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EDITORIAL

COMPETITIVENESS = QUALITY

To remain competitive in today's global marketplace, U.S. manufacturers must improve product quality. Meeting that challenge calls for total commitment. Managing for quality, says Business Week, means nothing less than a sweeping overhaul in corporate culture, a radical shift in management philosophy and a permanent drive by all organizational levels to seek continuous improvements.

Just a short time ago, "Made in the U.S.A." represented the best the world could buy. But foreign industries looked for a better way. After years of trial and error, they developed an even higher plateau of product quality. Now, it's up to American industries to respond—or to retire.

Fortunately, most U.S. companies have chosen to react in a positive manner to the quality challenge. But improved quality doesn't happen overnight. Fixing the manufacturing system, not the products, appears to provide the thrust to improved quality. Using this technique, the causes of product deficiency are detected at the source rather than after assembly. Called statistical process control (SPC), this technique measures a manufacturing process by monitoring progress in product production. SPC spots potential difficulties before they result in defective products.

Statistical quality methods have been used for more than 30 years. In the 1950s, the noted American quality authority, W. Edwards Deming, was invited by Japanese technologists to instruct them on statistical methods for improving quality on the factory floor. Later, the Japanese asked another reknown American quality expert, J.M. Juran, to discuss quality management techniques.

Few U.S. companies paid heed to either acknowledged authority, but Japan Inc. embraced the quality principles of Deming and Juran. Thereafter, in the 1970s, higher quality Japanese products, which set advanced standards for performance, reliability and durability, impacted the global marketplace, quickly stole market share and emerged as the world's premier goods.

Most product design and manufacturing groups in U.S. companies work in isolation. That is, a product is designed and then turned over to production. The design team moves on to the next priority. Meanwhile, the production team struggles to mass-produce an unfamiliar design. Industry quality experts claim that only about 20 percent of a product's defects can be attributed to the assembly line. The other 80 percent gets "designed-in" or comes from low-priced marginal parts.

The cure? Incorporate product-quality principles during the design phase. The means? Use computer-based systems to analyze product quality while the design details are merely images and symbols on a computer screen. The people? Engineers, administrators and assemblers must work together as a coordinated team to ensure product quality. And company executives must let everyone know that they are all essential team members. Quality costs more and takes time, but it ensures competitiveness and, therefore, survival.

George V. Kotelly
Chief Editor
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A CLUSTER OF NEW PRODUCTS HIGHLIGHTS LOTUS' 1988 CALENDAR

Lotus Development Corp.'s first DBMS will be among several new products the Cambridge, Mass., company is planning for 1988. The DBMS is scheduled for the fall along with a fourth-generation application programming language, the Lotus Extended Applications Facility (LEAF). Scheduled for early spring is the Agenda information manager, demonstrated at COMDEX/Fall in Las Vegas. Other releases: a multiuser version of 1-2-3 (Release 3) targeting computing work groups and a mainframe-based 1-2-3 (Lotus 1-2-3M) aimed at IBM Corp.'s System 370 and 9370. The DBMS will feature a cooperative processing architecture, a graphical user interface, support for IBM's SQL, and a flexible application development environment.—Tim Scannell

SPECTRAGRAHICS WEDS WORKSTATIONS, IBM CAD/CAM GRAPHICS

Spectragraphics Corp. recently announced agreements to provide Digital Equipment Corp., Maynard, Mass., and Hewlett-Packard Co., Palo Alto, Calif., with graphics terminals that emulate the IBM Corp. 5080. The terminals will enable DEC's VAXstation and II/GPX, and HP's 350 workstations to hook up to IBM 4341 mainframes via a Spectragraphics DesignSet Communications Controller and to run such applications as CADAM and CATIA. Spectragraphics, of San Diego, is expected to sign a similar agreement with Silicon Graphics Inc. Spectragraphics already provides 5080-emulation products for Apollo Computer Inc. workstations, as well as for its own line of 5080-emulation workstations.—Dave Simpson

IBM AIMS FIRST SAA APPLICATIONS AT OFFICE ENVIRONMENT

Early 1988 is apparently IBM Corp.'s release target for the first products incorporating its Systems Application Architecture. According to details released by the company's Applications Systems Division in Milford, Conn., the products will include an SAA version of IBM's PROFS professional office system that initially will be based on the company's high-end PS/2 machines. However, it may not be a full implementation of the SAA environment, according to IBM senior vice-president Allen Krowe.—Tim Scannell

GENICOM PLAYS AN ACE FOR STAKES IN THE POSTSCRIPT MARKET

Look for the first shipments of laser printers equipped with Genicom Corp.'s ACE page description language in the second quarter of next year. ACE is billed as a high-speed alternative to Adobe Systems Inc.'s PostScript. The printers are based on raster image processors that use a Motorola Inc.'s MC68000 processor and a bit-slice coprocessor. The first shipment will be 6- to 8-ppm units that print at 400 dpi. The Waynesboro, Va., company demonstrated the printers at last month's COMDEX/Fall show in Las Vegas.—Dave Simpson

NEC ENTERS 286 PORTABLE FRAY WITH LUNCH-BOX POWERMATE

NEC Information Systems Inc., Boxborough, Mass., enters the luggable-computer market this month with a 22-pound lunch-box-like device based on Intel Corp.'s 80286 processor. The Powermate 286 represents the company's first use of 3¼-inch micro-flexible disk drives. The portable is available with an 8- or 10-MHz microprocessor and offers three full-size IBM Corp. PC/AT-compatible expansion slots. The system costs $3,995 with a 20M-byte rigid disk drive and can be outfitted with an optional 5¼-inch flexible disk drive.—Tim Scannell
CDC TO FIELD 3½-INCH WINCHESTERS

Control Data Corp. of Minneapolis, which boasts a strong presence in OEM markets for 5¼- and 8-inch Winchester disk drives, has made its first move toward a smaller form factor. Around February, CDC expects to have evaluation units of its 3½-inch Swift family ready for shipment. The top-of-the-line model has an unformatted capacity of 200M bytes. It uses five platters and comes with either SCSI or ESDI interfaces. Average access time is about 16 msec. The rest of the Swift family (variously sporting 150M bytes, 100M bytes and 55M bytes, all unformatted) come with an ST506 interface. Prices will range from $5 to $8 per megabyte.—Mike Seither

HP CALLS ON DEVELOPERS TO RIDE 'NEW WAVE'

Hewlett-Packard Co., Palo Alto, Calif., is busily lobbying for independent software vendors (ISVs) to support its just-released object-oriented programming environment, called the New Wave Object Management Facility (OMF). At last count, the company had about five ISVs signed up to develop products, and it expects to attract up to 100 more by the end of 1988. New Wave was developed with Microsoft Corp., Redmond, Wash., and is heavily dependent on Microsoft’s Windows program. New Wave eventually will be compatible with OS/2 and Microsoft’s Presentation Manager environments. Prices are $195 for the software, $895 for the developers kit and $1,100 for training and support.—Tim Scannell

VEN-TEL CLAIMS LATEST PS/2 MODEMS WORK WITH MICRO CHANNEL

Ven-Tel Inc. of San Jose has begun shipping add-in modems for IBM Corp.’s PS/2 models 50, 60 and 80 that, reportedly, take full advantage of the automatic-configuration capability of IBM’s Micro Channel. The Ven-Tel 24/2 modems operate at 2,400, 1,200 and 300 baud; support communications ports No. 1 through No. 8; and are compatible with the Hayes Microcomputer Products Inc. AT command set. List price: $549 with Crosstalk Communications/DCA’s Cross-talk XVI software, $449 without.—Mike Seither

HP BOOSTS DATA TRANSFER RATE ON 5¼-INCH DRIVE

Hewlett-Packard Co., Palo Alto, Calif., is wringing more performance out of its high-end 5¼-inch rigid disk drives by pushing the data transfer rate up to 4M bytes per second and using the synchronous mode of the SCSI interface. The HP 97530D (which comes in unformatted capacities of 136M bytes, 204M bytes and 408M bytes) uses differential drivers that allow the Winchester to be located as far as 25 meters from the host computer. The company’s earlier versions of those drives had to be placed within three meters of the host. The 408M-byte version sells for $2,100 in OEM quantities.—Mike Seither

NON-VOLATILE MEMORY BOARDS GIVE PCs 5M BYTES OF STORAGE

Bubble-memory manufacturer Magnesys, San Jose, Calif., is courting OEMs with its latest solid-state, non-volatile add-in boards for rugged environments. The company’s DriveCard comes in 360K- or 720K-byte master-card versions along with a host bus adapter for IBM Corp. PCs and compatibles. Up to six additional satellite DriveCards can be linked to the master card, providing up to 5M bytes of storage. Magnesys claims its memory boards operate in temperatures ranging from zero C to 70 C. Volume pricing at under $900 is available.—Mike Seither
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Winchester drive makers check into 'disk hotels'

Mike Seither, Senior Editor

Following the lead set a few years ago by mainframe disk drive manufacturers a number of 5¼-inch Winchester drive makers and subsystem builders are clustering 360M- and 765M-byte disks together into single systems to create so-called "disk hotels."

Through the use of innovative controller electronics and caching schemes, the disks function as a single unit, offering multigigabyte storage and fast data transfer rates. They also boast a high reliability, all in relatively compact enclosures.

One of the first of these disk clusters comes from Micropolis Corp. of Chatsworth, Calif., which introduced its Parallel Drive Array 1800 Series in November. The first member of the series, model 1804, has a capacity of 1.5G bytes, uses the small computer systems interface (SCSI) and is built with five of Micropolis' 380M-byte, 5¼-inch rigid disk drives. Working in unison, the drives offer a sustained data transfer rate of 4M bytes a second. By comparison, typical 8-inch drives using the storage module device (SMD) interface peak out at about 3M bytes a second.

One of Micropolis' chief competitors, San Jose's Maxtor Corp., has also been pushing the idea of clustered drives through its subsidiary, U.S. Design Corp., Lanham, Md. U.S. Design has a 3G-byte cluster that has four 765M-byte, 5¼-inch Winchester drives. Also, a handful of other disk drive makers have, or are about to follow up with, similar products.

Analyst James Stone, who follows the computer storage industry for Shearson Lehman in New York, says that many of the soon-to-be-produced high-capacity 5¼-inch Winchesters (380M bytes and above) will find their way into clustered subsystems. "They'll be aimed squarely at the minicomputer market" as a replacement for conventional 8- and 9-inch drives, he maintains.

More disks in the driver's seat

In the mainframe world, Amperif Corp. is generally credited with pioneering clustered mass storage, often referred to as disk arrays. The Chatsworth, Calif., OEM convinced Unisys Corp. (then called Sperry Inc.) that clusters of 8-inch Winchesters—the mainstay of minicomputers—could do the job better than mainframe-class 14-inch drives. For example, Amperif's 16-drive subsystem uses less power, takes up a quarter of the floor space and stores twice the data as IBM Corp.'s latest 7.5G-byte, 3380 14-inch drive system.

Companies like Micropolis basically follow the same clustering blueprint for their disk hotels, except for using smaller rigid disk drives. In the
Micropolis model 1804 Parallel Drive Array, four drives are used for actual data storage, while a fifth drive is used for parity. The fifth drive also is available to replace data in real time, data storage, while a fifth drive fails. For the complete subsystem to go down, a second drive would have to fail before the first one was repaired.

Thanks to the parity system Micropolis claims that the 1804's rating for mean time between failure (MTBF) is 140,000 hours, almost five times as high the MTBF for most single drives.

"Provided that you replaced the first failed drive within 24 hours, the calculated MBTF could go above a million hours" on a parity-based subsystem like the one Micropolis builds, says Bob Katzive, vice president of Disk/Trend Inc., the Los Altos, Calif., outfit that tracks the drive business.

Drives in the Micropolis 1804 are deliberately designed to be easily replaced. The individual Winchester's have slide-in mounts and can be installed in about 4 minutes, according to Micropolis. In fact, the drives can be replaced while the system remains operational. That's because the parity units enable data to be reconstructed on the replacement drive, says Micropolis marketing manager Tom Kent.

**Access times under 2 msec**

Micropolis has just begun shipping evaluation units of the model 1804, which fits into a standard 19-inch rack. Production systems, to be priced at $8 per megabyte in OEM quantities, are expected to be available in early 1988. Micropolis hopes to sell the 1804 to system integrators who market superminicomputers, high-end workstations and graphics and imaging systems.

"We couldn't address these high-end markets without this clustered approach," says Kent.

U.S. Design, which builds add-on storage subsystems for Digital Equipment Corp.'s Q-bus and UNibus computers, introduced its 3G-byte cluster drive earlier this year. Each one of the four Maxtor 765M-byte Winchester's uses one of the company's proprietary 4200 disk controllers that contains up to 4M bytes of caching memory and algorithms that predict disk-access patterns.

U.S. Design president Bill Anderson claims that the 4200 controllers boost average access times by an order of magnitude because of a 70 percent "hit rate" of data inside the cache. So while the drive may carry a specification of an 18-msec average access time, the cache produces the data in about 1.4 msec.

At the COMDEX/Fall show last month in Las Vegas, U.S. Design displayed a 19.2G-byte configuration made up of eight VIP 3000 four-drive clusters housed in racks 19 inches wide and 60 inches tall. Although the company doesn't intend to sell such a system right now, Anderson contends the company was trying to make a point.

"We believe 5 1/4-inch drives can offer the densest storage per square foot of any rotating magnetic media," Anderson says. Moreover, he asserts, it's possible to achieve higher levels of performance with multiple drives than with a single-spindle system such as the IBM 3380.

While U.S. Design in the past has concentrated on the DEC market, Anderson says the company has changed gears by unbundling its drive and controller technology and pedaling it to high-volume system integrators who, Anderson says, "don't want to worry about packaging storage products."

Another company enamored of parent company Maxtor's 765M-byte Winchester's is Aviv Corp., of Woburn, Mass. The subsystem builder has put four of the drives into its DFS (disk file system) 904-1765 cluster—a 2.4G-byte package 5 1/2 inches wide, 19 inches high and 22 inches deep. The cluster can fit inside a standard DEC MicroVAX chassis or stand alone as a pedestal.

This month, System Industries Inc., a storage vendor that targets the DEC market, plans to introduce a new controller that will allow 16 380M-byte, 5 1/4-inch Winchester's to be clustered, says Ron Bingham, vice president of R&D for the Milpitas, Calif., company. Since July, the company has been shipping two- and four-drive clusters of the 380M- and 765M-byte, 5 1/4-inch drives. Before that, System Industries packaged chiefly 8- and 9-inch rigid disk drives for the DEC market.

"There is no doubt 5 1/4-inch will replace 8-inch," says Bingham. "The physics get better as you scale down—less heat, less space, better access times."

Back in the mainframe world, even IBM apparently is reading the writing on the wall and thinking about downsizing from 14-inch devices. IBM's 3380 business, estimated to be in excess of $9 billion annually, is expected to increase a year from now when Big Blue brings out a high-performance 10 1/4-inch replacement for the 14-inch 3380. In addition, IBM is at work on a 1G-byte, 5 1/4-inch Winchester that analysts expect to see packaged as a cluster.

"IBM can't afford to let itself be outflanked by PCMers[plug-compatible manufacturers]," says Katzive of Disk/Trend. "Compare $8 a megabyte to $32 a megabyte, and you can see why the smaller drives are an attractive approach."

Where will all of this clustering lead? Technically downward in one sense, if the activities at leading disk drive makers are any indication. Apparently, 5 1/4-inch drives will not be the limit in miniaturizing clusters. Ampere, the company that started the whole cluster trend, is already buzzing about its plans to check 3 1/2-inch Winchester's into disk hotels.
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CIRCLE NO. 16 ON INQUIRY CARD
Phoenix Technologies rises to integrate emerging architectures

The name of Phoenix Technologies Ltd. recalls the mythological bird that was consumed by fire, only to rise stronger from its own ashes. Phoenix the company, based in Norwood, Mass., is the end result of several companies and projects launched by its founder, Neil J. Colvin. They ranged from a 1970s garage-type computer manufacturer, which was then only one of five or six in the United States, to a maker of compilers and debuggers for the CP/M programming environment. These companies came and went as Colvin made the transition from hardware to software, where he foresaw more action and more profits.

As in the myth, Phoenix Technologies has risen to become a strong force in the computer industry because of the past-corporate-life experiences of its founder, and of others who were hired from many of those early companies. However, unlike the bird, the influence Phoenix Technologies has on the computer industry is real—particularly as personal computers become more powerful, and the lines separating workstations and minicomputers continue to fade.

