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Microsystems

Volume 5/Number 4

April, 1984

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- Viewer for Debugging
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- Low Cost 120 cps Printer

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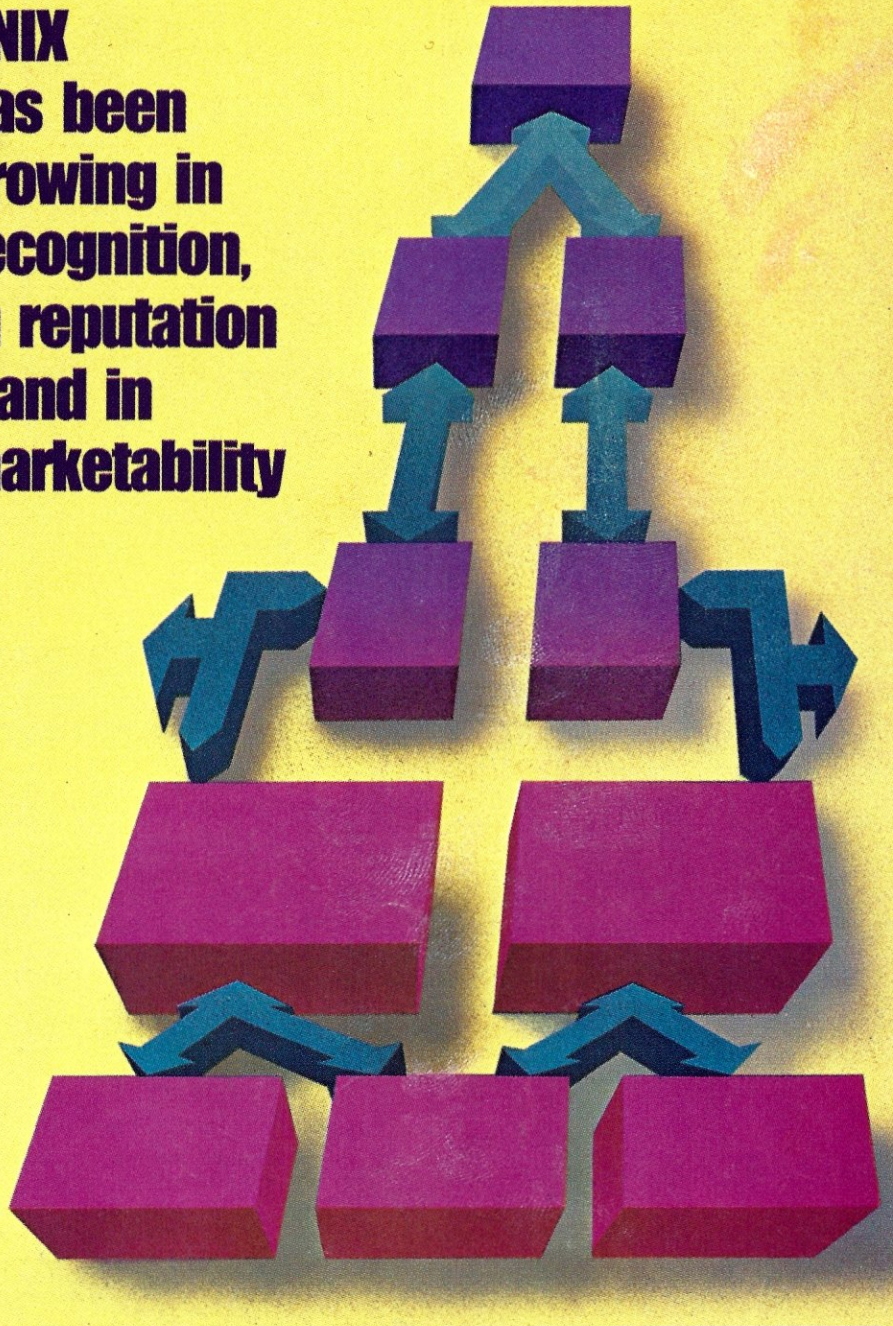

