view to the first page, which presumably is the cover sheet.

Callers themselves perform the most secure method of fax routing. There are two ways to accomplish this. One is by having the caller use a Touch-Tone pad to dial an extension number after the connection is established. The other is by setting up your PABX so that callers can deliver faxes to a variety of numbers, much as they would call specific telephone extensions. The PABX receives the call on its trunk line and reports to the fax server which line the call came in on. The fax server software uses this number to route the fax after it is received.

continued

Two products, the GammaLink series and the SkyTek*Fax*Net, offer options that allow callers to use DTMF or direct inward dialing (DID) to route your faxes directly to you. Touch-Tone, or DTMF dialing, works only if the caller has equipment that allows the entry of a routing number when prompted. Many fax machines, and virtually all fax cards, can't enter added numbers once the connection is established. This makes the feature useless for now, although it's conceivable that it might be added in the future if the requirement grows. DID does not require any special equipment on the part of the caller, but it does require a PABX that's capable of handling individual fax extensions. This is not a trivial requirement: Many small or medium-size businesses can't afford such an installation or don't have phone companies that can provide the services.

Screen 1: *Intel's Net Satisfaxtion FAX.EXE program runs from within DOS and offers an easy character-based interface that works well with a mouse.*

Common Ground

I found a lot of commonality in fax server software. Intel, for example, may be sharing some software modules with Alcom, if the screens are any indication. Likewise, most of the fax server vendors used a version of Alien Computing's FaxIt software for Windows support. When set up properly, FaxIt is a very nice package that watches the printing process and captures the data stream destined for the printer for conversion into a fax. FaxIt sets itself up as an additional printer. To use it, you only need to select it on the Printer Setup menu. FaxIt produced some of the most attractive output of the packages I looked at.

I tested the fax servers on a Novell NetWare LAN running on Ethernet. I used NetWare 386 version 3.10 as the network operating system and MS-DOS 5.0 as the computer operating system. The NetWare workstation software used IPX and SPX 3.01 and Shell 3.10 Rev. A. Network interface cards in the workstations were either 3Com 3C503 or 3Com 3C505 EtherLink cards.

The fax server used a Micom-Interlan NI5010 card, and the file server a Novell NE2000 interface card. The fax server was a Zenith Z-248/12, which is a 286-based IBM AT-compatible computer. Printing was handled by an Intel NetPort Ethernet printer server driving a Hewlett-Packard LaserJet IIIP printer. The Zenith computer is typical of older equipment that companies are likely to use as a fax server, and the Micom-Interlan card is likewise typical of the existing Ethernet cards most companies are likely to find on hand.

I tested the software packages using Intel's Satisfaxtion board, a hot-selling card for both single-user and network faxing. It's easy to install and use, and it's reasonably priced. The Satisfaxtion board is easy to install because it has a wide selection of possible interrupt levels, and it can be set up by software. Intel wisely made Satisfaxtion work with much more flexibility in the available interrupt requests. On my Zenith server, for example, the Satisfaxtion board provided a choice of seven different interrupt requests between IRQ2 and IRQ11. In addition, Satisfaxtion offers a wide choice of memory I/O addresses. The result is that a combination that is suitable for nearly any computer should be available.

Software Servers

Intel's Net Satisfaxtion software is a new entry into the universe of networked fax servers. Once you have Net Satisfaxtion set up on the fax server, and the software placed on your NetWare file server, setting up the workstations is trivial. You need only log onto the file server and run the Setup program. Setup copies the required files to your hard disk and installs the necessary commands in your CONFIG.SYS and AUTOEXEC.BAT files. At that point, it reboots your computer for you, and you're ready to fax.

You have two ways to use Net Satisfaxtion. The first is through the FAX .EXE program, which you run from within DOS. FAX.EXE gives you an easy-to-use character-based interface that works well with a mouse (see screen 1). You make selections from a menu bar across the top of the screen, which is usually followed by another menu. From within the FAX.EXE program, you can send and receive faxes, forward faxes to other users, check on the status of faxes sent and received, and print incoming faxes. Net Satisfaxtion does not support automatic routing of faxes.

Windows fax support comes from Alien's FaxIt. This popular application installs automatically in the workstation's Windows package and sets itself up as an alternative to the normal system printer. To send a fax, you just enter a print command. When you select the print option in Windows, an additional dialog box opens that asks for the fax recipient and the fax phone number. Once you supply these, the print file converts to fax format, the cover sheet is attached, and the document is sent on its way.

Overall, Net Satisfaxtion was the best of the packages that used the Satisfaxtion board. It did what it was supposed to do, supported commonly available printers (including the HP LaserJet), and was sufficiently flexible to work easily into nearly any network installation. Equally important, especially in this collection of products, it was fully functional, appeared to be bug-free, and had extensive documentation covering all aspects of using and diagnosing the product. In all, Net Satisfaxtion is a class act.

By contrast, SofNet's ShareFax fax server is an incomplete product. You have a choice of four ways to send a fax, but no way to receive one. If you're a ShareFax user, you'll have to use the software that came with your Satisfaxtion board to print your incoming faxes. Sadly, three of the four programs that come with ShareFax perform very similar functions, so you don't really get a wide variety of fax support. QuickFax is a simple memory-resident program that will let you send a text file as a fax. MultiFax is a more complex and interactive memory-resident program that will let you send faxes. XFax is a command-line faxing program.

QuickFax is the easiest of the three to

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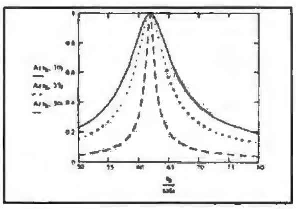

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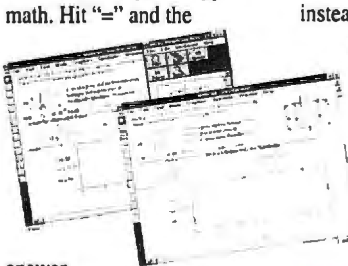

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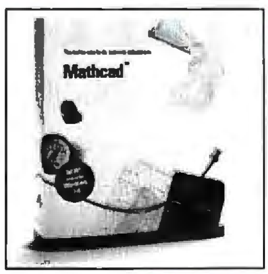

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use. First, you run it by entering `QUICK-FAX` into the command line, followed by `share=F:\FAX`. You have to tell QuickFax the path every time you want to load it. Once you load the program, you can send a fax by pressing Alt/Left-Shift/Q to run the program.

MultiFax requires that you enter a long and somewhat cryptic string of arguments telling it which directories you want to use, along with some information about configuration and whether you want the program to be memory resident (it can also run as a standard program). The differences between MultiFax and QuickFax are few.

The XFax program requires commands that are the most complex of the three. Because this is only a command-line utility, you have to enter all instructions, including the addressee and the phone number, on the command line. This is not a user-friendly package, but it might be useful for automating the sending of a fax through a batch file.

As with the Intel product, SofNet includes Alien's FaxIt software for Windows. Unlike the Intel product, this version has problems. I received frequent unrecoverable-application-error messages while trying to use SofNet's version of FaxIt. A company representative said that there may be a problem with some of the drivers for Windows 3.0.

Overall, I found SofNet's product line disappointing. The requirement to use complex command lines in a repetitive process such as running the fax workstation software is like an artifact of the CP/M days. The inability to receive faxes and the Windows problems also mitigate against this product. While it's easy to install, it's still unnecessarily inconvenient to use. There are plenty of better products out there.

Optus Software took a different route from the other companies that support both Windows and CAS boards. Instead of using FaxIt software, Optus wrote its own Windows software that's designed to have great performance and also be easy to use.

Like the other Windows-based fax packages, FacSys has a component that runs on the fax server and a Windows package that runs on the workstation. Both use an automated installation process that's trouble-free, although the manual recommends that you make the fax server a supervisor-level user. This means that your LAN security has a big hole at the fax server.

FacSys also includes a set of command-line utilities similar to (but not quite as complex as) those provided by SofNet. You still have to add a series of command arguments when you run it, but at least the program knows what directory it's supposed to use. These utilities are probably most useful for automatically sending or printing faxes.

The FacSys Windows software loads like the other Windows-based packages, and like them, it replaces the printer drivers with the fax interface. This means that you can send a fax as easily as you can print. Actually, in the case of FacSys, you can send a fax a great deal more easily than you can print, since the fax-printing capability seemed to be nonfunctional on my network. Discussions with Optus failed to resolve this problem, although eventually blame was aimed at the Windows drivers. An Optus representative said that FacSys uses a method of printing that's different from that used by other fax programs. Whatever the reason, the other fax programs could print faxes with their Windows software.

continued

Assuming that the problem with printing is fixed, FacSys is certainly an acceptable package. It does offer good performance, and it is well documented. While the printing problem wasn't in the manual, most of the more common problems were there. FacSys is worth a look.

Hardware/Software Bundles

Alcom makes a great fuss about the fact that its LanFax Redirector technology works in a peer-to-peer fashion rather than requiring a shared directory on the file server. Peer-to-peer is probably a little faster, since the fax file is sent directly to the fax server instead of waiting for discovery in the shared file. Unfortunately, it didn't do a lot to make Alcom's product more palatable.

The biggest problem with the LanFax Redirector was the documentation, or more accurately, the lack of it. The manuals are sketchy at best, and wrong at worst. In many places, they do not reflect the actual software at all. A good example is in the instructions for printing faxes. The manual covers the issue, and it shows where on the setup menu you need to go to set up the type of printer and the required printer port. Unfortunately, that menu choice does not exist at all. The type of printer can be selected in another area of menus, but you're only allowed to choose LPT1 to print your faxes.

In a network printing environment, the restriction to a single printing port is ludicrous. You can't assign output to a print queue, and you can't even arrange to use the print capture assigned to a port other than LPT1. You'd never be able to tell all of this from the manual, though, because the manual lacks even a simple index. In short, you're in the dark with Alcom.

Fortunately, portions of the LanFax Redirector do work, so you can send faxes easily from either DOS or Windows. It includes a version of FaxIt. You can also view a received fax on your computer screen. Once Alcom cleans up its printer restrictions (and provided that the manual is made usable), the LanFax Redirector may be a useful product. For now, though, I'll pass. (At press time, Alcom announced a new version of LanFax Redirector, which should be shipping by the time you read this. It includes Dynamic Data Exchange and dynamic link library support for Windows, plus the ability to assemble multiple print jobs into a single fax message.)

It took me 11 hours to get GammaLink's GammaNet and GammaFax installed and working properly. During that time, I installed the package seven or eight times. I also tried other network interface cards, reinstalled DOS, and ran diagnostics on the fax card several times. But I digress.

The GammaLink family of products offers a choice of fax server cards, and it includes the software to run the fax server and the workstations. You can add software to make your GammaFax card available as a networked fax server. For this review, I looked at the GammaFax CP and the GammaFax CPD. The two are similar, except that the CPD version is receive-only and supports DID.

Installing the GammaFax CP card is easy, mostly because the card doesn't use interrupt requests, so you don't have to worry about setting them. What configuration there is can be done with software. All you really have to do is plug the card into an 8-bit full-length slot. However, the GammaFax board's software and the GammaNet software together apparently have a conflict with DOS 5.0.

continued

(As of press time, GammaLink says that the current versions of GammaNet and GammaFax have not been tested with DOS 5.0. Likewise, the company says that the most recent versions of Novell's IPX and NETX haven't been tested with GammaLink's software.)

The DOS 5.0 conflict shows up by making the software crash with memory allocation errors at random points in the program. I eventually overcame this problem, and once I had it installed, GammaNet worked reasonably well. A problem did show up when the fax server had a file to be faxed in the shared directory but wouldn't fax it. I was able to solve this problem only with another installation.

Once running, GammaFax and GammaNet produce and receive fax information quickly and easily. Emulation is limited to Epson printer fonts unless you add the optional GammaPage software. GammaFax has an additional method of faxing, called the *message*. Essentially, this lets you write a note that will be placed on a cover sheet, which is then faxed. It's great for sending a quick note to someone when you don't want to send a formal letter. In general, once you overcome the installation, these products are easy to use and offer good functionality.

SkyTek*Fax*Net deserves an award for simplicity. The product consists of an 8-bit half-length board, server software, and workstation software. However, the fax board installation gives you a choice of only three options for interrupts and has only a limited choice on I/O addresses. If you can't use one of those, you're out of luck.

The setup is simple. You run an INSTALLS program from any workstation on the network, and the proper files are copied to the file server. To set up the hardware, you run INSTALLH, and you get a series of screens that show you where to position jumpers and switches on the fax board. Once you're done, you insert the fax board, and you're ready to run. (You'll probably need two empty slots in your computer since an attached daughterboard makes the card wider than standard and may touch an adjacent board.)

SkyTek*Fax*Net is available with optional DID or DTMF fax routing, and it comes standard with a proprietary routing scheme that works with all other SkyTek products. If you're sending to another SkyTek product, you just type a colon and an extension number following your party's phone number. The boards will prompt each other when they need


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the information. The SkyTek software is capable of either routing the fax image or re-sending the received fax to yet another destination. You can use the SkyTek* Fax*Net server as a sort of fax post office.

The SkyTek*Fax*Net does not even pretend to be all things to all users. You get a single workstation program, and the package doesn't offer HP or PostScript emulation. It is, however, easy and fast. More important, it includes a series of features that businesses need, such as the ability to restrict long-distance faxing and the ability to use diskless workstations as fax servers.

Screen 2: *SkyTek*Fax*Net menus and Windows let you easily create and send fax documents.*

The SkyTek*Fax*Net workstation uses menus and windowing, but it is not a Windows application (see screen 2). You can create a fax with an existing file, and you can use print-to-fax, so any application can be used to create a fax file. The fax image display is quite fast, and the printing process works well and without drama. All in all, if you can do without some bells and whistles and live with limited installation parameters on the fax server, it deserves serious consideration.

Some Final Fax

I haven't said a lot about output quality because this is not a differentiating factor among these fax products. All the candidates turned out good, crisp text that is far superior to the fuzzy stuff that comes from the scanners on most fax machines.

Oddly enough, price doesn't seem to be closely related to quality or functionality. If you price both hardware and software in a fax server installation, the range among these products is less than $500 per LAN. All these products are reasonably priced and require a lot less money (even when you include the computer) than high-end plain-paper fax machines, which give poorer output quality.

As a group, computer-based fax products have matured. The software and hardware are faster, and manufacturers have added features important to users. On the other hand, there are still major

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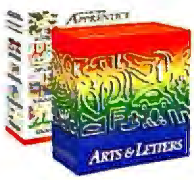

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pitfalls. Some products are difficult to use and don't give full value. You'll need to check carefully to make sure a potential purchase really meets all your requirements. In addition to the products discussed here, I also suggest you consider the stand-alone fax servers, such as the Castelle FaxPress.

That said, once GammaLink gets its new version of the software functioning, it too will deserve a look. For now, I can recommend the Intel Net Satisfaxtion software and the SkyTek*Fax*Net hardware/software bundle. Both products offer relatively easy installation, high-quality output, and the efficiency you expect but don't always get from network faxing. ■

Wayne Rash Jr. is a contributing editor for BYTE and a principal and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He is coauthor of two books for business network users: The Executive Guide to Local Area Networks *and* The Novell Connection. *You can contact him on BIX as "waynerash," or in the to.wayne conference.*

COMPANY INFORMATION

Alcom Corp.
(LanFax Redirector)
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fax: (415) 694-7070
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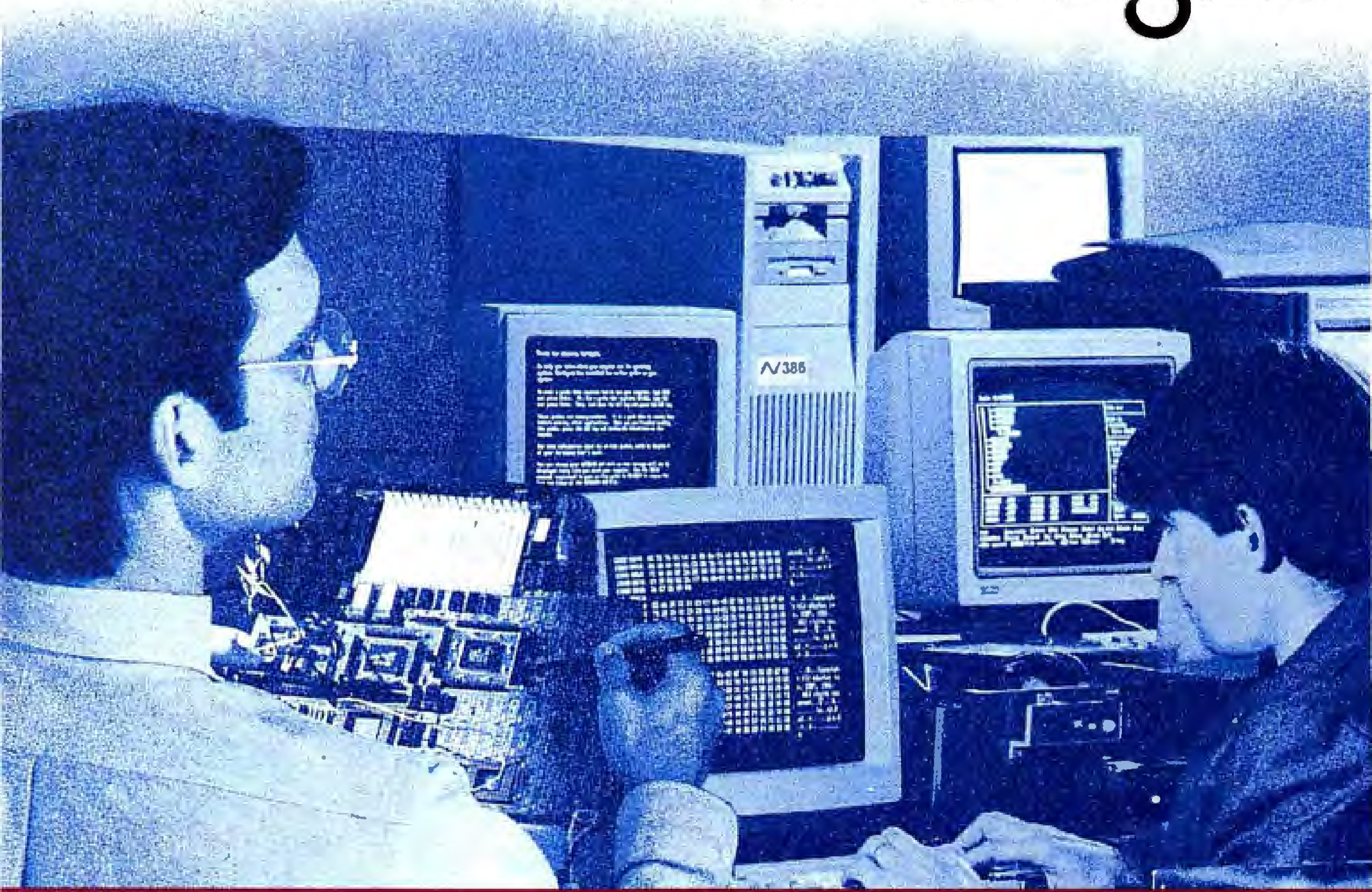

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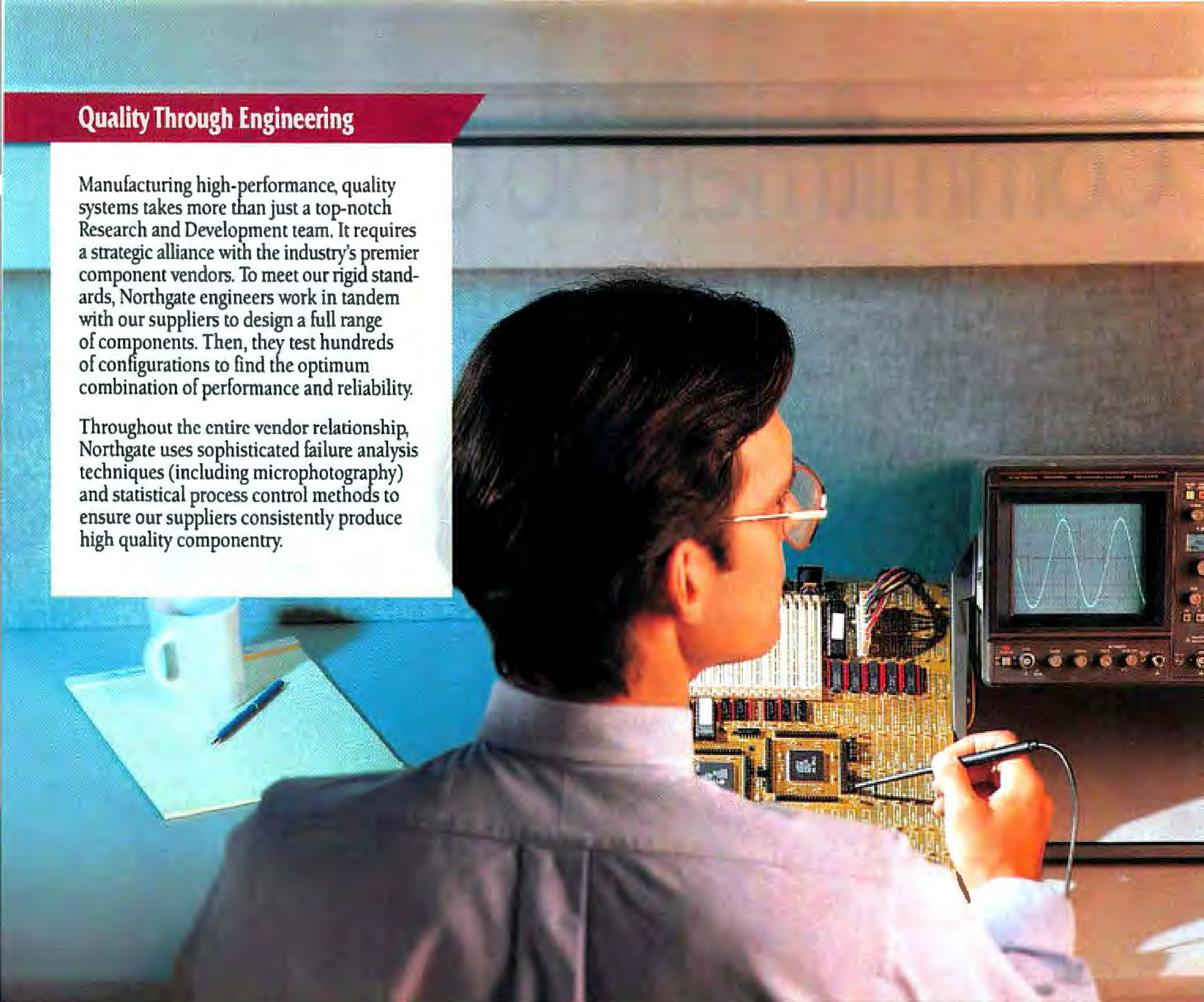