The following is an excerpt of interviews held with Colvin, Phoenix Technologies' chairman, CEO and chief scientist; and Lance Hansche, vice chairman and vice president of strategic planning. Posing the questions for Mini-Micro Systems is senior editor Tim Scannell.

MMS. What forces do you see pushing computer systems development and integration right now?

Colvin. I think we’re in a very strange situation. The hardware is advancing almost an order of magnitude faster than the software. The capabilities of the machines that are being produced today, and that are being designed for production tomorrow and the day after, are ahead of our capabilities to use them in the software sense. The industry is becoming constrained, and to a large extent driven by software.

MMS. What about all the concern for newer software architectures designed for Intel Corp.’s 80386 and both Microsoft Corp.’s and IBM Corp.’s version of OS/2?

Colvin. A lot of software developers, except for the very big ones, are very concerned about putting a lot of effort into software for an operating system that’s going to run on less than 10 percent of the machines. What about the other 18 million machines out there that run DOS and not OS/2, and all the [IBM] Model 30 and Model 30 equivalents that can’t run OS/2? There’s a lot of software development happening for LIM 4.0 [Lotus-Intel-Microsoft] for instance. A lot of people see the LIM 4.0 standard as a viable alternative, because it doesn’t lock them out of the marketplace. They have access to every machine ever produced.

Hansche. I believe that most of the new extended-operating-environment stuff is interesting to us as engineers, it’s interesting to the press because it’s news, it’s interesting to a small segment of people using PCs, and it’s interesting to MIS [management information systems] departments because it’s a chance to get back control of all those nasty personal computers out there. But, if you go to the bulk of the people using PCs, they could care less. They want their word processing, they want their spreadsheets, and beyond that, they ask very little of their machines.

Windows is going to be fun to play with, but, good God, what is OS/2 and what does it mean to me?

MMS. What about the area of windows and windowing technology, is that a concern to Phoenix Technologies?

Hansche. Windows is very important to us and the hardware industry, because it begins to move the software away from absolute hardware knowledge. Without that, our ability to innovate and really add value is constrained by how many drivers
we're willing to write. If you take the intersection of all the creative software in the world and all the creative hardware and particular video and then try to write drivers for that intersection, you'd go mad. We know. We've tried.

MMS. How does Phoenix view the IBM PS/2, is it a personal computer, or more of a workstation?

Hansche. We view the PS/2 as more of a workstation because, other than packaging things and the ease of adding boards, it has very little to offer the user until the Micro Channel starts taking on coprocessors. When you start adding coprocessors, which are typically not cheap, you'll find the PS/2—classes 60 and up—growing in cost and going very easily into the workstation market.

MMS. Has Phoenix been talking or collaborating with IBM on Micro Channel compatibility or products?

Hansche. No, IBM doesn't really work with us much on this stuff. The chippers [semiconductor manufacturers] have all had at least one serious conversation with IBM about what it all means. What is happening strategically is that the chippers will all emulate the product in the first go around and then try and actually design better solutions, which will bypass any potential patent.

MMS. Are you working with non-IBM computer manufacturers to make a PS/2 clone of some type?

Hansche. We told our customers that, if they really want "micro channel machines," then we'll see that they have those products. That is our duty to them. It is better for them to receive standard technology from us than it is to build it internally. The dark side of that, however, is that we are then responsible to them for any standard technology, since they have given up their internal ability to do it.

MMS. What about UNIX? With all the promotion of OS/2 and its multitasking capabilities, is there still a chance for growth in UNIX-based commercial applications?

Colvin. I think this is the best chance UNIX has ever had. Every single processor in the world current-

ly being produced today—processor, not computer—runs UNIX. There is no exception.

UNIX has been ignored or, in some cases, shunned by the vast majority of users partially because they don't understand it and partially because nobody has ever tried to sell it. UNIX is the most portable operating system ever written. It is the most standardized operating environment ever written. Software written for UNIX can be, in most cases, very easily ported from machine to machine. OS/2 isn't the first solution to multitasking. It doesn't even take advantage of the 386, while UNIX with DOS under it takes full advantage of the 386.

MMS. So, will UNIX be the operating system platform of the future, over OS/2?

Colvin. I would like to see that happen. Who knows? IBM definitely has a vested interest in doing something else.

MMS. What about IBM's AIX [Advanced Interactive Executive]? Is it a viable UNIX alternative, or will it fragment the market even further?

Colvin. No. The RT PC [which employs AIX] has never gone anywhere. From most peoples' point of view the RT is dead. Its very interesting. You look at something like UNIX 386 or XENIX 386, since they're both fully operational at this point in time, and you compare it with OS/2. In OS/2 you run a DOS application in a compatibility box and a protected-mode application in the background. The DOS application runs about one-quarter the speed of a PC/XT, even though its on a 386. But, run a DOS application under UNIX or VP/IX, which is our implementation of DOS under UNIX, and you find that the DOS application runs at about 94 percent of what it would run under UNIX by itself—while you're running a UNIX task in the background.

There's such an incredible difference. The [UNIX] platform is the right platform and not the wrong platform. And a lot of people are going to start seeing that and making decisions in that direction.

MMS. Where is Phoenix Technology planning to make its next big push or, at least, concentrate the majority of its efforts?

Colvin. The next big push is in the whole peripherals area. To integrate and to unify peripherals to provide much greater flexibility for the software vendors, and for the manufacturers to hook up peripherals to various parts of their machines and not cause major confusion for the customers. Also, to provide consistent software interfaces to peripherals.

MMS. What about desktop publishing? Phoenix has a desktop publishing group and is actively working on products for that industry. How do you view this area as a whole?

Hansche. Right now, its a badge of honor to say "I'm in desktop publishing," or "I am in the new wave of graphic arts."

Well, those waves are small and short. Most people don't want to use most of that stuff. Twenty percent of the things [in desktop publishing] they'll use all the time, and the rest is just window dressing.

Basically, we went into it to rearchitect the whole thing so that the price of the controllers could be dropped.

We want to see personal page printers...so cheap that getting any other kind of printer is illogical, unless you're looking for color.

MMS. With all this talk of standardization, and the rush by some companies to force standards, do you see this as a potential problem for you?

Colvin. We don't see standards as an obstacle, we see them as opportunities. The more standards there are that people feel they have to have, the more opportunity there is for us. It will be our effort to make sure standards are easily consolidatable and to provide people with environments that allow them to easily move to these new standards, without having to redo their entire product line from scratch.

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CIRCLE NO. 18 ON INQUIRY CARD
Twisted-pair Ethernet moves into standards limelight

Tim Scannell, Senior Editor

Look out fiber. Stand aside coaxial. The next big push in desktop local area connections is a medium as familiar as your telephone, yet as dependable as sophisticated high-speed links.

It is also cheaper and more available than most competing technologies, which would attract users and compel system integrators to boost supply to meet the anticipated demand.

What is this miracle technology? Not a miracle at all, really, but good old 10M-bit-per-second (bps) Ethernet. The difference is that it now runs over unshielded twisted-pair wiring, instead of shielded coaxial cable. This wiring is the same found in the private automatic branch exchange (PABX) systems of most offices. The desktop telephones linked to these systems often use only a fraction of the wire capacity, which leaves the rest for local computer and peripheral connections, say proponents of the 10M-bps twisted-pair push.

"We think this is going to be a very, very important technology for our customers," says Joseph Skoruza, manager of product marketing at MICOM-Interlan Inc., Boxborough, Mass.

Apparently, so do a lot of other companies that have joined MICOM-Interlan in its efforts to convince the Institute of Electrical and Electronics Engineers (IEEE) to establish a standards committee for 10M-bps twisted-pair Ethernet. These include Digital Equipment Corp., 3Com Corp., Ungermann-Bass and Wang Laboratories Inc., all of which sent representatives to a preliminary standards meeting held in Boston in October. They were expected to present their case before the IEEE last month in Florida.

"When it becomes standardized, people can then interoperate and make selections based on features and functions rather than trying to remember whose product works with who else's," Skoruza explained.

Iron out the differences

Before you plug your computer into your telephone and take your twisted pair out for a run, however, be aware that a lot has to be ironed out before things really get rolling. As those who have gone the route know, standardization is no easy task. To establish a recognized standards committee, a group must first demonstrate that a proposed technology is viable and has market appeal. Then, it must be shown that the technology has a distinct identity and conforms to existing IEEE specifications that may be affected by a new entry—in this case the IEEE's 802.3 network rules.

Even if twisted-pair Ethernet is standardized, it still may not catch fire unless enough companies seriously dedicate themselves to developing products that strictly adhere to its format. For example, DEC took part in the initial work group meetings for twisted-pair Ethernet and even unveiled a product at its DECworld meeting in Boston last September. However, CEO Kenneth Olsen admits he reluctantly bowed to user demands for twisted-pair Ethernet, preferring to promote coaxial Ethernet—what some critics call "cheapernet"—as the medium of choice.

"Coax is so much easier," he remarked. "But alas, a number of our customers have put twisted pair into their building, and they're too embarrassed to take it out."

The DEC difference

To further complicate things, DEC's version of the 802.3 Ethernet is not totally compatible with the
Ethernet offerings of other companies. It apparently has some technological quirks that are unique to DEC. As a result, DEC is actively pushing its version as the standard by the sheer numbers of its Ethernet users, observes Kim Myhre, an analyst with International Data Corp.'s (IDC) Communications Research Group in Framingham, Mass.

Some companies also will not publicly support a proposed standard or admit to product development before a standard is set in stone. Excelan Inc., the San Jose maker of, primarily, coaxial-based network systems is one. "We do feel it's a viable standard," says product marketing manager Steve Spanier. "However, at this point in time there are competing standards... and we at Excelan are strictly a standards company. So, we're essentially waiting for the results of that standards committee."

Still, the chief cheerleaders of twisted-pair Ethernet are undaunted. In fact, MICOM-Interlan started showing an unshielded twisted-pair Ethernet product in mid-October at the NetWorld show in Dallas. They are also sure there is more support for the proposed standard than most companies are willing to admit. "I would be surprised to see any major player in the Ethernet marketplace who does not have a 10M-bit Ethernet product," observes MICOM's Skorupa.

Besides DEC and 3Com, companies that have unveiled twisted-pair Ethernet products include Hewlett-Packard Co. and SynOptics Inc.

Casts a net for Big Blue

While twisted-pair Ethernet would seem to compete with its coaxial cousin, it really targets everyone's favorite whipping boy—IBM Corp. At the moment, IBM's PC Net architecture—an IEEE 802.5 token-ring coax-
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Facit P23350 Matrix Printer—IBM, Epson compatible, plug-in character font cards, four-way paper handling, and other options provide exceptional versatility.
ial-based technology—is the most popular personal computer local area network in Fortune 1000 corporations, by a small margin. In its "Professional Automation Report," Forrester Research Inc., Cambridge, Mass., notches this market penetration at about 43 percent, as compared with Ethernet's 40 percent share.

Two things will fuel 10M-bps twisted-pair Ethernet's advance over PC Net-type of installations. First is its inherent speed, which is 2 1/2 times faster than the 4M-bps PC Net. Second is the cost. Since the wiring is already in place, users do not have to drill holes and install expensive coaxial cable to connect computers and peripherals.

More importantly, it will also save money when workstations and personal computers are shifted around an office—which typically happens at least once per year, according to some estimates. Again, since twisted-pair wiring already wends its way through most office buildings, the cost to move a single coax-tethered workstation may be reduced by $1,200 to $1,700, according to MICOM-Interlan.

Timing is also on the side of twisted-pair Ethernet, or any type of networking for that matter. Local area networking is hot. Currently, only about 10 percent of installed departmental computer systems are connected within a network, according to IDC. Most of these connections have occurred in single-vendor environments, whereas multivendor sites make do with simple, often fragmented networking schemes, says IDC's Myhre.

What will most certainly attract system integrators to twisted-pair Ethernet, however, is MIS (management information systems) disappointment with IBM's network strategy. In a recent survey of 107 large-system sites—those with two or more mainframe computers, operating to some extent with IBM's Systems Network Architecture (SNA)—IDC found that nearly half of those polled were either not sure or did not believe that IBM had a clear and competitive LAN strategy. More than 62 percent also felt that IBM's network would be better if it were faster.

More than 25 percent of those surveyed also had some type of Ethernet already installed.

Of course, IBM has a few networking tricks up its sleeve, most notably a 16M-bps shielded, twisted-pair token-passing network that it has reportedly demonstrated to a number of select customers. However, with speed come sacrifices in distance. The maximum distance between workstations linked in a 10M-bps network without controllers and signal boosters is about 100 meters, says MICOM-Interlan's Skorupa. At 100M-bps the distance degrades substantially, to several meters.

Besides, noted Skorupa, "Some people are already running 50M and 80M bps on unshielded twisted-pair networks. So, 16M bps is, quite frankly, nothing earth shaking."

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Can new life be pumped into an old, but still widespread and useful bus technology? More importantly, is resuscitation even necessary?

Zendex Corp., based in Dublin, Calif., thinks so and has proposed a new specification for Multibus I that would allow for 32-bit data transfers and a 256M-byte physical address space. Right now, Multibus I architectures are limited to 16-bit data transfers and have a 16M-byte physical address space.

"Zendex wants to see Multibus I specifications grow to meet user's demands in a slow, defined way," says Jerry Underwood, a hardware engineer for the small company. "We want to encourage Multibus I manufacturers to see new alternatives while embracing current specifications."

Maybe. But Intel Corp., the developers of Multibus I and later of the more powerful Multibus II, disagrees. Officially, the Hillsboro, Ore., company does not feel 32-bit expansion is necessary for most general applications, and they want Zendex and others to leave Multibus I the way it is.

"We are happy with Multibus I the way it stands," insists Mike Pritchard, Intel's product marketing manager for Multibus I. "There is no doubt that in certain applications people can benefit from Zendex's design. But the general market will not have much need for it."

**Puts a stop to stopgaps**

Zendex's theory is simple: In order to remain competitive and meet the needs of most open-architecture systems, the current crop of Multibus I-compatible board products must boost their performance to match that of 32-bit microprocessors. This is basically done by increasing both memory speed and I/O throughput.

Board designers tackle this problem in a number of ways. To rejuvenate memory, for example, they can provide a 32-bit local-memory data bus, implement memory caching and interleaving, or use high-speed dynamic and static random-access memories. To decrease the impact of a slow bus-transfer rate, they can also offload as many I/O operations by giving responsibility to the host processor board.

At best, however, these are stopgap solutions. As the demands of an open...
architecture on a system increase, keeping up becomes more difficult, says Russ Gamble, vice president of marketing for Zendex.

Zendex's answer to the problem is to rewrite the specifications for the P2 connector. Their product—deemed Tru-32—uses 28 undefined lines on the P2 Multibus I connector to expand the data bus from 16 to 32 bits and the address bus from 24 to 28 bits. These lines increase physical address space from 16M to 256M bytes.

In operation, Tru-32 allows each board in a system to check to see if it is equipped for extended data transfers. If it is, Tru-32 will accommodate increases in data speeds. If not, stand-

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**TRU-32 CONTROL FLOW**

In the Zendex Tru-32 expansion idea for the Multibus I, one board queries another to see if the second board is equipped for extended data transfers or addressing. If not, operations follow the traditional Multibus I specifications.
ard Multibus I specifications are implemented. Tru 32 initially will be implemented on an Intel 80386-based single-board computer with a memory board and will cost between $4,000 and $6,000. It is due to be shipped in the first quarter of 1988.

Zendex maintains that its product is a good solution for people who want greater I/O throughput at a low cost; particularly in industrial automation, military, medical and aerospace applications. The goal is to prolong the life of a good architecture, points out Carl Dossenbach, Zendex vice president of marketing.

“We’re coming from the angle of, ‘How can you possibly put everything on the same board?’ You have to have a generic architecture that is allowed to grow,” he says. “We’re not out there to hurt Multibus II, we’re just enhancing Multibus I.”

Intel’s response to Zendex’s expansive view of Multibus I has been a one-page release decrying the whole idea. In the statement, Intel says:

1. 32 bits are required only for memory operations, not I/O, unless they are direct memory access (DMA) functions.
2. As faster processors became available, the system bus became inadequate for memory execution. As systems built around the Intel 8086 microprocessor were developed, the Multibus I specification was enhanced to include iLBX (Intel local bus extension). This was necessary because memory technology had not yet advanced to the point where executive memory could be located on the processor board cost-effectively.
3. As memory migrated to the CPU board, the Multibus became an I/O bus. The memory-to-CPU performance does not typically have as large an affect on overall system performance as does the operation of the local CPU and memory.
4. The performance boost achieved by widening data paths is less than that achieved by increasing the performance of the local CPU and memory.