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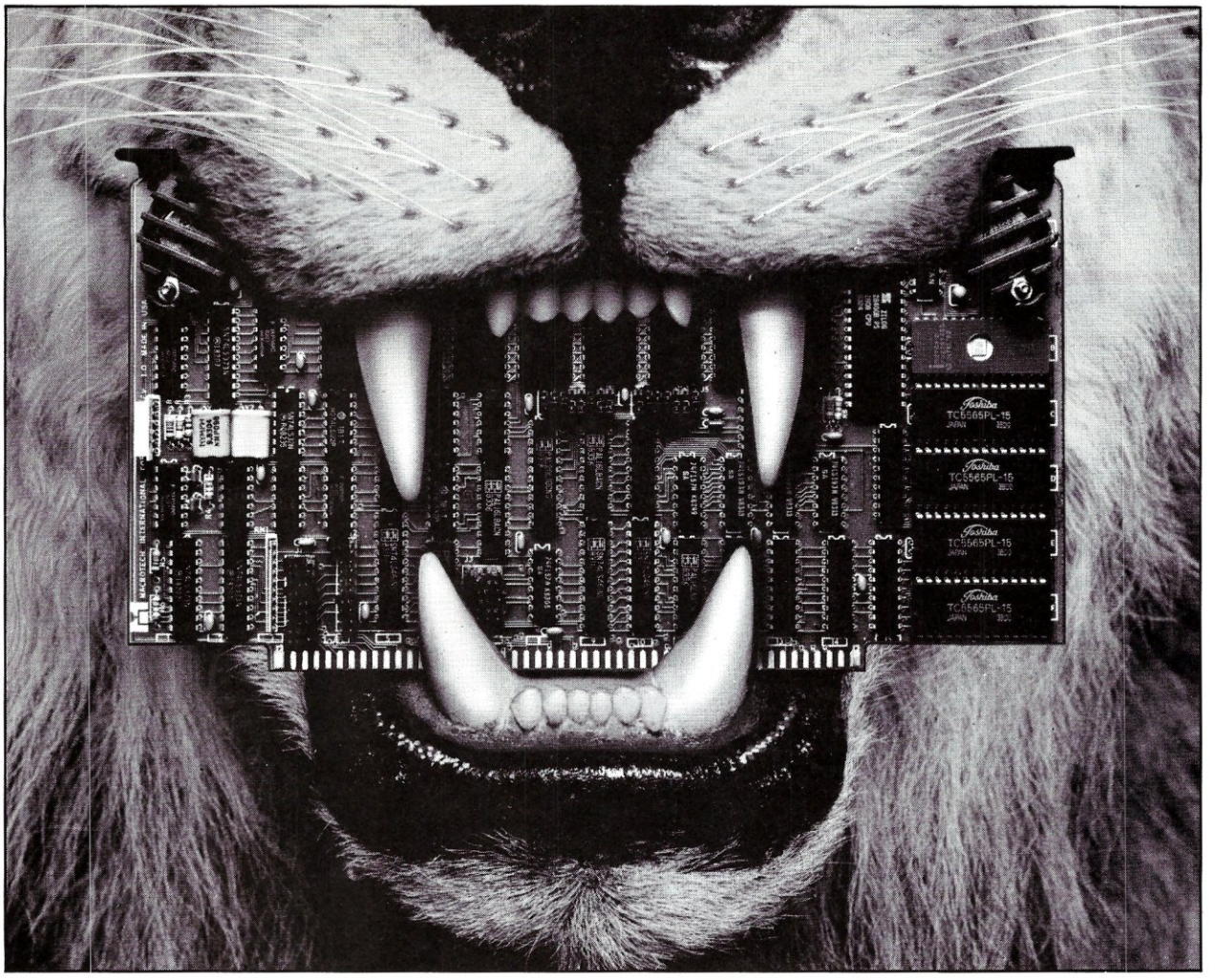

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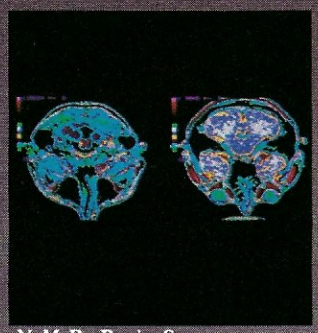

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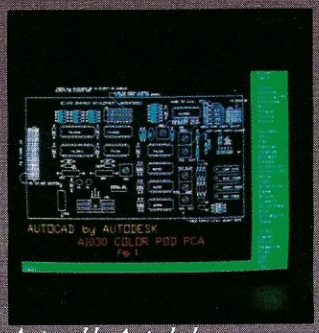

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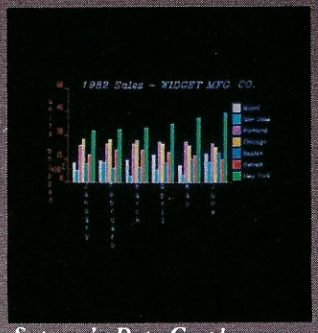

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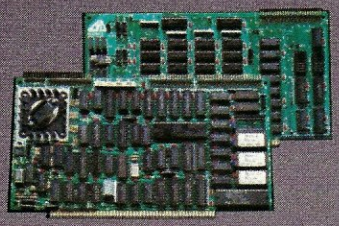

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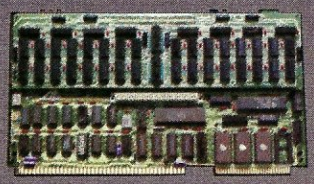

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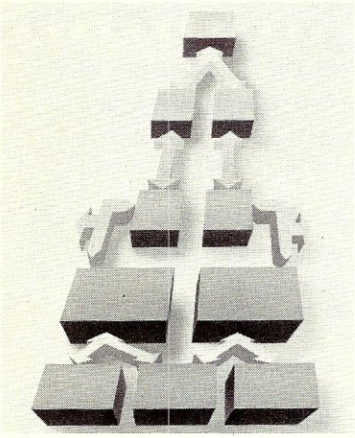

