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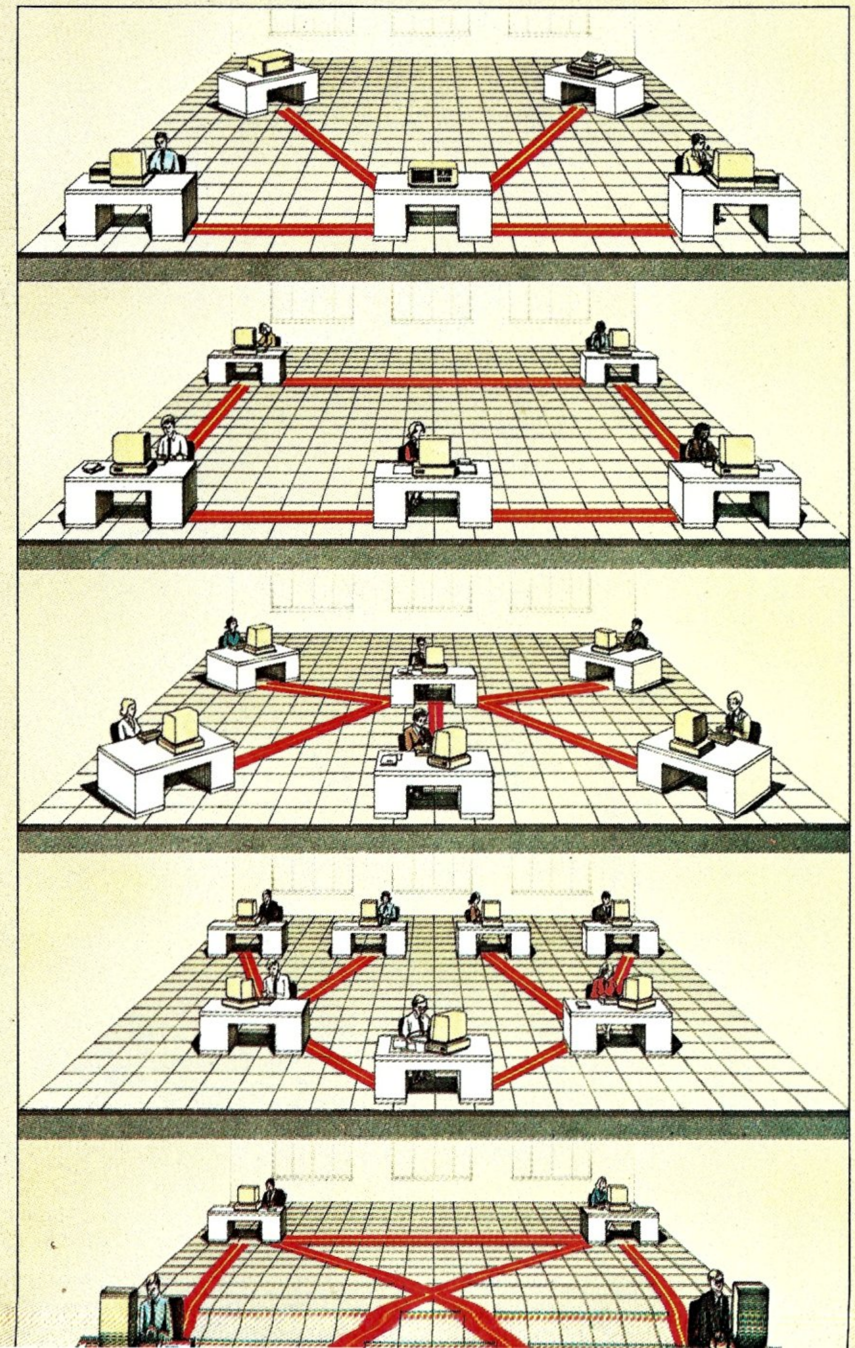
Networking–Select the right architecture and supporting software



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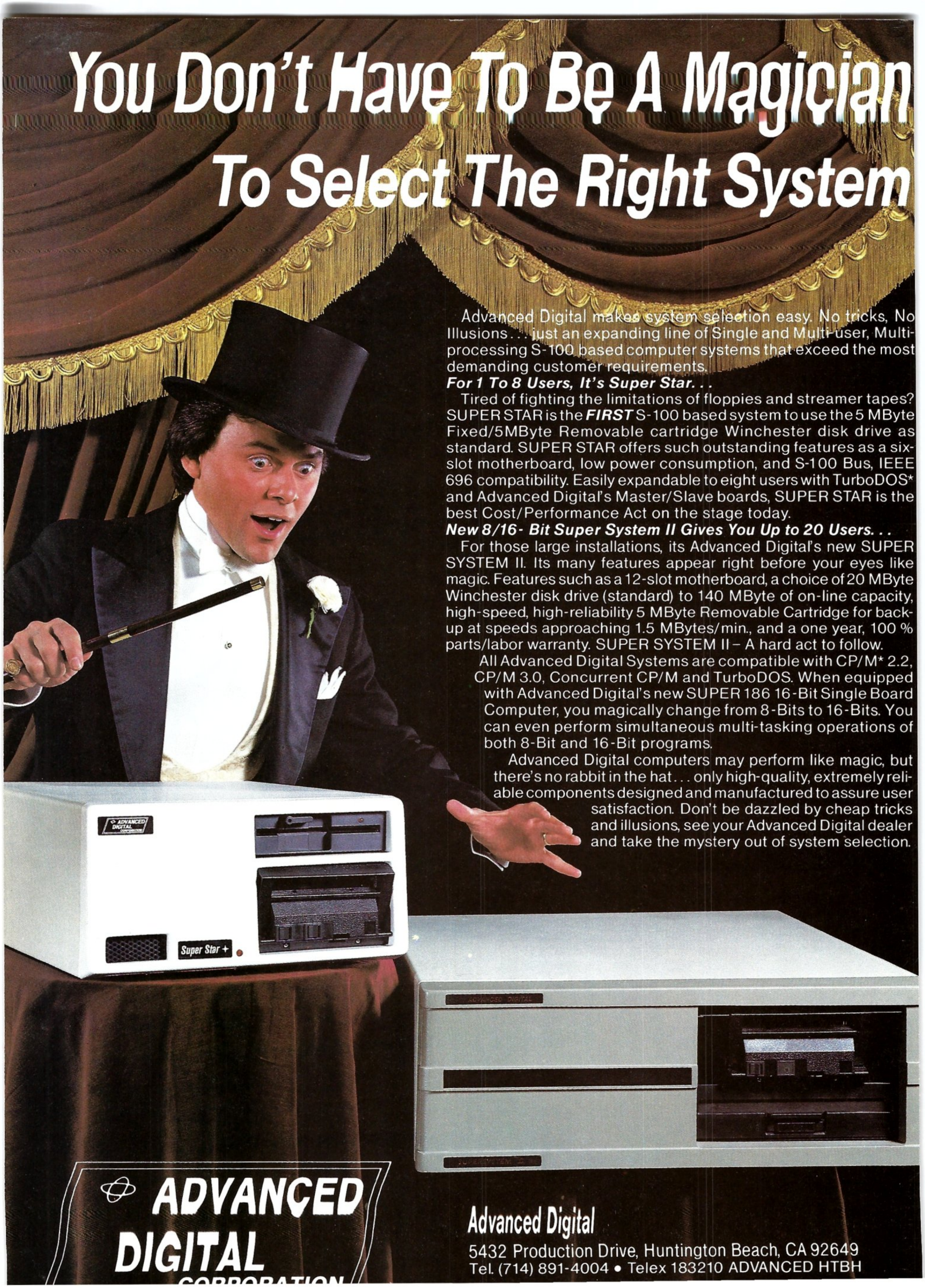
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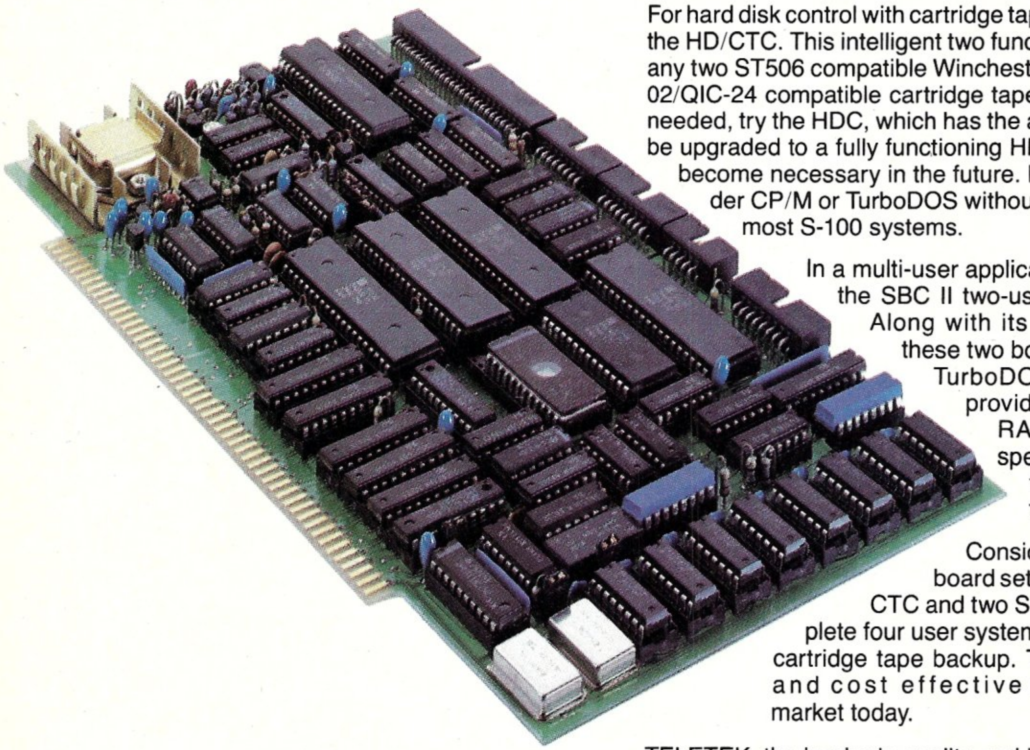

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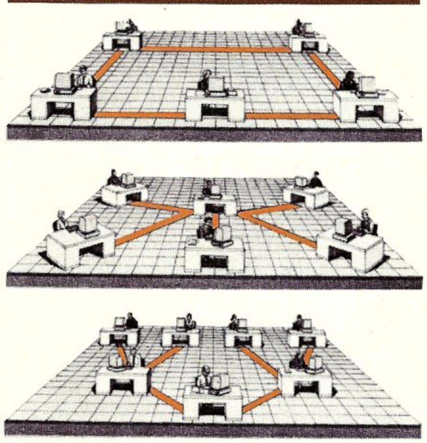

Networking—

Select the right architecture and supporting software.

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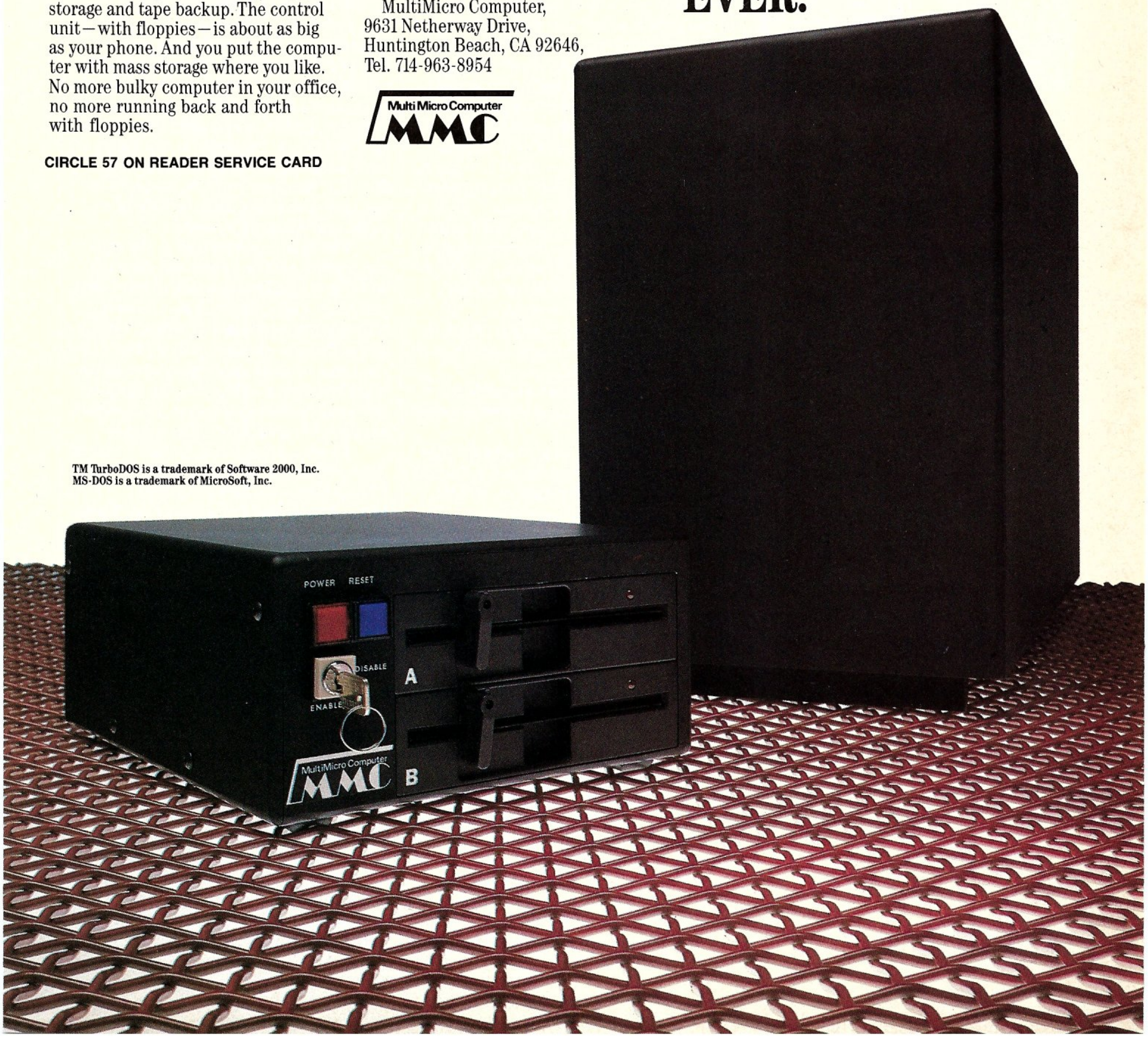
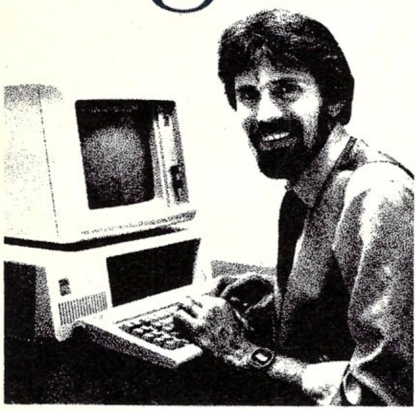


Editor's Page



Things to look out for when choosing a LAN architecture

by Mark Rollins

The concept of networking—the micro connection, if you will—is one of the most powerful system development areas currently being worked on in the microcomputer industry. The idea of micros talking to micros from the same vendor, to micros from various other vendors, and to mainframes, all on a local area network, expands the traditional role of the micro as a self-contained, single-user machine to one in which it is an element of a much broader, connected system.

Before going any further, let's define a couple of terms. *Communications* generally refers to the ability of a machine to talk to another machine over some sort of direct or semi-direct connection. Taken broadly, it would include local area networking; however, as generally used, communications usually implies going over greater distances than allowed by the idea of the local area. It also implies the use of a modem, or some other long-range transmission technology. *Local area network*, on the other hand, means a direct, hard-wired connection within the distance feasible over a direct cable—which is, in general, 10 to 200 feet, though somewhat longer distances are possible.

Three dangers, or pitfalls, need to be avoided in order to fully understand the value and capabilities of networking, and hence to be able to choose the networking architecture that is right for you.

The first is the misconception that a network brings a system into a unified whole using a single protocol. In fact, two distinct protocols are involved with networking: hardware and software. Choosing a particular hardware interface, with its attendant hardware protocol, does not automatically force you to use that vendor's software support. On the other hand, if you decide you want the features of a particular software product, with its attendant software protocol, that doesn't mean you have to purchase a particular hardware vendor's product.

It is important to realize that a network architecture consists of several components, each with various features and capabilities. The issue of whether all of the components supplied by a single vendor can satisfy your needs is a complex one, requiring a good understanding of what a network is and careful consideration of every element. Because a sales pitch often oversimplifies the capabilities of a product, if you haven't done your homework, in the end it will cost you—in time, functionality, and money.

The second pitfall to avoid is the misconception that short-cut cost savings are possible when choosing a local area network. The same complexity and oversimplification described above provides a sales pitch wedge to argue that a particular product has the advantage of some inexpensive feature.

For example, an attempt might be made to convince you to use a product because its protocol allows a twisted pair cable instead of the more expensive coax cable. However, the fire standards that exist in many places, and pure common sense regarding safety where they don't, dictate the use of teflon for the twisted pair cable. This makes a network using twisted pair cable almost as expensive as one requiring coax.

Further examples of where cost savings are attempted impact such things as the number of nodes possible on the network, whether a given file can be accessed by more than one node, and whether the file, and indeed the directory structure, is protected if multiple node accesses are possible on a single file. Extreme care must be taken to investigate the entire architecture of a particular network system.

The final major pitfall is the misconception that once you are on a network, any machine can talk to any other machine. Talk, maybe, yes—meaningfully communicating is a whole 'nother story. Even hooking together two of the same machines doesn't guarantee meaningfully talking—they may be running different operating systems, with different data file structures, for instance.

To get a greater insight into some of these problems, see the excellent article, "The Philosophy of Local Area Networking," by Leo Hoarty, in this issue. And if your needs are for a relatively small installation of, say, up to eight users, then TurboDOS may be the answer. It is now available in a 16-bit version for the IBM PC and other MS-DOS machines, and is no more expensive than other more traditional networking configurations for relatively small installations.

Errata

We have found two errors in the article "An Introduction to NAPLPS," *Microsystems*, July 1984, p. 54. On p. 57, l. 24, the reference to 'Figure 1' should read 'Figure C-10 (p. 102)'. On pp. 62-63, the line numbers in the listing were presented out of order: line no. 0057 follows 0022 (p. 62), and 0023 follows 0089 (p. 63)—they should be read in the proper numeric order.

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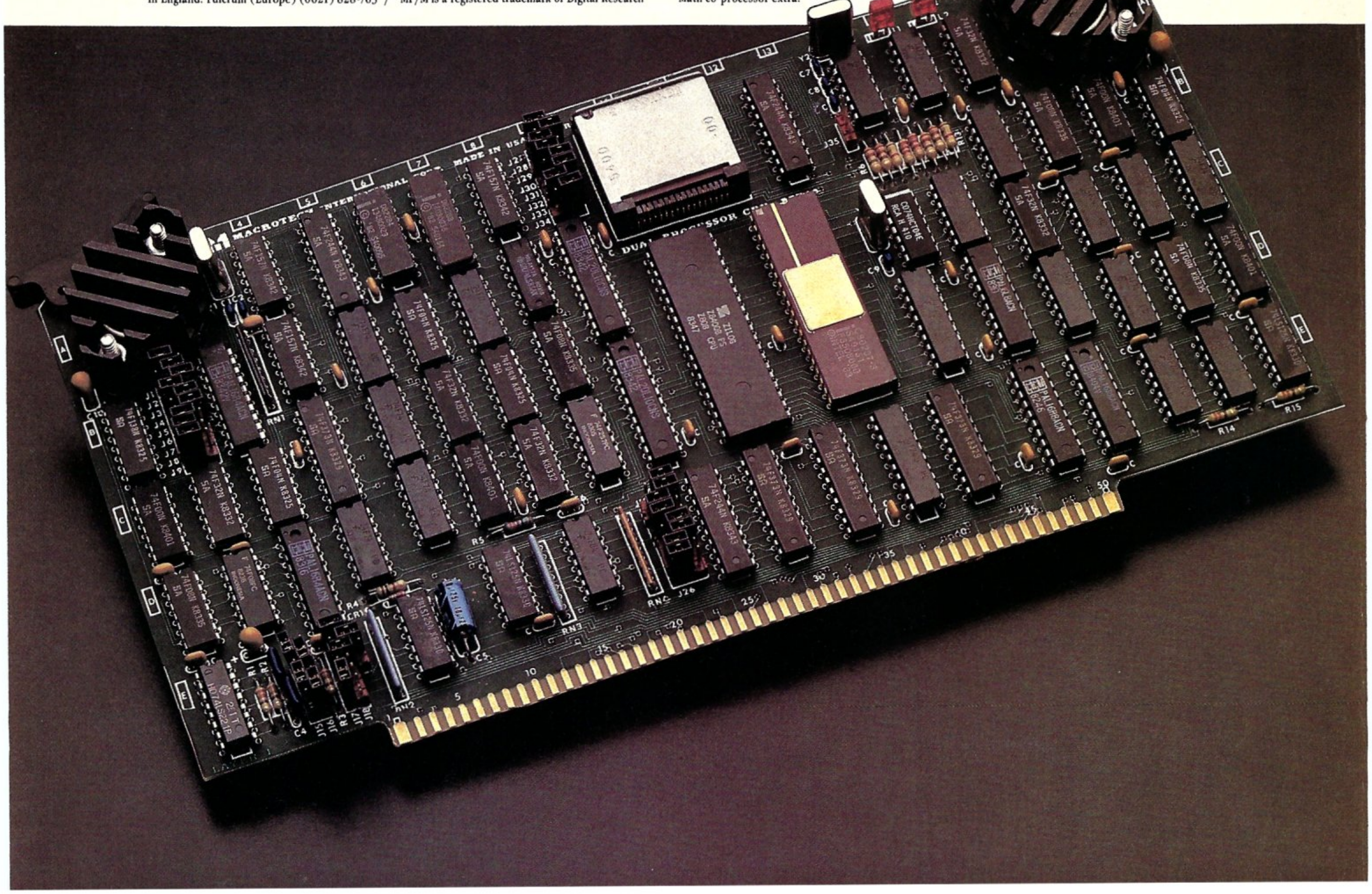

News & Views

Random rumors and gossip, plus a view of the industry's latest trends

by Sol Libes

Digital Research is rumored to be working an operating system for the new IBM 3270-PC that will run CP/M, UNIX System V, and MS-DOS applications software. This OS is also expected to feature local area networking and graphics functions. . . . This fall, Commodore is expected to introduce its new 256K IBM PC-compatible in Europe first (see description under "New IBM systems rumored"); introduction in the U.S. is not expected until next year. . . . AT&T is shortly expected to announce their IBM PC-compatible desktop computer; it is rumored to be an upgraded version of the Olivetti using an 8 MHz 8086 and 512K of RAM. An XT version should contain a 10 MB winnie and dual slimline drives. The basic system should contain serial and parallel ports, calendar/clock, disk controller, seven expansion slots, and have better graphics than the IBM PC. AT&T is expected to sell their machine via Bell system stores and at least one chain of computer stores. . . . Rumors continue that IBM will, this fall, announce a lap-portable battery-operated version of the PC that may contain a 24-line x 80-character display. . . . National Semiconductor is rumored to be readying an IBM PC-compatible in both desktop and lap-portable versions with super graphics capabilities. Rather than marketing it themselves, they are expected to enter into an DEM arrangement. . . . Mitsubishi, who private-labels IBM compatibles for Sperry and Leading Edge Products, had indicated that they plan to begin selling PC compatibles in the U.S. under their own name.

Epson intros portable CP/M system

Epson has begun private showings of a new battery-operated lap portable, called the PX-8, that runs CP/M. Based on CMOS Z80 and RAM chips, the PX-8 has an 80-character x 8-line display, a microcassette, and 120K of ROM that contains CP/M. There is no word as to what else is in the ROM.

Epson will offer an optional 3.5″ disk drive with rechargeable battery that communicates with the CPU via a serial port (which is also used as the printer port). The unit is expected to sell for about $1200 and to be the smallest (physically) CP/M computer on the market.

MicroPro has announced that it will sell a 64K ROM (actually two 32K ROM chips) for the PX-8 that contains WordStar, a spreadsheet, and a scheduler program. These programs will work with either the microcassette or disk drive. The "portable" version of WordStar will have the most of the standard WordStar functions, but not all of them; it will work with the eight-line display so that there will be two status lines and six lines of scrolling text. The spreadsheet, called "Portable Calc," will not be compatible with MicroPro's CalcStar program.

32-bit micro news

Flexible Computer Corp., Dallas TX, has announced plans to introduce a computer system by year end that will use as many as 10 National Semiconductor 32032 32-bit microprocessors. Each micro will be on a separate single-board computer (SBC) plugged into a 20-slot motherboard. Each SBC will contain the 32032, a math coprocessor, 1 MB of RAM, and a cache memory. Thus each SBC can handle separate concurrent tasks. Flexible expects to furnish UNIX System V with the system.

IBM is rumored to be readying a new computer based on a proprietary 32-bit microprocessor developed at their Austin, TX facility (see IBM story below).

UNIX news

Commodore has begun showing prototypes of its Z8000 "Micro Mainframer" mulituser UNIX-based system and is promising delivery by year end. Prototypes running the Coherent version of UNIX have very-high-resolution color graphics.

The system uses the Zilog Z8001 microprocessor, 256K of RAM, 128K of screen RAM, 32K of ROM, and dual 1.3 MB 5.25″ disk drives. The operating system loads from disk. Planned options for the system will include an IEEE-488 interface (to interface current Commodore peripherals), a Z8070 math

IBM will announce three new systems based on the new 80186 and 80286.

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CIRCLE 181 ON READER SERVICE CARD

News & Views

Continued from page 8

coprocessor chip, Pilot, Assembler and C-compiler software.

Commodore is promising that the system will support at least two remote terminals and possibly as many as eight. Expansion will be via external peripheral boxes. For example, the system will be expandable to up to 16 MB of memory via these external boxes. An 8088 coprocessor, available as an option, will provide some IBM-PC compatibility. A hard disk drive will be another add-on option. Commodore is also promising that the graphics system will be capable of displaying 16 windows with concurrent programs, on a 1024 x 1024 pixel color display.

Commodore has stated that they expect to sell a 256K system with dual drives, separate keyboard, serial and parallel ports, and single remote terminal capability for under $4000. It is expected that Commodore will introduce the system in Europe first, where it has a large number of dealers currently selling Commodore business systems. In the U.S., however, Commodore sales are made up almost exclusively of the C64 and VIC-20 home computers sold via mass merchandisers, implying a very weak dealer organization. Thus the system may not appear here until long after its introduction in Europe.

Public domain software news

SIG/M (Special Interest Group for Microcomputers, Amateur Computer Group of New Jersey, Inc.) has issued five new volumes of public domain software, bringing their total up to 172. The new volumes are:

Vol.	Description
168	MODEM 727 and overlays
169	More MODEM 727 overlays
170	COMM 726 amd more MODEM 727 overlays
171	68000 Complier written in Laboratory Microsystem Z80 Forth & Atari-to-CP/M file transfer program
172	CP/M-86 and CP/M-80+ programs and printer control programs

For complete SIG/M software information, send $2.50 ($4 foreign) for printed catalog to: **SIG/M,** *Box 97, Iselin, NJ 08830* or call: Bill Chin (201) 778-5140.

The PC-BLUE user group has issued five more volumes of software for PC/MS-DOS system. They have now released 53 volumes, and their most recent volumes are now on doubled-sided format containing up to 320K of programs. The new volumes are:

Vol.	Description
49	Remote Bulletin Board System
50	FreeCalc (spreadsheet)
51	Lotus 123 tax template
52	Eleven utility programs, game and color demo
53	Communications, word processing and file management programs

For a copy of the PC-BLUE printed catalog, send $1.50 ($2 foreign) to: **Sol Libes,** *Box 1192, Mountainside, NJ 07092.* The disks ($6 each, $9 foreign) can be ordered from: **New York Amateur Computer Club,** *Box 106, Church Street Station, NY NY 10008,* or call: *(212) 864-4595.*

Elliam Associates, *24000 Bessemer St., Woodland Hills, CA 91367; (818) 348-4278,* has issued a 50-page catalog listing the contents of the CPMUG,

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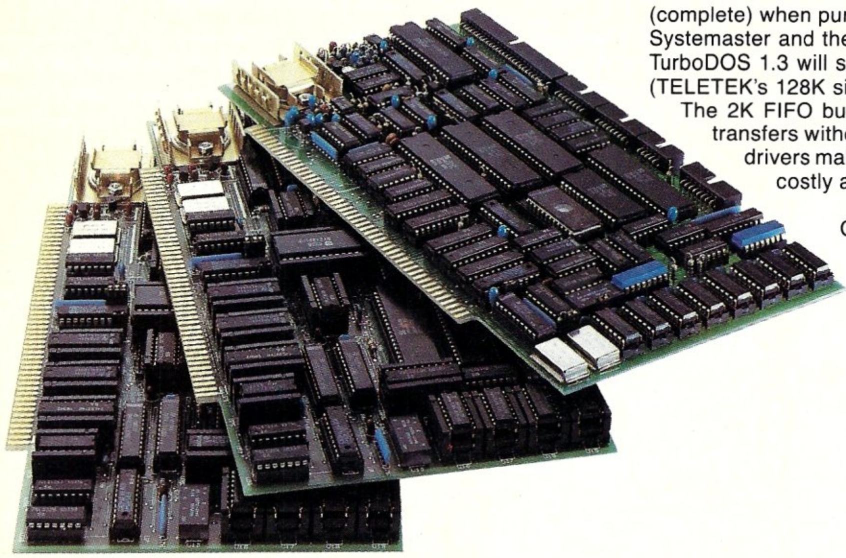

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CIRCLE 72 ON READER SERVICE CARD

SIG/M and Pascal/Z user groups ($5/$7.50 overseas). They can also furnish this software in 35 different disk formats.

New IBM systems rumored

There are rumors that IBM will shortly announce three new systems based on the new 80186 and 80286 microprocessors. The systems are expected to be sold through VARs (Value Added Resellers) and to use either Microsoft's multiuser/multiprocessing XENIX operating system or a new operating system written by IBM.

The system appear to be designed to compete with the new AT&T 3B series of microcomputers. The first system is expected to use the 80186 microprocessor, have 256K of memory and a 10 MB hard disk drive, support high-resolution graphics, and run a new version of PC-DOS. The second system is expected to use the 80286 8-MHz microprocessor; have a cache memory system, virtually unlimited hard disk capacity, and 512K of memory; and accomodate up to 16 users. The operating system is expected to be an upgraded version of XENIX, with windowing and a PC-DOS emulator to allow the execution of most PC software. The machine is further expected to find application as a file server in a local area network for PCs running Microsoft's MS-Net version of MS/PC-DOS.

The third system is expected to use a proprietary 32-bit microprocessor developed by IBM in Austin, TX. It is expected to support mainframe software enviroments such as VM (Virtual Memory) and act as a cluster controller for SNA devices.

It is also expected that the IBM scientific instruments division will unveil a new version of Microsoft XENIX operating system for their CS9000, 68000-based office system. This new OS should provide enhanced graphics with icons and windows.

Epson has developed a new battery-operated portable that runs CP/M.

IBM PC shortage over

IBM dealers report that shortages of IBM PCs and XTs that plagued dealers for the past year and a half are now over, that they are no longer on allocation from IBM, and that most dealers have machines in stock. The result is an upsurge in discounting PCs, XTs, and their compatibles. Even the IBM PC portable, which IBM began shipping in April, is already being discounted by many dealers. The PC*jr*, which has proved a somewhat disppointing product, has been heavily discounted by dealers since its first availability in February.

Another result is the dumping of systems by authorized IBM retailers, VARs and VADs to unauthorized dealers and discounters. These sellers invariably have to pay banks interest on systems in their stock for over 30 days, as well as fulfill purchasing quotas with IBM. The result is that at the end of the month they will dump their inventory to unauthorized dealers at very substantial discounts. These unauthorized deal-

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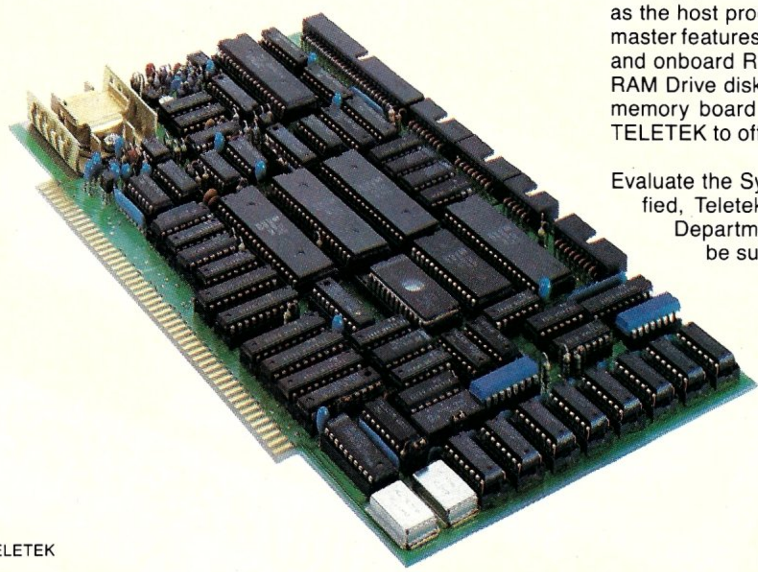

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CIRCLE 77 ON

News & Views

Continued from page 11

ers are invariably low-budget retail or mail-order operations and are therefore in a position to discount the systems. IBM, contrary to the policy followed by Apple Computer, has chosen to ignore this "grey" market and thereby appears to be encouraging it.

Josephson technology lives again

Last year IBM announced that it was dropping development of a new generation of computers based on ultra-high-speed Josephson junction devices. After spending several billion dollars and building several small prototype systems, IBM claimed that the technology was too difficult and expensive to implement outside of the laboratory. At the same time, advances in conventional LSI solid state devices no longer made Josephson technology as advantageous as before.

Now comes the news that the Japanese Ministry of International Trade and Industry (MITI) and Hitachi Ltd. (the largest computer company in Japan) have produced several prototype devices based on Josephson technology. They have further announced that they plan to continue development with the objective of building a complete computer based on this technology. The computer is expected to operate several times faster than the fastest current systems and occupy about a quarter of the space. However, it will be necessary to house the computer in a sealed liquid-helium container.

Random news

Zenith has announced that they will cease marketing all 8-bit computer systems. This will include both their Z89 and Z90 systems. Production will continue for some OEM customers.... Cromemco, a privately held manufacturer of S-100 systems, reported sales for 1983 of $50 million and a profit of $2.5 million.... At the recent IEEE-Intermag conference, IBM researchers reported an experimental magnetic recording head that increases magnetic disk storage density up to six times. The head integrates thin-film coils to write data on the disk and high-sensitivity solid state sensors to read the data.... IBM researchers at its Essex Junction, VT facility have announced the development of a dynamic RAM chip that has a capacity of 1 MB and operates from 5 volts.

Readers may contact me directly at Box 1192, Mountainside, NJ, 07092. If a response is desired, enclose a stamped, self-addressed envelope.—Sol Libes

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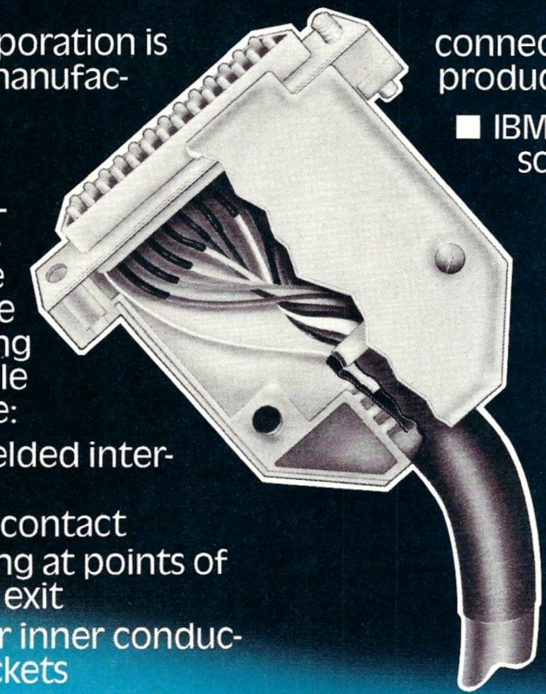

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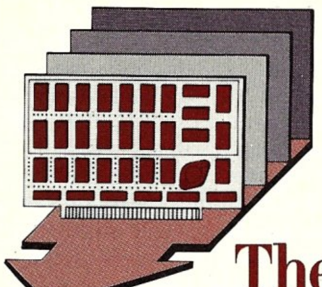

The S-100 Bus

Multiprocessing on the S-100: TMA applies to active as well as passive devices

by Dave Hardy

One of the most interesting features of the IEEE-696 S-100 bus is its ability to allow Temporary Master Access, or TMA, to its bus cycles using a (relatively) simple arbitration scheme (see "The S-100 Bus," July 1983). What is not so immediately obvious about the IEEE-696 TMA procedure is that it can be applied not only to passive devices, such as I/O boards or disk controllers, but also to *active* devices—particularly other CPUs. In fact, because virtually any processor can be "fitted" into the S-100 bus, the IEEE-696 TMA procedure will allow several different CPUs to exist on the same bus at the same time. For example, it is possible to have a single, multiprocessing, S-100 frame that contains a Z80, an 8086, and a 16032 processor—all sharing the same bus.

Which brings us to the subject of this month's column: multiprocessing. Multiprocessing is exactly the same as TMA, except that the temporary master using the bus is also a CPU. Using the bus arbitration scheme outlined in IEEE-696, up to 16 temporary bus masters may exist at any one time on an S-100 bus. Multiple processors sharing the same bus can also share all of the passive devices on the bus, including disks, printers, and other expensive I/O devices like color graphics displays, modems, or whatever (another reason that the S-100 bus is so nice), which is one of the reasons that S-100 multiprocessing is becoming so popular. In other words, it's cheaper to let 16 users share one set of expensive peripherals than to buy 16 sets of expensive peripherals and 16 mainframes.

Multiprocessing on the S-100 has been around since the early days of the S-100 bus; it became a "formal" reality with the release of the proposed IEEE-696 standard way back in 1979. Many manufacturers have been making S-100 single-board computers for multiprocessing since that time, and now there are more than a dozen manufacturers with fine-tuned 8- and 16-bit multiprocessor systems that rival the high-end minicomputers of "the big boys" in performance, at a small fraction of the cost.

Remember?

Before we get into some specific systems, however, let's refresh our memories a bit about Temporary Master Access in the S-100 bus. You should recall that during a TMA operation, the device that takes over control of the bus cycles is called the "Temporary Bus Master" or "TMA Controller," and that the devices that follow the commands given by the bus master (usually memory and I/O devices) are called "bus slaves." Although not technically correct, I sometimes refer to temporary bus masters that have a CPU as "active" TMA devices, and those that do not have a CPU as "passive" TMA devices.

TMA is a term coined by the authors of the IEEE-696 standard to describe the procedure by which a board may take control of the S-100 bus to perform bus cycles. This is a broader application of the old term DMA (Direct Memory Access) in which a board may take over the bus for memory bus cycles. The important difference is, of course, that in TMA, a board may take the bus for *any* kind of bus cycle, which means that virtually all of the functions of the CPU may also be taken over during TMA, which is exactly what S-100 multiprocessing systems do.

Although the temporary master can take control of most of the S-100 bus lines, there are a few important lines that it can't have, including the master system clock, which must be generated by the permanent bus master (and which also limits the speed of all of the temporary bus masters, since each temporary bus master must synchronize its operations with the master system clock), and the bus arbitration logic itself, including the TMA control bus.

16 users are usually all that can exist on a single S-100.

Although it is obviously most convenient and economical to have all expensive peripherals controlled by the master processor (so that they can be shared by all the temporary masters), it is only necessary for the master processor to provide the master system clock and arbitration interval of one clock cycle between each TMA request.

Common features of multiprocessing systems

In most commercially available S-100 multiprocessing systems, the permanent master performs all system I/O

S-100 Bus

Continued from page 15

(that is, all I/O to devices external to the S-100 frame, such as printers, modems, disk drives, etc.) except for each user's local console, which is usually a unique serial port on each temporary master. Many temporary master CPUs (called *slave processors*) are full-blown single-board computer systems, with on-board disk drive controllers in addition to 64K or 128K of RAM, one or more serial ports, and a printer port. Some slave processors, however, contain only a single console I/O port, 64K RAM, and of course, a CPU.

Regardless of the features of their individual slave processors, most S-100 multiprocessing systems that I have worked with try to maintain a single-user environment for the operations of each slave processor, so that individual users can operate with as little concern for the other slave processors as possible. In general, coordinating use of the master processor's peripherals is left up to the system's software, not its hardware, so hardware requirements are greatly simplified.

Since the IEEE-696 bus arbitration scheme allows for only 16 individual temporary bus masters per frame, 16 users are usually all that can exist in a single S-100 installation. There are, however, some slave processors that are capable of running in a multiuser mode (with MP/M and 128K of on-board RAM). So it is possible to have more than 16 users, but still, only 16 temporary masters can be allowed. Although operating slave processors in multiuser mode will allow more users, it will also degrade system performance for those sharing the CPU of the multiuser slave processor; so unless no more slave processors can be added, multiuser slaves should probably be avoided. I suspect that for many future S-100 slave boards based on wider, more efficient processors, multiuser degradation will be less significant, but my own observations of current Z80-based systems show that it's just a bit too klutsy and slow.

Most of my experience with multiprocessing S-100 systems has been with the TurboDOS operating system (or one of its derivatives) which, to the individual slave processor user, looks like CP/M. No doubt my observations are biased by this, but until recently, TurboDOS was the only operating system that made full use of the S-100 multiprocessing abilities. (Forgive me, MP/M, CP/NOS, OASIS and UNIX look-alikes, but this is a *hardware* column!) Many companies now offer multiprocessing systems that run CP/M Plus and other single-user OSes in each slave processor, and can even run different OSes in the same S-100 box.

The players

There are several companies currently selling S-100 slave boards and multiprocessing systems. Below is a list of those I am familiar with, which may a good place to start if you are looking for some S-100 multiprocessing hardware. Many of these companies manufacture slave processors and single-board computers that have been reviewed here in *Microsystems.*

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Readers are encouraged to send in questions on the S-100 bus. Please write to: Dave Hardy, 736 Notre Dame, Grosse Pointe, MI 48203.

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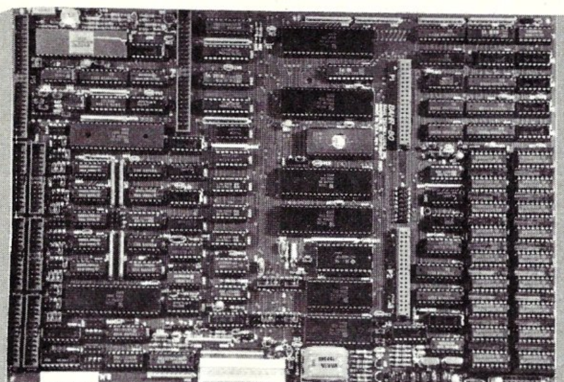

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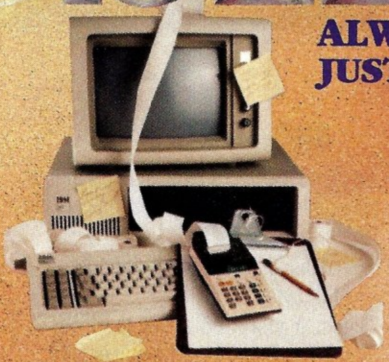

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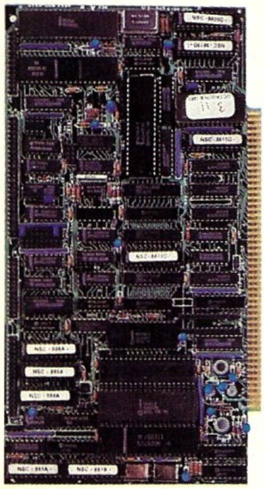

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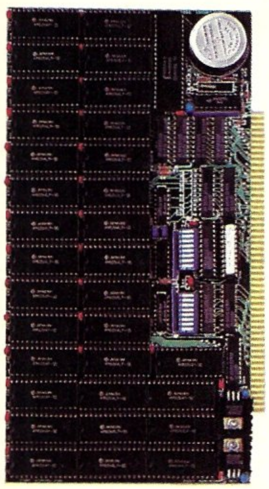

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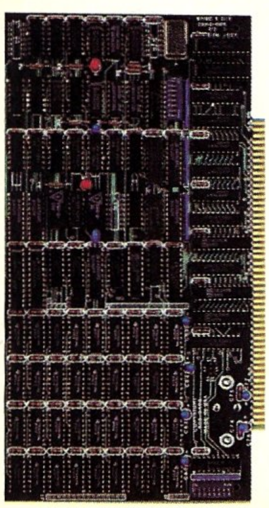

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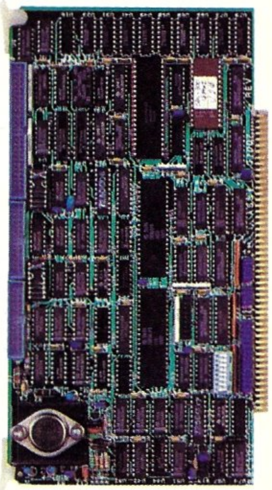

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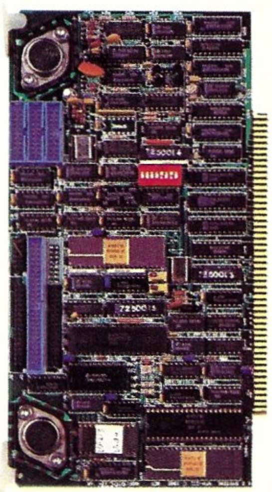

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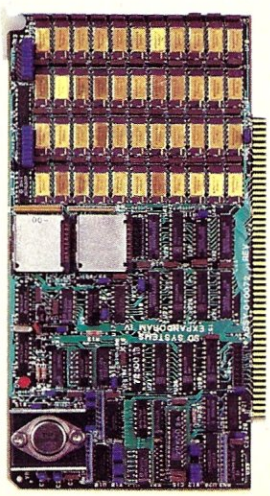

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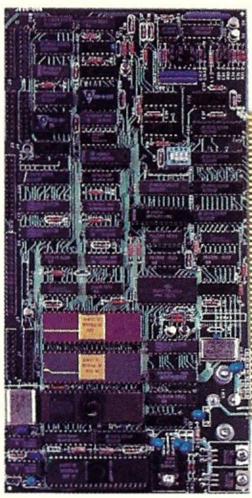

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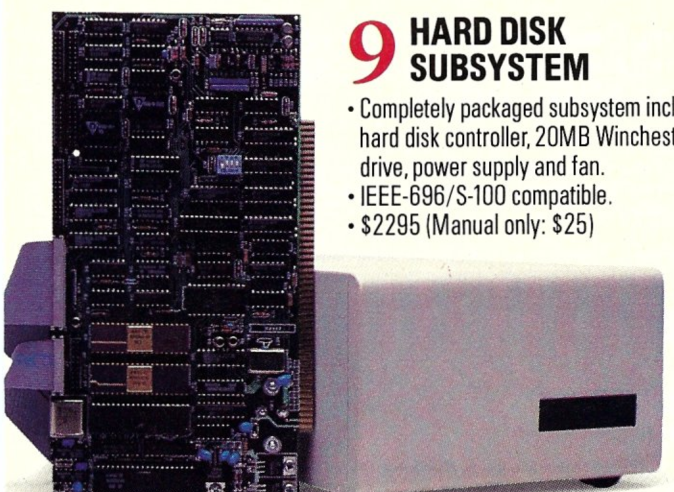

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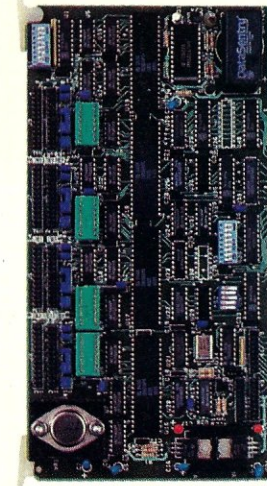

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CIRCLE 21 ON READER SERVICE CARD

The MS-DOS Window

Details of the XT/370; the PC's impact on the industry; direct memory mapping

by Hank Kee

With the dog days of summer upon us, we have already witnessed a plethora of personal computing announcements this year—each one with more desirable features and at lower cost performance. This technological leapfrogging leaves us with the feeling that the more things change, the more things stay the same. The kingpin of the personal computer market is still IBM, which sets the benchmarks for all other comparisons.

Enter the Dragon

The technical information to date on the XT/370 has been very sketchy. Since its announcement late last year, it has not been possible to view even a demonstration unit. Deliveries of the XT/370 have now started to trickle out of the factory, and evaluation of this system has just begun.

The XT/370 is sold directly by IBM marketing. Their target customers are the major corporations. The XT/370 is an IBM XT with a monochrome display and three additional circuit boards. The three boards consist of the 370 processor card, a coprocessor board containing 512K of memory, and a 3277 adapter card.

The operating system for the XT/370 is a single-user version of VM/CMS. VM is a virtual memory operating system that permits a program to address logical memory greater than the available physical memory. CMS is the conversational monitor interfacing the user to the VM system; it coexists with PC-DOS 2.1 for PC functions.