All true, says Zendex’s Underwood. But these arguments relate to any bus structure. The Zendex specification, on the other hand, supports a much more dense global memory, without forcing users to “go through the pain of upgrading to more sophisticated technology and software,” Underwood says.

“You don’t have to abandon an industry to get the latest and the greatest,” adds Dossenbach, noting that his scheme would preserve the Multibus I customer base.

Intel also is concerned for the Multibus I users, but maintains they are satisfied with the present technology and don’t want to upgrade. “I’m happy for Zendex. They’ve managed to maintain IEEE-796 compatibility,” says Pritchard. “But maturity
and compatibility are the great strengths of Multibus I. Many people don't want to do anything to change it."

"We're selling trucks"

The key question, though, is how Multibus II fits into the scheme of things. Although Zendex concedes that Multibus II and VMEbus can execute some applications more gracefully than other buses, it also feels that there are a lot of situations where it is not appropriate.

Zendex's Gamble claims that Multibus II is not designed for applications but for applications where processors want to talk to processors, such as with multiprocessor computers where single CPUs are dedicated to specific functions like disk control or communications. "Some people say we're not making a substantial step. Our philosophy is, if you want a Porsche, buy a Porsche. We're selling trucks."

Not all bus/board manufacturers share Zendex's enthusiasm for putting more into Multibus I. Michael Curran, president of Micro Industries in Westerville, Ohio, points out that Tru-32 doesn't implement the DIN connector system—a major advantage of 32-bit buses. He feels there may be a short life span for edge-connector buses.

Tom Cramer, president of Single Board Solutions, Cupertino, Calif., finds promise in the Tru-32 idea, but with some reservations. He believes that 16 bits are adequate for most applications, and that the cost of upgrading to 32 bits might not be worth the effort. When access to greater amounts of memory is needed, however, Cramer sees Tru-32 as a better idea than the iLBX specification.

Such criticisms are expected, says Gamble. "We are giving the world a lot more power at a little cost, and some people are upset that they didn't think of this themselves. But other people are coming to us saying, 'Thank you for doing this.'"
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CIRCLE NO. 30 ON INQUIRY CARD
ERASABLE OPTICAL DISKS: WHEN, WHAT . . . WHY?

System integrators face tough storage decisions—erasable optical disk drives are due by mid-1988, but competing technologies dim the once-bright optical promise.

David Simpson, Senior Editor

The road to erasable optical disks has been fraught with wrong turns and false starts, but a handful of manufacturers will reach the finish line by the middle of next year. Consequently, system integrators who buy large volumes of storage devices can no longer ignore optical technology when planning future data storage hierarchies. However, a larger question looms on the horizon: Who needs them?

The slow progress of erasable optical technology has embarrassed industry pundits, stymied system integrators and forced a few early players into bankruptcy. However, in case you're still a non-believer, consider what a device with the following could do for your data storage strategy:

- A full 650M bytes in a 5¼-inch form factor
- Removable media
- An embedded small computer systems interface (SCSI), or an enhanced small device interface (ESDI), for easy attachment to a variety of hosts
- A 1M-byte-per-second burst transfer rate with a maximum sustained data rate of 510K bytes per second
- Expected OEM pricing (quantity 10,000) of about $1,500, with end-user subsystem prices around $4,500.

Those specifications describe Sony Corp.'s new erasable optical disk drive. According to Jim Moore, account manager for the optical storage group, Sony is shipping limited quantities of engineering samples and plans production shipments by the second quarter of next year.

Sony, Sharp Corp. and Verbatim Corp. (in conjunction with its parent company, Eastman Kodak Co.) are the apparent front-runners in the race for commercially available erasable optical disk drives and media. Other companies expected to ship production volumes in 1988 include Olympus Optical Co. Ltd. (which uses media from 3M), Maxtor Corp. and Canon Inc. in Japan.

Slow access slows prospects

Other key specifications of the Sony drive include a 1,024-byte sector size, 18,750 tracks, 1,800 revolutions per minute (rpm) and an average access time of 120 msec. While the drive includes a SCSI interface, Sony will make an ESDI interface available if the OEM market demands it. Sample prices for the drive (including the controller) and media are $6,600 and $200, respectively.

Because of the initial high price, erasable optical disk drives will probably not find much acceptance in the personal computer market, at
least for a few years. “PCs won’t be a big market [for 5 1/4-inch erasable optical disk drives] until the price comes down to, say, $1,500,” admits Moore. And the slow access times will probably prohibit the use of these drives in the mainframe arena. The drives’ 120-msec average access times are a far cry from the sub-20-msec access times available with Winchester drives of similar capacities.

The most likely home for erasable optical disk drives, at least for the next few years, is in applications that do not require fast access times but do require high capacities, removable media and rewritability. Imaging and CAD/CAM jobs typically handled by engineering workstations are prime examples. In addition, government agencies and banks may opt for optical because of the data security advantages it offers.

Sony will ship hardware only. Supplying software, such as device drivers and retrieval packages, is up to the OEM or system integrator. However, that may not prove too difficult a task. Moore maintains that it’s “not much harder than writing device drivers for magnetic disk drives” and would take a programmer a matter of weeks, at most, not months.

Bob Abraham, vice president of Freeman Associates, a data storage market research outfit in Santa Barbara, Calif., concurs: “Device drivers are not a big job,” he says, adding that the big integration job lies in evaluation and testing. “Large system integrators will go through a painfully long process of evaluation and testing,” he says. Abraham expects initial erasable optical disk drives to find their way into new systems, and that Sun Microsystems Inc.-level machines are the most likely hosts.

‘The check’s in the mail’

Although Sony is expected to win the race for erasable, Sharp will most likely follow closely on Sony’s heels with a 5 1/4-inch drive. Reports from the Tokyo Business Show last May, at which Sharp showed the drive, indicated the following: 211 M bytes per side on double-sided media; 150-msec average access time; a burst recording data rate of 1.14M bits per second (bps) with a sustained data rate of 0.228M bps; a rotation rate of 900 rpm; and an embedded SCSI controller. The media is available now, and sample drives were scheduled for shipment last month for around $7,000.

Sharp’s magneto-optic media comprises a glass substrate, an aluminum-nitrite layer and an aluminum reflector layer, housed in a cartridge meeting International Standards Organization standards. Sharp will sell the drive to OEMs and will also separately sell magneto-optic heads and lasers.
Verbatim Corp. also will ship an erasable optical drive in 1988. Verbatim will manufacture both the media and drive and sell the media, while Kodak sells the drive.

The exact specifications were sketchy at press time, but sources at both Verbatim and Kodak confirmed the following: a 3½-inch drive using thermo-magneto-optic technology (see Diagram); capacity exceeding 50M bytes, but not more than 100M bytes; an average access time under 70 msec.; and a data transfer rate of more than 1M bps. The drive will come in a half-height form factor and will include either an ESDI or SCSI interface.

Those specifications represent the official line. Industry insiders, however, think the drive will hold 65M bytes and have a much more attractive average access time of 35 msec. Kodak/Verbatim officials would not confirm those specifications.

Kodak will sell the drive either as an OEM unit or as a subsystem. According to Chandran Cheriyan, marketing manager for Verbatim's 3½-inch erasable program, the company will ship evaluation units in the second quarter, with production volumes due before the end of the year. Cheriyan says the drive will cost 25 percent to 50 percent more than Winchesters with similar capacities. Kodak, a major player in the 12-inch and 14-inch write-once optical arena, has no plans for a 5¼-inch drive.

The comparatively low capacity of the Kodak drive leads many potential buyers to wonder what its advantages are relative to standard 3½-inch Winchesters. "The main advantage," says Cheriyan, "is removability, and that the data can be locked up." Cheriyan adds that removable Winchesters—potential competition for erasable optical disk drives—have experienced reliability problems that have stalled acceptance.

One of the major technological debates in the

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**Write-once optical drives crawl toward standards**

CDROM (compact disk ROM) technology is fairly well-established and looking for applications, while erasable optical disk drives are floundering between hype and hope. Overall, optical write-once technology is healthy but hardly free of controversy. Much of the action centers on the 5¼-inch form factor.

The 5¼-inch write-once market is mired in a miasma of controversy concerning standards. Three bodies are at work on the problem—ANSI, ECMA (European Computer Manufacturers Association) and ISO (International Standards Organization)—but it's unclear if or when consensus will arrive.

One of the major debates centers on recording format; specifically, the servo format for tracking. Until IBM Corp. announced the Model 3363 write-once optical drive with its PS/2 systems last April, there were two dominant methods: sampled servo and continuous composite servo. IBM's 3363 threw a wrench in the works by not conforming to either, thus establishing a third possible standard. Reportedly, IBM has already shipped over 10,000 3363s, which are manufactured by Matsushita Ltd. in Japan. On the other hand, it is generally acknowledged that the 3363 is over two years old from a technology standpoint. This might prompt the company to introduce a completely different drive in the near future, possibly one that complies with ANSI standards—if they exist.

Of the two non-IBM servo methods, continuous composite is currently the more popular. The big question for system integrators is whether to wait for standards or to buy now.

The advantages and disadvantages of each of the methods are acrimoniously debated in ANSI committees. Currently, both approaches are de facto standards. But media interchangeability requires a single standard. Resolution of the controversy is not expected before the first quarter of next year, and many observers don't think it will happen that quickly. Quite possibly, the two standards will survive.

**Standards help optical drives**

Despite the controversy, it's important to note that, because of the applications that write-once drives are being used for, standards may not be that important. Few users need interchangeability except, perhaps, within their own company. Hank Meyer, manager of product line management at Maxtor Corp., says: "Very few customers are pressing for interchangeability. Standards are much more key to erasable optical disk drives, where interchangeability is more important." Meyer explains that most of his company's write-once drives (which are manufactured by Ricon Ltd. in Japan) are being used strictly as archival backup units.

Jeff Dulude, vice president of marketing at Optotech Inc., another major manufacturer of 5½-inch write-once drives, agrees: "Users don't really care about interchangeability," he says, adding, however, that it will become more important as write-once drives go beyond their current applications. Dulude says that most of Optotech's drives are used for archival storage, with a much smaller percentage being used for image processing, and data collection and distribution. The devices replace microfilm or microfiche and, to a lesser degree, tape drives.

A recent report on the Japanese market revealed that twice as many optical disk users cited high cost and lack of rewritability as their primary reasons for dissatisfaction as did those citing incompatibility and
An erasable optical field revolves around magneto-optic vs. phase-change recording. (Kodak’s thermo-magneto-optic recording is essentially synonymous with magneto-optic recording.)

Magneto-optic recording combines the heating effect of a laser with the magnetic properties of a ferromagnetic recording layer. The laser raises the temperature of the recording layer above the Curie temperature so that the applied magnetic field can set up magnetic domains representing Is and zeros. To read the data, an incident beam of polarized light is rotated on the basis of magnetic orientation. By taking advantage of the Kerr effect, a polarized analyzer in the read head distinguishes between polarities.

One drawback to magneto-optic recording is that it currently requires two revolutions to overwrite data—one to erase and one to write. This in turn slows down write-transfer rates. Nevertheless, magneto-optic technology is considered to be more promising than phase-change recording, and enjoys more proponents among those companies planning erasable optical disk drives. In fact, Ed Rothchild, president of Rothchild Consultants, a San Francisco research company specializing in the optical disk market, contends that magneto-optic will be the only type of erasable disk technology available for the next two and a half years.

However, not everyone agrees. For example, Panasonic Technologies Inc., a U.S. division of Matsushita Electrical Industrial Co. in Japan, is currently working on both phase-change and magneto-optic products. Tony Jasionowski, manager of memory products at Panasonic, is not convinced that magneto-optic recording will necessarily be the way to go.

For one thing, Jasionowski contends, if both phase-change and magneto-optic media use plastic substrates, phase-change media will have longer life spans. The difference may be insufficient capacity. The report was prepared by ODS Corp. in Japan and is available in the U.S. from InfoCorp, a market research company in Cupertino, Calif.

Products in the 5¼-inch write-once category vary widely. Capacities range from 200M bytes on IBM’s 3363 to 800M bytes (400M per side) on drives from Maxtor and Laserdrive Ltd. Optotech and ISI (Information Storage Inc.) are other major suppliers. Most vendors offer IBM PC or SCSI interfaces, and some sell versions for specific workstations.

Other form factors for write-once drives include the 3½-, 8-, 12- and 14-inch. As yet, there is little activity and no products in the 3½-inch size, although industry convergence on that form factor for flexible and rigid disk drives could spur increased development efforts over the next year.

There are no major U.S. manufacturers of 8-inch write-once optical drives, and analysts agree that it’s a dying form factor. However, it may be kept alive because of shipments by Japanese manufacturers to captive markets.

The 12-inch write-once drives are the granddaddies of optical storage, representing the largest revenue percentage of the total market. There are no standards for this class of drive, and most observers think that the market has progressed too far for any standards to develop. Capacities of 12-inch drives generally are in the 2G- to 3G-byte range.

The fastest growing application for large optical disks is in full-scale image- and document-processing systems, where sophisticated data-retrieval software and jukebox configurations are key distinctions among systems.

Although most high-end activity revolves around 12-inch drives, Eastman Kodak Co.’s 14-inch drive, which the company integrates into large document-processing systems, has been well-received. The drive holds 3.4G bytes per disk surface. Kodak sells the drive to end users or OEMs.

Rothchild Consultants of San Francisco estimates 1987 shipments of 5¼-inch write-once optical drives at around 25,000 units and those of 12-inch optical write-once drives at about 12,000. Similarly, Freeman Associates of Santa Barbara, Calif., which tracks the market by capacity categories, pegs 1987 shipments of under-1G-byte write-once drives (almost all of which are 5¼-inch units) at 26,000; and over-1G-byte write-once drives (including 8-, 12- and 14-inch units) at 23,000.

Maxtor’s RXT-800S offers 400M bytes on both sides of a 5½-inch disk for document storage and retrieval archival backup applications.
Packing 810M bytes, Laser-drive's 5 1/4-inch write-once optical drive, the model 810, includes Winchester emulation software in its embedded SCSI controller.

In thermo-magneto-optic technology, an optical head writes on the disk by focusing a laser beam on a magneto-optic recording layer while, opposite, a bias coil exerts a magnetic field. The absorbed light heats the layer's film at the point of focus, lowering the coercivity at that spot. This permits the bias field to magnetize that region of the disk.

write or erase on a disk) of magneto-optic recording is better. With phase-change, there is a limit, usually specified at about 1 million cycles. But Jasionowski adds that 1 million cycles is perfectly adequate for most personal computer environments and, in fact, may exceed the life of the product anyway.

Panasonic Technologies, in concert with its parent Matsushita, will field an erasable optical disk drive "within a year of making the decision on whether to go with phase-change or magneto-optic recording," according to Jasionowski.

Who needs it?

Not everyone is greeting the arrival of erasable optical disk drives, or for that matter write-once optical drives, with enthusiasm. Beyond the technological issues looms the ultimate, nagging question: Who needs them?

"For erasable optical disk drives to succeed, they have to be low-cost enough to displace tape or high-performance enough to replace Winchesters," says Jeff Dulude, vice president of marketing at Optotech Inc., a major producer of 5 1/4-inch write-once drives. Given the initial specifications of erasable optical disk drives, they have a long way to go to achieve either goal. Access times are far slower than those of Winchesters, thus making them unsuitable for high-speed transaction database applications. Also, erasable optical disk drives cost much more than tape drives, and their transfer rates are slower than those of streaming-tape drives.

The major reason for the slow access times of optical drives is the large size and mass of the read/write head, which requires a lot of energy to move. To decrease access times, manufacturers will have to decrease the mass of the read/write head, and software companies will have to develop operating system modules that improve data organization on the disk. On the other hand, although slow compared to magnetic disks, optical disks offer vast improvements over microfilm or paper.

The key advantage of erasable optical disk drives is removability, a characteristic shared minimal where glass is the substrate, but glass substrates cost more. They also are weightier, thereby requiring more power to rotate the disk.

Another advantage of phase-change media is the ability to do single-beam (one laser diode) overwriting, compared to the more conventional two-diode technique. This increases speed and decreases the drive cost. Single-beam overwriting is possible with magneto-optic media, too, but development of this approach is behind that with phase-change media.

In addition, the CNR (carrier-to-noise ratio) of phase-change media is higher. "The CNR of magneto-optic heads tends not to be as good, because it uses a Kerr rotation angle that is very slight, so you have to compensate for that by amplifying the signal," explains Jasionowski.