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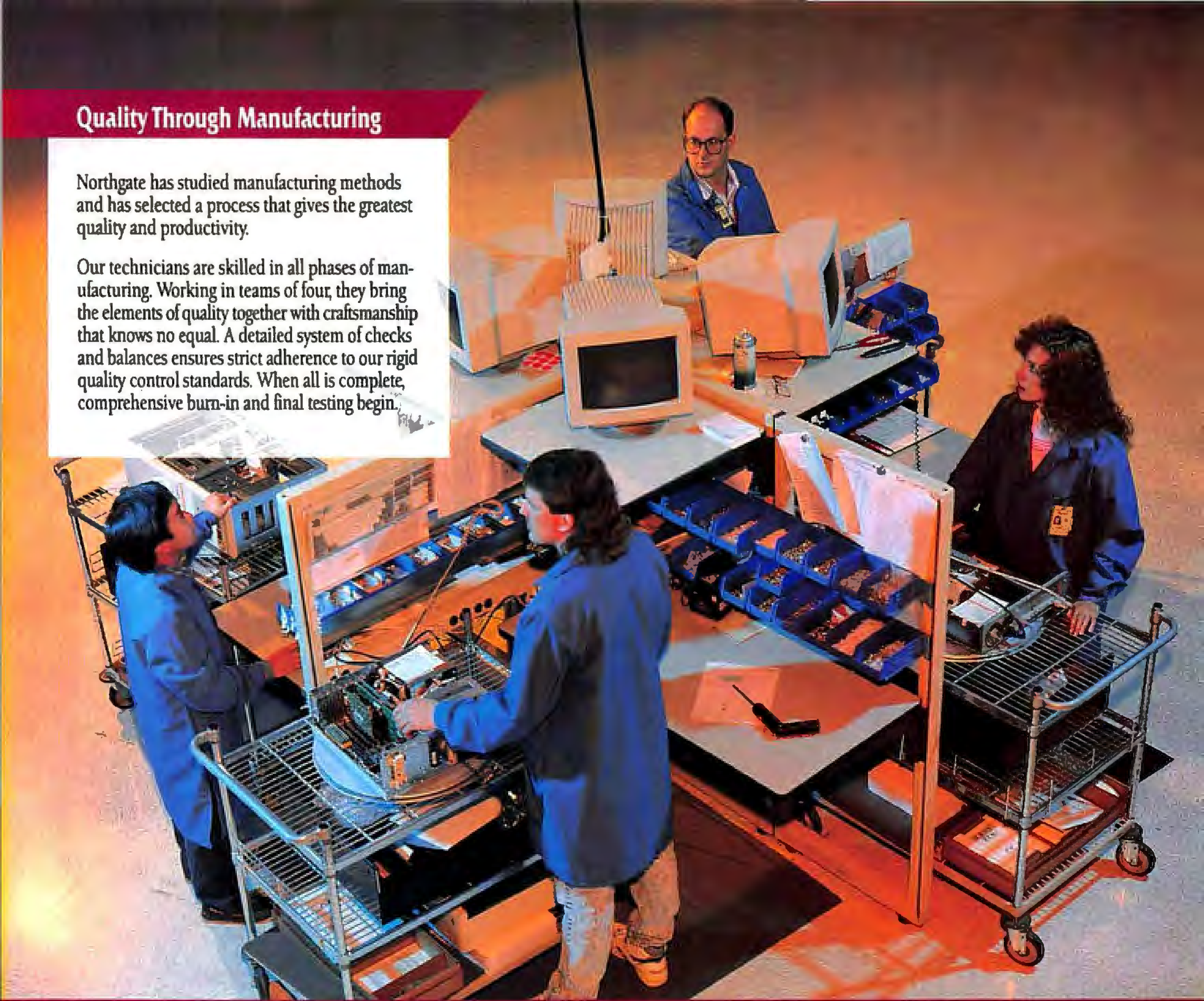

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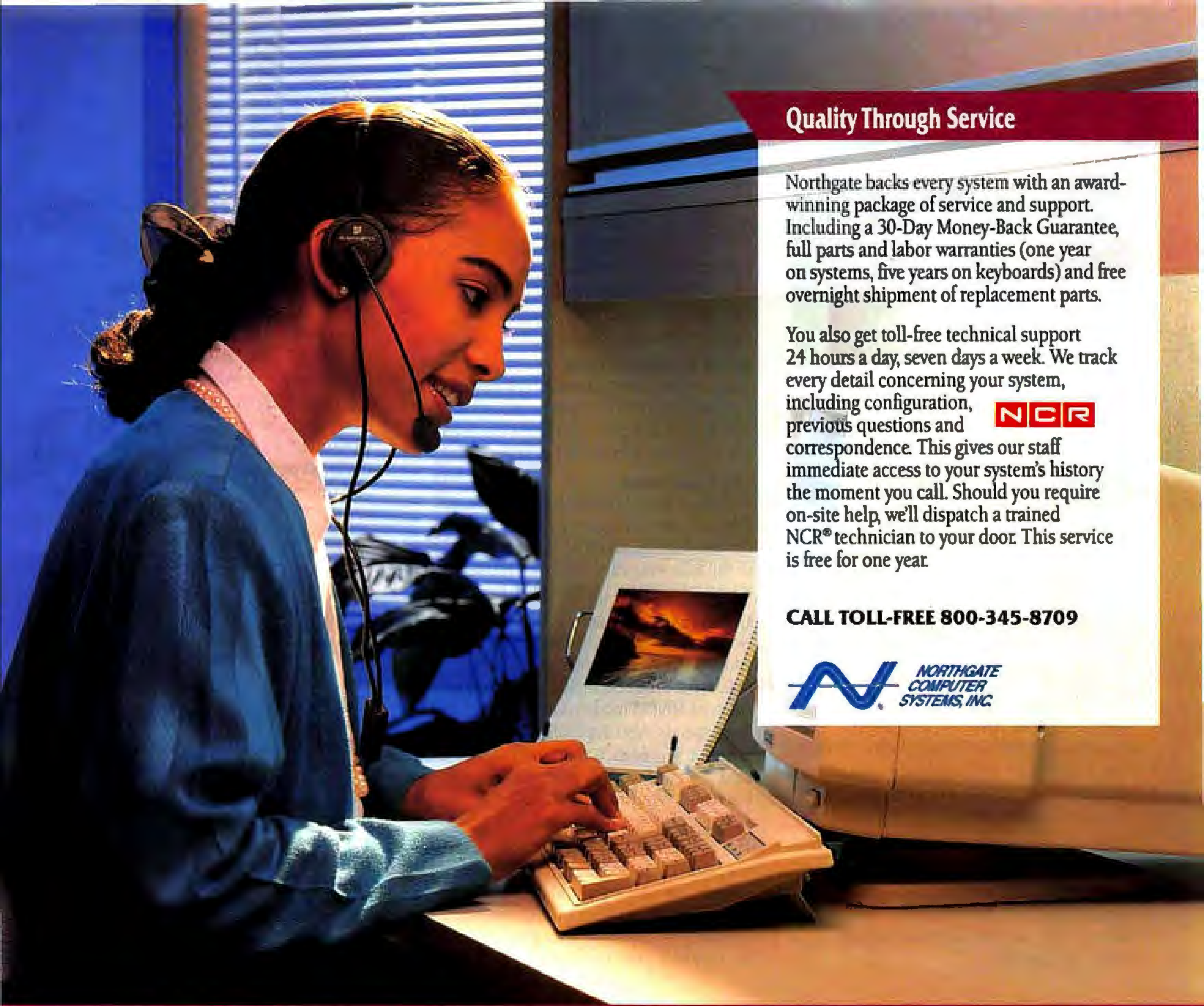

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SYSTEM

Notebook Power Management at Its Zenith

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The newest notebook computers have captured the imagination by packing the wallop of a 386-class desktop computer within a shell smaller than a three-ring binder. Most of the obstacles blocking the advance of notebook computing have gradually fallen away, but the greatest limiting factor—battery life—remains. Battery power in today's most sophisticated models supports only 2 to just over 3 hours of continuous use.

Enter Intel. The venerable chip maker began shipping the 386SL processor earlier this year. The new chip introduced a set of features designed specifically for battery-powered computers. Zenith's Mastersport 386SL is the first of a new generation of notebook computers that exploit this new chip.

The 386SL offers a programmable environment, including a new operating mode and dedicated interrupts for building power management architectures. Intel doesn't offer a system BIOS; each notebook computer vendor must develop its own or wait until companies such as American Micronics and Quadtel offer a BIOS for the 386SL. Zenith's experience in designing BIOS code and its close relationship with Intel gave it a jump on the competition.

What You Get

The Mastersport 386SL is a full-featured, no-holds-barred notebook. The standard system retails for $4995 and includes a 20-MHz 386SL CPU with a 64-KB static-RAM cache, a socket for a 387SX FPU, 2 MB of 80-nanosecond RAM (user-expandable to 8 MB), a 60-MB hard drive with a 19-millisecond average access time, and a fluorescent-backlit supertwist LCD screen that supports standard VGA. Zenith also throws in a copy of DOS 4.01 and Windows 3.0. The list price sounds high, but dealers discount Zenith systems steeply. We did some checking around and found the street price for a Mastersport well below that of a comparably configured Toshiba T2200SX (a 20-MHz 386SX machine)—and the T2200SX has a lower list price.

The Mastersport weighs 6.8 pounds with the nickel-cadmium measures 12.4 by 1.8 by 8.:

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- **DISLIKES**
  Advanced power management doesn't help battery life if you use the machine continuously.
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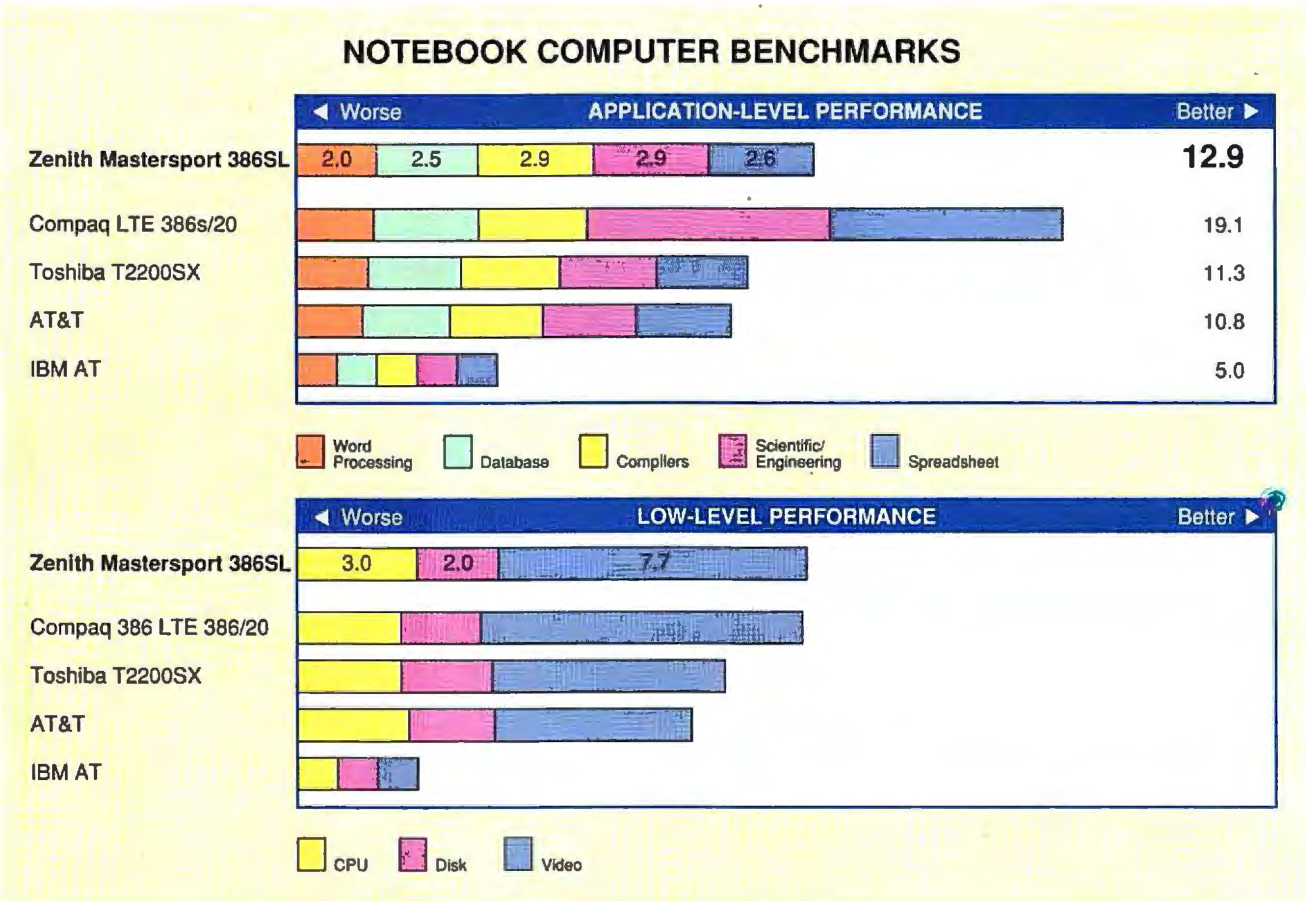

The notebook computer benchmark suite includes a battery-life test, the standard low-level benchmarks, and a modified version of the standard application-level benchmarks. See the text box "Testing Battery Life" on page 252 for details on the battery-life tests. We index all test results to show relative performance; for each index, an 8-MHz IBM AT running MS-DOS 3.30 = 1.

For details on the notebook computer benchmarks, see "From the Testing Notebook," February BYTE, page 152.

SYSTEM CONFIGURATION AS TESTED

	Zenith Mastersport 386SL
Processor	20-MHz 386SL; socket for 20-MHz 387SX FPU
Memory	2 MB of RAM; 64-KB static-RAM cache
Mass storage	60-MB hard drive; high-density 3½-inch floppy drive
Display	Supertwist VGA LCD with fluorescent backlight
Keyboard	82 keys
I/O interfaces	Serial, parallel, and PS/2 mouse ports; external video, keyboard, and floppy drive connectors; modem and memory sockets
Size	12.4 by 1.8 by 8.3 inches; 6.8 pounds with battery
Other	MS-DOS 4.01; Windows 3.0

keyboard is one of the best we've seen on a notebook computer. The extra width allows for a roomy keyboard that boasts 82 full-size keys, including a full set of function keys and cursor keys. The Fn key invokes the break, keylock, and numeric keypad overlays. Zenith compromised key travel (2 millimeters instead of a full 3 mm) to obtain a shorter height. The action is good, although not quite on a par with Toshiba's T2200SX.

The blue-on-white display has good contrast and a wide viewing angle. It's not as crisp as the triple-supertwist display on the AT&T Safari or the Texas Instruments TravelMate 3000, and we saw some image streaking when running Windows 3.0. But we had no trouble reading it under a variety of lighting conditions.

The Mastersport appears sturdier than many other notebook computers we've tested. The fold-up display sports a double latch, and a hinged port cover protects the external VGA port, the serial port, the parallel port, and an external floppy drive connector. A 3½-inch high-density floppy drive graces the side of the case, along with a modem socket and connectors for an external keyboard and numeric keypad/mouse.

The Mastersport's system BIOS resides in flash ROM, and Zenith plans to make updates available. Using the NEWBIOS command, you can reprogram the BIOS from a floppy disk image instead of installing new BIOS chips. Other firmware commands support testing functions, BIOS instructions, and alternative booting options.

Flattening the Power Curve

The Mastersport has several power management capabilities. Hot keys toggle CPU speed down to 5 MHz, put the machine into low-power "standby" mode, and configure the power switch to place the machine in "rest" mode. The setup menu has inactivity time-outs for these

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Testing Battery Life

We've seen some amazing advances in laptop computer technology over the last few years—not the least of which are the lengths to which some manufacturers go to make their machines last longer on a battery charge. While our standard notebook computer benchmarks are good at determining relative performance, estimating effective battery life is more of a problem.

Until now, the BYTE Lab's standard battery-life test consisted of a software-driven application that ran continuously with all power-conservation functions disabled. These tests suggested the battery life you might expect under the worst conditions. We're just finishing the design of a unique hardware/software test system that should give a more realistic battery-life estimate.

The battery-life test station uses positional servo motors to actuate a remote rubber finger. To press a key, the motor extends a cable that pushes the finger into the key. Two arms handle most laptops—one for the Return key and one for the standby/power switch. Some laptops may require a third arm to press a Shift or function key.

The new test station consists of mechanical actuators that simulate keystrokes (see the photo) and a host 286 system that monitors the notebook computer's status by way of the printer port. A script types characters into a word processor application for several minutes, saves the file to disk, and rests for 15 or 20 minutes before entering data into a spreadsheet program. The process then repeats. The host system presses keys on the notebook computer to wake the screen when necessary and turns the laptop's power back on if the battery-saving modes turn the machine off. In essence, it simulates a real work session, watching the screen and reacting as you would.

This approach works great in theory, but it proved difficult in practice. For instance, the Compaq LTE 386s/20 monitors the printer port for activity. It saw our software talking on the printer port and refused to shut itself off during periods of inactivity. We were able to test the Mastersport and one comparison machine—the Toshiba T2200SX. As this review went to press, we were constructing an optical sensor to watch the screen, eliminating the need to monitor activity through the printer port. We should have a system ready in time to test the next roundup of notebook computers. It will test battery life while taking into account new power-conservation features. One thing's for sure—the laptop manufacturers are going to be keeping us on our toes!

modes, as well as for display backlighting and hard drive power.

Standby mode stops the CPU clock and shuts off power to the display, the drives, and other subsystems, reducing power consumption by 75 percent. It also maintains the operational state in memory and restores it when you resume operations. Rest mode uses even less power by taking advantage of the 386SL architecture. As with standby mode, it saves the current operating state in memory, but it shuts off the CPU and all subsystems, using power only to refresh memory. Zenith claims that a fully charged machine can maintain rest mode for about two weeks, versus 12 hours for standby mode.

In either mode, the machine resumes where you left off when you reactivate it. The state of your applications remains intact—even programs that are running in protected mode. That's something other notebook computers can't do. We found this feature convenient while running Windows in enhanced mode. We didn't have to wait for the computer to boot, for Windows to load, or for our application to start up to resume our work. We simply pressed the power switch and were up and running in a few seconds. At the end of the day, we reconfigured the power switch to power the computer down for the night. There is one drawback, however. If you put the system at rest while in Windows, the system clock stops and isn't updated when you resume. That could be a problem if you use an appointment calendar or personal information manager program.

Many notebook computers support modes similar to standby, but none can claim the scant power draw of the Mastersport in rest mode. A 386SX CPU draws over 2 watts in its most conservative power state; the 386SL draws just 65 milliwatts to keep memory refreshed. The 386SL dedicates interrupts and RAM specifically to power management functions. There's no chance of memory conflicts, since the power management interrupts and RAM space are invisible to applications. You can be sure your data is safe, even if you forget to turn the machine off for the night or the weekend.

The power management system includes several security features. You can create passwords for accessing the configuration menu or for using the machine after system boot-up or reactivation from standby or rest modes. If you invoke either mode during disk activity, the Conner Peripherals hard drive waits

until the drive finishes before powering down.

Long Life, Fast Times

The Mastersport performed admirably on BYTE's notebook computer benchmark suite (see the benchmark graph). It beat every other notebook computer that we've tested, except for Compaq's LTE 386s/20, which had the assistance of a math coprocessor.

Battery life is harder to determine because it depends heavily on how you use the machine. Zenith claims up to 8 hours of battery life if you use the machine intermittently, allowing rest mode to kick in. We got 4 hours, 2 minutes during continuous use. Your actual mileage will probably fall somewhere in between. By contrast, the Toshiba T2200SX, a 20-MHz 386SX machine with two nickel-hydride batteries, ran for 4 hours, 50 minutes—longer than any other notebook computer BYTE has tested (see the text box "Testing Battery Life" on page 252 for testing details).

The Mastersport has much to recommend it. Its battery life is longer than that of most notebook computers that we've tested. And by configuring the machine optimally, you might be able to go through the day without searching for an AC outlet.

The real advantage is one of convenience, not battery life. You'll be able to walk away from a running notebook without worrying about returning to a dead machine. And, in the end, that should afford you more flexibility in your work habits. You won't have to be as concerned about battery failure as in the past. If you leave the notebook on for long stretches, the chip will save your environment and keep it safe for extended periods. You can use the machine as you might a desktop system, without having to continually turn it on and off throughout the day. When you need to write a quick memo or check a calculation, you can access your programs quickly. The time it takes to boot up a notebook and load an application sometimes deters casual use. This is the kind of convenience the Mastersport will deliver.

Power users who work continuously probably won't see much benefit; only advances in battery technology will get them over the hump. For fast performance and solid construction, however, the Mastersport can't be beaten. ■

Stanford Diehl and Howard Eglowstein are testing editors for the BYTE Lab. You can reach them on BIX as "sdiehl" and "heglowstein," respectively.

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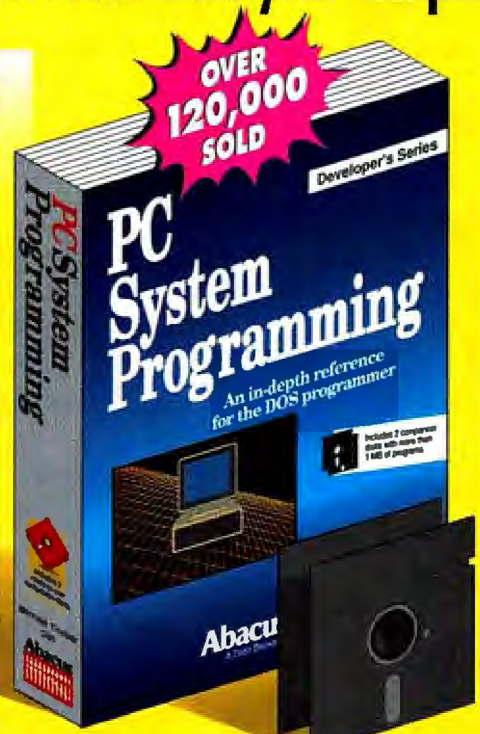

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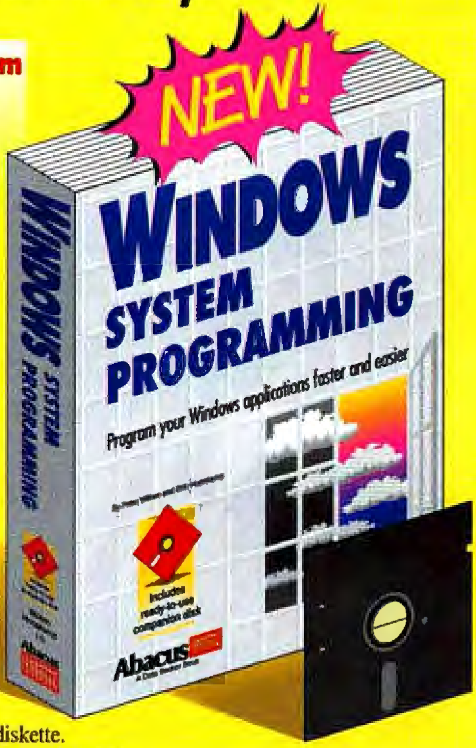

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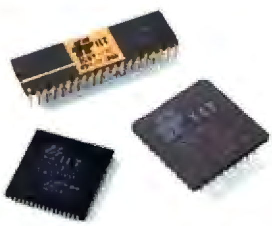

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HARDWARE

Sun's Newest Desktop Powerhouses Raise the SPARC Performance Ante

TOM YAGER

A fresh, restructured Sun Microsystems, the undisputed leader in the Unix workstation market, is aggressively attacking one of the PC's last remaining strongholds: price. With its two new low-end ELC and IPX Sparcstations and a significant price reduction on its popular IPC (which, as of this writing, is a limited-time deal), Sun is opening its workstation line to those who previously couldn't afford a SPARC machine.