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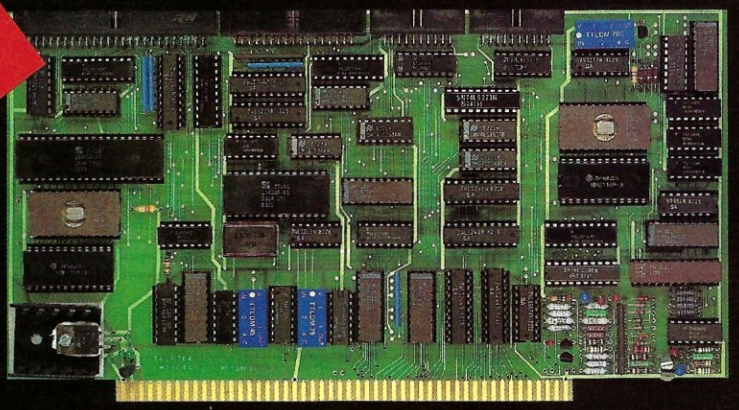

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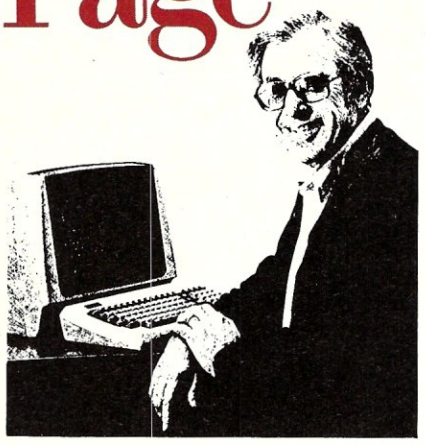


The next battle in the DOS war

by Sol Libes

There is no doubt that a war of the microcomputer disk and operating systems exists between Digital Research, Inc., and Microsoft. And Microsoft over the last three years has proved itself the "aggressor." After all, DRI virtually owned the microcomputer DOS business with its version of CP/M-80. It was even the initial leader in the 16-bit area, introducing CP/M-86 well before the IBM PC even saw the light of day.

However, when IBM began searching around for an operating system for their personal computer, they got a cool reception from DRI. Bill Gates, who is an aggressive marketing-oriented President of Microsoft, seized the opportunity. First he acquired the rights to a 16-bit DOS that had been developed by Seattle Computer. SC had introduced an S-100 8086-based computer system in 1978 and had been forced to develop the DOS when DRI took a slow attitude to developing CP/M-86. The SC-DOS actually was closely patterned after CP/M-80.

I can understand DRI's hesitation to place emphasis on the development of a version of CP/M for the 8086 in the late seventies. At the time the Z80 dominated the personal computer market and no company, other than Seattle Computer, was producing an 8086-based personal computer. Further, the SC machine was expensive and therefore was well out of the personal computer mainstream; and, at the time, no one was developing software for 8086-based machines. Thus, DRI placed its DOS development efforts behind projects such as MP/M-80, CP/Net and CP/M-80 Plus.

The first round

When Microsoft acquired the SC-DOS they immediately set about to add some enhancements. Thus, the first version of the DOS, called "PC-DOS" on the IBM PC and "MS-DOS" for non-IBM systems, appeared to be very close to CP/M-86, although it did contain some minimal enhancements.

Apparently, Microsoft gave IBM a real "low-ball" price deal for MS-DOS so that IBM was able to sell PC-DOS version 1 for $40 while charging $350 for CP/M-86. Since the two operating systems were virtually the same, as far as the user was concerned, DRI ended up losing in this first battle. The loss became a serious defeat when the IBM PC proved to be a real success in the personal computer marketplace, and software developers jumped on the bandwagon to develop application software to run under PC/MS-DOS. Microsoft seized the opportunity by offering MS-DOS to other system manufacturers, thus creating a huge IBM PC compatible market. Today there are about 100 manufacturers of PC compatibles.

DRI's response to the battle was to lower the price of CP/M-86 to $90 and to convince many OEMs to adopt it as the DOS for their 8088/8086-based machines. Thus companies such as Digital Equipment Corp., TeleVideo, Hewlett-Packard, Data General and Honeywell, just to name a few, adopted it for their entries into the 8086-based system fray. However, these companies soon discovered that PC/MS-DOS was achieving the position of a DOS standard as more and more application software developers were supporting it than were supporting CP/M-86. Thus these computer system makers also began offering MS-DOS as well as CP/M-86.

The second battle in the 16-bit DOS began with DRI's introduction of a significantly enhanced version of CP/M-86 called "Concurrent CP/M-86" that provided true multitasking capability and an improved user interface. Microsoft's response was a significantly improved version of PC/MS-DOS—version 2.0*. Version 2.0 offers many new features that are very UNIX-like, as well as an improved user interface. The price for the DOS was raised by IBM to $60. Incidentally, the IBM PCjr version (2.1) is $65.