However, Jasionowski admits that the cyclability (the number of times you can re-
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087107
by one of the technologies that it is supposedly going to replace: quarter-inch and half-inch tape drives. On the other hand, because they use sequential rather than random access, tape drives provide much slower data access times than optical drives.

Rothchild expects the first generation of erasable optical disk drives to be used as backup units for Winchester drives. Thus, the optical drives will be competing with streaming tape drives. As optical disk manufacturers decrease the mass of the heads (from their current 50 to 130 grams to, say, under 10 grams), erasable optical disk drives will compete head-on with Winchester drives. Rothchild expects that to happen in about three years.

Adding to the confusion is imminent competition from the two new kids on the data storage block: helical scan recording and vertical recording.

Helical scan expands options

Helical scan refers to the way in which magnetic tape is wrapped around the drum upon which the recording heads are mounted. Rather than being passed across a stationary recording head, helical scan drives move the drum past the stationary heads. Helical scan is used in IBM's 3480 tape drive, Sony's D-100, and the Sony 3600 optical disk drive.

Integrating software for optical disk drives

Brian A. Berg, Berg Software Design

Most optical disk drives on the market today use the small computer system interface (SCSI). As a result, the support software typically includes a SCSI interrupt handler. This low-level piece of software can be used for any type of device on the SCSI bus (i.e., magnetic tape or disk drives as well as optical drives).

A key feature of the SCSI architecture is that all of these devices can reside on the same bus, using a single host adapter. Portions of the software that issue SCSI commands and handle the return status from a device can also be common code for other devices that use the SCSI common command set.

The software that harnesses the device-driver code must deal with the write-once nature of the drive and media. The write-once characteristic results in defects being detected only when the user writes on the media. Thus, one of the requirements of a reliable write-once system is a way to verify data after it has been written. Some drives use a technique called "direct read during write" (DRDW) to verify each bit immediately after it has been written. In contrast, drives that do not use this technique require additional drive software to verify data. This process involves rotational latencies and often negatively affects data throughput while writing.

When formatting data on a write-once disk, there are two critical decisions to make. First, the logical format to be supported on the disk must be determined. It may be a standard file system such as UNIX or MS-DOS, a customized file system, or the logical format proposed by the ANSI X3B11 committee. Next, the manner in which data is added and updated must be defined.

A common technique for updating data involves writing from each end of the disk. Data sectors and sectors containing file pointers are written sequentially, starting at the beginning of the disk. The addresses of the current file pointers are periodically rewritten reverse-sequentially from the end of the disk. Locating the most current file pointers is accomplished by taking advantage of a special characteristic of write-once media—the ability to distinguish written sectors from unwritten sectors. Due to this characteristic, a written sector that follows an unwritten area near the end of the disk will contain the latest set of file pointers. The file pointers can be located at a later time by using a binary search algorithm or a backward "leap-frog" algorithm. The latter would search for an unwritten area near the end of the disk by trying to read the first sector of each track. It would start with the last track on the disk and continue backward until an unwritten sector is found. It would then search forward for the first written sector.

A possible trend in second-generation write-once drives is to embed this technique into the controller firmware, within the drive. The benefit of this would be the complete transparency of the write-once nature of the system. However, many current applications for write-once systems use this characteristic to their advantage (e.g., to guarantee that data written will always be available). Hence, this sort of second-generation write-once system would not be desirable in such an application.

This technique for updating data is only applicable to write-once systems, because erasable optical media needn't differ in logical format from magnetic media. Erasable optical systems require an initial pass over the media to complete an erase-before-write cycle, a step that is handled by firmware embedded in the drive. Therefore, software development for erasable systems should be much simpler than that for write-once systems.

Brian A. Berg is a software design consultant with Berg Software Design, Sunnyvale, Calif. He has been involved with four write-once optical implementations during the last three years, including the recently announced LD-510 drive from Laser Magnetic Storage International (LMS).
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head, the tape is wrapped in a helical fashion around a rotating drum, much as tape would wrap around an ice cream cone. Data is recorded in “stripes” at an angle to the horizontal plane of the tape.

Three standards for helical scan media exist: 8 mm, VHS (video home system) and DAT (digital audio tape), each of which are derived from consumer markets.

The main advantage of helical scan tape recording is increased data density (see “Helical-scan recording expands tape capacity”). Also, because of its consumer origins, the media and drives are relatively inexpensive.

One of the first commercially available tape drives using helical scan technology was Emerald Systems Corp.’s VAST (virtual archive storage technology) Device, introduced in September. The $6,995 VAST Device packs 2.2G bytes in a 5¼-inch disk drive using audiocassette-size cartridges. The major OEM supplier of helical scan drives is Exabyte Corp.

Although helical scan drives use sequential access (as opposed to the much faster random access of optical and Winchester drives), that is not a drawback in strictly archival applications, where data is infrequently accessed. Michael Harris, product manager at Emerald Systems, expects the VAST Device to be used primarily in archival applications. Harris adds that helical scan drives will have faster throughput rates than will erasable optical disk drives. Emerald began production shipments of the drives last month.

Another advantage of helical scan tape drives is cost. The 2.2G-byte cassettes for the VAST drive cost $40, or about 2 cents per megabyte.

Although helical scan technology would appear to be a logical competitor to erasable optical disk technology, that may not be the case. For example, Lee Elizer, president of Peripheral Strategies Inc., a Santa Barbara, Calif., market research company specializing in data storage, thinks that the two technologies

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**Test equipment tracks optical media quality, performance**

**Ben Carter**  
California Peripherals Corp. (CaliPer)

The data storage industry used to wonder whether it could achieve low enough error rates for optical media. Not any longer.

The quality of 5¼-inch (130-mm) write-once media has stabilized, and the industry is working on erasable media. In addition, 3½-inch (89-mm) media in both write-once and erasable versions is already in the development stage. Further, the cost per megabyte of optical disk storage is low enough to allow the incorporation of powerful error-correction codes. These codes reduce the error rates of optical media to levels below those of both Winchester disk and magnetic-tape devices.

California Peripherals Corp. (CaliPer) has seen proof of these quality advances from companies that analyze their optical media with CaliPer test systems. These are manufactured and marketed under license from the Nakamichi Corp., Japan. CaliPer’s test equipment can currently evaluate more than 15 parameters of optical media quality and performance, on a sector-by-sector or track-by-track basis, at spindle rotation speeds of up to 3,600 revolutions per minute. These parameters can be tested in a variety of combinations to analyze mechanical, electrical and optical characteristics.

Mechanical test parameters include disk warp and tilt, and the rate and speed of both axial and radial deviation (which affect the laser’s ability to stay in focus). Electrical test parameters include defect mapping and signal-to-noise ratio (which affects data detection). Optical parameters include read, write and erase performance, plus the affect of protective coating and associated stresses on the transmission of given laser frequencies.

With more than a dozen manufacturers expected to ship magneto-optic erasable media by the end of 1988, accurate optical test parameters will become increasingly important.

One critical concern is the difference between laser power needed for write operations as compared to that needed for read operations. Write-once drive manufacturers need only care about read power, but magneto-optic erasable drive manufacturers must worry about both. And, because too much power during the read operation can erase data and shorten the life of the laser diode, precise test capabilities are critical.

Another challenge facing both write-once and erasable optical drive development is the need for test-parameter standardization. Currently, there is only a handful of test equipment suppliers, but de facto standards have developed. In addition, the ANSI X3B11 committee has established an initial four-part standards document, which was submitted to the International Standards Organization in October. In compliance with the ANSI document, leading test equipment manufacturers are working with media vendors to ensure that media is interchangeable between drives from various manufacturers.

**Ben Carter** is the marketing manager for optical products at California Peripherals Corp. (CaliPer), Torrance, Calif.
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can coexist. Elizer states: The two technologies won't compete for the same applications, because 8 mm and DDAT (data DAT) capacities will be much higher than those of erasable optical products and because of the random vs. sequential addressing trade-off. Elizer adds that the big unknown at this point is pricing.

The primary application areas for helical scan products, according to Elizer, are archival storage, fixed-disk backup and data distribution.

Although media standards are fairly well established, the industry still has to settle on recording formats and interfaces before it can achieve media interchangability. And that isn't likely to happen before late 1988 or early 1989. Most probably, standards for both 3½-inch and 5¼-inch erasable optical disk drives will arrive before standards for helical scan products.

**Ups and downs of vertical recording**

In vertical recording, magnetic particles are oriented perpendicularly to the plane of the media, rather than horizontally as in conventional magnetic recording. Although the advent of vertical recording drives has been trumpeted for almost as long as erasable optical disk drives, products now appear to be on the verge of coming to market.

Commercially available drives using vertical recording will start to appear next year. Expected capacities are 1.8G bytes for 8-inch drives; 1.2G bytes for 5¼-inch drives; and 120M bytes for 3½-inch drives.

The vast capacities and random access of vertical recording drives could pose formidable competition for erasable optical disk drives. However, for applications where removability is a prime concern, optical disks may be the better solution. And many early participants in vertical recording for rigid disks have dropped out of the race, thus casting doubt on the availability time frames cited by the few current participants.

The drawbacks to erasable optical disk drives seem formidable, at least for the time being, and will give system integrators good reason to hesitate before embracing the new technology. However, few industry participants doubt that erasable optical disks will eventually earn a

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**CDROM standards: the making of High Sierra**

Two years ago, a lack of standards was bugging the compact disk ROM (CDROM) industry. That lack was a critical threat to business, vendors said. They couldn't make volume sales without standards.

Today, nobody worries much about standards. And business is starting to boom. While U.S. shipments of CDROMs this year will total just 30,000 drives, valued at $20.7 million in 1991, they should total more than 1 million drives, valued at $168 million. That's according to Venture Development Corp., a market research concern in Natick, Mass.

"I think it's amazing that we've come as far as we have with standards for CDROM in the short time they've been around," says Bill Zoolick, vice president at Avalanche Development Co., Boulder, Colo. "The industry has done pretty well in getting its house in order."

How did the CDROM people do it? A bunch of them invented the High Sierra Group, that's how.

In mid 1985, CDROM vendors had no standards at all. They did have the "Yellow Book"—a set of specifications for the disks put out by Sony Corp. of Japan and N.V. Philips of The Netherlands. Since those two companies license the manufacture of CDROM disks, the Yellow Book was a de facto physical standard.

For example, it set the diameter of the disk (12 centimeters); the amount of information in a data block (2,352 bytes, of which 2,048 are user data); the use of a spiral track; a formula for error correction; and a mode for sector-by-sector addressing.

Lacking was a file-management standard. That's a common directory structure and a file format for converting the disk from a collection of sectors with data into a collection of files.

Typical were stories of users needing drives from different manufacturers to read different CDROM disks. "Imagine if you had that situation with floppy disks," says a vendor who was around in those days. "It was killing us."

But, the vendors faced the elephantine pace typical of standards-writing organizations, like the ANSI. In writing standards, says Paul Peters, systems coordinator at the New York Public Library, "ANSI is not that interested in making it a timely process."

**No vacation from standards**

So, a group of U.S. CDROM vendors decided to throw caution to the wind (there are anti-trust law risks involved when vendors get together) and write a draft proposal for a file-management standard.

For their first meeting, in August 1985, they picked Lake Tahoe, a California resort. "It sounded like an interesting place to go in August," says John Einberger, vice president of software development at Reference Technology Inc., Boulder, Colo., and one of
permanent place in the data storage hierarchy.

**Big three poised to enter**

Underscoring its importance, IBM Corp. (at its Tucson, Ariz., facility), Digital Equipment Corp. (in Shrewsbury, Mass.) and Hewlett-Packard Co. (in Boise, Idaho) have all set up internal R&D units for erasable optical disk drives. In fact, industry insiders have reason to believe that IBM will introduce a magneto-optic erasable drive in 1988, although it’s unclear whether it will be manufactured in Tucson, Japan, or both.

Although these companies may eventually

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The organizers of the meeting.

They became the High Sierra Group (named for the hotel where they met). After six more meetings over the next nine months, the group had a draft proposal, which it submitted to the National Information Standards Organization (NISO) in the U.S. and to the European Computer Manufacturers Association (ECMA). That done, still mindful of the anti-trust risk, the High Sierra Group disbanded.

The file-management standard, still about 95 percent the original High Sierra proposal, is nearing approval by the International Standards Organization.

That’s a sprint from no standards to an international standard in a little more than two years.

Einberger uses an analogy to explain CDROM standards: “Think of the Yellow Book as saying, ‘We’re going to write on paper, the paper is going to be 8½ by 11 [inches] and we’re going to have lines on it.’ It doesn’t tell you how to write on the paper.” What the High Sierra Group did was to say, “In order that somebody can read this piece of paper, we’re going to suggest that when you write on it you ought to start in the upper left hand corner and write across.”

Standards may not be the burning issue in the CDROM world today, but there still are problems to solve. One revolves around disk cartridges and the other around retrieval software.

Half-height CDROM drives, now coming on the market, require cartridges to protect the disks in the cramped quarters. In Japan, vendors appear to be adopting Sony’s version of the cartridge. But, in Europe, Sony’s old partner, Philips, seems to be working on another version. “It’s odd, isn’t it?” asks Einberger. “You’d have thought they would have seen this coming years ago and would have figured out how to solve it.” In any event, he says, “there’s a fair amount of stirring of the pot right now to try to standardize on the cartridge.” But no standards body is working on the issue.

Vendors are engaged in a heated argument about standards for retrieval software. The argument is about what to standardize: the file indexes on the disk, the retrieval engine, the user interface or something else.

The problem is that CDROM technology is evolving, and some vendors fear standards would choke off progress. “Putting on standards is a good way to lock off innovation,” says Zoellick.

However, many CDROM vendors believe a standard of sorts is evolving at the user interface, spurred by the advent of the windowing interface in the IBM Corp./Microsoft Corp. Operating System/2.

As with the cartridge issue, no standards organization is considering retrieval software.—James F. Donohue
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IBM Corp.'s new Operating System/2 (OS/2) offers system functions commensurate with the expanding capabilities of personal computers. Its primary features are support for large real-memory and the concurrent execution of multiple applications. OS/2 is also intended to be easily extendable and provides tools to aid application developers and system integrators in the development of complex applications. Yet OS/2 retains many of the characteristics of DOS. OS/2 executes on Personal System/2 models 50, 60 and 80 and on the PC/AT and PC/XT model 286.

IBM has announced two versions of the Standard Edition of OS/2 (1.0 and 1.1) in addition to the Extended Edition. This article describes the features of OS/2 common to all of these products (see "A check list of OS/2 system features").

Large memory support

The Intel Corp. 80286 and 80386 processors extend the addressing range of the 8086 and 8088 processors by adding a new mode of operation called "protect mode." Both the 80286 and 80386 can also execute in 8086/8088 mode, which is called "real mode." The 80286 and 80386 can switch between real and protect modes under program control. In order
to run a DOS application under OS/2 while OS/2-mode applications are also running, OS/2 switches the processor between real mode and protect mode.

Like the 8086 and 8088, the 80286 and 80386 processors divide memory up into ranges of addresses called segments. The 8086 and 8088 and 80286 limit segments to a maximum of 64K bytes, because these processors can generate only a 16-bit offset into the segment. Although the 80386 can generate 32 bit offsets, OS/2 uses the processor as though it were an 80286. Therefore, the 32-bit mode of the 80386 will not be described in this article.

When the 80286 or 80386 is running in protect mode, addressing is done indirectly through either a single global descriptor table (GDT) or one of the multiple local descriptor tables (LDTS). The 16-bit values in the segmentation registers are no longer addresses but rather indexes called selectors. The selector refers to a descriptor in the GDT or LDT that contains the base address of the segment, the length of the segment and usage and protection information.

The processor calculates the address of the location being accessed by adding the segment base address to the offset value. By making the base addresses larger, the 80286 and 80386 provide 24 bits of real addressing range for a maximum storage size of 16M bytes (Fig. 1). The 80386 can further extend the addressing range of the processor, but this extension is not used by OS/2.

The memory layout in the OS/2 system is split to minimize its use of storage below 640K bytes (Fig. 2). This provides the largest amount of room possible for real-mode programs. Real-mode programs are run in the area below 640K bytes, so that they have the same addressing environment as they do in DOS.

Each OS/2 protect-mode program has its own LDT, which contains the descriptors for the data, code and stack segments that it uses. There is a single GDT for every program in the system. Although any individual segment is still limited to 64K bytes in size, a protect-mode program can use a large number of segments. Thus, since the 80286 and 80386 can address up to 16M bytes in protect mode, a program may have an address space that is much larger than the 640K-byte limit that DOS imposes.