Sun's least expensive workstation is now the new ELC. This system is almost identical to the SLC, the model it replaces. It has no separate unit housing the CPU; the guts of the system lie inside the monitor case. The unit takes just one power cord and very little desk space. What's more, the system is virtually silent: There's no fan, and when it runs as a diskless workstation, all you'll hear is your own typing. Working as I do in a noisy environment, I can appreciate that.

The ELC is built to be a basic diskless workstation. It includes 8 MB of memory and a 17-inch monochrome display for $4995. The ELC has no expansion slots, and the standard (1152- by 900-pixel) monochrome graphics and display aren't upgradable. But in all other respects, the ELC is a true Sun system. It is endowed with precisely the same mix of external I/O as its more expensive relatives: two serial ports, one audio I/O port, a SCSI port, and a thick-wire Ethernet port.

The ELC's SCSI port accepts an external hard drive, but the upgrade is not cheap: The 207-MB hard drive in my test system jumped the price $1300 to $6295. That price seems to dovetail nicely with the reduced price of the IPC—for $700 more, you can have color, internal expansion slots, and a floppy drive.

That's one of the curious things about the ELC: There's no floppy drive, and according to the literature from Sun, you can't get one. That might not seem like a life-or-death issue in these days of CD-ROM, but the lack of any kind of local, removable storage is a hindrance. I work on an IPC, and I like being able to pocket a floppy disk at the end of the day. It's hardly leading-edge technology, but at least my most irreplaceable files are stored in more than one place, and one's a place I can carry home with me. I'm glad Sun didn't leave out the SCSI connection. That lets you add a hard drive, tape drive, and CD-ROM reader.

But the real attraction of the ELC is its

Sun's entry-level ELC (left) integrates the CPU inside the monitor housing; the performance of the IPX (right) rivals that of Intel-based PCs.

BYTE ACTION SUMMARY

■ **WHAT THE SPARCSTATION ELC AND IPX ARE**
A low-cost, diskless, monochrome and a midrange color SPARC Unix workstation, respectively.

■ **LIKES**
The ELC is quiet, fast, cheap, and compact. The IPX's beefy standard configuration makes it an excellent choice for demanding users.

■ **DISLIKES**
The ELC could have benefited from a floppy drive and even limited gray scale, and both systems lack BNC Ethernet connections.

■ **RECOMMENDATION**
Both are recommended. The ELC is a strong alternative to high-performance Intel-based PCs.

■ **PRICES**
ELC, $6295
IPX, $13,495

■ **FOR MORE INFORMATION**
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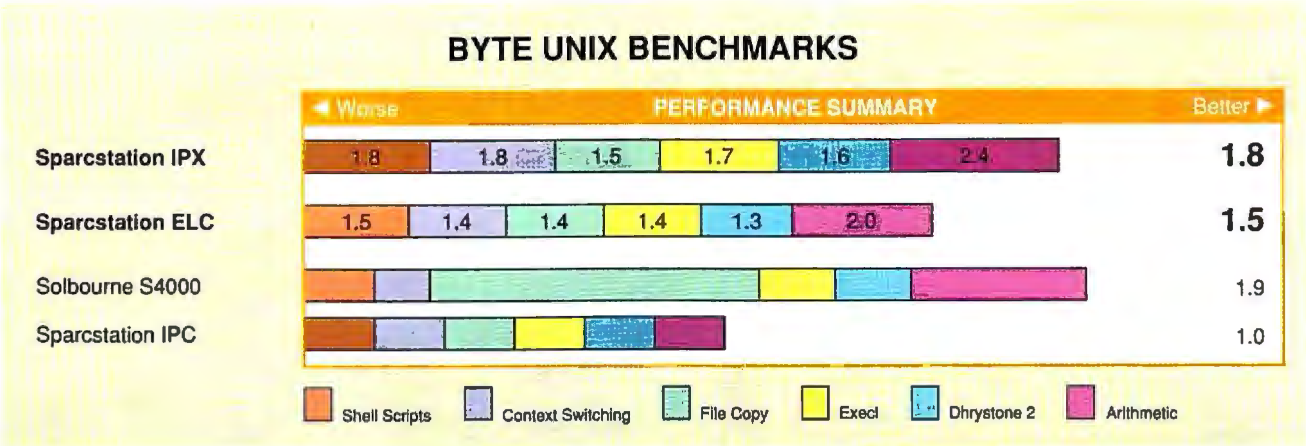

The graph above summarizes the results of BYTE's Unix benchmarks (version 3). We index the results to show relative performance; for all tests, a Sun Sparcstation IPC = 1. We formed the summary index by adding the cumulative performance index results for the individual tests and taking the average. The tests show relative performance for running a shell script with eight concurrent scripts running, pipe-based context switching, file copy throughput (in 5 seconds), spawning a process (execl()), the Dhrystone 2 benchmark, and double-precision arithmetic.

BYTE's Unix benchmarks are available on UseNet, from Demolink, in the "listings" area on BIX, or on disk. See page 5 for details. Comprehensive results are available by contacting BYTE.

price, and I doubt many buyers will be inclined to deck their units out with lots of external devices. In a diskless setting, where I have *no* local storage, the paranoiac in me longs for the ability to drop some key files onto a floppy disk before I head for home.

Looking at the ELC, it's easy to see what Sun chose as a model: the X terminal. While most of the other workstation companies have rolled out their own X terminals, Sun has remained steadfast in its insistence that diskless workstations are a better solution. That claim has merit, if for no other reason than that diskless workstations can *do* more than X terminals. At a list price of $4995, and considering the discounts that are bound to apply in many cases, the ELC does leave me wondering how an X terminal, or even a PC, could keep up.

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FACT: Computer Shopper compared 3 systems in its July cover feature. TOUCHE beat NORTHGATE and DELL in the overall total speed test for performance! Shopper also said, "TOUCHE's system operated quietest . . . TOUCHE obviously offers the fullest expansion of the three systems . . . TOUCHE's ESDI edged out NORTHGATE'S IDE drive and DELL'S slower IDE" Of all three systems TOUCHE was the least expensive. Shopper also said, "In fit and finish TOUCHE offers among the best we've seen."

FACT: Our AMI partnership enabled us to begin shipping 386 to 486 upgradable systems in 1989 . . . 2 years before NORTHGATE even announced theirs! Northgate President Art Lazere is quoted in PC WEEK 06/03/91, "Upgradable is the wave of the future . . ." Unfortunately anyone riding the NORTHGATE wave is sunk when it comes to upgrading their 386 systems. Now that everyone wants a 486 anyway, what good is that to customers that bought Northgate systems for the past 2 years? Only GATEWAY knows when their upgradable system will ever become available.

FACT: TOUCHE was first to offer a 386 caching motherboard because AMI was the first to design a caching 386 motherboard.

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Using the ELC is just like using any other Sun or Sun-compatible system, except for the black-and-white display. Here again, I wish Sun had been more generous and given this system a gray-scale monitor. Sun's pet graphical environment—Open Windows—cries out for the shading that color and gray-scale monitors can deliver. Open Windows looks flat on the ELC, and some of the more haphazardly written X Window System applications depend on variances in shading to make their interface layouts decipherable. Still, the monitor is sharp, and with fewer bits to move around, the ELC's graphics perform well.

There's another reason the ELC performs so well: Its SPARC processor runs at 33 MHz, up from 25 MHz in the IPC (the baseline system for the BYTE Unix benchmarks). The ELC's benchmark results (see the benchmark graph) show a noticeable step up in performance with the increased clock speed. In fact, while the system lacks internal SBus slots, the CPU and floating-point performance are excellent, and you can expand memory to 64 MB. This is *not* a crippled system.

The IPX

While the ELC is a capable machine in its own right, it pales a bit next to the IPX. This color system doesn't quite qualify as "low end," but it packs in more standard functionality than most other systems in its price range. The IPX looks like the older IPC, but the similarities end there. The standard configuration includes the usual Sparcstation port array listed above, a 40-MHz SPARC CPU, 16 MB of memory (expandable to 64 MB), a 207-MB hard drive, a 1.44-MB floppy drive, two SBus expansion slots, a 16-inch color monitor, and GX accelerated graphics.

This system is equivalent in CPU and graphics performance to the venerable Sparcstation 2GX but with a smaller case and an attractive price: $13,495. In fact, the only qualities that the 2GX has over the IPX relate to space: The 2GX has one more SBus slot and greater capacity for memory and internal disk expansion.

The performance of the IPC is nothing to sneeze at, but the IPX sings. The combination of a 15-MHz boost in clock speed and the accelerated GX graphics makes Open Windows cruise right along. Sun was wise to make the graphics acceleration standard. A responsive interface is what most users mean when they speak of performance, and Open Windows has no trouble getting data to the GX display. Demanding applications like FrameMaker and IslandWrite, IslandDraw, and IslandPaint reveled in the higher performance. For the number-conscious, the benchmark graph shows how the IPX stacks up.

Interesting Times

These systems come at what will be an interesting time for Sun. In 1992, Sun's new System V release 4 operating system will become the standard, replacing the Berkeley Standard Distribution variant Sun users have grown to love. It should also be a time of tremendous growth for the SPARC. It's possible—even likely—that by later next year the least expensive SPARC system won't be a Sun.

It's possible, too, that SPARC clones will shatter Sun's performance lead as they take advantage of the faster CPUs that are scheduled to appear and of multiprocessor technology. Solbourne has already proved its ability to stay a few steps ahead of Sun in CPU and I/O performance, as shown in the benchmark graph (the S4000 has a 33-MHz Panasonic SPARC chip). With more chip suppliers and better-defined standards in place, the field will soon be wide open.

While that's a likely vision of the future, the present looks promising for these two new Sun systems. Both the ELC and the IPX place serious computing power on the desktop without using up much space, and their users will benefit from one of the largest, fastest-growing application libraries outside of DOS.

I recommend the ELC for anyone who is considering a high-performance PC. As a midrange workstation, the IPX stacks up well against the competition. My advice for potential buyers of any Sun workstation is to budget in the optional CD-ROM drive. The $995 price is high, but Sun is distributing its operating system and other software on CD-ROM, and vendors of SPARC software are following suit. CD-ROM media are cheaper and more reliable than tape, and their random accessibility means that you can use them as mountable Unix volumes.

My only serious criticism of these machines, and most SPARC systems in general, is their lack of BNC (thin-wire) Ethernet connectors. That would help ease these systems into networks of PCs and Macs. But even without the connector, I'm pleased to see that as prices drop and standard horsepower increases, SPARC systems are becoming ever better equipped to give PCs a run for their money. ■

Tom Yager is a BYTE technical editor who manages BYTE's Unix Lab. He can be reached on BIX as "tyager."

Photo 1: *ALR's new PowerPro configuration boosts disk performance.*

ALR Adds Cache, Improves Performance

Our May Product Focus concerning 486/33 EISA systems ("486 EISA: Born to Blaze") faulted the disk performance of Advanced Logic Research's PowerPro VM. We noted that ALR's choice of a noncaching, 16-bit drive controller in its low-end PowerPro configuration caused it to fall behind the leaders in disk-intensive applications.

But configurations change with time, of course. ALR's new low-end VM/64 includes an UltraStor 22C caching ESDI drive controller with 512 KB of cache memory. Except for the new controller, this is the same system that we tested in last spring's review; it includes a single 486/33 processor, a 64-KB external processor cache, 5 MB of system RAM, a 320-MB hard drive, and a 150-MB tape backup unit. The new configuration, at $11,993, is also significantly cheaper than the $13,477 model we tested.

As you might expect, our benchmarks show significant performance improvement on disk tests and in overall application speed (see the table). Our Unix benchmarks also showed excellent disk performance; we don't show the results here because the Product Focus used an out-of-date version of our Unix tests, so we're unable to make any comparisons.

In our opinion, the reduced price and the 28 percent improvement in application performance make the new PowerPro VM worth a second look.

BYTE DOS BENCHMARK SUMMARY

The PowerPro VM/64's new caching drive controller dramatically improves disk and overall application performance. All results are indexed; for the CPU and Disk tests, an IBM AT = 1; for the Application index, an IBM AT = 7.

Computer	CPU	Disk	Application index
PowerPro VM/64 with hard disk cache	8.3	9.1	75.7
PowerPro VM/64 as originally tested	8.4	3.6	59.1

Ethernet Macs Learn to Share

Macintosh networks that run over Ethernet enjoy several advantages over their LocalTalk-connected cousins: They are faster and let you more easily link your Mac network to PCs and Unix networks. We discussed the benefits of interoperability in last month's Solutions Focus ("Mix 'n' Match LAN," November BYTE). There is one small problem left: How do users print from network Macs? You want laser-printer-quality output, but you'd like to save costs by purchasing a networked printer.

Photo 2: *Dayna's EtherPrint Plus links Ethernet-bound Macs to printers on LocalTalk.*

If you've looked at the printer market lately, you've probably noticed that few printers have Ethernet interfaces (yet) but nearly all have a LocalTalk interface. One way to access such printers is to tie into a LocalTalk network using one of the gateway/routers that we discussed last month. However, if your office setup doesn't require the processing might of the FastPath 5 or GatorBox CS, then Dayna's EtherPrint Plus, at $899, may provide a cost-effective solution.

The EtherPrint Plus is essentially a miniature LocalTalk/Ethernet router. You can daisy chain four LocalTalk devices—laser printers, file servers, or Macs—from it. EtherPrint Plus handles both AppleTalk Phase 1 and 2 protocols. It looks like a modem box, but it has a mini-DIN-8 LocalTalk, a thick Ethernet, and a thin Ethernet connector at the back. There's also a version that supports 10Base-T.

Setup is simple: Hook up the Macs and printers to the unit's LocalTalk port, attach the appropriate Ethernet cable, and plug in the power supply. A Mac EtherPrint Setup application lets you change the Ethernet zone the unit resides in.

This was the one routing product that didn't give us migraines while we tied it into the LAN Lab's network. Once it was up and running, laser printers appeared in the Chooser desk accessory and in the selected zone. Macs running System 7.0 file sharing or AppleShare servers also appeared in the Chooser, and we could access files on these systems. Printing from a Mac worked reliably, as did printing from a PC running NetWare and a SPARC workstation using `lpr`. ■

—The BYTE Lab

Reviewer's Notebook provides new information—including version updates, new test data, long-term usage reports, and reader feedback—on products and product categories.

ITEMS DISCUSSED

EtherPrint Plus $899
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Salt Lake City, UT 84144
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fax: (801) 359-9135
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PowerPro VM/64 ....$11,993
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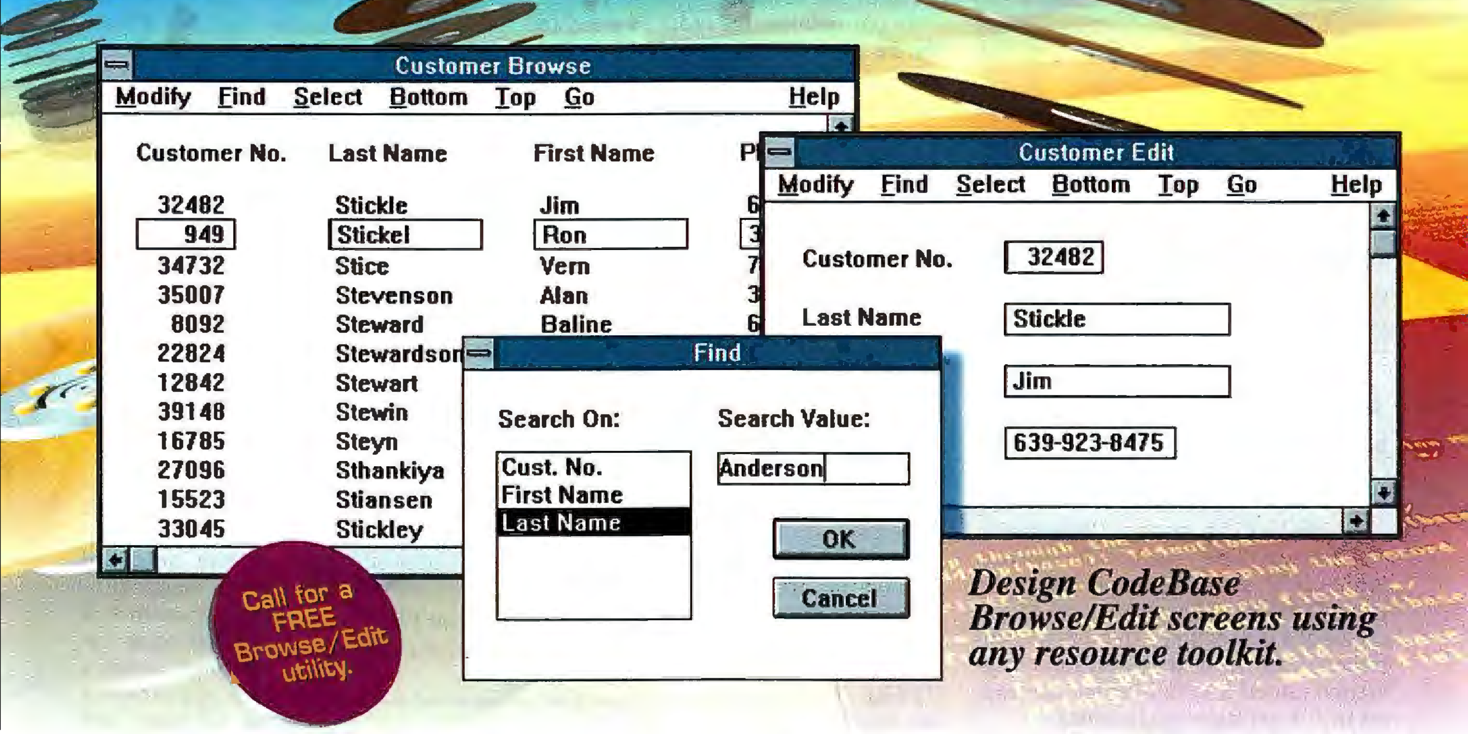

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MARK MALLETT

SORTING OUT SCHEDULES

Coordinating schedules can be more than a trivial problem, even for a computer

One thing that computers are supposed to be good at, or at least good for, is putting things in order—sorting. And while computers *can* arrange things in sequence quite well, it's when we ask them to straighten our lives out that the computing becomes tricky.

This article discusses one example of sorting things out—specifically, scheduling. When you put the words *scheduling* and *computer* near each other, most computer types immediately think of process scheduling or time scheduling or queuing analysis. But computing and communications schedules are not the only complex scheduling problems; scheduling human activities, coordinating tournaments, making travel plans, and arranging meetings have some very real challenges that make them fine examples for methods of coordinating multiple data sets over a base data set.

No matter what the application, a scheduling job is nearly always complicated by a set of constraints imposed by the requirements of the particular purpose. I'll look at a few specific applications and illustrate some of the constraints that can make them difficult and the algorithms you can use to solve the problems.

Tournaments

To start with a simple problem, look at what is necessary to maintain a schedule for one type of chess tournament. In this example, contestants are paired off for each round of games. As much as possible for each round, winners of the previous round play other winners, and losers play losers. After a fixed number of rounds, the winner is determined based on the rating of the games that have been played.

A simplistic scheduling algorithm is as follows:

- Sort the contestants by number of games won so far in the tournament.
- Group this list by twos; these are the pairings.

If it sounds too simple to be good, it's because it isn't as good as it sounds. One drawback to the simplistic algorithm is that it can pit very good players against much inferior players, upsetting not only the interest of the participants (and the spectators) but the method used to rank the results. Another problem is that this algorithm could pair up the same two players many times. The algorithm needs some real-world constraints:

- Players should be matched only in their own rank.
- If possible, any two players should not be paired with each other more than once.

The modified algorithm is in listing 1. It requires only keeping track of games won by each contestant and

Listing 1: *The chess tournament algorithm. It attempts to pit equally ranked players against each other while reducing the number of times the same two individuals play against each other.*

```
-Sort the contestants primarily by ranking, secondarily by number of games
 won so far in the tournament.
-Cut the list into sections according to player skill category. (If a
 section contains an odd number of participants, migrate the top player
 into the next section, and so forth.)
-For each section:
   -For each player not yet paired:
      -Find another player not yet paired with this player; create a new
       pairing. If there is no such player, pair the player with another
       player at random.
```

Listing 2: *An algorithm for a little-league team scheduler.*

```
-Create a table of field-time slots for the entire schedule.
-Allocate two sets of links to each slot. Each of these points to all the
 teams that can possibly play on this slot: one set is for the home team,
 the other for the away team. Initially, each set connects to all teams n
 times, where n is the number of times each team should play as a home team
 or an away team.
-For each slot:
   -Randomly choose one team from the first set of links (the home team).
   -Cut all the other home possibility links.
   -Remove all links (if there are any) to the chosen team from the away
    team possibility set.
   -Remove one link to the chosen team from all other home links on all the
    remaining unscheduled slots.
   -Randomly choose a team from the away set.
   -Cut one link to the chosen away team from all other away sets on each
    of the remaining unscheduled slots.
```

people played by each contestant. Other requirements may suggest a different approach. For instance, another constraint on a pair-based tournament might arise from limited seating. Each round might require several shifts; here, it might be necessary to ensure that no contestant is required to play an early morning game following a night game.

Tournaments such as tennis matches that use succession by elimination do not necessarily need a computer to lay out the match. But you can approach this kind of tournament as a sequence of individual scheduling problems, with each requiring quick and accurate scheduling according to some set of conditions. And even if there is a preordained line of pairing of winner versus winner, a scheduling program can generate the first round according to basic criteria (e.g., maximizing distance in ranking to weed out the weaker players first) in an attempt to arrive at the most probable interesting contests during the final rounds.

Group Schedules

You can extend the tournament-scheduling method to any situation where the problem can be described as an *n*-way combination that is optimal according to some set of rules. (Listing 2 shows how to build a sports league schedule.) Sometimes the rules are such that a shortcut can be used. For example, in the chess tournament, you can limit the choice of combinations by presorting the contestants because that's stipulated by one of the conditions. In other scheduling problems, there may be no such shortcut.