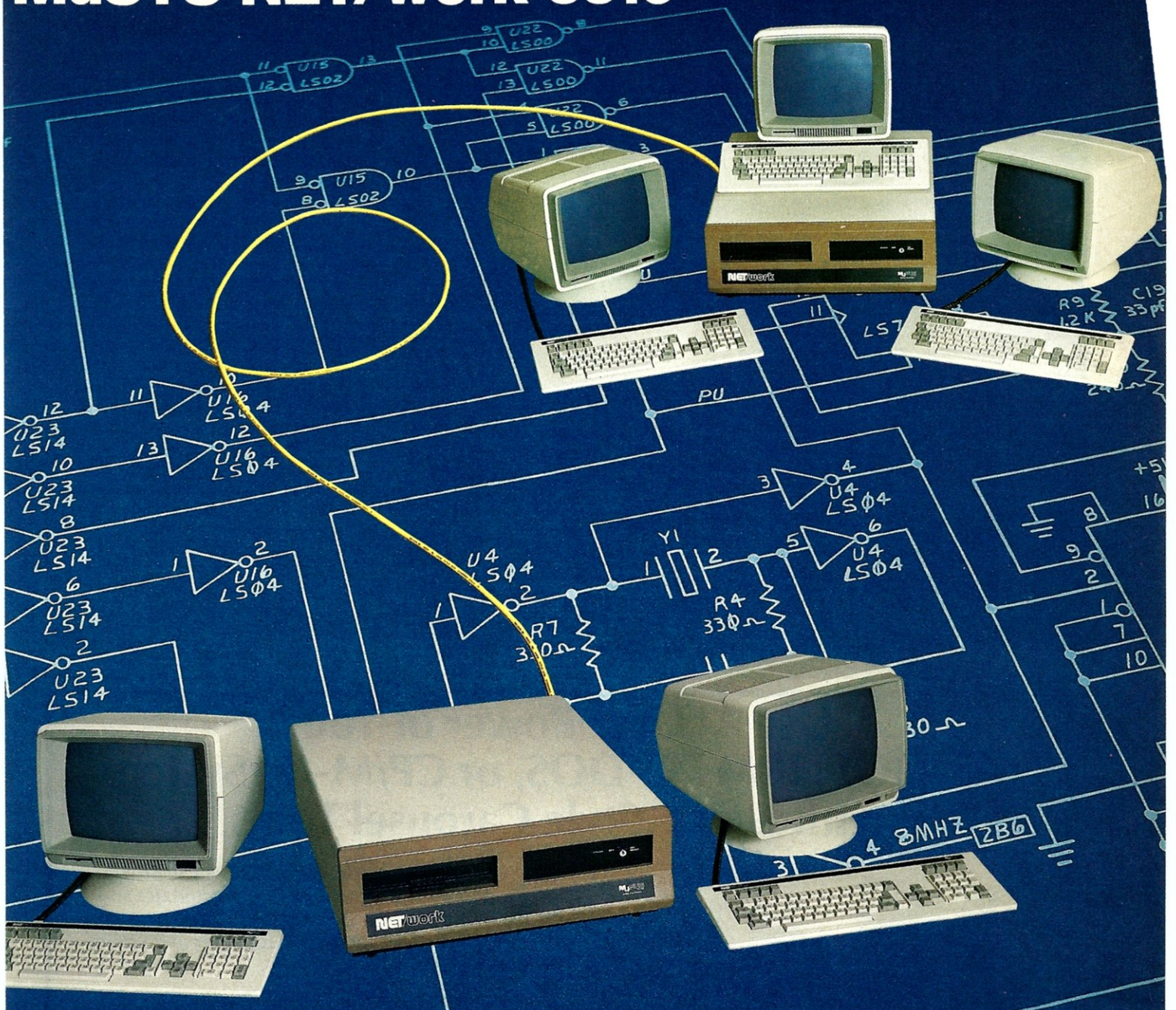
Microsoft appears to be the victor in this second battle, as most personal computer users appear to be satisfied with a single-tasking DOS and unwilling to pay $300 more for Concurrent CP/M-86. Only the more sophisticated users have gone for the increased power offered by Concurrent. Some manufacturers have abandoned CP/M-86 altogether in looking for the greater software support: for example, HP on their new touch screen 150 system offers only MS-DOS.

A continuing battle

DRI has not, however, conceded the war and is continuing to do battle: if anything, they are getting more aggressive. Thus, battle No. 3 appears to be getting underway as DRI and Microsoft get ready to introduce new versions of

*Microsystems *published an article last month which compared the features of MS-DOS versions 1 and 2 and CP/M in great detail. I refer the reader to "MS-DOS: An Overview, Part 1" (page 46) for an in-depth discussion. Part 2 starts on page 68 of this issue.*

THE SMALL BUSINESS MAINFRAME
MuSYS NET/work 8816



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CIRCLE 83 ON READER SERVICE CARD

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EDITOR'S PAGE

Continued from page 8

their operating systems. Both companies have announced that they will shortly begin shipping new versions of their operating systems with windows, color graphics, and still more friendly user interfaces. These multitasking operating systems will also be competing with packages such as VisiOn from VisiCorp.