The hardware-protection features of protect-mode require the operating system to manage segments, determining both their base addresses in real storage and their lengths. Accordingly, OS/2 provides system calls that allocate and deallocate segments for programs. There are also operating-system routines to manage data areas larger than 64K bytes.

The whole is greater . . .

OS/2 manages physical memory in such a way that more memory can be allocated than the machine actually has. This feature, known as "memory overcommit," allows the user more flexibility by permitting the system to execute programs that are larger than the amount of physical memory installed on the machine.

Segments that are not actively being used may be swapped out to the rigid disk, only to be swapped back into memory when they are needed. Since all the memory that a segment uses must be contiguous, OS/2 moves segments around in main memory in order to accommodate segments that are currently needed.

To help user programs manage the storage in the segments that they are using, OS/2 provides a set of routines to suballocate the space in a segment. Although these routines are provided with the operating system, they run as a part of the user program, rather than as system routines.

Linkage to such routines is very efficient and does not involve the overhead associated with an operating-system call. The smallest unit of
storage that the operating system is required to manage is a segment.

OS/2 supports both multiprogramming and multitasking. A multiprogramming system allows the concurrent execution of multiple applications. A multitasking system distributes processor time among multiple programs by giving each short periods of time on the processor.

OS/2 allows a user to run up to 12 concurrent sessions. A different application may be run in each session. For example, one session can be executing a compilation while another is doing a file copy and a third is running a spreadsheet.

OS/2 implements multitasking using "processes" and "threads." A process is the collection of resources under the control of a program. On OS/2 all programs execute as processes. All resources used by the program become part of the process. Allocated memory, files, queues and semaphores are some of the resources that are owned by a process. When a process terminates, OS/2 frees the resources that the process had been using.

In OS/2, the basic unit of execution is the thread. Every process in the system has at least one thread. A program may choose to employ multiple threads within a process. For instance, a program could be written to read from the disk with one thread while the data was printed with another thread. This permits the overlapping of processing and I/O activity.

Threads do not own system resources. Other than their own execution stack, they use the resources of the process that owns them. A new thread can be created by any other thread in the process. If all the threads in a process are terminated, then the process itself is terminated.

Pre-emptive scheduling

OS/2 implements what is known as a "pre-emptive time-slicing scheduler." This means that a thread executes for some relatively short period of time before the scheduler gets control again. When it does, it may determine that another thread ought to run. If so, it pre-empts the currently running thread by saving its state and dispatching the other thread. However, OS/2 allows the user to configure the maximum and minimum time-slice values.

All the threads in the system compete for processor time. The OS/2 scheduler implements a multilevel priority scheme with dynamic priority variation and round-robin dispatching within a priority level (Fig. 3).

Dynamic priority variation means that the scheduler changes the priority of threads based on what they are currently doing. This improves overall system performance and ensures that the system responds rapidly to user interactions.

Round-robin dispatching within a priority level ensures that if there is more than one thread at the same priority level all of the threads at that level have an equal chance to execute.

When multiple processes are running, the scheduler identifies one as the foreground process. The threads of this foreground process are given a higher priority than others in order to make the system even more responsive to the interactive user.

Protect application turf

OS/2 supports several facilities for synchronization and interprocess communications. These include semaphores, signals, pipes and queues.

Since OS/2 applications may be multi-threaded, it is important that they protect their resources. To do so, common data areas, those shared by all the threads in a process, must be accessed in a serialized fashion.

OS/2 allows an application to serialize common data area access by using semaphores. A semaphore is a part of data structure that is owned by one thread at a time. If two different threads of a program need to access a data

Fig. 2. The IBM OS/2 memory layout is split to reduce storage to below 640K bytes and to provide the largest possible space for real-mode programs, which run below 640K—as they do in DOS.
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structure, each must request the semaphore. OS/2 grants the semaphore to one of the requestors and blocks the other until the first relinquishes control.

OS/2 has two types of semaphores, system semaphores and RAM semaphores. System semaphores may be used to serialize between threads in different processes. The operating system tracks the ownership of system semaphores. RAM semaphores differ in that they are a simple, efficient form of semaphore that can be used to serialize among the different threads of a single process.

Signals are used to notify OS/2 processes that some external event has occurred. A process can define signal handler routines that are invoked when the various signals are received by the process. An example of a signal defined for OS/2 processes is the signal indicating that the user has pressed control-break and that the process, therefore, should terminate itself.

When a signal is received, if there is no signal handler defined, the system usually either ignores the signal or terminates the process. If there is a signal handler defined for the signal, then it is invoked under the original thread of the process. OS/2 also provides a function that permits a process to disable and to enable signaling.

**Dynamic linking and demand loading**

OS/2 implements new mechanisms for linking and loading programs. DOS links code segments statically by appending them to the application’s .EXE file, causing this .EXE file to grow with each referenced routine. The entire .EXE file is loaded when DOS starts the program.

OS/2 permits static linking, but it differs from DOS in that it also supports the linking of code segments when a program is loaded. Whenever the OS/2 program is linked, the linker includes only a reference to a dynamic-link, or “dynalink,” library containing the code. The actual code itself is not included. When the program is loaded into storage, OS/2 resolves the references to the dynamically linked segments.

The programmer has a choice as to when a dynamically linked code segment is actually loaded into storage. Dynamically linked segments may be loaded when the main program is first loaded by the system. Or, the segments may be loaded only when they are actually referenced through a “FAR CALL.”

In the latter case, at load time the system sets up the references to the segments in such a way that the program takes a hardware fault when it executes the FAR CALL instruction. The OS/2 fault handler determines that the reference is to a dynamically linked segment that is not loaded and loads the segment into storage (Fig. 4).

Dynamic linking and demand loading offer several benefits. For one, applications will generally use less memory since seldom-used routines may not be loaded until they are needed. Second, applications consume less disk storage space because there is a single copy of common routines, rather than a copy bound into each application. Third, dynalink libraries can be updated to newer levels without relinking the
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CIRCLE NO. 39 ON INQUIRY CARD
applications that use them. Many of the functions of OS/2 are implemented as dynalink libraries to improve the modularity of the system and to make it easier to share storage between processes.

**Application programming interface**

OS/2 uses calls to implement its application-programming interface (API), rather than the software interrupts (INTs) used by DOS and by the BIOS. A "calls" technique was chosen because the software-interrupt mechanism for invoking system services has a number of disadvantages.

First, the number of INTs is very limited, thus restricting future growth. Second, it is impossible to add new parameters to existing INTs in a compatible fashion. This makes it difficult to extend current interfaces. Third, the software-interrupt interfaces are easy to code in assembler, but they do not translate very well into higher level languages.

In view of these drawbacks, rather than using software interrupts, the OS/2 API is based on the dynamic-link mechanism of the system. Dynamic linking allows an application to make direct calls to system services. The references are resolved by the loader when the application is started. System service calls are coded in the same fashion as application subroutine calls.

Parameters are passed on the application stack through a convention that is consistent with that used by many compilers. The system API can be directly supported by higher level languages. There is no need for bindings that remove parameters from the stack, load the registers and issue a software interrupt.

The OS/2 API can be easily extended by adding new function names to the system library. Subsystems can also be added by introducing new dynalink libraries. The application developer is provided with a single, consistent mechanism for accessing base system functions and extensions. The dynamic-link mechanism enables the system to change APIs in future releases while maintaining compatibility for the existing calls.

There is a subset of the OS/2 API called the Family API. It is supported by both OS/2 and DOS 3.3. Programs written to the Family API can be linked and bound to produce .EXE files that are executable on either OS/2 or DOS. On OS/2 the Family API calls are handled in the usual manner by the system. On DOS there is a special piece of code bound to the application, which translates the Family API calls to software interrupts. This code also loads and transfers control to the program, so that it seems to be executing in the OS/2 environment.

**Compatibility with DOS**

OS/2 executes real-mode programs one at a time in low storage. Real-mode programs run only when the DOS environment is selected as the foreground session. Protect-mode applications may continue to execute in the background.

When the real-mode program is put into the background by the user, it is frozen and does not run again until the user returns it to the foreground. This means real-mode data communication functions cannot be reliably supported in the DOS environment when the user switches to a protect-mode OS/2 application.

The software interrupts issued by real-mode programs are serviced by OS/2. This includes both the DOS software-interrupt function calls and the BIOS software interrupts. This arrangement permits the real-mode application and the protect-mode applications to share, under the control of the operating system, common resources and services such as the file system. Some BIOS functions that are particularly difficult to emulate are given to the ROM BIOS to execute. In this case, the system serializes itself, so that the ROM BIOS code operates correctly.

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Dynamic linking allows an application to make direct calls to system services.

requires storage space below 640K bytes. Consequently, there is less application space available in the DOS environment than in a system running DOS 3.3.

Provides synchronous filing

OS/2 uses the same file-system formats as DOS 3.3, so that media written by one system can be read by the other. Like DOS 3.3, OS/2 permits the user to organize the files on a rigid or a flexible disk into tree-structured directories. The file-naming and drive-letter conventions of OS/2 are the same as those of DOS 3.3.

The OS/2 file system provides the same file-sharing features as DOS 3.3, allowing a file to be shared among processes that are running concurrently. File access can be serialized among threads of the same process, using semaphores.

Unlike DOS, OS/2 provides asynchronous file I/O as well as synchronous file I/O. This means that a program may issue a read or a write and then proceed with other processing while the I/O operation is being done by the system. When the program needs the data being read or needs to reuse the buffer containing the data being written, it can wait on a semaphore that is set when the I/O is completed by the system.

Also, since the file system runs under the thread of the caller or, in the case of asynchronous I/O, under the thread created to run the request, file-system operations are multi-threaded. This means OS/2 does not wait for disk I/O to finish. Instead, it can dispatch other threads and do other work while the disk is returning the data requested.

For devices larger than 32M bytes, OS/2 provides a method of partitioning the disk into logical drives, each with its own drive letter. This partitioning scheme is identical to that in DOS 3.3, so media compatibility between the two systems is maintained.

Device drivers are bimodal

Like DOS, OS/2 has two types of device drivers: character device drivers and block device drivers. Also like DOS, OS/2 device drivers may be broken down on the basis of strategy and interrupt routines. However, OS/2 device drivers must operate in multitasking environments. Thus, they must be written to relinquish control whenever they are forced to wait for I/O to finish.

In addition, since OS/2 operates in both real and protect mode, the device drivers must be capable of "bimodal operation," i.e., must be able to execute in either real or protect mode. In particular, an asynchronous I/O may be started by the device driver in one mode, but the device driver may receive the interrupt for it in the other mode.

To assist in implementing such device drivers, OS/2 has a common interrupt manager that handles all hardware interrupts and routes them to the correct device driver. Also, the system provides a number of services called device-helper, or "DevHelp," routines that a device driver may call. These DevHelp calls provide services for the device driver such as

A check list of OS/2 system features

- Real memory larger than 640K bytes;
- Multiprogramming—the ability to run more than one application at a time;
- Protection between applications;
- Multitasking—the ability to divide applications into pieces that are independently scheduled by the system;
- Interprogram communication and synchronization, so that programs can work together;
- Dynamic linking, so that library routines can be bound to a program and loaded into storage only as needed;
- A "call" application-programmer interface rather than the software-interrupt application-programmer interface of DOS and BIOS;
- A "family" application programming interface intended to allow applications to run on OS/2 or DOS 3.3;
- An environment for executing existing DOS applications;
- The same file-system and media formats as DOS to simplify data and media interchange between the systems;
- A set of device drivers for various IBM Corp. devices;
- A way for users to add new device drivers and to replace ones supplied by IBM;
- Monitors that act as filters on the input or output streams for character devices;
- A set of subsystems for video, keyboard and mouse;
- A command processor and a set of utilities that are extensions of those found in DOS;
- An installation program to make it easy to install both the system and applications;
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converting logical and physical addresses, semaphore handling, storage locking and request-queue management. In particular, there is a set of DevHelp calls that permit the device driver to translate addresses into a common form that can then be translated back into the correct format for use in either real or protect mode.

**Filters and monitors screen I/O**

Since OS/2 uses the protect mode of the 80286 and 80386, applications cannot revector interrupts to their private interrupt handlers to monitor characters coming from or going to devices. However, there are many programs that act as filters on character input or output streams, and they need to be able to process every character.

To provide this capability, OS/2 implements monitors. Character device drivers permit processes to register as monitors. Once registered, a monitor may alter the character stream going to or coming from a device.

The monitors registered for a particular device are chained together. On output, commands and data going to the device driver are placed into a monitor-request packet that is passed in turn to each monitor on the chain by the OS/2 monitor dispatcher. The monitor manipulates the data in the monitor-request packet and passes the packet back to the monitor dispatcher.

When the monitor dispatcher reaches the end of the monitor chain, it passes the monitor-request packet back to the device driver, which updates the request being made to the device and does the output. On input, the data received from the device is placed in the monitor-request packet and passed to each monitor before being returned by the device driver to the program requesting it.

An example of a device monitor is the OS/2 print spooler, which uses multiple threads. One thread intercepts the characters that are being written to the printer and writes them to a disk file instead. Other threads read characters from the disk and pass them back to the printer device driver to be written to the printer.

**Replaceable video, keyboard, mouse**

OS/2 manages the video buffer so that the display can be used by multiple applications concurrently. Each session has a single logical display, keyboard and mouse.

The system manages sessions so that when a session is in the foreground, a process performing video output sends it directly to the hardware video buffer. When the session is moved to the background, the hardware video buffer is saved to a logical video buffer for the session.

While the session is in the background, the process sends its video output to this logical video buffer. When the user returns the session to the foreground, the system copies its logical video buffer to the hardware video buffer.

Keystrokes and mouse inputs are directed to one of the processes in the foreground session. There are programming interfaces to control which process receives them.

OS/2 has a base session manager that permits the user to switch between sessions using a hot key. The session manager maintains a list of all currently active sessions that can be used to select the foreground session. It also permits the user to go directly from one session to another using a hot-key sequence.

Video, keyboard and mouse are implemented as three separate subsystems. Each of them can be replaced by the user, if desired. They are also examples of dynamic link packages. These subsystems provide high-performance protect-mode replacements for the video and keyboard BIOS functions and the real-mode mouse device drivers that are used on DOS.

**A familiar command processor**

The command processor for OS/2 is an extension of the COMMAND.COM command processor of DOS. With minor exceptions the familiar command set of DOS is supported, and the syntax of the commands and the meaning of the parameters to the commands are the same.

There are some new commands that are unique to OS/2 because they support new capabilities. In particular, OS/2 provides a START command that permits the user to start a program in another session and let it execute asynchronously to the command processor.

OS/2 supports a compatible extension of the DOS batch-file language. This permits old batch files to be brought over from DOS and used on OS/2. However, the OS/2 batch-file language is more powerful than the one in DOS. For example, it allows the user to nest batch files, and it also permits alternative commands to be placed on the same line so that, if a first command fails, a second is executed. Unlike DOS, OS/2 commands routinely set the error level, so it is easy to determine whether a command has succeeded or not.

The STARTUP.CMD command file, if present, is executed during system start-up and may be used to contain initialization commands. It is the functional equivalent of DOS' AUTOEXEC.BAT file. The AUTOEXEC.BAT, if present, is executed when the DOS environment is started. In addition, at the start of each
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Snap in a multistrike film ribbon and the P9XL will turn out top-drawer letters and documents. At a speed of 140 cps in letter quality mode. And with its impressive speed of 400 cps in draft mode, it can barrel through payroll, invoices, multipart forms, and continuous forms. Switch to color and you can whip around a few curves, charts, graphs and presentations. On paper or transparencies.
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So if you want a single printer that can do everything, there’s only one in the running. The Pinwriter P9XL.
Although the 80386 can generate 32-bit offsets, OS/2 uses the processor as though it were an 80286.

session the system executes OS/2INIT.CMD, if present.

OS/2 utilities are implemented using the Family API, so the same programs can be used as real-mode programs in the DOS environment or as OS/2 protect-mode programs. The DOS environment uses the COMMAND.COM command processor of DOS to process commands entered at the keyboard.

Installation and configuration

OS/2 has an installation facility that provides an interactive installation process for the operating system and products that run on it.

If there is a CONFIG.SYS file in the root directory of the system, OS/2 processes it during system start-up. This file contains configuration and start-up information about the system, analogous to that of DOS. For example, it permits the user to start background processes and to set the search path for dynalink libraries.

OS/2 also lets the user add device drivers to the system, using the CONFIG.SYS file. Some of the device drivers in the base OS/2 system, such as that for asynchronous communications, can be replaced by user-written device drivers that are specified in CONFIG.SYS. CONFIG.SYS may also contain device drivers for devices not supported by the base OS/2 system. Several other options can be specified in CONFIG.SYS to tune the system and to set system parameters.