The 370 processor card contains two customized Motorola 68000 MPUs and an Intel 8087 floating-point chip. The 68000 MPUs were developed jointly by IBM and Motorola to emulate the 370. The 8087 coprocessor was incorporated for hardware floating-point functions of the 370. This card is joined to a second board containing 512K of memory, using 64-kilobit chips in its design. More effective swap space would have been achieved if 256-kilobit chips had been used.

The 370 processor can address up to 4 MB of logical memory with only 512K of real memory, even though there is another 256K of memory on the system motherboard. In PC mode, the XT/370 addresses 640K of the total of 768K of physical memory. The standard XT/370 occupies all six of the available XT long connector slots. That leaves only the two short connectors for other peripherals. In 370 mode, the XT/370 references only the monochrome screen. This is a very important point, because substitution of the color graphics adapter into the unit would not be possible. PC software requiring color graphics could not be used.

The 3277 coaxial connector card interfaces with the 3274 controller. It does not connect directly to the 3705. In 370 mode, it will communicate with either a VM host system or a TSO-based MVS host system, provided that the host has had a remote file driver installed to let it talk to the XT/370.

The VM/CMS operating system for the XT/370 is supplied on six diskettes. Application software for this system must be initially downloaded from a VM host system. The primary focus on the marketing of the XT/370 emphasizes new local application development and as participation in a very loosely coupled VM/CMS system.

The XT/370 is also designed to compile Cobol programs for eventual transport onto an MVS host system. The relocated output file from such a compilation can be uploaded onto the host and then link-edited to run under TSO. Almost all major corporations are using MVS. This TSO compatibility could greatly reduce the programming development compilation demands on the mainframe host.

Almost all new software development today is done on the PC.

There is an import/export facility within the 370 VM operating system. This permits the user to move data files between PC-DOS 2.1 and VM/CMS on the XT/370. The software licence to use the VM application programs is a nonrecurring charge of $1000 per system.

Experimentation with third-party components will be needed to maximize the use of the six connector slots. It will be a while before all current third-party hardware and software vendor add-ons can be verified. The unit list price is in the low teens. Some cottage industry en-

MS-DOS Window

Continued from page 21

trepreneurs may not find this to be too steep a price, since the overall competition will be much less.

The universal PC

Just as the 8″ SS/SD floppy diskette has become a standard for CP/M, the IBM PC may very well continue to be the all-purpose, universal PC—even if IBM were to discontinue their present PC model. The IBM PC accounted for 20.6% of the over $10 billion PC market in 1983. An almost equal portion of the market was made up of various IBM PC clones.

Almost all new software development today has its genesis on the PC. The number of third-party manufacturers is staggering, and the products cover a multitude of functions. Many people shop around and buy IBM PC clones because the price differential to the hobbyists can be significant. Thus, the number of manufacturers in the PC clone business grows each day.

A question often asked in the PC market today is: "What is a good IBM PC clone to buy?" In this instance, the question itself provokes a series of other questions. The fundamental question is, "What are you going to do with a PC?" Remember that form follows function.

The answers have ranged from "acquiring a modern day educational tool for the kids" (a likely story!) to "extending one's knowledge of a dynamic technology." People today seem to base their purchase less on definitive logic than on undefined therapeutic reasons. Money does not seem to be an inhibiting factor, even though the cost of a complete system would be equivalent to a healthy down payment for a family automobile.

If your primary purpose is to use a predetermined set of programs, then by all means test those programs on a selected number of IBM PC clones that will meet your budget, as well as on those offering desirable PC features. If, however, you want to be able to run any and all programs written for the IBM PC as well as programs yet to be written, then spend the few extra dollars and buy the real McCoy.

If you are a hacker at heart—like me, for whom the PC is a tool for writing the next great commercial software success (albeit an improbable dream)—then any MS-DOS machine would do. The PC should be an art medium instead of an art form. Theoretically any program written under MS-DOS should be relatively easy to convert onto another MS-DOS system. The operating system, in this case, provides the means of interchange.

Direct memory mapping

Many authors who write commercial programs for the IBM PC use direct memory mapping of the video to increase operating speed. This, in turn, propagates the IBM PC as a de facto standard, even though there are many fine clones and compatibles in the field that have implemented MS-DOS.

Within MS-DOS, there exists the ability to universally address the cursor and thus maintain a fairly high portability between the various personal computers. With MS-DOS 2.0, you can issue escape character sequences from within your program that can be used to control cursor attributes. On the IBM PC, the escape sequences are issued through function calls 1, 2, 6 and 9, and require the extended drivers to be brought in by including "DEVICE=ANSI.SYS" as a part of CONFIG.SYS.

Most users of the modern-day personal computer do not program, but

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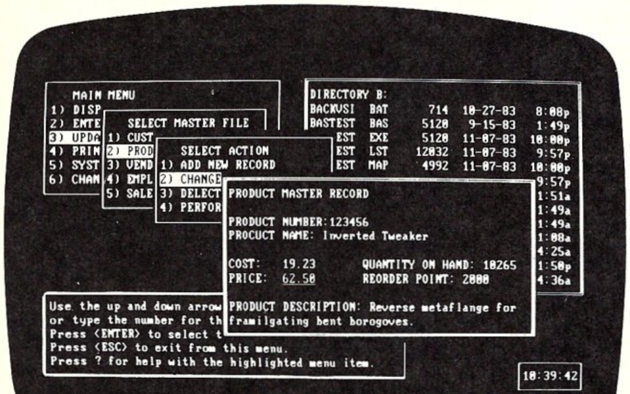

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prefer to use commercial packages. For most of those who do write programs, the language of choice is Basic. Unfortunately, the various versions of IBM Basic trap the cursor access calls and prevent you from writing a program in Basic to take advantage of standard MS-DOS functions.

This incongruity of IBM is not limited to interpretive Basic. Both interpretive and compiled Basics, as distributed by IBM, suffer from syntactical differences. It still mystifies me why IBM, with very few exceptions, continues to distribute original software even when problems have been properly identified and presumably resolved. Are they trying to tell us they always deliver perfect PC software? Software is organic. It should continue to grow in function over a period of time.

Microsoft Basic

All is not lost, however. It is possible to install a copy of Microsoft interpretative Basic on the PC that is 100% syntax compatible with the Microsoft Basic compiler for MS-DOS. The Microsoft versions of Basic will enable you write screen cursor control Basic programs that are portable.

So, if you want to write a program under MS-DOS and also make it transportable onto other MS-DOS systems, here are a few pointers on how to ensure screen compatibility.

The following is a list of equivalent escape sequences, in Basic format, which address the cursor:

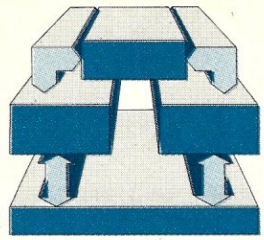
```
print chr$(27)+"[r;cH"
    ;move cursor to the position
    ;spec'd by (r)ow and (c)olumn;
    ;similar to LOCATE
 or chr$(27)+"[H"
    ;home if (r)ow
    ;and (c)olumn are not spec'd

print chr$(27)+"[#A"
    ;move cursor up # lines
    ;without ;changing cols

print chr$(27)+"[#B"
    ;move cursor down # lines
    :without changing cols

print chr$(27)+"[#C"
    ;move cursor # cols fwd

print chr$(27)+"[#D"
    ;move cursor # cols bkwd

print chr$(27)+"[2J"
    ;erase screen; on IBM,
    ;Wang, and NCR PCs, cursor
    ;will return home; on Rainbow,
    ;cursor will return to its
    ;last original pos; thus,
      chr$(27)+"[2J";chr$(27)+"[H"

    ;should be used to insure
    ;compatibility of clear
    ;screen and Home

print chr$(27)+"[k"
    ;erase from cursor to
    ;end of line

print chr$(27)+"#;..;#m"
    ;set screen attribute spec'd
    ;by parms: 0 = all attributes
    ;off; 1 = high intensity on
    ;(on the NCR PC it's low
    ;intensity); 4 = underscore
    ;on; 5 = blink on;
    ;7 = reverse video.
```

The graphics facilities on the IBM PC are extensive, and include choice of colors on background and foreground. See your equipment operations guide for more information. It is interesting to note that the Wang PC references a Lear-Siegler ADM31a, the NCR PC looks like a Hazeltine 1510, and the Rainbow uses the VT100 protocol as its native means of screen cursor control. Yet only a single copy of a screen-oriented program needs to be written and compiled once for all these systems.

Hank Kee, 42-24 Colden St., Flushing, NY 11355

CIRCLE 191 ON READER SERVICE CARD

The UNIX File



The versatile UNIX sort; unraveling ciphers; and some UNIX enhancements

by Ian F. Darwin

This time out your wandering UNIX columnist talks about sort utilities, delves (very lightly) into codes and ciphers, and improves upon a few tips given in past columns.

101 uses for a live sort

When designing an operating system, you have a great deal of power in deciding how to build the sort utility. For example, you can write a sort utility capable of sorting only certain kinds of files, or you can build one that can handle any kind of text file, you can make it simple to use, or you can design a complicated control language which the user must master to sort simple records. To be low-class, you can leave it out entirely, or charge extra for it.

The designers of UNIX had many uses for a general sort program, so they did not leave out the sort but provided a simple, general-purpose one. This has eliminated the need to build sort routines into every program written since the system was released. (When sorting must be done from within a program, there is a library routine, **qsort(3)** for the purpose). If you equip the operating system with a good sort program and a way to fit it into the input side of any application, then it's not a burden on users if certain programs require that their input be presorted; it also makes the development of new programs considerably easier. Added to this is the fact that the UNIX mechanism for joining programs together, the *pipe*, is inherently multiprogrammed (multiple UNIX processes generated from a single keyboard command run simultaneously).

I was going to write about one of the common examples of shell files using sort—a kwic index, a word frequency count, a spelling check program—which I use in my introductory talk on UNIX. However, since these have been described in the UNIX literature by writers more able than myself, I decided to let our UNIX system find some new examples for me.

I spent a few hours one weekend writing a program to find all the shell files on the system that were publicly readable, contained printable characters, and contained the string "sort." Any user can do a fair job of this on UNIX, since most files are readable by everyone on the system. (Of course, you can specify alternate protection for files or change your own default if you are preparing secret material.) I ran my program on a medium-sized research UNIX system (approximately 200 user accounts) and it provided me with more than 200 files meeting the above criteria. Many of these, however, were invocations of **dsort**, a part of the UNIX typesetting package, or **tsort**, a program for ordering object libraries. These other sort programs were eliminated. The remainder used the normal system **sort** in the following operations:

- Word frequency counts of the general form

```
preparation | sort | uniq
```

as described in the paper "Statistical Processing of Text" by McMahon, Cherry and Morris (*Bell System Technical Journal,* Vol. 57, Number 6, July/August 1978). These operations were used to look for unique words in a text file; to see who used particular programs; to see how often they used them (these programs automatically wrote the name of the user into a file on each invocation); to check for duplicate figure numberings in a large document; and to check variable names used in the source for a compiler.

One variation on this theme used the Berkeley **strings** program to list all the printable strings in an executable file (.COM file in CP/M terms), then sort them and check for duplicates. About 20K of wasted space disk space was covered—a small amount relative to the total size of the file space on that system.

- In conjunction with a disk usage program, sorting users by disk space used, in order to determine the biggest users of disk storage (used both by the system administrator and by one professor to look at his students). This function can be performed better by **quot** on systems which provide that utility.

The designers of UNIX sort had the right idea.

- In conjunction with **strings** and **grep** to produce a sorted list of all the error messages that a particular compiler can produce.
- In a system in which one program generates a table to be compiled into another program, to sort the table so that it's easier to debug the second program.
- To sort the entries in a table of

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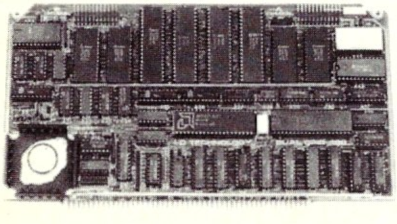

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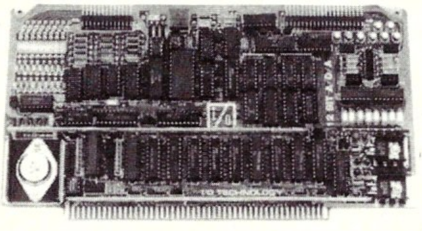

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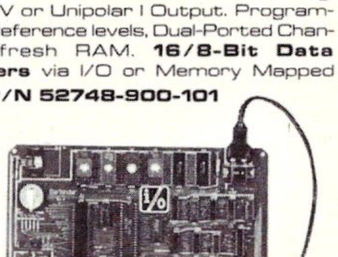

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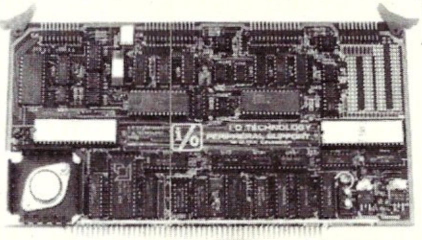

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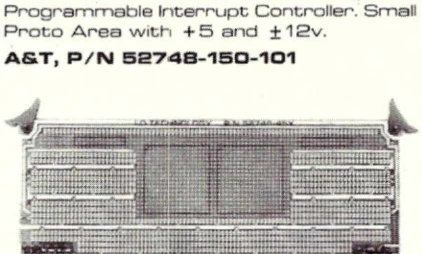

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UNIX File

Continued from page 24

commercially available cross-compilers which are—by environment, by target and by vendor—to produce several reports from the same file.

- In conjunction with a text editor to produce a table of contents for a large document.

We'll discuss sorting a few more times in this column. Not all of these applications are part of what one usually calls word processing, but each involves word manipulation. I repeat my point that the designer of a utility ought not to build in too many assumptions about how the tool will be used, in order to allow the tool to be used in the widest variety of circumstances. The diversity of applications found on one system for the UNIX **sort** makes it clear that the designers of this program had the right idea in mind.

Simple ciphers made simpler

A major chocolate company recently ran a series of advertisements concealing how their chocolate bars are made. One of the ads presented a telegram that purported to reveal the secrets "by popular demand." The telegram, of course, was encoded!

Everybody is familiar with ciphers—they are usually simple substitutions or transpositions of the characters in a text. The simplest ciphers, often used by children to transmit secret messages to their friends, are not very resistant to attack. For example, the message:

```
rqh jldqw vwhs iru pdqnlqg
```

is made from the phrase

```
one giant step for mankind
```

by using a cipher letter that is three places to the right of the clear letter in the alphabet (convert *a* to *d* to go from clear to ciphertext, or *d* to *a* to get from cipher to clear). This particular kind of cipher—just rotating the alphabet to the left or right—is called a Caesar Cipher after Julius Caesar, who is alleged to have invented it.

On CP/M you would likely have to write a Basic program to do simple ciphers. An easy way to perform ciphers in UNIX (or CP/M with a UNIX-like shell) is to use the **tr** command. The above example was created with:

```
tr a-z d-za-c
```

which says "translate the letters a to z into the letters d through z then a through c," which results in the translation given above.

Since the relative frequency of characters is the same in the ciphered alphabet as in English (i.e., as many *d*'s in the code as *a*'s in the clear text), you should be able to map one to the other simply by tabulating the frequencies of letters in the ciphertext and using the table as a guide by which to do your substitutions. The catch is that your sample of intercepted ciphertext has to be large enough for the count to be statistically meaningful. It is well known that *e* is the most common letter in English text, followed by *t*, *o* and so on—the mnemonic for the most common letters is the almost-pronounceable "etoain shrdlu."

How can we get the computer to help with the decryption? Getting frequencies printed out is easy. Many versions of UNIX have a command called **freq** that prints out a table of the frequencies of all the characters in a text. If you don't have such a command, it's easy to write a simple C program to do just about what **freq** does, but without the fancy formatting. A program of this kind might put out

```
a    19
b    7
c    5
```

and so on for a given text. Then it's just a matter of sorting the file on the frequencies (you thought I'd forgotten about **sort**, right?), eliminating the numbers from the file and reassembling the letters on a single line. If you sort the file using

```
sort -rn +1
```

(do a reverse numeric sort, skipping one field) you will get

```
e    57
t    40
i    35
```

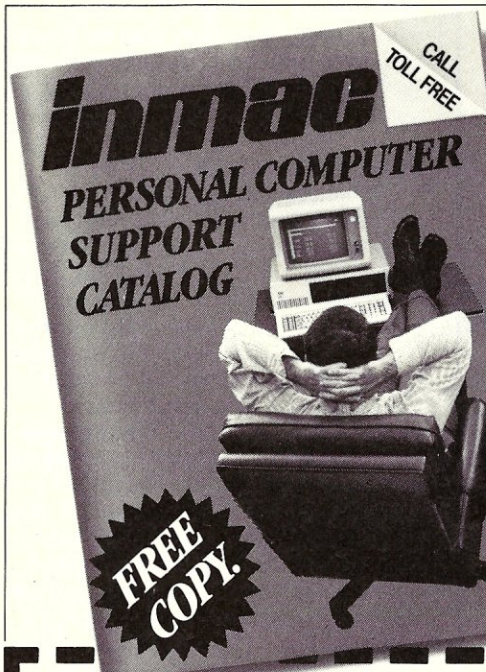
and so on for some arbitrary text. Then you can edit this file, and the commands

```
1,$s/	.*//
1,$jp
```

will remove the tabs and numbers and join all the lines into a single line. This line becomes one of the two arguments to tr; the second is the English distribution of text.

```
tr "rwp,hxaoeclyidtgfskmnb(" \\
   "etiosrahdnlfmpcubgwvqky"
```

(I can send a more complete public do-



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UNIX File

Continued from page 27

main version of **freq** which optionally outputs the **tr** format directly; if you're on the UNIX net you can get it by sending me electronic mail). I used the distribution of letters in "The UNIX File" instead of English standard distribution. Immodest of me, I know. This will give you a good start on cracking the secrets of chocolate bar manufacture. To get it right, you will have to do some careful editing on the second argument.

Of course, UNIX has many more tools that are useful in dealing with ciphers. The standard **crypt** command (and the encrypt subcommand of the editor) use a variation of the "German Enigma" routine, and the standard password algorithm uses a modified DES algorithm (see "Password Security: A Case History" by Robert Morris and Ken Thompson in Vol. 2B of the standard UNIX manual set).

Any simple substitution cipher could be cracked using the methods given here. Of course, the smaller the sample of ciphered text the less accurate will be the frequency count produced. Somewhat more complex methods must be applied to a transposition cipher, in which all the letters of the clear text are used, but are jumbled in a manner which ensures that there is no simple relationship between a cleartext letter and the letter substituted for it, which is context-dependent.

Minor enhancements

Changes made to UNIX by AT&T have eliminated some of the minor suggestions I have made. For regular readers with System III or V UNIXes, I offer the following: what I said about using **case** instead of **test** in shell scripts is no longer true on System V, since **test** is now built into the shell. I presume that this was done as an efficiency move—I just hope it was not the beginning of a plan to build all the commonly used commands into the shell. Henry Spencer, a University of Toronto UNIX guru, suggests that a good test to use for developers in deciding what goes into the shell is this: programs whose startup time is long compared to their running time might be put into the shell for performance reasons; others should not. Thus **test** and **echo** (which is in the SVR2 shell) are good candidates, but **cat** is not (although it's used often in shell files) nor are **ed**, **ls**, or other utilities.

And my kludge for putting \r into your L.sys file has been replaced by a better kludge. The System III terminal driver allows you to turn on and off various mode settings selectively. Here is a way to get a real \r into a file:

```
$ ed file
*2p
Line with \r in it.
*!stty -icrnl
!
*s/\\r/<CR>/p^J      # type RETURN
                       key
 in it.h \\r           # line now has
                       \\r, prints
                       funny
*l^J
Line with \\r in it.
*!stty icrnl^J
!
*w
240
*q
```

Once you have entered the funny "-icrnl" mode, the system no longer translates \r to \r\n (CR to CR-LF) on input. This allows you to enter a \r into a file, but you have to type the \n at the end of each line manually. So you type <NEWLINE> (shown as CTRL/J) at the end of each line. If you forget, the cursor will just sit at the left margin after you type a command. Just type a CTRL/J or <NEWLINE) to have this command processed. And get back to "icrnl" mode as quickly as possible, as I've done in the example.

The System III/V terminal driver has jillions of options and is incompatible with Seventh edition and Berkeley UNIX. But it does have some useful features; this is one of them.

Please feel free to send questions or comments. Addresses for regular mail and electronic mail are given below. I can't always answer immediately, but I will get back to you, and I'm always glad to hear from readers with comments either on the column itself or on their reactions to particular UNIX systems or products.

Corrigenda

Two typos traumatized my June '84 column. On page 29, in the quotation from Dennis Ritchie, change "it is incredibly difficult" to "it is an incredible difficulty" (these are not his exact words, which the editors apparently considered impolite).

And at the top of the next column, change the closing quotes to opening quotes. The sentence beginning "The kernel is the only UNIX code that..." should thus be shown as starting the quotation from Ken Thompson, which continues on into the next paragraph.

Microsystems apologises to both gentlemen for any inconvenience this may have caused.

Write to Ian Darwin, Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8.

If you have UNIX mail access to the UUCP network, you may contact me at **ihnp4!darwin!ian.**

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The CP/M Bus

Seeing double—disk capacity and "gotcha's"

by Randy Reitz

I recently purchased two Siemens FDD-200-8 floppy disk drives. These are double-sided drives with a formatted capacity of over 1 MB each. Since these are available for around $240 each, I figured that this inexpensive upgrade would put off the day when I would eventually have to add a much more expensive hard disk. In theory, the swap should not be difficult. In practice, however, there are enough "gotcha's" that you can end up seeing not only double storage capacity but double everything, if you don't plan ahead and find out what you are getting into. The possible problems fall into three categories: mechanical, operating system, and format/test programs.

Mechanical

If your single-sided drives are of the same make as the new doubles and your cabinet was made for them, you should have no mechanical problems. However, if you are a Shugart user, you should know that the dc and ac power connectors are on the left side of the Shugart drives, but on the right side of the Siemens. This in itself may require lengthening the cabling between the power supply and at least one of the drives. You will either have to get a new set of 3-pin and 6-pin Molex connectors (which are not easy to find), or prepare to patch about 6″ of wire into each conductor. The ac connector may also be a different type.

A more annoying problem is that the ac power connector is mounted so far to the rear on the Siemens drive that the cable connector does not clear the power supply wall of a cabinet made for Shugarts, so you may have to remount this connector in a different place.

Operating system

If you are lucky, your disk controller manufacturer will have provided source code for your BIOS, and will perhaps even have included conditional assembly directives for changing the BIOS to accomodate double-sided drives. If you are luckier yet (a Tarbell or Delta user), your BIOS will be capable of reading the first sector of an unlogged disk and determining the number of sides and the density automatically. In the case of the Tarbell controller, this is done by reading the boot sector (side 0, track 0, sector 1) and examining the byte at offset 7Eh from the start. The value found there is 0E5h for an SS/SD disk, 0E7h for DS/SD, 0DDh for SS/DD 51 x 128, 0DEh for SS/DD 16 x 512, 0DFh for DS/DD 51 x 128, or 0DCh for DS/DD 16 x 512. If this mechanism is not present in your BIOS, then side/density determination is done by reading a sector ID Address Record and examining the second and fourth bytes, which specify number of sides (0=single, 1=double) and number of bytes per sector (0=128, 1=256, 2=512, and 3=1024), respectively. More on that later, however.

If you are picky about format, and want a format not supported by your controller manufacturer, you will have to make more extensive modifications. Any sector size greater that 128 bytes will require you to use some kind of buffering, perhaps incorporating the Digital Research blocking/deblocking routines. An article explaining these was published in the February 1984 issue of *Microsystems*. In addition, you will almost certainly have to write your own formatting program—and this brings us to the whole question of which format to use and how to implement it.

Which format?

The easiest double-density format to implement is almost certainly 51 sectors per track with 128 bytes per sector. If you go to double-sided disks, you have the choice of doubling either the number of sectors per track (odd sectors on one side, even on the other) or the number of bytes per sector—the latter will require deblocking. In either case you have a capacity of 979,200 bytes (excluding the system tracks). This is only 6528 bytes per track per side, whereas the theoretical maximum would be 10,400 in a single sector. That would be impossibly inefficient in terms of allocation block siZe, but we can find a format that gives us a good tradeoff between maximum capacity and maximum utility. Nine sectors of 1024 bytes give us 9216 bytes per track per side (or 1,228,800 total both sides), and 16 sectors of 512 bytes yield 8192 bytes per track (1,228,800 total both sides) which is a good compromise. Again, we shall have to use the blocking/deblocking routines in our BIOS. The sacrifice in capacity is offset by (some people say) more reliable performance. The gaps between sectors can be slightly larger, and if a sector does become unreadable, only half the amount of data is lost.

Formatting the disk

If you want to use any format other than those supported by your disk controller, you will probably have to write your own formatter program. When I realized this, I looked around for models, and found none. Enquiries at the computer club elicited replies such as "Oh, formatting is easy!"... but nobody

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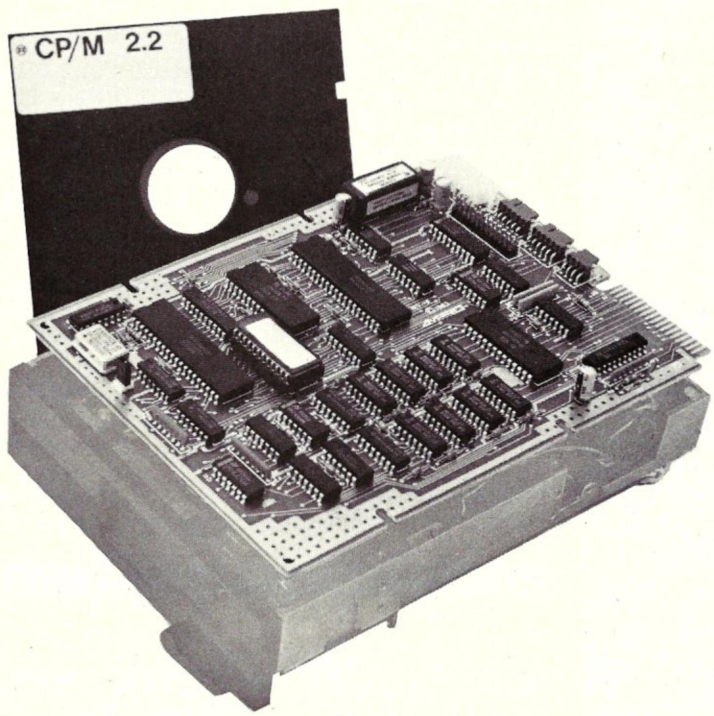

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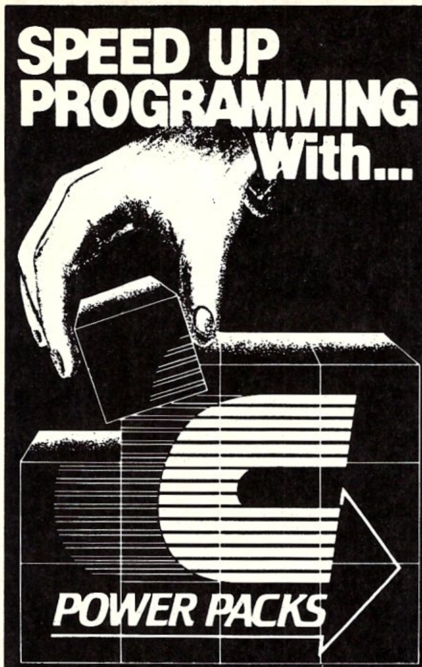

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CP/M Bus

Continued from page 30

could remember having written one. I did not have source code for the formatter supplied with my Versafloppy. I did not hear, until a few days ago, about public domain formatters (FORMAT, FORMAT91 and DFORMAT, available on Tarbell Public Domain Disk #2, at $10; and DFOCO, a format/copy program for Tarbell and Delta controllers on Vol. 38 of the CPMUG library—reputedly buggy but worth study). I therefore had to start from scratch, using information in the Western Digital 179x spec sheet, and decided to write the program in Forth, using the F83 Model version of the FORTH 83 Standard written by Michael Perry and Henry Laxen, which is available in the public domain. There is no space to describe that program here, but I will send a listing to anyone who requests it (but *please* send a stamped addressed envelope with your request). It is more relevant to describe the functions that a formatter must perform.

Formatting setup

The setup routines are nearly as important as the writing routines. Setup should provide facilities for selecting the drive in which the blank disk is to be formatted. Some formatters insist that drive A: be used; this means that the system disk must be removed and replaced with the blank disk—a most error-prone and dangerous proceeding, especially if adequate warnings are not provided! Setup should also allow selection of single/double sides, DMA/non-DMA data transfer, and standard single-density format as well as several double-density format(s). Above all, there should be good handling of erroneous responses—none of this nonsense about aborting if you reply 'y' instead of 'Y' after several correct responses! Case should not matter, and potentially dangerous actions should bring up conspicuous warnings and perhaps ring the terminal bell also. If you don't pay attention to these points, you can lose a lot of files!

Data stream

The data stream that must be written to each track on the blank disk is shown in Table 1 for four commonly used formats, and consists of eight sections. The Western Digital controller

Table 1. Track information for four typical formats

	IBM compatible		non-IBM	
	SD	DD	DD	DD
Fields	26 x 128	26 x 256	51 x 128	16 x 512
Preindex Gap	40 x 0FFh	80 x 4Eh	16 x 4Eh	16 x 4Eh
Index Mark	0FCh	0FCh	0FCh	0FCh
Gap 1	26 x 0FFh 6 x 00	50 x 4Eh 12 x 00 3 x 0F5h	16 x 4Eh 9 x 00 3 x 0F5h	16 x 4Eh 9 x 00 3 x 0F5h
ID Record:				
IDAM	0FEh	0FEh	0FEh	0FEh
Track #	xx	xx	xx	xx
Side #	xx	xx	xx	xx
Sector #	xx	xx	xx	xx
Sector Length	00 0F7h	01 0F7h	02 0F7h	03 0F7h
Gap 2	11 x 0FFh 6 x 00	22 x 4Eh 12 x 00 3 x 0F5h	22 x 4Eh 12 x 00 3 x 0F5h	22 x 4Eh 12 x 00 3 x 0F5h
Data Record:				
DAM	0FDh 128 x 0E5h 0F7h	0FBh 256 x 0E5h 0F7h	0FBh 128 x 0E5h 0F7h	0FBh 512 x 0E5h 0F7h
Gap 3	27 x 0FFh	54 x 4Eh	16 x 4Eh 8 x 00 3 x 0F5h	16 x 4Eh 8 x 00 3 x 0F5h
Gap 4	0FFh til INTRQ	4Eh till INTRQ	4Eh till INTRQ	4Eh till INTRQ

chips (type 179x) interpret bytes in the range 0F5h through 0FDh as instructions to perform an action such as presetting the CRC generator, writing two CRC bytes, or writing a different byte with a special, easily identifiable clock pattern.

In all of the gaps, the number of bytes shown is the *minimum* recommended by Western Digital, except that gaps 1 and 3 must contain exactly three bytes of A1 with missing clocks.

Because there is very little time for computation during writing, it is usual to establish a buffer into which the requisite number of bytes are placed before writing starts. This allows one to use the Write Track command provided on the Western Digital controller chips. The sequence of steps required is then:

1. Lay out the data and gap information for a complete track in the buffer.

2. Execute the Write Track command.

3. Transfer the data from RAM to the controller chip as requested by the chip (if DMA transfer is used, this is done by the DMA controller chip).

Items written at start of track

1. Preindex gap. Upon detection of the leading edge of the index pulse, write the preindex gap.

2. The Index Mark, indicating the start of the track, is 0FCh for all formats, but the chip writes it with a special clock pattern.

3. Gap 1 separates the Index Mark from the Sector ID record.

Items written for every sector

4. Sector ID record. Five bytes followed by two CRC bytes. The ID Address Mark (IDAM) is 0FEh for all formats. This byte causes the chip to preset the CRC generator. Track number is updated after writing.

The side number is initially 00, updated to 01 when all sectors on the first side have been written. The sector number is updated after writing. Sector Length can have only five values: 00=128 bytes, 01=256 bytes, 02=512 bytes, 03=1024 bytes, 04=2048 bytes. 0F7h in the data stream instructs the chip to write two CRC bytes.

5. Gap 2. In MFM (double density), 0F5h in the data stream causes the chip to write 0A1h with a special clock pattern.

6. Data record. The Data Address Mark (DAM) presets the CRC generator. The 0F7h in the data stream causes the controller chip to write two CRC bytes.

7. Gap 3 separates a data record from the following sector ID record. The program loops back to item 4 until all sectors of the track have been written, at which time it drops through to item 8.

Gap 4

8. Gap 4 is specified by Western Digital as 374 bytes for SD and 722 bytes for DD. In practice, writing of Gap 4 continues until detection of the leading edge of the index pulse generates INTRQ (interrupt request).

At this time Gap 4 is terminated. On a double-sided disk, the second side is written. Finally, the head is stepped to the next track; depending on the stepping speed, one or more revolutions of the disk may be needed before the drive and chip are ready to write the new track.

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CIRCLE 5 ON READER SERVICE CARD

The Graphics Palette

X3.64 graphics standard— its strengths and weaknesses

by Dave McCune

"And the Lord came down to see the city and the tower, which the sons of men had built. And the Lord said, 'Behold, they are one people, and they have all one language; and this is only the beginning of what they will do; and nothing that they propose to do will now be impossible for them. Come, let us go down, and there confuse their language, that they may not understand one another's speech.' " And so, the Lord created computer graphics. . . .

Graphics is the speech of computers. CRTs, printers, and plotters are the machines' mouths. The speech ranges from the grunting reticence of CP/M and MS-DOS to the effusive elegance of Lisa and Macintosh. Like the sons and daughters of Babel, though, these machines and their programs jabber confusedly in many tongues, each a potential poet speaking only to a mirror. There is no common graphics language.

Change is afoot, though. Graphics standards are slowly emerging. Like new towers of Babel, they are monuments to the power of communication. Some of these new standards may be smashed and scattered by the Lord of the marketplace, but others will survive and rise.

For the next few months, this column will be devoted to describing graphics standards, one each month. The purpose is not to make you an instant expert in a standard's use. Instead, we will try to describe the purpose, potential, strengths, and weaknesses of each of the standards. You may not be a sophisticated user of a new graphics standard after you read one of these columns, but you should know enough to decide whether to spend the time and energy to learn to use it.

The first standard in the series is also the simplest: it describes how to manipulate alphanumeric characters on CRTs and hardcopy devices.

It is easy to overlook the fact that alphanumeric characters are graphics elements, just like arcs and rectangles. In fact, one of the first computer graphics standards was the American Standard Code for Information Interchange (ASCII), which associated each of the 128 possible combinations of 7 bits with one alphanumeric character, punctuation mark, or simple formatting operation (such as carriage return or horizontal tab).

Because it enables computers to exchange data, the ASCII standard may be the most important agreement in the history of computing. But ASCII provides only very simple ways to format an alphanumeric display. The only way to put, say, an 'x' in the middle of a blank line is to enter enough spaces or tabs to move the cursor (or printhead) to the middle of the line, which is both clumsy and inefficient. And for video displays, ASCII provides no means of moving the cursor up the screen, in order to set up and fill in fields. ASCII also does not define text attribute commands such as **reverse video, blink, double-height text,** and so on.

Before we go on to examine a set of formatting control functions that address these issues, a bit of background concerning computer display devices is in order. The traditional mainframe or minicomputer configuration consists of a smart host computer connected to one or more dumb video terminals and printers. The video terminals consist of a CRT, video RAM, a character generator, and video refresh circuitry. In order to update the video display, the computer sends data bytes over a communication line (usually an RS-232 async line). Each byte represents an ASCII character, and the terminal arranges each incoming byte in video RAM for display. As the user enters data at the keyboard, each byte is sent back to the host. The host interprets the inbound byte and echos it back to the terminal, which then displays it on the screen. DEC's VT-100 video terminal is a common example of this type of display.

This configuration of host/terminal has a number of implications. First, updates to the video display can only occur as fast as data can be transferred over the communications line connecting the terminal and host. Even at 9600 bps, it takes more than 2 seconds to fill a 25-line by 80-character screen this way.

Second, if each character entered at the keyboard must be processed individually by the host's terminal driver and later (as is often the case) sent back to the terminal, the host wastes much time servicing character I/O on its communications ports.

Third, and most interesting to us, the storage of user data in the host's RAM must remain totally separate from the organization of data in the terminal's video RAM. An application cannot create a video display by directly storing its working data structures in video RAM. Even worse, the application can only transfer data from the working host RAM to the terminal's video RAM at relatively slow speeds. Finally, in the case of most dumb terminals, the host cannot address video RAM directly.

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Palette

Continued from page 34

we can compare our dumb terminal to the display generation process used on the IBM PC. In the PC, as in many modern micros, the video display is very closely integrated into the computer package. The functional elements tend to be the same, but the communication between the host (i.e., the CPU and its RAM) and the video RAM is much faster. Data is moved into video RAM over the micro's bus at blindingly high speeds. Further, the IBM PC can address specific bytes in video RAM. If the programmer knows how the sequence of bytes in video RAM maps to the character cells of the video image, he can manipulate the location of characters on the video image by simply moving bytes around in video RAM—and he can do this at very high speeds. On the PC, further, video RAM is dual-ported, so the video display circuitry can read bytes from this memory at the same time that the microprocessor reads and writes bytes. In fact, with a bit of clever organization, a programmer writing a word processor can arrange to have the arrays which make up the on-screen lines of text exist only in video RAM. Thus, as the program manipulates the data, the video image is instantly updated as well.

The advantage to the very open relationship between the PC's video display unit and the CPU is that applications can quickly and directly manipulate the video display; the disadvantage is that applications which do this are very hardware specific. A program that directly addresses specific bytes of PC video RAM is not likely to run on any computer other than the PC and very good clones.

A higher-level, less hardware-specific video interface is needed. The software that provides this interface insulates an application from the need, say, to address specific video RAM bytes or to set specific video attribute bits. The application need only invoke a high-level command, such as 'put cursor at row 10, column 15.' Manipulations of video RAM are irrelevant to the application.

There are two basic approaches to this high-level video interface. The first is to standardize calling conventions for a set of subroutines that provide the required graphics functions on a variety of computers. We could provide a library of C subroutines for various machines; one of the subroutines might be called **set_curs** and require two integer arguments, the row and column of the intended cursor position. As long as this standard subroutine existed on any computer, then our application could position the cursor in the same manner on very different computers. A major problem with this approach (which we will discuss in greater detail in future columns on other graphics standards) is that we must provide each target machine with library subroutines for all the popular programming languages. Furthermore, the calling conventions need to be identical for all the languages.

A second approach is to extend the primitive ASCII display driver included in most video display units and printers. Nearly all computers provide a simple, byte-oriented interface to ASCII output devices, e.g., Basic's PRINT and C's **putchar**. When we use this simple interface, we are actually passing bytes to the output device driver, which does the work of creating the proper display.

X3.64 is intentionally very broad, providing functions useful on 2D character-imaging I/O devices.

Suppose, however, that we extend this device driver so it can do more than simply output a character to the screen and then advance the cursor one cell. We could agree that certain sequences of bytes, when sent to the driver, should not be displayed, but should be interpreted as formatting commands. If we agree, for example, that the four-byte sequence '1Bh, 5Bh, 32h, 4Ah' means 'clear entire video screen,' and if our video driver can interpret and execute this sequence, then we can clear the screen by simply outputting these bytes using the PRINT or **putchar** calls. As long as the video driver on a particular machine has been extended to interpret these formatting sequences, applications on different machines and in different languages can easily manipulate graphics output devices in predictable ways.

The extended device driver can work just as well on the integrated host/VDT of the typical microcomputer as it can on the separated host and terminal typical of mainframes and minis. An application that interfaces to this extended graphics device driver is oblivious to the physical configuration of the computer system: the same display I/O code that manipulates the VT-100 display could work on the IBM PC.

In 1979, the American National Standards Institute (ANSI) adopted a set of control sequences that defines a wide range of formatting capabilities for ASCII display devices. The specification is officially designated X3.64-1979, and is entitled "Additional Controls for Use with American National Standard Code for Information Interchange." Some microcomputer and terminal manufacturers have adopted part of this standard. The ANSI.SYS video device driver provided by IBM for optional use on the PC is based on X3.64-1979, as are the formatting controls provided by DEC on its VT-100 terminals.

X3.64 manipulates and enhances the 7-bit characters described in the ASCII standard (X3.4-1977), but does not define any so-called 'character graphics,' such as the horizontal and vertical lines provided on some terminals for drawing menu borders, graphs, and so on. (There is no current standard which defines these simple character graphics. I wish there were.) X3.64 deals only with the positioning, editing, and formatting attributes of ASCII characters.

The standard is intentionally very broad and provides functions useful on "two-dimensional character-imaging input-output devices." These devices can include CRTs, printers, line printers, microfilm printers, bit-mapped typesetting terminals, and many others. Some functions, such as erase to end of display are obviously impossible to implement on non-buffered hardcopy printers. Any current implementation of X3.64, therefore, will be a subset of the functions covered by the standard. When you investigate an X3.64 implementation, you must carefully check which of the specific control functions are provided. As we shall see when we compare the IBM PC and DEC versions, implementations vary widely.

Table 1 lists a selection of the X3.64 control functions. A short mnemonic code is attached to each function (e.g., **CUP**, for cursor position.) Note that the mnemonic is merely a label for the function and is not the actual string of bytes that is sent to the X3.64 driver.

The actual string of bytes consists of an *escape sequence*. This is a technique used to encode non-ASCII control functions using only those characters contained in the ASCII set. This 'code extension' technique is described in another ANSI standard, X3.41-1974.

Table 1. Representative sample of X3.64-1979 functions

Name	Description	Code format
	Cursor movement	
CBT	Curs Bkwd Tab	CSI Pn 5Ah
CHA	Curs Horiz Abs—to spec'd pos in cur line	CSI Pn 47h
CHT	Curs Horiz Tab—tab fwd	CSI Pn 49h
CNL	Curs Next Line—to beg of nth subseq line	CSI Pn 45h
CPL	Curs Preced Line—to beg of nth preced line	CSI Pn 46h
CUU	Curs Up—up n rows of cur col	CSI Pn 41h
CUD	Curs Down—down n rows of cur col	CSI Pn 42h
CUF	Curs Fwd—forward n cols	CSI Pn 43h
CUB	Curs Bkwd—back n cols	CSI Pn 44h
CUP	Curs Pos—set curs at spec'd row and col	CSI Pn 3Bh Pn 48h
CPR	Curs Pos Rpt—ret cur curs pos to host.	CSI Pn 3Bh Pn 52h
NP	Next Pg—display nth pg fwd	CSI Pn 55h
PP	Preceding Pg—display nth preced pg	CSI Pn 56h
SL	Scroll Left—scroll visible dsply left n cols	CSI Pn 20h 40h
SR	Scroll Right—scroll visible dsply right n cols	CSI Pn 20h 41h
SU	Scroll Up—scroll visible dsply up n lines	CSI Pn 53h
SD	Scroll Down—scroll visible dsply down n lines	CSI Pn 54h
	Edit visual display	
DCH	Del Char—delete n chars at curs pos	CSI Pn 50h
DL	Del Line—delete n lines	CSI Pn 4Dh
ECH	Era Char—erase n chars (doesn't shift)	CSI Pn 58h
ED	Era in Dsply—erase display, w/parm: 0=fr curs to end, 1=fr strt to curs, 2=entire dsply	CSI Ps 4Ah
EL	Era in Line—erase line, w/parm: 0=fr curs to end of line, 1=fr strt of line to curs, 2=all of line	CSI Ps 4Bh
EA	Era in Area—erase dsply area	CSI Ps 4Fh
IL	Insert Line—insert n blank lines	CSI Pn 4Ch
	Format effectors	
HTS	Horiz Tab Set	ESC 48h (7-bit) or 88h (8-bit)
VTS	Vertical Tab Set	ESC 4Ah (7-bit) or 8Ah (8-bit)
PLD	Partial Line Down—subscript	ESC 4Bh (7-bit) or 8Bh (8-bit)
PLU	Partial Line Up—superscript	ESC 4Ch (7-bit) or 8Ch (8-bit)
HVP	Horiz & Vert Pos—set curs pos to row and col spec'd	CSI Pn 3Bh Pn 66h
SGR	Sel Graphic Rendition: 1=bold; 2=faint; 3=ital; 4=undscore; 5=slow blink; 6=fast blink; 7=rev video	CSI Ps 6Dh
	Typesetting and composition controls	
FNT	Font Sel—sel up to 10 fonts for SGR	CSI Pn 3Bh Pn 20h 44h
GSS	Graphic Sz Sel—set fnt ht	CSI Pn 20h 43h
GSM	Graphic Sz Mod—vert & horiz	CSI Pn 3Bh Pn 20h 42h
	Form Filling	
SPA	Strt of Prot Area	ESC 56h (7-bit) or 96h (8-bit)
EPA	End Prot Area	ESC 57h (7-bit) or 97h (8-bit)
	Miscellaneous	
DSR	Dev Stat Rpt: 0=rdy, no errs; 1=bsy, try ltr; 3=err, try lter; 5=pls rprt stat; 6=pls rprt curs pos	CSI Ps 6Eh
DA	Dev Attr—req/snd term ID	CSI Pn 63h
MC	Media Copy—strt/stp copy of incoming data to aux dev; e.g., lcl prntr	CSI Ps 69h
REP	Repeat—repeat preced char n times	CSI Pn 62h
	Modes	
SM	Set Mode—set 1 mode, per parm below	CSI Ps 68h

(Table continued on next page)

[This well-written, thorough standard should be required reading for all programmers. If you ever need to create control or graphics functions exceeding those provided by ASCII, X3.41 describes how to organize and invoke the new functions. The NAPLPS graphics standard described in "An Introduction to NAPLPS" (*Microsystems*, July 1984, pg. 54) is organized according to X3.41]. The basic principle is that the escape character (1Bh) is interpreted as the beginning of a control function. The particular function is defined by the final character, which must be in the range 30h to 7Eh. Thus the byte sequence "1Bh 40h" will be interpreted as an extra control function, supplementing the 32 standard ASCII controls in the 00h to 1Fh range.

The X3.64 standard builds on the X3.41 code extension technique and allows a parameter list inside an escape sequence. The escape sequence '1Bh 5Bh' is called a 'control sequence introducer' (CSI) and can be followed by a string of parameters in the range 30h to 39h (ASCII 0 to 9), separated by 3Bh (ASCII ';') and terminated with a final character in the range 40h to 7Eh. (A final character may also be preceded by an 'intermediate character' in the range 20h to 2Fh.)

Symbolically, then, the form for an X3.64 escape sequence can be:

```
ESC, F
```

or

```
CSI P ; P ; P ... I, F
```

where ESC = 1Bh, CSI = 1Bh 5Bh, F is a final character, I is an optional intermediate character, and P is a parameter.

To position the cursor (CUP) at row 10, column 43, then, we send this code to the X3.64 driver:

```
1Bh 5Bh 31h 30h 3Bh 34h 33h 48h
```

or, in the ASCII representation:

```
ESC [10;43H
```

Table 1 also lists the coding sequence for the X3.64 functions.

X3.64 functions

X3.64 provides eight basic types of functions:

1. Cursor movement. Cursor Position (CUP) described above belongs here, along with functions to move the cursor up, down, right and left. Also included are functions to move to Next Page or Preceding Page as well as to scroll the display up, down, left and right.

Palette

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Table 1. Representative sample of X3.64-1979 functions *(continued)*

Name	Description	Code format
RM	Rst Mode—reset 1 mode, as per parm below	CSI Ps 6Ch
IRM	Insert-Replace Mode	Parm = 34h
ERM	Era Mode—*reset*: era only unprot areas; *set*: era all areas	Parm = 36h
HEM	Horiz Edit Mode—*reset*: "del" or "ins char" shift data fol curs; *set*: shift data preced curs	Parm = 31h 30h
KAM	Kybd Act Mode—*reset*: enab; *set*: disab	Parm = 32h
GATM	Guarded Area Trnsfr Mode—*reset*: xfer only unprot data; *set*: xfer all data	Param = 31h

ESC = 1Bh; CSI (Cntrl Seq Introducer) = 1Bh 5Bh (7-bit) or 9Bh (8-bit); Pn = num parm; Ps = sel parm (index into a parameter list). Note: this is a partial list of the nearly 100 functions in the full X3.64 spec.

These latter functions assume a terminal which buffers more data than it displays at any one time; i.e., the display screen is a window into a much larger display. This is a feature that would be useful in a word processing or spreadsheet application, since the host computer could download several 'pages' of data to the terminal at once. The terminal might have enough intelligence to manipulate this large chunk of data locally, sending it back to the host only when the user was finished with it.

The scrolling functions are one of the unfortunate weaknesses of X3.64, since they only permit scrolling of the entire screen display. It is not possible, for example, to create a 'scrolling window,' i.e., a subset of the display screen that can be scrolled without disturbing the rest of the screen.

2. Editing of visual display. These functions allow you to erase lines and characters from the display, or to insert blank lines and spaces.

3. Format effectors. These include setting and clearing horizontal and vertical tabs, super- and subscripting, the normal ASCII format controls (carriage return, linefeed, etc.), and a function to set graphics attributes of text such as blink, reverse video, underscore, etc.

4. Typesetting and composition controls. These functions are intended primarily for bit-mapped graphics terminals or phototypesetting equipment, and can be used to specify character size (in typesetting units called "decipoints"); select one of several implementation-dependent fonts; change the number of characters and/or lines per inch; and justify, center, or hyphenate.

5. Form filling. This allows an application to protect areas of the display so that users can input data into unprotected, blank areas only.

6. Device and software control strings. The programmer can use various delimiters to encode ASCII command strings intended to be read by a program running on the target machine.