The new DOS versions will take full advantage of the features offered by the 8088/8086 and associated hardware. In fact, their features may be so demanding of the hardware as to lead an accelerated movement toward more powerful systems such as the 80188/80186 and 80286 and systems with color-graphics controller interfaces much more powerful than the one presently used on the IBM PC and its look-alikes.

This competition is healthy, with users profiting from the rapid introduction of integrated hardware/software improvements. *Microsystems* will be reporting on these new operating systems in great detail in the near future.

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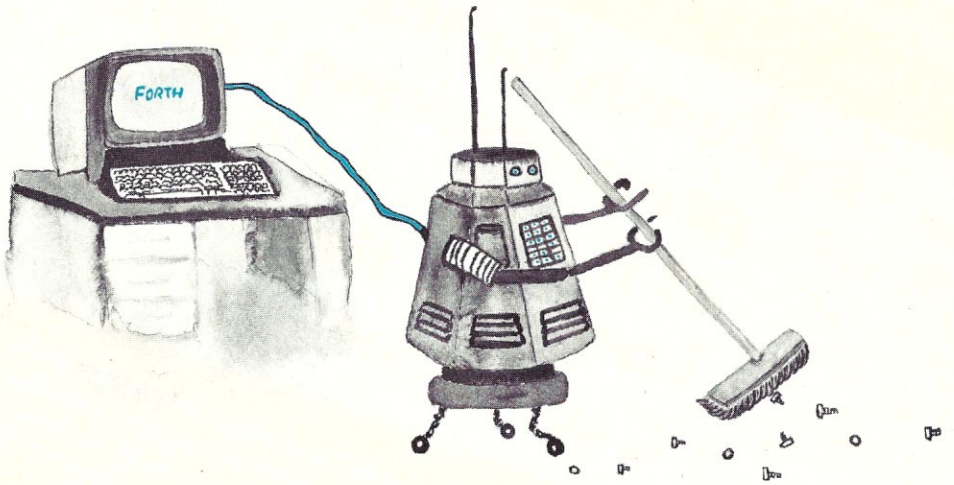

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AUGUSTA, Ada subset compiler from Computer Linguistics for Z-80 CP/M 2.2 systems, $90.00

"Starting FORTH" tutorial by Brodie, softcover, $16.00.

INTEL 8087-3 Numeric Coprocessor, $250.00

Z-80 and 8080 *FORTH* require 48 Kbytes RAM. 8086 and 68000 *FORTH* require 64 Kbytes RAM. Disk formats available include: 8" standard CP/M SSSD, Northstar 5¼" QD, Kaypro 5¼", Apple 5¼", Micro-Mate 5¼", MS-DOS 5¼", Osborne 5¼", DD, and Sage. Most other formats can be special ordered. Dealer inquiries invited.

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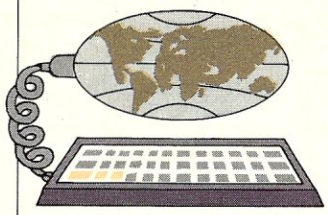


News & Views

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

by Sol Libes

It is rumored that North Star Computers Inc. will go public this year. Sales last year were estimated at $40 million. . . . Sony Corp. is shortly expected to announce a 5 MB version of its 3.5″ microfloppy drive. The current version stores 1 MB. . . . Tecmar is rumored to be preparing a 68000 plug-in card for IBM PC-compatible machines and will include with it a version of the UNIX-like Coherent operating system.

UNIX news

Commodore has confirmed a rumor which appeared in last month's column that it has contracted with Mark Williams Co. to use the UNIX-like Coherent operating system on its Z8000-based system. The release of the system is expected later this year. *Microsystems,* which reviewed Coherent running on the Intersystems Z8000-based system in the January 1983 issue, found the Z8000 to be an underrated device—the fastest of the three major microprocesssors then available. . . . Commodore may have another winner here.

Reportedly, Mark Williams furnished Commodore with a set of tapes, and Commodore did the actual installation. Coherent is a true multiuser, multitasking system.

It is rumored that the Commodore system will have a base price of $700 and will include 128K of RAM and a single drive. It is difficult to imagine how a full-featured Coherent will run on a 128K single-drive floppy disk system or even on a system without a hard disk. There will be an optional 8088 card.

Western Electric has announced UNIX System V release 2.0, an enhanced version more oriented to the commmercial marketplace. It includes enhanced versions of the C compiler, **uucp** and other programming tools, an approximately 10% performance improvement and improved error messages. Surprisingly, it does not include file or record locking.

Concurrent CP/M 4.0

Digital Research has disclosed that it expects to release version 4 of its Concurrent CP/M-86 before year end. It will use a VM (Virtual Machine) concept. There will be a highly sophisticated system kernel, including low-level primitives, and will surround the kernel with a shell through which system calls from virtually any operating system, or even calls to hardware, can be mapped into the kernel. It will be capable of supporting applications written for virtually any other operating system/hardware combination. Thus it will have a PC/MS-DOS mode to run such software and handle calls to the operating system, to ROM, and to other hardware.