National language support

OS/2 can customize itself, and programs running on it, to meet different countries' needs. Among the things that differ among countries that can be specified in OS/2 are the time and date format, language collating sequence and language case mapping. Also, OS/2 permits the user to select a keyboard layout from 17 national choices.

The character encoding (called a code page) for keyboard input and display, and the spooled printer output, can be selected from five choices including the standard United States Personal Computer code page and a multilingual code page. Run-time code page switching is available through user command or program API between two system-configured code pages.

OS/2 system messages are displayed in one of 11 languages available in separate OS/2 versions.

Versatile development environment

OS/2 has available a comprehensive set of development tools that enable the application developer to create efficient and complex software with less effort than with previous systems.

For example, new OS/2 language processors that produce OS/2 language code include IBM C/2, IBM COBOL/2, IBM FORTRAN/2, IBM Macro Assembler/2, IBM Pascal Compiler/2 and IBM BASIC Compiler/2.

The IBM OS/2 Linker provides a number of new features while maintaining the ability to create DOS-style executable modules. Foremost of these new features is support for the dynamic-linking feature of OS/2. The linker can create dynalink libraries, and it permits other programs to make FAR CALLS to these routines.

The OS/2 BIND utility provides an additional optional processing step for OS/2 executable modules. An executable module that is passed through the BIND step, assuming it has been coded to the Family API and coded as a mode-independent program, is capable of executing in both a DOS and an OS/2 environment.

The OS/2 Toolkit contains two utilities that make the processing of user messages by an application both simple and reliable. They also make possible the creation of applications intended for an international audience, without the necessity of modifying application code each time a new language needs to be supported.

In addition, the Toolkit contains a set of sample programs that are provided in source code in several languages. These documented programs show, in a simplified manner, how applications may interface to the various programming facilities of OS/2. Sample programs exist for mouse interactions, process and thread creation, dynamic linking, and other programming tasks of interest to the OS/2 programmer. There are also programming aids for the C and MASM (macro assembler) programmer to ease the task of declaring and interfacing to the OS/2 programming interface.

In summary, OS/2 is a logical extension of IBM DOS 3.3 that provides large real memory beyond 640K bytes, multiprogramming and multitasking. Yet, OS/2 retains the ability to run most DOS applications. Furthermore, OS/2 is designed to be extended to serve as a base for future requirements.

J. R. Gillig, advisory programmer, Advanced System Design; E. E. Iacobucci, senior programmer, OS/2 System Architecture; F. L. Rawson III, senior programmer, OS/2 System Architecture; and J. A. Tunke1, advisory programmer, OS/2 System Architecture, work in advanced system design at IBM Corp.'s Entry Systems division, Boca Raton, Fla.

Interest Quotient (Circle One)
High 517 Medium 518 Low 519
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CIRCLE NO. 46 ON INQUIRY CARD
APPLES, ORANGES . . . AND BENCHMARKS

Benchmarks can be abused, but aptly applied they help system integrators, OEMs and VARs avoid the lemons.

Andrew Allison,
Contribution Editor

While microprocessor and computer system manufacturers shout from the rooftops the importance of selected benchmark results, a backlash is developing among resellers and end users. Why? Because they are becoming more aware of the gap between implied and attainable performance. It is especially important for resellers, standing as they do between manufacturers and end users, to understand how (and how not) to use benchmarks.

Useful as benchmarks are to measure and compare the relative performance of computers, they should form only part of the evaluation equation. Although benchmarks can identify products that meet minimum performance criteria, a reseller needs to know the best combination of price, application software, and pre- and post-sales support. "After the value-added product has been developed, benchmarks are needed to identify areas where performance can be improved, often by the system supplier as well as by the VAR," says Dan Feldman, manager of performance analysis at Advantage Systems Inc., a third-party wholesaler of banking system software. "They measure the effectiveness of enhancements and help configure systems to meet specific customer requirements when a VAR is bidding systems or when the customer needs more capacity."

Benchmarks can also be used to verify performance. In Advantage Systems' market, with typically $750,000 worth of software running on $3 million to $4 million online transaction processing (OLTP) systems, specific performance criteria are usually written into the purchase agreement. In such applications, performance-measurement tools provide a vital protection for both customers and resellers. In addition, benchmarks provide a means of evaluating your competitive position.

Unfortunately, metrics like MIPS (million instructions per second), MFLOPS (million floating-point operations per second) and KUPS (thousand logical inferences per second) are meaningless unless the instruction mix is specific and relevant to your application. IBM Corp.'s J.C. Gibson, developer of the "Gibson Mix" (precursor of today's synthetic instruction mixes), has suggested that load-and-store speed is an equally good predictor of CPU performance. It's also less ambiguous. And Jack Dongarra, author of the widely quoted Argonne National Laboratory LINPACK program, says, "A benchmark is only good if you know what you're measuring. If you don't, it's useless."

LINPACK is an application-specific program that measures the ability of a given FORTRAN compiler and arithmetic unit to solve dense systems of linear equations. Like the synthetic Whetstone and Dhrystone benchmarks, which test arithmetic and non-arithmetic CPU capabilities, respectively, LINPACK gives little
weight to I/O. So, it is not particularly relevant to the interactive, multiuser and multitasking operating environment.

Nevertheless, the rigor that academic laboratories apply to benchmarking can provide lessons for technical and commercial computer purchasers. For example, a Lawrence Livermore National Laboratory report, *The Livermore FORTRAN Kernels: A Computer Test of the Numerical Performance Range. (UCRL-53745, December 1986)*, by LLNL computer scientist Frank McMahon, furnishes interesting background information.

The LFK test consists of 24 FORTRAN samples that have been found to characterize CPU performance for most FORTRAN applications. Results of this benchmark (see Graph) show the substantial difference that the specific code can make. The harmonic mean, which weights results according to execution speed in order to account for the fact that fast kernels spend less time executing, provides the best indication of likely performance.

**Weigh benchmark variables**

The performance of a computer system depends, among other things, on architecture, operating system and compiler efficiency, configuration (especially relating to cache, main and disk memory size and speed), algorithms, application mix and system loading. In many applications, the speed with which data is moved in and out is more important than the speed at which it is processed, and I/O and file-transfer capability govern performance. This is particularly true for interactive systems, in which response time is both critical and

**LFK test results** for several scientific processors illustrate the normalized performance range for the 24 Livermore kernels and the average, geometric and harmonic mean rates. The harmonic mean weights results according to execution speed to account for the fact that fast kernels spend less time executing and provides the best indication of likely performance.

---

**A reseller’s guide to benchmarking**

1. Avoid paying too much attention to individual architectural features or clock frequency. Focus instead on how well the specific hardware-software system does in your applications environment.
2. Start by taking the time to characterize your application and establish the minimum acceptable performance level. Then identify appropriate benchmarks. To evaluate several systems, use standard, easily portable benchmarks to reduce the number of candidates to a manageable level.
3. Obtain results for the chosen benchmarks, weight them according to the characteristics of your application, and determine the harmonic mean-execution rate. Then weigh the equally important price, vendor-support and name-recognition factors to come up with the best overall price/performance.
4. Finally, in the words of software engineer Neal Rhodes of Sales Technologies Inc., “Spend enough time with each new system to discover its quirks.”
The results of individual function tests in the UNIX benchmark suites can be weighted for various application mixes within given environments. The charts illustrate how Aim Technology estimates the application mix in standard environments.

**HOW POPULAR PLATFORMS STACK UP**

<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
<th>SP-1</th>
<th>SP-2</th>
<th>SP-3</th>
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<td>133</td>
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<td>978</td>
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<td>235</td>
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<td>489</td>
<td>505</td>
<td>2,650</td>
<td>418</td>
</tr>
</tbody>
</table>

Notes:
N/A - not available
*SP-1 - flat plate
**SP-2 - ½-pound weight dropped 40 feet
†SP-3 - pressure vessel
‡SP-4 - 2-D axisymmetric thermal/stress

Source: Swanson Analysis Systems Inc.

**ANSYS benchmark results**

Tabulate the CPU seconds used by various machines and models while running benchmarks provided by Swanson Analysis Systems Inc. The times are the best made available to SASI for each computer and are given without reference to configuration, system load, etc.
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dependent upon file-system and communications performance.

Since the purpose of a benchmark is to permit an apples-to-apples comparison, any differences in test conditions or exceptions should be given special attention. Benchmark results that do not include information about the conditions under which they were derived can be quite misleading.

Benchmarks written in high-level languages check the target system's compiler and associated utilities in addition to the operating system and hardware. The ease with which a program can be ported is, itself, an important benchmark. System integrators and value-added resellers, therefore, should be wary of some pitfalls. First, beware of optimizing compilers. Some optimizers are better than others, and some are smart enough to find and eliminate the empty loops used in many benchmarks. It's a good idea to turn off optimizers when compiling standard benchmarks and to test optimization separately.

There's another kind of optimization to be concerned about. Gregory Baryza, director of product management at OLTP supplier Stratus Computer Inc., points out, "Because the originators tend to be conditioned by the operating environment in which the benchmark is developed, it's very difficult to write a neutral one." In other words, benchmarks tend to be optimized for the system on which they're developed. Therefore, many industry insiders caution against relying on a single benchmark.

Benchmarks need to be flexible enough to measure performance in your operating environment. For example, if your application uses programs big enough to exhaust cache, make sure that your benchmarks do too or you may get a nasty surprise. Repeatability, attained by standardizing the operating environment (i.e. by using the same configuration and initial conditions and limiting the external variables), is another important criterion. For instance,
the dispersal of data within the mass-storage subsystem (known as fragmentation) can degrade performance by as much as 20 percent. Not even the time to execute the benchmark can be taken for granted. You need to know whether you're looking at user CPU time (the amount of time spent executing the application or benchmark), system CPU time (the amount of operating system time used), or elapsed (wall-clock) time.

**Application-specific benchmarks**

More often than not, resellers will be benchmarking against an existing configuration, and they will be concerned about the performance of their own application. Given the application-mix and operating-environment dependencies, the closer the benchmark is to your usage, the better.

The increasing reliance on high-level languages is making it easier to port proprietary software, but widely used third-party application packages and benchmark suites have a role to play. If you are reluctant to disclose proprietary software, evaluating platforms in parallel with software development, or looking at a lot of candidate systems, you may have to rely on such programs.

In the CAD/CAE area, for example, finite-element analysis software from companies like Swanson Analysis Systems Inc. (ANSYS) and MacNeal-Schwendler Corp. (MSC/NASTRAN) has been widely ported, and specified problems are frequently used for benchmarking. (The accompanying table showing ANSYS benchmark timing results for some popular CAE platforms illustrates the importance of specifying the test conditions.) MacNeal-Schwendler offers a similar summary, also without specifying the configuration and workload data necessary for true benchmarking.

"There are too many new systems for all to be supported by application-specific benchmarks," says Swanson Analysis president John Neal Nelson & Associates is an endorsement of Altos' products that carries with it some risk of optimization for the Altos. Neal's decision may have been influenced by the fact that Neal Nelson & Associates is an Altos VAR, an endorsement of Altos' products that carries with it some risk of optimization for the Altos.

A similar flexible benchmark suite, Power Meter from The Database Group Inc., is offered for MS-DOS systems. It includes 23 different tests in four categories: overall system (i.e., spreadsheet, word-processing, database, CAD/CAE and program development), CPU and memory, disk (random/sequential seeks and data transfer) and video/graphics performance. Like the UNIX benchmark suites, Power Meter provides application-environment simulation.
Take a look at the specs on VISTA™, a good look. Notice the processing, programming, and video capabilities? Now think real hard about what you could do with the power of VISTA and a microcomputer. Incorporate it with your system to create a digital pre-press proofing station for publishing. Design a graphics work-station which outputs both colorful hi-resolution slides and broadcast-quality animated images. Construct a CAD system which merges computer generated images with real-life backdrops for architecture, packaging or other industries. And, after you’ve brainstormed your way to new horizons of videographics possibilities, get your own VISTA and start working.
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- Binary and fractional programmable zoom capability, creates horizontal and vertical magnify or minify
- Smooth horizontal and vertical programmable panning, includes wrap-around and split screen
- Suggested Retail Price: $5995.

ADDRESSABLE RESOLUTIONS:

<table>
<thead>
<tr>
<th>Bits/pixel</th>
<th>32</th>
<th>16</th>
<th>8</th>
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<tbody>
<tr>
<td>1024x1024</td>
<td>2048x1024</td>
<td>4096x1024</td>
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<tr>
<td>512x2048</td>
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CAPTURE RESOLUTIONS:

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<th>RS-170A</th>
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<tr>
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<td>756x486</td>
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<tr>
<td>604x486</td>
<td>486x374</td>
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<tr>
<td>432x486</td>
<td>374x299</td>
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</tbody>
</table>

Suggested Retail Price: $5995.

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Swanson. For example, the company is now porting ANSYS only to systems for which there are customers prepared to license the program. If you can’t find a third-party benchmark or simulate your operating environment with one of the off-the-shelf benchmark suites, you’ll have to synthesize your own. To do this, select a subset of system-independent tasks (kernels) representative of the processing, disk I/O, communication and other I/O requirements of your application and weight them appropriately (see Pie Charts).

On-line transaction processing

The benchmarking of OLTP systems provides an example of the need for defining test conditions. Primarily associated with credit/debit operations, OLTP actually encompasses inventory control, health care, telecommunications and other interactive database applications. OLTP systems incorporate special features, such as fault-tolerance, modularity and database integrity. Nevertheless, the standard OLTP benchmarks actually evaluate database processing, communications and file subsystem capability (disk I/O) . . . all important to interactive systems in general.

The two most widely used OLTP benchmarks are ET-1 (also known as Debit/Credit), which simulates bank teller usage and TP-1, developed by Stratus to emulate ATM activity. TP-1 uses larger files, more complicated access routines and disk I/O. Unlike ET-1 (which performs only communications and disk I/O), TP-1 executes processing operations.

OLTP benchmark results, quoted in transactions per second, should include the response time, the size of the database and the number of interbranch (i.e., network) transactions (15 percent typical). A response time of 95 percent in under 1 second is a requirement in many applications, but since many low-end systems cannot achieve this speed, 90 percent in under 2 seconds is often used for minicomputer-based systems. The recommended database size is 100K-byte account records, 100 teller records and 10 branch records, each 100 bytes in size, per anticipated transactions per second.

Stratus’ Baryza offers a caution that applies to all benchmarks: “Be careful that you are measuring what you want to, and that what you want to measure is pertinent your application.” In other words, start by deciding what it is that you are looking for and how well the benchmarks correspond to your requirements.

Andrew Allison is a management consultant specializing in minicomputer and microcomputer technology, products and markets. He had been more than 12 years with Digital Equipment Corp., Rolm Corp. and Advance Micro Devices Inc. before founding his business in 1977.
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MISSING LINKS:
SAA STILL A MYSTERY

IBM's Systems Application Architecture leaves independent software vendors and VARs long on questions, short on answers

Mary Jo Foley
Special to Mini-Micro Systems

IBM Corp.'s intention to provide a common software environment across its microcomputers, minicomputers and mainframes received a lot of press when the company announced it formally this spring. Almost overnight, the environment, dubbed Systems Application Architecture, or SAA, became the industry's hottest buzzword.

In July and August, Fujitsu America Inc., San Jose, and Hitachi America Ltd., San Bruno, Calif., rushed to announce their own (in Hitachi's case, IBM-compatible) SAA types of environment. And even before they knew the details, software developers were expressing optimism that SAA would enable them to achieve substantial money and time savings in product development and in maintenance.

Despite this early hoopla, value-added resellers (VARs), independent software vendors (ISVs) and—some argue—even some IBM executives still know precious little about SAA. They are unsure how to achieve SAA compatibility and whether such a state will be possible and/or necessary. Will they need to modify existing software or write entirely new versions? Will IBM help? The only fact ISVs and VARs are sure of is that they are long on questions but short on answers.

Granted, some of the biggest ISVs report that IBM has provided them with copies of its publicly available, management-oriented overview document on SAA. Others have been fortunate enough to have IBM executives make formal SAA presentations at their respective companies and offer vague guidance on IBM's software intentions. A couple of analysts claim to have seen copies of manuals that explain each of the four SAA components—common user access, common programming interface, common communications support and common applications—in greater technical depth (see "SAA's four key components"). IBM has promised that these manuals should be available by year's end.