A more difficult combinatorial problem is found in scheduling sessions for a conference. Here, a population of attendees should be distributed across a set of lecture rooms over time, with the goal of giving each attendee his or her desired tutorials or sessions (even though in some individual circumstances it may be better to stay outside). An initial set of operating parameters might be these:

- Each participant has chosen a set of sessions to attend.
- For every session, there is a list of possible presenters and the time required.
- There is a set of rooms of varying capacity.

continued

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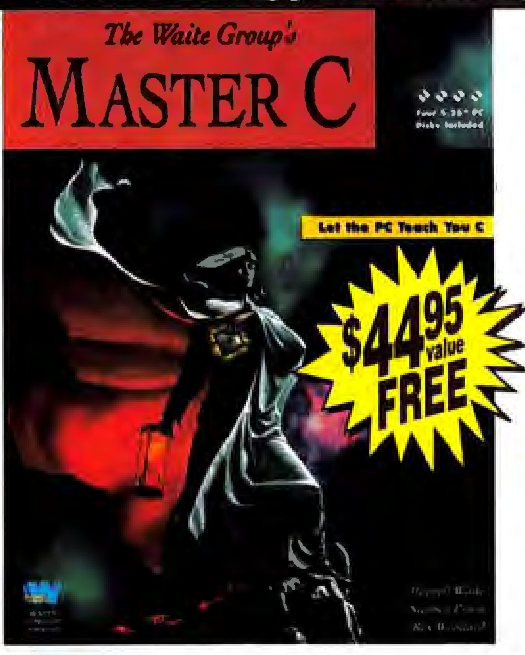

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- The schedule is mapped into hours, with constant class-time boundaries.

The problem is to schedule a week of sessions to maximize the granting of attendees' choices. (The problem is nearly identical for setting up classes for high school or university semesters.)

Other fairly normal conditions are applied: Once grouped into a session, participants maintain the same grouping throughout the course (i.e., the grouping is not fluid), and no class group is scheduled in two separate sessions in any day.

This is a much more difficult problem than the simple sort and partition used in the chess tournament. The solution lies in combining participants, presenters, lecture rooms, and schedule slots in a way that minimizes the number of denied selections.

This complex scheduling problem is solved using game-theory programming methods. Consider each partial combination as a move in a game. A way to decide if a move is the best is to pretend to make a move and see where it gets you, by making subsequent moves until you can make no more (i.e., you've reached a winning position or all the possible moves result in a rule violation). At this point, you analyze the situation for its strengths and weaknesses and, if it is the best one you've found so far, remember its path. Now undo the very last move and make another. Proceed with every combination of moves in every order until you've found a best move.

Listing 3 presents an algorithm that solves the puzzle in this way. This is an example of depth-first combination analysis, trying each combination in every order until a best one is found. (For clarity, the procedure is broken into several separate algorithms.) Note that each combination is undone after it has been tried and all consequences have been found by recursive schedule generation.

This looks tedious, and it is. This brute-force method can consume huge amounts of computing resources if you try to evaluate many deep paths to the full extent of each. As with game solving (just to stretch the analogy a little farther), a human can often approach the problem with a little insight and strategy and not even bother trying most of the dumb moves. Building a little knowledge of strategy into the algorithm can help here, too.

You can improve the algorithm in listing 3 in various ways. By counting the number of selections per session, the order in which rooms are first selected can be made on a best-fit basis, resulting in a good solution appearing faster. Similarly, the algorithm can analyze which choices are bound by the most constraints and process these first. Also, the algorithm can be made to quit when a "good" solution is found, rather than trying for a perfect one.

Keep in mind that this example schedules sessions based on a very simple set of rules. In a real-world application for a school, some additional constraints might be as follows:

- There may be restrictions on teacher migration.
- Certain classes may be restricted to certain rooms or sets of rooms (e.g., science labs).
- There may be different class lengths and different numbers of classes per week, depending on the course (or the algorithm may be asked to divvy up a course into sessions of appropriate length, based on room availability).
- Accommodations may be required for lunch.

Listing 3: *An algorithm for a class scheduler. This algorithm consists of a number of mutually recursive subroutines that together select all combinations of various parameters to be scheduled.*

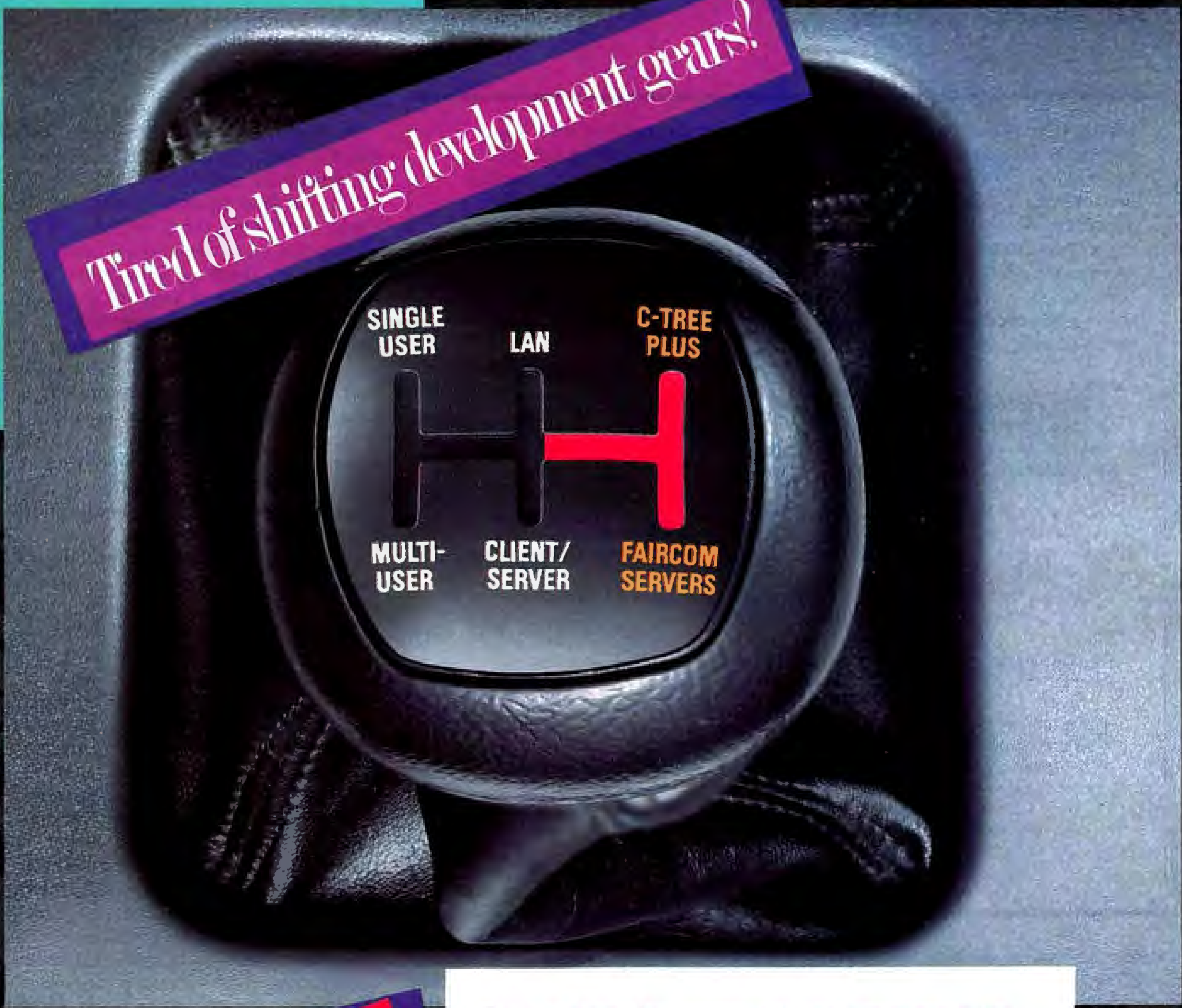
```
Given
  -A set C of all courses, each with
     -A currently instantiated course that is being filled
     -A list of filled instantiated courses that have been filled
     -A list of valid teachers for the course
  -A set S of all students, with
     -A list of requested courses
  -A set R of all rooms, each with
     -A list of time slots marked as available and taken
  -A teacher database, each with
     -A list of times available and unavailable
-Create a null "best found" schedule.
-Execute the recursive scheduling algorithm.


Scheduling algorithm
  -For each course c in set C:
     -For each student s in set S:
        -If student s has not requested course C, continue with next
         student.
        -Remove request of course c from student s.
        -If s's request list is now empty, remove s from set S.
        -Execute course-/student-scheduling algorithm with c and s.
        -If s's request list is empty, add s back to set S.
        -Add request of course c back to student s.
  -If there were no selections attempted (we're at a finished schedule):
     -Evaluate the schedule.
     -If it's better than saved "best found" schedule,
        -Save this schedule.

Course-/student-scheduling algorithm (parameters c and s)
  -If course c has not yet been instantiated:
     -For each room r in set R:
        -Execute room-scheduling algorithm with c, s, and r.
  -Else
     -Add student s to instantiated course in c.
     -If course is full:
        -Move instantiated course to filled list, leaving c uninstantiated.
     -Execute scheduling algorithm recursively to try next combination.
     -Undo the student assignment.

Room-scheduling algorithm (parameters c, s, and r)
  -For each combination of available time slots in room r that are valid
   for course c:
     -For each teacher t in teacher list for course c:
        -If teacher is unavailable, continue with next teacher.
        -Instantiate course with room, time slots, and teacher.
        -Execute course-/student-scheduling algorithm with c and s.
        -Undo the course instantiation.
```

continued



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Listing 4: *An algorithm for scheduling meetings at any possible time. Many variations are possible. For instance, the initiator may specify rooms and times to try. Certain times may not be available for meetings (e.g., does the time overlap lunch?). The scheduler may not have direct access to modify schedules of rooms or people, or it may do so in a staged fashion (i.e., it may tag schedule times as being requested, not taken). It may be better to check room schedules before attendee schedules (particularly if there are only a few rooms to choose from). The scheduler loop may have to occur in a macro time scale, with schedule inquiries taking place by a slow protocol (e.g., mail) and proceeding only after all replies are in.*

```
Given
  -A list of rooms of specific capacity, each with a schedule
  -A list of desired attendees, each with a schedule; some attendees may be
   considered required, and some optional
  -An estimated length of meeting

  -For each time increment (e.g., each half hour):
     -For each desired attendee (including the initiator):
        -If the attendee's schedule is open for this time, count the person
         available.
        -If the person is not available and is a required attendee,
         continue to the next time increment.

  -If there are insufficient available attendees (e.g., according to a
   quorum threshold), continue to the next time increment.

  -For each meeting room:
     -If room is available for this time:
        -Present the time, room, and attendee list to the initiator. If the
         initiator does not approve, continue to the next room.
           -Claim the meeting room for the desired time.
           -Mark each attendee's schedule (if this is an option).
           -Optionally send out meeting notices.
           -Be done.
```

- Regular spacing of classes throughout a week may be given preference over irregular spacing.
- The school budget may have to be considered: Some schedules could cost more than others.
- Students may be able to specify alternative selections.

Some constraints can be handled in the final evaluation; some can act as filters affecting the selection of the appropriate item. A program with such filters will probably be more complicated but can often find a solution faster. If, for example, a course is only available in one room, fewer combinations need be tried. The program could also be taught not to examine aliases of solutions already found (as in the cases of students who have selected the same courses).

What happens when a less-than-ideal solution is found? Human intervention should occur. You may find that even in the best solution, an unacceptably large number of students are not able to take a required course. Here, the administrator must solve the problem externally (e.g., by hiring another teacher or telling the gym teacher to teach math), or the students may be asked to choose other courses that are not yet full. Relatedly, the scheduling program should not simply spit out a schedule; rather, it should present acceptable solutions to the human involved and let the human choose among them. The sample class-scheduling program available with this article deals with some of these constraints and lets the operator of the program examine multiple solutions.

The Business World

Business provides another example of multiple combination scheduling: coordinating employees. Employee scheduling can be much more complicated than the classroom problem. A chain of department stores may need to coordinate its staff. Considerations include person skills (at what position each person is trained to work), locations (an individual may be able to work at more than one store), even coverage of all hours, part-time versus full-time, lunches and breaks, vacations, seminars, promotion possibilities, levels of trust—these and more, while at the same time minimizing the amount of money spent over time.

Airlines have a particularly difficult job of it. Not only do all the normal employee factors have to be taken into account, but these must be combined with flight schedules, travel abilities, FAA regulations (e.g., time-off/time-on restrictions), training schedules, and more. This can be so hard that some airlines use specially designed linear-processing systems to tackle the problem.

Another business-world example is that of arranging meetings. Meeting schedules are very fluid, and scheduling is done in real or near-real time. Required data includes information about rooms (their availability, capacity, and sometimes location) and calendar information for the individuals involved.

One way to approach the problem of scheduling meetings is to use an immediate search technique. The initiator of a meeting identifies the required and requested attendees. The scheduling system searches through the calendars of all the invitees as well as all available meeting rooms, and picks one or more meeting times. (See listing 4.) Once a room, time, and participant list have been decided on, the program reserves the room, sends out meeting notices, and perhaps even alters attendees' schedules.

Several other approaches are possible. A variation on the meeting scheduler lets the initiator specify a time and place, using these factors as constraints. To avoid the problem of the last schedule request having more or less priority over the others, the computer could batch meeting requests and then schedule using techniques like class scheduling. Or a combination of immediate and batched scheduling can be used (e.g., staff meetings can be scheduled immediately, with code reviews being batched). Note that the system must also allow meetings to be canceled or rescheduled. ■

Editor's note: *The complete source code (in C) that implements the algorithms is available in electronic format; see page 5 for details. The programs are a chess tournament scheduler, a little-league scheduler, a classroom scheduler, and a simple meeting scheduler.*

Mark Mallett is an independent programmer at Zinn Computer Co., a writer, and a BIX moderator. He lives in Litchfield, New Hampshire, and can be reached on BIX as "mmallett."

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

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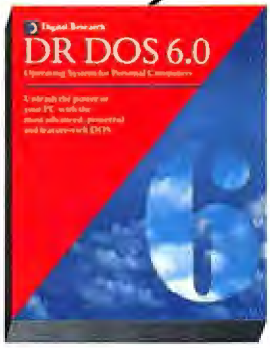

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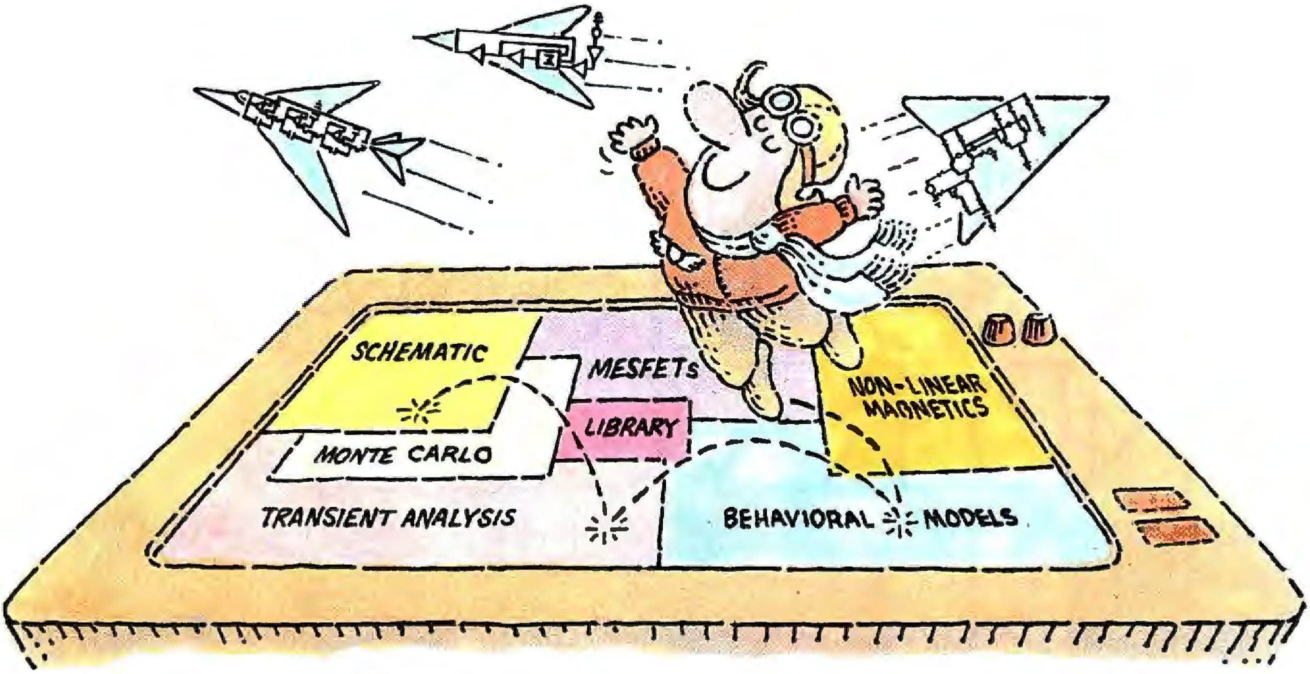

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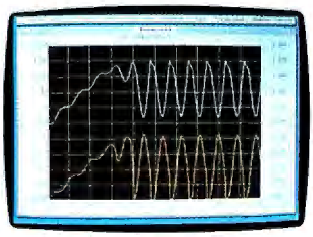

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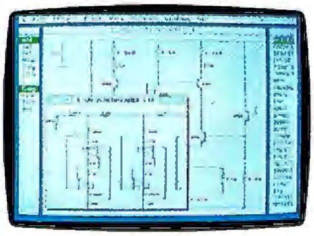

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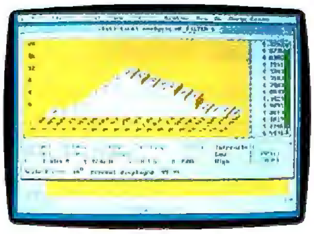

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BRETT GLASS

THE MIPS R4000

On October 1, Mips Computer Systems formally announced the R4000—the newest member of the Mips family of RISC processors. Like Sun Microsystems' SPARC (see "SPARC Revealed," April BYTE) and IBM's RISC System/6000, this architecture is a strong contender for the hearts, minds, and checkbooks of workstation designers and users. It's also the core of the Advanced Computing Environment (ACE), a workstation standard currently under development by a consortium that includes Compaq, DEC, and Microsoft.

What does the R4000 have to offer, and why did the ACE vendors choose it—before it existed in silicon—over other established (and proven) architectures? This month, I'll take a look at some of the novel features that make the R4000 a competitive RISC for the 1990s.

Extending the Line

The R4000's architecture wasn't created ex nihilo. Rather, it's an extension of earlier Mips designs—the 32-bit R2000, R3000, and R6000—all of which have solid track records. The most important difference, however, is that the R4000 increases the widths of the internal and external data paths—as well as the widths of the addresses, registers, and ALUs—to 64 bits.

Although this expansion makes the chip larger, it has several advantages. First, it allows a bigger address space—large enough to let an operating system map more than a terabyte of files directly into the memory space for easy access. In contrast, a 32-bit address can map "only" 4 gigabytes. One-gigabyte drives are now common and relatively inexpensive; 32-bit micros lack sufficient address space to use more than four such drives for virtual memory. (For more on the advantages of 64-bit addressing, see "64-bit Computing," September BYTE.)

This superpipelined RISC processor will be the spearhead of the ACE consortium

With 64-bit data paths, the R4000 can process certain types of data—such as single-precision IEEE floating-point numbers and strings up to eight characters long—in single gulps. Certain important algorithms, such as the Data Encryption Standard, benefit greatly from the enlarged word size. Moreover, the larger word size helps reduce the impact of a minor weakness in the Mips architectures: Because the ALU cannot propagate a carry, multiple-precision additions, subtractions, and shifts take several more instructions than they do on some other RISCs.

Downward Compatibility

Users with 32-bit Mips software won't be disappointed when the new chips come out. Mips has wisely protected customers' investments in previous generations of Mips software by making the R4000 fully downward-compatible with 32-bit software. All the original

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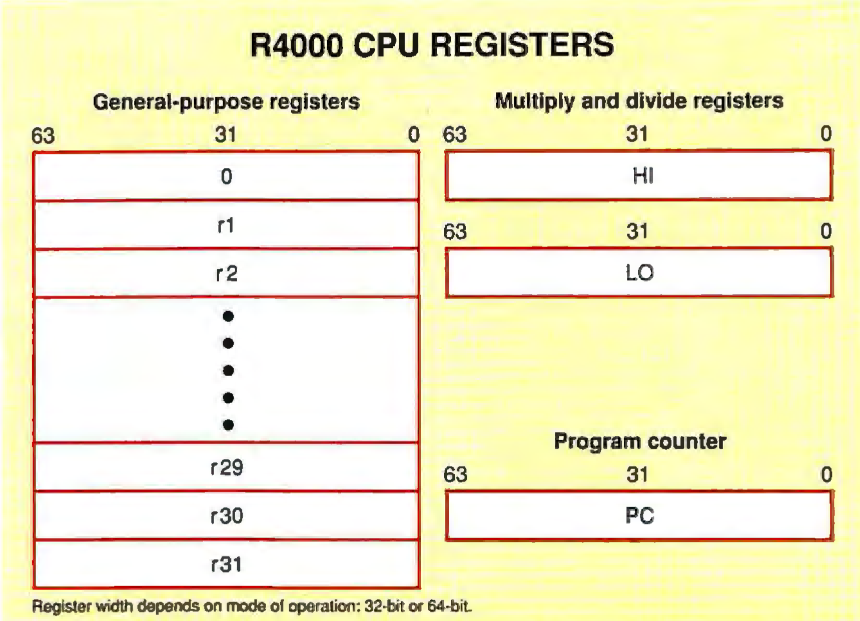

Figure 1: *Only two of the R4000's registers have special functions: Register 0, following RISC convention, is a bit bucket, and register 31 gets the return address during subroutine calls. The multiply and divide registers store the 64- or 128-bit results of integer multiplication operations or the quotient and remainder of integer division operations.*

32-bit instructions function exactly as they did before, and the same machine can run 32- and 64-bit software simultaneously with no glitches. This is done in an especially clever way: Operations performed in the R4000's 32-bit mode actually do work on all 64 bits of each register, but in a downward-compatible fashion. Also, software written for "big-endian" Mips chips (which store the most significant byte of a variable in the lowest address) and "little-endian" Mips chips (which store the least significant byte in the lowest address) can run concurrently on the R4000, as long as programs that have opposite orientations do not try to communicate through shared memory.

Like the R3000, the R4000 has a bank of 32 integer registers (see figure 1), all but two of which are completely general-purpose. As on many RISC chips, register 0—written $0—is hard wired to 0 and discards what's written to it. The last of the registers, $31, receives the return address during a subroutine call and thus must be reserved for that purpose. Also, there is a program-counter register and two special arithmetic registers called *hi* and *lo*. These last two hold the 128-bit result after a multiplication and the quotient and remainder after a division.

All R4000 instructions are 32 bits wide, so they can be fetched from memory two at a time. In typical RISC fashion, all the instructions are laid out in one of three formats, as shown in figure 2: I-type, for instructions that contain immediate constants; J-type, for jumps to absolute addresses; and R-type, for instructions that work on values found in registers.