Microsoft announces MSX-DOS

Microsoft's MSX operating system for 8-bit Z80-based home computers lacked one important feature: it was not designed to work with floppy disks. Thus it was inevitable that they would also announce a floppy version to compete with DRI's Personal-CP/M—and they have: it is called MSX-DOS.

Microsoft promises that MSX-DOS will be fully compatible with CP/M-80 version 2.2 and will occupy only 8K of memory. *Microsystems* will test the system as soon as one becomes available.

32-bit update

National Semiconductor's 16032 chip has been in production now for almost a year, and initial quantities of its 32032, full 32-bit version, became available last November. So far two S-100 16032 CPU cards have appeared: one from CompuPro and another from InnerVision Computers. Also Acorn, in England, has anounced a personal computer to be based on the 16032.

Silicon Valley Micro Inc,. San Jose CA, is the first company to announce its intention to use the 32032 in a general-purpose machine. They have announced $5,000, $10,000 and $15,000 portables which will use both the 32032 and 8088 (for IBM PC compatibility). The low-price unit will have a 9″ display, two floppies and 512K of RAM. The larger unit will add a 75 MB hard disk, 20 MB tape drive, and 1 MB of RAM. The largest unit adds an 8087 math processor chip, another $^1/_2$ MB of RAM, 175 MB hard disk and a 40 MB tape drive. Delivery is promised for the third quarter.

The 32032 is not the first 32-bit microprocessor to appear. Intel released its iAPX-432 chip set back in early 1982 and, later that year, Hewlett-Packard and Western Electric announced 32-bit chips. HP's and WE's chips were designed for internal consumption.

Intel's 432, with a radically new architecture, proved slow and difficult to work with, and Intel recently announced a new, improved version with better development software support. The result was that so far only one company has announced a 432-based system, and that company is in England.

In the meantime, Intel has an-

NEWS & VIEWS

Continued from page 13

nounced that it will shortly begin sampling its iAPX386, a 32-bit version of its popular 8086 architecture. Motorola is expected to do the same with the 68000–the chip will be called the 68020.

Computer hobbyists to meet

Over 15,000 avid computer hobbyists are expected at the Trenton Computer Festival on April 14 and 15. The big attraction is an outdoor flea market that covers about 20 acres, where hobbyists can buy everything from complete used computer systems and components to used software and rare out-of-print manuals.

The Trenton Computer Festival, is now in its ninth year and has the distinction of being the first personal computer show ever held. It takes place at Trenton State College, Trenton NJ. There will also be an indoor commercial exhibitor area, speakers, and user group meetings.

TCF-84 is sponsored by three nonprofit organizations: The Amateur Computer Group of New Jersey, Philadelphia Area Computer Society, and Trenton State Computer Society. For information call *(609) 771-2487* or write **TCF-84,** *Trenton State College, Trenton NJ 08625*

Osborne files reorganization plan

Osborne Computer Corp. has filed a reorganization plan with the U.S. Bankruptcy Court. Robert Brown, currently VP and General Manager of Osborne's International Division, will take over as President. Robert Jaunich, previous President, and Adam Osborne, previous Chairman of the Board, will step down to Director positions.

The plan calls for a slashing of costs and a focusing on selling to niche markets. All existing stock will be cancelled and new stock issued to creditors, venture capital investors, and new management. OC will pay off $15.5 million of its $41 million debt and offer creditors stock options on the rest.

The company will concentrate on the after-sale market for hardware and software products. It will continue development of products that were in development previously, including the IBM PC compatible Executive II, the low-priced CP/M-based Vixen, and IBM PC upgrade board for existing models.

New public domain software

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 157 volumes. The new volumes contain the following:

Vol.	Description
153	XLISP for CP/M-86
154	FORTH-83 (includes editor and assembler)
155	dBASE-II programs
156	Updates of FIND, LU, SQ and MODEM & XMODEM for TRS-80
157	CP/M-86 Relocatable Utility Routines & misc. CP/M-86 programs (incl. Z80 emulator, MODEM, SETTIME & SCRUB); LTYPE update; program to attach Atari to CP/M.

For complete SIG/M software information, send $2.50 ($4 foreign) for

COMPARE

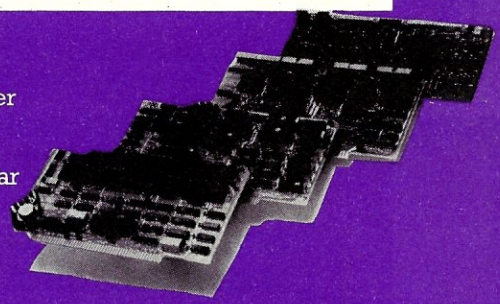
The Benchmarks: Lomas Data Products vs. Compupro*