SAA remains an enigma

However, for the most part, the majority of ISVs and VARs seem to know little about the set of software conventions and protocols, which promise to become de facto industry standards—as do most IBM products and services. Numerous IBM VARs and systems houses contacted by Mini-Micro Systems had never even heard of SAA. And not surprisingly, IBM refused numerous requests made by MMS
to elaborate on its SAA strategy.

"Everybody—including IBM—can sing the SAA song verbatim, based on the published materials," notes Steven Scheidt, director of systems product marketing for Cullinet Software Inc., Westwood, Mass. "But once you step a little outside of that, everything's an unknown." Agrees a representative of ISV Cincom Systems Inc., Cincinnatti, "I don't think even IBM knows what to make of SAA yet."

Many IBM watchers consider SAA to be IBM's attempt to derail archrival DEC.

Despite the confusion, some basics are known about SAA. SAA is a marketing tool, not a product or group of products. Analyst George Colony of Forrester Research Inc. in Cambridge, Mass., describes SAA as "the contract between IBM and its customers to assure that there will be galactic glue to ensure compatibility across [IBM's] hardware lines."

These lines (the only ones that IBM has included under the SAA umbrella so far) are the PS/2 microcomputer, System/3X minicomputer and System/370 mainframe families. The degree to which vendors' system- and application-software products for each of these families "complies" with SAA depends on how closely they adhere to the user-interface, program language and communication standards IBM has outlined in its SAA definition. So far, IBM has touted two of its new software offerings as being SAA-compliant: the still-to-be-shipped OS/2 operating system for the PS/2 (along with the Presentation Manager user interface) and Release 3 of its Database 2 (DB2), based on the Structured Query Language/Data Systems (SQL/DS) language, for its System/370 line. But Big Blue also has declared that many existing IBM products fill the SAA bill. They include the Graphical Data Display Manager (GDDM), Netview and DisplayWrite/36, among others.

The difficulty or ease with which other companies will develop SAA applications remains to be seen. One communications company racing to adapt SAA is Orion Network Systems Inc. of Berkeley, Calif. At a recent user group meeting, Orion's marketing manager announced that the company is working on an SAA-compliant communications package for the IBM environment. The company, which specializes in communications products, is working with both IBM and its users to develop SAA-compliant products.

The confusion surrounding SAA is partly due to the fact that IBM has not yet made public the factors that determine this compatibility. Analysts agree that the key to SAA's success will be the ability of IBM to define a clear and consistent set of standards that can be used by vendors and users alike. Until that happens, the future of SAA remains uncertain. But for now, the focus is on the promise of compatibility and the potential benefits that SAA holds for IBM and its customers.
meeting, Orion customers, all non-IBM OEMs, voiced the desire to make products that can fit into IBM shops. Orion president Paul Rampel projects that writing sufficient C language code to integrate and support the communications features of the new scheme will require 75 work years of development (see Table). That estimate does not include compiler features, graphics and database interfaces. "It is clear that many non-IBM vendors will seek help from third parties," says Jim Mullen, Orion vice president of sales and marketing.

SAA eyes VAX/VMS

Specifics aside, many IBM watchers consider SAA, first and foremost, to be IBM's attempt to derail archival Digital Equipment Corp.'s successful computer strategy. Members of this camp cite the ability of DEC's VAX hardware (ranging from its MicroVAX microcomputers, through to its VAX 8800 superminicomputers) to run compatible versions of the VMS operating system. They credit this to the Maynard, Mass., company's growing ability to compete favorably against Big Blue, especially in the midrange.

But at least one analyst, Gig Graham, program director for software-management strategies at The Gartner Group in Stamford, Conn., questions the applicability of the VAX-SAA parallel. "Employing a single architecture is DEC's own marketing strategy. VMS and DECN et (DEC's proprietary networking product) are DEC's SAA," he contends. A more appropriate comparison may be made between SAA and the UNIX System V interface definition created and distributed by AT&T Co., Graham claims.

The only fact ISVs and VARs are sure of is that they are long on questions but short on answers.

Like the System V interface definition, that of SAA ultimately will take form in published documentation. At present, IBM is in the process of hammering out the finer points. It is promising that technical manuals on each of the four main SAA components will be available by the end of 1987. Several analysts predict that documentation availability will be

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**Common programming interface**

**Elements:** SAA-compliant programming languages are C, COBOL and FORTRAN. IBM also includes specifications for application generators, procedure language, nonprocedural language and a dialog interface (for microcomputers) in its programming interface.

**Examples of IBM software known to adhere to standard:**

Application generators—IBM's System/370 and EZ-RUN (which runs under the OS/2's DOS-compatibility mode) and Cross System Product/Application Execution products; nonprocedural languages—SQL/DS (Structured Query Language/Data Systems); procedures language—REXX (part of the VM operating system); dialog interface—EZ-VU Run Time Facility; standard programming languages. An SAA-compliant C product does not now exist. But IBM says such a product ultimately will be based on ANSI C (IBM C/2 for the PS/2). IBM's 1985-ANSI-COBOL-based VS COBOL II (with IBM extensions) and COBOL/2 for the PS/2; and its VS FORTRAN Version 2 (with IBM extensions) and FORTRAN/2 for the PS/2 are its other languages of choice.

**Examples of IBM software known to adhere to standard:**

IBM says its initial common applications development work is in process. It claims it initially is focusing on integrated-office (document processing, document library, personal services, mail) and decision-support software. IBM's Release 3 of its DB2 for its System/370 family of mainframes is one existing SAA-compliant package.
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closer to the first quarter of 1988 (around the same time the Microsoft Corp.-developed OS/2 is expected to start shipping).

One ISV's two cents worth

Contrary to what's believed in some quarters, IBM is not devising SAA in a vacuum. Some of the larger ISVs have offered their two cents worth regarding what should be included and/or deleted from SAA, based on the sketchy first-draft provided by IBM's SAA overview document. (Whether or not IBM will take their concerns into consideration is another matter.)

For one, Atlanta software giant MSA Inc. told IBM, according to MSA vice president of applications technology and research Philip Ross, "If you're not careful, you may aim SAA too far away from anyone to be useful." MSA's quibble with IBM? "In some senses, SAA, as it is [written] currently, applies to zero percent of our customer base," Ross says. IBM has said the mainframe operating environments that it plans to include as part of SAA are VM/CMS and MVS/XA (TSO/E). But 50 percent of MSA's IBM-mainframe customer base is running VSE versions of MSA's accounting, general ledger and other business software. The other 50 percent is running VM software, but primarily under CICS, Ross points out.

The possibility that IBM will revamp its initial SAA specifications to include CICS, as well as other facilities—including RPG 2 and IMS/DC—is rumored. MSA also is pushing for increased support and more product offerings (especially compilers) for the C and the 1985 ANSI COBOL programming languages that IBM has included in its preliminary SAA specs.

Other vendors, too, are suggesting improvements in SAA as IBM outlined it earlier this year. "The overview document doesn't give enough information for us to evaluate our products" in terms of how closely they comply with SAA, a Cincom representative says. He adds that Cincom, a vendor of database management, manufacturing and other application software for IBM and DEC hardware, always has supported IBM standards, such as SQL and SNA (Systems Network Architecture). Both are part of IBM's current SAA definition. In the meantime, he says, "We're working with major research organizations to try to figure out what SAA will mean."

Database vendor Cullinet is experiencing similar difficulties. The company is in the midst of attempting to review its products in order to determine how closely each complies with SAA as IBM has outlined it thus far. Cullinet is planning a series of announcements by the end of the year regarding how it sees itself fitting into the SAA picture, says director of systems product marketing Scheidt.

"It's a bit frustrating that we can't get more information from IBM," acknowledges Scheidt. He points out that IBM has been more explicit in defining the SAA environment for microcomputers than it has for minicomputers or mainframes. At the mainframe level, for instance, IBM has not announced what the preferred SAA windowing environment will be, while it has singled out Presentation Manager at the low end, he says.

"We want to play by their rules, but we would prefer to define it (SAA) a little more broadly," Scheidt adds. In particular, SAA fails to address the reality of multivendor customer installations—especially those including DEC hardware—he claims. Cullinet's ongoing attempt to ensure the portability of applications across various vendors' microcomputers, departmental minicomputers and mainframes—a strategy Cullinet calls its 3X3 Architecture—addresses this need directly, he says.

Unwarranted attention

But even if IBM hadn't announced SAA, Cullinet would have continued its own cross-
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hardware compatibility endeavors, Scheidt says. Other vendors probably would have continued their own efforts to increase compatibility and portability between and among IBM and non-IBM hardware and software products. These facts support Gartner Group analyst Graham's contention that the emphasis on SAA "compatibility" by both the press and the IBM user/value-added vendor communities is unwarranted.

"Some [software] product retooling will take place" as a result of SAA, Graham claims, "but not a lot more than what's happening now. SAA is not the means to write compatible code. And just complying with SAA doesn't mean code will be portable." Instead, he says, SAA demonstrates that, from IBM's point of view, "there are no longer strategic products; just strategic interfaces."

This is not to say that vendors and users can afford to ignore SAA. Joseph Guglielmi, the vice president heading IBM's newly formed Application Software division, was recently quoted as saying one of the division's top priorities is to facilitate the use and acceptance of SAA within both IBM and the software community.

But precisely how ISVs and VARs should best prepare for SAA remains a question. IBM's intentions in the S/3X arena are especially murky. Most market watchers expect IBM to merge its S/36 and S/38 products into a hybrid (under the code name Project Silverlake) within the next couple of years. In the meantime, third-party vendors can do little more than piece together the clues IBM has provided in the microcomputer and mainframe environments, MSA's Ross admits. For its part, MSA is studying the PS/2 and its software (as it becomes available), he says, "because we believe it will be so closely in synch with the rest of SAA."

The bottom line, Ross acknowledges, is that, "A lot of SAA is still very undefined. And many of those areas where specifics have been defined are not available yet."

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TAPE DRIVES

Helical scan recording expands tape capacity

Winn Schwartau
Sleepy Hollow Engineering

Tape drives based on helical scan technology, such as the VAST (Virtual Archive Storage Technology) Device from Emerald Systems Corp., now offer high-capacity data handling (e.g., more than 250M bytes) in the desktop environment.

The VAST Device is based on the proven helical scan technology used in professional and home video recorders. But, digital data recording is significantly more error-prone than video and requires extensive modifications to the recording system to achieve a sufficiently reliable tape subsystem.

The VAST Device, with all of its associated electronics, weighs 12 pounds and has dimensions of 13 by 9 1/2 by 6 inches. The device interfaces to IBM Corp.'s PC, PC/XT, PC/AT, PS/2 Model 30, Compaq Computer Corp.'s Desktop 286 and 386, and compatibles via a 60-inch cable and a SCSI (small computer systems interface) board that plugs directly into the PC. Up to seven SCSI interfaces may be addressed per PC slot, resulting in a total capacity of 16G bytes. Emerald Systems' device incorporates advances over established helical scan recording technology.

Recording technology made easy

Helical scan recorders were first commercially produced by Ampex Corp. in 1961 for use with video recording. They employ many of the rules of magnetic recording, yet yield a much higher data density.

Rather than having three fixed heads in a tape path, as in conventional tape drives, in helical scan recording three heads are mounted on a drum that rotates at 1,800 revolutions per minute (rpm). The tape is wrapped around the drum in the shape of a distorted “C” (C wrap) at an angle of about 5 degrees to the face of the drum.

The recorded data (track) is not a longitudinal path along the tape, but a track that crosses the tape at an angle.

Recording on helical tracks, or stripes, offers several technical advantages when compared to conventional longitudinal recording. For example, it uses a narrow-width, narrow-gap, single-track head that is easy to manufacture—rather than a complex multitrack head, as in conventional longitudinal recording.

While head manufacturing technology is beyond the scope of this article, consider the following statements. In the recording pattern, a series of very narrow stripes (0.00098 inches wide) are written acutely across the tape. Each stripe (about 3 inches long) represents a single rotation of the head travelling at 1,800 rpm. Each track can hold about 8K bytes of user data, and there are 820 tracks per lineal inch of tape. Thus, with an effective areal recording density of 35.4M bits per square inch, a 346-foot tape can store more than 2.3G bytes of user data. (The actual formatted capacity is slightly less, due to error correction.)

Helical scan recording also allows for reducing the tape speed. In the case of the VAST Device, the tape speed is 0.43 inches per second (ips), which is substantially slower than the common 60 ips, 90 ips or faster speeds of fixed-head systems. Although the tape speed is slow, the rotating heads make contact with the tape for an actual head-to-tape speed of about 150 ips. This allows higher linear recording density and reduces tape wear.

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Ultra-fine media offers advantages

Helical scan recording requires media with much higher coercivity and retentivity than conventional recording media. This is because there is less magnetic material correspond-
ing to each piece of data. Conventional tape media has a coercivity of 350 Oe (Oersteds) to 450 Oe, but helical scan requires approximately 1,450-Oe media to ensure data integrity.

The VAST cassette contains 8-mm video media that uses ultrafine magnetic metal particles. Each needle-shaped particle is about 1/12th the volume of conventional iron-oxide particles and is only 0.15 microns in length. The tape itself is only 13 microns thick (compared to a typical iron-oxide VHS video tape thickness of 20 microns). But, it has a breaking strength of over 6½ pounds and a residual elongation of only 0.02 percent. The cassette is only 3 by 2¼ by one-half inches, taking up only 0.02 pounds and a 3.037 inches in length.

Errors easily corrected
Putting gigabytes of data onto a single cassette requires extensive software support and manipulation, as well as elaborate error-correction schemes. To simplify these tasks, the VAST Device uses a simple stripe/track data format. Tape formatting is automatic and transparent to both the user and the host, thus simplifying installation and use of the device.

Each stripe is 3.037 inches in length and holds a maximum of 8.1K bytes of formatted user data. The data are organized into eight data blocks, each with 1K user bytes, 16 address bytes and 400 bytes of appended ECC (error correction code). A servo zone with the equivalent of 1.2K bytes is located within each track, providing mechanical, motor and servo feedback information for precise tape positioning.

However, error correction is key to any storage device, especially one that stores more than a gigabyte per cassette. Proprietary error-correction codes in the VAST Device allows for 10^-15 bit write errors and 10^-13 bit read errors.

The ECC used in the VAST Device is powerful enough to correct an erroneous data burst of 256 bytes and 80 additional random errors in each 1K-byte data block.

The basis for the device's ECC is a modified Reed-Solomon interleave. To oversimplify, the device uses a read-after-write scheme, which is difficult to implement with helical scan recording.

In a read-after-write implementation, the first half (180 degrees) of the drum's rotation is used for writing and formatting. The second half of the rotation is used for the read-and-verify process. The servo information is interspersed throughout the complete rotation.

But, this scheme would seem to create a problem. While the write head is writing the diagonal track during the first 180-degree rotation of the drum, the tape is also moving. By the time it gets to the second 180-degree drum rotation to read and verify the previously written track, the tape has moved just enough so that the read head will miss the data altogether. To compensate for this, the tape could be repositioned after each write half-cycle, to read and verify. But, this would cause a substantial loss in throughput speed and the margin for error would increase unacceptably.

To solve this problem, the VAST Device uses the previously mentioned three heads on a rotating drum. The erase head has been taken off the drum and a fixed, full-width erase head has been placed in the tape path. To compensate for the lateral movement of the tape, the read head (and the servo head) of the VAST Device is out of the write head's plane. When the second half of the drum rotation occurs, the read head is already properly positioned to read and verify the written data. (In conventional helical scan recording, both the write-and-
TECHNOLOGY FORUM

TAPE DRIVES

There are two ECCs in the VAST Device. The first one is the write ECC, which occurs on the fly during the data-writing process and is transparent to the user and host. During the read-verify process (of the write cycle), the ECC is effected by the ECC code written during the first 180 degrees of drum rotation in each data block.

During the write operation, if an error is detected, the system rewrites the same 1K-byte data block 11 blocks farther down the tape. This operation repositions the written data to the next track. And it moves the data vertically away from where it was previously written, to escape any potential, isolated, media defects.

During this rewrite, the system maps out serial data-address shifts on the fly, always knowing where the accurate data is located.

During the second attempted write, another read-verify occurs. If the data passes the ECC, then the next block of data is sequentially written. However, if another error is detected, the system will again write the same data block 11 blocks down the tape. The VAST Device will perform this operation up to 12 times until the written data is verified. If a hard error is indicated after 12 unsuccessful attempts, the media itself is probably defective.

The second implementation of the device's ECC occurs during a later read-only pass. Under the sophisticated buffer-management scheme, the read-only ECC is able to correct a previous write error. When the ECC corrects a write error, the rewrites are tossed away and the read process continues.