Load/Store Architecture

The R4000, like most RISCs, is a load/store architecture. All load and store instructions are I-type, and there's only one addressing mode: base register plus 16-bit offset. This addressing mode adds the contents of a register to the 16-bit immediate field to produce the memory address for the load or store.

To load a constant into a register, the programmer (or compiler) can use I-type instructions such as ADDI (for ADD Immediate) with $0 as the source register. The LUI (for Load Upper Immediate) instruction, inherited from earlier processors, loads bits 16 to 32 of a register, so any 32-bit constant can be produced in two instructions without the need to do a load from memory. There's no analogous instruction to load the upper 32 bits of a 64-bit register, though, because instructions are still only 32 bits wide. Therefore, loading a number of 64-bit constants is best done via a memory access or a longer sequence of immediate

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and arithmetic instructions.

Most complex instruction-set computers handle "misaligned" loads and stores by performing extra memory accesses invisibly, while RISCs often make them illegal. The R4000, however, has explicit instructions that perform misaligned loads and stores in, at most, two instructions. The R4000 does integer computations using R-type and I-type instructions—depending on whether the operands are two registers or one register and one immediate value. The available operations are the same as in most microprocessors—however, the R4000 implements a NOR instruction, which isn't found in many architectures.

Transfers of Control

J-type instructions execute an unconditional jump or subroutine call, but not in the way you might expect. The 26-bit target field is shifted 2 bits to the left (instructions must be aligned on 32-bit boundaries) and is combined with the high-order bits of the current program counter. This means that a J-type jump instruction must always lead to an instruction in the same 256-MB block of memory. Jumps that use the R-type instructions get their target addresses from 32-bit or 64-bit registers and thus are less restrictive. Jumps on the R4000 execute after a one-instruction delay; in other words, the instruction immediately following the jump instruction is executed before control is transferred to the target address.

Branches (i.e., conditional jumps and calls) use R-type instructions. Because the R4000 does not have condition-code flags, each branch instruction compares a register either to 0 or to another register and bases its decision about whether to jump on the results of the comparison. One form of a branch, also supported by the R3000, is a *delayed* branch, in which the instruction immediately following the branch instruction (said to occupy the delay slot) is always executed whether or not the branch is taken.

Programmers (and compilers) can use one of three tactics to fill the delay slot. One way is to move an instruction forward from the block of code before the branch (since the delay slot is logically part of that block). Another is to insert a NOP, effectively wasting the delay slot. The third is to move the instruction at the target of the branch. However, in this case, the moved instruction must not cause any untoward effects if the branch is not taken—a constraint that often precludes this tactic.

To make it easier to shift an instruction from the target of a branch into the delay slot, the R4000 adds a feature found in SPARC but not in earlier Mips processors: *annulling* branches. These instructions annul, or cancel, the effects of the instruction in the delay slot if a branch is not taken, so it's always possible to shift an instruction from the target to the delay slot. The names of annulling branch instructions have the word *likely* at the end (e.g., "Branch on Less Than Zero and Link Likely") to indicate that they offer the greatest benefit when a branch is likely to be taken.

Subroutine Calls: Jumping and Linking

The R4000 has six instructions—two unconditional and four conditional—that can call subroutines. When executed, these instructions leave a link, or return address, in $31. If the called routine wants to call yet another subroutine, it is responsible for saving the old return

address either in another register or on a stack. There are no explicit stack-oriented instructions on the R4000, however, so the logistics of maintaining a stack pointer can be handled by the compiler designer or the operating system in any way either sees fit.

To see how a typical language might create and use a stack, I took a peek at the Unix System V release 4.0 ABI (for Application Binary Interface). This document designates $29 as a stack pointer and specifies a stack-frame structure similar to those of C implementations on other processors. Updating the stack pointer takes slightly more work on the R4000 than on a processor with explicit stack instructions like PUSH and POP. However, the R4000 has the advantage of being completely general. Languages like Forth (which uses two stacks) and Prolog (which can use several) don't need to force themselves to behave like other languages to work on this CPU.

Accessories Included

Mips was the first RISC manufacturer to place a memory management unit on the same chip as the central processor, and the R4000 continues this trend with a still-higher degree of integration. It contains an MMU, two 8-KB caches (one for instructions and one for data), and an FPU built right in.

The R4000 is designed to allow expansion of the internal caches: They can be enlarged to 16 KB on a 0.8-micron implementation and 32 KB on a 0.6-micron design. A controller for a secondary cache (as well as for the two primary caches) is also implemented on-chip. All these devices are managed as coprocessors, which are given numbers from Coprocessor 0 (CP0) to CP3.

The CPU accesses CP0 to control memory management and caching; CP1 is the FPU. The FPU has 32 floating-point registers—twice as many as on older Mips FPUs—and there's a control bit that can be used to mask the new registers from software that doesn't expect them to be present. The FPU is fast, but its instruction set is unremarkable; it's very similar to what you see on other FPUs.

The R4000 was designed to fit into a wide range of systems, from desktops to supermicrocomputers. The cache controllers on the R4000 were designed to support every coherency scheme the designers could imagine—including several that work well in multiprocessing systems. The external bus that communicates with the secondary cache (or with main memory) can be configured to stagger its accesses—a doubleword every three cycles, two every four cycles, four every five cycles, and so on—so that it can match the speed of virtually any memory subsystem. This makes it possible to design systems in which the user can plug in a new CPU and speed up the processor clock without worrying about overtaxing the main memory. The external buses can provide bytewise parity checking or error-correction codes to ensure data integrity, and they offer a peak throughput of 400 MBps.

The R4000's external buses also contain a unique hardware feature that guarantees accurate timing in a wide range of silicon and board designs. When laying out an R4000 motherboard, a designer adds a trace that leaves the R4000, loops around the motherboard, and returns to another nearby pin—traveling the same distance as the longest connection between the R4000 and the bus control logic. The R4000 uses an internal, high-speed phase-locked loop to measure the length of the loop and adjusts the *slew*

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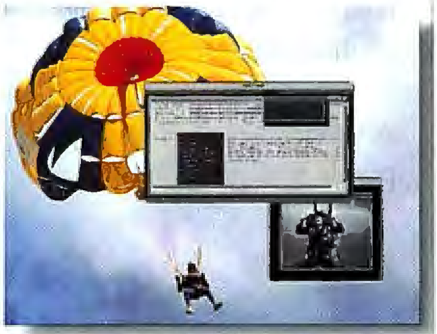

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R4000 INSTRUCTION FORMATS

I-type (immediate)

31 26	25 21	20 16	15 0
op	rs	rt	immediate

J-type (jump)

31 26	25 0
op	target

R-type (register)

31 26	25 21	20 16	15 11	10 6	5 0
op	rs	rt	rd	shamt	funct

where

op	is a 6-bit operation code
rs	is a 5-bit source-register specifier
rt	is a 5-bit target (source/destination) register or branch condition
immediate	is a 16-bit immediate branch displacement or address displacement
target	is a 26-bit jump target address
rd	is a 5-bit destination-register specifier
shamt	is a 5-bit shift amount
funct	is a 6-bit function field

Figure 2: *Every instruction is a 32-bit word, but there are three distinct formats: I-type for immediate operations, J-type for jumps, and R-type for register-to-register operations.*

rate of its outputs (i.e., the rate at which they turn on and off) so that the signals arriving at the bus controller have exactly the right timing relationship.

Superscalar vs. Superpipeline

Perhaps the most controversial aspect of the R4000 is the structure of its internal pipeline. Most RISC designers are moving toward superscalar designs, but Mips eschewed this approach and made the R4000 a superpipelined CPU instead.

Most current RISC processors can achieve execution speeds that approach one instruction per system clock cycle, but the race is on to do better. So far, two classes of CPUs have evolved to offer multiple instructions per clock cycle: *superscalar* and *superpipelined* architectures.

To understand the relationship between the two approaches, imagine that you own a car wash business and want to increase the number of cars you can wash per hour. You know that each car passes through a series of stages: soapy water, various scrub brushes, a rinse, and a dryer—followed by stations where employees perform manual tasks such as polishing the windows and vacuuming the carpets. Finally, a foreman inspects the car before it's delivered to the customer.

One way to speed things up would be to install a second car wash next to the first one, so that two cars could be processed at one time. This is how a superscalar processor works: The chip designer literally builds a second processor pipeline beside the first. This works well as long as there are no dependencies between what goes on in the two lines. However, if there *is* a dependency—for instance, if there's only one foreman and he has to run back and forth between the

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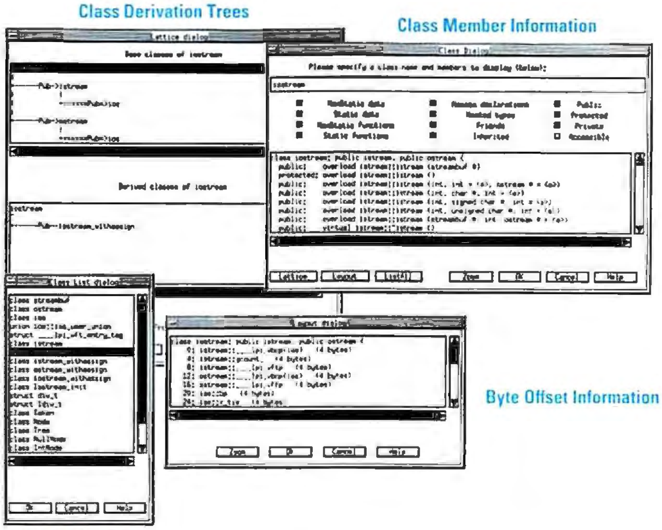

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two lines—it's possible for things to bog down due to contention for the shared resource. Similarly, if instructions in two microprocessor pipelines compete for resources—an ALU, a bus interface, or control of a register—a superscalar processor may not be able to deliver optimal performance.

Another way to speed up your car wash would be to increase the rate at which cars enter and leave the car wash. After watching the car wash in operation, you realize that the maximum speed at which cars can advance depends on the time it takes to finish the task that's done at the slowest station—for example, the one at which an employee polishes the front and rear windows. You realize that if you split this job between two stations—one for the front window and another for the rear window—neither one would be the limiting factor any longer, and the line could advance as quickly as the next fastest job could be done. Repeating the procedure, you subdivide the next slowest job, and then the next, until it does not make sense to divide the work any more. This is how superpipelining works: The CPU's internal pipeline is broken up into small, fast stages so that instructions can advance through it more quickly. However, as with the car wash, you can only divide the stages so much before it becomes unfeasible to divide it any more. At that point, it would be time to consider adding a second line—that is, going superscalar.

The R4000's eight-stage pipeline evolved from the five-stage pipeline of the R3000 (see figure 3). The larger number of steps means that the R4000 can process eight instructions simultaneously. Also, because the pipeline advances at double the system clock rate, two instructions can be issued on every clock cycle.

Mips's architects admit that the superpipelined approach will take them only so far in their efforts to produce a top-performing CPU. Mips believes, however, that superpipelining yields a more uniform increase in overall performance (superscalar CPUs, they say, speed up floating-point operations more than integer operations) and requires less silicon for comparable throughput. Time will tell if they're right. Since most of Mips's competitors are taking the superscalar approach, it won't be long before users will be able to evaluate the trade-offs with real-world benchmarks.

A "Portable" Design

Although Mips makes and sells computer systems, it doesn't make chips. Instead, it operates as a "fabless" design center and licenses other companies to create the silicon. Thus, it's important to Mips that the design for the R4000 be portable (i.e., manufacturable by a large number of vendors). The companies that actually make Mips chips—including IDT, PSC, LSI Logic, Siemens-Nixdorf, and NEC—all receive masks from Mips as well as copies of the CAD database that was used to produce them.

To make certain that mainstream computer vendors have a choice, each chip maker is contractually obligated to do a plug-compatible "generic" version of the chip but may then do others as well. IDT, for instance, produces versions of the R3000 with reduced pin-outs for embedded applications, and LSI Logic produces single-chip microcomputers with integrated peripherals connected to a Mips core.

continued

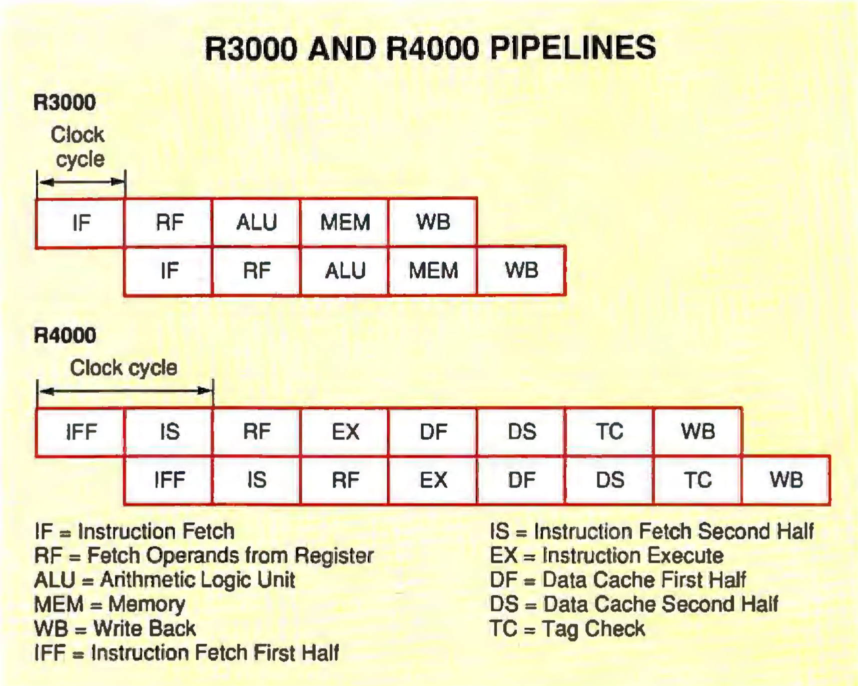

Figure 3: *The R4000's eight-stage pipeline advances twice per clock cycle; the R3000's five-stage pipeline advances once per cycle. A superpipelined processor requires less silicon and less logic design effort than a superscalar processor. But since superpipelining depends on fast logic, circuit design is tougher. And since the pipeline can be split into only so many stages, the approach eventually runs out of steam—at which point the designers must contemplate a superscalar design.*

ACE in the Hole?

On April 9—long before Mips officially announced the R4000—21 companies held a press conference to announce the formation of the ACE consortium. Its purpose was to create a "nonproprietary, standards-based computing environment that includes two powerful operating systems and two open computer hardware platforms." The two hardware platforms were to include PC-compatible systems and a new architecture called Advanced RISC Computing, or ARC, based on the Mips R4000, while the two operating systems were to be Microsoft's NT (for New Technology) environment and SCO Unix. Microsoft also owns a substantial share of The Santa Cruz Operation, so it would have a lock on the operating-system market for the new platform.

A political reason that ACE chose the R4000 over competing RISC architectures was that the other members of the consortium—including Microsoft, DEC, and Compaq—saw Sun as a fierce competitor. They also felt that Sun's close ties to SunSoft (makers of Solaris—formerly SunOS), its control of SPARC distribution channels, and its early access to new and better chips gave it too much of an edge in the SPARC marketplace.

Other reasons were technological: The members of the consortium accepted Mips's arguments that the lean, mean R4000—with its superpipelined architecture—would be able to successfully compete with the first generation of superscalar SPARCs. An important logistical concern was that the R4000's capability to operate as a "little-endian" chip set, like the Intel 80xxx series, allowed greater portability of software and data from the PC to the new platform.

At this writing, few technical details of the proposed ARC platform have been announced. Given its technical merits, the R4000 is likely to succeed as a processor in its own right. If the ACE consortium realizes its goals, it will guarantee the R4000 a place on many desktops for the foreseeable future. ■

ACKNOWLEDGMENTS

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Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. You can contact him on BIX as "glass."

BARRY NANCE

REMOVE TSR DOS PROGRAMS

This month: A TSR remover, a help enhancer, and a communications and file transfer program

The two DOS programs MARK and RELEASE are popular tools on PCs. After you run MARK, you can load TSR programs into memory and later remove them by running RELEASE. Along with the memory-mapper utility MAPMEM, MARK and RELEASE are essential tools for dealing with TSRs.

Recently I needed to remove a program from memory while it was running. Since RELEASE has to be run at a DOS prompt, MARK and RELEASE wouldn't do the job. I scrounged around in my assembly toolbox, put some program fragments together, and came up with KILLPROG. Basically, KILLPROG does the same thing as MARK and RELEASE, but you use a hot key to remove those programs loaded after KILLPROG.

KILLPROG comes complete with assembly source code. Use it to remove TSRs or even errant (e.g., crashed, unresponding) foreground applications from memory. And if you are interested in the undocumented aspects of DOS internals, you can study the source code to learn about memory control blocks and other techniques.

Running KILLPROG is simple, but you have to remember to do it before you run the program(s) you want to remove from memory. The hot-key combination built into KILLPROG is the Control key and the 5 key on the numeric keypad (of course, since you get source code, you can change this to any combination you want). If Scroll Lock is on when you press Control-5, KILLPROG will remove itself from memory, too.

Basically, when you press the hot key, KILLPROG waits for a safe time to use DOS. It then walks the chain of memory control blocks and puts things back the way they were when KILLPROG was loaded. It performs a few housecleaning chores along the way, including restoring the table of interrupt vectors, clearing and resetting the screen to text mode, closing any open files, resetting the COM1 and COM2 serial ports, restoring the 8259 chip's Interrupt Mask Register, and generally putting DOS and the computer back to its previous state.

KILLPROG is also handy for stopping some kinds of buggy programs. If a program crashes and the keyboard is still active, KILLPROG may be able to give you back your DOS prompt without a reboot.

You can optionally run KILLPROG (a second time) from a DOS prompt to remove TSRs from memory. This mimics MARK/RELEASE, and you might use this to put KILLPROG into a batch file of DOS commands. KILLPROG/U removes TSRs loaded after KILLPROG. KILLPROG/A additionally removes the resident KILLPROG process.

I used MASM 5.1 to write KILLPROG. Because I used some of the assembler macros Microsoft provides with MASM, you will need the DOS.INC and BIOS.INC files if you want to modify and assemble KILLPROG.

Have a DOS program you want to kill? This month's free KILLPROG utility could be your weapon of choice. ■

MAC/Tom Thompson

Blow Up Balloons with Helium

Balloon Help is a nifty help mechanism for the Mac's System 7.0 software. It is named for the cartoon-style voice balloons filled with descriptive text that materialize and disappear as you move the mouse pointer over the Mac's Desktop or within applications. But be aware that, once you turn Balloon Help on, those balloons pop up everywhere. Pretty quickly, you want those balloons out of your face, which defeats Balloon Help's purpose.

Helium is a shareware ($5) Control Panel that saves the situation. Written by Robert L. Mathews, it lets you define user-selectable "hot keys" that activate Balloon Help on demand. When you need on-screen assistance, simply press the hot keys and you'll get help balloons. When you're finished, simply release the hot keys again and Balloon Help wafts away in the breeze. It's a neat hack and will help you make the best use of Balloon Help.

UNIX/Ben Smith

An Enhanced Kermit

If you've been around electronic BBSes or have often had to transfer files between disparate systems, you've likely heard of Kermit. Most people know it as a file transfer protocol that is well suited to reliable data transmission over noisy physical links.

But now Kermit is more than just a communications protocol. It is a communications and file transfer program that supports X.25 and TCP/IP connections along with serial connections. It also has a complete script language with all the bells and whistles so you can fully automate your non-UUCP data transfers. We aren't including it on disk this month because of its size, but you can download it from BIX or Demolink.

Folks at Columbia University in New York City developed Kermit and its protocol. Most of the work is attributed to Bill Catchings and Jeff Damens, but the final product is the combination of dozens of programs created by a number of people.

Editor's note: *Software Corner programs are available in a variety of formats. See "Program Listings" on page 5 for details. We solicit your contributions for this column. If you've written a program or utility that you think others might find useful, let us know. We'll pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

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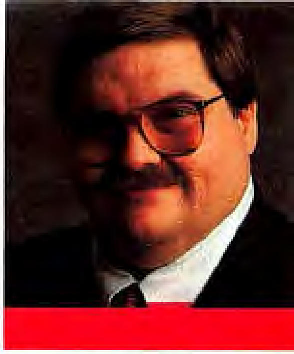


DON CRABB

Making Yourself Truly Mac Portable

In my October column, I took a stab at dealing with the issues of true Macintosh compatibility, especially when it concerns portable Macs. You'll recall my woes with the System 7.0 installer's incompatibility with the Outbound laptop: It somehow fried the machine so that the Outbound wouldn't boot from anything, not even the floppy drive. Not good behavior, especially in what purports to be a portable Mac. Since then, I've learned a few things about portable computing in general, and Macintosh portable computing in particular.

First, let me set the record straight on Outbound Systems. A long session with David Ferguson, Outbound's hardware designer and guru, produced lots of insights into how the Outbound laptop came into being and why the Apple installer did its heinous deeds. The installer issues an eject-disk command soon after it has wiped the existing System file from your hard disk. The point of this eject-disk command is to eject the 7.0 Install 1 disk so that you see a dialog box telling you to pop in the next installation disk, called Install 2.

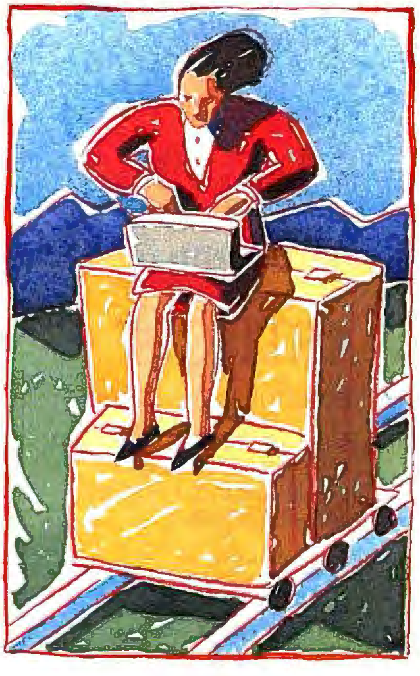
This is all according to plan for the installer, of course, but the Outbound laptop lacks a software-controlled, ejectable floppy Superdrive. What happens next is that the Outbound interprets the eject-disk command to mean "dismount the built-in hard drive." Ouch! When you pump in the Install 2 disk, the installation immediately fails, because the hard disk has gone away.

Now it's double-whammy time. You can't continue with the installation, and you can't boot from the Outbound's hard disk, because the Apple installer has already clobbered the existing System file. In my case, the problem was so severe that the Outbound wouldn't boot from a minimal System floppy, either. The only way I could fix the Outbound was by installing new Mac Plus ROM chips and then reformatting the hard disk (the silicon RAM disk was toast, too). I still don't know why the ROM change worked, but it did, so I'll leave that mystery for a later column.

This episode brings me to what I really want to talk about this month—putting together a decent portable Mac computing environment. Now that my Outbound laptop is up and running again, it's back to being a useful portable workhorse. I've always liked this machine, despite its many quirks. It works, it's not too heavy, and, except for the glitch with the System 7.0 installer, it has been remarkably reliable.