A benchmark comparison was made of the Lomas Data Products board set (LIGHTNING ONE, HAZITALL, LDP72 and RAM67) and a comparable COMPUPRO board set (CPU86/87 10MHz, INTERFACER-4, DISK1 and RAM21). *Both* CPUs were setup to run without waitstates during memory cycles. *Both* systems used double sided disk drives with 3 ms. step rates and used double density diskettes with 1024 byte sectors. The test consisted of assembling the source code for the example BIOS (BIOS.A86), distributed with standard CP/M-86**. The results should be self explanatory, *LOMAS DATA PRODUCTS offers superior performance.*

	LIGHTNING ONE™ 10 MHZ	COMPUPRO CPU86/87 10 MHZ	LIGHTNING 286™ 6 MHZ
ASSEMBLY TIME (SEC.)	47	55	41
RATIO TO 10 MHZ LIGHTNING ONE	1.00	1.17	.88
BOARD SET COST LIST PRICE AS TESTED	$2545.00	$3040.00	$3290.00
COST PERFORMANCE	$2545.00	$3556.80	$2895.20
RATIO	1.00	1.40	1.14

Other LDP Advantages

There are many additional reasons for choosing LDP as your supplier for S100 16 bit products. We don't choose the operating system you can run on our board sets, we let you make the choice. We support CP/M-86, CCP/M-86**, MP/M-86* and MS-DOS***. MS-DOS is by far the most widely distributed 16 bit operating system and more application and support is offered to run using MS-DOS than the other competing operating systems. Our 1 year guarantee on our boards offers the customer the protection he deserves.



LDP offers the following advanced boards for the S100 bus:

■ LIGHTNING 286

The fastest processor on the S100 bus contains many advanced features. Based on the Intel 82086 processor this board maintains software compatibility with earlier 8088 and 8086 products.

■ LIGHTNING ONE

Our 8086/8088 based processor board may be operated at speeds up to 10 MHz, and will accept optional 8087 and 8089 co-processors.

■ THUNDER 186

The first and only complete 16 bit processor on a single board. This processor board uses Intel's advanced 80186 microprocessor to provide a high degree of integration and allow a complete computer to be built on a single S100 bus board.

■ MEMORY BOARDS

We offer both DYNAMIC and STATIC RAM for the S100 bus. Our STATIC RAM will run with our 80286 CPU without waitstates.

■ HAZITALL System Support Board

The HAZITALL provides complete I/O support for our systems including two serial ports, two parallel ports, battery protected clock calendar and a host interface for a WD100X hard disk controller.

■ LDP72 FDC

The LDP72 floppy disk controller is an advanced disk controller allowing intermixed 5" and 8" floppy drives. The digital data separator insures long adjustment free operation.

■ SYSTEMS

LDP offers a full range of ready to plug in systems for your convenience. Our S100—PC is an ideal choice for the user wishing to purchase a compact, high-performance personal computer.

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** *CP/M-86, CCP/M-86 and MP/M-86 are trademarks of Digital Research*

*** *MS-DOS is a trademark of Microsoft*

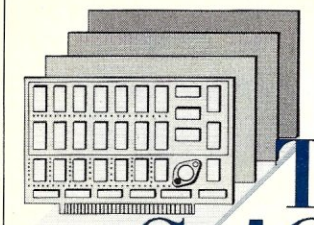
NEWS & VIEWS

Continued from page 14

printed catalog to: **SIG/M,** *Box 97, Iselin NJ 08830.*

Random news

FIG (Forth Interest Group) has announced a public-access on-line bulletin board system (300 baud). Dial *(415) 538-3580*. . . . Morrow Inc. has announced an 8088 coprocessor board for its Micro Decision 8-bit computer. The board includes either 128 or 256K of RAM and comes with MS-DOS, CP/M-86, and SuperCalc 2—all for either $500 or $700. Also announced is a low-cost Local Area Networking system for the Micro Decision and a 24-lb transportable computer. . . . KayPro reported that for the fiscal year ending August 21st, it did over $75 million business and shipped 53,000 machines versus 2,000 the previous year. . . . Digital Research has announced a Fortran-77 compiler that they contend is the fastest Fortran to run on a micro. . . . Zilog Inc., creator of the popular Z80 microprocessor chip, has disclosed that, after nine years of consistent losses, it had a quarter with an operating profit. Hooray! (Zilog is a wholly owned subsidiary of Exxon Corp.)



The S-100 Bus

Phantoming and bank selecting

by Dave Hardy

As promised last time, this month's "S-100 Bus" will give some examples of simple circuits that can be used to add bank switching and phantoming to any S-100 machine.

The circuit shown in Figure 1 is a simple latched parallel output port that can be used to control multiple banks of memory in a bank-switched system. It is similar to most standard parallel ports and has eight individually selectable latched output lines. Depending on the number of banks that need to be controlled, fewer lines may also be used (or even more, if you have a lot of spare memory).

Any latched parallel port can be used. It doesn't have to be a special piece of hardware. In fact, many S-100 machines have an extra parallel port that can be used for bank switching by just hooking up the parallel output lines to the individual memory boards' enable lines. A Centronics-type printer port can even be used, if its open-collector outputs are tied to +5V through 1K pull-up resistors.