7. Miscellaneous functions. These include a code to reset the local terminal

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to its initial state (this state, unfortunately, is not defined in the standard); to command the local terminal to send all further input to an auxiliary device, such as a local printer; or query the local terminal as to its current state (e.g., the current cursor location).

8. Modes. The precise action of many the functions is determined by which of 19 modes is currently set. For example, if Insertion-Replacement Mode (IRM) is set, the insertion of a new character causes all subsequent characters to be moved one character position to the right; if IRM is reset, a new character overwrites the character at the current cursor position. To give another example, if the Control Representation Mode (CRM) is set, incoming control characters are displayed on the screen. (A little-known ANSI standard defines the graphic representation of all 33 ASCII control characters. Unfortunately, most terminal manufacturers ignore this standard—called X3.32-1973—and make up their own graphic representations of control characters. The IBM PC's awful "happy face" graphics for 01h and 02h are an annoying example.) Modes are set with the Set Mode and Reset Mode (SM and RM).

Given all of these whiz-bang functions, why doesn't everyone use X3.64? Basically, because X3.64 is not a very good standard.

First, it is both poorly written and badly presented. Compared with other ANSI standards—X3.41 on code extension is a good example—the language here is scandalous. Try this sentence: "In each structured capability described private or experimental positions, or both, are provided for implementors to use without risk of negative impact by later standardization." Is this English? And with a subject matter requiring clear, typeset tables, we get uneven, typewritten columns. It is ironic that the committee which developed and wrote this standard included representatives of IBM, DEC, and Xerox—companies that would never have released documentation as shoddy as this.

Alphanumeric characters are also graphics elements.

Second, in an attempt to remain hardware-independent, the standard tries to be everything for everybody, and succeeds in being little for anybody. It is not reasonable to attempt to present one complete, consistent, and coherent standard that satisfies the graphics needs of every kind of hardware, from line printers to bit-mapped typesetting terminals. The purpose of a standard is not simply to offer a collection of suggestions or ideas to manufacturers of different types of hardware, but to provide a clear and concise yardstick against which endusers can measure competing hardware and with which programmers can write code that is portable from, say, one printer to another. As anyone who has struggled with printer drivers for Epsons, Okidatas, etc., is aware, a clear and basic set of standard character/printer functions would be a godsend. Those functions may lurk inside the forest of functions provided by X3.64 for the generic "two-dimensional character-imaging input-output device," but they are hard to find.

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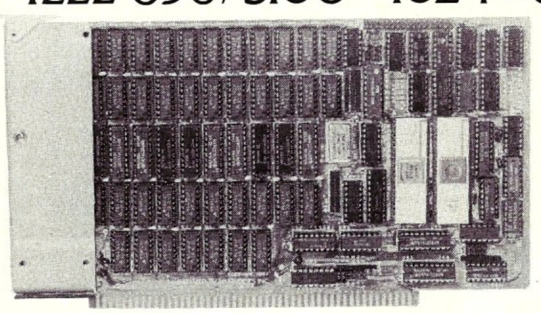

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Palette

Continued from page 39

A more useful approach would be a set of standards that explicitly defined a set of functions for each type of device currently on the market, e.g., dot-matrix character printers, line printers, bit-mapped color video units, and so on. Moreover, the standards should carefully define what a device should do if requested to perform a function that is beyond the hardware's capabilities.

Third, and most aggravating, X3.64 either fails to deal with many fundamental issues, or leaves them to the manufacturer's discretion. We mentioned variable scrolling regions and simple line graphics, which are ignored by X3.64 and so implemented in totally different ways on different terminals. In fact, X3.64 offers a set of control sequences that are to be interpreted as private codes for use by individual manufacturers. It is indicative of X3.64's problems that both DEC and IBM—neither of whom supply unusually sophisticated capabilities on their monochrome terminals—were forced to make heavy use of these private codes. Other missing features: shape and size of cursor, color (the color functions defined in the IBM PC's ANSI.SYS come from a different spec, ISO 6429, by the International Standards Organization), save and restore graphics attributes, and definition of programmable keys.

Phrases such as "not defined by this standard" pepper X3.64. As an example of an intentional but painful ambiguity, we can look at what happens if a character is received by a terminal when the cursor is already at the rightmost column. X3.64 lists six possible implementation-dependent actions, such as blocking all further input, causing the cursor to disappear, wrapping around to the next line, or "some other implementation-dependent action." God help the programmer [and the user—Ed.]. The standard should at least offer a means of selecting among the options via the Set Mode function.

All in all, it would be hard to write a complex application, such as a competitive word processor, that relied entirely on X3.64 functions for terminal I/O. This does not mean that we can do without standards for I/O to various kinds of printers and video devices. Indeed, as multiterminal microcomputer systems spread, standard functions for driving remote video terminals are becoming as important to microcomputer programmers as they have been in the mini and mainframe world. But X3.64 is not the ideal standard.

Dave McCune, Proteus Group, Inc., 195 Garfield Place, Brooklyn, NY 11215

Titles of the standards referred to in this series are given below. They may be obtained from: **American National Standards Institute,** *1430 Broadway, New York, NY 10018.*

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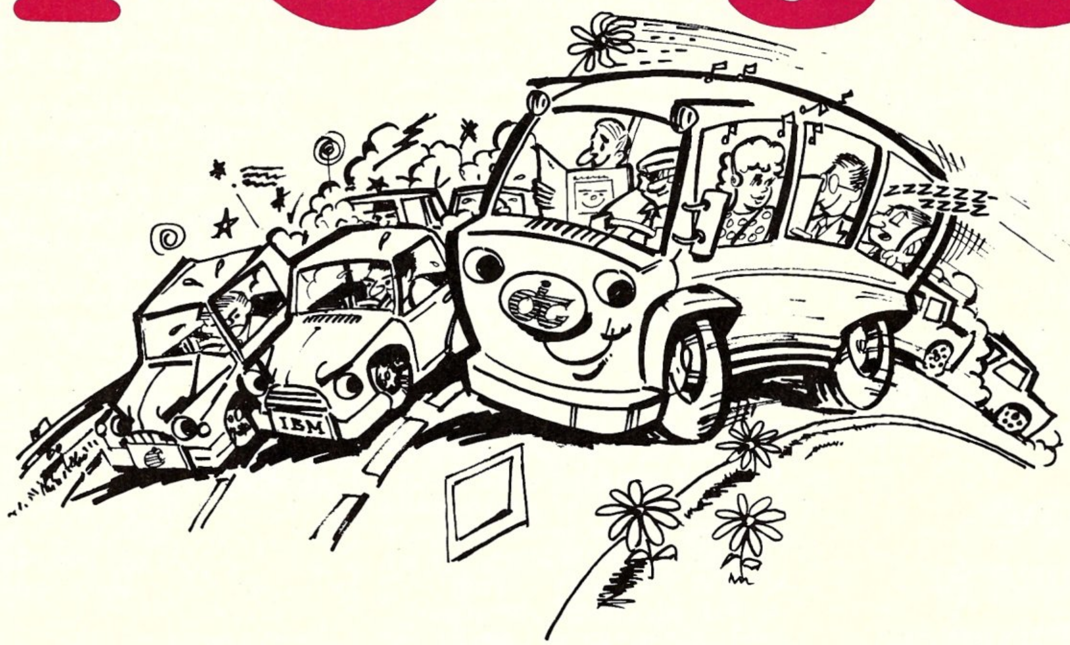

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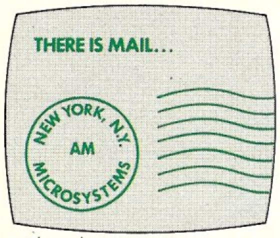

Letters to the Editor

This month... Converting to MS-PRO may be easier than you think; updating our user group directory

Dear Sir,

Let me make some comments on Andrew Bender's review of MS-PRO in the March 1984 issue of *Microsystems.*

He is quite right that you need the hardware configuration as specified by Computer House to bring the system up, but converting over to other interface hardware is not quite the problem he portrays. At least not with the release I received (version 2.3). Computer House now supplies source for three I/O drivers—Console, Printer, and Auxiliary. A quick change in port assignments and possibly in status masks will get these drivers working with most, if not all, CompuPro I/O boards and many others.

Bender states that a different console driver cannot be installed in the system because it is part of the IO.SYS. This is only partially true. Computer House will supply the memory location of the port addresses within IO.SYS to allow a board like the Interfacer 1 or 2 to be fully used. These are easily patched with DEBUG. Furthermore, using the source for the Console driver supplied, a new CON may be attached via the CONFIG.SYS. The only drawback to this approach is that the sign-on message is lost. This part of the sign-on message is sent to the System Support Board.

Bender complains that MS-DOS does not have a user-modifiable BIOS, but that drivers must be attached by the CONFIG.SYS file. This is an important advantage of MS-DOS 2.0, since the user can very easily add or omit drives as required for a particular task. Furthermore, any number of drivers of any description, within memory limitations, may be attached with user-supplied names. He is right that drivers are much more complex than in CP/M and are difficult to debug.

Computer House claims that programs written for MS-DOS and PC-DOS which don't use "the graphics and screen commands peculiar to the IBM PC" should run under MS-PRO. There are at least two further limitations that I have encountered:

1. Buffers a little over 512 bytes under PC-DOS are a little over 1024 bytes under MS-PRO. Therefore, programs that work up to limit of available memory on the IBM-PC may not work under MS-PRO. Some programs require eight or more buffers to work properly.

2. In the IBM PC implementation of MS-DOS 2.0, there is a device driver called ANSI.SYS which emulates a console using the ANSI control sequences. To write a full ANSI.SYS for a particular terminal is a major task, if it can be done at all for some terminals.

MS-PRO has at least two serious disk error-handling problems. The first occurs if a 5.25" drive is accessed and a disk is not present: then the system will hang, requiring a hardware reset. The second is that the system will try to write to a write-protected 8" disk and not know it!

I have on several occasions experienced scrambled disk files for unknown reasons.

With respect to the EPROM for the Disk 1 supplied, it will support both the CPU 85/88 and the CPU 86/87. It does not support the CPU 68K. Also, it will only work with Rev. F of the Disk 1. I believe that they now have a patch for the Rev. D of the Disk 1.

Although MS-DOS still has some problems, I am happy to have it. Further updates, which cost very little, will hopefully correct the outstanding problems.

Robert H. Hamstra, Jr.
Electronics Consultant
669 Kirk Glen Drive
San Jose, CA 95133

Editor's note:

News of two users groups came to our attention recently:

EpsonConnection—Detroit, MI. This is an international Epson computer users group with approximately 4000 members. EpsonConnection is also assisting in the formation of local users groups, with approximately 250 such groups already formed or in the forming stages.

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The EpsonConnection
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Another reader, Jeff Johnston from Columbus, GA, has sent in the address for INSUA (International North Star Users Association). Dues are $20/yr.

INSUA
P.O. Box 2789
Fairfield, CA 94533

We are planning to update our directory of users groups in a future issue. If you would like your group to be included, please send full information to Chris Terry, Technical Editor, *Microsystems,* One Park Ave., New York, NY 10016.

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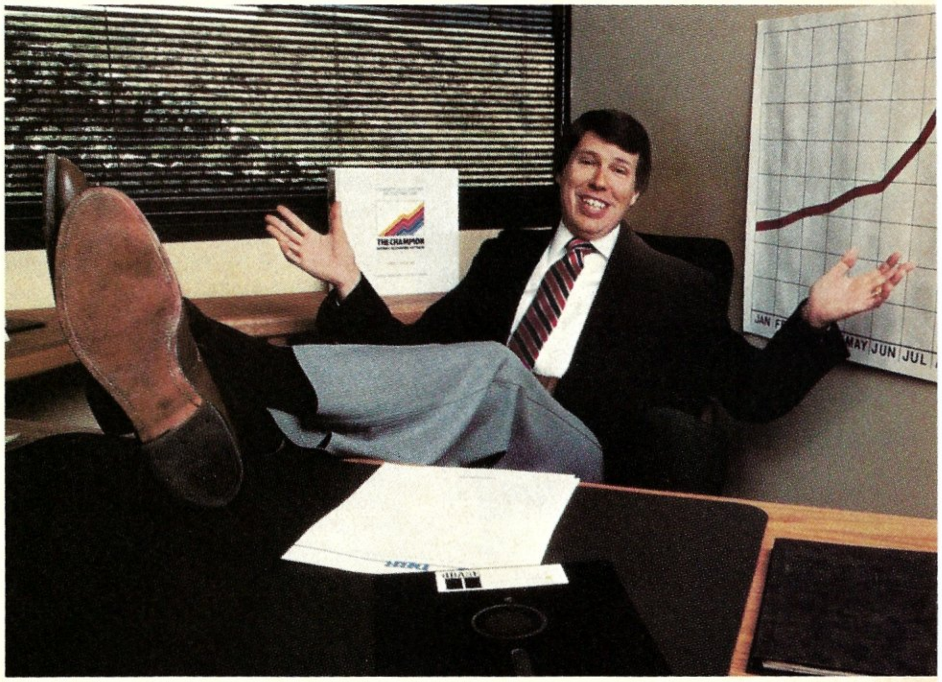

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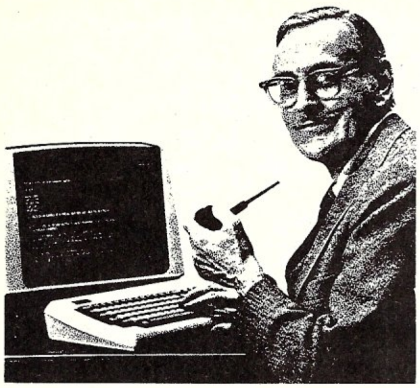

New releases for 16-bit software; recent books

by Chris Terry

As of June, the CPMUG library appears to be static; nothing has been issued since Volume 92, which came out about a year ago. The SIG/M and PC Blue libraries, on the other hand, continue to grow at the rate of several volumes a month—June saw the release of SIG/M Vols. 173-176, and PC Blue is up to 53.

New release highlights

SIG/M Vol. 173 has a program (80T86.CNV) that translates 8080 assembler source code to 8086 assembler code as part of a Regular Expression Compiler. Also, Vol. 175 is entirely devoted to CP/M-86 programs, including MODEM901, Squeeze and Unsqueeze, and a program that demonstrates BDOS Function 47 for Chaining from one program to another.

SIG/M Vol. 176 has some interesting tidbits. New items include a library of routines for CP/M Plus; more of these routines will appear in future releases. Another library contains routines for calculating dates in various formats, using DRI's base date of 1978. Even more useful is a SUBMIT facility that allows conditional statements. Updated versions of Super Directory and DU are also on this disk.

Books

A number of books, directly or indirectly related to public domain software, are addressed to nontechnical readers, but may be valuable to the sophisticated user also because of the wealth of information on large databases.

Computer Communication Techniques, by E.G. Bruner and Phil Wells (Howard Sams & Co, Inc., 1983) is a competent overview of hardware standards, basic principles of communications, and protocols. If you built your own computer, you won't find anything new, but it's the kind of book to recommend to anyone who is just starting. It was written before inexpensive and intelligent 1200-baud modems became readily available, but it is a good book for people who want just the basics.

Microcomputer Communications: A Window on the World, by Barbara E. and John F. McMullen (John Wiley & Sons, Inc., 1983) concentrates more on the software side. It appears to be addressed to the Apple user who wants to access databases such as the Dow Jones or the New York Times. Appendices list vendors of terminal programs; bulletin board systems; Telenet, Tymnet, and Uninet telephone numbers for access to timesharing systems; examples of how you would use various databases provided by The Source; a CompuServe database subject index; sample Dow Jones data; and an alphabetic listing of subjects for the Dialog Information Retrieval Service.

The Complete Handbook of Personal Computer Communications, by Alfred Glossbrenner (St. Martin's Press, 1983), is a much more comprehensive book of 324 pages. It covers all of the information in the McMullen book in a great deal more detail. In addition, step-by-step procedures are given for logging onto various services and accessing databases. A chapter on "What you need, and need to know, to go online" gives basic information for nontechnical users on modems and how to choose them. The last chapter gives basics on communications, and tips on how to handle some of the problems you may encounter (such as transmitting control characters); Appendix A has some troubleshooting tips that are helpful in pinpointing troubles to equipment malfunction or operator error. Clear, readable, and valuable to anyone who needs information on what databases are available to the public, and how to access them.

Free Software for the IBM PC, by Bertram Gader and Manuel V. Nodar (Warner Books, Inc., 1984) is a guide to public domain software available on bulletin boards and RPC stations. The programs are grouped by topic, with the size of each and telephone numbers of the stations that have them. For each program, the known variants and updates are listed. There are also some useful comments on the programs. One chapter describes bulletin board procedures, and another gives information on how to go about setting up your own bulletin board.

A Guide to Free Software is being published in several volumes by Glenn Hollowell, P.O. Box 47527, Garland, TX 75047. *Volume 1: The CP/M Users Group Public Domain Library* appeared early this year. It consists of a volume summary, listing the main topics of each CPMUG disk volume; a function index; a filename index; a file description section, by volume, showing program name, size, function, format (MAC, executable object, text, etc.), and a brief description of the program. Useful for the listing by function, but nothing like as good as the more expensive NYACC catalogs, which have full documentation for the major programs. No information is yet available about future volumes in this series.

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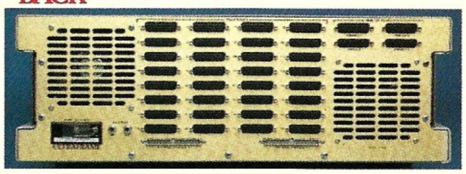

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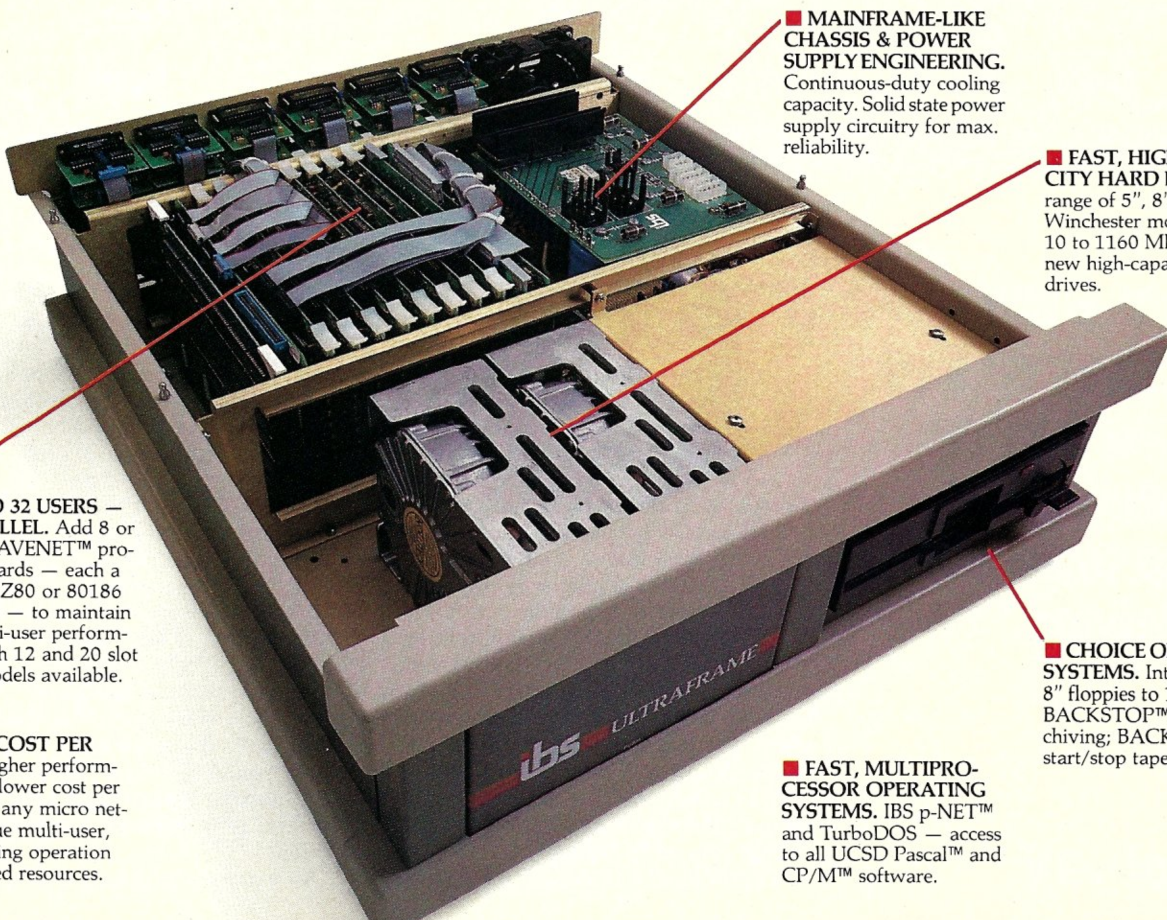

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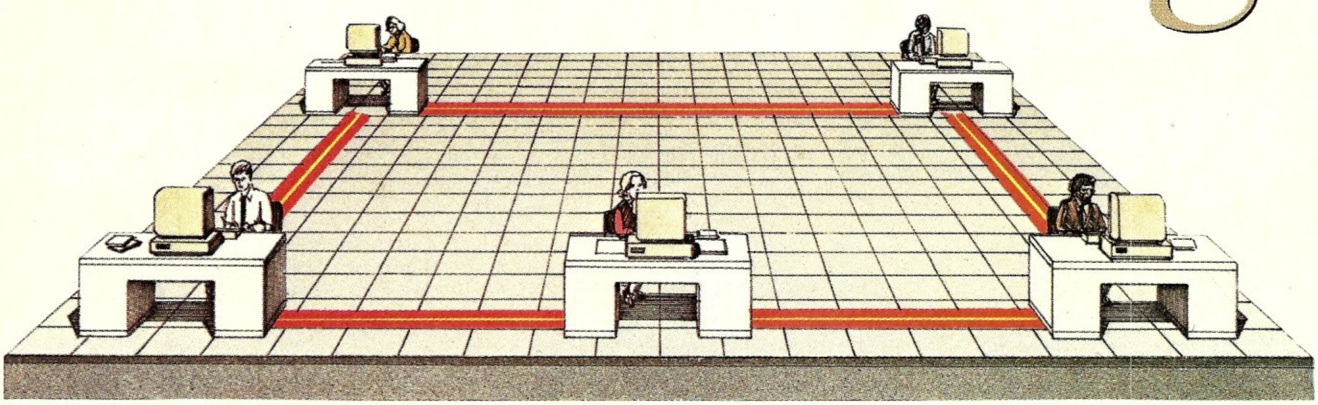
Philosophy of Local Area Networking



Select a LAN architecture and the supporting software with these practical guidelines

by Leo Hoarty

The explosion of personal computers into the corporate environment has created a real need for a technology to tie the scattered resources of these individual workstations into a more powerful whole. The tremendous profits possible have created a similar explosion in solutions. Local area networks are one increasingly popular approach. The problem for the potential purchaser is complicated by the fact that no firm standards yet exist for defining the methods (protocol) of communicating (data interchange) on local area networks. As a result, one is faced with a babel of factions, each touting the unique (and thus incompatible) merits of their respective products.

I would like to detour a bit from previous discussions of networking and present an overview of current LAN technologies. Rather than giving a strictly technical presentation, this article will address the practical questions of a prospective user of LANs—someone looking to make a decision or a possible acquisition today. To do this, one needs to know the many LAN technologies and the significance of each.

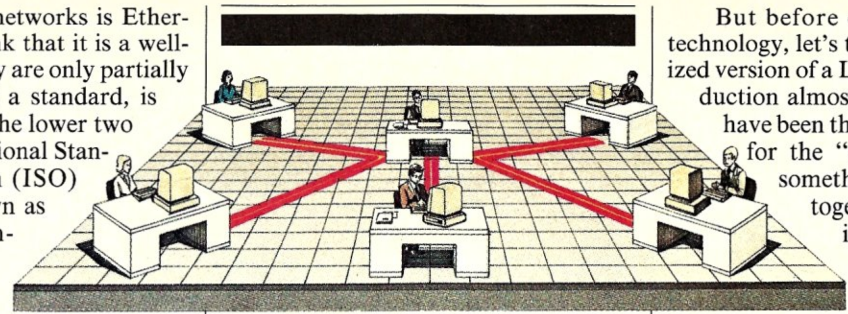
What is baseband and what is broadband? What is the difference between contention and token passing? Does a user need the high speed of Ethernet, or will a lower-speed network suffice? Should a user choose a token-passing network, with its guaranteed response time, or will a simpler contention-based system be adequate? These are just a few of the questions to be addressed here. As much as the various vendors would like you to believe otherwise, choosing a particular product/technology is by no means a straightforward task.

An example of the confusion surrounding local area networks is Ethernet. Most people think that it is a well-defined standard; they are only partially correct. Ethernet, as a standard, is embraced as part of the lower two layers of the International Standards Organization (ISO) network model known as the Open System Interconnect (OSI). However, Ethernet is just a *hardware* standard and makes no attempt to define data exchange standards (the five higher layers of the OSI definition). Any computer equipment claiming Ethernet compatibility will function on the same network with other Ethernet devices without causing interference. However, unless the various computers on the network use the same network interface software (such as EtherShare from 3Com) the various dissimilar devices will not be able to communicate.

In defense of Ethernet, however, incompatibility problems plague other local area networks as well. In fact, Ethernet has a greater possibility of overcoming this limitation than do other LANs, because the Ethernet community has agreed on hardware standards. At least different makes of computers can peacefully coexist on the same Ethernet network, even though they cannot exchange data—yet. Most other LAN systems are designed only for one manufacturer's hardware, such as DECnet for Digital Equipment Corporation computers or WangNET for Wang. Of the dozen or so (at last count) LANs for the IBM PC and compatibles, very few can even share a cable with anything but similar personal computers.

The International Standards Organization (ISO), with the cooperation of other organizations such as IEEE, ANSI, ECMA, and CCITT, is attempting to resolve this problem of total incompatibility by defining a data interchange protocol (as well as three hardware protocols) through the Open System Interconnect (OSI) standard (see "Implementing X.25 Communications Protocol," *Microsystems,* June 1984, p. 46). The OSI protocol, when completed sometime in 1985 and when adopted by the LAN industry, will allow more compatibility, but the standard will take some time to reach the market in the form of compatible LAN systems.

Even when the open system interconnect standards are cast in concrete, compatibility will still not be a bed of roses. By the time a standard does exist and does become implemented, so many LANs will

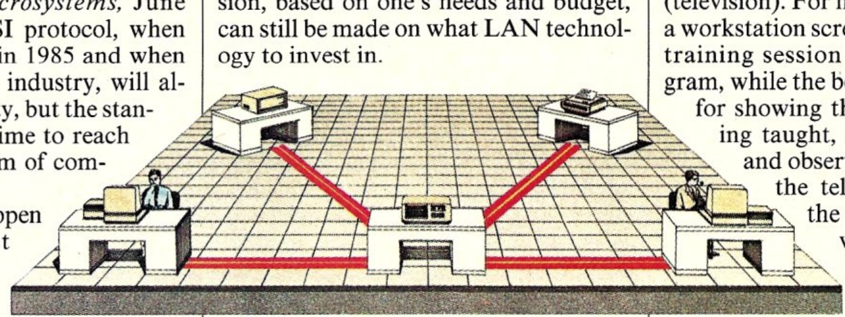


Star-based LANs radiate from a hub. Bus LANs tap into a single cable.

be in service that conforming to the standard will require extensive modification to the LAN software used in every installation. This assumes, of course, that the particular LAN in use is capable of being converted to conform. Not all are.

Ironically, many manufacturers of local area networks, particularly for the IBM PC and compatibles, are claiming conformity with the ISO OSI. This is very interesting, considering that the ISO is only halfway through developing the OSI standard. What these companies mean by their claim of conformity to the open system interconnect model is simply that they have adopted a portion of the seven-layer network approach used by the ISO—which does not mean much at this point.

The computer industry is still far from the original dream of open-architecture local area networks, where dissimilar devices can communicate with each other. However, a practical decision, based on one's needs and budget, can still be made on what LAN technology to invest in.



But before discussing available technology, let's take a look at an idealized version of a LAN. Since their introduction almost 10 years ago, LANs have been thought of as the answer for the "office of the future": something that would weld together the ever-increasing universe of automated office equipment—from the desktop workstation to the copy machine. The thread linking these together would be an electrical or optical cable snaking through the workplace, under floor tiles or overhead, connecting machine to machine.

Somewhere in the office a master control computer (called a disk or file server) monitors the information traffic, sending and receiving data items on request from the various workstations (nodes), maintaining the confidentiality of the data entrusted to it, and sharing the programs designated common to all. Users on the network could send electronic mail or share data with one another, and access peripherals such as printers. For instance, the draft of an annual report could be set by a dot matrix printer for proofreading. When ready, the same report could be merged with graphs and sent to a high-quality laser printer, perhaps in another part of the building, for final output.

When an office worker is given a new workstation, a tap is made into the nearby cable, allowing *community access telecomputing.* Another tap connecting the node to the corporate computer via a *gateway* (a device that translates data to a form understood by both the mainframe and the network personal computers) would give the user access to vast pools of information formerly locked in the electronic vaults of the data processing department. (Remember, this is only an idealization.)

One existing LAN technology known as broadband allows multiple information channels on a single cable. Thus one or more channels can carry data while other channels carry video (television). For instance, the top half of a workstation screen can display a video training session on using a new program, while the bottom half can be used for showing the actual program being taught, keying in commands, and observing the results. When the telephone rings next to the workstation, the conversation is carried over the same cable as the computer data. One wire, serving all the needs of the office.

The above vignette illustrates the future of local area networks. To under-

Philosophy

Continued from page 47

stand the advantage and limitations of available LAN technologies, it is helpful to understand that local area networks consist of quite separate hardware and software aspects. We will begin with an overview of the different LAN hardware types.

LAN hardware

Baseband vs. broadband. Two methods exist for carrying information over the cable in a LAN. One, called baseband, is exemplified by Xerox's Ethernet. The other, called broadband, is typified by Wang Computer's WangNet. Baseband systems carry only one channel of information. This information is combined with a clock signal—usually done with the Manchester encoding technique—and then the combined clock and data are pushed out onto the LAN cable at a fixed rate from about 300,000 bits per second (bps) upwards to 80 million bps, depending on the manufacturer.

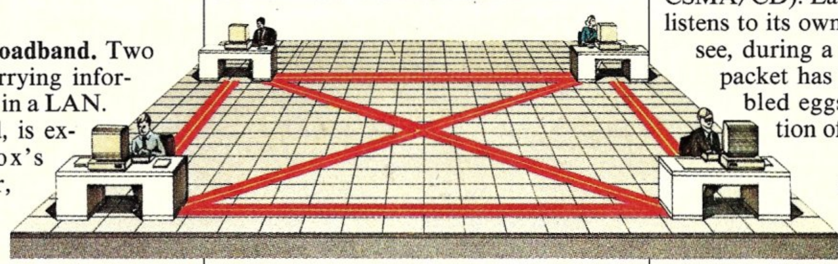
Broadband, on the other hand, usually has a total cable bandwidth of about 300 MHz (million bps), and typically has six or more channels that carry information (data, video, or telephone) at anywhere between $\frac{1}{2}$ million and 20 million bps. Broadband LANs have a distribution system similar to cable television in that similar cable and distribution amplifiers are used. A major expense of broadband LANs comes from the need for RF (radio frequency) modems to encode and decode the high-speed data channels for each workstation on the network. RF modems are considerably more expensive than the cable TV decoder box that sits on top of your home TV, though they have the similar function of extracting the desired channel from the cable traffic.

LAN network protocols

Contention vs. token passing. Two methods, or protocols, are available for communicating on either baseband or broadband. The first, known as the contention method, is asynchronous. Each workstation (called a node) transmits whenever it has something to send and the cable is free of other traffic. The second, known as token passing, is synchronous. A token is a specially marked, empty data packet that is passed from node to node around either a physical or logical loop. When a node wishes to transmit, it waits for the token and replaces it with the data packet(s) it wants to send. The token is put back on the loop when the message is complete, so that another node can grab it and speak.

Contention

With the contention method, each workstation contends for service on the network. When a node (user) wishes to send a message, the network interface electronics in the user's computer first checks to see if there is any traffic on the LAN cable. If the cable is busy, the node simply waits. When all is clear, a message is transmitted. Data transmitted over the network is broken up into small packets of 64 to 1500 bytes each. At the head of the data packet is the address of the intended recipient, as well as the address of the sender (Figure 2). At the tail end of the packet is an error correction code, so a recipient can be assured of the integrity of data received. In short, data sent over the network gets bundled up with lots of codes to make the trip. If a long file is being transmitted and another node urgently needs to use the network, enough time exists between packets of the first transmission to interleave packets of the second.



Tightly coupled LANs are a variation on star topology.

For any data packet put out on the network cable, every node must examine the packet to see if it is addressed to that node. If not, the packet is just ignored. When a node receives a packet addressed to it, the packet is broken up. The sender's address is removed, then the data portion is examined against the error correction code. A confirmation is sent back to the sender if the data is intact (most of the time). Otherwise, a request to retransmit the data is returned to the sender.

Collision detection. Depending on the number of computers connected to the LAN and the amount of traffic, two computers may try to send a message simultaneously. If so, a collision will occur. Two popular methods are used to alleviate this "contention" problem. The first is called collision detection (the full name is Carrier Sense Multiple Access with Collision Detection, or CSMA/CD). Each transmitting station listens to its own transmission and will see, during a collision, that its data packet has been turned to scrambled eggs by the superimposition of a foreign data packet. After a collision is detected, a jamming signal is sent out notifying the intended receiver to discard whatever part of the data has already been received. Next, the stations involved in the collision wait for a random interval and try again—this is called random back-off. To make this scheme workable on large, contention-based LANs, an additional method called exponential back-off is used. If collisions continue after a random back-off, each node doubles the length of the random interval. This technique will always resolve heavy traffic contention problems, but involves noticeable delays in accessing the LAN.

Another interesting cause of collisions is the travel time required by the data packets. On medium-to-long networks of 500 feet or more, the data packet sent by one node may not reach the receiving node before that node assumes a quiet cable and begins its own transmission, causing a collision.

Consider that electrical signals travel through copper cable at approximately $\frac{7}{10}$ the speed of light, or about 600′ per millionth of a second. Ethernet sends a bit of data every 100 billionth of a second, which means that a data packet moves only 60′ per bit of data transmitted. If two nodes are 600′ apart, then 10 whole bits can be transmitted by one node before the other node knows about it. You see, the speed of light isn't all that great.

Collision avoidance. A variation on the above protocol is called collision avoidance. Its full title is Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). This is a much simpler protocol, and no attempt is made to detect a collision. The transmitting station knows about a collision only by the absence of a confirmation from the intended recipient. The reason the term "collision avoidance" is even used (it sounds superior to collision detection, though it is not) is that the transmitting stations each wait for a random time interval after the cable goes quiet before attempting to transmit. This is not the greatest way to do business, but for small systems (3 to 10 users) it is adequate. For a large system, it loses effectiveness.

The loss of effectiveness in large systems occurs because each station uses a pseudo-random-number generator that cycles through a limited number and range of delay times, typically 1 to 700 microseconds. With a large network, close delay times can come up on two or more stations wishing to talk. When collisions occur on avoidance-based systems, the transmitting station has to wait many seconds before realizing the absence of a reply, as other nodes' transmissions could be delaying the response.

Collision detection based systems can also use the collision avoidance technique of short random delays before transmitting after the network cable goes quiet. Though this can reduce collisions, it will also slow down the network. Nothing is free, folks.

Token passing

The other major protocol is the token-passing method. Token-passing is more complicated to implement than the contention-based system—both in the hardware and particularly in the software. Its attraction is that it offers a guaranteed response time to every node on the loop. Because there is no contention for service, the possibility of collisions is removed, guaranteeing access to the LAN when the token arrives. This translates to a much greater sustained throughput on the network under heavy traffic, while contention-based systems, in contrast, experience considerable delays under heavy traffic due to increasing numbers of collisions.

With the good comes a little bad. One small problem with token passing is the finite delay of the packets each workstation on the LAN causes. This delay is caused by the node's electronic circuitry. Every node on the network reads the destination address at the head of a data packet as it goes by. When a data packet addressed to a particular node arrives at its destination, the destination node keeps the packet. Otherwise, the data packet is retransmitted to the next node in the loop. This analysis of the data packet address is what causes the delay, which can range from one to several hundred microseconds per workstation.

The delay on a 100-user network can be as much as 10,000 times more than the actual network transmission time. A limitation to the total network throughput is felt, particularly when there is a high volume of short data packets, such as network service requests and acknowledgments due to this delay between requests. The delay problem becomes less acute during long transmissions, such as sending lengthy word processing files.

Another problem encountered with token-passing loop delays is that it limits the maximum number of nodes to which the loop can grow. This is because the token-passing network operates synchronously, with all nodes clocking data in and out in concert. If the delays around the loop are too long, stability and immunity to noise become a problem.

Broadband technology is the ultimate approach to local area networking, but the price for this flexibility is high.

The access delay on a token-based network may seem lengthy, but at least it is predictable. One hundred workstations on a contention-based LAN such as Ethernet can lead to considerable and unpredictable delays during heavy network usage. (Network usage is rarely evenly distributed, but more likely follows the statistical observation known as a Poisson distribution, or the clustering of events. In other words, for a while few workstations use the network; then suddenly everyone wants to speak. This is not a law, but just an observation.)

A disadvantage of the token-passing LAN is that it requires more sophisticated hardware than the contention system. The software required to control token systems is also more complicated. For instance, on a token-passing LAN, the file server/system controller has to be able to detect the absence of a lost or mangled token and replace it. Tokens can be lost due to a node failure or electrical noise on the cable.

In summary, a token-based network can be considered as a well-disciplined, synchronous approach to local area networking with predictable response time and an orderly flow of information. A contention-based network is an asynchronous, open approach where all nodes can have equal status but no guaranteed response time.

Broadband: all things to all people

Broadband local area networks have the distinct advantage of carrying multiple channels of information. These channels of information are superimposed onto individual radio frequency carriers in exactly the same manner that television channels travel over a common cable and remain independent. This technique is equivalent to having 5 to 20 baseband (single channel) local area networks on one cable. If desired, some data channels can use the contention method while others can use token passing.

Not only can broadband carry data, but it can carry video and voice channels as well. For instance, one can have video disk archives of company products, or perhaps video disk software training programs, any of which can be randomly accessed and displayed on the user's color display. Voice channels on the cable can carry an entire corporation's telephone traffic. In addition, voice messages can be digitized (digital audio) and stored on disk to be forwarded to another network station in a fashion similar to electronic mail. The recipient, in this case, listens to the message on the workstation's telephone handset or speaker.

Broadband technology is the ultimate approach to local area networking, but the price for this flexibility and capacity is high. For this reason, broadband is appropriate only for very large systems that can exploit the full potential of this technology. Needless to say, broadband is not a viable choice for small personal computer based networks. The software needed to control such a system would overload a little engine such as the Intel 8086 family used in today's PCs. Obviously, in the near future, the power of personal computers will increase, and the cost of broadband hardware will decrease to the point that broadband will become practical for even a small system.

In summary, the broadband local area network serves all the needs of an office with just one cable common to all functions.

The PBX as a Local Area Network

The private branch exchange (PBX) is the dark horse candidate in the local area network race. Almost all me-

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dium-to-large businesses already have voice-only PBXes. The latest trend is to add data transfer capability to PBXes, creating the voice/data PBX. This approach has one plus and a few minuses. The major advantage of the PBX as a local area network is that it uses existing telephone wiring. The disadvantage is a severe restriction in data channel bandwidth that translates to a very compromised data transfer rate.

Broadband LANs use many channels of data, each superimposed on a different frequency carrier, whereas the voice/data PBX shares its single channel among time slots for voice intermixed with time slots for data. Voice information is first converted to binary numbers (digital audio) before it is mixed with data. This is done so fast that there are no audible interruptions to the voice channel. Voice/data PBXes cannot handle video information.

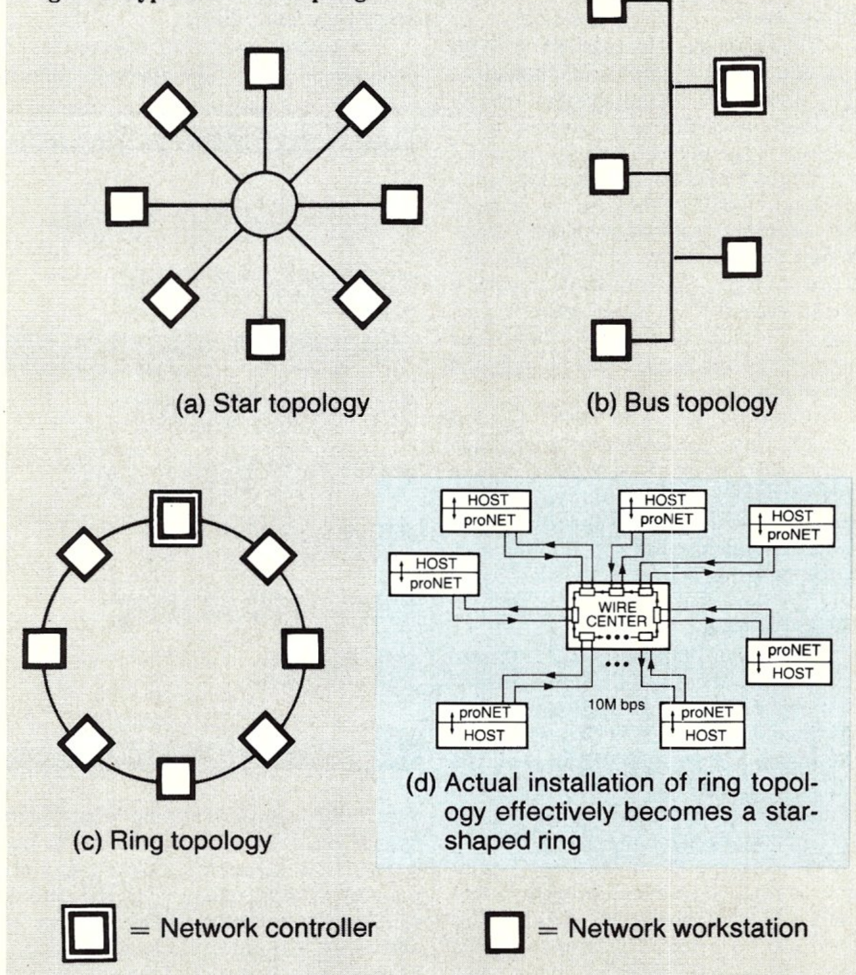
LAN topologies

There are many ways to interconnect workstations (nodes) on local area networks. Of the many methods, by far the most common are the bus, the star, and the ring (Figure 1). Each of these terms describes a particular *topology*, or physical layout.

The easiest system to install is the bus-oriented LAN. This describes a single cable running from a predetermined starting point in the office to some distant location where the cable terminates. Along the way, each workstation taps into the cable to gain access to the network. Although any given network places some limit on the number of nodes allowed as well as on the cable length, a node can tap into the cable at any point. There is also a minimum distance required between nodes for any network, but this is certainly no problem. Ethernet, for example, requires a minimum spacing of 3′ between nodes.

Another common LAN topology is the star (or cluster) system. Star-based systems use a hub approach where each workstation connects directly to the hub (central computer) much like the spokes of a wheel. To some extent, the star approach is not a true LAN. Since each workstation has to be wired directly to the hub, it is more a multiuser computer with intelligent terminals attached than a LAN. If an office has workstations placed in rooms down a long corridor, the bundle of cables from each workstation back to the hub can be a problem. The star is the least flexible LAN topology and usually cannot accommodate more than 16 to 32 workstations. In addition, placement of

Figure 1. Typical network topologies



shared peripherals such as printers is restricted to areas adjacent to the hub.

A variation on the star topology is the tightly coupled LAN. Instead of individual workstations being distributed about the office and interconnected by the LAN cable, each workstation is just an ordinary CRT terminal connected to a single-card computer (CPU, memory, and I/O on one printed circuit board); all of the single-card computers are plugged into a common parallel bus inside one cabinet. A master computer card acts as a controller, processing read and write requests to the common hard disk and printer. Data is transferred at much greater speeds because it travels along a short, parallel path between the cards instead of serially on long, conventional LAN cables.

An operating system software package called TurboDOS (see the articles on TurboDOS elsewhere in this issue) has been around (and has steadily improved) since April 1981 to implement this tightly coupled network concept. TurboDOS is both a network controller and an operating system. It is compatible with CP/M-80 applications software for 8-bit systems and CP/M-86 applications software for 16-bit systems. Also, one can mix 8- and 16-bit single-card computers in one cabinet; in this configuration, TurboDOS transparently handles disk and printer requests from both types concurrently. TurboDOS wins in the price/performance category, but is limited to a maximum of 16 workstations. For a small network, it is a very good choice, and much applications software currently works on it, as well.

The ring topology is used exclusively by token-passing networks. As the name implies, the workstations on the LAN are connected in a physical ring. A cable enters and leaves each workstation. This is not too different from the bus approach, except that the cable from the last workstation must return to the first to complete the loop.

An obvious problem develops with this technique. When a workstation is turned off, the ring is interrupted. To al-

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leviate this problem, a bypass relay in the workstation closes when power is removed. This relay routes the signal past the workstation as if it were not there.

LAN: the software perspective

To understand the significance of local area network control software, one must understand what their various functions are. In discussing the software aspects of local area networks, the focus will be on the IBM PC and compatibles. There are four more or less distinct types of networks (in increasing order of sophistication): the partitioned disk server based, the disk server based, the file server based, and the fully distributed network. All three types offer similar services to network users.

The main function of LAN control software is to create and maintain a remote (virtual) link between a network workstation and the central hard disk storage of whatever server (in some networks, there is only one server) a user is accessing. The user sees the hard disk as if it were attached to his local workstation. The network server gets its name from the fact that it "serves" up data and/or programs from its remote location to all requesting nodes, with password protection when and where needed. Another service is to create a virtual link to one or more common printers and route (spool) all print requests from the workstations to a common printer. Still another service is to act as a switching center for storing and forwarding electronic mail (not all LAN software offers this feature).

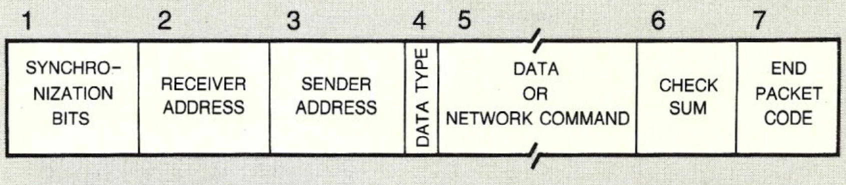
The distinction between distributed, file, disk, and partitioned disk servers is important in evaluating LAN performance and facility. All types of network servers allow users on the network to share a common mass storage device such as a hard disk. The differences lie in how the mass storage is shared.

The partitioned disk server, such as the Corvus Omninet using their Constellation II LAN software, allows each user to have a private partition on the central disk. That common disk can support a variety of different operating systems and different computer types such as IBM PCs, Apples, and the Corvus Concept workstation. In other words, Omninet allows Apples and oranges to share the same disk. The disadvantage is that network users cannot easily exchange data with one another, even among computers of the same make and having operating system.

The disk server, such as EtherShare from 3Com (EtherLink™ Ethernet hardware), works only with one operating system on an IBM PC based LAN. There are three classes of access to the common disk. One is via the public directory, where all users may read data and execute programs without restriction but may not write to the directory. The second class of access is the private directory. Here, only the creator of the directory has access, but can read and write at will. The third class is the shared directory, where all users may read and write to files in the directory.

The shared directory behaves in much the same way as a file system on a multiuser computer. If two or more users wish to access the same data file, some sort of arbitration must be used, so that different users cannot modify the

Figure 2. Simplified data packet structure.

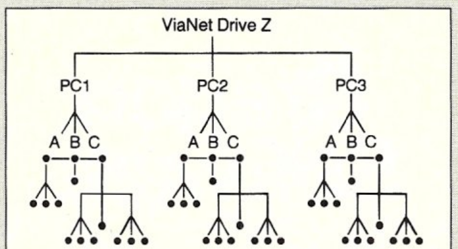


1. Sync bits: *Allow each receiver node to lock its internal clock into exact synchronization with sender's clock.* **2. Receiver address:** *Every node has to look at this code to see if packet is for them.* **3. Sender address:** *The address of the sender is needed so that the receiver can send confirmation of receipt; or, when requesting some network service from the network controller, the receiver address is that of the network controller and the sender address is that of who wants the service.* **4. Data type:** *Tells receiver what type of data is being sent. This code is very application dependent. Frequently, this is just the length of the data block following.* **5. Data or command:** *This section contains, usually, 40 to 1500 bytes of data.* **6. Checksum:** *A "cyclic redundancy check" (CRC) code used to assure data integrity.* **7. End-packet code:** *Often not used; if used, sometimes contains codes notifying receiver that more data follows.*

Network software: ViaNet

A generic LAN software package

ViaNet is a fully distributed local area network with shared-disk file access and a tree-structured file directory system, in which the disk drive serves as the basic organizational unit. Each drive therefore has its own hierarchical file system: file organization is not possible at a level higher than that of the drive. A network of three PCs, each equipped with two floppy disk drives and one hard disk serves to illustrate this configuration. ViaNet appears as a superset of this structure, treating the PC and its associated drives as subdirectories of the network by making the network a file system for the virtual Drive Z, as illustrated in this figure. PC2 uses virtual Drive Z to access the PC1-Drive C. When the user types DIR Z: \PC1\C the root directory of PC1-Drive C appears on screen. One of the disadvantages of this configuration is that it offers unlimited disk access and hence cannot prevent unauthorized personnel from using confidential data. To avoid this situation, protection devices exist that restrict read/write file access to specified users. To control multiple file access, a file-locking device is available: because a file is only accessible to the first node that opens it, it remains locked to other nodes until it is closed by the first node. File locking may be either default or explicit, depending upon the accessing program: "default" always locks the file during access; "explicit" allows the program to specify whether it will lock or share. A record-locking facility, used to prevent two programs from attempting to update the same record in a shared read/write program, can also prevent an attempt to read data currently being updated. For programs using explicit file locking and multiple file access, record locking is supported through network system calls.