But the Outbound laptop is not for everyone. Indeed, even with Outbound's new notebook computers (I just started using one of the prototypes), the portable market on the Mac side of town needs more machines. Apple is trying to respond with its new PowerBook computers, which are quite nice (except for that trackball, which should be eighty-sixed in favor of the Outbound Notebook's much slicker TrackBar), but even that isn't all that's needed. In short, Mac users need the same level of portable computing diversity that's been enjoyed by their DOS friends for years.

Even with Apple's new PowerBook notebooks, flexible Mac portability is still a chore



In DOSdom, you can choose from machines as small as the Poquet PC and as large as the Dolch 386 color lunchbox and still have some measure of useful software interoperability, which is the true measure of ease of use (not the oversold "data compatibility" mantra). The ability to plug and play at the application level is what we all want, and most DOS-compatible portables deliver it.

Over in MacVille, though, we only have two kinds of Outbounds (laptop and notebook); niche players Colby and Dynamac (Dynamac's new portable 16-gray-scale LCD screen for the Mac LC makes that machine into a reasonable luggable); Macesqe machines like the Cambridge Z88; the old Mac Portables (backlit and non-backlit); and the new PowerBooks. That's it. Where is the market and cost diversity offered by the likes of Toshiba, Zenith, Compaq, Librex, AT&T, Dolch, Zeos, Dell, Panasonic, Sharp, Tandy, Texas Instruments, and others? Sadly absent, of course, because Apple won't license its ROM chips. If there was ever a case where a computer vendor has hurt its customers by holding back on licensing, this is it.

Well, then, how do MacFolk get around the problem? How can you build yourself a truly first-rate portable computing environment that happens to be Macintosh interoperable?

Compromises and Choices

You have two choices to make here. The first and most obvious way to go is not interoperability, but data compatibility. You can buy just about any DOS palmtop, notebook, portable, or whatever, so long as it

ILLUSTRATION: KATHERINE MAHONEY

will run applications that can read and write to your Mac files directly (try to avoid using a format translator to keep this connection uncomplicated). If you choose this route, though, you'll find that the constant transition between the Mac on your desk and the PC on your lap will be annoying, even if you have a fast 386-based laptop and are running Windows. (Windows 3.0 just ain't no Macintosh.)

Choice number two involves living within the limited world of movable Macs. If you're like me, you probably don't want to give up interoperability just to buy a DOS laptop that might cost less or offer features not found on a comparable Outbound, Apple, Dynamac, or Colby machine. You want to hook your portable Mac up to your desktop Mac and use System 7.0's file sharing to interchange files by clicking and dragging. Stuff like Traveling Software's LapLink Mac is great to have, but it is about as intuitive as high-energy physics. I want my Macs to be *Macs*.

Crabb's Guide to Mac Portables

With all this in mind, then, how do you put together the best portable Mac system for your needs? Here's my quickie guide:

- Be honest with yourself. How much portable Mac power do you really need? While we all might want a 68040-based Quadra 900 packed into a case the size of a Sharp Wizard, we aren't all willing to pay the multithousands of bucks necessary for that. How much RAM, CPU, and disk space do you really need?
- Pick your two or three most critical applications and buy your portable Mac to suit them. If you mostly write and check E-mail while on the road, you don't need disk drives large enough to hold gigabytes, 256 gray scales, or whatever else you might have on your desktop. You need a reliable, comfortable keyboard and a clear, backlit screen that doesn't smear when things on-screen change. Buy for those needs.

If your portable Mac is to act as your office while you're traveling, then consider buying a IIsi or an LC, match it with a Dynamac backlit LCD fold-up display, and lug the whole thing in the Dynamac's carrying case. This setup weighs about the same as an old Mac Portable and has about the same general bulk. The new 68030-based Classic II, stuck in a Mac tote bag, would give you similar functionality (less the Dynamac's gray-scale display) in a slightly bulkier and heavier configuration. Even the old Mac Portable—when you add an 8-MB third-party pseudo-static RAM card and the Apple backlighting—is a pretty good performer and is quite rugged.

Don't underestimate your need for quick portability. Even if you find that you have to lug that LC/Dynamac combo around for the big jobs, you might also need something quick and light to take notes at meetings, or to take on that one-day consulting trip, or to keep with you in the field when you are tracking down clients or troubleshooting problems. For those needs, you don't want to carry anything heavy, but you still want something that's all Mac.

You might consider the Apple PowerBook 100, but it lacks a built-in floppy drive and sports a cumbersome trackball. For me, the Outbound Notebook is the better choice. It's smaller than the PowerBook, has a floppy drive, and can be configured with a 20-, 40-, or 60-MB hard drive. It comes with an improved Isopoint tracking device called a TrackBar. The screen is backlit and highly readable, and you can specify a 16-MHz 68000 CPU or a faster 68030.

Its only drawback is that it's based on

the Mac Plus or SE's ROM chips, so it can't directly address more than 4 MB of RAM. But Outbound has worked around that by offering a fast 60-MB silicon RAM disk in the 68030 model. The company has even come up with its own virtual memory implementation that works on the Notebook 2030. I look forward to beating up on a Notebook over the next year to see if it can stand the abuse that both the Outbound laptop and the Mac Portable have undergone over the past year.

As a Mac user, then, I have no choice but to make do with the portable offerings available while hoping that the "new" Apple starts licensing its ROM chips. (Hey, anything is possible. Did you ever think that Apple and IBM would make a deal with one another?) Even though I'm jealous of the DOS folks and their myriad different portable PCs, I wouldn't trade 'em for a single old nonbacklit Mac Portable. Maybe you think I'm nuts, but I prefer to call it dedication. ■

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 contacted on BIX as "decrabb."

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

ITEMS DISCUSSED

Dynamac LCD for Mac LC $1349
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fax: (303) 296-9540
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Outbound Notebook 2000, 2030 .... $2829–$4399
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fax: (303) 786-8611
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PowerBook 100, 140, 170 .... $2299–$4599
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March 26, 1991
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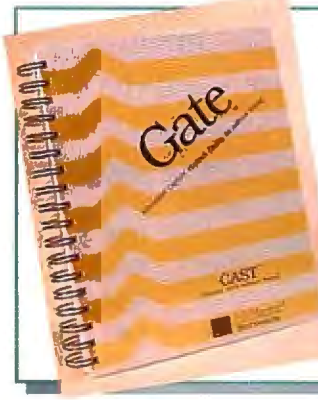

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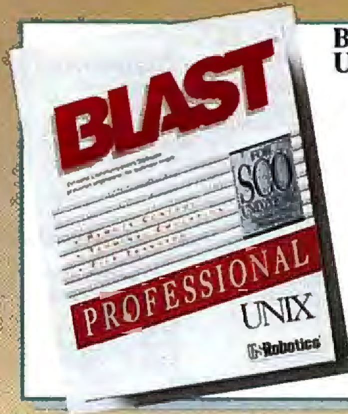

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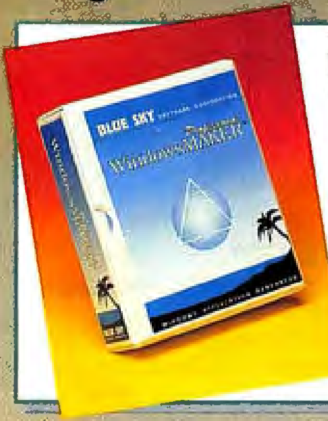

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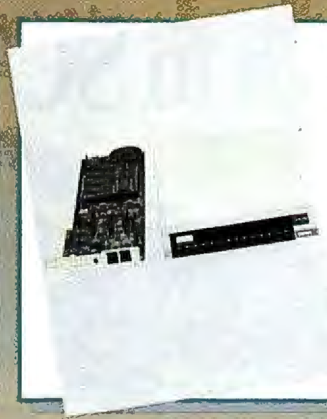

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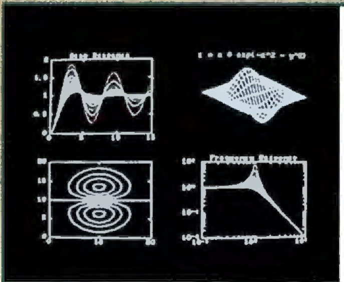

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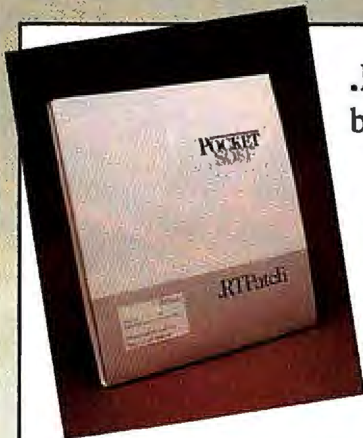

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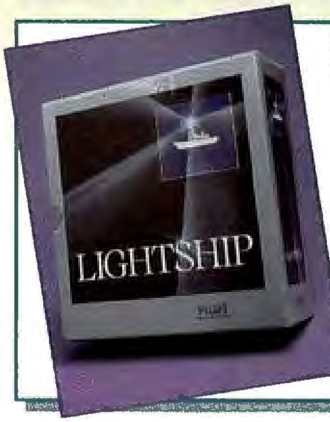

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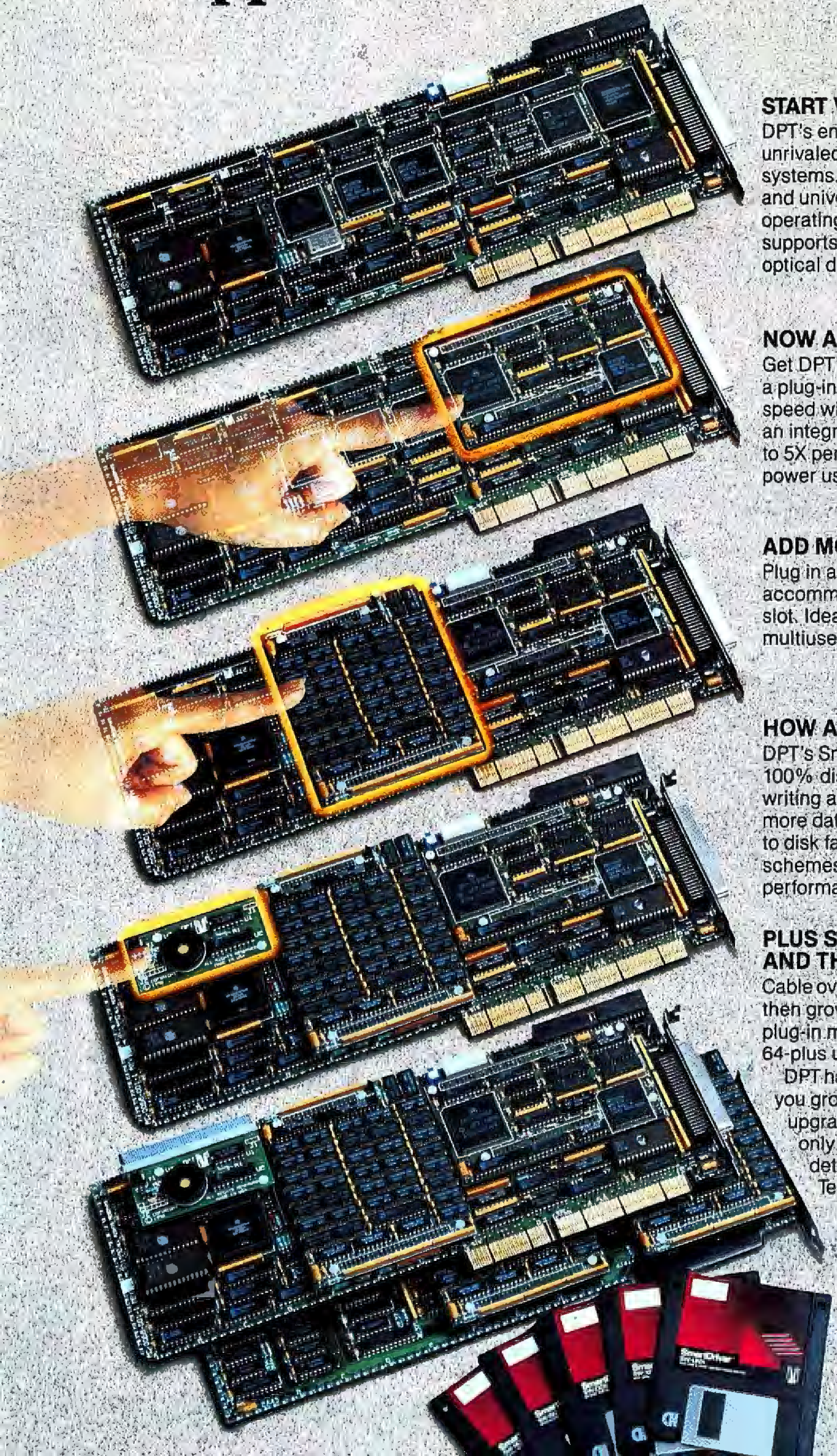

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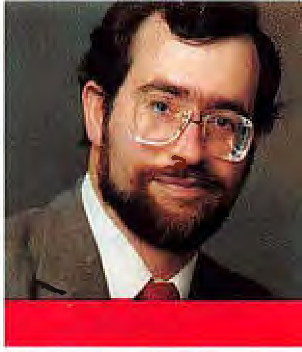

DAVID FIEDLER

E-MAIL FOR POWER USERS

Postmaster, postmaster,
Look and see.
Is there some E-mail
In your spooler for me?

Unless your computer really is an island, you no doubt spend a certain amount of your day sending and receiving E-mail. And unless you like poring over mail-header information, you probably want your mail-interface program to shield you from as many details of the mailing process as possible.

What else you demand from your mailer depends on your style, technical expertise, and how much time you have to fool around with this sort of thing. That's why the selection of a mailer is as intensely personal as your favorite text editor.

Elm

I am no fan of the standard Unix mailer, and long ago I settled on Elm as my own mailer. Elm, originated by Dave Taylor, is a full-screen, intelligent "user agent" program that works with the mail-delivery program (e.g., `smail`, `execmail`, or `rmail`) already on your computer. It's easy and intuitive to use.

Elm is compliant with RFC-822-standard messages, and it knows how to access the `pathalias` database for the fastest routing of your E-mail. Because of this, you only have to save someone's log-in name and machine node when storing an alias, and Elm will automatically determine the best file path (which may change over time as the comp.mail.maps are revised). Perhaps Elm's best feature is its ability to automatically save incoming and outgoing mail in separate folders by the name of the sender or addressee.

Elm comes with a filter program for programmable, automatic handling of routine correspondence. It also has an auto-reply function, much like a mail answering machine, for when you're out of the office. (However, I've never been able to get either of these features to work satisfactorily on my machine.)

Elm is a large (almost 300 KB on a 386) but fast program. At this writing, Elm 2.3.11 is the current version, but version 2.4 is expected to be available about the time this issue reaches you. The main disadvantage of Elm is that you can't buy it anywhere: It's free, but you have to find, download, configure, and compile it yourself. For those who enjoy working with top-quality, freely available software, this is also one of its main advantages.

However, Elm has already been ported to most popular Unix machines, so you won't have much debugging work to do. Best of all, you can easily configure many of Elm's operations to your personal style simply by changing a few lines in the `.elmrc` file—no C expertise is needed.

There's a Unix mail management program for every personality

Cymail 1.2

Cymail is an attempt to take some of the features of other mailers, make those features easier to use, add a few new ones, and sell a good product for a reasonable price. With those parameters in mind, it should be a successful product for Cyantic Systems.

A quick perusal of the excellent manual should have even the newest users up and running in a short amount of time. Virtually everything you need to know appears on the full-screen menu interface, and warnings are displayed at just the right time (before you do something that can get you into trouble).

Aliases are supported, although you have to specify the full machine-to-machine "bang" path if you're using UUCP, because Cymail doesn't make use of the `pathalias` database. Aliases let you specify a name that's easy to remember (e.g., "david" for the equivalent "david@infopro.uucp").

Cymail looks forward to a future when more Unix machines will have the ability to perform fax transmissions. For sending mail via fax, the authors provide a menu choice that you can configure to your fax program.

One of Cymail's best features is its simple method of attaching either text or binary files to mail messages. It uses the `uuencode/uudecode` facility available on virtually all Unix machines, so attached files can be extracted by the receiving party even if that person doesn't have Cymail.

Cymail comes with a simple text editor—all the commands are displayed at the top of the screen. However, you can easily specify your favorite editor in the `cymailrc` file, along with a few other options.

Cymail is currently available on the Sun

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Elm ....free
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Sparcstation, 386- and 486-based Unix systems, and the Amiga 3000UX. I found that it installed and worked exactly as advertised. This is not an inconsequential feature with today's complex mail and operating systems. If I could change anything in Cymail, I would let users be able to hide the mail headers when reading mail; there can be a lot of them!

Z-Mail 2.0.0

Z-Mail from Siren Software, written by Dan Heller and Bart Schaefer, is a tour de force of good GUI coding. In fact, it's arguably more configurable than Elm (for which you get the source code!). Available under both Motif and Open Look environments, Z-Mail is huge (about 1.5 MB) but fast on a machine of decent speed (e.g., a 33-MHz Compaq Deskpro 386 with 12 MB of RAM). While Z-Mail doesn't have the database-search capabilities of Elm, it does have some optimization built in, and it can be told which nodes connect directly to your host machine for more direct reply routing.

Like Cymail, Z-Mail supports attaching either text or binary files to mail messages. However, Z-Mail goes further in its implementation of this feature. It lets you specify the exact program needed to deal with the attachment, so the person receiving the message can run that program automatically, using the attachment as input data.

Z-Mail is almost *too* full featured. For instance, 10 "message status codes" can appear on the screen next to each message header being displayed, and almost 90 variables and conditions can be set. If you like to tinker with your environment and program start-up files and write your own shell aliases, you'll love Z-Mail. You can even create your own GUI "buttons," with user-specified actions, adding to the many possibilities on Z-Mail's menu.

This last feature is possible because many of Z-Mail's operations are written in a language called Z-Script, which lets you configure Z-Mail to operate the way you want. The program has already been set up to provide all the functions of regular Unix mail, so new users won't have any trouble learning it.

As the authors point out, the ability to add buttons, write high-level code, and recognize attachments means that you can write a distributed application based on already-existing programs (e.g., spreadsheets or databases) using E-mail to route and process the data. Z-Mail can do much more than just handling your E-mail for you.

The reference manual is over 220 pages long, and a 350-page book is available with sample scripts and in-depth coverage of Z-Script. Just so you don't think I'm trying to scare you off, the Z-Mail user's manual is only 80 pages long, clearly written, and not the least bit technical. Actually, the user's manual is almost unnecessary, because the interface is so obvious (count that as better than intuitive) and the on-line help is so clear. I doubt that you'd even have to open a manual for anything less than writing your own Z-Script programs.

Z-Mail will also run in a full-screen mode suitable for ordinary character terminals, although this user interface is disappointing and not at all comparable to the GUI implementation. Consider character-based Z-Mail an emergency measure for dialing via laptop (i.e., don't bother buying Z-Mail if you don't have a GUI). Z-Mail is available on most popular workstations, including those from Sun, Mips, DEC, and Apollo, and on machines that run SCO Unix and Open Desktop.

I had a bit of trouble getting Z-Mail to install and run, due to Siren's license server setup routines. Apparently, some file permissions were incorrect. Z-Mail is also unique in that you can't use it when you get it; you must first contact the vendor for a special password before it will run. Finally, although file attachments are

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nicely supported, I wasn't able to automatically run particular programs by file type exactly the way the documentation promised, although they could be detached as separate files.

A Range of Choices

There's much to like about Elm, Cymail, and Z-Mail. They improve on the standard Unix mail program by having a full-screen interface with simple menu (or button) commands. All three products have the

Cymail would be great for "just users": people who don't want to get heavily involved in the details of E-mail.

ability to save your mail in separate named folders, which helps greatly when you want to review a particular piece of correspondence. They all support address and group aliases, message printing, forwarding, and replying (by reversing the original mail path). And they all can operate seamlessly even with complex mail delivery agents like MMDF, which is delivered on SCO Unix.

My feeling is that Cymail would be great for "just users": people who don't want to get heavily involved in the details of E-mail or mailers in general. Elm is perfect for installations that can provide their own support (or that have access to the network for support), and you can't beat the price. Z-Mail, perhaps the ultimate mailer, should be considered by anyone with a workstation. ■

David Fiedler has been a consultant and writer on Unix topics for over a decade and has started several Unix publications. His company, InfoPro Systems, produces corporate image and marketing videos for high-tech firms. 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.

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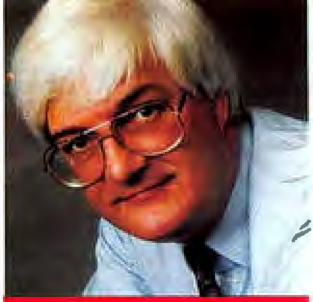


BARRY NANCE

The Black Art of Networking

Last June, I ran into three situations that point up a fact of life about LANs. Vendor claims to the contrary, most LANs still require a high level of expertise and many hours of ongoing troubleshooting to make them work.

Sometimes the problem lies in the physical LAN, and you must figure out which cable, network adapter, or repeater/access unit isn't working right. Sometimes the problem is relatively simple—a missing or out-of-date workstation software component, or a changed CONFIG.SYS or AUTOEXEC.BAT file. Less obvious are the problems that involve LAN setup parameters and tuning. The most complicated kind of LAN problem, however, is the one in which you discover a bug in your LAN vendor's hardware or software. Such bugs are fairly rare, thank goodness, but I recently had the misfortune of encountering three of them.

I get a lot of personal satisfaction from the frequent problem solving I do on networks. Unless you're prepared to diagnose and solve LAN problems, though, you may see your new LAN as more of a challenge than you had bargained for. Here's just a few examples of how problems can crop up.

Token-Ring Trouble

Not long ago, I recommended buying Thomas-Conrad TC4045 16/4 token-ring cards to solve performance problems with my company's NetWare 3.11 file servers. (I mentioned this problem in the August column.) These TC4045 cards have 128 KB of RAM, a 16-bit path to the CPU, an on-board processor, optimized driver software, and a few other bells and whistles. When I tried one out, it did indeed perform well with most network file-sharing tasks. Unfortunately, my company's application (an insurance-rating system) crashed when it ran on a Thomas-Conrad-equipped workstation.

I suspected incorrect jumper settings on the adapter; the card has 12 jumpers—which is plenty of room for error. I checked and rechecked the settings and then tried several jumper placements to see if that would solve the problem. None worked. I replaced the new network adapters with IBM cards and then with Western Digital token-ring cards. In both cases the application ran slower, but it didn't crash.

Perhaps I had a bug in one of my assembler modules. The interaction between my code and the adapter driver code might have somehow brought this problem to the surface. I pored over my assembler modules to see what the interaction might be. I tried to use a debugger to trace into

LANs aren't yet simple, off-the-shelf products; you still need some black magic

the adapter driver instructions after my code had issued a server file request, but the length of the code path (i.e., the sheer number of instructions), the lack of source code, and the inability of most commercial debuggers to reveal timing dependencies and other potential problems made this approach difficult.