If the error is non-recoverable by the read-only ECC, the read sequence continues 11 blocks down the line. The system keeps track of the locations of both good and bad data. After 12 unsuccessful attempts at reading the subsequent rewrites, the tape will reposition itself back to the first read-write error location. It will then attempt to accurately read the data blocks by skewing the tape-head position for off-track reading. Eight such attempts are made before a hard error registers.

**Electronics control processes**

The VAST Device contains a complex array of electronics that controls the various processes. The microprocessor board drives the device and its internal peripheral components.

A 256K-byte data buffer resides on the SCSI interface board, permitting transmission burst rates of 1.5M bytes per second and a nominal data transfer rate of 250K bits per second (bps). Logical user data blocks of 1K byte are formatted into physical blocks for writing to tape. Each block is then appended with the appropriate tag and address information. Buffer management operations are performed in firmware.

The read/write board contains all of the write-head driver circuits, the read-head preamplifiers and equalization circuits, and the frequency generator and current driver for the erase head.

The motion-control system directs the drum and capstan servos, reel motor, load motor, mode-change motor and control solenoid. Sensor circuits for the drum, capstan, reel tachometers, EOT/BOT (end of tape/beginning of tape), tape length, write protect and door status are interfaced to the other logic systems.

The only external components that the VAST Device uses (which are included) are the 52-conductor, shielded interface cable that connects the device to the PC Bus (or IBM PS/2 Micro Channel), and a single, half-slot SCSI board. The software installs on the resident rigid disk.

---

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Smartcom III includes on-line help facilities for the novice as well as more advanced features for the power user. Features like a peruse buffer to automatically store information for later disk capture, printing or editing, an editor for creating and revising text, both on-line and off-line, and the support for multiple communications sessions with two remote systems simultaneously.

Smartcom III also offers on-line DOS operations for the performance of common disk and subdirectory operations without ever having to exit the Hayes program. It even provides file compression and scrambling techniques for the enhancement of effective throughput and private data transmission.

Plus, with Smartcom III's Simple Communications Programming Environment, SCOPE,™ the transmission process can be totally automated. This easy-to-use scripting language comes complete with a learn mode and provides access to the programming tools used to create Smartcom III itself.

So now that you know what Smartcom III is capable of, you may wonder where intelligence of this caliber will lead you. And the answer to that is the future.

If you currently use Smartcom II* or Crosstalk*, take advantage of our special introductory offer:

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This offer good through 12/31/87 only in the USA and Canada.

For more information, contact your local Hayes Dealer, write Hayes at the address below, or call 404-441-1617.

Hayes Microcomputer Products, Inc., P.O. Box 105203, Atlanta, GA 30348

CIRCLE NO. 58 ON INQUIRY CARD
Megan Nields, Staff Editor

Desk-side system boasts 1.6 MIPS

• Up to 40 users
• 774M bytes of storage
• LAN-compatible software

An addition to the 50 series of desk-side computers, the model 2455 provides a 50 percent boost in storage capacity and an 88 percent increase in performance to that line. The unit supports up to 255 simultaneous processes for up to 40 direct users. It stores up to 375,000 pages of typed information in a system the size of a typical typewriter stand and operates at 1.6 MIPS. The 2455 can handle up to 12M bytes of main memory, as well as three 258M-byte, 5½-inch Winchester disk drives in the same cabinet. The LAN-compatible system can be linked to other computers via the proprietary LAN300 software and Ethernet. Applications include CAD/CAM. $62,810 and higher. Prime Computer Inc., Prime Park, Natick, Mass. 01760, (617) 655-8000.

UNIX, IBM programs coexist on 386 supermicro

• 10 asynchronous lines
• 90M-byte storage
• 60M-byte tape backup

An 80386-based supermicrocomputer, the PRIME EXL 316 runs programs for UNIX-based systems and IBM PCs simultaneously. A standard configuration includes the UNIX V.3 operating system, 2M bytes of memory expandable to 8M bytes, 90M bytes of formatted disk storage, a 60M-byte streaming tape backup system and 10 asynchronous lines. The system accommodates up to 58 asynchronous lines. $23,900 and higher. Prime Computer Inc., Prime Park, Natick, Mass. 01760, (617) 655-8000.

Server series runs on UNIX

• 10-MIPS performance
• OSN networking
• Single-board upgrades


Workstation achieves 4-MIPS

• Surface DRAM
• Motorola MC68020-based
• 32M-byte memory

Available in monochrome or color versions, the Domain Series 4000 Personal Super Workstation features a Motorola MC68020 microprocessor, and incorporates a 25-MHz 68881 floating-point coprocessor. The Series 4000 uses 1M-bit surface-mounted DRAMs capable of delivering up to 32M bytes of main memory. Up to eight planes of color are packed onto a single IBM PC/AT-compatible graphics controller board, resulting in up to 16 million colors. $5,000 to under $10,000 for monochrome and color versions. Apollo Computer Inc., 330 Billerica Road, Chelmsford, Mass. 01824, (617) 256-6600.

Diskless computers target LAN operations

• 10-, 12.5-MHz 80286
• Up to 640K bytes RAM
• Three configurations

The three versions of LANstation systems are based, respectively, on a 10- or 12.5-MHz Intel 80286 processor and an 8088-based Turbo XT that operates at 8 MHz and is expandable to 640K bytes of RAM. All three systems feature a zero wait state and function as “diskless” stations in a LAN. The units supply both serial and parallel ports, as well as a choice of monochrome or color video displays. $599, Turbo XT; $979, 10-MHz model; $1,279, 12.5-MHz version. Racore Computer Products Inc., 170 Knowles Drive, Los Gatos, Calif. 95030, (408) 374-8290.
Not only do we know who it's for, we know who's calling and what the message is. That's because an NCR 286 CPU board is at the heart of an innovative new voice mail system. Handling the calls for as many as a thousand users, sixteen at a time. All in a single personal computer chassis. And the next call we take may be for you.

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NEW PRODUCTS

DISK/TAPE

Subsystem suits IBM PS/2

- 45M bytes
- Proprietary board
- 28-msec access time

The Double Play disk drive subsystem offers 45M bytes of storage for the IBM PS/2 Model 50. The 3½-inch unit includes a proprietary interface board and partitioning software. It boasts a 28-msec average access time, an ST412/ST506 interface and an 18,000-hour MTBF. Automatic head parking and locking are provided. $899. Rodime Inc., Peripheral Systems Division, 29525 Chagrin Blvd., Pepper Pike, Ohio 44122, (216) 765-8414.

Circle 546

WORM drive frees LAN space

- Up to 115M bytes
- 2.5M-bps transfer rate
- Proprietary software

The ISi WORM disk drive subsystem frees LAN rigid disk space for read-write data files. It stores up to 115M bytes per side. An external subsystem includes a disk drive, controller card, disk and proprietary software. Average access times are 135 msec for a full data band, 18 msec for 1M byte and 1 msec track-to-track. Data transfer rate is 2.5M bps. The optical disk supplies 14,901 tracks with 32 sectors per track. $2,595, internal version; $2,795, external version. Information Storage Inc., 2768 Janitell Road, Colorado Springs, Colo. 80906, (303) 579-0460.

Circle 547

MINI-MICRO SYSTEMS/December 1987

You can exist in one environment.

But you can’t prosper.

You’ve spent a lot of time and effort developing your product. And you’ve given a lot of thought in choosing which environment. But the fact remains, one environment isn’t enough. You need more if your applications are going to realize their full potential in the marketplace.
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Talk about life in the fast lane, with the NEC Multispeed you have the fastest processing speed of any competitive laptop on the market. It has more power, more memory and twice the speed of the IBM convertible, and that gets you your answers when you need them — NOW!

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CIRCLE NO. 72 ON INQUIRY CARD
NEW PRODUCTS

PRINTERS

Letter quality printer achieves 264 cps

- 88 cps letter quality
- 6K-byte buffer
- 55 dBa

A 136-column, bidirectional, 24-pin printer, the LQ 1050 is compatible with Epson LQ escape sequences and extended graphics. The unit reaches speeds of 264 cps in draft mode and 88 cps in letter-quality mode, prints at 55 dBa and has a 6K-byte buffer. Roman and Sans Serif, resident fonts can be printed at various pitches in either normal or condensed modes. A SmartPark paper-handling feature allows users to print single sheets without removing continuous-feed paper from the tractor feed. Serial and parallel interfaces, built-in tractor, two slots for font modules, forms handling and envelope printing are standard. $1,099 (an LQ 850, the 80-column version costs $799).

Epson America Inc., 2780 Lomita Blvd, Torrance, Calif. 90505, (213) 539-9140.

Circle 548

Printer outputs

300 dpi

- 30 ppm
- Six resident forms
- 16 fonts per page

Boasting LaserJet Plus and Diablo 630 emulation at 300 dpi and a throughput of 30 ppm with memory resident fonts, the S3000G ion page printer suits high-volume applications. Paper-handling options include a 2,000-sheet elevator and six resident fonts. In addition to all-points-addressable graphics, the devices support line, arc and circle draw commands. The printer supports downloadable fonts and prints up to 16 fonts per page. It includes six resident forms. Centronics, Dataproducts and customizable interfaces are available. $10,500, quantity 100.

Delphax Systems, 35 Pacella Park Drive, Randolph, Mass. 02368, (617) 961-2312.

Circle 549

You can migrate your application.

But you still can’t prosper.

Migrating your application from machine to machine is the only way for your product to realize its potential. But migrating has always been labor-intensive. Expensive. And a lot of times the results aren’t what you expected.
NEW PRODUCTS

TERMINALS

Touch screen suits IBM PS/2

- 1,024 by 1,024 touch points
- RS232 controller
- RGB input

Equipped with an analog capacitive touch screen, the PS Touch Monitor has a resolution of 1,024 by 1,024 touch points. An intelligent RS232 controller permits a range of baud rates, data formats, communication parameters and operating modes to be software-selected. The monitor has an RGB analog video output and can be used with IBM PS/2 computers. $995. Micro-Touch Systems Inc., 10 State St., Woburn, Mass. 01801, (617) 935-0080.

Monitor supplies 1,024 by 768 pixels

- 60-Hz refresh rate
- Flicker-free operation
- Automatic transient protection

The CM-1420 color graphics monitor features a 14-inch screen, 1,024 by 768 pixels and a black Trinitron CRT with an aperture pitch of 0.01 inch. It provides a 60-Hz, non-interlaced refresh rate for flicker-free operation. The monitor incorporates an automatic transient protection device that prevents phosphor burn. The raster size stability is less than 0.5 percent from minimum to maximum brightness. $2,245. Seiko Instruments USA Inc., 1130 Ringwood Court, San Jose, Calif. 95131, (408) 943-9100.

Terminal stores voice and data

- 32K bytes of RAM
- Two lines
- 16 characters

The pocket-sized MultiPortable "smart" card personal computer terminal with both voice and data features has a 66-character QWERTY keyboard; a two-line, 16-character LCD; 32K bytes of RAM; and 32K bytes of ROM. As a smart telephone, it stores names, addresses and numbers in an electronic directory for automatic dialing. The monitor has Touch-Tone or pulse dialing capability, auto redialing and a speaker for "hands free" operation. For data transfer, the terminal has an optional 1,200-bps modem that communicates via standard telephone networks and two RJII telephone jack interfaces. Under $500. Multimil Inc., 670 International Parkway, Richardson, Texas 75081, (214) 644-7724.
Introducing Migration Master from SEED Software. A unique combination of software and services that simplifies the movement of software from one hardware system to another.

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The 965 can display up to 49 data lines, enough to show large spreadsheets or two normal display pages of text at the same time. No other terminal this affordable can do that. There’s also an interactive calculator mode and dedicated memory for even more custom features.

The 965's state-of-the-art single board design uses a 16-bit CPU and sophisticated gate array to give you a high-performance, very reliable terminal that's very easy to service. There's also a full one-year end-user warranty.

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   Total system expansion in a single card slot. It's /AT compatible, 12 MHz operation with 0 wait states, up to 4 mega bytes of main memory, 2 serial ports, parallel port, 64K ROM, PROM resident diagnostics, on-board BIOS, and PROM resident boot-up routine. Dynamic clocking logic allows the onboard memory and processor to operate at maximum speed without inducing operational problems with slower I/O devices.

2. CAT 901 SB/AT COMPUTER
   Adding the ST506 hard disk interface and Floppy Disk Interface decreases the number of add-on boards in the system; in addition, it's /AT compatible, 12 MHz operation with 0 wait states, up to 4 mega bytes of memory, 2 serial ports, parallel printer port, 64K bytes of disk cache, PROM resident diagnostics, on-board BIOS and PROM resident set-up routine. Dynamic clocking logic prevents problems with slower I/O.

3. CAT 902 SB/AT COMPUTER
   Adding the SCs Interface and high resolution graphics for CGA and Monochrome compatible displays further decreases the system add-on board count. It's /AT compatible, 10 or 12 MHz, up to 1 meg of main memory, 2 serial ports, 1 parallel port, floppy disk interface, 128K bytes of ROM memory, PROM resident diagnostic, set-up routines and RTC.

4. CAT 922 SB/AT COMPUTER
   With 16 MHz speed and the addition of EGA, CGA, and Monochrome compatible high resolution graphics this board provides near 386 benchmark performance. It's /AT compatible, with up to 4 mega bytes of main memory, 2 serial ports, parallel printer port, SCs interface with a unique 64K SCs buffer, floppy disk interface, PROM resident diagnostic, set-up routines and battery backed RTC.

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PC-to-host adapter suits IBM PC
- 10M-byte transfers
- Multitasking
- 255 mailboxes

Able to support synchronous and asynchronous peripherals concurrently. The AHA-1540 IBM PC/AT-to-SCSI host adapter offers data-burst transfer rates of 10M bytes per second. The transfer rate reaches 5M bytes per second, synchronous mode, and 2M bytes per second, asynchronous mode. A programmable mailbox architecture supports 255 tasks through which the host communicates with the I/O system. $285, quantity 100. Adaptec Inc., 580 Cottonwood Drive, Milpitas, Calif. 95035, (408) 432-8600.

Circle 553

Graphics controller enhances PS/2 screen
- 1,024 by 1,024 pixels
- 16 colors
- 1M-byte memory

The first graphics controller for IBM PS/2 computers, the ARTIST 10/16 achieves 1,024-by-1,024, interlaced, and 1,024-by-768, non-interlaced resolutions. Engineered for the IBM Micro Channel bus, the product has 1M byte of graphics memory, a 64-MHz bandwidth and offers 16 colors from a 4,096-color palette. $2,995. Control Systems Inc., 2675 Patton Road, P.O. Box 64750, St. Paul, Minn. 55164, (612) 631-7800.

Circle 554

SBC Based on the 8051
- 128K-byte memory
- RS232C port
- Two 28-pin sockets

Aimed at the wide variety of applications attainable by the Intel family of 8051 microcontrollers, the SBC-51A single-board computer can be used standalone or as part of an industrial control unit. Its two 28-pin sockets can be configured for RAM, EPRom and EEPROM chips. Product offers an onboard RS232C interface, 32 buffered and registered I/O lines and supports 128K of directly addressable memory. $299. Zytek Inc., P.O. Box 2400, Berkeley, Calif. 94702-0400, (415) 524-1946.

Circle 555
Case History #47582

"With over a million lines of source code, MortgageFlex is probably the largest application ever written for a LAN," says Lester Dominick, the developer of this monster program for mortgage banking back office management. "We probably encountered just about every programming challenge imaginable, but DataFlex's powerful 4th generation programming language proved more than a match for every situation."

A Straightforward English-like Syntax

"MortgageFlex is very easy to maintain and, because of DataFlex’s English-like structure, new programmers with minimum training find it easy to figure out what programmers before them have done. DataFlex macro commands also take much of the burden off the programmers by automatically taking care of the tedious chores of index manipulation, screen handling, cursor positioning and file management. We also like the way DataFlex uses indexes because it really lets the program take advantage of the capabilities of the system and run extremely fast."

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"We chose DataFlex 4½ years ago because of its outstanding multi-user capabilities and are very pleased with the way in which DataFlex has been continually adapted to new hardware and made even better as technology has improved. Not only do DataFlex programs run on more multi-user and LAN systems than any other DBMS product, but do so with absolutely no changes in the source code from system to system! I don't have to tell you what that means to a developer with a million and a quarter lines of programming."

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"100 data files, 4,500 fields and 1.2 million lines of source code. Just try that with anything but DataFlex!"

Lester Dominick
MortgageFlex Systems, Inc., Irvine, CA.
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