A networked directory system

same record of a data file at the same time. Otherwise, only the last user to write to the disk has his changes recorded. To avoid this problem, a system of *semaphores* (software flags) is used to lock a given data record while it is being altered, so that only one user can make changes to it at a time.

But wait, there is a catch. With EtherShare, for example, each network user who is linked to a shared directory has a copy of the file allocation table in that user's workstation memory. The file allocation table, or FAT, is the mechanism by which the operating system knows where free space is available on the common hard disk. If one user should add data to a file, thereby extending it (using up some free space), only that user's FAT is modified—no one else sharing that directory knows about the reduction in free space. Needless to say, this is not allowable, as the common disk system could be turned to shredded wheat. The shared directory can only allow files to be modified, but not extended. Therefore, all data files must have preallocated space, and many database programs common today have no mechanism that lets a user do this.

File server systems also use the concept of private, public, and shared directories. In addition, the file server system allows file sizes to extend in the shared directories. Where the disk server can manage allocating directories efficiently, the file server can manage directories, files, and records of a file with equal ease.

The fully distributed network allows each workstation to share its local disk storage with any other network workstation. The Fox Research 10-Net or any network hardware that can use the ViaNetix Vianet network software, of which there are many, are examples of distributed networks.

The homogeneous environment of the distributed LAN allows tremendous flexibility in establishing and administering network resources such as disk storage, printers, or communications channels. However, just because one *can* share disk access with any other user does not mean one *has* to. Any disk or part of a disk can be made private (local access only).

With any of the server types described above, where more than one user has read and write access to the same data file, a method of file or record locking must be used to arbitrate file access so that data records are not written on top of one another. This function must be handled by the application program running on the network, usually by using software *flags* called semaphores. Also, a file cannot be extended by adding data records to it without some method for letting the other users who are also sharing the file know of the addition. This function is usually handled by the network control software and not the application program.

LAN control software works in tandem with each local OS.

After choosing a particular local area network, only half the job is done. Each LAN manufacturer usually sells both the LAN interface hardware, and the software to make the LAN function. But when it comes to software one has many choices—more than what the manufacturer offers. Just as the IBM PC can support MS/PC-DOS, CP/M-86, UCSD p-System, or UNIX, so can local area networks for PCs be used with LAN control software from independent software houses.

At the time of this writing, only Novell, Inc., actually had a series of LAN software packages available. Their NetWare network software works on at least eight LAN systems for the IBM PC. However, soon to be released is DRnet from Digital Research. MicroSoft is preparing their own networking software, and a new company called ViaNetix is about to release a network product called ViaNet.

The generic LAN software products smooth out the differences between the various LAN hardware systems. An application program written for Novell's NetWare will function the same on the Corvus Omninet as it will on 3Com's EtherSeries. The only difference to the user will be in speed of execution. Under Novell's NetWare, Proteon's ProNet and Davong's MultiLink will execute network—based programs the fastest, 3Com's EtherSeries will be somewhat slower, and the Corvus Omninet will be slower yet.

The choice of which LAN hardware to purchase becomes one of price vs. speed vs. expandability (and ease of

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expandability). The obvious advantage of using any of these generic LAN software systems is that more applications software will be available for them from the various manufacturers.

This follows the same philosophy that made microcomputing the strong industry it is today. CP/M initially—and later, MS-DOS—forged the foundation of an enormous software industry because they made it possible for a software author to write a program that worked, without modification, on perhaps a hundred dissimilar microcomputers. Today, the same thing is happening with generic local area network control software.

The LAN control software works in tandem with each workstation's local operating system, be it MS-DOS, CP/M, or UNIX. The difference between a PC operating system and the LAN network control software is that the LAN software must coordinate the actions of all the individual workstations on the network, regardless of network type. In effect, LAN control software is a super-operating system for the network as a whole. The proper choice of this software can determine the quality of performance of a LAN.

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LAN control software does not replace the PC's operating system, but works in conjunction with it. A copy of this software must be loaded at each workstation on the network after that PC's normal operating system is booted up.

The apparent enthusiasm for this generic, or multinetwork, LAN control software does not contradict earlier pessimism about the state of incompatibility of local area networks. For instance, if one had a network of PCs using the 3Com EtherLink hardware network interface and Novell NetWare/E LAN software (a typical combination), no connection could be made to a PC with a Corvus or PCnet hardware network interface, even if it also used the Novell NetWare.

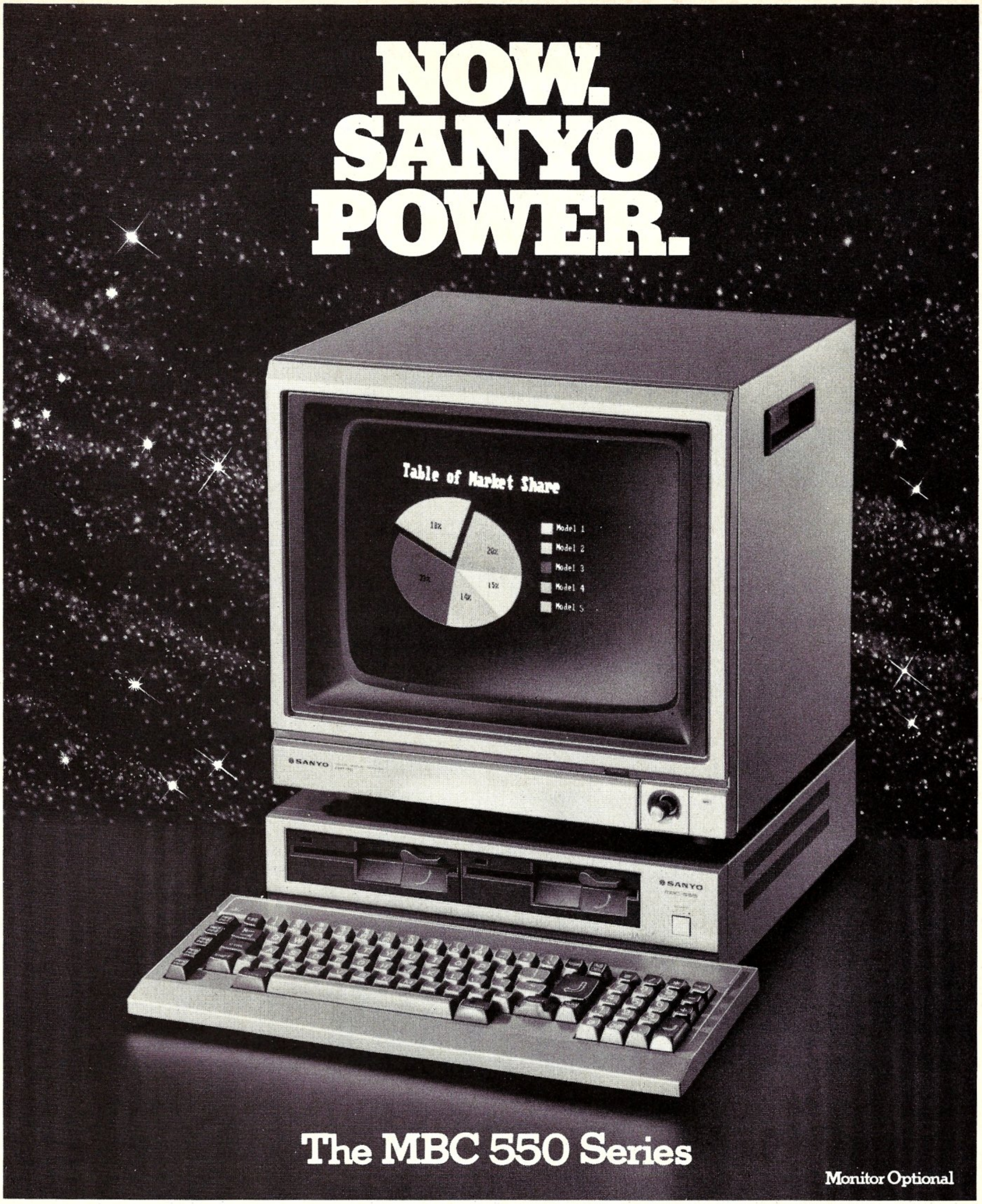
This is hardly a limitation in respect to a network of PCs. One would want to use just one manufacturer's LAN hardware for nothing more than for the quantity discount on multiple purchases. Where the LAN open architecture concept falls apart is that different computer types, such as minicomputers and microcomputers, cannot share data or resources such as printers or magnetic tape backup devices. In two or three more years, this incompatibility will begin to disappear.

Summary

Each local area network type has its own advantages. However, when choosing a particular LAN technology, if you care at all about future expandability (and the survival of the manufacturer from whom you plan to purchase a product), one is best advised to stick to whichever system is the closest to the proposed open system interconnect. At this point, 3Com's EtherSeries is a good choice because it is Ethernet compatible and hence close to the physical and data link layers (layers 1 and 2) of the OSI.

A relatively new product, the Proteon ProNet, uses a wiring scheme that is compatible with the recently announced IBM token ring network, if that is meaningful to you. However, after investing the time and many thousands of dollars in implementing a particular network, one would think more than twice about throwing out the old for something new, regardless of what network one purchased. In Proteon's defence, they have the highest performance LAN for the IBM PC to date.

Although there is almost no chance of their conforming to the OSI standard, the PCnet manufacturers (Orchid Technology, Santa Clara Systems, and AST, Inc.) have evolved their own LAN pseudo-standard for the IBM PC and compatibles. Though it is a lower-performance LAN (1 MHz baseband), three manufacturers support it. If a



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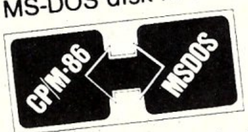

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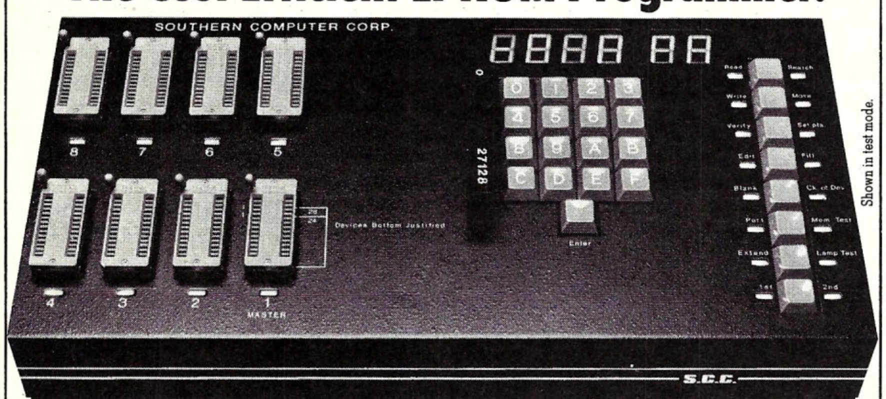

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manufacturer were to disappear, even though this seems unlikely at present, one would have alternative sources. Certainly this is better than the situation with other single-manufacturer local area networks. (Recently, Proteon and Quadram have joined forces to offer the high-performance ProNet token ring LAN.)

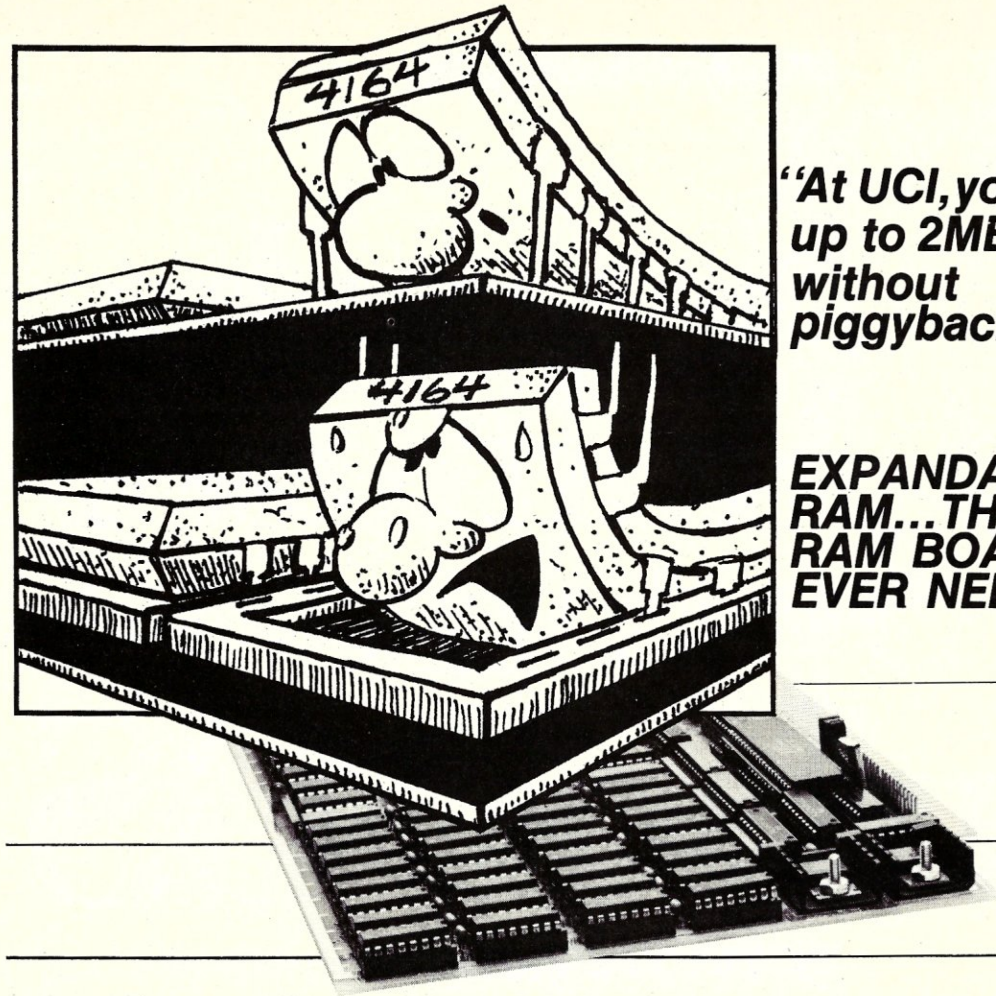
Many new integrated circuits implement the entire local area network electronics on one or two chips, such as the Intel 82586/82501 chip set for Ethernet. With these new chips, the cost of network interface electronics will fall significantly in the near future. The cost of the network interface at any given time is inversely proportional to expandability. So, choosing a network today on price alone can leave one stranded in the future if or when there is a need to expand.

One should also keep in mind the limitations of using the IBM PC or a PC-compatible as a network server on *any* network. It is necessary to use a PC with a hard disk as the server, of course, but still, only 5 to 10 workstations can be simultaneously logged on to that server before service degrades appreciably. Therefore, it is necessary to have multiple network servers to support any system larger than about 10 users. Some network software, such as Novell NetWare, will not allow multiple network servers. Regardless of the network software used, do not be led to believe that 64 users can share one PC hard disk successfully.

Some manufacturers offer dedicated network servers using Motorola 68000 microprocessors, or fast versions of the Intel 8086 or 80186. This is a very good idea for networks of more than 10 users. It can be even better than multiple PC-based servers. 3Com has an EtherLink interface for the DEC VAX 11/750 superminicomputer to act as a network server for IBM PCs, if you really want to fly.

Without the finalized open system interconnect standard to glue the LAN industry together, choosing a system today is not an easy task, to say the least. Before purchasing a network read voraciously, talk to other users of LANS, and remember the famous words—*caveat emptor.*

Leo Hoarty, United Nations Statistical Office, DC2-1552, 2 UN Plaza, NY, NY 10017. Mr. Hoarty is a technical advisor for the UN Dept. of Technical Co-operation for Development. He specializes in microcomputer systems for their developing nations support program.



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For Networks and Multiuser Systems—TurboDOS

Learn the capabilities of this alternative multiuser environment

by Ron Fowler

Gone are the days when simple operating systems satisfied the needs of most small-system users. Once written primarily to satisfy the relatively modest requirements of hobbyists and experimenters, microcomputer operating systems are now designed for performance, with special concern for providing maximum versatility to the user.

One such operating system is TurboDOS, a product of Software 2000. Written originally for the Z80 (and recently converted for the 8086/8088 family), this package offers a high degree of CP/M compatibility, multitasking background processing, powerful networking capability, built-in communications facilities, print spooling, and much more.

This article will take an in-depth look at this powerful system: what you can expect to gain by using TurboDOS, and what (if anything) you might lose by giving up CP/M in favor of TurboDOS. We'll examine the system and its utilities in detail, and conclude with a section addressed to the programmer or system developer interested in writing TurboDOS applications.

Background

Much of the information presented here is based on my own custom implementation of TurboDOS version 1.3. The evaluation copy of the software was provided courtesy of North Star Computers, Inc. North Star provides a full implementation for their own hardware, and offers it bundled with TurboPlus, a TurboDOS enhancement package (which I hope to review in a future article).

While the 1.3 release of TurboDOS provides 8088 compatibility, this discussion is limited to the Z80 version. The evaluation system is a networked version, interconnecting a Z80-based S-100 system with a diskless single-board Z80 computer, through 8255 PIO chips in each computer. Figure 4 is a schematic of the circuit used to interconnect the two systems.

The S-100 system consists of an Integrand mainframe housing a Delta Products 4-MHz A80 CPU, 128K of CompuPro memory, and various I/O boards.

Overview

TurboDOS is structured in a two-tier arrangement: the main body of the operating system is analogous to CP/M CCP and BDOS. This portion is machine-independent and is supplied as a group of Microsoft-format .REL files (relocatable machine code). The remainder of the system is similar to CP/M's BIOS and consists of a collection of *device drivers* (for such things as disks, printers and network communications). These driver modules are written by the system integrator; if you purchase a packaged system, these drivers are already written for you.

The modular design of the system allows it to be configured in an almost infinite variety of forms (Table 1 lists a number of the more commonly used modules). Each major function is isolated in its own module, many of which can be added to and deleted from the system by the user, thus providing the ability to add or subtract functionality. For example, the SPOOLR module contains the necessary code to implement the TurboDOS print spooling function (described later). By deleting this module in systems that do not require print spooling (e.g., single-user systems), the operating system can be made smaller, allowing more room for disk buffers and transient programs.

Flexible as this assortment of modules may be, it would be demanding a lot to ask all users to build their own system. To avoid this, TurboDOS is packaged with a number of "standard" versions (Table 2), each providing a commonly required configuration.

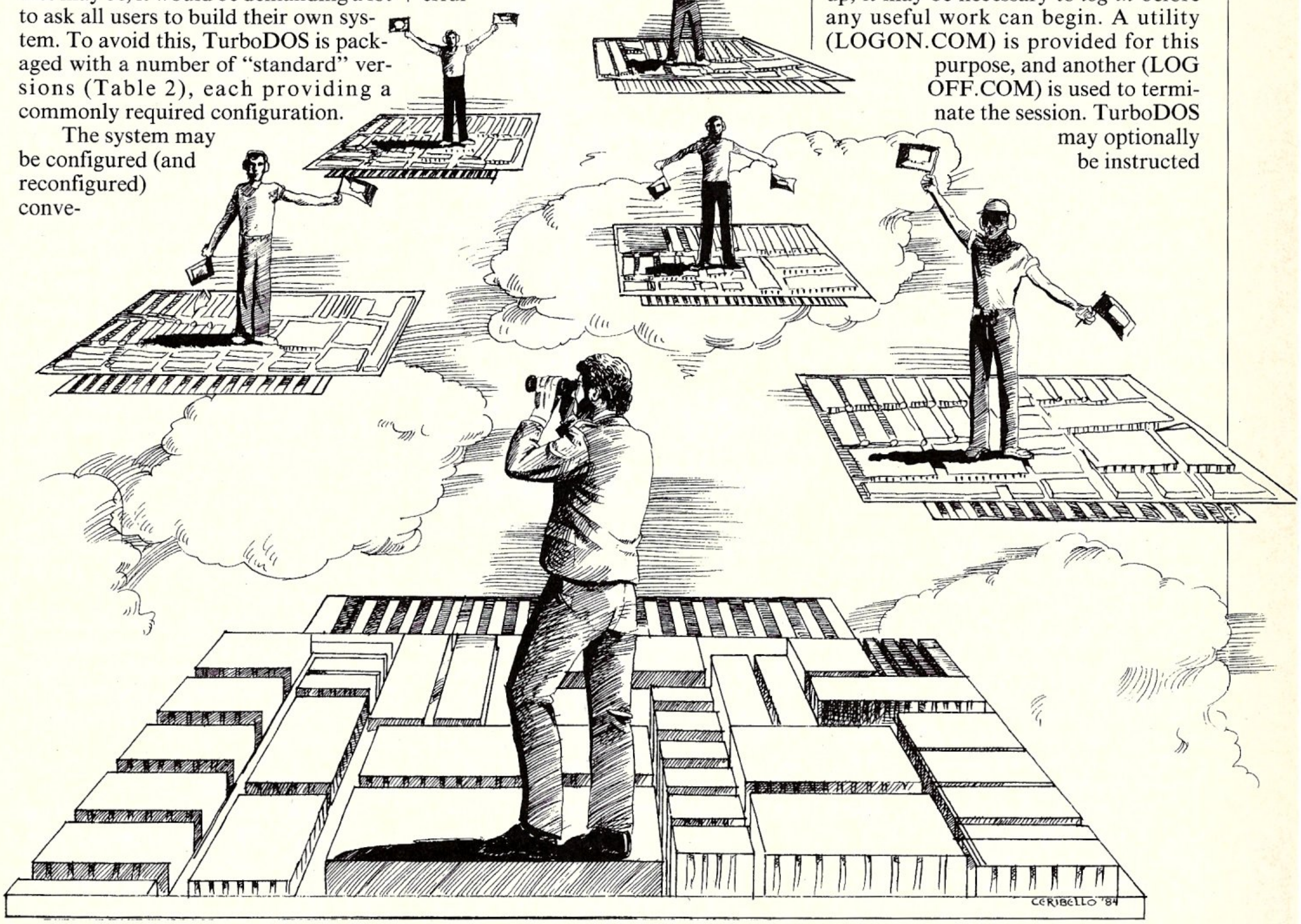
Your system may be configured (or reconfigured) conveniently by using GEN.COM.

The system may be configured (and reconfigured) conveniently by using GEN.COM, the supplied system generation utility. This program is, in fact, a sophisticated linkage editor that takes its commands from disk files, providing a high degree of automation in the system generation process. An additional file (called a .PAR file) can be specified to GEN.COM. The .PAR file references, *by name*, patch points within the system. It is a powerful concept: you can restructure major portions of the system (such as the network definition tables, disk assignment tables, command-search paths, and many others) merely by editing the .PAR file and regenerating the system.

Most implementations of TurboDOS provide for a boot PROM, allowing the system to start up automatically at power-on. The boot PROM contains just enough code to load a file named OSLOAD.COM into the program area. OSLOAD then brings in the rest of the system. My own implementation boots from CP/M, running OSLOAD as a CP/M transient. This suits my particular needs better than setting up a boot PROM—and incidentally illustrates the versatility of TurboDOS.

When the system starts up it prints a sign-on message followed by the system prompt. This is where TurboDOS begins to differ from standard CP/M: the prompt contains the user number as well as the drive name. (TurboDOS supports 32 user numbers—twice as many as CP/M; and the familiar angle-bracket prompt character of CP/M is replaced with a brace "}").

Depending on how the system is set up, it may be necessary to *log in* before any useful work can begin. A utility (LOGON.COM) is provided for this purpose, and another (LOG OFF.COM) is used to terminate the session. TurboDOS may optionally be instructed



Alternative

Continued from page 59

to maintain a file of logons and logoffs, and require that a password be specified at login. Passwords are maintained in a special user accounts file maintained with a text editor. Additional security allows logon to be restricted to a single user area (this restriction is specified in the user accounts file). Another login option provides for privileged logins (nonprivileged logins may not change user areas, and several of the supplied utilities will function only for privileged logins).

The rhythm of this system is a bit different from that of CP/M. For example, there is no warm boot, since the entire system remains resident in memory at all times (CP/M, of course, allows the Console Command Processor to be overwritten by a user program, thus requiring that a portion of the system be read back in from disk when a program terminates). Additionally, there are no built-in commands; all commands are loaded as transient programs from the disk. Hence, functions such as ERASE and RENAME take a bit longer to complete than their CP/M counterparts because time is needed to load them. Most of the utilities, however, make up for this in expanded power and versatility, as we shall see. In any case, if a hard disk is used, the extra time is so small as to be unnoticeable.

From the command level, TurboDOS works similarly to CP/M in that commands are typed into the system, and the specified files are executed as transient programs. If, however, your TurboDOS is part of a network, the programs and files you use are not necessarily located on your local computer (in fact, your local computer may not even have any storage facilities at all). This networking capability is one of the strongest features of TurboDOS, and we'll examine that aspect of the system in detail later.

CP/M compatibility

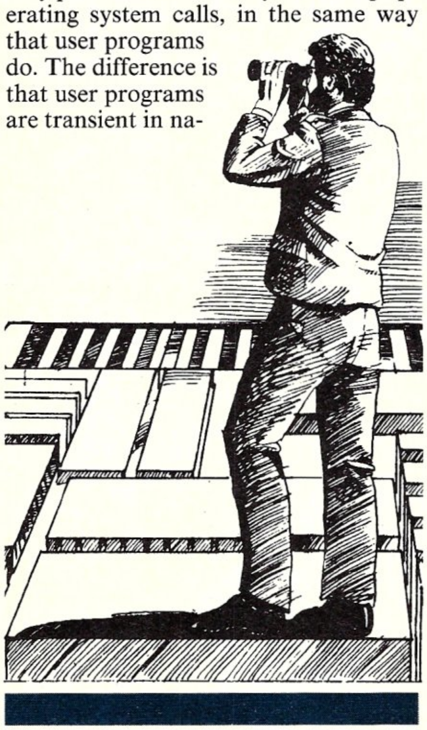
TurboDOS is compatible with almost all CP/M programs. There are only a few CP/M programs I've seen that do not work properly under TurboDOS—mostly public domain utilities that access some of the more obscure system calls (7, 8, 24, 28, 29, 31, and 100-107). However, TurboDOS may be installed with an optional CP/M-support module that will simulate these missing functions.

Another incompatibility involves CP/M's SUBMIT processing: I'm aware of several commercial packages that make use of CP/M's special $$$.SUB for batch-command processing and that do not work under TurboDOS because $$$.SUB file is not processed. Another optional module is supplied that modifies the TurboDOS batch function to emulate CP/M's more closely (but at the expense of slowing down DO file processing). The packages mentioned do work properly under TurboDOS if this module is installed.

Multitasking the CPU

Beginning a more detailed study of TurboDOS, one of the first things we should note is that it can execute more than one task at a time; this capability is usually referred to as *multitasking.*

Integral to the concept of multitasking is the *resident process.* A resident process is a program that excutes within the system; under TurboDOS, resident processes are physically attached to the operating system, but logically maintained outside of it. (That is, they perform their task by executing operating system calls, in the same way that user programs do. The difference is that user programs are transient in nature, while resident processes are always present).



At any given time, a process may be in any of three states: ready, running or suspended. A running process is one that is currently executing on the CPU; a ready process is one that is waiting to execute (but otherwise ready). A suspended process (sometimes referred to as "blocked") is a process that is waiting for some event to happen, or waiting for a period of time to expire. (TurboDOS provides a system call that allows a process to delay execution for a fixed time interval.)

The suspended state is perhaps the most significant. A process that is suspended is "stacked" on one of a number of special lists (called "semaphores"), and thus does not slow down the system by consuming CPU cycles. At any given time, most processes will be in this suspended state. Hence, user programs that are CPU-intensive (i.e., spend most of their time processing data rather than waiting on I/O devices) run nearly as fast as they would on a single-task system.

A number of "background" processes, present in each CPU running TurboDOS, perform such actions as monitoring the network, flushing disk drive buffers periodically, etc. Additionally, user-written resident processes are supported; any such process is physically part of the operating system and must be added to TurboDOS when the system is generated.

Banking the system

TurboDOS makes good use of bank-selectable memory. When more than one bank is available, most of TurboDOS resides in bank 0, while transient programs execute from bank 1. Since a full-featured network-master version of TurboDOS exceeds 24K in size, this frees up a lot of program area.

Banked systems are often measured by the amount of *common memory* they consume. Common memory is a section of memory (usually located physically at the top of the address space) that is always present within the CPU's address space regardless of which system bank is switched in. Since the Z80 is limited to 64K of total address space, it's obvious that the common-memory requirement increases at the expense of the banked segments, and thus at the expense of memory available to transient programs (in the case of TurboDOS, at the expense of the allowable size of the operating system).

The only portion of TurboDOS that *must* remain in common memory is a small interbank communications module, plus some portions of the interrupt-service routines. Thus the amount of transient program area available is 63K, even if banked memory hardware allows bank switching only on 4K or 16K boundaries.

A utility program (BANK.COM) allows the system to be switched between banked and nonbanked mode. When nonbanked mode is selected, programs must share bank O with the operating system.

Disk drives and files

TurboDOS supports file sizes of up to 32 MB and a disk drive capacity of up to 134 MB. Obviously, such large drives will have a lot of files and will need a lot of seek time during such operations as

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file opens, directory searches, etc. In an effort to decrease this time, TurboDOS supports a special directory format called a *hashed directory.* A disk directory may, at any time, be restructured as a hashed directory (although the opposite is not true) by running a program called FIXDIR. Although hashing the directory made little difference on my small-capacity floppy disks, a hardware dealer I've worked with (who sells TurboDOS on IMS systems) reports a dramatic speed increase on his 40 MB hard disk systems.

Another technique used by TurboDOS to increase performance is disk buffering. The system contains a built-in buffer manager; moreover, a utility program supplied with the system (BUFFERS.COM) lets you change the size of each disk buffer and the number of buffers *while the system is running.* These buffers are taken "off the top" of the transient program area (in unbanked versions of TurboDOS). If you're going to run small, disk-bound programs, you can set up a large number of buffers and increase disk access speed. Conversely, memory-hungry programs (such as WordStar) should be run with a small number of buffers to provide as much memory as possible.

(I should point out that while directory hashing made little performance difference in my system, increasing the number of disk buffers in the system increased disk throughput dramatically.)

Systems using banked memory may set up most of the unused part of bank 0 as disk buffer space and not affect program memory space at all.

A fast file-load function supplies yet a third performance increase: generally used by the Command Interpreter (the portion of the system that processes user command lines), this module allows a section of memory to be loaded in the fastest manner possible. It works by scanning the disk allocation map, detecting sequentially allocated segments, and loading these segments at the fastest transfer rate of the disk controller.

Computers running TurboDOS may be interconnected to share expensive peripherals.

File attributes

TurboDOS expands on the file attributes (also called "tags") employed by CP/M. The CP/M attribute is replaced by the GLOBAL attribute. Files resident in user area 0 and tagged as GLOBAL are accessible from any user area, thus circumventing the need to duplicate frequently used files in each user area of the disk. This global access applies equally to files that are accessed by application programs (such as WordStar's overlay files), or chained Basic programs.

ARCHIVE is another file attribute that saves time and space when backing up files. New files are created with the ARCHIVE tag off. When a file is backed up using the COPY program, the ARCHIVE bit is set; when a file is changed (extended, or written to with a random write), TurboDOS resets the ARCHIVE attribute. COPY can be instructed not to copy files that have been archived and have not been modified since. This process is called "incremental backup."

The final "new" file attribute is FIFO; it defines a special type of file accessed using a "first-in/first-out" technique. FIFO files are accessed from programs like any other file, except that sequentially written records are appended at the end of the file, and sequential reads are taken from the beginning. Moreover, a FIFO may be declared as an in-memory file (accessed much faster, since it really doesn't exist on disk at all; this limits the size of the file, however, to available memory). This whole scheme provides a very handy technique for passing data between background processes, and between programs executing on different processors. Since a FIFO can be made to "suspend" (deactivate) a process reading the FIFO when it's empty, it's easy to visualize a background process that only "comes alive" when a program posts a record to a file monitored by the background process.

Two special utilities are provided to work with FIFO files: SEND and RECEIVE. SEND is invoked with a FIFO filename and a text string to place in the FIFO. RECEIVE takes only a FIFO filename; it reads one record from the FIFO (thus deleting the record) and displays it. Together, these two utilities may be used to form a rudimentary mail facility between users.

File interlocks

TurboDOS features file and record lockouts, since it supports background processes that may access files at the same time as foreground processes. In fact, network support for shared files requires at least one such process in each file system offering file resources to the network. Interlocks are used to coordinate file accessing by multiple simultaneous processes and are necessary, for

TurboDOS version 1.4

As this article went to press, Software 2000 released version 1.4 of TurboDOS after six months of field testing. This latest release introduces a number of major enhancements not available in prior versions of TurboDOS. Here is a brief synopsis of a few of the most significant changes:

Full 8086 support. All TurboDOS features, functions, and commands are now available on 8086-family CPUs, as well as on the Z80. Z80s and 8086s may be intermixed as desired in a single network.

IBM PC support and PC-DOS emulation. TurboDOS now runs on the IBM PC. A PC-DOS emulator and a PC-DOS–to–TurboDOS diskette conversion utility allow most IBM PC packages to run under TurboDOS.

User prefixes. TurboDOS now accepts user number prefixes wherever drive letter prefixes are allowed.

A user/drive prefix may be entered alone as a command to change the current user number and/or disk drive. (The transient USER command is gone.)

Multisector I/O. TurboDOS now supports multisector I/O in a fashion compatible with function 44 of CP/M. The network protocol has been enhanced to allow multiblock network messages. Loading of transient programs is consequently much faster than before.

MP/M queues and other functions: TurboDOS now supports MP/M queue functions. Additional MP/M functions are now supported by TurboDOS and further changes have been made to support Digital Research's graphics packages GSX-80 and GSX-86.

New documentation. All five TurboDOS manuals have been updated extensively to reflect version 1.4 enhancements, and to correct previous errors.

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example, when an update program must replace an inventory item's wholesale and retail price fields. With no coordination, a querying program might read the record sometime after the update program has begun writing new data, but before the write is complete. Hence, the querying program reads inconsistent data. With record locking capability, however, the update program can obtain exclusive access to the record, "locking out" any other process that may be attempting to access the same record.

File lockouts under TurboDOS may be configured for strict MP/M compatibility; thus existing programs written for MP/M's record-locking techniques will work correctly under TurboDOS. Alternatively, a set of compatibility flags is available (during system generation) to change certain rules, providing a number of new modes not previously available under MP/M.

Networking

TurboDOS provides a plethora of features, facilities, and utilities, but to me the single most outstanding one is its built-in networking capability. Multiple computers running TurboDOS may be interconnected and share such relatively expensive peripherals as disk drives, printers, plotters, etc.

In this discussion, I will use the terms "node," "CPU" and "processor" interchangeably. Generally, a node can be thought of as a workstation containing a CPU, memory, a network interface, and (optionally) a terminal, disk drives, and printers. A node is attached to the network via one or more connection points. It usually has some peripherals, but does not *require* any.

Two other terms will be used to refer to processors on the network: *master* (or *server*) and *slave* (or *satellite*). Generally, a server processor provides resources to the network (such as disk storage and/or printers), while satellites do not. If satellites have local disks, these can also be available to the network if the satellite contains the network service module (NETSVC).

First, it's important to note that TurboDOS does not support multiple users on a single CPU. The philosophy here is that since processors and memory are relatively cheap, why attempt to split up a hundred dollars or so in CPU and memory hardware when each user can have his own CPU and memory, and suffer none of the processing delays that are so severe in such operating systems as MP/M and OASIS?

This concept works, and works well. Each user has full use of his own CPU; delays are generally noticeable only when shared disk drives are simultaneously accessed by multiple network users. (Even these delays can be abated by using faster drives with more sophisticated seek mechanisms—a cost that can be justified more easily with TurboDOS, since these expensive peripherals are more easily shared among all the users).

TurboDOS supports just about any kind of local network, ranging from simple implementation involving two computers (linked through, say, an RS-232 channel), to sophisticated structures with many processors sharing resources over high-speed data channels. The actual network structure is defined by the system designer and implemented in the network driver modules. These modules constitute what is known in network vernacular as the "physical layer"; they control the hardware that interconnects the computers.

TurboDOS defines the network as being composed of *circuits* (which can be better visualized as a cluster of nodes). A circuit may be composed of up to 255 nodes. Further, there may be up to 255 interconnected circuits in a full system, allowing for a total of up to 65,535 total workstations in a TurboDOS network.

The unit of information exchange among network nodes is the *network message*. This message is a packet of data, containing source and destination node addresses, byte length and other overhead, as well as the actual data itself (which may be a disk record, a file control block, or perhaps a block of characters to be sent to a printer).

A "forwarding" table may be specified in each node, allowing messages to be sent between network nodes that are not themselves directly connected.

One of the most common techniques I've seen for implementing a network with TurboDOS involves S-100 single-board computers. Generally, one "master" CPU is provided (to control access to disk, printers, etc.), and one or more "slave" processors are placed on the same bus as the master (often these slaves have no local storage of their

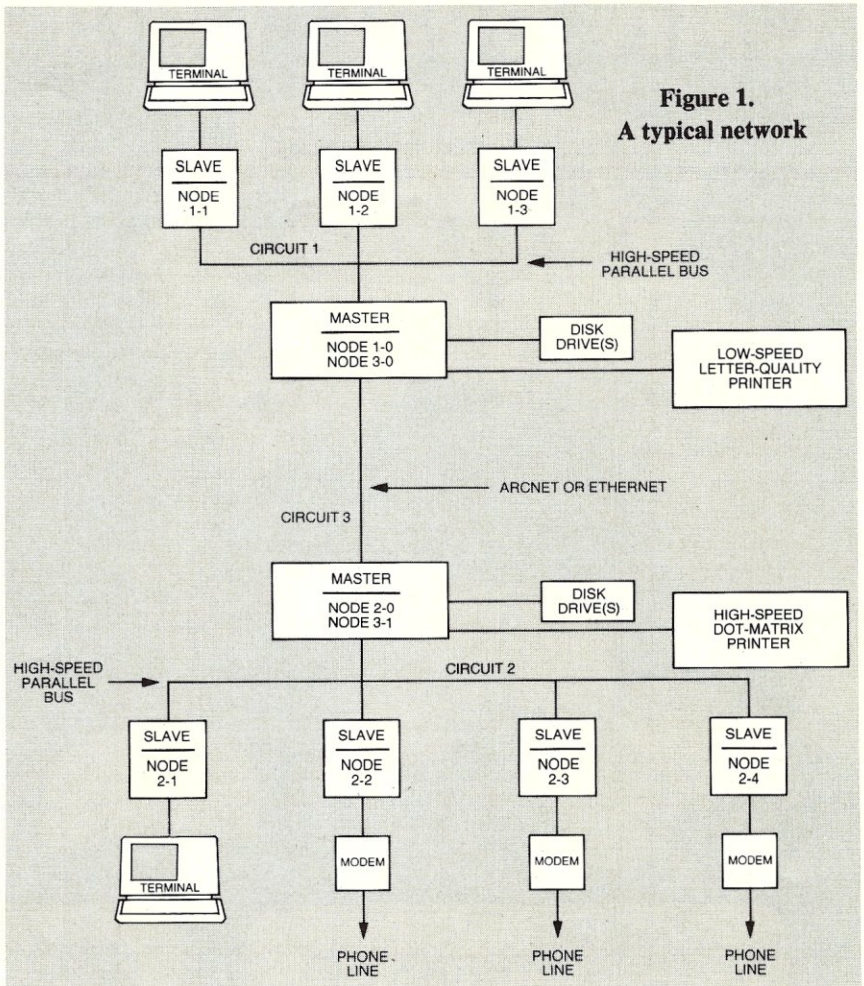
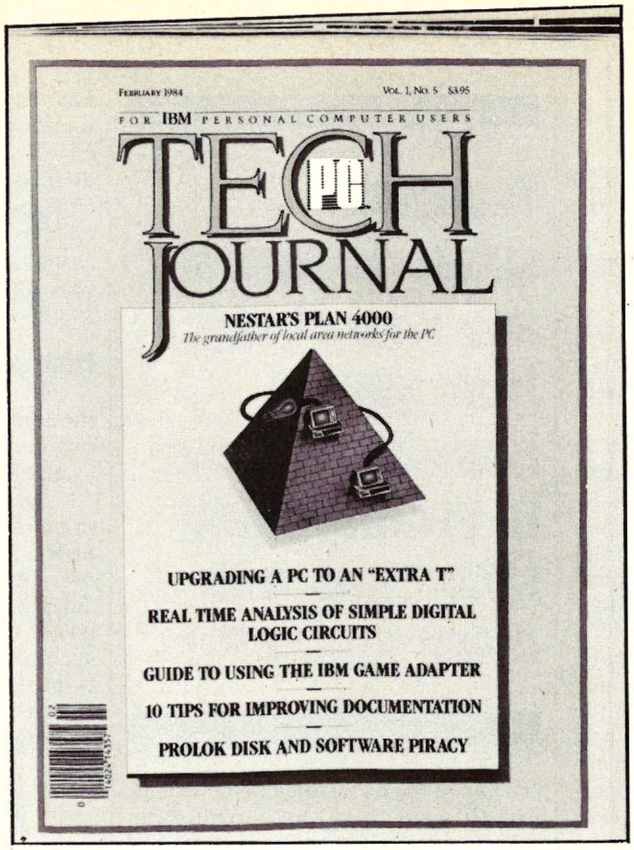


Figure 1.
A typical network



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Alternative

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own, but instead rely on the master to provide storage. The user will see the master's drives as if they were connected to his own CPU). Typically, high-speed parallel-port channels are provided to allow network transfers at near-bus speeds. One such system will generally be a circuit in itself; multiple systems may then be interconnected, forming a multiple-circuit network.

An example should help tie this all together. In Figure 1, we have two network circuits that are relatively independent. Each circuit has a master and several slaves, as well as disk drives and a printer. Master-to-slave communication is through a high-speed parallel bus. Master-to-master communication is through LAN interface and cable. Note that slave nodes do not have any local disk storage, but instead use the master's disk drive (this will likely be a large-capacity hard disk drive, segmented into several smaller drives and apportioned among the slaves). Circuit 1 consists of four nodes: the master and the three slaves. Similarly, circuit 2 consists of five nodes: the master and four slaves, three of which are connected via modems to dial-in phone lines.

Each of the two masters are actually "known" on two circuits (their own, and the other master's) and thus have two circuit drivers within their operating systems (and two network addresses, as a matter of fact).

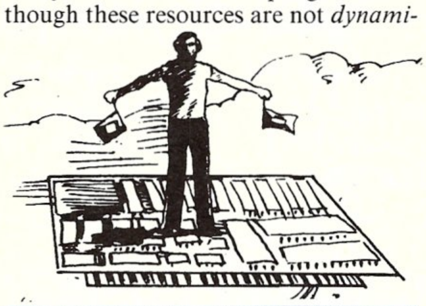
This system might be part of an overall data-gathering system where field agents phone in information to the nodes connected to modems (nodes 2-2, 2-3, and 2-4); the high-speed dot-matrix printer might be used to maintain a "running log" of these transactions. This raw information is sorted and formatted by programs entered by an operator at the terminal located at node 2-1 (the only "on-site" terminal in circuit 2) and made available periodically to circuit 1 through the RS-232 link between circuits, where service clerks work at terminals filling these orders. The finished orders are then printed up in the form in invoices on the letter-quality printer located on circuit 1.

Thus most information flow between the two circuits will take place between the two masters (perhaps under the control of a resident process in each). It is possible, however, to allow communications between slaves on different circuits, using forwarding tables contained in each slave's operating system. This might be necessary, for example, to allow field salesmen calling into circuit 2 to make an inquiry about an order to a clerk working in circuit 1. Proper setup of the forwarding tables will allow this (in fact, the Turbo-Plus enhancement package provides special system functions and utilities that simplify this kind of communication).

TurboDOS supports almost any kind of LAN, from simple implementations to sophisticated structures with many processors.

Reconfiguring the network

Although the physical network is defined in network driver modules, TurboDOS provides a lot of latitude in reallocating resources, using the previously mentioned GEN program. Although these resources are not *dynamically* changeable (that is, you can't make changes while the system is running), it's a relatively simple matter to patch the tables and regenerate the system.



An example should help to clarify this. Referring to Figure 2, we see two processors, named P1 and P2, each with local drives A and B. From the diagram, you can see that each processor has a drive C, which is the opposite processor's B drive. (These assignments are made in a table contained in each node's copy of TurboDOS; this table is called the Disk Assignment Table and is usually set up in a .PAR file).

Now, let's consider changing that. Let's say we want to delete P2's ability to reference P1's B drive, and increase P1's available storage to include P2's drive as P1's D. We simply make a few changes in each node's .PAR file, regenerate each TurboDOS, and we have the structure shown in Figure 3. This concept applies to other resources, such as printers and print queues.

Printers and spooling

Flexibility is apparent throughout the design of TurboDOS, but nowhere is this more evident than in the facilities available to produce printed output.

Each processor may have up to 16 printers defined in its tables, and each printer may be accessed either locally or over the network. Since TurboDOS provides a CP/M-like environment, only one of these printers may be "current" at any one time for any one user. A utility program (PRINT.COM) lets you change the routing of your logical printer output, using syntax such as

```
PRINT PRINTER=E
(or PRINT P=E)
```

which selects printer 5 in your local printer table. In addition, this utility allows you to select a much more flexible form of printing: *spooled printing.*

Spooled printing reroutes your printer output: instead of going directly to the printer, the output is routed to one of 16 *print queues.* A print queue is implemented as a set of disk files, using filenames of the form

```
"-PRINT-x.nnn"
```

where x is the queue name (A-P, corresponding to each of the 16 possible queues) and nnn is a three-digit number used to separate different print jobs within a queue.

Another utility (PRINTER.COM) controls despooling of these print queues. Any physical printer may be assigned to any of the queues with a command such as "PRINTER E QUEUE=C" (to assign printer E to the "C" queue). A third utility (QUEUE.COM) allows files to be manually entered into any of the various queues.

Let's tie this all together with an example: suppose your system has two printers: printer 1 is a fast dot-matrix printer, while printer 2 is a slower letter-quality model (remember, either printer may be attached to our local network node, or to a remote node—it doesn't matter *where* the printer to be used is actually located). Assume we have to print several program listings, a couple of letters, and a long report.

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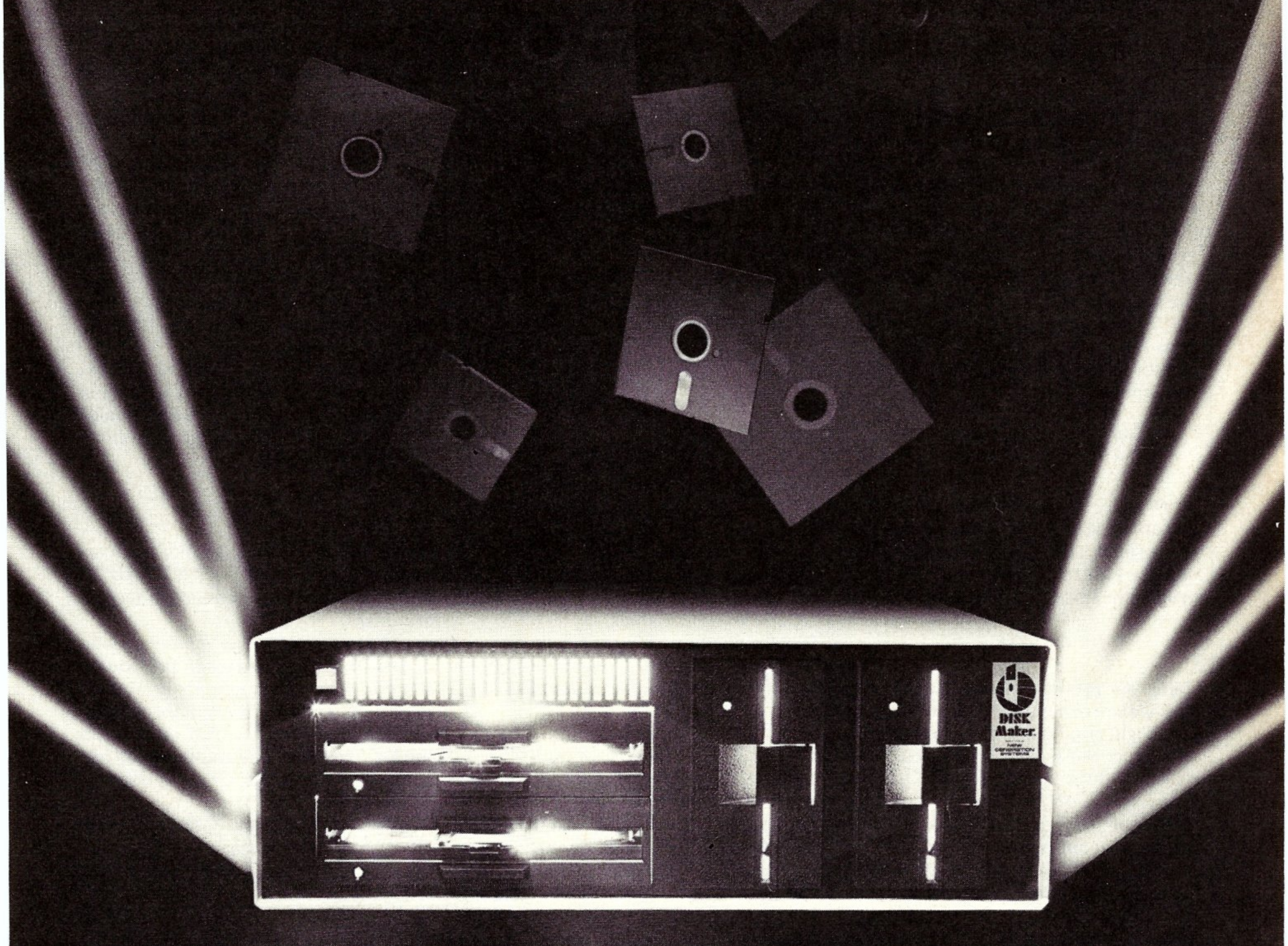

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they'll likely use single-sheet paper, requiring a good deal of manual intervention. The command

```
PRINT PRINTER=B
```

gives us direct access to the letter-quality printer (we must be careful here to coordinate access with any other network users, since direct printing by more than one user will result in interspersed characters in the actual printout). Now we fire up the word processor program, and print each letter. Not so different from CP/M, so far (except for the ability to switch printers).