Was the problem in the driver software? I called the Thomas-Conrad customer-support line. I was asked to sign a nondisclosure agreement and then sent a beta version of the company's newest driver software. It didn't solve the problem: Our application still crashed at the same place.

A Thomas-Conrad engineer asked for a sample of code with which to reproduce the problem. I obliged, and shortly thereafter Thomas-Conrad called back to confirm that I had indeed discovered a bug in its driver software. The bug could occur only when a combination of message packets filled the adapter's packet buffer precisely to the last byte. The application issued a sequence of file requests, and NETx.COM responded by building full packets that caused the driver to fail. We have since received corrected drivers from Thomas-Conrad, and they work just fine. One case closed.

A Tale of Corruption

Another unrelated incident occurred when we delivered our software application to the CIGNA insurance company. It uses IBM's OS/2 LAN Server 1.2 and OS/2 Extended Edition 1.2 (CSD level 4098) on the file server; the workstations run DOS LAN Requester (DLR). The software failed to run. We ended up with "device I/O error" messages and some corrupted files.

Again, we first suspected a configuration error. Perhaps our software had been installed incorrectly, or the file-server parameters were "too tight" and didn't let us share files and lock records to the extent we needed. I flew to Philadelphia to track down the problem.

continued

CIGNA technical experts and I went over the installation and the file-server parameters (the IBMLAN.INI file) in great detail. Everything checked out; something else was causing the I/O errors and corrupted files.

I traced through my code with a debugger, using Watch (a monitoring tool available from Jensen & Partners International) to display DOS function calls as they occurred. I could now see the two problems with some clarity. DLR would not let me lock records on a file located on the local hard disk, but it returned a DOS error code, which the application received as a "Device I/O Error." Record locking worked fine for files on the file server, but it failed miserably on files on the local hard disk.

The problem was version-specific, too; we have other clients using OS/2 1.3, OS/2 LAN Server 1.3, and DLR who haven't run into the same error messages. Because our application performs generic file I/O operations that don't depend on the location of the file, the behavior of OS/2 LAN Server/DLR was a problem for us.

The second problem, file corruption, also involved record locking. When you lock a record, you specify the beginning of the record as a byte offset into the file, and you specify the region to be locked as a number of bytes. Our application often needs to momentarily lock the entire file as one big record. To avoid having to exactly express the current length of the file each time, I designed the locking mechanism to always lock from the first byte of the file through the 268,435,455th byte (i.e., 0xFFFFFFF in hexadecimal).

Why on earth would I do this? The *IBM DOS Technical Reference* says, "Locking beyond end-of-file is not an error." I relied on this in my code, thinking that I would save a small amount of LAN traffic by not asking each time about the length of the file. Our application has used this approach for many years, working successfully on top of such network operating systems as NetWare, PC LAN, 3+Share, and others. But on these versions of OS/2 LAN Server/DLR, at this particular site, one of our files inexplicably grew from its correct size of 1536 bytes to 8 MB. I could see with Watch that the file corruption was related to the record-locking scheme I had adopted.

One of the IBM system engineers who works with the CIGNA account put me in touch with the IBM development staff in Austin, Texas. I talked with Bill Cartwright, the IBM programmer who maintains the OS/2 LAN Server code. After some discussion about the techniques I used for record locking and file sharing, Bill mentioned an old bug in OS/2 LAN Server having to do with record locks that extended beyond the end of a file. Obviously, this old bug, or a remnant of it, still existed in the version of OS/2 LAN Server we were using at this site.

I owe Bill a letter and some software that demonstrates the error, so IBM can issue an APAR (IBM-speak for problem log) and fix the problem. In the meantime, I decided that it would be just as effective to lock the first 5 bytes of every file as it would be to lock the first 200 million bytes.

OS/2 LAN Server and DLR would still give me the same record-level collisions, because I was in essence locking the entire file as one small record. I would avoid the locking-beyond-end-of-file bug in OS/2 LAN Server with this simple change, and I wouldn't have to think of it as a workaround—this technique works in all

LAN environments—so I could make the change permanent.

The File Not Written

Beginning with version 3.01E, the NetWare shell NETx.COM buffers file reads and writes at the local workstation. The program logic to do this is complex; NETx must carefully track which bytes are in the workstation buffer and which it must send to the file server. Based on the kind of month I was having, you can pretty well guess what I stumbled across: a bug in NETx's file buffering. While working on some new code in an AVL-based file access method, I wondered why NETx was not writing certain records. My own code was new and highly suspect.

I sweated long hours over a debugger trying to figure out what I was doing wrong. Then, just by chance, I happened to run a test at a workstation that was using an old version of NETx, and I was astonished to see the records get written properly. At my workstation, the test failed.

To make a long story short, I sent the code to someone I know who works at Novell, that person fixed the bug, and I now have a test version of NETx.COM that works much better. The new version should be released by the time you read this, but in case you need the workaround: Put `CACHE BUFFERS = 0` in your SHELL.CFG file to disable the buffering and avoid the bug.

No Easy Answers

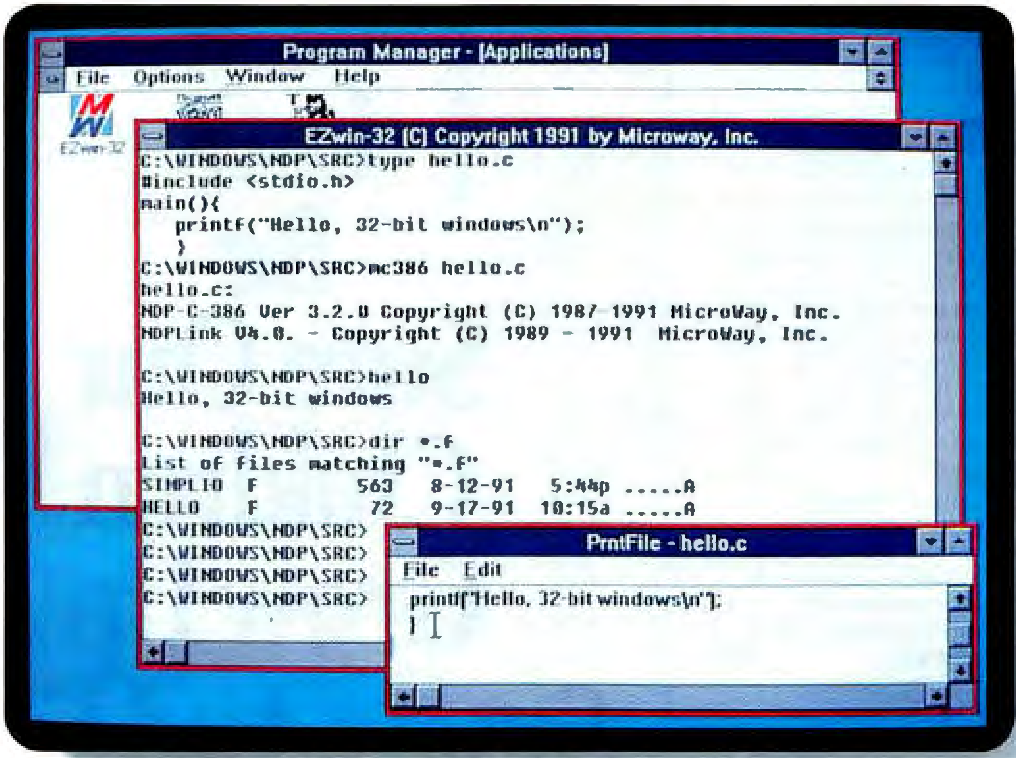
Problems like these don't happen every day, and I hope they never happen to you. Fortunately, all three vendors were cooperative. I'm not pointing a finger; these problems are examples of the complicated nature of LANs, not of poor quality.

I wish I could predict that LANs will become as easy to use and trouble-free as stand-alone PCs. However, as your computers become interconnected in increasingly complex LANs, you'll find that it takes a certain amount of black magic to keep the network going. Frankly, I don't see that changing anytime soon.

I'm writing this in a hotel room in Dallas; I'm at yet another client's site to determine why its OS/2 file server isn't serving up files as quickly as it should. I'm not sure yet what the problem might be; perhaps some of the IBMLAN.INI parameters just need tuning.... ■

Barry Nance is a consulting editor for BYTE. He manages a 70-node NetWare LAN and is editor of the IBM Exchange and moderator of the lans conference on BIX, where you can reach him as "barryn."

Hello 32-bit WINDOWS!



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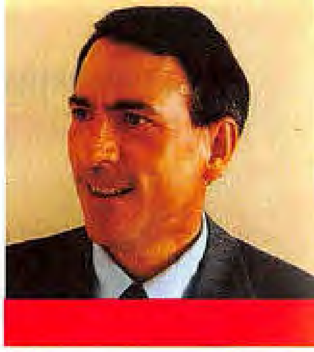

WALTER ONEY

WHY WAIT FOR NT AND WIN32?

Developers long to use the power of Intel 32-bit chips for the next generation of Windows applications. The future may hold new and improved 32-bit operating systems from IBM and Microsoft, but what can you achieve today? I'll describe several ways of building 32-bit Windows 3.0 applications. All of them require you to buy some sophisticated tools from third parties (or else build them yourself).

Why 32 Bits?

There are three reasons why an application benefits from a 32-bit implementation. The first one arises from the fact that a Windows application runs in protected mode. Every time an application dereferences a far pointer, it loads a new selector into one of the processor's segment registers. When a segment register changes, the processor also fetches the 8-byte descriptor for the selector and saves it in an invisible descriptor cache. The descriptor contains the actual memory address and length of the segment. Loading the descriptor cache imposes an additional expense that quickly adds up if the application makes heavy use of far pointers. On a 386DX processor, for example, a real-mode segment-load instruction (LDS) requires seven clock cycles, while a protected-mode LDS requires 26 cycles. Loading a flat address into a 32-bit general register, in contrast, uses only four cycles.

Second, a 32-bit implementation can exploit arrays larger than 64 KB. Because a 32-bit segment can be up to 4 gigabytes long, you don't have to worry about array elements crossing segment boundaries.

Finally, a program that does lots of long-integer arithmetic will benefit from using single 32-bit operations instead of concatenating 16-bit operations. For example, a 32-bit register multiply on a 386DX processor requires between nine and 38 clock cycles, depending on the actual data values. Calculating the same result using 16-bit multiply and add operations could consume 92 cycles. Dividing 32-bit values with 16-bit operations requires software loops that exaggerate the difference even more.

Virtual Device Drivers

Windows 3.0 is actually an application that runs on top of a 32-bit flat-address model operating system that is called WIN386.EXE. By writing a virtual device driver (or VXD, for virtual "x" device), you gain access to the internal parts of this operating system. By programming at this level, you can support new or exotic hardware, and you can provide new or modified system services. All you need to begin is a copy of the Microsoft Windows Device Development Kit (DDK).

Windows extenders build 32-bit Windows applications today

Although writing a VXD lets you write code for the flat-address model, it isn't a viable alternative for application programming. The DDK doesn't include a flat-address model C compiler or the run-time library you'd need to do C programming, so you're pretty much limited to writing in assembly language. Documentation of the VXD-level interfaces is very terse, which means that you have a steep learning curve to conquer before you can use them effectively. In particular, the interfaces that let a VXD communicate with a Windows application are hard to discern.

A Fast Path

One very quick way to adapt an application for 32-bit operation is to use a client/server architecture. In this scenario, you write a regular 16-bit Windows application that interacts with the user. You also write a back-end server as a DOS application, and you use a 32-bit DOS extender that is compatible with the DOS Protected Mode Interface (DPMI) to let you run it in extended memory. You connect the two pieces together with an interprocess communication facility that provides for memory sharing and process synchronization.

The main advantage of the client/server approach is that you can often port an existing 16-bit DOS application to 32 bits very easily as long as it can keep running under DOS. It's sometimes hard to change an application to use the Windows application programming interface (API) for memory management and other system services. Furthermore, you can avoid explicit yields because Windows preemptively multitasks between virtual machines.

On the other hand, overall performance can suffer by decoupling the front and back ends of the application because Windows isn't able to switch tasks more often than once every millisecond. The coarse granularity of the Windows scheduler won't matter, however, if your application is structured so that infrequent trips to the

ILLUSTRATION: KATHERINE MAHONEY © 1991

server result in large amounts of data for the client front end to digest.

Microsoft's WINMEM32.DLL

Microsoft distributes a dynamic link library (DLL) called WINMEM32.DLL that implements an API for 32-bit programming. WINMEM32 lets you create a "USE32" segment and fill that segment with code and data. Because there weren't (and still aren't) any widely accepted standards for 32-bit executable file formats, however, Microsoft didn't supply a tool to do one of the hard jobs that needs doing: loading your program into the segment that WINMEM32 creates for you. In addition, you are left to write your own code to switch between 16- and 32-bit programs when you use WINMEM32.

Given its limitations, WINMEM32 is useful mostly for "turbocharging" a 16-bit application with a 32-bit computational appendage. The articles listed in the bibliography show how to do this.

Apart from the hurdle of writing a loader and a 16- to 32-bit switcher, you have to deal with the very pesky problem of far pointers with a segment of 16 bits and an offset of 32 bits (16:32) when you use WINMEM32. All the library does is create a segment someplace in the middle of the linear address space and give you the tools to access it. The base address of the segment is not zero, and the limit of the segment is explicitly set to the length you supply when you first create the segment. There is an API for extending the segment, but it won't always succeed if the abutting linear memory happens to be committed at the time you request extension.

What's a Windows Extender?

The next level of functionality beyond WINMEM32 is provided by a class of tools known as Windows extenders. A Windows extender masquerades as a 16-bit application to Windows while presenting a 32-bit API to the extended Windows application. The key piece of the extender is a translation layer that mediates calls from the 32-bit "big application" into the 16-bit Windows API. For each possible 16-bit routine, the translation layer contains an entry that remaps that routine's unique arguments into the 16-bit format. Because there are roughly 500 entries into Windows 3.0, a full-figured translation layer is needed.

To appreciate what the translation layer needs to do, consider the `Dia-logBox` function, which displays a dialog box and manages the user's interaction with it. You might call `DialogBox` like this:

```
iCode = DialogBox
  (hInstance, lpTemplateName,
  hWndParent, lpDialogFunc);
```

In the 16-bit version of this call, `hInstance` is a 16-bit instance handle, `lpTemplateName` is a 16:16 far pointer to a character string naming the dialog box template in the resource file, `hWndParent` is a 16-bit window handle identifying the parent of the dialog box, and `lpDialogFunc` is the 16:16 far procedure instance address of the dialog box function that will handle messages. The CALL instruction that the compiler generates uses a 16:16 far pointer to the actual `DialogBox` function, whose address is discovered dynamically at run time as part of the normal DLL resolution mechanism.

The same call in a 32-bit flat-address model program will be different. The two integer arguments, `hInstance` and `hWndParent`, will be 32-bit quantities. The two pointer arguments, `lpTemplateName` and `lpDialogFunc`, will be 0:32 flat pointers. The CALL instruction will also employ a 0:32 flat pointer. The translation layer also needs to deal with callbacks from Windows to a 32-bit dialog box function and with the eventual return value from `DialogBox` itself.

Flavors of Windows Extenders

Two kinds of Windows extenders are now available. Several vendors of 32-bit compilers provide extenders that use a non-zero-based flat segment—much like the one you get with WINMEM32. In fact, two of the implementers started out with WINMEM32 and switched to direct selector management with DPMI calls when bugs surfaced in WINMEM32. The non-zero-based approach restricts your choice of compiler and forces you to use 16:32 far pointers to access memory outside your own flat segment.

These extenders include heap managers—the size of whose memory pool needs to be predetermined—because the mixed near/far pointer model makes it difficult to use the regular Windows memory management API. In addition, these extenders sometimes require you to use explicit subroutine or macro calls when you want to call an API function that requires a far pointer.

The other kind of extender uses a true zero-based flat-memory model, eliminating many of the problems associated with WINMEM32 and its derivatives. In the flat model, all the memory can be accessed with a 0:32 near pointer. Consequently, there's never a need to use a 16:32 far pointer or a special heap manager with a predetermined capacity. Furthermore, a 32-bit pointer is coincidentally and fortunately the same size as a 16:16 far pointer. This size equivalence lets the extended "big application" use structures that have the same layout as their 16-bit counterparts and simplifies the translation job of the extender. With this kind of extender, you can port a well-behaved application simply by recompiling and relinking it—no source code changes are needed except where you tried to be clever with the 16-bit segmented memory model.

Windows-extender technology is still in its infancy, and it's unclear how far the technology will need to advance to satisfy the needs of the development community. For high-end PCs (i.e., 33-MHz 386s with 8 MB of memory or better), either OS/2 or the NT operating system will provide full 32-bit functionality, and they should be available in 1992. Microsoft has announced that it will provide a DOS-based version of its Win32 API later, perhaps in 1993. These dates imply that 32-bit products aimed at midrange machines will need to use an extender for at least the next year, depending on the penetration of Microsoft's eventual Win32 solution. ■

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Walter Oney is a principal software engineer at Rational Systems in Natick, Massachusetts. He is responsible for Windows-related products such as the WinServe client/server API for Windows and the BigWin Windows extender. You can reach him on BIX c/o "editors."

ASK BYTE

Belly Up to the Foo Bar

As a regular BYTE reader, I make a point of reviewing the short program listings, even though I am not literate in many of the languages. From time to time, I've seen the terms *foo* and *bar* used. Are these acronyms or reserved command words, or perhaps just nonsense space-fillers, intended to represent an actual user's variable name?

In the 1930s, there was a comic-strip character who never said anything but "foo." I doubt a historical relationship, but I would like to know the background on the use of these terms.

Charles A. Jarvis
Leavenworth, KS

The characters in the popular comic strip Pogo *often use* foo. *I guess life* does *emulate art.*

Foo *and* bar *derive from the military acronym* FUBAR, *which sometimes expands to "fouled up beyond all repair." Computer programs often have serious bugs the first time through, so using* foo *and* bar *as variables and labels seems appropriate. I suppose you could say that they're a combination of nonsense space-fillers and, to some people, reserved words. To a true computer hacker from the old days,* foo *and* bar *would be the first two words that come to mind when naming an object.*

If foo *and* bar *are the first two words,* baz *(attributed to the Stanford AI lab) is the third. Any words beyond* baz *in the sequence are facility-dependent.* Quux *is a common one, and at MIT's Architecture Machine Group in the late 1970s, we used* face *and* damage.

If you need translations of any other old hacker terms, pick up a copy of The New Hacker's Dictionary *by Eric Raymond (MIT Press, 1991). Look for Hugh Kenner's review of it in next month's Print Queue.*—H. E.

Who Put the Bit...

I am interested in music-related computer software and hardware. I have searched through recent issues of some computer magazines, but I've had no luck. Could you recommend some sources of information on this topic?

My primary interest is in music "word processing" software that will let me write and edit music scores. I have heard that such software can be connected through my computer to keyboard instruments.

Mark Polczynski
Elm Grove, WI

The most popular way to get your computer to read music is with MIDI, the musical instrument digital interface. You'll need a MIDI-compatible musical instrument and a MIDI card for your computer. The Atari ST has a built-in MIDI port, and Apple offers a MIDI board for the Mac. On the IBM side, you should look for a card compatible with the MPU-401 standard. With sequencing software, you can then edit the captured music and—in most cases—lay down multiple tracks as if you were using a standard multitrack tape recorder. The software varies widely in sophistication and price.

Electronic Musician *is a fine resource. You may be able to find a copy at your library, or you can contact the magazine at 6400 Hollis St., Suite 12, Emeryville, CA 94608, (510) 653-3307. Mix Bookshelf is a professional resource company for the audio and music recording industry. Contact it at the same address or call (800) 233-9604 for a free catalog.*

The following sequencing-software products are available: Finale (Mac and Windows) from Coda Music Software, 1401 East 79th St., Bloomington, MN 55425, (800) 843-2066, (612) 854-1288; Ballade (Mac and DOS) from Dynaware USA, Inc., 950 Tower Lane, Suite 1150, Foster City, CA 94404, (800) 445-3962, (415) 349-5700; Performer and Professional Composer (Mac only) from Mark of the Unicorn, 222 Third St., Cambridge, MA 02142, (617) 576-2760; and Vision (Mac only) from Opcode Systems, 3641 Haven Dr., Suite A, Menlo Park, CA 94025, (415) 369-8131.—S. D.

Power to the Deskpro

I am looking for a power supply for a Compaq Deskpro 386/33 system. Are replacement power supplies available?

Bernhard Weis
Niklasreuth, Germany

PC Power & Cooling (31510 Mountain Way, Bonsall, CA 92003, (619) 723-9513) sells a direct-replacement power supply for Deskpro-series computers. The CD270 ($249) has a higher power rating than that in your Deskpro 386/33, and it can work with 110 or 220 volts AC.
—S. W.

Windows Driver Wanted

It's now more than a year after the introduction of Windows 3.0, and there is still no Windows display driver for the Toshiba T5100 computer. The T5100 is well qualified to run Windows, with its 16-MHz 386DX processor, 4 MB of RAM, and up to a 100-MB hard drive. Nevertheless, running Windows in enhanced mode (it works in standard and real modes) is not possible because the screen displays garbage after running a DOS session.

Armand Cachelin
Berne, Switzerland

The T5100 does have the features you've listed, but it's missing one vital component: a VGA display. Windows 3.0 is not suitable for EGA monitors. That may be the holdup in developing a Windows driver for the T5100. Toshiba does have a workaround that may solve the problems you are experiencing. Try holding down the Alt key and pressing Enter when the problem occurs. That should fix it.—S. D.

Oh, Brother!

I am using a Brother WP-500 dedicated word processor and have some 3½-inch floppy disks with information on them. I'd like to transfer the contents of these disks to IBM-formatted disks, but I don't know how.

Julian D. Morse
Tallahassee, FL

The Brother dedicated word processors (and others, like the Smith Corona line) use a proprietary floppy disk format. Unlike a conventional floppy drive, which formats discrete concentric tracks, Brother's drive couples the head motion to the disk rotation so that the head moves in smoothly as the disk spins. All the data is stored on a long, single spiral track. Unfortunately, it's simply not possible to program an IBM PC to read these disks.

I spoke with a product manager at Brother, and the company is investigating the idea of producing a PC drive to read to and write from its word processor disks. Unfortunately, Brother has no immediate plans to release one. If it does, that should make these wonderful little machines more interesting to more people.—H. E.

Eight of One, 16 of the Other

I have a Hewlett-Packard ScanJet attached to my 33-MHz 386 clone, and I cannot access my video card in 16-bit mode and run the ScanJet at the same time. I understand that the ScanJet has an 8-bit interface card and won't let a video card run in 16-bit mode.

I've tried all the settings on the ScanJet, and nothing seems to work. The ScanJet will coexist only if I set the video card to 8-bit mode. I would like to upgrade to a newer video card with greater resolution (e.g., High Sierra or Edsun), but I understand that these cards must run in 16-bit mode to access their extra features. Is there a card that will get along with the ScanJet, or is there a setting that I can change on the ScanJet card? Is software available to change the card from 16- to 8-bit mode? It is awkward (to say the least) to reach behind the computer with a pen and change the DIP switches on the video card when I want to use the scanner.