Now let's tackle the program listings. We can begin to make use of print queues here by entering the following commands:

```
PRINTER A QUEUE=A
PRINTER B QUEUE=B
```

Now we've established queue "A" as the queue associated with the dot-matrix printer, and "B" with the letter-quality printer. Now we're ready to print some listings. The command:

```
PRINT QUEUE=A
```

routes our printer output to queue "A"; now we can run our language translator and begin producing the program listings. Since our output is now going to a relatively high-speed disk file (as opposed to a slow printer) the language translator finishes long before the first printout is complete.

In fact, the first output file doesn't begin printing until its associated queue file is closed (either by the language translator terminating and returning to the operating system, or by a special end-print control sequence from the console). While the first file is printing (in the background) we can run our language translator once more to generate the second and third listings. We might also decide to queue some existing disk files:

```
QUEUE MYPROG.PRN ;Q=A
QUEUE MANUAL.DOC ;Q=A
QUEUE *.UPD ;DYQ=A
```

(Note that the "Q=A" options specify which queue to send the file to. The third example illustrates queueing multiple files by specifying a wildcard filename. Additionally, the ";DY" portion specifies options: in this case, "D" causes each file to be deleted after printing, and "Y" causes the QUEUE program to display the name of each file to be queued, allowing the operator to select specific files).

Figure 2. Drive allocation example.

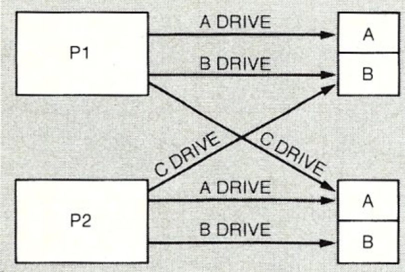
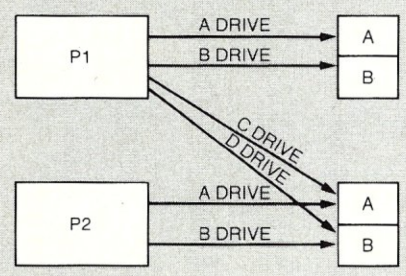


Figure 3. Allocation after reconfiguration.



Now we're ready to print the letter-quality documents. The command

```
PRINT QUEUE=B
```

switches our printer output to the queue we've previously associated with the letter-quality printer. (It doesn't matter that the files we've already queued are still printing; they're now destined for the dot-matrix printer, and changing the destination of our printer output no longer has any effect on the previously queued files). Now we can use our word processor and send the letters and the report to the "B" queue, similar to the way our language translator output went to the "A" queue.

At this point, we have two printers running a number of print jobs entirely in the background, and our console is free for new work. In addition, any number of network users can simultaneously queue files on the same printers without intermixing printer output.

To conclude the discussion, I must mention that there are many more print options and features than those mentioned here; to review each of them, however, is beyond the scope of this article.

Batch files

TurboDOS allows the execution of batch-command files in a way similar to CP/M's SUBMIT facility, but with enhanced capabilities. The TurboDOS version of SUBMIT is called DO.COM; specifying DO with a filename will cause the system to begin reading its input from the file.

DO files may be nested, to any reasonable depth, merely by placing a DO statement within a DO file. After the subservient DO file is executed, control returns to the superior file at the point where processing left off.

Command-line parameters may be specified in a fashion similar to CP/M's SUBMIT. However, the parameters are referred to in the DO file by enclosing them in braces, rather than the dollar sign notation of CP/M. Also, the parameters in the DO command line may be made to contain embedded spaces by enclosing them in quotes.

A handy option within the DO file allows default parameters to be filled in by adding a comma and a default value within the braces. Consider the following line within a DO file:

```
L80 {1} {2,SYSLIB}
```

If this DO file is envoked only with argument 1, then the value "SYSLIB" is automatically supplied as the second argument.

Another important characteristic of DO files is that they can provide input for more than just system commands. Programs that require interactive input will receive that input from the DO file (thus, DO combines the features of both of the CP/M programs SUBMIT and XSUB).

DO is somewhat faster than CP/M's SUBMIT when no command line parameters are specified: since there is no need to rewrite the DO file with parameters filled in, DO simply informs TurboDOS to begin executing the file (SUBMIT must always write a $$$.SUB file).

Utilities

TurboDOS is supplied with a large number of utilities, some of which have already been described. The major remaining utilities are as follows:

AUTOLOAD allows a user to set up command lines that automatically execute on either cold or warm boot. COLDSTRT.AUT, the cold boot file, executes only once, when the system is first started up. WARMSTRT.AUT is executed at the completion of each transient program.

BACKUP performs a fast disk copy. It is usable only when the source and destination diskettes are of the same format.

BATCH is useful in network environments, and uses a special FIFO file

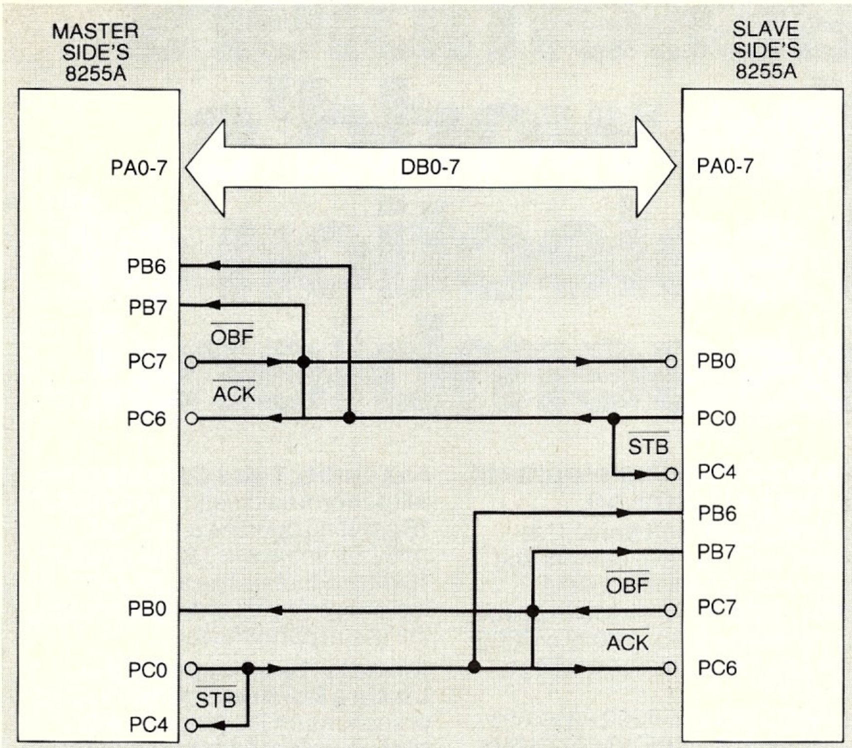


Figure 4. Two-computer network interface circuit.

(named BATCH.DO) to send a command line to a remote processor for execution. Remote processors that use this facility (i.e., those which are to be available for batch jobs) must execute the command "DO BATCH" via an autoload file at system startup.

BOOT allows the system tracks of a diskette to be copied to another diskette. Note that TurboDOS allows 100% of the disk space to be used for file storage; however, in some implementations the hardware demands cold-starting from reserved system tracks.

CHANGE is used to safely allow removable disks (i.e., floppies or removable cartridges) to be changed in a network environment. CHANGE.COM takes one or more drive letters as arguments and aborts with an error message if any process has open files on the requested drive. If the requested drive is free, CHANGE locks the drive until the user indicates that the disk has been changed (any user trying to access the drive while it is locked will receive a disk error message).

COPY, which was previously mentioned, allows files to be copied between drives. A large number of command-line options make this an extremely versatile file copy and archiving program.

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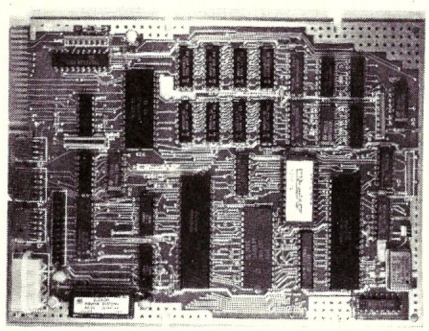

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8086/88 XASM	$199.50	$750.00			$199.50
80186 XASM *new*	199.50	750.00	199.50	199.50	199.50
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Z-8000 XASM	199.50		199.50	199.50	
Z-800 XASM *coming soon*	199.50	750.00	199.50	199.50	199.50
Z-80 ASM	49.50				
Z-80 XASM		500.00	99.50	99.50	99.50
Z-8 XASM	99.50	500.00	99.50	99.50	99.50
6301(CMOS) *new*	99.50	500.00	99.50	99.50	99.50
6500/11 XASM *new*	99.50	500.00	99.50	99.50	99.50
6502 XASM	99.50	500.00	99.50	99.50	99.50
65CO2(CMOS) XASM *new*	99.50	500.00	99.50	99.50	99.50
6800,2,8 XASM	99.50	500.00	99.50	99.50	99.50
6801,03 XASM	99.50	500.00	99.50	99.50	99.50
6804 XASM *new*	99.50	500.00	99.50	99.50	99.50
6805 XASM	99.50	500.00	99.50	99.50	99.50
6809 XASM	99.50	500.00	99.50	99.50	99.50
8748 XASM	99.50	500.00	99.50	99.50	99.50
8051 XASM	99.50	500.00	99.50	99.50	99.50
8080 XASM	99.50	500.00	99.50	99.50	99.50
8085 XASM	99.50	500.00	99.50	99.50	99.50
8096 XASM *new*	99.50	500.00	99.50	99.50	99.50
1802 XASM	99.50	500.00	99.50	99.50	99.50
F8/3870 XASM	99.50	500.00	99.50	99.50	99.50
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Continued from page 69

DELETE performs the same function as CP/M's ERA. A command-line option causes DELETE to present each filename to be erased and requests the operator to confirm before deleting.

DIR prints a sorted directory on the screen (or optionally, on the printer). The display contains a lot of the information available under CP/M only through the STAT command (such as filesizes and disk free space). It also includes time of day and combined size of files displayed, as well as user-number specification.

DRIVE displays information about the disk format (similar to CP/M's STAT DSK:).

FIFO is used to create and delete the previously described FIFO files.

FIXDIR is a handy utility that reorganizes a disk directory. This is useful when frequent file creations and deletions occur (especially on hard disks). FIXDIR compacts the directory, eliminating "holes," and makes file searches faster. Also used to convert a directory to the hashed format, or vice versa.

FORMAT allows a diskette to be formatted in single density or in CP/M or TurboDOS double-density format. It automatically calls VERIFY after formatting is complete.

TurboDOS offers a great many system calls to the programmer.

MONITOR is the TurboDOS replacement for CP/M's DDT program. Intended mainly for program patching, etc., it contains a save function as well as a load function (this is necessary because TurboDOS lacks CP/M's SAVE command). A number of other commands not found in DDT are present in MONITOR.

Noticeably lacking, however, are DDT's opcode assembler and disassembler, and single-step trace functions. For program debugging, DEBUG (Phoenix Software Associates) or ZSID (Digital Research, Inc.) both work well under TurboDOS.

RENAME is used to change the names of files. This utility has a syntax backward from that of CP/M. (Most people who have worked with other systems claim it's CP/M that has it backward. I'm inclined to agree.) This utility has the handy option of renaming by using wildcards. For example, the command "RENAME *.BAK *.ASM" renames all BAK files to ASM (a command-line option allows you verify any rename that would cause an existing file of the same name to be overwritten).

SERVER has been renamed by North Star. The standard TurboDOS distributed by most vendors refers to this utility as MASTER.COM. In any case, its purpose is to allow a slave console to act as a terminal to the master, a function useful for running programs in the master processor.

SET is used to set and clear file attributes; SHOW displays them.

Table 1. Common TurboDOS modules

Name	Function
LCLUSR*	Supports the Transient Program Area
LCLMSG	Contains the system error messages
CMDINT	Command line interpreter, similar to CP/M's Console Command Processor
AUTLOG	Supports COLDSTRT.AUT and WARMSTRT.AUT files
NETSVC*	Services network requests, necessary only in processors that provide facilities to the network (servers)
NETREQ	Makes requests of the network
NETTBL	Defines network topology from viewpoint of the local node
DSPOOL*	Printer de-spooler (background print)
FLUSHR*	Periodically flushes disk buffers
OSNTRY	Decodes system calls (C-functions and T-functions)
FILMGR	Handles the local file system. Nodes without disk storage do not require this module
FILLOK	Handles file interlocks
FFOMGR	Handles the special FIFO files
FASLOD	Fast program-load optimizer
BUFMGR	Manages the disk buffers
DSKTBL	Defines the available disk drives (local and remote)
CPMSUP	Special support for CP/M: makes system more CP/M-compatible
CONMGR	Handles all console I/O
CONTBL	Connects CONMGR to hardware console driver module(s)
DOMGR	Handles batch commands
LSTMGR	Handles printer output
SPOOLR	Handles background spooled-print functions, as well as routine printer output over the network
RTCMGR	Maintains system date and time (realtime clock)
BNKMGR	Banked memory support
DSPCHR	Multitasking kernel; controls CPU dispatching between competing processes, as well as synchronization and interprocess communications
DSPSGL	Special "null" dispatcher: allows a non-multitask version of TurboDOS to be created
MEMMGR	Controls dynamic allocation of memory
OSLOAD	Special module used to create a loader program
COMSUB	Common subroutines needed in all versions of TurboDOS

Note that modules denoted by an asterisk (*) after the module name are resident processes.

Table 2. Standard TurboDOS configuration packages

Name	Function
STDLOADR:	cold-start system loader
STDSINGL:	single-user version, no spooling
STDSPOOL:	single-user version with spooling
STDMASTR:	network master
STDSLAVE:	network slave without local disks
STDSLAVX:	network slave with local disks

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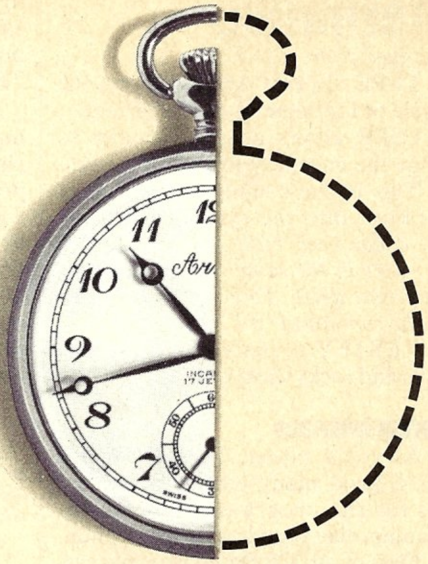

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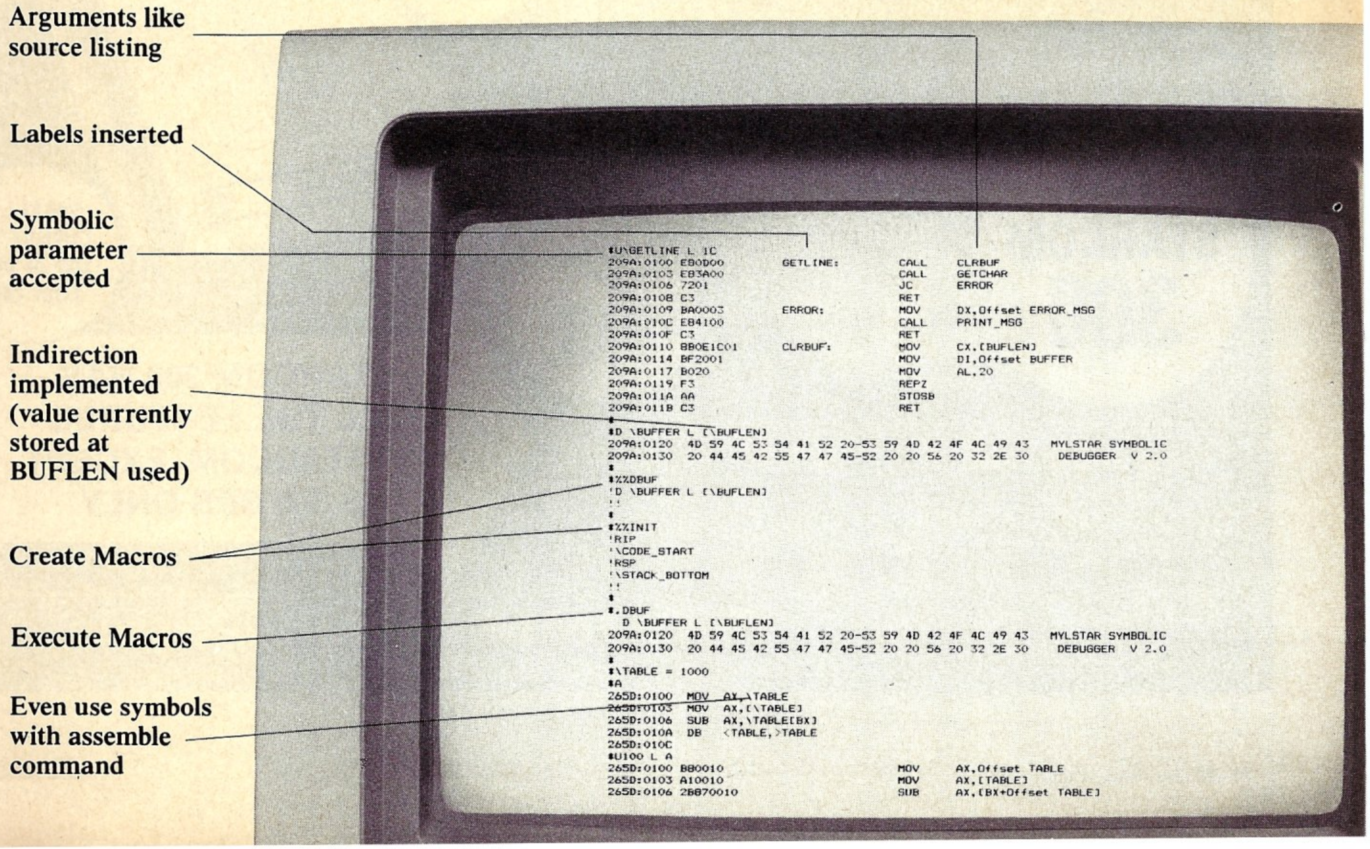

Alternative

Continued from page 72

TYPE displays ASCII files on the console or (optionally) on the printer.

USER allows privileged logins to change the currently logged user number. This is one command I wish had been built into the system. *(Editor's note: it has been built into version 1.4, and works in the same way as changing the current drive. To go to user 17 you type the command "17:".)*

VERIFY scans a drive for bad blocks and locks them out.

Program interface

As you'd expect, TurboDOS provides a good many additional system calls for the programmer. Nonprogrammers may want to skip this section.

First of all, CP/M-compatible system calls are vectored through location 5 (as you'd expect); versions of TurboDOS prior to 1.3 included extended system calls vectored in the same way. Recent re-releases of CP/M and MP/M, however, have caused some conflicts with TurboDOS extended functions.

To correct this problem, version 1.3 moved all TurboDOS extended calls to location 80 (50H). CP/M-compatible calls are now referred to as "C-functions," and TurboDOS extended calls as "T-functions."

Resident processes must often make system calls; they cannot call location 5 or 50H. Two special entry points are provided for this purpose, and must be called symbolically. They are: OCNTRY (C-functions) and OTNTRY (T-functions). The calling conventions are otherwise strictly the same as they would be for a transient program. For example, to set the DMA address, you'd use the following code:

```
MVI  C,26
          ;SETDMA function code
LXI  D,BUFFER
          ;location to set
CALL OCNTRY#
          ;this is a C-function
```

A wide range of T-functions is provided (see Table 1) for such varied things as creating and deleting resident processes, allocating and de-allocating memory, interprocess communications, date/time functions, extended file and disk drive requests, and more. A few of the more interesting functions are described here.

Communications channel support (T-functions 34-40): a full complement of functions allows complete access to the optional communications system (generally implemented in the form of RS-232 drives by the system implementer). These functions allow such actions as send/receiver character, read status, get/set baud rate, and get/set modem controls. They also allow the creation of system-independant communications software for TurboDOS—something that's impossible with CP/M.

Delay process (T-function 2) circumvents the need for software timing loops. This function allows a program (or resident process) to delay by increments as fine as the system "tick" time (generally 1/60th of a second).

Return serial number (T-function 12) returns the complete serial number of the operating system. (This function can be used to discourage piracy by keying the purchaser's operating system to your software package).

Load File (T-function 15) uses the previously described Load Optimizer to load code segments into the program area. Handy for loading overlays.

Activate Do-File (T-function 16) allows a program to begin a batch processing job. (Compared to writing the old backward $$$.SUB file with CP/M,

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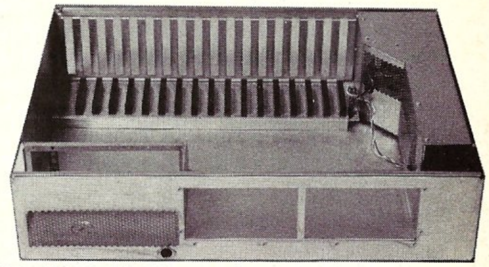

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Alternative

Continued from page 74

starting batch jobs under TurboDOS is simple with this system call).

Send Command Line (T-function 18) allows creation of applications such as menus from assembly language programs. It doesn't work quite the same way as MP/M's similarly named function, however, in that the passed command line is not executed immediately (as it is in MP/M), but is instead deferred until the calling program terminates. You may "stack" command lines by calling this function more than once.

Printer control functions (T-functions 27-30) allow complete programmatic access of the printer spooling and despooling mechanisms. Function 28 (signal-end-of-print) is especially handy, since it allows a queued print job to actually begin printing.

User-defined function (T-function 41) belongs to the user, for any purpose he desires to write code for. It can take full advantage of the network for communications between processors. To implement this function, you must write your function in a module that defines the public symbol USRFCN; register passing conventions are described in the Z80 Programmer's Guide. Once the function is in place, your applications program may communicate with it simply by calling T-function 41.

Documentation

No software evaluation can be considered complete without a look at the documentation supplied with the package. In the case of TurboDOS, I have to rate the documentation effort outstanding!

Three manuals are provided with the Z80 system: a User's Guide, a Z80 Programmer's Guide, and the Z80 System Implementer's Guide. Each includes a table of contents; the System Implementer's Guide is the only manual lacking an index.

The User's Guide begins with basics and takes the reader through the gradually more complex subjects of files, disks, printing, and processing, concluding with a summary of the entire set of 35-odd utilities that are provided with the system. The language is "gentle" and very readable.

The Programmer's and Implementer's Guides are understandably more complex, since they deal with subjects that are technical in nature. They are complete, and provide sufficient information to enable the programmer to do his job. *(Editor's note: the complete set of TurboDOS manuals for version 1.4 also includes the* 8086 Programmer's Guide *and the* 8086 Implementer's Guide.)

Conclusion

As you see, TurboDOS provides powerful facilities for both the user and the programmer. After more than three years on the market (it was first released in April 1981), TurboDOS is still being continually refined. (By the time you read this, version 1.4 should be available. This new release will feature full 8086/8088 compatibility at both the slave *and* the master level, as well as a PC-DOS emulator.)

I've recently obtained a Mega Z80 system, featuring 512K bank-selectable RAM and 27 MB Winchester disk drive, for which I plan to do a full master-to-master implementation of TurboDOS (complete with RAM disk). As *Microsystems* expands its TurboDOS coverage, I hope to provide a follow-up article on this project, as well as a review of Turbo-Plus, and (if there is sufficient interest) a turtorial on TurboDOS implementation and programming techniques.

For further information on TurboDOS, contact **Software 2000,** *1127 Hetrick Ave., Arroyo Grande, CA 93420; (805) 489-1977.*

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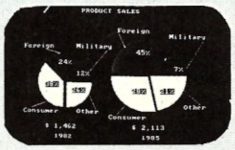

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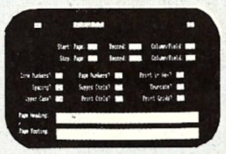

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The Networking Capabilities of TurboDOS

Create the network to meet your needs using TurboDOS

by Michel Simon and William Poole

By now, most people in the CP/M world are at least vaguely familiar with TurboDOS. It is fairly well known that TurboDOS runs most off-the-shelf CP/M (and soon MS-DOS) software, and that it can be found on S-100-based, multiuser, multiprocessor systems (networks). Less well known is the fact that a multitude of network configurations are possible with TurboDOS. Some manufacturers are now experimenting with different network architectures, and a number of interesting products already exist. Given the availability of TurboDOS on 16-bit processors and the growing list of manufacturers integrating TurboDOS with their hardware, we should see the use of TurboDOS networks increase in the days to come.

TurboDOS is truly a network operating system. This article focuses on the networking aspects of TurboDOS, including its capabilities and uses. First, we will describe the features of TurboDOS that distinguish it as a network operating system. Second, we will discuss the various possible networking configurations. Next, we will address the limitations of TurboDOS in configuring larger networks. The remainder of the article contains some general guidelines for choosing a TurboDOS network, followed by a review of TurboDOS networking products currently available. Detailed descriptions of the network architectures of three different manufacturers' products are included as examples.

What makes TurboDOS a network operating system?

The single most important characteristic of TurboDOS—one which, in essence, distinguishes a network operating system from a single-processor operating system—is that it permits transparent message routing between physically connected processors. This feature allows a request for a *device* (TurboDOS devices are drives, printers, and queues) to be automatically routed, in logical form (see below), to the processor on the network that controls the device. Routing takes place between nodes on a circuit and, in a multicircuit network, between circuits via common nodes.

TurboDOS recognizes a 'world' that consists of 1 to 255 network *circuits*, each of which can have from 1 to 255 *nodes* connected to it. A node is a microcomputer (single-board, standalone, diskless, etc.), and a circuit is the means (hardware and software) by which nodes are connected. The S-100 bus is currently the most widely used transmission facility (hardware) for a TurboDOS circuit, although there is a rapid growth in the use of LAN circuits (RS-422/SDLC, Arcnet, Omninet, Ethernet, etc.) with TurboDOS. A node can be connected to, and thus can transfer information between, more than one circuit.

In order to illustrate and clarify what makes TurboDOS a network operating system, let's compare the way CP/M handles a resource request with the way TurboDOS handles the same request. When the operator of a single-user CP/M system makes a request for a resource, such as:

```
A>dir C:
```

the chain of events is as follows:

1. CP/M's command line interpreter sees a request for directory information from the C drive, and makes a *logical function request* (in CP/M, a BDOS call) requesting this information.

2. The BDOS makes the appropriate calls to the BIOS, which contains disk drivers and has access to information about the particular characteristics of drive C.

3. The BDOS retrieves the information from the BIOS and passes it back to the command line interpreter, which then displays the information on the console.

All along, CP/M assumes that the drive is attached to the requesting processor, since CP/M does not recognize the existence of more than one processor.

Under TurboDOS, however, the chain of events is quite different:

1. The TurboDOS command line interpreter sees a request for directory information from the C drive and makes a logical function request to the TurboDOS file system asking for this information.

2. TurboDOS checks an internal table to see if drive C is attached to the requesting processor (i.e., is a local resource) or if it is attached to some other processor on the network (i.e., is a nonlocal resource).

3. If drive C is a local resource, the procedure followed is similar to that followed by CP/M.

4. If drive C is not a local resource, TurboDOS gets a *network address* from its internal table. The address indicates the circuit and node numbers of the processor to which the resource is attached.

5. TurboDOS forms a *message packet* consisting of the logical function request, the data, and the network address, and passes it on to the *circuit driver* of the circuit indicated in the network address.

6. The circuit driver has access to all the information it needs about the hardware characteristics of its physical transmission facility, and transmits the message packet to the processor indicated in the network address.

7. At the receiving processor, the same cycle is repeated: the TurboDOS system on that processor checks to see if the resource is local or nonlocal. If the resource is local, the receiving processor carries out the request; if nonlocal, the processor forwards the message packet. The requested information is returned, via the same path, to the originating processor. This processor passes the information to the command line interpreter, which displays it on the console.

TurboDOS recognizes a "world" that consists of 1 to 255 network circuits.

The internal tables mentioned in items 2 and 4, which are called *device assignment tables*, are configured when the TurboDOS system on each processor is generated. Thus the message-forwarding process is completely transparent to the user, who enters a DIR command to get a directory listing.

In the above scenario, it is important to note that messages are transmitted over the network in the form of logical function requests, enabling TurboDOS to meet one of the fundamental requirements of a network operating system: that only one processor recognizes the hardware characteristics of a given device. For example, it is imperative that only one processor maintain a disk drive's allocation vector or storage-used list; otherwise, assuring data integrity in a multiuser environment would be impractical. To meet this requirement, TurboDOS messages are transmitted in a device-independent format until they arrive at their final destination.

Print spooling is accomplished through a network in the same manner as drives are accessed: printer and queue requests are forwarded to the processor that controls the resource, just as drive requests are forwarded.

Other features

An important and related feature of TurboDOS is its modular construction. Networking hardware dependencies are isolated in circuit driver modules, while peripheral hardware dependencies are isolated in device driver modules. Device drivers and circuit drivers take hardware-independent instructions from TurboDOS and execute them on the specific device or network hardware that they control. In addition, modules of the operating system and device drivers are easily linked by the TurboDOS GEN command. Therefore, individual versions of the operating system can be configured to contain only those modules needed to control the resources attached to a given processor on the network.

A notable consequence of TurboDOS's modularity is that a wide variety of peripheral devices and network hardware can be integrated into TurboDOS systems by OEMs and system integrators. Device drivers can be replaced or updated as new disk and networking hardware becomes available.

Another feature of TurboDOS that deserves note is its support of network file and record locking. The processor that controls a given device keeps an open file and record list locally. When a logical function request for a locked file or record is received, access to that file or record is denied and a return code indicating the error is sent back over the network.

TurboDOS's network file and record locking allows almost all single-user CP/M and multiuser MP/M software to run on a TurboDOS network without modification. File lockout prevents single-user programs from corrupting files when they are simultaneously accessed by more than one user. Record lockout allows simultaneous multiuser access to data files in an organized fashion.

The above features combine to make TurboDOS a versatile operating system for configuring a wide variety of networks with different topologies and transmission facilities. We will now classify and describe some of these network configurations.

Tightly coupled networks

As we mentioned earlier, the most common TurboDOS networks currently available are on multiuser, multiprocessor S-100-based systems, including IMS International, North Star, MuSYS, and Advanced Digital, to name but a few; for a more complete list, refer to Table 1. Networks of this type

Networks

Continued from page 79

are referred to as *tightly coupled* networks. In a tightly coupled network, disk resources are largely centralized, and all the processors are booted from one disk.

The master processor is called a "server" because it services requests from the satellites for access to the (many or all) global resources attached to it (disks, printers, etc.). Slave processors are called "satellites" because this is a more accurate description of their function as part of the network. Although their primary function is to execute user programs, and they are booted by the server and dependent on it for most operations, satellites are independent processors and, in some cases, possess local disk or printer resources.

In a discussion of network configurations, it is important to distinguish between the hardware architecture of the transmission facility and the logical topology. For example, in a typical S-100 bus implementation of a TurboDOS network, the bus is the transmission facility, but the network has a star topology (Figure 1). That is, even though all the processors are physically connected on the bus, the satellites cannot directly communicate with each other; all communication on the tightly coupled, S-100-based network is controlled by the server. Although tightly coupled networks are predominantly S-100-based, other tightly coupled architectures have been implemented. Examples include Alspa, JC Systems, and TeleVideo (see Table 1).

Loosely coupled networks

Networks having processors that are independent of each other for basic operations and disk resources that are distributed throughout the network are referred to as *loosely coupled* networks. Loosely coupled networks can connect standalone, single-user systems or tightly coupled networks.

Loosely coupled networks of tightly coupled systems require that at least one processor on each tightly coupled network belong to both its internal circuit and the loosely coupled circuit (see Figure 2). Either the server of the tightly coupled circuit or a satellite can be the dual-purpose processor, providing, of course, that it has a physical means to transmit messages. Server-to-server networks typically require additional hardware; they are generally considered desirable when the loosely coupled network will be used for high-volume disk access and/or chassis expansion (e.g., MuSYS and Intercontinental Micro). Satellite-to-satellite networks use hardware already on satellite boards and run at low-to-medium speeds for file and peripheral sharing (e.g., Commercial Dynamics, MuSYS, and IBS).

Eight-bit single-user personal computers have not been widely networked using TurboDOS because of memory considerations. Until recently TurboDOS did not support more than 64K of memory, and a fully configured TurboDOS (including file system and disk drivers) leaves only a 43K-to-45K TPA on a 64K system. With TurboDOS now available on the 8088/86 family of processors, we can expect to see TurboDOS become a popular environment for implementing networks of 16-bit single-user machines, such as the IBM PC.

TurboDOS offers the user a wide variety of networking options.

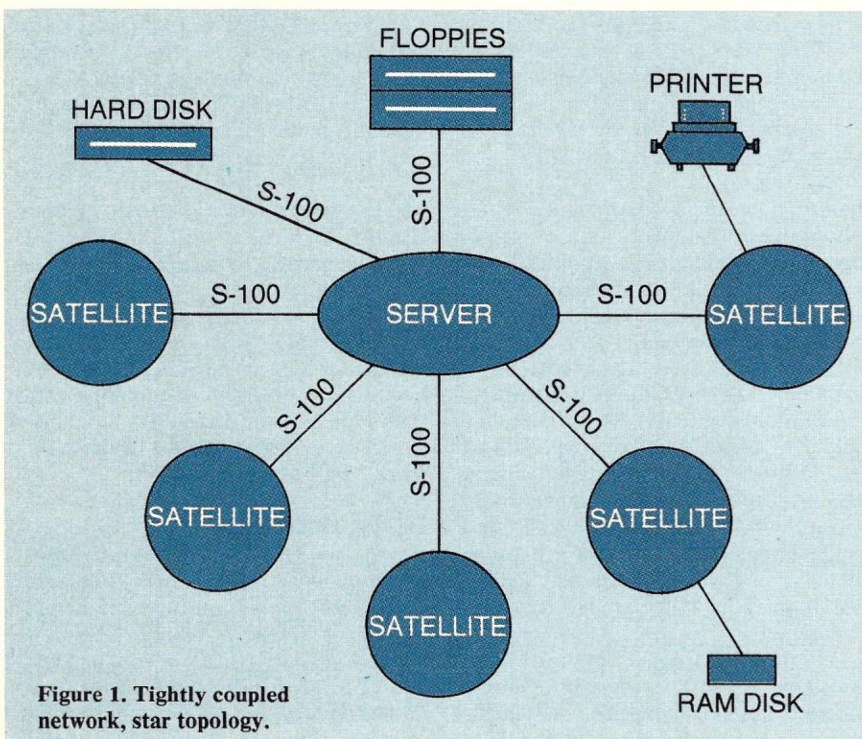

Figure 1. Tightly coupled network, star topology.

Gateways

As TurboDOS networks become available for a wide variety of processors, *gateways* will become increasingly important. Since a processor can be connected to as many TurboDOS network circuits as it has circuit drivers (and corresponding transmission facilities), a gateway processor that has different types of network interfaces can interconnect networks using dissimilar hardware (Figure 3).

Because of the TurboDOS network's forwarding mechanism, each network circuit connected by a gateway processor can be accessed by nodes throughout the entire network. If a processor is not itself connected to a given circuit, its internal *network forwarding table* tells it how to access the other circuits. Network forwarding is part of the general message-forwarding mechanism of TurboDOS described earlier and is transparent to the user.

As TurboDOS networks for IBM PC and PC compatibles begin to appear, we can expect to see gateways implemented to connect them to existing TurboDOS networks. The introduction of banked memory support in Z80 TurboDOS 1.3 has made it both feasible and desirable to network 8-bit as well as 16-bit PCs together.

TurboDOS limitations

Any TurboDOS network that has fewer than 16 devices of any one type can be configured to emulate a large computer system: no matter how the hardware is physically distributed, users have access to all network devices at all times. However, since TurboDOS uses the CP/M device-naming convention (letters A through P), when there are more than 16 devices on a network, users may access only a subset of the network at any one time. While 16 devices may seem sufficient, it is easy to imagine a network that has more than 16 drive volumes (or printers); it is also reasonable for network users to want to access most, if not all, of them.

This situation can be handled in three different ways. First, the network can be restricted to a maximum of 16 of each device. This limitation is reasonable for small point-to-point systems (e.g., two systems communicating directly over a dedicated wire) but is prohibitive for larger networks. Second, one might change the device assignments of one or more processors. This has the serious disadvantage that TurboDOS has no mechanism for changing device assignments in a running system; device assignments can be made only when the system is generated. Thus this scheme would entail generation of a separate version of the system for each set of device assignments; to change the assignments, the user would have to shut down the current system and reboot it with a different version. Since few end users generate their own systems, this is not a very practical solution. Last, TurboDOS networking products can be provided with utilities that allow device assignments to be edited and patched while the system is running, without re-SYSGENing the operating system or rebooting it (see the Commercial Dynamics example, below).

Choosing a TurboDOS network

If you already own a TurboDOS tightly coupled network, your choice for further networking products will probably be limited to whatever network hardware your manufacturer or dealer supports. However, if you have not yet purchased a system or are in a position to choose between different types of networks, an analysis of your applications is important to determine which type of tightly coupled and/or loosely coupled network will best suit your needs.

All of the currently available tightly coupled networks provide similar network performance. Tightly coupled networks that use an RS-422 transmission facility have a somewhat slower network transfer rate and therefore will not perform as well as S-100 and parallel bus systems, especially in disk-intensive operations. The costs of most tightly coupled systems are similar, so your choice will depend primarily on the other features of the TurboDOS system including disk storage, application software, dealer support, etc.

Loosely coupled networks, on the other hand, differ significantly in price and performance. A low-speed network can cost less than $100 per node to implement, while the highest speed system currently available costs more than $2000 per node. Loosely coupled network transmission rates also vary significantly, anywhere from 9.6 Kbaud to 10 Mbaud per second.

Low-speed networks (9.6 Kbaud to 40 Kbaud) are primarily useful for occasional file transfers, low-volume printer sharing, and the transmission of user-to-user mail and messages. They are generally unacceptable in situations where large volumes of data must be transferred or more than a few nodes use the network at the same time.

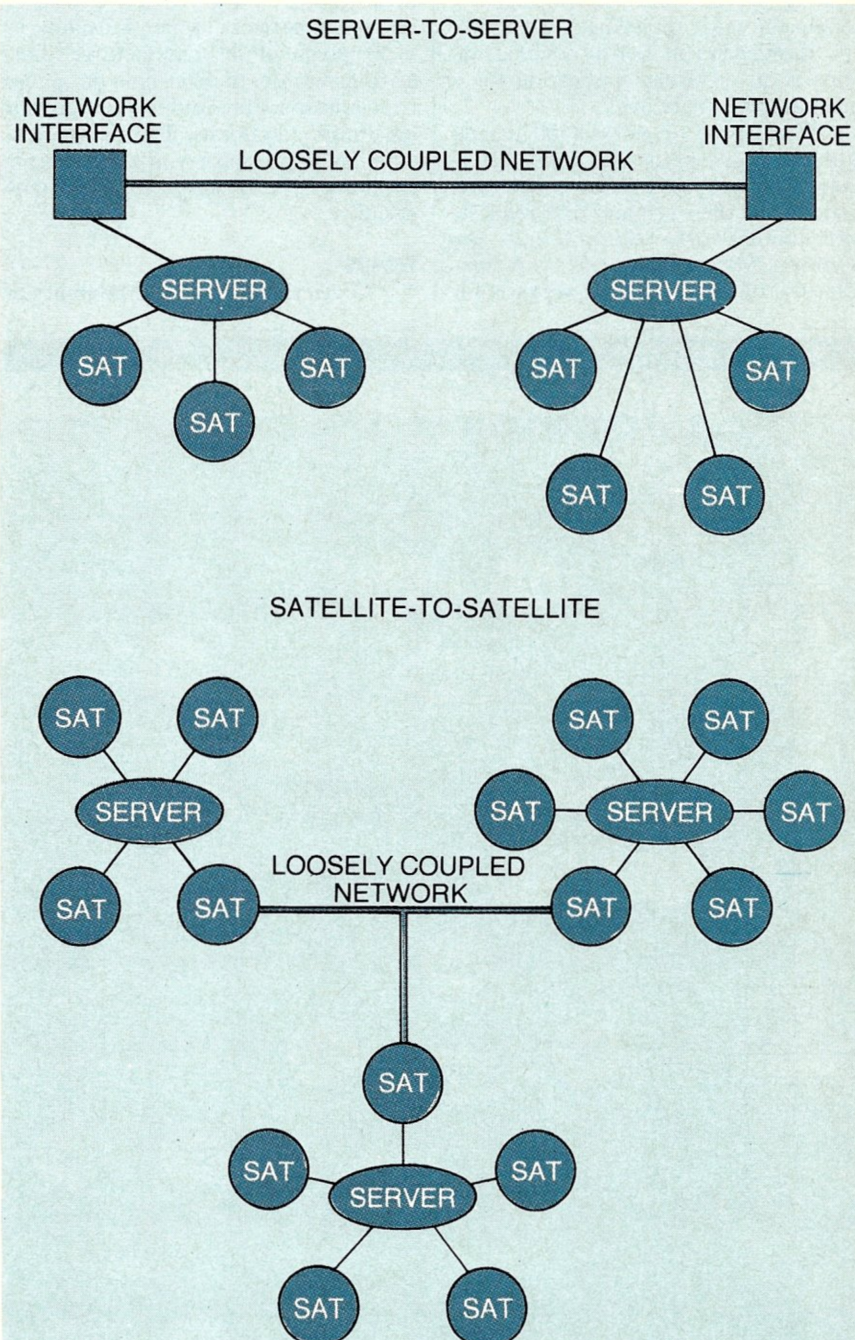

Figure 2.
Loosely coupled networks.

Networks

Continued from page 81

Medium-speed networks (100 Kbaud to 500 Kbaud) provide adequate throughput for all but the most intensive networking needs. A network in this speed range should be able to load executable files, transfer large amounts of data, and have multiuser access over the network. Medium-speed networks are most often used in situations where network nodes use primarily local disk resources and only go to the network for access to globally shared resources. Sharing printers and file transfers between a loosely coupled network of otherwise independent, tightly coupled systems is an excellent application for a medium-speed network.

High-speed networks (500 Kbaud and higher) are needed for good performance in situations where network nodes make their primary disk requests over the network. *(Editor's note: See Software 2000's comment no. 2.)* A common use of high-speed networks is for chassis expansion; e.g., two separate tightly coupled S-100 networks sharing a single large hard disk. In this case, the system without the hard disk uses only a floppy or small hard disk to boot its processors and, from that point on, all disk requests are transmitted over the high-speed network to the system with the large hard disk.

To determine whether a given network speed suits your specific needs, you must first calculate, in bits, the average and maximum amounts of data that will be transferred over the network simultaneously. Divide each of these figures into the effective transfer rate of the network (which is usually 10 to 50 percent of the manufacturer's stated transfer rate) to determine the actual transmission time under average and maximum conditions. This simple calculation should give you a reasonable estimate of how well a network will perform.

Trends

Given the increasing availability of lower-cost networking hardware and the decreasing price of hard disks, we expect to see large multiuser TurboDOS networks configured somewhat differently than they are at present. S-100-based systems are usually loaded with as many users as they can hold (10 to 20). To add more users, another S-100 system is networked to the first (provided there is a networking product available), and the second system is loaded to its fullest potential. The major advantage of this approach is that it offers the lowest cost per user; the disadvantage is that contention for shared network resources slows down all users on the system. In most common applications, better overall performance can be obtained by distributing the users throughout several smaller (four- to eight-user) systems. These systems can then be networked together to provide all users with access to all network resources.

The arrival of inexpensive hard disks and networking products will make distributed networks more common. The distributed approach also provides more protection against system failure: if one small network goes down, all others can still continue to operate. In a large, centralized system, a system crash can disable all users.

TurboDOS permits transparent message routing between physically connected processors.

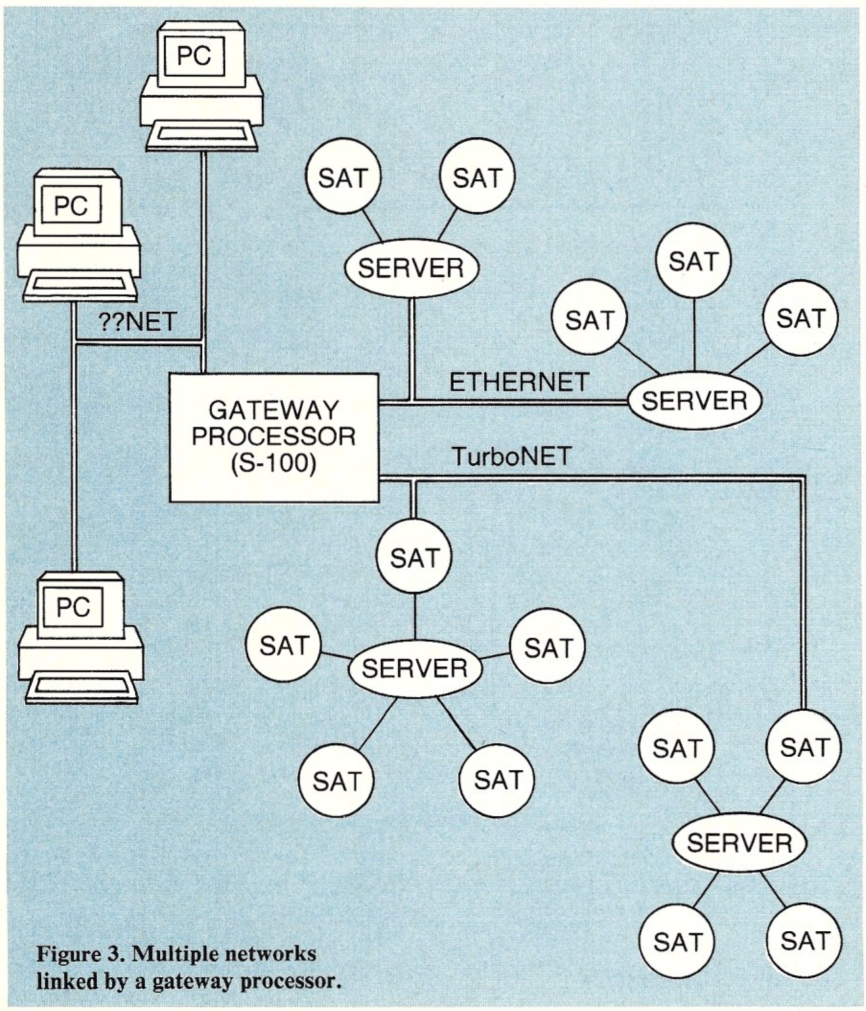

Figure 3. Multiple networks linked by a gateway processor.

Sample architectures

The **MuSYS** product line provides examples of all of the most common TurboDOS network configurations. Their tightly coupled network includes satellite processors with an S-100 star topology. They also offer an Ethernet board set that connects tightly coupled S-100 star networks into a loosely coupled high-speed master-to-master bus network. A user will see very little difference in response time between making a disk request over this high-speed master-to-master network and making the same request on a local disk. For lower-volume applications, MuSYS provides both a medium-speed (RS-422) and a low-speed (RS-232) point-to-point, satellite-to-satellite network that uses a dedicated satellite processor board as a controller. It would not be cost effective to connect more than two or three tightly coupled systems with these latter two networks, since each system must contain one dedicated satellite for each of the other systems to which it is connected.

The **Televideo** 808/816 network architecture is significantly different from other TurboDOS networks. At the center of Televideo's tightly coupled star network is a dedicated server processor that controls hard and floppy disks, printers, and either 8 or 16 RS-422 ports. Each RS-422 port may be connected point-to-point to a workstation, which is a terminal with processor, memory and, optionally, a local floppy disk. Although the workstations can have local disk storage, they are not capable of booting off the local disk and connecting to the network at the same time; thus the system is a tightly coupled network even though the processors are physically distributed.

The Televideo network also allows point-to-point, master-to-master networking through the same RS-422 ports. As with MuSYS, an RS-422 port must be dedicated to each system that is networked. But since the ports are provided with the initial purchase of the system, two 816 systems can be networked for a very small incremental cost.

Commercial Dynamics provides a workable solution to the network size limitations imposed by TurboDOS. They introduce the concept of a network *environment*, which is a particular view of a network. An environment consists of a set of logical-to-physical device assignments that specify which physical devices (drives, printers, queues) are

Table 1. TurboDos networking products

Manufacturers	Tightly coupled architecture	Loosely coupled architecture: Server-to-server	Satellite-to-satellite	Topology	Max. dist. (ft)
Advanced Computer Technology	S-100 star	<< In development >>		—	—
Advanced Digital	S-100 star	<< In development >>		—	—
Alspa	RS-422 800K bus 2000 ft	no	no	—	—
Business Operating Systems	Parallel star 10 ft	RS-232 19.2K	RS-232 19.2K	Point-to-point	300
California Computer Systems	S-100 star	no	RS-232 9.6K	Point-to-point	300
Commercial Dynamics	S-100 star	no	Differential 300K	Bus	1000
HM Systems Ltd. (United Kingdom)	S-100 star	2.5M Arcnet	no	Ring	2000
Intercontinental Micro Systems	S-100 star	2.5M Arcnet	no	Ring	2000
Independent Business Systems	S-100 star	no	RS-422 800K RS-232 38.4K	Point-to-point	600 5000
Industrial Micro Systems	S-100 star	no	Differential 307K	Bus	1000
JC Systems	2.4M parallel Bus 600 ft	no	Parallel 2.4M	Bus	600
Litton Industries (Sweda Int'l.)	2M token-passing LAN	2M token-passing LAN	2M token-passing LAN	Ring	2000
MuSYS	S-100 star	10M Ethernet	RS-422 500K RS-232 9.6K	Eth. Bus/ Point-to-point	9000/ 900/ 300
NCR Corp.	no	2M Omninet	no	Bus	2000
North Star	S-100 star	no	no	—	—
N.V. Philips (Netherlands)	Euro-BUS star	2M token-passing LAN	no	Ring	2000
QDP Computer Systems	S-100 star	no	no	—	—
Sierra Data Sciences	S-100 star	no	no	—	—
Teletek	S-100 star	no	no	—	—
Televideo	RS-422 800K star 300 ft	RS-422 800K	no	Point-to-point	300

In this table only, K = kilobauds and M = megabauds.

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Networks

Continued from page 83

accessed when a logical device is requested. Commercial Dynamics supplies utility programs to create, store, modify and activate the environments desired by the users.

Each user on a network can define any number of environments by running a menu-driven, environment-editing utility. Environment definitions are stored in files, to be activated when they are needed by running the ACTIVATE command and specifying the environment to be activated. Although only one environment can be active at a time, a new environment can be activated with one command. Thus a given user's view of the network can easily be redefined and activated without affecting any of the other users on the network, and without regenerating the operating system. These utility programs are supplied with Commercial Dynamics' satellite processor and TurboNET network, and can also obtained for any TurboDOS network.

TurboDOS's message switching facilities and multicircuit design make it a versatile OS.

Commercial Dynamics also produces a satellite processor with an onboard network interface. As many as 16 tightly coupled S-100 networks that contain at least one CD satellite can be connected at medium speed over a bus network. The CD satellite can be a user processor and a network interface at the same time; thus loosely coupled networks can be configured for a very low cost. The satellite can be integrated into any S-100 TurboDOS network and is currently running on IMS International systems.

Summary

A wide variety of networking options are available with TurboDOS, using different network topologies and networking hardware. TurboDOS's work *environment*, which is a particular view of a network. An environment consists of a set of logical-to-physical device assignments that specify which physical devices (drives, printers, queues) are accessed when a logical device is requested. Commercial Dynamics supplies utility programs to create, store, modify and activate the environments desired by the users.

Each user on a network can define any number of environments by running a menu-driven, environment-editing utility. Environment definitions are stored in files, to be activated when they are needed by running the ACTIVATE command and specifying the environment to be activated. Although only one environment can be active at a time, a new environment can be activated with one command. Thus a given user's view of the network can easily be redefined and activated without affecting any of the other users on the network, and without regenerating the operating

Michel Simon, Box 953, Brooklyn, NY 11202

Michel Simon is a New York-based networking and microcomputer consultant. William Poole is president of Commercial Dynamics, Inc., a Providence, RI developer of hardware and software products.

Comments from Software 2000, Inc.

Software 2000, Inc., the creators of TurboDOS, disagree with Messrs. Simon and Poole on the question of network speeds. They contribute the following comments:

1. After performing extensive benchmarks, we disagree with the authors' statement that RS-422/SDLC circuits are somewhat slower than S-100 or parallel circuits. The 800 Kbaud/sec RS-422/SDLC circuits used by TeleVideo, for example, yield every bit as good a performance as the S-100 circuits used by MuSYS, North Star, and others.

2. We also disagree with the authors' estimate of speed requirements in situations where primary disk requests are made over the network. Our experience is that a network speed of 500 Kbaud/sec is optimum for networks using 4-MHz Z80 processors, and that transfer rates above 1 Mbaud/sec provide no noticeable performance improvement (CPU speed becomes the bottleneck at this point). As CPUs become significantly faster (e.g., 80286s), the higher network rate may begin to pay off.

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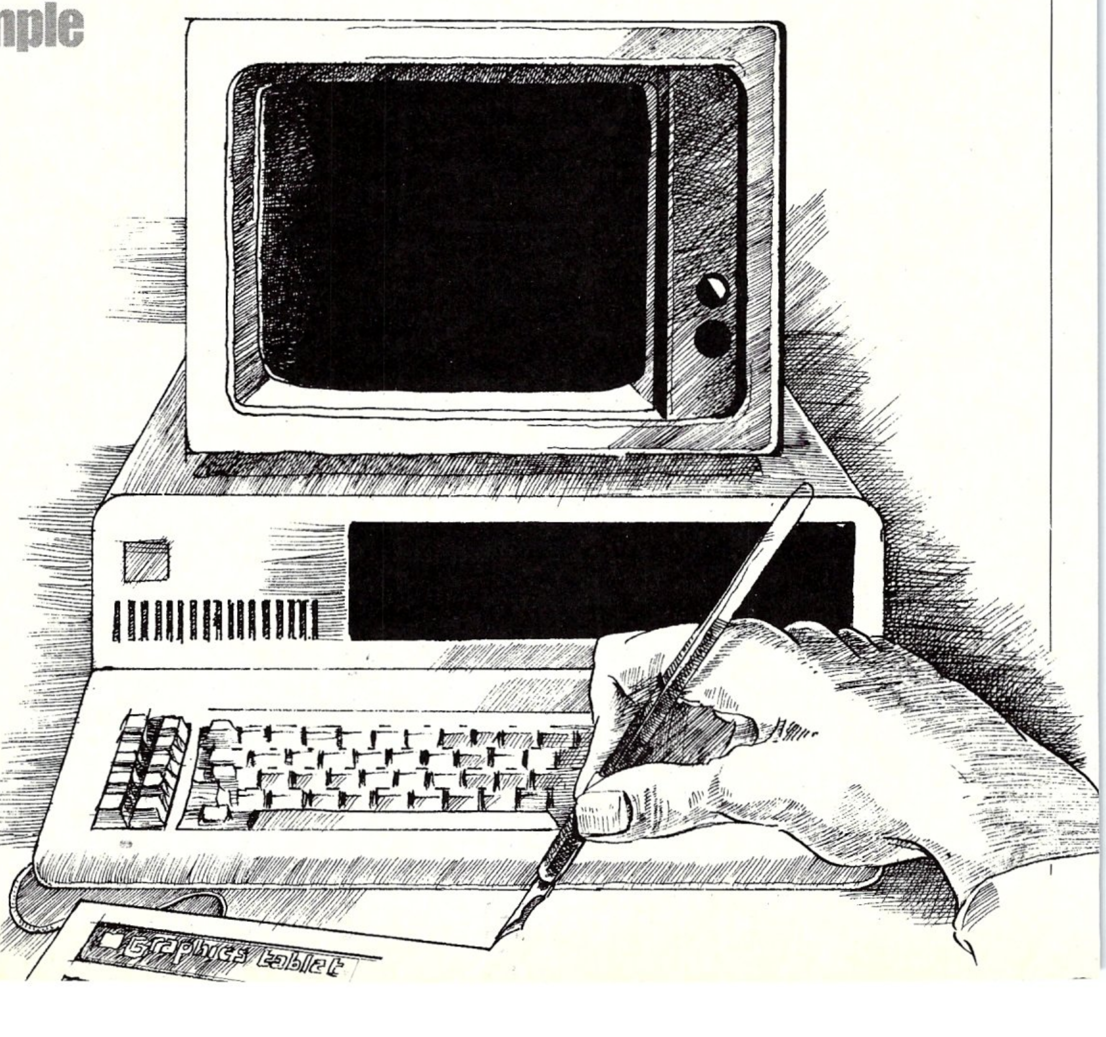
Graphics Subroutines in C for NAPLPS

Create a simple graphics workstation editor



by
Dave McCune

A computer protocol agreement—graphics, communications, etc.—should cater to both end users and programmers. The graphics protocol known as the North American Presentation Level Protocol Syntax (NAPLPS) does both quite well.

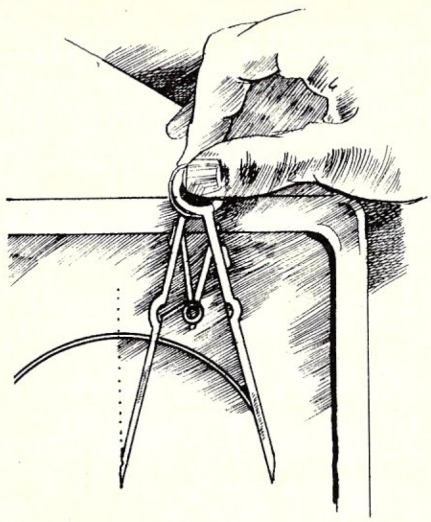
NAPLPS offers a wide range of graphics functions. Its compact, extensible coding scheme is especially useful for transmitting, storing and displaying graphics information from videotex host computers to a wide variety of graphics terminals.

Beyond providing impressive graphics functions and making efficient use of storage space and communication bandwidth, NAPLPS is easy for the programmer to use. The NAPLPS programmer's task is generally to write some form of interpreter. Basically, a NAPLPS interpreter does one of two things. It may translate incoming NAPLPS bytes into a physical graphics display. This type of interpreter is generally called a 'decoder.' Or it may translate input from editorial users or even data files (e.g., DIF files from a spreadsheet) into NAPLPS code. This latter type of interpreter is a graphics-creation workstation.

The demonstration program in Listing 1 is a very simple graphics-creation workstation. It requires a user to interact with a menu of graphics functions (**set color**, **line**, **rectangle**, and so on). The input is then translated into NAPLPS code. The NAPLPS bytes can be output to any number of devices, such as a disk file or communications port. Since users generally want to see the graphics they are creating, the output of the workstation interpreter is sent to a decoder that creates a video display. In Listing 1, the NAPLPS bytes are simply written to the DOS AUX port. When I wrote the program, I connected a standalone NAPLPS decoder and color monitor to that port.

The C language is particularly well-suited to NAPLPS work. As we saw last month, NAPLPS code consists of opcodes (for the graphics functions) followed by operands (for data arguments, such as coordinates or color specifications). A NAPLPS opcode is one byte, while operands consist of one or more bytes. As we shall see, the NAPLPS programmer must constantly set and reset specific bits within each byte. The easy-to-use bit-manipulation capabilities of C are very helpful here.

Listing 1 is organized as a **main()**, which is a dispatcher linking the nine menu options to the functions that exe-



Once we have defined colors, we can draw geometric shapes.

cute them. These functions fall into three categories: console I/O, NAPLPS creation, NAPLPS output.

Console I/O is handled by the standard C library function **scanf()**, the Lattice function **cputs()** and a custom function **get_coord()**.

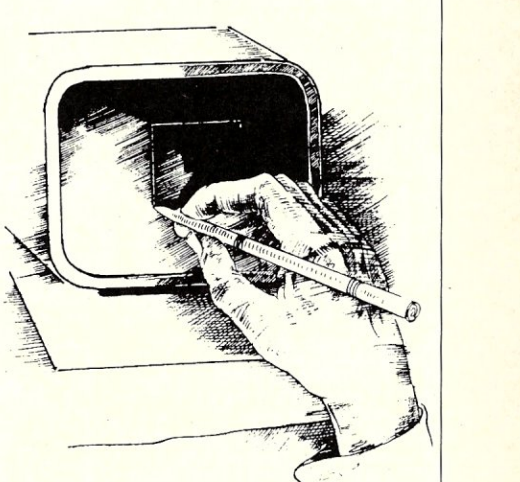
NAPLPS output is performed by the custom function **write_naplps()**, which here simply sends single bytes to the DOS AUX port via **bdos()**. Since the purpose of this listing is to explain NAPLPS algorithms rather than general C I/O techniques, we need say no more about these parts of Listing 1. (Note only that in order to save printed space, the program intentionally excludes all error-handling. I trust the reader will not imitate this practice.)

Listing 1 provides only a small subset of NAPLPS graphics. Five graphics primitives are provided (point, line, arc, rectangle and polygon), along with functions to select an entry from the color map and then to define the color of this entry. Finally, a function to initialize the decoder is included. Many important functions—defining text attributes and entering text, defining textures, creating blinking colors, for example—have not been included. After examining the techniques used to manipulate the limited set of NAPLPS functions in Listing 1, though, the reader should have no trouble creating algorithms to implement other features.

The first NAPLPS option—NEW_FRAME—actually consists of three distinct operations. First, **init_dec()** outputs three control characters, which stop any looping macros or current macro definitions (for more details on this, see the discussion of a NAPLPS frame in "An Introduction to NAPLPS," *Microsystems*, July 1984, pg. 54, hereinafter called the "Introduction"). Then, **nsr()** resets many of the decoder's variable attributes to their default states. Finally, a further reset is performed by **pdi_reset()**. [Note that we switch the in-use code table by means of a **shift_out()** before we execute **pdi_reset()**. See the "Introduction" for an explanation of NAPLPS code extension.] **Pdi_reset()** is a good illustration of how NAPLPS operands sometimes consist of bit-masks. By using only 1, 2, or 3 bits for each argument to **pdi_reset()**, NAPLPS manages to pass nine different arguments in only 2 bytes of operand data.

Note that during construction of the packed operands, the bytes are "OR-ed" with 40h (OPERAND_BIT). All NAPLPS operands have bit 7 (bits numbered from 1 to 8, least to most significant) set to 1, while bit 7 is 0 for all opcodes. This makes it very easy for a decoder to recognize when a variable-length string of operands ends.

In a more complex graphics-creation workstation, the user would be allowed some control over the arguments to **pdi_reset()**. To shorten the program, I have simply set the values for these operands myself.



Before drawing any graphics, a NAPLPS artist should select a color. Actually, the user selects a color map entry by using **select_color()**, and then sets the red, green and blue values

Subroutines

Continued from page 87

that will define the color entry, again using **set_color()**. The only noteworthy feature of **select_color()** is that it produces a variable number of NAPLPS operands (0 to 2), depending on the color mode selected by the user (see the "Introduction" for a discussion of how NAPLPS handles colors.) Also, note that, since the decoder I use has a color map 4 bits wide, color map entries can range from 0 to 15. NAPLPS requires that the 4 bits used to specify this entry be left-justified within bits 6 to 1 of the operand, so I shift the map entry bits 2 places to the left.

Colors are defined in terms of fractions of full intensity of each of red, green and blue (see "Introduction" for a table showing how this data is packed). Function **set_color()** translates user input—an integer in the range 0 (no intensity) to 63 (full intensity) for each color—into a packed, 3-byte string.

Once we have chosen and defined colors, we can draw geometric shapes. The general format of these graphic primitive commands is "opcode, coordinate operands." The opcode itself specifies which geometric shape to draw. In fact, only bits 5 to 3 of the opcode determine which primitive has been selected. Bits 1 and 2 are used to define attributes. In the case of "point," for example, bit 2 is set to indicate that the point should be visible on the display screen. If bit 2 is 0, the point is invisible; i.e., the current drawing point is shifted, but nothing is drawn on the screen. Other attributes controlled by these two bits are set/join, absolute/relative and fill/outline. Thus each primitive function in Listing 1 requires arguments to specify bit settings for bits 1 and 2.

I was impressed by the compact way that NAPLPS stores data.

After each geometric primitive is set, the coordinate must be packed into operand bytes. This translation, from integer values entered by the user for x- and y-coordinates to packed NAPLPS, is handled by **coord_convert()**.

Note that the arc and polygon options in **main()** end with a **shift_out()**. Since these two primitives take a variable number of coordinate operands, the decoder must be told when the string of operands ends. Since only operands have bit 7 set, we simply end a variable-length string of operands with any character which has bit 7 set to 0. Sending a 0Eh (**shift_out()**) is an innocuous way to do this.

I enjoyed writing this program. NAPLPS is a clever standard, and I was impressed as I translated from the wasteful, byte-oriented manner in which I normally store data in programs to the compact way NAPLPS stores this same data. As you examine this listing, I hope you will understand as I did that programming is more than just making computers work. It is a matter of making them work with style —and NAPLPS does this.

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```
/*****************************************************************
* FILE - NAPLPS.C                                                *
*                                                                *
* FUNCTION -    Tutorial program to create simple NAPLPS         *
*               graphics.                                        *
*                                                                *
* LANGUAGE -    C (Lattice)                                      *
*                                                                *
* DESCRIPTION - NAPLPS.C consists of selected NAPLPS-creation    *
*               functions, such as a function to convert decimal*
*               integer coordinate data into packed NAPLPS data,*
*               and functions to create opcodes for the NAPLPS   *
*               graphics primitives.  The functions are called   *
*               from main(), which presents a menu of selected   *
*               NAPLPS actions.                                  *
*                                                                *
*               The user should be aware that this program is    *
*               primarily pedagogical.  It is only a very        *
*               primitive graphics-creation workstation.  Only   *
*               a small number of NAPLPS features are            *
*               included.  To save space, almost no error        *
*               handling is provided.                            *
*                                                                *
* COMPILER -    Lattice C, vers 1.04                             *
*                                                                *
* HISTORY -     001  84.06.07   David McCune                     *
*****************************************************************/
#include <stdio.h>

/*****************************************************************
* NAPLPS C0 & C1 control codes, and some PDI opcodes.            *
*****************************************************************/

/* Define C0 control characters: */
#define C0_BEL  0x07  /* Bell                                    */
#define C0_APB  0x08  /* Active Pos Backward (backspace)         */
#define C0_APF  0x09  /* Active Pos Forward (horizontal tab)     */
#define C0_APD  0x0A  /* Active Pos Down (linefeed)              */
#define C0_APU  0x0B  /* Active Pos Up (vertical tab)            */
#define C0_CLS  0x0C  /* Clear Screen (form feed)                */
#define C0_APR  0x0D  /* Active Pos Return (carriage return)     */
#define C0_SO   0x0E  /* Shift Out (invoke G1 set)               */
#define C0_SI   0x0F  /* Shift In (invoke G0 set)                */
#define C0_CAN  0x18  /* CAN (end currently executing macros)    */
#define C0_SS2  0x19  /* Sgl Shft 2 (invoke non-locking G2 set)*/
#define C0_ESC  0x1B  /* Escape (used for code extension)        */
#define C0_APS  0x1C  /* Active Position Set                     */
#define C0_SS3  0x1D  /* Sgl Shft 3 (invoke non-locking G3 set)*/
#define C0_APH  0x1E  /* Active Position Home                    */
#define C0_NSR  0x1F  /* Non-Selective Reset                     */

/* Define selected C1 control characters: */

#define C1_DEFM 0x40  /* Define Macro                            */
#define C1_END  0x45  /* End all macro definitions               */
#define C1_CRSS 0x5C  /* Cursor Steady                           */
#define C1_CRSO 0x5D  /* Cursor Off                              */
/* Define selected PDI opcodes: */

#define PDI_RES         0x20     /* PDI reset                    */
#define PDI_DOM         0x21     /* Domain                       */
#define PDI_TXT         0x22     /* Text control                 */
#define PDI_TEX         0x23     /* Texture                      */
#define PDI_PNT         0x24     /* Point                        */
#define PDI_LIN         0x28     /* Line                         */
#define PDI_ARC         0x2C     /* Arc                          */
#define PDI_REC         0x30     /* Rectangle                    */
#define PDI_POL         0x34     /* Polygon                      */
#define PDI_SETC        0x3C     /* Set color                    */
#define PDI_SELC        0x3E     /* Select color                 */

#define OPERAND_BIT  0x40    /* 7th bit set = NAPLPS operand     */

/***  end of NAPLPS control and opcode definitions  ************/

#define NEW_FRAME       '1'      /* Menu selections */
#define SELECT_COLOR    '2'
#define SET_COLOR       '3'
#define POINT           '4'
#define LINE            '5'
#define ARC             '6'
#define RECTANGLE       '7'
#define POLYGON         '8'
#define EXIT            '9'

#define TRUE    1
#define FALSE   0
#define BUFFER_LEN 10
char buffer[BUFFER_LEN];

main()
{

    char menu_selection;


    int count, i;
    int row, column;
    int x_coord, y_coord;
    int  res_domain, res_color, res_clearscreen, res_txt,
         res_blink, res_field, res_texture, res_macros, res_drcs;
    int color_mode = 1;
    int fore_color, back_color;
    int red, green, blue;
    int fill = FALSE;         /* Filled or outlined ? */
    int set = TRUE;           /* Set or Join mode ? */
    int relative = FALSE;     /* Absolute or Relative coordinates? */
    int circle = TRUE;        /* Circle or Arc? */
    int visible = TRUE;       /* Point visible or invisible? */

while (menu_selection = menu_draw())    /* Get a menu choice */

   switch (menu_selection)              /* Act on it, & loop */
   {
      case NEW_FRAME:
         init_dec();            /* End any macros & def's */
         row = column = 0;
         nsr(row,column);   /* Non-sel'v reset; curs @ u.l. */
         shift_out();       /* Put G1 (PDI) set into in-use
                               table */
         res_domain = 1;
         res_color = 3;
         res_clearscreen = 7;
         res_txt = res_blink = res_fields = 1;
         res_texture = res_macros = res_drcs = 1;

 /* PDI reset of 9 NAPLPS attributes: */
         pdi_reset( res_domain, res_color, res_clearscreen,
              res_txt, res_blink, res_field, res_texture,
              res_macros, res_drcs );
         break;

      case SELECT_COLOR:                          /* Sel entry */
         cputs("\r\nColor mode [0,1,2]: ");  /* from the */
            scanf("%d",&color_mode);          /* color map */
         cputs("\r\nForeground color [0-15]: ");
            scanf("%d",&fore_color);
         back_color = 0;
         if (color_mode == 2)
         {
            cputs("\r\nBackground color (mode 2) [0-15]: ");
               scanf("%d",&back_color);
         }
         select_color(color_mode, fore_color, back_color);
         break;


      case SET_COLOR:                      /* Modify the color */
         cputs("\r\nRed [0-63]: ");     /* of the selected */
            scanf("%d",&red);           /* map entry */
         cputs("\r\nGreen [0-63]: ");
            scanf("%d",&green);
         cputs("\r\nBlue [0-63]: ");
            scanf("%d",&blue);
         set_color(red,green,blue);
         break;


       case POINT:
          relative = FALSE;
          visible = TRUE;
          point(relative,visible);
          get_coord();
          break;


      case LINE:
         relative = FALSE;
         set = TRUE;
         line(set,relative);
         get_coord();
         get_coord();
         break;


      case ARC:
         set = TRUE;
         cputs("\r\nFill? [0=n ; 1=y]: ");
            scanf("%d",&fill);
         cputs("\r\nArc [0] or Circle [1]: ");
            scanf("%d",&circle);
         arc(set,fill);
         i = 0;
         while ((count = get_coord()) != 0)
         {
            ++i;
            if((circle) && (i > 1)) break;
         }
         shift_out();
         break;


      case RECTANGLE:
         set = TRUE;
         cputs("\r\nFill? [0=n ; 1=y]: ");
            scanf("%d",&fill);
         rectangle(set,fill);
         get_coord();
         get_coord();
         break;


      case POLYGON:
         set = TRUE;
         cputs("\r\nFill? [0=n ; 1=y]: ");
            scanf("%d",&fill);
         polygon(set,fill);
         while ((count = get_coord()) != 0)
            ;
         shift_out();
         break;


       case EXIT:
          shift_out();
          _exit(0);
      default:
          break;
   }
  _exit(0);
}
```

Subroutines *Continued from page 89*

```
/*****************************************************************
* ARC:  draw an arc/circle/spline
*****************************************************************/
arc(set, fill)
int set, fill;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = PDI_ARC | (set << 1) | fill;
   write_naplps(buffer);
}

/*****************************************************************
* COORD_CONVERT: converts integer coordinate data into a
* 3-byte packed NAPLPS coordinate code string.  With the 3-byte
* string, we can encode coordinates in the range -255 to 255.
*****************************************************************/
coord_convert(x_coord_integer, y_coord_integer, naplps_coord_str)
char *naplps_coord_str;
int x_coord_integer, y_coord_integer;
{
   x_coord_integer = (x_coord_integer >  255) ?  255 :
      x_coord_integer;
   x_coord_integer = (x_coord_integer < -255) ? -255 :
      x_coord_integer;
   y_coord_integer = (y_coord_integer >  199) ?  199 :
      y_coord_integer;
   y_coord_integer = (y_coord_integer < -199) ? -199 :
      y_coord_integer;

   x_coord_integer =
      (x_coord_integer < 0) ? (x_coord_integer - 1) :
         x_coord_integer;
   y_coord_integer =
      (y_coord_integer < 0) ? (y_coord_integer - 1) :
         y_coord_integer;

   *naplps_coord_str   =  OPERAND_BIT |
                          (((x_coord_integer < 0) ? 1 : 0) << 5) |
                          (((x_coord_integer & 128)/128)   << 4) |
                          (((x_coord_integer & 64)/64)     << 3) |
                          (((y_coord_integer < 0) ? 1 : 0) << 2) |
                          (((y_coord_integer & 128)/128)   << 1) |
                          (( y_coord_integer & 64)/64);
   *(naplps_coord_str+1) = OPERAND_BIT |
                          (((x_coord_integer & 32)/32) << 5) |
                          (((x_coord_integer & 16)/16) << 4) |
                          (((x_coord_integer & 8)/8)   << 3) |
                          (((y_coord_integer & 32)/32) << 2) |
                          (((y_coord_integer & 16)/16) << 1) |
                          (( y_coord_integer & 8)/8);
   *(naplps_coord_str+2) = OPERAND_BIT |
                          (((x_coord_integer & 4)/4) << 5) |
                          (((x_coord_integer & 2)/2) << 4) |
                          (( x_coord_integer & 1)    << 3) |
                          (((y_coord_integer & 4)/4) << 2) |
                          (((y_coord_integer & 2)/2) << 1) |
                          (  y_coord_integer & 1);
}

/*****************************************************************
* GET_COORD:  asks user for X and Y coordinates, calls
* coord_convert to convertthe decimal integers to packed NAPLPS,
* and outputs the packed string.  get_coord returns the number of
* leading numeric characters entered by the user.
*****************************************************************/

get_coord()
{
   int x_coord, y_coord, count;
   char *coord_str, *cgets();
   setmem(&buffer, sizeof(buffer), '\0');
   *buffer = sizeof(buffer) - 2;

   cputs("\r\nX coord [0 - 255]: ");
      coord_str = cgets(buffer);
      count = stcd_i(coord_str,&x_coord);
   if(count > 0)
   {
      cputs("\r\nY coord [0 - 199]: ");
         coord_str = cgets(buffer);
         count = stcd_i(coord_str,&y_coord);

      if(count > 0)
      {
         coord_convert(x_coord,y_coord,coord_str);
         write_naplps(coord_str);
      }
   }
   return(count);
}

/*****************************************************************
* INIT_DEC:  stops ongoing macros and macro definitions.  It
* should be called at the start of any new frame, before any other
* reset functions.
*****************************************************************/
init_dec()
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = CO_CAN;         /* Cancel ongoing macros */

   *(buffer+1) = CO_ESC;     /* End all ongoing macro definitions */
   *(buffer+2) = C1_END;
   write_naplps(buffer);
}

/*****************************************************************
* LINE:  draw a line
*****************************************************************/
line(set, relative)
int set, relative;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = PDI_LIN | (set << 1) | relative;
   write_naplps(buffer);
}

/*****************************************************************
* MENU_DRAW:  display the menu
*****************************************************************/
menu_draw()
{
   char menu_selection;

   cputs("\r\n\r\n\r\n\r\n\r\n");
   cputs("          NAPLPS TUTORIAL PROGRAM\r\n");
   cputs("\r\n");
   cputs("1 - New Frame      4 - Point   7 - Rectangle\r\n");
   cputs("2 - Select Color   5 - Line    8 - Polygon\r\n");
   cputs("3 - Set Color      6 - Arc     9 - Exit\r\n");
   cputs("\r\n              Please choose: ");

putch(menu_selection = getch());
return(menu_selection);
}

/*****************************************************************
* NSR:  performs a non-selective reset.  The effect is:
*       - all G-sets are set to default states;
*       - in-use table is set to default state;
*       - Domain parameters set to default values;
*       - Text parameters set to default values;
*       - Texture parameters set to default values (though
*         programmable texture masks are not cleared);
*       - Color mode set to 0 and drawing color set to nominal
*         white.  Color map not changed;
*       - The two operand bytes position the cursor.  Bits 1 to 6
*         of each operand are interpreted as a binary number
*         representing the row and column character cell position
*         of the cursor.
*****************************************************************/
nsr(row,column)
int row,column;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = CO_NSR;
   *(buffer+1) = row | OPERAND_BIT;
   *(buffer+2) = column | OPERAND_BIT;
   write_naplps(buffer);
}

/*****************************************************************
* PDI_RESET:  reset the decoder
*****************************************************************/
pdi_reset(res_domain, res_color, res_clearscreen, res_txt,
         res_blink, res_field, res_texture, res_macros,res_drcs)
int res_domain, res_color, res_clearscreen, res_txt, res_blink,
    res_field, res_texture, res_macros, res_drcs;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer =       PDI_RES;
   *(buffer+1) = res_domain | (res_color << 1) |
                 (res_clearscreen << 3) | OPERAND_BIT;
   *(buffer+2) = res_txt | (res_blink << 1) | (res_field << 2) |
                 (res_texture << 3) | (res_macros << 4) |
                 (res_drcs << 5) | OPERAND_BIT;
   write_naplps(buffer);
}

/*****************************************************************
* POINT:  draw a point
*****************************************************************/
point(relative, visible)
int relative, visible;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = PDI_PNT | (visible << 1) | relative;
   write_naplps(buffer);
}
```

```
/*****************************************************************
* POLYGON:  draw a polygon
*****************************************************************/
polygon(set, fill)
int set, fill;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = PDI_POL | (set << 1) | fill;
   write_naplps(buffer);
}



/*****************************************************************
* RECTANGLE:  draw a rectangle
*****************************************************************/
rectangle(set, fill)
int set, fill;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = PDI_REC | (set << 1) | fill;
   write_naplps(buffer);
}



/*****************************************************************
* SELECT_COLOR:  select foreground/background colors
*****************************************************************/
select_color(color_mode,color1,color2)
int color_mode, color1, color2;
{
   setmem(&buffer,sizeof(buffer),'\0');

   *buffer = PDI_SELC;
   if (color_mode >= 1) *(buffer+1) = OPERAND_BIT | (color1 << 2);
   if (color_mode >= 2) *(buffer+2) = OPERAND_BIT | (color2 <<2);
   write_naplps(buffer);
}
```

```
/*****************************************************************
* SET_COLOR:  set color palette for current color slot
*****************************************************************/
set_color(red, green, blue)
int red, green, blue;
{
   setmem(&buffer,sizeof(buffer),'\0');

   red   = (red   > 63) ? 63 : red;
   red   = (red   <  0) ?  0 : red;
   green = (green > 63) ? 63 : green;
   green = (green <  0) ?  0 : green;
   blue  = (blue  > 63) ? 63 : blue;
   blue  = (blue  <  0) ?  0 : blue;

   *buffer = PDI_SETC;
   *(buffer+1) = OPERAND_BIT                |
                 (((green & 32)/32) << 5)  |
                 (((red   & 32)/32) << 4)  |
                 (((blue  & 32)/32) << 3)  |
                 (((green & 16)/16) << 2)  |
                 (((red   & 16)/16) << 1)  |
                 (( blue  & 16)/16);
   *(buffer+2) = OPERAND_BIT                |
                 (((green & 8)/8) << 5)    |
                 (((red   & 8)/8) << 4)    |
                 (((blue  & 8)/8) << 3)    |
                 (((green & 4)/4) << 2)    |
                 (((red   & 4)/4) << 1)    |
                 (( blue  & 4)/4);
   *(buffer+3) = OPERAND_BIT                |
                 (((green & 2)/2) << 5)    |
                 (((red   & 2)/2) << 4)    |
                 (((blue  & 2)/2) << 3)    |
                 (( green & 1)    << 2)    |
                 (( red   & 1)    << 1)    |
                 (  blue  & 1);
   write_naplps(buffer);
}



/*****************************************************************
* SHIFT_IN:  outputs a 0x0F.  This byte shifts the G0 set into
* the in-use table.  G0 is the ASCII character set by default.
*****************************************************************/
```


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Subroutines

Continued from page 91

```
shift_in()
{
   setmem(&buffer,sizeof(buffer),´\0´);

   *buffer = CO_SI;
   write_naplps(buffer);
}



/*****************************************************************
* SHIFT_OUT: outputs a 0x0E.  This byte shifts the G1 set into
* the in-use table.  By default, G1 is the PDI graphics set.
*****************************************************************/
shift_out()
{
   setmem(&buffer,sizeof(buffer),´\0´);

   *buffer = CO_SO;
   write_naplps(buffer);
}



/*****************************************************************
* WRITE_NAPLPS: outputs a string of bytes.  In this sample
* listing, it simply writes each byte to the DOS AUX port.
* It uses the Lattice bdos function to invoke DOS function 4.
*****************************************************************/
#define DOS_AUXO        4
write_naplps(out_str)
char *out_str;
{
   int i;

   for(i=0; *(out_str+i) != ´\0´; ++i)
   {
     printf(": %d\r\n",*(out_str+i)); /* debug line */
     bdos(DOS_AUXO,*(out_str+i));     /* i/o to decoder channel */
   }
}
```


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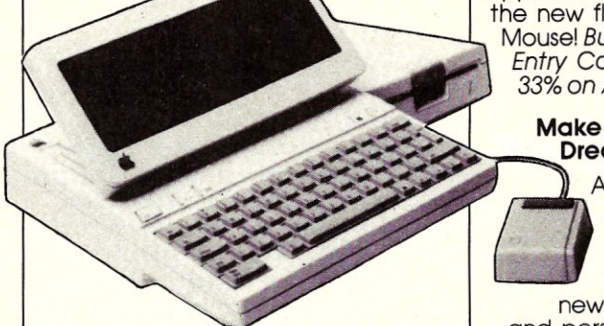

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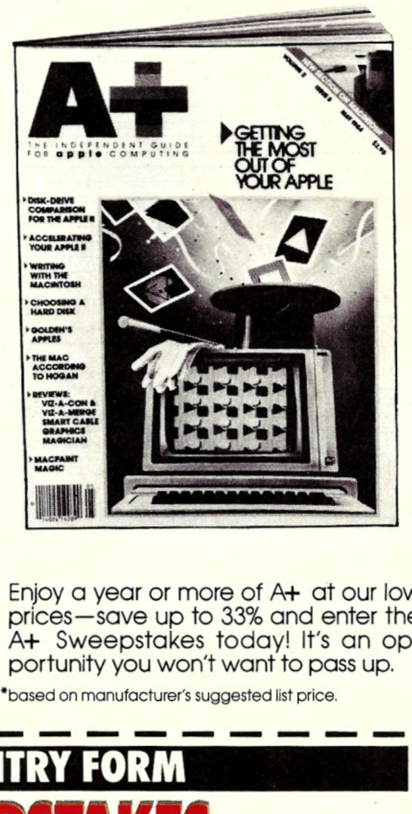

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Declarative Languages Under Unix

yacc, make, and Prolog offer you powerful UNIX declarative tools

by John Malpas
and Kathy O'Leary

Understanding the declarative languages make, yacc, and Prolog :reading this article.

If you are not familiar with declarative languages, the syntax of the sentence above may seem outright nonsensical. But try replacing that stray colon with the phrase "depends on." Now we have the intelligible (though perhaps immodest) statement "Understanding the declarative languages **make**, **yacc**, and Prolog depends on reading this article." The point we are making is that the colon is an *operator,* and that one way of looking at its effect in declarative languages is to replace it with the phrase we suggested.

Languages, including those in the form of operating system utilities, can be classified as either procedural or declarative. Most conventional programming languages (Cobol, Fortran, C, Pascal, etc.) are procedural, since they require the programmer to code the steps by which a goal is to be achieved.

Declarative languages, on the other hand, require only statements of a program's goals; the programmer never needs to describe how the program accomplishes them. Unlike a program written in a procedural language, in which the critically important elements are the flow-control constructs (e.g., GOTO, FOR, WHILE), a declarative language program consists of a set of rules governing the relationships between various types of data. (For this reason, declarative languages are also known as *rule-based* languages.) When a program is run, these rules are fed into a black-box component, called an *executor,* which then "magically" produces the desired output.

The most commonly used declarative languages today are probably relational database query languages of the SQL type. Less well known are the two declarative languages that UNIX features among its utilities, **make** and **yacc**. In the same breath, we should also mention Prolog (the first general-purpose programming language with a declarative syntax), which has recently become popular among AI researchers.

make

The UNIX utility, **make**, enables a programmer to create a single executable program from various component object files. When you ask **make** to create an executable program, it first checks the corresponding source code (*.c* file) for each of the component modules. If the source for any component has been modified since the last compilation, the component is recompiled *before* the executable program is made.

Rules in a **make** file take the following form:

```
programA :main.o screen.o db.o
```

This line is best read as a dependency list: in order for an up-to-date version of *programA* to exist, there must exist up-to-date versions of *main.o*, *screen.o*, and *db.o*. However, since **make** is very smart, it realizes that up-to-date here means "compiled since the last modification." Therefore, an additional set of dependency rules is implied:

```
main.o     :main.c
screen.o   :screen.c
db.o       :db.c
```

Only after **make** has confirmed the existence of an up-to-date source file will create an executable file (e.g., *programA*).

yacc

yacc (Yet Another Compiler Compiler) is a UNIX utility that creates a bottom-up parser from a list of rules. **yacc** first generates C code from these rules, which can then be compiled into executable code.

A **yacc** rule takes this form:

```
block      :'{' statements '}'
```

Since **yacc** matches rules in a bottom-up fashion, you might read this rule as follows: IF you have a '{' followed by one or more *statements* (defined elsewhere) followed by a '}', THEN you have an object called a *block*. If you read this rule as if it were a top-down assertion of those ingredients which make up a block, it would sound similar to the **make** rule above: for a block to exist, there must be a '{' followed by *statements* followed by a '}'.

A program in **yacc** is a set of hierarchically linked dependencies. Here is a **yacc** program describing a simple procedural language:

```
fn         :fn_name block
block      :'{' stmnts :'}'
stmnts     :stmnts stmnt
stmnt      :if_stmnt
if_stmnt   :"if" block
```

If you have ever tried to write a bottom-up parser without **yacc**, you will definitely appreciate how much easier this task becomes with **yacc**, and how clean **yacc** code is.

Prolog

Prolog, which stands for *PROgramming in LOGic*, is a declarative language invented 12 years ago by Kowalski and Colmerauer. Their objective was to design a computer language that resembled predicate calculus, so that mathematicians could use computers without having to translate their ideas into an algorithm-driven computer language such as Fortran. Although the first application of Prolog was theorem proving, the language turned out to be useful in many areas other than abstract mathematics. Thus it became the first general-purpose declarative language. (Other rule-based languages, such as **make** and **yacc**, are limited to specific purposes.)

Declarative languages can greatly amplify a programmer's productivity.

In Prolog, all program statements and data must be given as rules, written in *Horn clause* form, which consists of a *predicate name* followed by a number of arguments, and possibly by subgoals. The predicate defines the relationship between the arguments. For example, entries in a Prolog database, recording the shifts worked by a company's employees, might look like this:

```
work_shift(rose, day).
work_shift(jeff, night).
work_shift(fred, day).
```

This tells us that Rose works the day shift, Jeff works the night shift, and Fred works the day shift.

Suppose you want to define a relationship between people listed in the database. To write a rule in Horn clause form, begin by stating the conclusion, and follow it with a set of subgoals. (The conclusion is separated from the subgoals by ':-', the Prolog symbol for 'if'.) The following Prolog rule, for example, asserts that one worker knows another if both work the same shift. (Variables begin with capital letters, while constants begin with lower-case letters.)

```
knows(PersonA, PersonB) :-
      work_shift(PersonA, X),
      work_shift(PersonB, X).
```

This rule can be read in either de-

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Declarative

Continued from page 95

clarative or procedural terms. The first way to read it is in a top-down declarative fashion: for it to be true that PersonA knows PersonB, it must be true that PersonA works on shift X, and that PersonB works on shift X (the same shift). Another way to read it is as a bottom-up assertion: IF PersonA works on shift X and PersonB works on shift X, THEN PersonA must know PersonB. Finally, probably the easiest way for procedural language programmers to read this is, naturally, in procedural terms: to find out if PersonA knows PersonB, first identify the shift worked by PersonA, then find out if PersonB works on the same shift.

Any C programmer will tell you, of course, that Prolog code looks all backwards. Where else do you find a conclusion stated *first*, followed by the conditions? If, however, you can adjust to this form of reverse logic, you'll be amply rewarded with greatly simplified, higher-level programs. This becomes immediately apparent when you consider what the same program would look like if written in a procedural language. The following is a rough translation into C. (The work_shift function called below does a simple table lookup.)

```
#define FALSE 0
#define TRUE  1
typedef struct person
{
      char *name;
      int  wrk_shift;
} PERSON;

knows(persona, personb)
PERSON persona, personb;
{
      if (work_shift(persona) ==
      work_shift(personb))
            return(TRUE);

      return(FALSE);
   }
```

As you can see, once you get into the spirit of a declarative language, you have access to control constructs that can be much more powerful than any in a procedural language. This means that source code written in a declarative language is more succinct than equivalent code in a procedural language. Since declarative languages are higher level than procedural languages, using a rule-based language can greatly amplify a programmer's productivity. Unfortunately, a rule-based language can amplify your errors, as well. Therefore,