Cliff Millward
Salt Lake City, UT

I don't see any reason why you should have this problem. The 8-/16-bit phenomenon you're referring to is due to the way the ISA bus addresses 8- and 16-bit cards. In short, all cards must identify themselves as either 8- or 16-bit cards at system start-up time. If you put more than one memory-mapped card in the same segment, the cards have to run as 8-bit cards. Most people see this when they try to add a monochrome display card (at B000 hexadecimal) to a VGA system (with the VGA at B800h). You can configure the ScanJet to a number of locations in the C and D segments and shouldn't experience a problem.

I have a similar configuration with a 16-bit VGA display card and an 8-bit ScanJet interface card. I ran a few informal speed tests, pulled the ScanJet card, and tried again. No difference. Then, to make sure the VGA card flipped itself into 8-bit mode, I put a monochrome display card in the system. It ran slower, as expected. My guess is that there's something else going on with your system that you didn't mention in your letter. Perhaps some other card is contributing to your problem. You might try pulling out everything except the VGA and ScanJet cards and doing your tests again.—H. E.

Make Mine Mandarin

I want to do some Chinese-language word processing, but I don't know what is available, what is good or bad, and where I can purchase these programs. My computer is a PS/2 Model 70. I hope you can help me.

Mickey Mah
Edmonton, Alberta, Canada

The problem with writing a Chinese-language word processor is that the language uses ideograms that don't correspond to ASCII text. One Chinese word processing package I've seen is XianTianMa. It allows data entry in a number of ways, including phonetic spelling. Written by Dr. Peter Leimbigler, it's designed for IBM PC-compatible systems with a VGA display and a laser printer.

XianTianMa is available for $695 from Asia Communications, 1117 Ste-Catherine W, Suite 606, Montreal, Quebec, Canada H3B 1H9, (514) 434-9373.—S. W.

LCD Search

I am building a project that requires a 25-row by 80-column LCD unit. Can you tell me where I can purchase one?

Allan R. Summers
Pasadena, TX

I wasn't able to find a supplier of 25-row by 80-column modules. However, companies like Hitachi, Seiko, and AND offer 640- by 400-pixel graphics displays that you could draft for your project. Each of these manufacturers sells through distributors that you should be able to find in your area.—S. A.

Where Does That Neat Stuff Go?

I have been reading BYTE for a while, and recently something has started to bug me. What do you do with all the items that you get to review once you're done testing them? Do you have some giant warehouse somewhere, or what? Just wondering.

Paul J. Kahn
Kew Gardens, NY

Just on the outskirts of Peterborough, there's a heavily guarded landfill where every month we send...

But seriously, when we request equipment or software from a manufacturer, we return it after the review is complete. If a vendor says to keep the product, we add it to our collection for future reference or dispose of it.

Occasionally, we arrange with a manufacturer to keep equipment for long-term use in the BYTE Lab. When purchasing hardware and software for the BYTE offices, we buy through retail channels like everybody else.—S. W. ■

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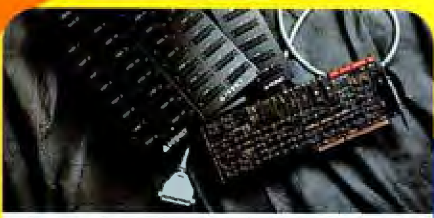

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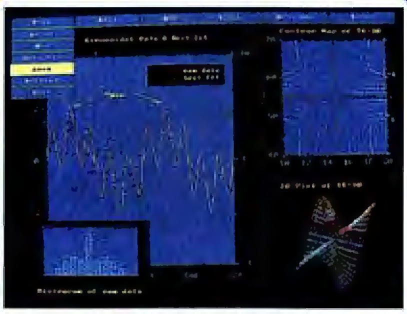

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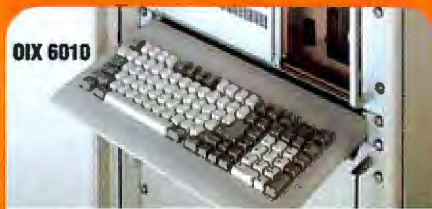
PC SYSTEMS



Elma Rack-Mount Keyboards

If you use a standard keyboard with your rack-mounted system, you know what a nuisance and a hazard it can be. These new industrial keyboards are designed to fit easily into any EIA 19" rack. Rugged and reliable, these keyboards are made in the U.S.A. by a Swiss company and demonstrate classic Swiss craftsmanship.

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- **OIX 3010** keyboard is set in a drawer (not shown).
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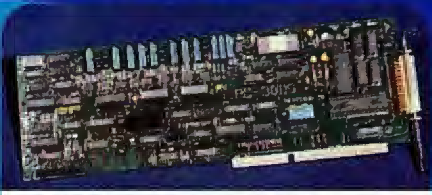
DATA ACQUISITION



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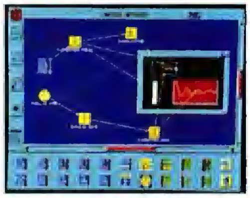

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DATA ACQUISITION

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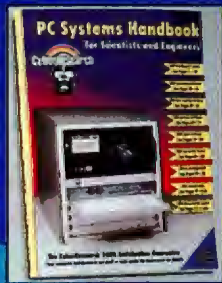

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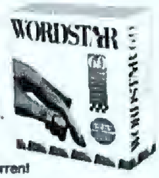

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ST3096A	84MB	16MSEC	IDE	299.00	339.00
ST4096	80MB	28MSEC	MFM	449.00	538.00
ST4144R	122MB	28MSEC	RLL	499.00	599.00
ST3144A	125MB	16MSEC	IDE	349.00	389.00
ST1239A	211MB	15MSEC	IDE	599.00	639.00
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DESKPRO	1MB MODULE	118688-001	78.00
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386S	4MB BOARD	113634-001	328.00
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DESKPRO	1MB MODULE	113131-001	88.00
386/20, 25, 286E	4MB MODULE	113132-001	228.00
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386/20E/25E	4MB BOARD	113645-001	328.00
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386/33, 486/25/33/33L	8MB MODULE	116561-001	698.00
SYSTEMPRO	32MB MODULE	116568-001	3950.00
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	2MB KIT	107332-001	128.00
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	4MB MODULE	110237-001	458.00
LTE/386S/20	1MB	121125-001	238.00
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	4MB BOARD	117081-003	398.00
PORTABLE	1MB KIT	107651-001	179.00
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	4MB BOARD	107653-001	698.00
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64X4	1.95	2.25	2.45	2.95	
256X1	.95	1.05	1.10	1.15	1.98
256X4		3.95	4.45	4.95	5.45
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PORTABLE T1200XE	2MB BD	PC13-PA8306U	148.00
PORTABLE T1600	2MB BD	PC8-PA8302U	148.00
PORTABLE T3100E	2MB KIT	1PC9-PA8341U	148.00
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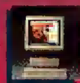

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486-33MHZ

- *80486 Running at 33MHz, 128K Cache* • *4MB RAM*

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386-25MHZ

- *80386 Running at 25MHz* • *4MB RAM*

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386-33MHZ

- *80386 Running at 33MHz, 128K Cache* • *4MB RAM*

HARD DRIVE	VGA (640x480)	SUPER VGA (1024 X 768)	TRINITRON (1024 X 768)	17" SVGA (1024 X 768)
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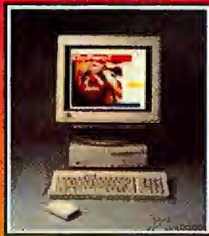

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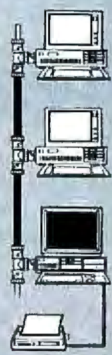

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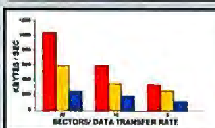

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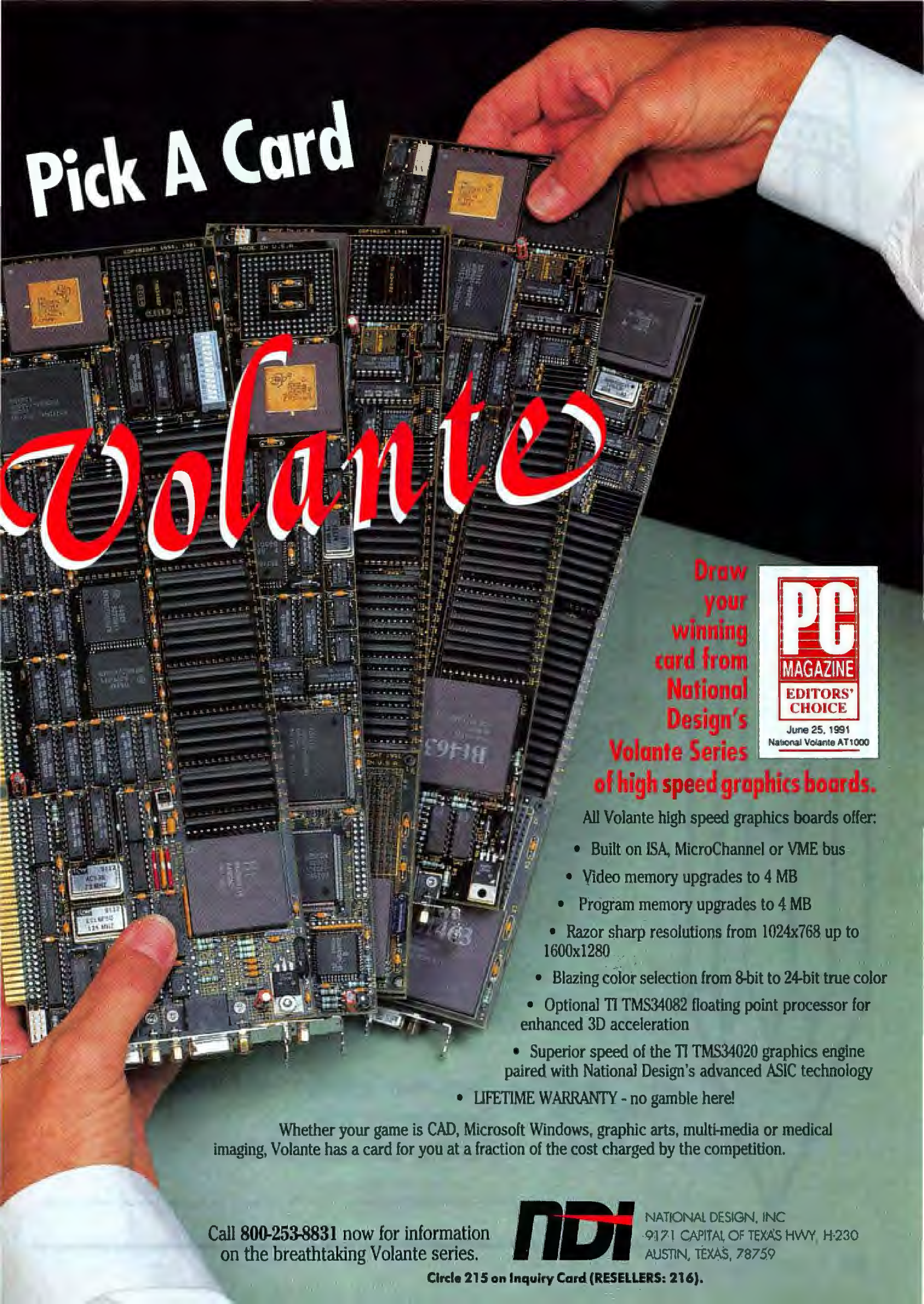

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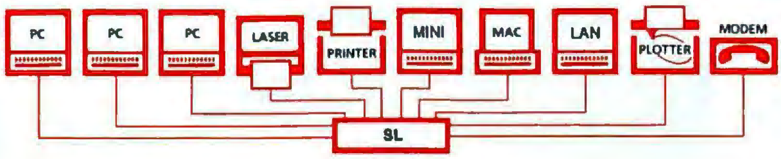

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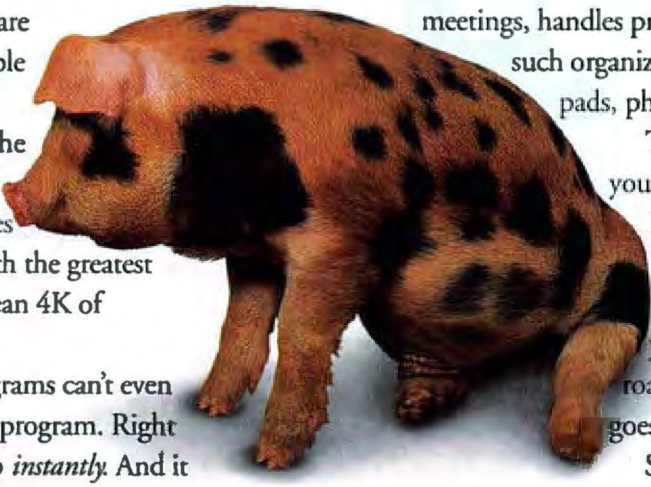

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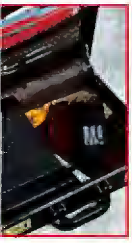

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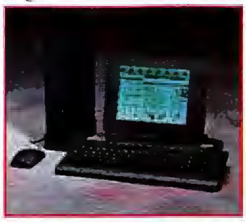

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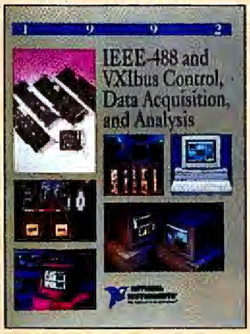

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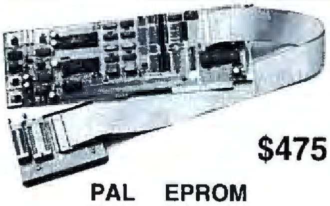

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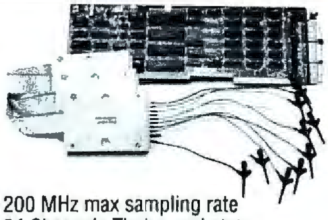

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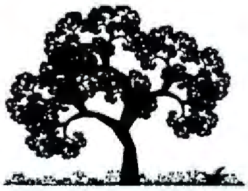

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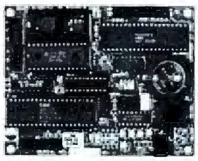

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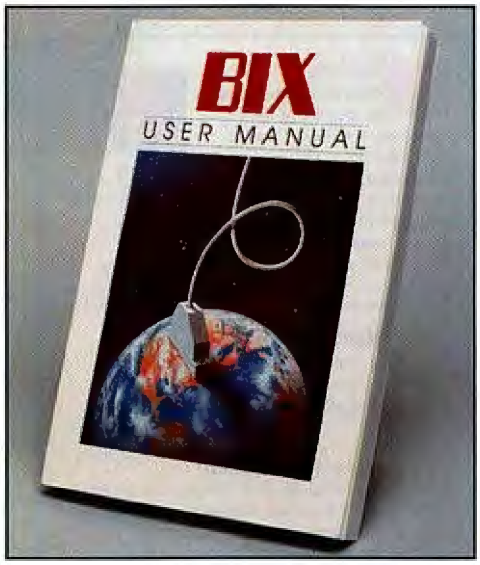

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HUGH KENNER

The Bubbly and the Babbly

AI guru Roger Schank explores the human mind through the art of fine dining

Roger Schank's work you've likely heard of if you've followed AI lore. At Yale he and his students worked out "scripts." To make sense of the sentence, "Jim went to McDonald's and had a hamburger," a script needs to tell the program that *had* means *ate*; also that Jim paid money. "Jim went to McDonald's with 11 cents in his pocket" won't work if the script knows about hamburger pricing; nor will "Jim went to McDonald's and had a bath," if it knows anything about McDonald's at all. What needs to be known about McDonald's is in a "fast-food script."

A "restaurant script" would be different; for instance, you don't line up at a counter but are shown to a table, and someone approaches with a menu, maybe also a wine list. Either way, there's food, and there's payment. Scripts, constantly updated, make the world habitable, whether for you and me or for AI programs. The more refined your script, the fewer the surprises. "Regional cooking" is even apt to mean that you'll not be surprised at all; hence you won't even remember the meal save as an instance. (Gourmets try to have meals they'll remember: controlled surprise.)

Schank now heads the Institute for Learning Sciences at Northwestern University. Also, he flies about the globe delivering papers, but only if (a) the host institution will fly him first class and (b) it's located where there's decent food, by his pretty exacting standards. "Roger Schank loves to eat and drink," commences the jacket bio on his newest book. "He also loves to think about eating and drinking. And, in *The Connoisseur's Guide to the Mind*, he takes us on an idiosyncratic tour of restaurants and wineries in order to explain how the mind works." That's a fair description of a strange book indeed.

Subtitled *How We Think, How We Learn, and What It Means to Be Intelligent*, it has chapter titles like "Knowing in Japan" and "Finding and Following Scripts in Atlanta." What we do in such places, it seems, is mainly *eat*, and it's true that our experience of foreign cities is apt to be defined by restaurants. So what script do we need, Schank is asking, to cope with a Paris three-star restaurant?

Well, a long one. Part of it goes, "Order the cheapest wine on the list. If it isn't any good, they will tell you; if they don't tell you, and it is bad, send it back." What you're after is *the best wine at the lowest price*; but you're also countering the wine-steward's script, which says, "An American knows nothing and will either order something ridiculously expensive...or will order some cheap white wine because he doesn't really like wine." It's when you send it back that your script is besting his. In America (although not in savvy France), Schank has more than once ended up with a good wine gratis.

So what, you are asking, is the computer connection? Well, that AI depends on succinct worldviews, which are always scripts. A way of learning to write them is to study our own behavior, always script-dependent. And it seems that if we narrow our attention to restaurants, we can cover the entire field. Eating being the most basic of human needs, ways to get something decent—even memorable—to eat seem to comprise the whole theory of scripts.

We memorize, for instance, by telling stories; and the sooner after the event we narrate its story, the more surely we'll recall it coherently. Otherwise, its details will get scattered among other scripts. A wonderful chapter records what seven guests remembered of a fine dinner after 42 months. Since none of them seems to have made a story of it soon enough, they might have been describing events on different planets.

Another theme: When we drink beer for the first time, we "create a new category. Beer is something else." And, "Once that is done, we are on our way to becoming an instant expert. The next time someone serves us a beer, we can announce proudly that Miller just doesn't have the flavor of Budweiser." And such pronouncements, made by amateurs who've had but two beers in their life, "are usually quite accurate." Think about that when you think about small databases.

And, "Questions are the important thing. Answers are less important. Learning to ask good questions is the heart of intelligence. Learning the answer—well, answers are for students. Questions are for thinkers." And there are just three kinds of questions: (1) Reasons: "What goals does a relevant actor have?," (2) Causation: "What chain of events caused an event to take place?," and (3) Outcomes: "What will happen next?"

But where do answers come from? "Answers come from remindings. This is one reason that your mind wanders. Every time you get reminded you get an answer of sorts, but, more important, you get a new question." No, this isn't an AI how-to, but it deepens your respect for what can go into AI.

One dissent: Despite several Schankian assertions, it is not true that there is no good food in Spain. In a week in Barcelona, my wife and I were never let down, not even when we chose a place at random. Next time, if he'll wrangle three first-class fares to Barcelona, Roger Schank can play an unfamiliar role: *He* can be *our* guest. ■

The Connoisseur's Guide to the Mind: How We Think, How We Learn, and What It Means to Be Intelligent, Roger C. Schank, Summit Books, 1991, $20, 288 pp., ISBN 671-67855-8.

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. He writes for publications ranging from the New York Times *to* Art & Antiques. *His recent books include* Mazes *and* Historical Fictions. *He can be contacted on BIX as "hkenner."*

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

STOP BIT

BEN SMITH

The Dangers of Multitasking

Once a month, I begrudgingly clean up the stacks of press releases, article proofs, and reference books that I accumulate in my little office. The truth is, I love organized clutter. It means that everything is close at hand.

Even when there are no piles of books and papers, and all the pens and pencils are neatly arranged in my collection of coffee mugs, I still have a private place of organized clutter: the windows on my workstation screen. Each has a separate application program running in it. You know the expression about people with a neat desk? My corollary is: "A cluttered screen is the sign of a productive mind." But there is a tragic element to this temperament.

Becoming accustomed to a complex multitasking environment can harm human communications

As anyone who swims daily in the white-water rapids of information flow will explain to you, all but the most menial tasks involve interrelationships of information that are as important as the information itself. A software designer cannot anticipate all these relationships for us because we create the relationships ad hoc. Even with pop-up windows and drop-down menus, most application programs cannot give us the flexibility that we need.

The best computing environment for us is one where we can create, reveal, hide, and destroy areas of information as we need them: a multitasking window environment. MultiFinder for the Mac, Windows and Presentation Manager for the PC, and the X Window System for Unix provide us with what we need. But before we jump in, we need to look at the compound-windowed environment issue from the viewpoint of how it affects not only how we work, but also how we think.

The simplest environment is a single-tasking command-line environment like the DOS command line. When using this single path to a single computer program, we tend to think linearly: one step after another. Compared to the way we handle the information of the events in our daily lives, this environment is simplistic. When we work with a multitasking shell like the Unix C shell or Korn shell or even virtual terminals on a PC Unix console, we start thinking in terms of doing operations in parallel, but with only one stream of input and output in front of us at a time. The parallel relationships must be maintained in our minds as we deal with each stream independently, one at a time.

When we are working in a multitasking windowed environment, we have concurrent paths of communications with many programs, and we begin to think in a multitasking sort of way. Rather than focusing on a single task at hand, we widen our focus to several tasks. If the tasks are connected, our attention includes the relationships between those tasks.

The mental difference is somewhat similar to the difference between conversing with one other person and carrying on conversations with a number of people at the same time. When the conversation is one-on-one, our attention focuses primarily on content. However, when more than two people are involved, our attention will often drift to focus on the relationships of the other participants.

Some of us find it impossible to get any content from conversations with more than just a few people. We all have some upper limit at which the relationships (and cross-conversations) make it impossible to get any information from the subjects of conversation—the cocktail party syndrome. Likewise with computer interfaces, there is an upper limit of productive complexity, and that limit moves upward with experience.

The dangerous aspect of becoming accustomed to a complex multitasking windowed-computing environment is that it can become habit forming; as we learn how to accept one level of information, our appetite increases. And as we become dependent on seeing the world through our highly evolved computer systems, we become intolerant of the slower and less predictable world of normal human communications. We become impatient. We filter out the subtleties of conversation. Eventually, we will eliminate the richest aspect of our lives: the real world around us. Instead of computers becoming extensions of us, *we* will become little more than extensions of our computers. ■

Ben Smith is a BYTE technical editor. He is the author of UNIX Step-by-Step *(Howard W. Sams, 1990) and coauthor of* Unix System V Release 4 System Administration, *2nd ed. (Howard W. Sams, 1991). You can reach him on BIX as "bensmith" or on the Unix network as ben@bytepb.byte.com.*

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