```
successfully use declarative
      languages
:keep this warning in mind
```

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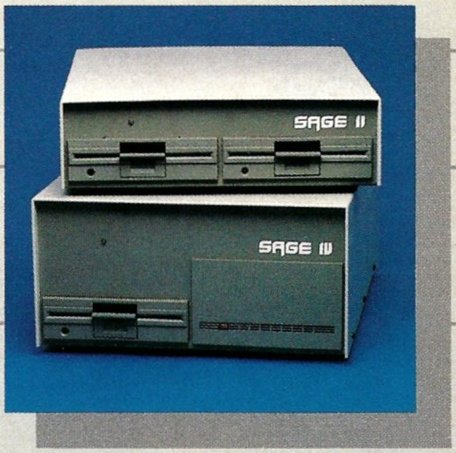

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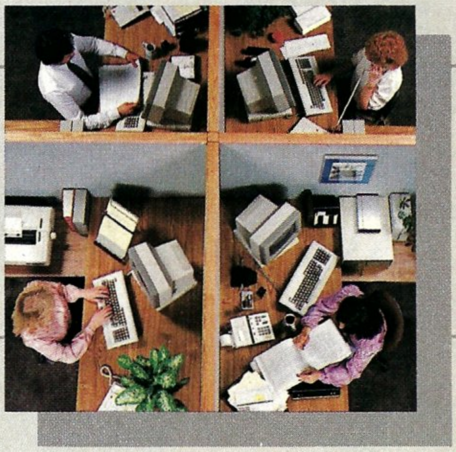

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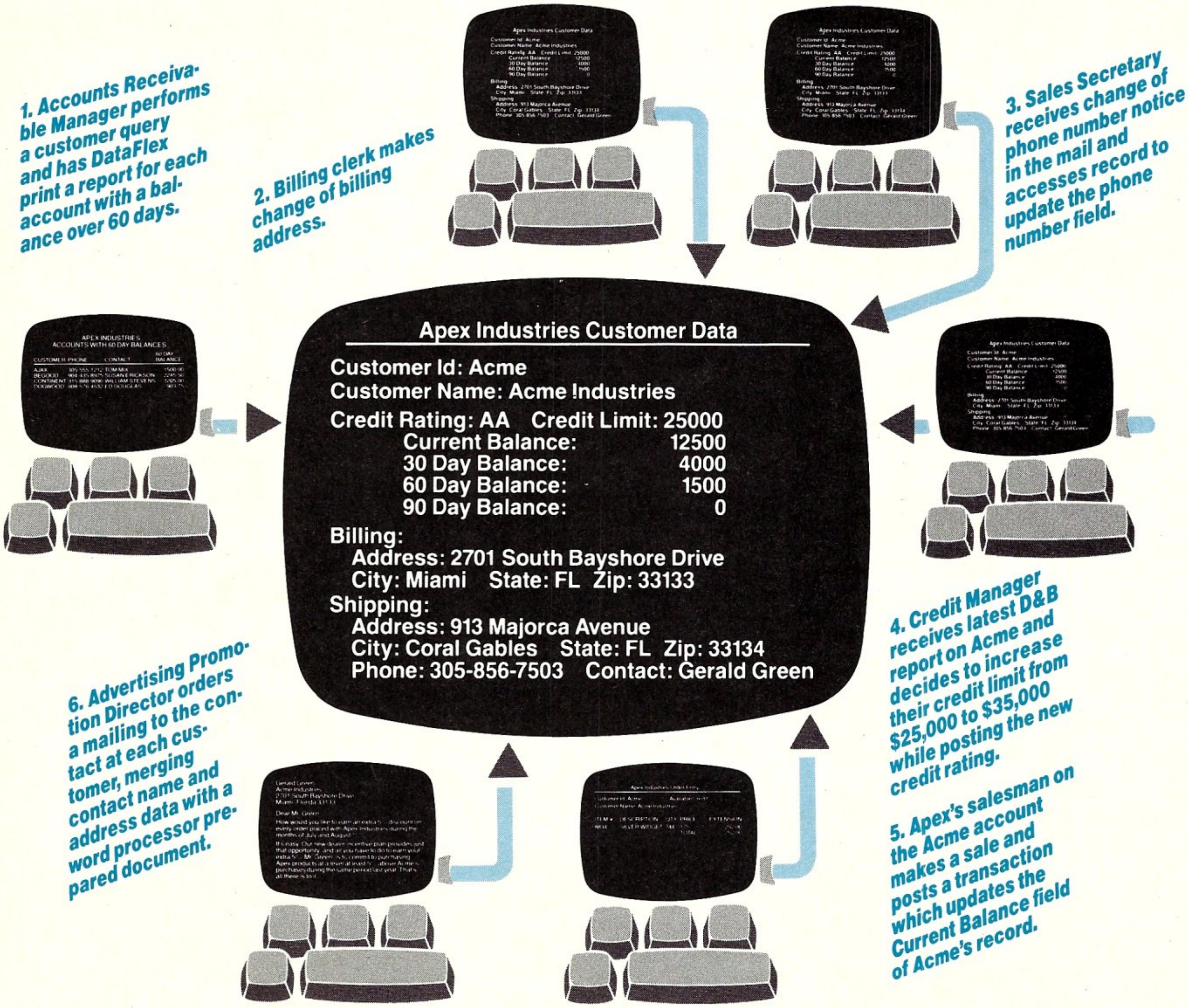

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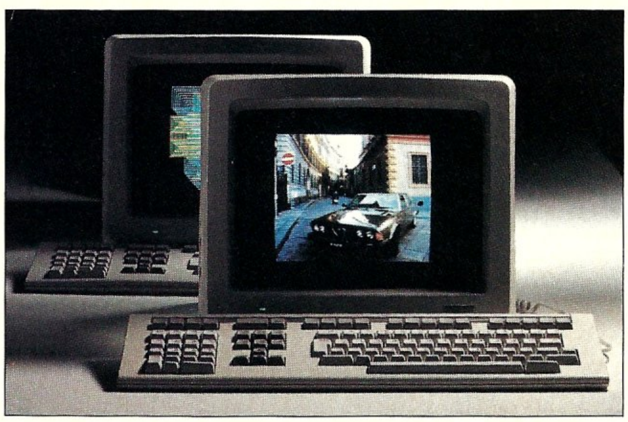
In our July issue we published an article comparing the graphics capabilities of three microcomputers (the NCR Personal Computer, Mindset, and the DEC PRO/350), each in a different price range and suited to different purposes. We now present more detailed reviews of these three machines, paying more attention to the hardware options and available software. Reviews of the NCR PC and the Mindset appear in this issue; the DEC PRO/350 review will appear next month.

The Mindset, because of its 80186 CPU and 10 MHz clock rate, is several times faster than the IBM PC. The strength of this machine lies in its remarkable graphics capa-



bilities, provided by a custom VLSI display processor. A problem is that not much software has yet been written to take full advantage of the graphics hardware.

The strength of the NCR machine lies in its dual Z80/8088 CPUs, which give it access to software written for CP/M-80 as well as for CP/M-86 and MS-DOS. In addition, it has good color graphics and a networking interface. Software support is provided both by NCR and by third-party vendors.

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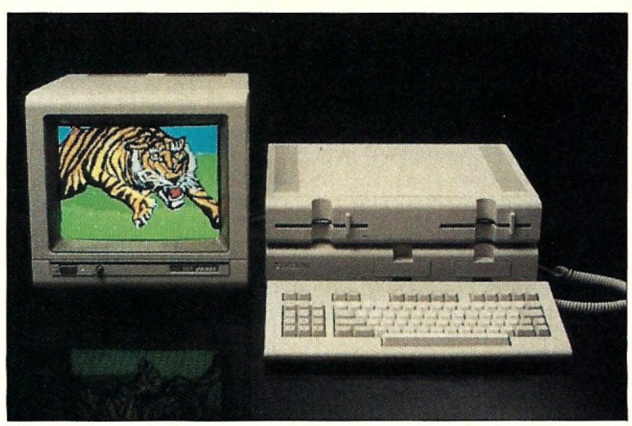

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The NCR Personal Computer

Use this dual processor system for powerful graphics

by David Fournier

The NCR Personal Computer, formerly sold under the name *Decision Mate V*, is a system combining fairly advanced graphics features and compatibility with both CP/M and MS-DOS. It offers the possibility of achieving quality graphics in a form compatible with existing programs and data from other portions of the microcomputer world.

Packaging

With the exception of its detached keyboard, the system is entirely contained within a single compact unit that houses the dual CPUs, the color monitor, and the Winchester hard disk. However, the unit is much too heavy to be considered portable.

The system enclosure is quite nicely designed for ease of use. The screen is low glare and tilted back at a slight angle for easy viewing, although the angle is not adjustable without buying an option to tilt the whole unit. The enclosure also has a recess into which the detachable keyboard can partially slide while still maintaining room to see the keyboard and to comfortably reach the keys. This allows the option of being closer to the screen than many systems with detached keyboards permit.

The power switch, brightness, and volume controls are all easily accessible. In fact, some might consider the power switch too easily accessible, as it is a fairly large rocker switch located just below the right-hand diskette drive. My normal hand motions for inserting a diskette into a vertically oriented drive cause my fingers to brush the power switch each time I do so, which makes me fairly nervous.

The easily accessible volume control is a great idea, present on far too few computers with sound capabilities. I found the sounds used for keyclick feedback annoying, but the volume control made this easy to defeat.

One of the best features of the enclosure from the user's perspective is its method of handling expansion options. Instead of an internal card cage, there is an external set of seven slots in the rear. Rather than having to disassemble the unit, insert a card, possibly adjust internal switches and attach cables, the user merely slides a completely packaged, plastic-enclosed option unit into one of the external slots. Any cables required are already included in the expansion option.

The detached keyboard has its main portions laid out fairly similar to

NCR PC

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the IBM PC's, but with a few additional (major) annoyances: as on the IBM, the backslash is where a typist would expect the shift to be; but, above the shift is a CAPS LOCK key, where you might normally expect to find CONTROL. Worst, in my opinion, is the TAB key, which is on the extreme upper right, just to the right of the BACKSPACE, which I found myself often hitting instead.

The numeric keypad has the advantage of having separate numeric and cursor keys, so there is no concern about mode of the keypad. However, this was achieved only at the cost of laying the four cursor keys in a line, which makes them very difficult to use without looking at them repeatedly, a feature that can be especially annoying while editing. The feel of the keys themselves is excellent, and is easy for both touch typing and hunt-and-peck.

The CRT text display is a professional 80 x 25 format with well-formed characters. A low-glare CRT with a green on black default color scheme makes this a display that is extremely easy to read. Graphic display quality will be discussed below.

Hardware and options

The basic system comes equipped with an 8-bit Z80A CPU running at 4 MHz, a 12" monochrome display capable of displaying 640 x 400 pixel resolution graphics or 80 x 25 text; 64K of system memory; and two 360K floppy disk drives. In this configuration the system supports CP/M-80 only.

The basic system unit may also be purchased with an additional built-in 8088 processor, or with both an 8088 and color graphics capabilities. The 8088 processor allows the user to run CP/M-86 or MS-DOS, as well as CP/M-80. The color graphics capability replaces the monochrome monitor with a color monitor and adds the graphics memory required to allow the system to display its 640 x 400 pixel graphics in any of eight fixed colors.

Any of the three systems described above may be purchased with an internal 10 MB Winchester hard disk instead of the second floppy disk, for a total of six possible configurations for the system unit. In addition, either the 8088 CPU or an external 10 MB Winchester drive can be added on as options in the seven expansion slots provided in the system unit.

Other possible uses for the expansion slots include system memory expansions to 128K, 256K, or 512K, RS-232C serial interface, parallel interface, and NCR Omninet interface (requiring two slots).

The Omninet interface may be of special interest to systems integrators,

The NCR PC helps you achieve quality graphics.

as it provides the ability to network up to 63 systems composed of NCR PCs, IBM PCs and PC-XTs, and Apple IIs. In addition, file sharing systems are available with Omninet interfaces, having up to two hard disks with capacities of either 12 or 32 MB unformatted each, as well as a single floppy disk and an optional 20 MB streamer tape.

Additional options expected to be announced by the time this is published include an 8087 arithmetic coprocessor for the 8088 (supported, in software approved by NCR, only by the newly released UCSD P-System); interfaces for a mouse, a realtime clock, and the IEEE 488, and a buffered serial interface. The 8087 will be installed in the spare socket wherever the 8088 is, rather than taking up an expansion slot. For this reason, NCR recommends that it be installed by field service personnel, if purchased as an upgrade.

The system reviewed had the 8088, color, and hard disk options, and 512K of system memory.

Software

The basic system comes equipped with a Z80A capable of running CP/M-80. No operating system is included in the purchase price of the system, however. CP/M-80 may be purchased as an option for $150. This allows the user to run CP/M-80 software in the NCR disk format as purchased from NCR directly. In addition, NCR provides a utility called EXCHANGE which allows the NCR PC to read the following other CP/M-80 diskette formats: ITT 3030 (DS/DD); DEC VT180 (SS/DD); Zenith Z100 (DS/DD); TA Alphatronic P2U (SS/DD); Osborne 1 (SS/DD); KayPro (SS/DD).

If the system is equipped with an 8088 CPU, the NCR is also capable of running CP/M-86 and MS-DOS, which may be purchased for $60 and $50 respectively. By the time this issue reaches the stands, the UCSD P-System should also be available for $450. Although the system runs only one operating system at a time, facilities are provided to allow MS-DOS to read CP/M files, allowing the two systems to share files, to a limited extent. Unfortunately, the reverse does not seem to be true: there is no utility to allow CP/M to read MS-DOS files.

In addition, the hard disk is initialized as two logical devices, drives C and D, each 5 MB in size. These can be separately formatted for two different operating systems, allowing the hard disk to be accessed by two different operating systems. Sharing files, however, is still subject to the restrictions above.

These days, it is rare for a system to run MS-DOS and not claim compatibility with the IBM PC, but the NCR PC is such a system. This does not mean that they are less compatible than some systems which make such claims, but merely more honest. The NCR and the IBM PC both have the capability of running MS-DOS, and they can both read each other's diskette formats. However, their BIOS interfaces and hardware configurations are not compatible.

The result of this is that some IBM PC programs which access only the MS-DOS functions will run directly on the NCR, and vice versa. However, the number of such programs which rely only on MS-DOS functions is very limited. Most of the IBM PC programs I tried on the NCR did not run properly.

However, the fact that the two systems share versions of the MS-DOS operating system means that the conversion to an NCR-specific version is not very difficult. Consequently, many IBM PC software products, as well as products for other operating systems, are being converted to the NCR.

NCR provides two different varieties of approved software for its Personal Computer. The first category involves products sold and supported by the software portion of NCR, known as Data Entry Software Systems (DESS). These are products produced by third-party software vendors, but sold and completely supported by NCR. The second category is their software referral program. These are software products sold and supported solely by the third-party vendors, but advertised in its catalogs by DESS. Software from either group has been verified as being able to run on the NCR Personal Computer.

The DESS catalog I received contained 63 NCR-supported products and 127 referral products in areas such as finance, general business, specialized vertical markets, and utilities. However, this catalog was quite out of date, and many major applications packages which were not in the catalog are in fact supported at this time. This merely confirms the fact that applications are being converted at high rates. The second price list for the NCR-supported software that I received, dated two months later, had more than 100 new listings. A few of the really major products, such as Lotus 1-2-3, are not supported. Those which are not supported are mainly those which circumvented the operating system in major ways to improve performance, and are now difficult to port to other systems.

The products listed generally ran on several of the operating systems provided for the NCR Personal Computer, and were about evenly distributed among CP/M-80, CP/M-86, and MS-DOS: no one operating system seems to be getting preferential treatment by NCR.

Documentation

The documentation provided with the NCR Personal Computer is high-quality user documentation. It comes in the professional-looking boxed mini-binders made popular by the IBM PC, and is very similar in documentation style as well. The manuals are clear and concise, and it is very easy to find the information contained in them.

The problems with the documentation arise when a professional programmer or system integrator tries to use it. The user documentation supplies insufficient information for professional users, and the technical manuals intended to fill this need do not address all such areas either.

For example, in the software area, all information about the ROM BIOS is provided. However, it is provided only in the form of assembly language listings. It would be nice to have these only as a last resort, along with documentation on usages, entry points, side effects, and other information pointedly lacking. Also, this is only for the ROM BIOS. The DOS functions are documented only with their intended inputs and outputs. Information on how to access information maintained by DOS, such as where the current program is located in memory and what device drivers are currently installed, and information on interactions between DOS calls and BIOS calls, is not provided in any form. This is not a problem with NCR in particular, but with the microcomputer industry in general.

The NCR PC offers great potential for systems integrators to configure systems for specialized markets.

Interfacing

The unusual expansion slot feature, which may be considered a major blessing by users, will more likely be considered a curse by OEMs and systems integrators. The expansion adapters house a board with less than 12 square inches of usable board space.

The only option available if you wish greater functionality than can fit in this space is either to expand to multiple boards and thereby occupy multiple slots, as NCR did for its network interface, or to expand to an external unit. Each of these alternatives has significant disadvantages.

Also, one might expect that a card cage where cards are entirely enclosed in plastic packaging and placed very close together might have overheating problems, although the technical manual does not mention any such restrictions.

The cables included with the purchase of options may also be a problem. This may lead to requirements for specialized adapters or cables to interface equipment with unusual interface characteristics. Although the RS-232C adapter comes in three different models with different internal jumper strappings, the technical manual still warns that none of these may work without added special hardware.

To offset these problems somewhat, NCR does offer a blank I/O bus interface adapter and documentation of the available signals. This could facilitate interface development.

Graphics

In addition to the large microcomputer software base made available by the NCR Personal Computer's support of multiple simultaneous operating systems and encouragement of third party software vendors, a major advantage which this system shows over similar systems is its graphics support.

Compared with other comparable microcomputer systems, the NCR Personal Computer has greater resolution—at least in the eight colors it supports—and greater graphics hardware support for much increased performance.

Graphics hardware capabilities

The NCR Personal Computer comes in both color and monochrome models, at a price difference of about $350. The monochrome model supports monochrome graphics at a resolution of 640 pixels horizontal by 400 vertical. This is in what is called the "medium resolution" range by graphics professionals, who have relatively high standards as such things go. It closely approaches television-quality resolution, which has approximately 500 visible scan lines of vertical resolution.

The color model supports this same resolution in up to eight fixed colors simultaneously displayed. While several other systems offer this resolution in monochrome, few offer it in color. Most color graphic displays in microcomputer systems are classed as "low resolution." The limitation of eight fixed colors impairs its applicability to certain markets where artistic properties or faithful reproduction of color are important, but still leaves the system well suited for applications where color is added for information content, visual cueing, overlays, or other such areas.

Increasing resolution, by itself, will not necessarily improve a graphic system. As you increase resolution, you greatly increase the number of individual pixels which must be affected to accomplish the same graphic effect on the screen. If the processor power associated were to remain constant, all operations would be expected to be much slower.

For example, an IBM PC can operate in a mode such that its resolution is 320 x 200 x four colors, which means its entire screen representation requires 16K. The NCR, at 640 x 400 x eight colors, requires 96K. Since they use the same processor, one would expect that graphics on the NCR would operate about six times slower than those on the IBM PC. However, this is only partially true.

Unlike the IBM PC, the NCR Personal Computer has an additional pro-

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cessor assisting with its graphic operations, the NEC 7220 raster graphics controller. This is a high-speed processor specifically designed for executing graphics primitives. This adds to the speed of graphics operations both because it is much faster for such operations than an 8088 and because it runs simultaneously as a coprocessor with the 8088.

The drawback to a controller such as the 7220 is that it is not able to do just anything, only those very primitive operations which it has built in, such as drawing lines and arcs or filling areas with patterns. Consequently, graphics operations which use only these primitives and are written to take advantage of the 7220 will run very fast—in fact, much faster than those same operations on the IBM PC with one sixth as many bits to manipulate.

Those operations which cannot be done by the 7220 or are written without using the 7220 will, in fact, run much slower on the NCR, as one would expect. However, most desired operations can either be done by the 7220 directly, or programmed as a series of primitives be executed by the 7220. Consequently, with proper software, the NCR will act as a very high performance graphics system for most applications.

The earlier portion of this article, comparing the NCR PC to two other systems (*Microsystems*, July 1984, pg. 66), presented the results of several benchmark programs on the NCR. These show clearly the performance advantages of the 7220 over software graphics algorithms, as the interpreted Basic results used software algorithms on the 8088, while the compiled results used 7220 primitives. The compiled version of the filled quadrilateral benchmark shows the results of an algorithm which the 7220 does not support being written as a series of 7220 primitives. The 7220 did not have a fill algorithm capable of filling these quadrilaterals directly, so an algorithm was written using 7220 line-drawing primitives to implement such a fill. Note that the performance advantage over a software-only algorithm is still huge.

Another graphics-related option planned for release by the time this is published is a videodisk interface. This will allow the programmer full software control over a videodisk player, allowing the display of either frames or full-motion video on the same monitor the generated graphics are displayed on. In addition, the unit has the capability to allow overlaying the video display with program-generated graphics. This could have extensive applications in such areas as training systems and information displays (e.g., in museums, hotels, and office building lobbies).

A notable feature of the NCR PC's enclosure is its method of handling expansion slots.

Graphics software support

Because of the importance of proper software that takes full advantage of the functions of the 7220, the software support provided for the NCR Personal Computer is critical. At this point, NCR offers two packages that support programming graphics to two widely different levels: GW Basic and NCR Graph.

GW Basic provides the extremely limited graphics expected on the average microcomputer. In addition, the graphics appear to be implemented entirely in software. This makes them extremely slow, as can be seen in the benchmarks mentioned above: even straight lines are drawn at a maximum speed which can be easily followed by the naked eye.

The graphics support provided by GW Basic would be extremely frustrating to use in even the most primitive home applications. GW Basic comes in the interpreted version described above and a newly released compiled version for $500.

NCR Graph, by contrast, allows the user to get at the power of the 7220 in a fairly simple way. NCR Graph consists of a set of object modules which can be linked to programs in compiled Microsoft Basic, Pascal, or Fortran, or binary loaded into interpreted Microsoft Basic. In any of these cases, NCR Graph is available through a series of easy external subroutine calls from the main program. Currently NCR Graph is released only in a monochrome version, but an enhanced color version entitled "Graphics under MS-DOS" is now under preparation.

NCR Graph's subroutine calls provide direct but simplified access to much of the functionality of the 7220 in the mode in which it operates in the NCR Personal Computer. The benchmarks mentioned above show clearly the performance advantages of utilizing the power of the 7220 primitives. One of the demo programs distributed with the system shows entire pages of complex graphics, such as sample CAD or business graphics applications, being displayed in one to two seconds via such an interface to the 7220.

Unfortunately, NCR Graph does not support any functions fancier than the primitives supported by the 7220. For example, all coordinates passed as parameters to the subroutines must be expressed directly as pixel addresses. Higher functions such as filling of odd shapes, coordinate transformations, clipping, definition and manipulation of objects, and three-dimensional representation are not supported. However, the functionality of the 7220, by making the individual primitives much faster, may make many of these functions fast enough to be very useful, as was demonstrated in the filled quadrilateral benchmark mentioned above.

The market clearly exists for a product which allows a more sophisticated interface to the functions of the 7220, such as a graphics standard like CORE, GKS, or NAPLPS. The nearest thing currently available is the GSX package from Digital Research, available on the NCR for both CP/M-86 and MS-DOS. GSX adds only a few graphics features, such as filled polygons, above the support provided by NCR Graph. It also handles coordinate transformations, but only from normalized to physical device coordinates. User-defined coordinate spaces are not supported, nor are scaling, zooming, clipping, or many other functions that are frequently associated with coordinate transformations.

The main benefits of GSX are in terms of portability and device independence. GSX provides a standard programming interface across all systems on which it is implemented, much like CORE or GKS. Graphic applications written under GSX on one system can be easily ported to any other system running GSX. Also, GSX supports a large variety of printers and plotters, as well as monitors for its graphic displays. GSX runs as a Virtual Device Interface: any program can be written identically, no matter what device it is to be displayed on.

Graphics application software

In addition to graphics support for

programmers, another critical area for a powerful graphics system such as the NCR Personal Computer is support of its graphics functions at the user level. Ultimately, it will be those products which usefully exploit the unique capabilities of the system which will control its expansion into unique niche markets. As this type of market could account for a large number of sales of a unit such as this, applications software packages that exploit the system's unique graphics abilities may control the success or failure of this system.

At the end of this article is a brief description of the various graphics application packages available on the NCR. Business graphics packages are extremely well represented. Note especially that many of the packages are either productivity software packages in their own right, such as GraphPlan or SuperCalc3, or can access data from existing packages, such as DR Graph and Fast Graphs.

Although not a graphics application itself, DESQ deserves mention in discussion of graphics applications because it is an example of a type of application which can only be accomplished in a system such as this with powerful, high-resolution graphics.

Notably missing are packages for applications such as CAD, which would perform very well on the NCR, or packages catering to engineering or scientific graphics needs. With the advent of various hardware options such as the IEEE interface and the 8087, this system could potentially attract more customers from these markets, but only if they also have the software support they need.

Some IBM programs that access only MS-DOS functions will run directly on the NCR.

Similarly, there will be a need for simple animation packages and similar products when the videodisk interface is released. With several companies coming out with such interfaces, the battle for market share may be based largely on available software products and ease of applications development.

Summary

The NCR Personal Computer is a system which offers great potential to systems integrators to configure systems for specialized markets utilizing graphics. Areas which this would serve especially well include fields such as CAD or business graphics, where simple geometric primitives and fixed colors are sufficient, but drawing speed and resolution are of great importance for the task at hand.

The support of a large number of operating systems will allow such features to be made compatible with existing packages, such as data from existing productivity programs. Also, the rapidly expanding series of hardware options, especially the networking and videodisk interfaces, will make possible types of applications as yet unheard of in microcomputer systems.

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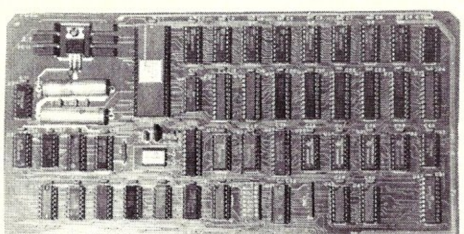

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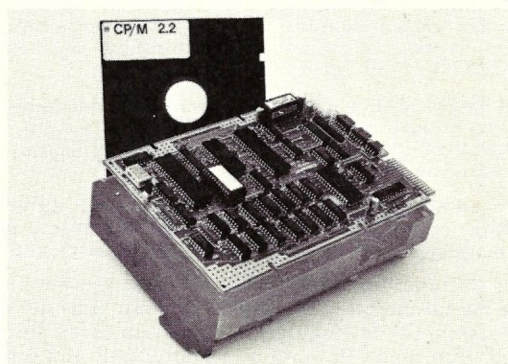

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NCR PC

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along is even better documentation and support for developers of hardware and software for the system, including graphics support and use of graphics standards, so that these products can be developed more rapidly with greater quality.

For more information on the NCR Personal Computer, GW BASIC and NCR Graph, contact *NCR Corporation, 1700 South Patterson Blvd., Dayton, OH 45479; (513) 445-2937.*

Graphics packages & vendors

DESQ—*Quarterdec Office Systems, $399.* General windowing package which will allow the user to run up to any nine standard MS-DOS applications simultaneously on their own individual screen windows, even allowing transferring information between windows. Windows can be redefined dynamically. Requires hard disk, MS-DOS, and 512K. *Quarterdec Office Systems, 1918 Main Street, Santa Monica, CA 90405; (213) 392-9851.*

DR Draw—*Digital Research, Inc., $295.* An interactive picture editor, used to compose graphics on the screen to be sent to a printer or plotter, such as for presentation graphics. Elements include circles, polygons, bars, lines, arcs, 14 typefaces, fill patterns, and more. Elements can be moved, copied, modified, deleted and undeleted. Zoom and pan are supported. DR Draw is Implemented under and includes GSX, and requires 256K and MS-DOS. *DRI, Box 579, Pacific Grove, CA 93950.*

DR Graph—*Digital Research, $295.* Interactive business graphics and chart editor, used to prepare charts to be sent to a printer or plotter. Includes pie charts, many types of bar and line charts. Automatically generates all labels, axis styles, colors, and other features with defaults which can be changed by the user. Accesses data from popular spreadsheets. Implemented under and includes GSX. Requires CP/M-80 and 64K or MS-DOS and 256K.

Fast Graphs—*Innovative Software, $350.* Integrated business graphics generator and graphics editor, allowing the user to customize the generated pie, bar, line or point graphs with user-defined graphics selected from arcs, boxes, circles, lines, color fills, and several text styles. Also provides a slide-show feature for automatically displaying prepared slides. Graphics may be printed on several plotters or printers. Requires MS-DOS and 256K. *Innovative Software, 9300 W. 110 St., Overland Park, KS 66210; (913) 383-1089.*

GraphPlan—*Chang Laboratories, $295.* Integrated spreadsheet, graphics, and data base. Includes several styles of pie, bar, and line charts, in several line styles and colors. Supports plotter and printers. Requires CP/M-86 or MS-DOS and 128K. *Chang Laboratories, 5300 Stevens Creek Blvd., #200, San Jose, CA 95129; (408) 246-8020.*

SuperCalc3—*Sorcim, $395.* Integrated spreadsheet, graphics, data management, and text editing. Includes several styles of pie, bar, and line graphs on screen or hard copy, user-defined colors, labels, line styles, fill patterns and orientation. Requires MS-DOS and 128K. *Sorcim, 27310 Landy Ave., San Jose, CA 95129; (408) 942-1727.*

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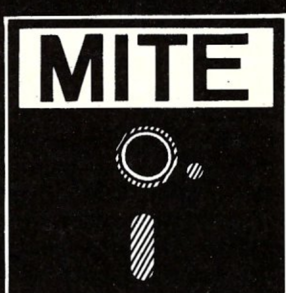

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Mindset: Fast High-Resolution Graphics

A custom VLSI display processor creates smooth, low-cost animation

by Christopher Hatton

Displayed on the screen in front of me is the word **Mindset**, spelled out in three-dimensional block letters. After a moment, the letters begin to rotate, showing all sides of the blocks. Their motion is utterly smooth; it's like watching a videotape of block letters being turned on a spit. "Wait a minute," I say to myself, "you can't do that with a microcomputer." But the Mindset Personal Computer *is* a microcomputer—with the graphics capability of a much larger machine.

Packaging

Though the Mindset comes in several pieces, it is remarkably compact. The system unit and expansion unit are exactly the same size and fit together so snugly (through a cable-free connector) that they give the impression of a single piece.

With the keyboard on top of the other parts, the entire machine takes up very little table space—an extremely valuable feature for anyone using a mouse. The entire system weighs 20 pounds, not including monitor, so with the optional carrying case, it's arguably portable.

The power switch is located on the back of the keyboard. This made me worry that I might accidentally turn the machine off by bumping the keyboard against the system unit or just picking it up; the latter actually happened to me once.

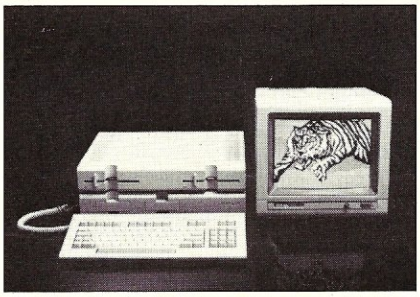
The keyboard itself is comfortably slanted; it is compact and lightweight without being cramped. The function keys are arranged in a row across the top, in two groups of five. The keyboard layout is more or less standard, with a typing block and a cursor-control pad on the right. IBM PC users may have a little trouble finding the backslash and backquote keys (in the upper right of the typing block), but those of us who have trouble *not* finding them on the IBM PC will find this refreshing. However, there is no numeric pad, which could be a problem in spreadsheet systems such as Lotus 1-2-3 for people who are used to having one.

Hardware and options

The basic system contains an Intel 80186 CPU running at 6 MHz, two proprietary graphics coprocessors, a proprietary sound microprocessor, and 64K of system memory, which consists of a 32K frame buffer and 32K of user memory. Adding an expansion unit increases the user memory, but not the frame buffer.

The unit has three I/O expansion ports, two cartridge slots, and built-in interfaces for an RGB color monitor, a composite video monitor, and a color or B&W TV RF modulator. It is available for $1099.

The Mindset expansion unit adds either 96K of user memory and one disk drive (for $699), or 224K of user memory and two disk drives (for $1299). It plugs directly into the top of the system unit, resulting in a fit the snugness of which must be seen to be believed.



The Mindset mouse is available for $149; it plugs into connectors on either side of the keyboard. Other options include a printer module, a stereo sound module, and two different modems; all of these plug into the I/O ports.

Mindset has the graphics capabilities of a much larger system.

The system reviewed had the two-drive expansion unit and the mouse. I used an RF modulator connected to a color TV set because I was unable to obtain an RGB cable.

The expansion unit is essential if you want to write your own software; without it, the Mindset is an extremely powerful games machine, but to save code one would have to use the 8K nonvolatile RAM cartridges. The only software packages currently available on cartridge are Basic and a communications program, though this will probably change once the capablities of the machine become more widely known.

Software

The list of software written specifically for the Mindset is rather short. It includes a version of MS-DOS 2.0 that is identical in both appearance and command structure (including obscure CONFIG.SYS statements) to the IBM PC version; a graphics-extended Basic; three different color graphics packages (*Designer,* by Datasoft, for paint and design; *Four Point Graphics Plus,* by IMSI, for business color graphics; and *Lumena,* by Time Arts, for professional color graphics); and Telecom and Telecom+, both communications packages. All of the above are sold by Mindset under their own label.

Software written for the Mindset but sold by other companies includes Vyper, by Synapse, a flying simulation game; Deep Sea Danger, by HES, an underwater adventure game; Chess, by Odesta, a three-dimensional chess game; The Writer, by Hayden, a word processor; Accounting Series, by BPI; and Windows, by Microsoft.

Of all this software, the only items available to me were DOS, GW BASIC, and Lumena. The following are my impressions.

GW BASIC is heavily extended for graphics and animation. It allows the user to specify an object—including several views of the object, its origin point, destination point, and speed of movement—then simply issue an ACTIVATE statement. The ACTIVATE command causes the object to appear at its origin point and move to its destination, with its view changing as often as specified by the user. The user controls what happens when the object arrives at its destination, collides with another object, or reaches the edge of the screen.

All of the displays of these states are implemented in hardware, as are movement and view changing. In other words, you're in control, but you don't have to do any of the work: the enjoyable aspects of animation programming are left to you, while the more tedious ones are executed by the machine. Unfortunately, time constraints did not allow me to explore GW BASIC in much detail, but I did see enough to be quite impressed.

My experience with Lumena, the Mindset professional graphics package, is limited to several hours of playing with a rather buggy pre-release version. Every aspect of the program is controlled by the mouse, including drawing, moving, and command selection. The new user is faced with what seems, at first, an arcane maze of menus; however, after a little practice this ceases to be a problem. It would certainly offer no

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Mindset

Continued from page 109

difficulties to anyone who used it professionally.

Once I became accumstomed to using a mouse and avoiding the commands which cause the machine to reboot (remember, this is a pre-release version), I was able to create visual images quickly and easily. The most impressive feature for me was the MOVE command, which allows the user to box in an area, then move it around as if it were attached to the cursor. In the hands of a talented screen painter, Lumena could be a powerful tool.

In addition to software written for the Mindset, there is an impressive array of software which the company claims will run without alteration on the Mindset.

To test this claim, I obtained some IBM PC software, put it in the Mindset, and tried to run it. The programs used for this test were Lotus 1-2-3, WordStar, Enchanter, Sorceror, Infidel, Deadline, Zork, and Starcross. They all ran without incident. The company's list of "Mindset-Compatible Titles" includes some 57 programs, and although these enhance the immediate usefulness of the machine, they do not take full advantage of the Mindset's capabilities. The machine still needs much more software of its own.

To this end, Mindset is developing a PLP interpreter and a library of C subroutines; what the actual products will look like remains to be seen.

Documentation

The Mindset is yet another machine whose manuals come in IBM-like boxed ring binders. The documentation is readable, accessible, and oriented toward the nontechnical or casual user. I had no trouble finding anything I needed to know about GW BASIC statements, for example, and if I didn't know how to insert a cartridge, I would need to look no further than page 5-3 of the Operation Guide.

Serious developers or programmers may not find the answers to all their questions in the standard books; however, Mindset offers the *Mindset Programmer's Development Library*, which includes a Programming Guide to MS-DOS, a Macro Assembler Manual and Diskette, and a Technical Reference Guide.

Graphics

During the following discussion of the Mindset's graphics, please bear in mind that I was using a color TV connected to the machine by RF modulator, which made everything look absolutely terrible.

The Mindset has two graphics modes: 320 X 200 pixels in 16 colors from a palette of 512, and 640 x 400 in two colors. In the high-resolution mode, the screen is refreshed 30 times per second. Raster operation graphics functions are implemented in hardware.

The Mindset's animation is very convincing; its smooth scrolling of text is the best I've ever seen. One of the demos draws a still life that is beautiful even on a TV screen; another bounces a little model Saturn around the screen, and, when the user exits the program, moves the Saturn gracefully off screen while the user continues in Basic.

As stated earlier, the Mindset's graphics hardware is so sophisticated that graphics software can be very simple, yet very impressive. It would be interesting to see what very sophisticated software developers can do with this machine once its hardware takes over all the drudgery.

Summary

The Mindset Personal Computer is a micro with the graphics capabilities of a much larger (and more expensive) machine. However, most of the software that currently runs on it was not written to take advantage of these capabilities. The Mindset Corporation provides

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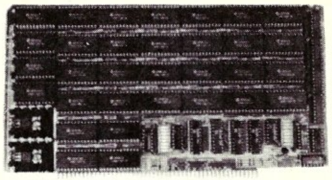

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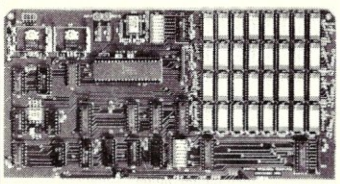

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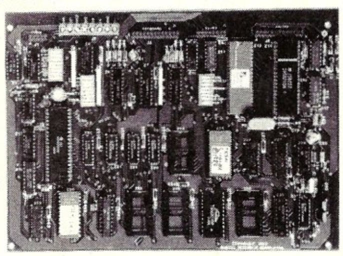

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Mindset

Continued from page 110

some development support in the form of manuals and a few C subroutines; it remains to be seen whether this is enough.

The Mindset is inexpensive enough to be in the home market range; it certainly is in the small business market range. Its design and documentation both indicate that is is intended for the nontechnical user. It is designed so that everything connects modularly to everything else in such a simple way that I cannot imagine an adult needing help to put one together, much less to run one. Yet its capablities are impressive enough to hold the interest of a much more sophisticated user.

In short, the Mindset is a good machine; it needs only the right amount and the right kind of software support to be a great machine.

Further information on Mindset is available from: **Mindset Corporation,** *617 North Mary, Sunnyvale, CA 94086; (408) 737-8555.*

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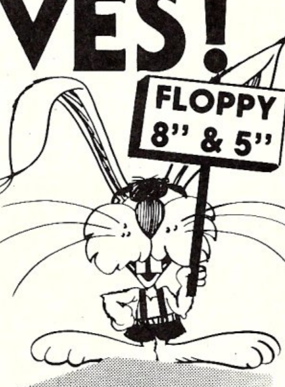

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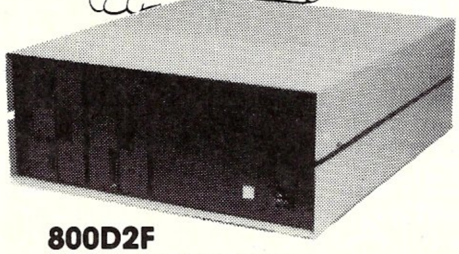

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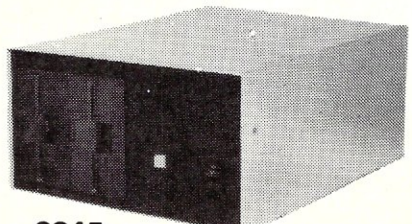

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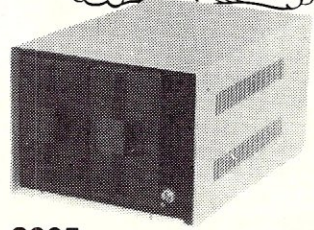

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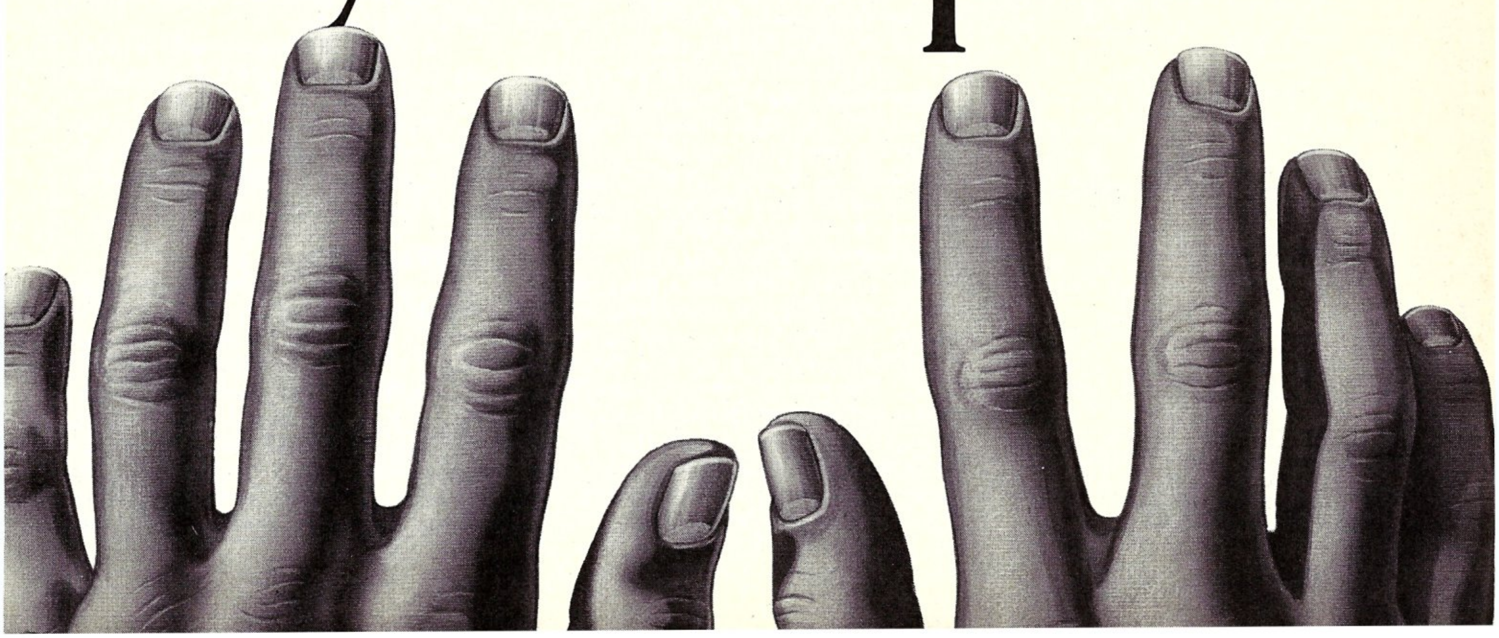

TurboDOS Spans the Horizon

A TurboDOS implementation for North Star

by Karl Sterne

The North Star Horizon, now six years old, is one of the few pre-1980 microcomputers still in demand. However, the Horizon, as it is built in 1984, is a very different system from its 1978 ancestor. Today's Horizon is a multiuser multiprocessor that uses North Star's version of TurboDOS operating system from software 2000, Inc., for both 8-bit CP/M and 16-bit CP/M-86 applications.

By the end of 1982, it was apparent that the Horizon's lifespan would be far longer than had been forecast. Its chief limitation was its timesharing operating system. To replace it, North Star evaluated a number of operating systems before choosing TurboDOS. Among the reasons for the decision were:

1. TurboDOS has a multiprocessing networking architecture. (In fact, North Star's latest computer, the Dimension, uses a similar architecture. The Dimension, however, incorporates a multiple-user IBM-XT-compatible operating system rather than TurboDOS, as well as the 80186 server processor rather than the Z80A and the IBM bus rather than the S-100 bus.)

2. TurboDOS provides true multiuser operation, including file sharing and record lockout.

3. TurboDOS permits simultaneous operation of 8-bit and 16-bit applications.

4. TurboDOS outperforms many other operating systems in timed benchmarks.

5. TurboDOS has powerful networking facilities, including support of multiple circuits, node-to-node communications, and the ability of any node to be a server. This allows, for example, direct access to the S-100 bus for control of special boards.

6. TurboDOS comes as close to being a minicomputer operating system as is practical on a microcomputer.

Given all its advantages, TurboDOS can still be improved. This article will discuss some of the improvements made by North Star.

16-bit operation

North Star's principal problem with TurboDOS was that release 1.22, the latest available in 1983, emulated only 8-bit CP/M and did not have 16-bit capabilities. Software 2000's assurance that a new release incorporating CP/M-86 emulation was imminent allowed North Star to proceed with the development of new hardware: an 8-bit Z80 satellite board, a 16-bit 8088-2 sat-

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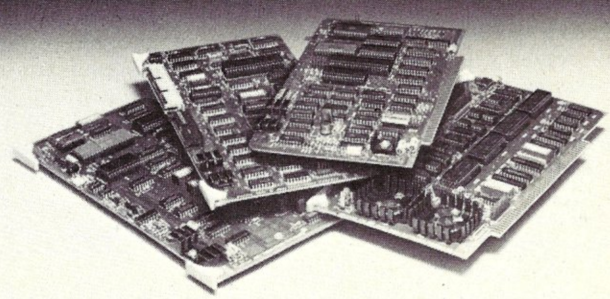

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CIRCLE 101 ON READER SERVICE CARD

N* TurboDOS

Continued from page 114

ellite board, and a memory expansion board to give the 8088-2 as much as 512K of RAM. The existing Horizon hardware was used without modification for the server (master). Although both the 16-bit hardware and the new TurboDOS release took longer than expected, they have been in use since April and have had excellent acceptance.

Installation and configuration

TurboDOS runs on a large variety of hardware, and one result of its versatility is that it tends to be difficult to install. Having once succeeded in installing the "vanilla" system, the user is confronted with the task of tailoring it to that particular hardware. This usually requires a word processor to create lists of operating system functions and other parameters. This process is a radical departure from the straightforward installation of other North Star operating systems.

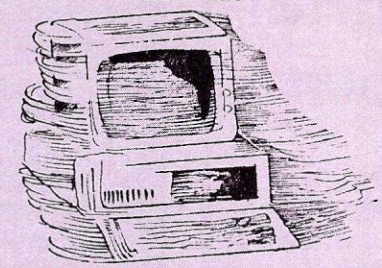
The North Star approach was to split the process into two functions: configuration and installation. The configuration program asks the user questions in English and does not require a word processor; installation is automated, using the operator's responses.

The North Star TurboDOS operating system is distributed as a four-diskette set. Each diskette is named for its particular function in the installation process: SYSTEM DISK, CONFIG DISK, HELP DISK, and SYSCON DISK. The SYSTEM diskette is a bootable operating system that contains a maximum hardware configuration. Some users will never need to generate another operating system.

Two manuals come with North Star TurboDOS: the TurboDOS User's Guide and the TurboDOS Reference Manual. The preface to the User's Guide contains step-by-step instructions for helping the system install itself. Three simple commands are entered from any user's console. The rest of the process requires only a few carriage returns and diskette changes.

The installation process uses the TurboDOS command file batch utility—an enhancement of the CP/M SUBMIT facility—and performs the system initialization tasks such as verifying the hard disk data tracks and formatting the TurboDOS directory area. The user is then asked to insert one of the four distribution diskettes. The proper user areas of the hard disk are loaded with the appropriate files. This process is repeated for each of the four diskettes.

Turbo-Plus



This is an enhancement package that provides powerful additional facilities for TurboDOS. The utilities included are: DIRDUMP displays the master directory of any disk; WHO displays a list of all the current users; LOCATE searches any or all drives for a file; BB schedules jobs to the background queue; STATUS monitors the activity of users and peripherals; HELP provides on-line help menus that users may customize; TWX sends messages to other users immediately; MAIL is an electronic mail facility.

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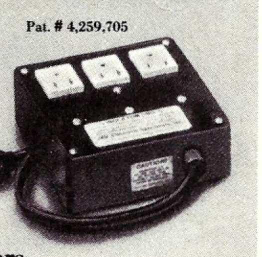

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N* TurboDOS

Continued from page 116

At this point, the installation creates a bootable diskette for daily use. The distribution diskette set can be set aside, and the computer is fully operational. If customizing of the operating system is not desired, this completes the process.

The operating system on the SYSTEM disk contains software drivers for a maximum system. It includes hard disk drivers for both types of North Star hard disks and two different kinds of printer drivers. Should the user wish a different configuration, the CONFIG program is run.

CONFIG asks the user questions in simple English about the desired hardware configuration. It builds the TurboDOS generation (.GEN) and parameter (.PAR) files required by the TurboDOS GEN command. No other programs are required. After the user finishes answering all the questions, a system summary is displayed on the screen. This can be accepted or aborted, and the user can change any desired parameters.

At the end of the session, the user can opt not to have the operating system actually generated. In this mode, CONFIG acts as a teaching tool, allowing the user to see how different configurations change the form of the .GEN and .PAR files.

If additional operating systems are desired, another command file batch is executed. This file, created by CONFIG, performs the system generation and copies the new operating systems to the proper area of the hard disk. The old operating system files are saved with an .ORG extension. Should any problems occur with the newly generated operating systems, the old ones can be recovered.

Bad spot de-allocation

All hard disk systems must deal with the question of how to detect and avoid defects (known as bad spots) on the hard disk medium. Typically, a disk drive will be shipped by the manufacturer with a few bad spots already on it, and additional bad spots will "grow" as the result of vibration (especially during shipping), power failures, or aging of the machine.

TurboDOS comes as close to being a minicomputer operating system as is practical on a microcomputer.

A good hard disk system must therefore deal with two different bad spot scenarios:

1. A disk arrives with bad spots already on it.

2. A disk grows bad spots while it is in use.

Hard disk systems must also deal with two kinds of bad spots: "hard" (permanent) bad spots and "soft" (intermittent) ones. It is good practice to recognize and avoid the soft ones as well as the hard ones (even though you can often retry enough times to get past the soft ones) because they tend to get worse with age.

The issue is complicated by the fact that the location of the bad spot can make a big difference in how bad it really is. A bad spot in an unused part of the

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disk is not a problem, as long as one can tell the operating system how to avoid it. A bad spot in a data area is a problem, because data has very likely been lost. A bad spot in the directory can be fatal.

Generic TurboDOS comes with a program (VERIFY) which de-allocates bad spots; i.e., it removes them from the pool of available disk space. VERIFY has two deficiencies, however. First, it finds only hard errors, because it is forced to do read-only tests via the normal hard disk drivers, which are fault-tolerant by design. Soft errors will trigger retries at the driver level, but these retries are not reported to VERIFY unless many successive failures occur. Second, it can be run only at startup—the directory must be empty for it to work properly. Therefore, it does not help at all with bad spots that grow during use.

North Star's answer was to create a program called MARKBAD. MARKBAD is similar to VERIFY in that it de-allocates disk blocks that contain bad spots. It differs from VERIFY in two important ways. First, it accepts manual input of bad spots. This allows identification of both soft and hard bad spots, which are taken from the manufacturer's disk label, from a hard disk test program, or from disk error messages put out by TurboDOS itself. Second, it can be run at any time, so a bad spot that grows during use can be removed from the available pool.

VERIFY and MARKBAD both deal with bad spots in the disk's data area. Neither can help if the bad spot is in the directory, because directory blocks cannot be de-allocated. TurboDOS requires the entire directory area (including allocation table) to be free of defects. On a 30MB disk with a 2K block size, for example, this area occupies 30 tracks, or about 240K.

To alleviate this situation, North Star developed a means of swapping bad directory tracks with good data tracks in a manner invisible to TurboDOS, so that the bad blocks end up in the data area (where they can be de-allocated by MARKBAD) and the good blocks end up in the directory. This preserves the maximum amount of good disk space possible. Another approach would have been to slide the beginning of the directory out into the first clear space big enough to hold it, but a potentially large amount of good disk space might have to be skipped, and that space would be lost.

The swapping of tracks takes place on power up, when a special section of the hard disk driver reads the North Star bad-spot table from a reserved portion of the disk. This bad-spot table is initially written in the factory and can be updated in the field by running the hard disk test and format program.

When a disk is shipped with a bad spot in the directory, the first system boot will swap the bad track out into the data area, and MARKBAD will be told to de-allocate the affected data blocks. The system will then appear like any other North Star TurboDOS system.

If a bad spot grows in the directory later, some or all of the disk will be unreadable. The procedure is to recover what can be read, then run the hard disk test-and-format program and tell it where the new bad spot is. On the next boot, the new bad track will be swapped out of the directory, and the system will again be usable. Any lost data has to be recovered from the backup media.

User interface

Even though TurboDOS provides a considerably more pleasant user interface than CP/M, it is designed for computer professionals rather than for the small businesses that are North Star's principal customers. To present a more easily understood set of screens, North Star has bundled Turbo-Plus into North Star TurboDOS (see sidebar).

Turbo-Plus is a set of utilities developed by Microserve Inc. for TurboDOS. It was chosen primarily for its extensive online HELP messages as well as for its versatile electronic mail facility. In ad-

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N* TurboDOS

Continued from page 119

dition, Turbo-Plus contains a group of commands that allows the network manager to track utilization, keep a log of user time, and control other users.

Besides these aids for less sophisticated users, Turbo-Plus also has a powerful Background Batch utility that allows users to schedule low-priority noninteractive jobs for execution in background mode or at times when the system is lightly used.

Conclusion

By adding TurboDOS and the new multiprocessor hardware developed for it to the Horizon, North Star has extended the usage of this popular computer for years to come. And North Star's implementation of TurboDOS brings the power of a sophisticated operating system to nonprofessional users who need only to follow a step-by-step procedure for successful installation and operation.

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Leverage Database Manager

This product lets you use standard UNIX tools to massage your data

by Ian F. Darwin

We all need to keep track of lists of similar things. Mailing lists, phone lists, and other lists. Standard UNIX provides tools to do just that; one such utility is a text editor designed for handling words, but it can also be used for lists since it knows nothing about the content of the text.

But suppose you want something that does know a little about content? How about a program to extract nicknames and print Mr., Mrs., Ms., or Jean, as in letter greetings? To give you a full-screen image of one record so that you can easily change the 17th field on that record? To merge your list with **troff** input or any other file format?

One answer is the Leverage list manager from Urban Software (330 W. 42nd St., 23d Floor, New York NY 10036, phone 212-736-1036). Leverage is available for many different UNIX systems, and I've used it on several projects. Neither the vendors nor I claim that Leverage is a panacea, but for certain operations it's a clear winner. Leverage was tested on a Dual Systems "System/83" with one Winchester disk, using Dual's Berkeletized V7 system. It is also available for PDP-11 and VAX systems, SUN, most UniSoft and Xenix ports, and the ONYX, IS/1 and Fortune systems. The binary price is $385. I used Leverage to enter and update all the data for the UNIX Software Directory that appeared in the April 1984 issue of *Microsystems*. Since I'm currently running an interim release of Dual's software, and Urban Software doesn't have access to this version, I'm temporarily without use of Leverage. I hope to be back on the air soon, because I have several lists that I'd like to use it for!

The basic system consists of a few major programs and several utilities. The two most important programs are **mkscr** and **edit**, which create screen images and edit data files respectively. Both use termcap, so work with almost any reasonable terminal on UNIX. Both are full-screen programs. When creating a screen image or editing a data record, what you see on the screen is what you get. The screen editor normally presents the image of the screen, just as the data editor will show it. When you are changing the attributes of a field, however, there is a small submenu with screen attributes. Figure 1 is an example of a simple screen.

This shows the actual screen image used in the creation of the vendor list for the Software Directory data in the April issue. Not shown is the ease with which the form was created; after learning the command keys, the screen took a few

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Leverage

Continued from page 122

minutes to set up, and a few more to get just the way I wanted it. One good feature of Leverage is the "template" data type; there are several predefined templates for common objects such as name/address combinations. The four lines of name/address data and the two lines of name/salutation fields were entered into the form with a single request of a few keystrokes on a secondary menu. Templates exist for name/address, date, and a few other specialised data types. Unfortunately, there is currently no provision for you to define your own templates, nor do they recommend that you modify the existing ones. The command keys, by the way, are Control/letter (control F for Field, etc.) so that no special keypad keys are required (it's not clear that such can be taken advantage of if you have them). Full-screen response is very fast and has a "snappy" feel most of the time.

Leverage is not a relational database, and does not claim to be. The first field on the record is the key field, and a hash table is used to provide quick access to any particular record based upon that field. You can also search on any particular field or series of fields, although this involves a linear search of the file.

A very UNIX-like idea that Urban has used is to make most of the data files plain ASCII text. Only the hash

Listing 1

```
# this awk file builds another awk file to check manual editing
of database
NR == 1 {
        print "NF != ", $5+1, "{print NR, NF, "
        }
$1 == "Field" && NF > 5 {
        TFNUM=substr($2,1,length($2)-1)
        print "length($" TFNUM ") > " $5 "{print NR," "
        next
        }
```

Listing 2

```
#       makefile for leverage db directory
checkedits: database checkedits.awk
        exec awk -F  -f checkedits.awk database
checkedits.awk: db.sav mkcheck.awk
        exec awk -f mkcheck.awk db.sav >checkedits.awk
OFFVNUM=7
final.out: database final.awk final.mer
        awk -F\|  -f final.awk database |
                sort -t  -n +$(OFFVNUM) |
                        merge final.mer |
                                sed '/:  *$$/d' >final.out
```


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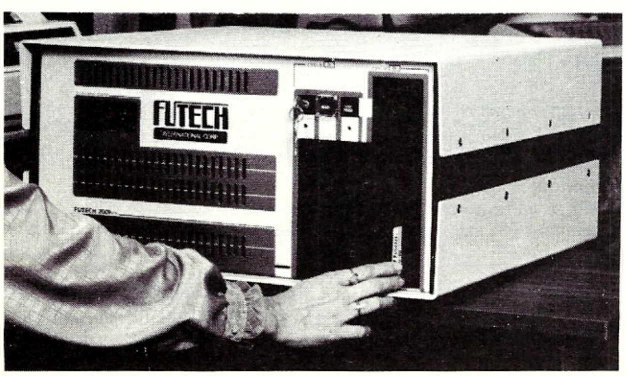

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CIRCLE 86 ON READER SERVICE CARD

table is a binary file; both the database description and the database itself are readable by all the standard UNIX utilities such as **ed**, **grep** and others, so that all the power of UNIX can be used on these files.

UNIX tools can also be used to write the files. Hence you can use your favorite editor to modify the database (or even the data description), or generate the database from an **awk** script, or any other program. You then simply run **fixdb**, whose primary task is to rebuild the hash table for Leverage.

As with many UNIX-based DBMS systems, each database and its related files are stored in a separate directory to prevent name conflicts, since the data and descriptor files have fixed names. The Urban Software manual and newsletter give a series of examples using **grep**, **awk** and **sort** to post-process the data. The final series of charts in the April issue was generated by a formidable **awk** script written by Laura Creighton to print the headings after the data had been sorted.

Because Leverage is not a relational database, I maintained two distinct files: one for the vendors' names and addresses, and another for the product descriptions. The tie-in was by numbers, to prevent typographical errors or variations in names from creeping in and un-relating a product from its vendor. In practice, the use of numbers did not create significant problems.

If you've read this far, you're probably interested in how easy it is to learn and use the data entry procedures. A friend who has used computers only in line-mode editing helped me enter some of the data, and learned in a very short time the half-dozen control codes needed to enter text and make corrections. She entered the data reliably in fairly short order. I didn't think to time it, but things went smoothly.

```
Organization:
--------------------------------------------------------------------
Address:
--------------------------------------------------------------------
             -------------------------------------------------------
City: ---------------  State: --------------  Zip: -------
Country:------------------------------------
Number: --------
Phone: -------------------        Telex: ------------------
UUCP: ------------------------------------------------------
First   Name: ----------  Middle: --------  Last: --------
Title: ---------Salutation: -------------  Title2: -------
Service:
--------------------------------------------------------------------
Include? [_]              Date entered:__/__/__
```

Figure 1. Simple screen

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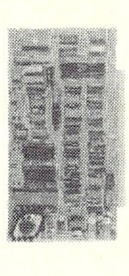

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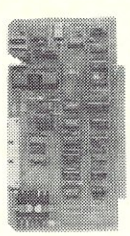

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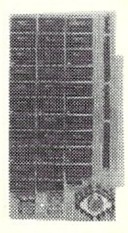

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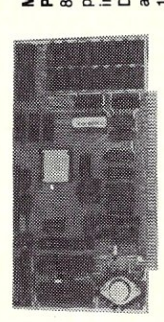

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CIRCLE 172 ON READER SERVICE CARD

Leverage

Continued from page 125

What about report writing? There are two approaches available. First, there is a merge program. This will merge fields from the database into a file you provide. To print a contact list, for example, you only need

```
{name} {phone}
```

This will cause **merge** to extract the name and phone number from each record in the database, and print the results. To generate a form letter, you would prepare the letter in **nroff** format with similar "tags" for the person's name, the form of salutation (Dear John vs. Dear Sir, extracted automatically), details such as the product they purchase from your firm, and the like. The output is piped to **nroff**, so that everything is neatly formatted and the result can be made to look very professional.

Most of the utilities can be invoked either from the main command menus or as UNIX-style utilities. I chose the latter for most operations, since that's what I prefer. I tried the menu-mode operations, and they seemed to generate about the same commands as I did, although they occasionally had a few extra programs running (mainly **cat**) which imposes a slight performance penalty that is most noticeable on small systems.

The second approach is to use **awk** as I did for the various reports I printed. The files are readable by UNIX utilities, as I mentioned, so this is easy to do and works quite well.

Here's a simple **awk** program to print the first two fields of a Leverage database:

```
awk -F\\| '{print $1, $2}'
```

This tells **awk** that the field separator is a vertical bar ('|', which must be escaped from the shell) and that you wish to have the first and second fields from each record printed.

More complex **awk** files can be built up easily once the elements of this language are grasped. The manual and newsletter contain several useful ones.

I had several minor problems and suggestions for improvements, which I passed on to Leverage some time ago. A few of the extra features I wanted were in the software but just hadn't made it into the manual. Urban Software tells me that most of the rest will be incorporated into the next software release.

Another problem has to do with editing the database using a text editor and then running **fixdb**. This program tells you if any records are incomplete or have invalid data, but its error messages tell you the offset in bytes into the file! This might have been useful to those using CP/M's ED editor, but is of little value under UNIX. I wrote a more complex **awk** script to check the results of manual editing, shown in Listing 1.

This generates a file to be given to **awk** to check the contents of the database for two common errors, records with the wrong number of fields, and fields which have too many characters to fit on the screen image (too many characters in a field). Listing 2 is a makefile showing use of this **awk** script. This awk script can be studied in detail by those desiring to learn **awk**; it is not light reading, as it generates a copy of a file similar to itself.

In summary, Leverage provides good management of mailing lists, contact lists, lists of books, lists of dogs and cats, or anything else. It's not a relational database, but you can do combined searches, and it's quite fast. You can get it to run on a wide range of UNIX systems. It doesn't try to reinvent all of UNIX, but gives you a set of tools which work together with existing programs and a way to use the UNIX tools from menu mode if you want. I like it.

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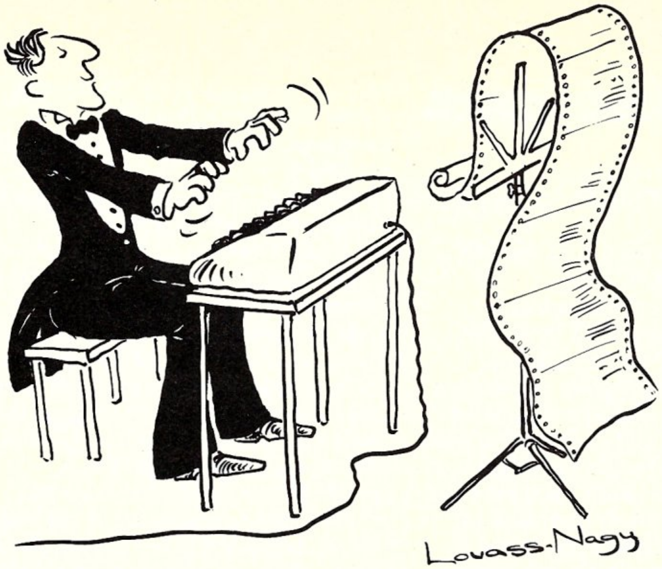

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Text Editor VEDIT -- full-screen text editor by CompuView. Makes source code entry a snap. Full-screen text editing, plus TECO-like macro facility for repetitive tasks. Pre-configured for over 40 terminals and personal computers as well as in user-configurable form.

CP/M-80 version $150
CP/M-86 or MDOS version $195
(when ordered with any Avocet product)

EPROM Programmer -- Model 7128 EPROM Programmer by GTek programs most EPROMS without the need for personality modules. Self-contained power supply ... accepts ASCII commands and data from any computer through RS 232 serial interface. Cross-assembler hex object files can be down-loaded directly. Commands include verify and read, as well as partial programming.

PROM types supported: 2508, 2758, 2516, 2716, 2532, 2732, 2732A, 27C32, MCM8766, 2564, 2764, 27C64, 27128, 8748, 8741, 8749, 8742, 8751, 8755, plus Seeq and Xicor EEPROMS.

Avocet Cross-assembler	Target Microprocessor	CP/M-80 Version	CP/M-86 IBM PC, MSDOS** Versions
XASMZ80	Z-80		$250.00 each
XASM85	8085		
XASM05	6805	$200.00 each	
XASM09	6809		
XASM18	1802		
XASM48	8048/8041		
XASM51	8051		
XASM65	6502		
XASM68	6800/01		
XASMZ8	Z8		
XASMF8	F8/3870		$300.00 each
XASM400	COP400		
XASM75	NEC 7500	$500.00	
Coming soon: XASM68K...68000			

(Upgrade kits will be available for new PROM types as they are introduced.)

Programmer $429
Options include:
Software Driver Package -- enhanced features, no installation required.
CP/M-80 Version .... $ 75
IBM PC Version .... $ 95
RS 232 Cable .... $ 30
8748 family socket adaptor . . . $ 98
8751 family socket adaptor . . . $174
8755 family socket adaptor . . . $135

G7228 Programmer by GTek -- baud to 2400 ... superfast, adaptive programming algorithms ... programs 2764 in one minute.

Programmer $549

Ask us about Gang and PAL programmers.

HEXTRAN Universal HEX File Converter -- Converts to and from Intel, Motorola, MOS Technology, Mostek, RCA, Fairchild, Tektronix, Texas Instruments and Binary formats.

Converter, each version $250

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CIRCLE 201 ON READER SERVICE CARD

Software Directory

Software packages designed to enhance the capabilities of your computer system

Program name: Telepath
Requirements: CP/M-80, CP/M-86, or PC-DOS
Miniumum memory: CP/M-80: 64K; CP/M-86, PC-DOS: 128K
Language: PL/1 and assembler
Description: Telepath 2.3 turns any computer into a communications workstation. The program can be used for accessing timesharing systems, information banks, and electronic bulletin boards as well as providing a common communications environment between most microcomputers, regardless of their respective operating systems. It can be used with virtually any modem or with directly connected computers. Multiple file-transfer protocols, including Modem7, are available for access to public domain software, EBCDIC for use with IBM mainframes, and Telepath protocol for very rapid file transfer. With two Telepath-equipped computers, an operator need be present at only one end of the connection. File directories can be listed for both systems and files transferred in either direction with error checking and automatic retransmission. Any type of file can be transferred, either singly or in batches. Numerous communications parameters can be set by the user to insure compatibility with almost any system. Up to 10 character strings can be stored as macros and transmitted in one keystroke for use in autodialing, logon, and similar sequences. All data that appears on the screen can be captured in a copy buffer and viewed, one screen at a time. The copy session can then be saved to disk for later editing. Files can also be viewed, one screen at a time, from within the program which is command driven. A status screen lists the current settings for the different communications parameters as well as the predefined macros. A help screen lists all the commands along with a brief description of each. Telepath comes preinstalled for the IBM PC and PC compatibles. The CP/M versions come with an installation program for most popular microcomputers, including various configurations of S-100 systems.
Price: $125
Available from:

Telepath Communications Software
8 Toyon Ct.
Sausalito, CA 94965
(415) 332-4271

CIRCLE 300 ON READER SERVICE CARD

Program name: DataPlotter
Requirements: 8- or 16-bit system running CP/M-80, CP/M-86 or MS-DOS
Miniumum memory: CP/M-80: 48K; CP/M-86, MS-DOS: 128K
Language: object code (source in C not available)
Description: DataPlotter is a system for printing publication-quality scatterplots and multiple-function line graphs. It does not display the graph on the screen so no graphics terminal is necessary. Data to be plotted is read from a text file. Several utility programs are included to aid in manipulating existing data files. The main program is interactive: it asks the user for specifications to define the graph. These specifications include the size of the graph in inches, automatic or manual scaling, lables and titles on axes, choice of symbols to use on the graph (11 different symbols in many sizes), and labels anywhere on the page. The user can also save the specifications in a text file for repeated use or modification instead of entering them interactively. DataPlotter supports any 8″ SSSD format, as well as $5^1/_4$ North Star and most soft sector formats. DataPlotter does not support the Apple format. The following printers can be used with DataPlotter: Epson, StarGemini, IBM Graphics, Okidata 92, C. Itoh Prowriter, NEC 8023A, IDS Prism and Microprism, DEC LA50 and LP100, GE 3000, Centronics 739.
When released: 1983
Price: $50 plus $3 shipping ($6 outside U.S. and Canada); $10 for manual
Included with price: DataPlotter with manual
Available from:

Lark Software
7 Cedars Rd.
Caldwell, NJ 07006
(201) 226-7552

CIRCLE 301 ON READER SERVICE CARD

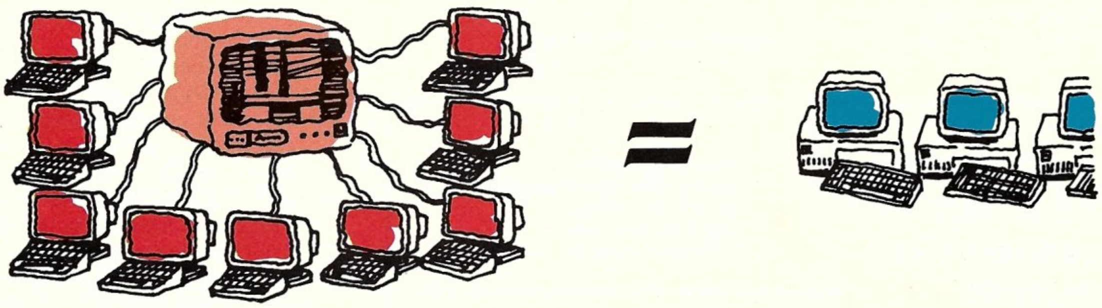
Program name: READIT
Requirements: Morrow Micro Decision
Miniumum memory: 64K
Language: Z80 assembly
Description: READIT is a utility program that enables you to read/write different disk formats, such as Superbrain, Xerox, Osborne, etc., up to 20 formats in all (some double sided). Optional FORMAT program lets you initialize disks in any format you wish.
When released: September 1983.
Price: $50 ($75 with FORMAT option.)
Included with price: Instruction guide, installation guide, Morrow MD2 and MD3 disk.
Available from:

Paul Bartholomew
18 W. Stephenson St.
Freeport, IL 61032
(815) 235-1655

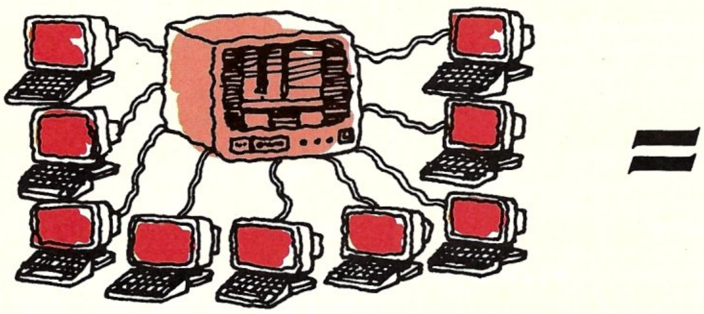
CIRCLE 302 ON READER SERVICE CARD

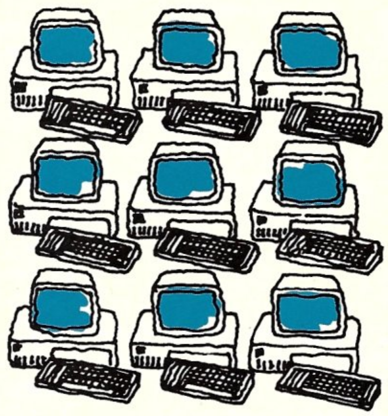
Multi User or Multi XT?

Compare Costs: The 9 terminal Calstar IV from California Computer Systems with printer and software, costs less than 3 IBM XTs



Compare Capabilities: The 9 terminal Calstar IV has more capabilities, more reliability than 9 networked IBM XTs





The promise of the "cooperative" XT is just so much lip service. No matter what you do a personal computer remains just that...a **personal** computer.

That's okay for a one-person office. But if your office is larger, even a networked XT could be obsolete.

California Computer Systems Calstar IV is an integrated system. All your data is accessible from any terminal, when you need it. And Calstar IV is a **complete** system:

- Multi-user OASIS operating system with integrated accounting package.
- Z-80B microprocessor running at 6 MHz and 192K RAM memory (expandable to 448K).
- 4 serial I/O ports, 1 Centronics-type parallel I/O port, full DMA and interrupt support (expandable to 10 serial ports).
- 20 Mbyte 5¼ inch Winchester disc drive and one **1.2 Mbyte 8 inch floppy disc drive** (double sided, double density) which also supports the standard IBM single sided, single density 3740 disk format as well as other California Computer System disk formats. A 20 Mbyte streaming tape drive and Winchester disc drive up to 110 Mbyte are optional.
- Nationwide maintenance.
- Financing available to dealers and end-users.
- Options:
  - retail point-of-sale module with cash drawers
  - integrated word processing, spreadsheet and database management software
  - 20 MB streaming tape drive
  - memory expandable to 448K RAM
  - serial I/O ports expandable to 10 ports
  - additional Winchester disc drive
  - bundling with printers and/or terminals

There's a big difference between networking and true multi-user capabilities. Ask your Calstar dealer to explain it to you today, or contact **California Computer Systems, (408) 734-5811.**

CCS

California Computer Systems
250 Caribbean Dr., Sunnyvale, CA 94089

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CIRCLE 99 ON READER SERVICE CARD

SOFTWARE

Continued from page 128

Program name: MAGIC/L
Requirements: any CP/M-based microcomputer
Minimum memory: 48K (64K recommended)
Description: MAGIC/L is an interactive, extensive programming language with a readable and maintainable forward notation syntax. Its structure is similar to that of C and Pascal. Language features include: data typing for CHAR, INTEGER, LONG, REAL and STRING data, record structures similar to the STRUCT facility in C, and a complete I/O package that can provide random-access, variable-length I/O to any CP/M file. In addition, MAGIC/L source code, which runs on any other processor, can be compiled and run under CP/M unmodified.
Price: $295
Included with price: 8″ SSSD disk with documentation
Available from:

Loki Engineering, Inc.
55 Wheeler St.
Cambridge, MA 02138
(617) 576-0666

CIRCLE 303 ON READER SERVICE CARD

Program name: W-BASIC
Requirements: WICAT Systems 140, 130, 160, 200 and 220 running the MCS operating system
Miniumum memory: 512K
Description: Designed primarily for technical and scientific applications, W-BASIC is fully Microsoft-Basic compatible and complies with the ANSI standard (ANSI X3.60-1978) for Basic. Any program written in Microsoft Basic should run unmodified under W-BASIC (except for operating system-dependent programs or those using special graphics or sound functions). Some of W-BASIC's features are:

- programs are stored in their original text format;
- user-defined functions can be created with any name;
- any Basic command can be executed from a program, including EDIT, AUTO, LOAD, DELETE, RENUM, KILL and DIR;
- program continuation (CONT) can be performed even after the program has been edited;
- error messages specify the line number of the statement causing the error;
- single- and double-precision floating point numbers.

A UNIX version of W-BASIC, currently under development, will be available in the Fall.
Price: $750
Available from:

WICAT Systems, Inc.
P.O. Box 530
Orem, UT 84057
(801) 224-6400

CIRCLE 304 ON READER SERVICE CARD

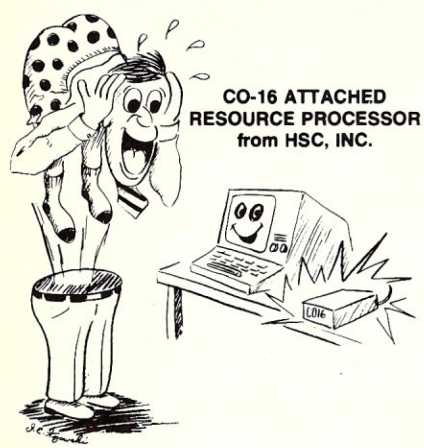
Program name: StarPolish
Requirements: Victor 9000, IBM PC or WordStar
Description: StarPolish is an enhancement to WordStar that provides on-screen boldface, underline, italics and sub/superscript display. The control characters for these print attributes are invisible and do not affect margin justification until the user wants to view them. Support of dot matrix printers via StarPolish exceeds that available with standard WordStar. A menu of common printers allows automatic installation of their full capabilities (up to 16 different functions.) No user-installed patches of printer escape sequences are necessary: less common printers may be custom installed through a simple interactive program that is available separately.
Price: $95
Available from:

TDI Systems, Inc.
620 Hungerford Dr., #33
Rockville, MD 20850

CIRCLE 305 ON READER SERVICE CARD

SAVE YOUR 8 BIT SYSTEM WITH THE ONLY TRUE 16 BIT CO-PROCESSOR THAT HAS A FUTURE

CO-16 ATTACHED RESOURCE PROCESSOR from HSC, INC.



DO NOT BUY INTO OBSOLESENCE LET HSC "STEP" YOUR 8 BIT SYSTEM INTO THE 16 BIT REVOLUTION THROUGH EVOLUTION.

- Easily attaches to ANY Z80 based microcomputer system. Successful installations include: Xerox I&II, Osborn I, DEC VT180, Zenith, Heath, Bigboard, Ithaca, Lobo, Magic, Compupro, Cromemco, Teletek, Altos 8000, Lanier EZ1, Zorba, Morrow, Kaypro, Televideo, etc.
- Dynamically upgrades a CPM-80 system to process under CP/M-86, MS-DOS (2.11), and CP/M-68K with no programming effort. (CCP/M-86 (3.1) and UNIX will be available soon).
- All 16 bit operating systems can use the un-used portion of C0-16 memory as RAM DISK.
- TRUE 16 BIT PROCESSOR SELECTION - 8086 (field upgradable to 80186), 80186, and 68000 (all 6mhz with no wait states - 16 bit data path). **Which spells much higher performance than 8088.**
- Available in a self contained attractive Desktop Enclosure (with a power supply), or in PC Card form for inclusion in 8 bit system. YOU DON'T HAVE TO CRAM IT INTO YOUR BOX / IF YOU DON'T WANT TO.
- Does not disturb the present 8 bit operating environment.
- Memory expansion from 256K to 768K RAM.
- Optional 8087 Math Co-Processor on the 8086, and up to FOUR (4) National 16081s on the 68000!!!
- MS-DOS and CP/M may co-share common data storage devices (such as hard disk).

* **MS-DOS Compatible**
* **IBM PC "Hardware" Compatible**
* **CP/M-86 Compatible**
* **CCP/M-86 Compatible**
* **CP/M-68K Compatible**

- Direct MS-DOS and PC-DOS formatted 5¼" Diskette read/write capability available on: Osborn I, Morrow, Kaypro, Televideo 803, and Epson QX-10 systems, More coming.
- All 768K can be used as high speed CP/M-80 RAM DISK.
- Optional Real Time Clock, DMA, I/O Bus, and 2 Serial Ports.
- **I/O MODULE CONTAINING AN IBM COMPATIBLE BUS (4 slot) & an IBM COMPATIBLE KEYBOARD INTERFACE** is an available option. THIS IS THE REAL DIFFERENCE BETWEEN MS-DOS and IBM PC "HARDWARE" COMPATIBILITY.

AFFORDABLE PRICES

C01686 - includes 8086, 256K RAM, Memory Expansion Bus, Z80 Interface, MS-DOS (2.11), MS-DOS RAM Disk, CPM-80 RAM Disk. $650.00

C01686X - includes all of C01686 PLUS Real Time Clock, I/O Bus Interface, Two (2) Serial Ports, DMA, and the provision for 8087. $795.00

C01668 - includes 68000, 256K RAM, Memory Expansion Bus, Z80 Interface, CP/M-68K, C Compiler, CPM-68K RAM Disk, CPM-80 RAM Disk $799.00

C01668X - includes all of C01668 PLUS Real Time Clock, I/O Bus Interface, DMA, Two (2) Serial Ports, and the provision for up to four (4) 16081 Math Co-Processors. $995.00

OPTIONS

Desktop Enclosure w/ power supply	$125.00
Memory Expansion - 256K	$467.00
Memory Expansion - 512K	$659.00
I/O Module - IBM Compatible 4 slot (multiple I/O Modules allowed)	$499.00
Math Co-Processor 8087	Call
Math Co-Processor 16081	Call
CPM-86	$150.00

For more information:
see your favorite Dealer or contact:
HSC. INC.
262 East Main Street
Frankfort, NY 13340
1-315-895-7426
Reseller, and OEM inquires invited.

CIRCLE 45 ON READER SERVICE CARD

Program name: SOFTPLOT/BGL
Requirements: Microsoft Basic-80 for CP/M or GWBASIC for MS-DOS
Miniumum memory: 15K
Description: SOFTPLOT/BGL is a device-independent graphics library for Microsoft Basic. Comparable to the "CORE" and "GKS" base-level standards in operation, but with the friendliness of Basic, SOFTPLOT/BGL makes full use of available device features, such as hardware text, area fill, and dashed lines. It supports advanced 2D viewing with windows, viewports, 2D rotation, and automatically adjusts for page-aspect ratios. Additional advanced features include axis, automatic label justification and 3D perspective plotting. A unique feature is EMUPLOT which allows the printing of high-resolution graphics on printers without graphics-display hardware (resolution rivals that of most CRTs). It is well suited for developing and transporting low cost, as well as more extensive, graphics in a wide variety of applications.
Price: $200
Available from:

Graphic Software, Inc.
P.O. Box 367 Kenmore Station
Boston, MA 02215
(617) 491-2434

CIRCLE 315 ON READER SERVICE CARD

Program name: NaturalLink
Requirements: Texas Instruments' Professional Computer or Portable Professional Computer with both one floppy and a Winchester drive
Minimum memory: 256K
Description: Texas Instruments has announced that it will license the NaturalLink Technology Package to qualified TI Professional-Computer software developers, giving them the right to develop and manufacture products incorporating TI's natural-language technology, a package that provides a set of interactive utilities which facilitates product development. NaturalLink uses a set of grammer rules to draw inferences on how to control user input; these grammer rules are stored along with a lexicon and screen description in a single interface file. To use a NaturalLink interface, the user learns to position the cursor and to recognize the English phrases accepted for commands. The interface thus controls the selection of items from windows on the screen so that only valid commands are created. Use of a NaturalLink interface also reduces the amount of code normally required for error checking and data validation. The NaturalLink Technology Package includes the following interactive utilities:

- NaturalLink Screen Builder—aids in specifying the appearance and behavior of the screen in a particular application;
- NaturalLink Message Builder—allows specification of help and error messages to be displayed by the NaturalLink Message Manager;
- NaturalLink Interface Builder—aids in debugging a grammer, specifying a lexicon and building and testing the actual interface file that drives the NaturalLink software. As a tool for database administration, NaturalLink provides an easy way to build natural-language command menus for any existing database, any portion of which can be isolated with its own set of natural-language commands; the user only has access to that portion of the database pertinent to his desired application, leaving total control of the database to the adminstrator.

Price: $8,000 for license plus additional royalty fees
Included with price: linkable object code, NaturalLink Window Manager's user's guide and NaturalLink Toolkit user's guide
Available from:

Texas Instruments
Data Systems Group
P.O. Box 1444, H-702
M/S 7929
Houston, TX 77521
(713) 895-4600

CIRCLE 316 ON READER SERVICE CARD

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CIRCLE 8 ON READER SERVICE CARD

New Products

What's new: a quick roundup of recent innovations and improvements

Quadnet LAN

Expansion boards from Quadram Corporation allow PC-to-PC interface and PC-to-mainframe communication.

Quadnet VI integrates the IBM PC, XT and compatibles into a multiuser environment. Connecting up to 255 workstations, Quadnet VI supports print spooling, electronic mail, multiuser DBMS, as well as file and communications servers. Each workstation requires an adapter board employing a low-overhead baseband topolgy with Carrier-Sense Multiple Access/Collision detection and Avoidance (CSMA/CA). Error detection, correction and positive acknowledgment ensure data integrity. Because it has its own CPU with 64K of memory, Quadnet VI imposes no overhead on, but works in parallel with, its host, and features 1.43 bps data-transmission rate, support of various coaxial cables (RB/59u,/llu) and plugs into any slot on the IBM PC, XT or compatible. The NetWare OS permits the sharing of up to 150 MB of disk storage attached to a central NetWare file server, which can be any 8088 IBM PC-compatible microcomputer, a PC with expansion chassis or one or more NetWare disk subsystems with disk interface card. Mass storage expansion is provided through additional NetWare disk subsystems with a minimum of 256K of RAM required. The NetWare file server is a dedicated machine and therefore cannot be used as a workstation. The NetWare file server allows each workstation to share up to 300 MB of disk storage and three printers, supports both DOS 1.1 and 2.0, and features applications support, data integrity (record and file locking) and multiple OS (PC/MS-DOS, CP/M-86, CCP/M).

Quadnet IX is a 10 MB/sec star-shaped ring system that supports up to 255 nodes per ring. Intended for LANs within and between buildings, Quadnet IX features: 9.94 MB/sec throughput under full loading; high data-transfer rate limited only by host-bus bandwidth; compatibility with multiple media (twisted pair, twinax, coax, fiber optics, microwave and infrared); low software burden on host.

Quad3278 allows an IBM PC, XT or compatible to emulate a 3278 mainframe terminal, transmitting/receiving to/from a 3278 and processing data through software running under MS-dos 1.1 or 2.0, PC-IX or QNX. It requires +5vdc +/-5% 1.75 AMPS, standard IBM category-A coaxial cable, RG62A/U, IBM 3278 coaxial line protocol (POLL/ACK) and features 2.35MB/sec transmission rate.

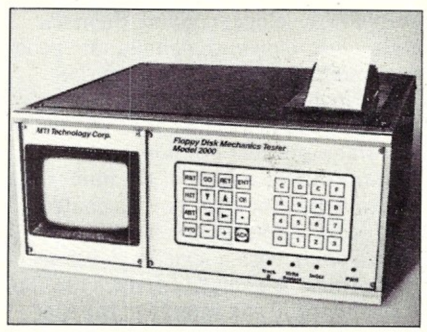
Quadmodem comes in two models: a standalone version that can be cable-connected to an RS-232C port; a plug-in on-board integral version. It requires 256K of RAM and features an RJ11-C modular phone plug, Bell 212 A. 103 communications protocol, data-transfer rate of 1200, 300, 110 bps with autoanswer, autodial, automatic parity, baud-rate selection, Hayes-compatible internal command set, call-progress monitoring, extended-results code set plus complete internal self-test capability. The Quadmodem comes with QuadTalk software. All four products are available from: **Quadram Corp.,** *4355 International Blvd., Norcross, GA, 30093; (404) 923-6666*

CIRCLE 306 ON READER SERVICE CARD

Disk-drive tester

The MTI/2000 accepts direct commands to perform 16 different user-selected tests, whose results are displayed directly on its own integral CRT with graphic presentation of drive alignment that facilitates drive calibration and verification. Using menu-driven prompting instruction, the user selects test sequences that are automatically executed by the MTI/2000. A uniquely designed EEPROM allows users to set up test sequences, change pass-fail limits and enter and simultaneously store both long- and short-term multiple test sequences in nonvolatile memory. Priced at $4500, the MTI/2000 is available from: **MTI Technology Corp.,** *6835 Rose Lane, Carpinteria, CA 93013; (805) 684-6676*

CIRCLE 307 ON READER SERVICE CARD



Token-passing LAN

MAGNet has a physical bus architecture allowing up to 64 nodes, each with a MAGNet board containing a Z80 microprocessor and 64K of RAM; an additional 192K can be added for a total of 256K of RAM. Any terminal can become a MAGNet workstation via the specific interface board available for it. Cables using the RS-422 standard connect each workstation, passing synchronous data via the SDLC protocol. No operating system is required: software resident in the EPROM controls data transmissions. This software recognizes each node as either a requestor of data, or a provider. When a request for a file is made, it is encoded by the requestor

Quadnet VI links the IBM PC, XT and compatibles into a multi-user system.

node within a data packet that includes the address of the provider node. The requestor waits for the token, then passes the packet through the network to the appropriate provider. Each node keeps track of activity on the network; when a packet comes by with its address, it opens the packet and acts on the data. Interpreting the data as a request, it then locates the file and makes up another packet; when the token arrives, it sends the data to the requestor, passing the token to the next node. This avoids the collision experienced with Carrier-Sense Multiple Access/Collision Detection systems (CSMA/CD). MAGNet components are available separately, including: intelligent workstations ($1,995); cable ($25-250: depending on length); interface boards ($695-895: depending on terminal); file servers ($699-4,495, depending on disk drive) from: **Magnolia Microsystems,** *2264 15th Ave. West, Seattle, WA 98113; (206) 285-2841* or *(800) 426-2841*
CIRCLE 308 ON READER SERVICE CARD

IBM PC-to-mainframe protocol

The HyDra II is a byte-multiplexor direct-channel controller that allows any brand of microcomputer to communicate with IBM mainframes and drive-associated printers. It is a Z8000-based instrument allowing local and remote attachment of asynchronous ASCII terminals, microprocessors, personal computers and high-resolution letter-quality printers to the IBM 360, 370, 43XX, and 303X mainframes.

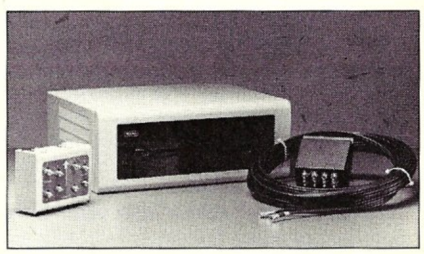
If the line drops during communication with the mainframe via the HyDra II and a modem, or if the user simply forgets to log off, the HyDra II automatically sends a default logoff to the host mainframe. The HyDra II also provides an interface with RS-232C printers, permitting them to emulate local 3211/1403/3286 or 3287 printers with no geographic restrictions. A general-purpose interface enables communication with RS-232C devices via a high-level language, permitting data transfer between a PC and the host mainframe. Baud rates, parity bits, time-outs, and similar functions are also controlled by the user program, permitting users to drive plotters, audio devices, machine tools or to create their own applications. The number of devices that the host mainframe's operating systems can support governs the number of HyDra IIs attachable to the host. HyDra II is supplied with either 8 or 16 ports. The 8-port unit priced at $6,900; the 16-port unit is $9,000: both are available from: **Diversified Data Resources, Inc.,** *25 Mitchell Blvd., #7, San Rafael, CA 94903, (415) 499-8870.*
CIRCLE 309 ON READER SERVICE CARD

MultiLink LAN

MultiLink is a shared resources local area network for up to 225 IBM PCs or XTs. With MultiLink, any PC or XT workstation can become a file server for other units in the network, while still being used as a standalone unit. Workstations may be added or removed with little or no effect on network operations. Apple-compatability is currently under development. MultiLink hardware is based on Datapoint's Arcnet technology and uses token passing for speed (2.5 megabits per second) and guaranteed minimal performance. Other special features of MultiLink include: passwords that permit access to be limited to no-access, read-only or read and write; locks that prevent one user from changing data while another user is working with the same file: and pipes that allow different applications being used on separate workstations to communicate and exchange data. The network may use a combination of passive 4-connector hubs ($100 each) or active 8-connector hubs ($800 each). Priced at $595, MultiLink is available from: **Davong Systems,** *217 Humboldt Ct., Sunnyvale. CA 94086; (408) 734-4900.*
CIRCLE 310 ON READER SERVICE CARD

FastLAN

A predesigned, user-installable cable system that links Wang and non-Wang equipment, FastLAN consists of three easy-to-install modules: FastLAN-A, a broadband radio-frequency (rf) amplifier unit; FastLAN-B, a network branch with two coupler boxes that connects to the amplifier unit; FastLAN-C, a drop cable with a four-port WangNet multiuser outlet that connects to a coupler box. These three basic components can be combined in configurations ranging from 4 to 640 ports and covering a radius of up to 300′ which can be incremented by just adding modules to the existing network. Regardless of size, any FastLAN configuration can be incorportated into a custom-designed WangNet installation to form a single network capable of linking one or several buildings. With a standalone FastLAN configuration, no design review is required because Wang has built fixed rf signal levels into the network; expanding FastLAN does not affect rf signal levels. FastLAN uses a dual-cable broadband medium and CATV components for the concurrent exchange of data, text, image and video information and offers five communications services: *Wang Band,* for communications between Wang systems at speeds up to 10 million bps; *Peripheral Attachment Service,* for the independent high-speed connection of Wang workstations, peripherals and IBM Type A 3270 devices to their host systems; *Interconnect Band,* for transmission pathways for industry-standard communications interfaces and protocols; *Utility Band,* for video applications; *Professional Computer Service,* for connecting Wang Professional Computers (PC) to the network. Three installation options exist with FastLAN: the user can plan the physical layout and follow instructions to install FastLAN himself; Wang can provide full design and consulting services and the user handles installation; Wang can provide a full turnkey network. A standard Wang maintenance contract is available; a premaintenance-contract inspection is required if a customer opts for this service after the FastLAN warranty expires. Cabling for each of FastLAN's three modules comes in either polyvinylchloride (PVC) or teflon. The



prices with teflon cabling are: FastLAN-A $1300: FastLAN-B: $800; FastLAN-C: $120. Prices with PVC cabling are: FastLAN-A: $995; FastLAN-B: $350; FastLAN-C: $120. All three modules are available separately from: **Wang Laboratories, Inc.,** *One Industrial Ave., Lowell, MA 01851; (617) 459-5000*
CIRCLE 311 ON READER SERVICE CARD

New Products

Continued from page 133

PC encryption board

The ENC-305 is a data-encryption board with bundled software for the IBM PC, XT and all PC-clones that supports both the Synchronous Data Link Control (SDLC) and the SNA IBM protocols, providing secure transmissions over networks, between individual PCs, and in PC-to-mainframe communications. The ENC-305 also provides emulation of the IBM 3274-51c with IBM's encrypt/decrypt feature. With the ENC-305, the IBM PC can emulate a 3278 or 3279 display station. Priced at $1,595, including licensed documentation, the ENC-305 is available from: **Futurex Security Systems,** *9700 Fair Oaks Blvd., Fair Oaks, CA 95628; (916) 966-6863*

CIRCLE 312 ON READER SERVICE CARD

Scrambler encryption device

The Scrambler is a hardware device that plugs into a modem and a CPU. Sold in pairs, the Scrambler implements the Federal Information Processing Data-Encryption Standard (FIPS 46) developed by the National Bureau of Standards. Each set of Scramblers has its own encryption key so that the devices within each set may only communicate with one another: no other Scramblers can decrypt the data. When communications are established between Scrambler units, automatic session-key distribution is performed and

the units are synchronized. Null traffic and automatic resynchronizing are performed during lulls in communication so that line-use patterns are not apparent. Full duplex operation is supported at the full baud rate of the Scrambler model selected: data from the computer is encrypted and sent to a modem for transmission; at the same time, received data is decrypted and sent to the computer. If the high-accuracy mode is selected, an error-detection/correction algorithm is performed using a cyclic-redundancy checkword. If errors are introduced by the telephone system, the data is retransmitted until the checkword indicates that the data has been correctly received. While this mode reduces the effective speed of communications, it ensures that the data is delivered correctly as well as securely. Priced at $295 per device, the Scrambler is available from: **Industrial Resource Engineering, Inc.,** *Box 57, Timonium, MD 21093; (301) 561-3155*

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Rapicom digital Fax

The Rapicom 5000 is a microprocessor-controlled CCITT Group 3 facsimile device with a built-in 9600 bps modem, transmission speed of 15 seconds per page, memory up to 100 telephone numbers and a 3-digit code to access them. Other features include: autodialing, which automatically initiates two redialing sequences five minutes apart if a remote device fails to accept its call; send-later, which accepts up to 30 documents for autothroughput at preprogrammed times. The operation panel includes a 10-digit keypad which serves as a built-in telephone for transmission initiation, programming of memory functions, and selection of machine operation. Keypad selection of a 4-digit department code identifies all transactions. The operation panel also contains selectable operator prompts and an LED. Rapicom 5000 comes with an adjustable document guide for varied document widths, page enlargement and reduction, copy mode, nonodorous thermal fax paper, stainless steel document table, and external telephone handset for voice coordination. High quality halftone reproduction is also available. The Rapicom 5000 becomes a highly flexible applications-oriented facsimile networking system when equipped with optional SAF-PAK, which expands memory capacity and provides storage of up to 30 8 $\frac{1}{2} \times 11''$ pages. Documents in memory are accompanied by preprogrammed instructions for transmit time and destination. A stored document may be broadcast to up to 100 remote stations. The fail-safe feature automatically redirects inbound documents to memory if paper outage or other unexpected interferences are incurred. Also, SAF-PAK will attempt to retransmit failed pages up to five times if an original transmission encounters difficulty. Confidential documents may be forwarded directly into the SAF-PAK memory for private access via 4-digit code, which will release the stored data as a fax printout; nonconfidential documents may be accessed by direct dialing. Priced at $6,200, the Rapicom 500 is available from: **Rapicom, Inc.,** *7 Kingsbridge Rd., Fairfield, NJ 07006; (201) 575-6010*

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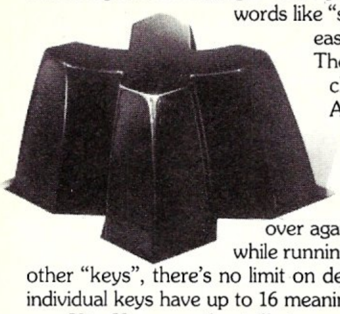

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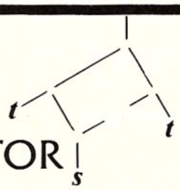

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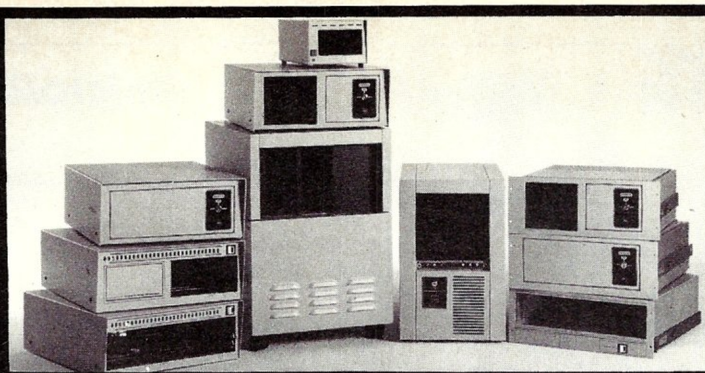

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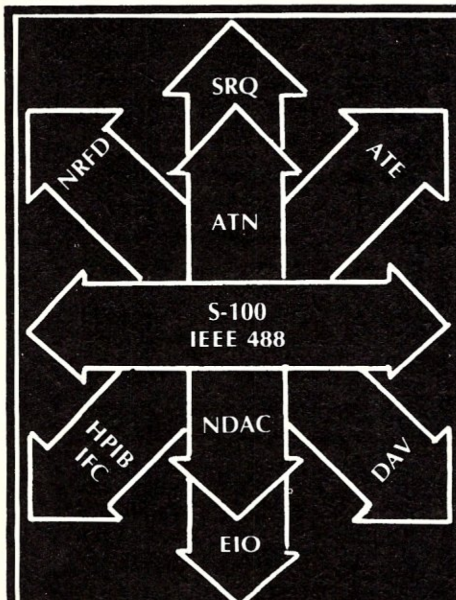

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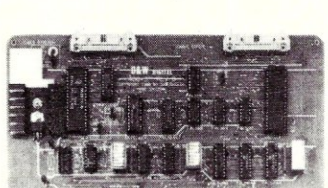

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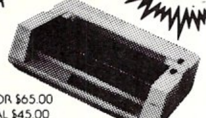

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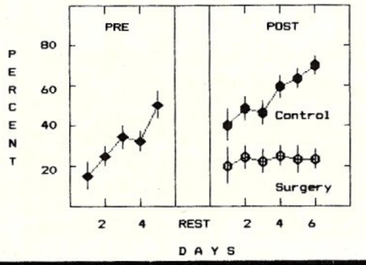

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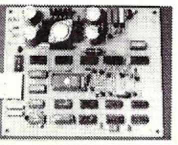

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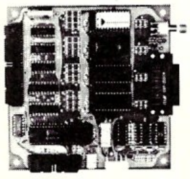

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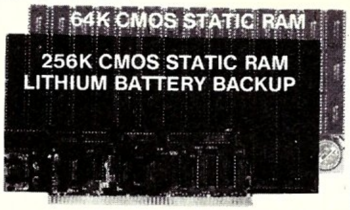

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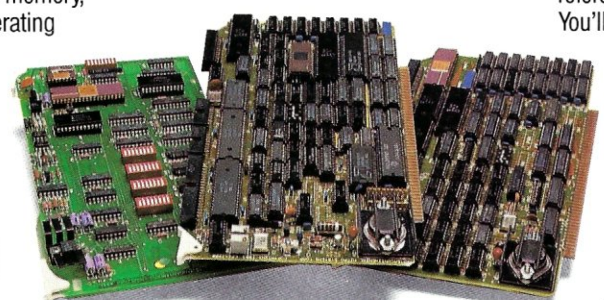

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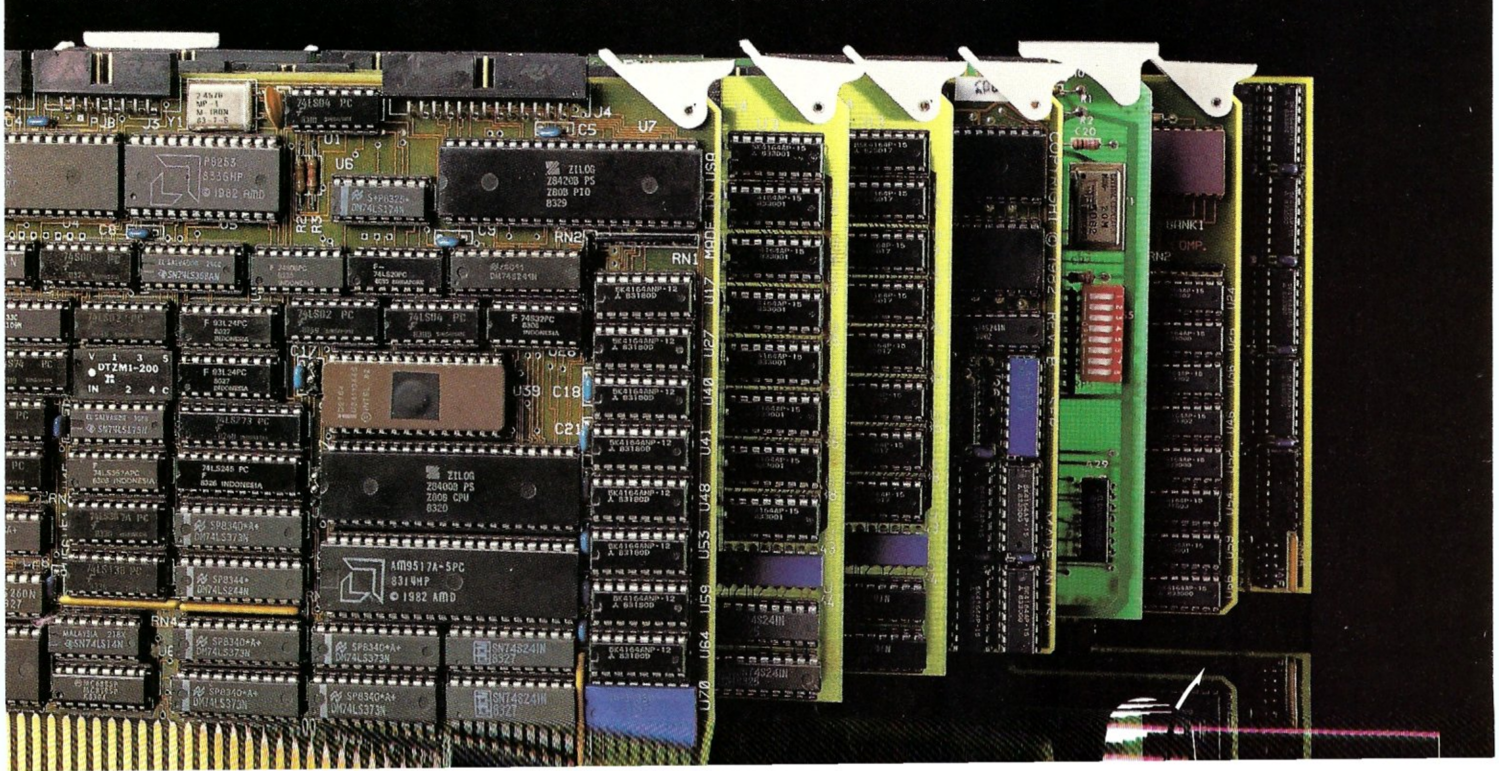

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