The circuit in Figure 1, however, has an additional feature that is usually needed when using bank select. Notice that the RESET* line is used to insure that each time the machine is reset, the latched outputs are also reset. This is so that a certain memory bank is *always* enabled after a hardware reset. Without this circuit, there is no way to guarantee which bank is selected after a cold boot. If all banks are the same size, then this feature may not be necessary, since the operating system could probably boot up in any bank. But if the system code needs to be in a particular bank (and it usually does) a reset feature is a must.

This type of circuit is also frequently (and incorrectly) referred to as "extended addressing" because it simply extends the amount of memory that a machine can access. However, extended addressing as defined by the IEEE -696 standard means 24 address lines (instead of 16) on the bus, for use with a processor that can directly address all 24 lines, like most 16-bit processors.

Phantoming is also a simple form of bank selecting in which a single S-100 bus line is dedicated to simultaneously switching off one board, or group of boards, and switching on another. This line, called PHANTOM* (pin 67), allows two slave devices to exist at the same address in memory. This sort of control is frequently used, for example, to allow a system boot ROM to temporarily exist at address zero to load CP/M into high memory, then switch out the ROM and replace it with RAM so that an entire 64K block of memory is available to the operating system. The idea of phantoming is fairly clearcut here, but more sophisticated phantoming schemes do exist (at least outside of the S-100 world). Several months ago, an associate of mine nearly went crazy implementing CP/M Plus in a non-S-100 system that actually uses *three* phantom lines in addition to bank selecting!

Figure 2 shows how the PHANTOM* line is used in a typical board select circuit to simultaneously enable one board and disable another. Asserting PHANTOM* (logic "0") in this case will cause the top board to be "replaced" by the bottom board until PHANTOM* is returned to its inactive (logic "1") state.

Reader questions

Over the past several months, I've received a number of letters from readers interested in adding termination boards to their S-100 bus machines so that they can run the newer 6 MHz and 8 MHz CPU boards. I've also received a number of letters from users who report erratic operation in their machines, depending on the position of certain boards in their machines (say, running the disk controller board in slot 10 instead of slot 2, etc.)

Many S-100 machines have an extra parallel port that can be hooked up to the memory board enable lines.

Most of these problems mysteriously seem to occur when using an older frame, like an IMSAI or an Altair, and many users tend to blame the memory or disk drives for the intermittant failures that plague them in situations like these.

SOFTWARE DESCRIPTIONS

TPM (TPM I) - $80 A Z80 only operating system which is capable of running CP/M programs. Includes many features not found in CP/M such as independent disk directory partitioning for up to 255 user partitions, space, time and version commands, date and time, create FCB, chain program, direct disk I/O, abbreviated commands and more! Available for North Star (either single or double density), TRS—80 Model I (offset 4200H) or II, Versafloppy I, or Tarbell I.

TPM-II - $125 An expanded version of TPM which is fully CP/M 2.2 compatible but still retains the extra features our customers have come to depend on. This version is super FAST. Extended density capability allows over 600K per side on an 8" disk. Available preconfigured for Versafloppy II (8" or 5"), Epson QX-10, Osborne II or TRS-80 Model II.

CONFIGURATOR I

This package provides all the necessary programs for customizing TPM for a floppy controller which we do not support. We suggest ordering this on single density (8SD).
Includes: TPM-II ($125). Sample PIOS (BIOS) SOURCE ($FREE). MACRO II ($100). LINKER ($80). DEBUG I ($80). QED ($150). ZEDIT ($50). TOP I ($80). BASIC I ($50) and BASIC II ($100)
$815 Value **NOW $250**

CONFIGURATOR II

Includes: TPM-II ($125). Sample PIOS (BIOS) SOURCE ($FREE). MACRO II ($100). MACRO III ($150). LINKER ($80). DEBUG I ($80). DEBUG II ($100). QSAL ($200). QED ($150). ZTEL ($80). TOP II ($100). BUSINESS BASIC ($200) and MODEM SOURCE ($40) and DISASSEMBLER ($80)
$1485 Value **NOW $400**

MODEL I PROGRAMMER

This package is only for the TRS-80 Model I. Note: These are the ONLY CDL programs available for the Model I. It includes: TPM I ($80). BUSINESS BASIC ($200), MACRO I ($80). DEBUG I ($80). ZDDT ($40). ZTEL ($80). TOP I ($80) and MODEM ($40)
$680 Value **NOW $175**

MODEL II PROGRAMMER

This package is only for the TRS-80 Model II. It includes: TPM-II ($125). BUSINESS BASIC ($200). MACRO II ($100). MACRO III ($150). LINKER ($80). DEBUG I ($80). DEBUG II ($100). QED ($150). ZTEL ($80). TOP II ($100). ZDDT ($40). ZAPPLE SOURCE ($80). MODEM ($40). MODEM SOURCE ($40) and DISASSEMBLER ($80)
$1445 Value **NOW $375**

BASIC I - $50, a 12K+ basic interpreter with 7 digit precision.

BASIC II - $100. A 12 digit precision version of Basic I.

BUSINESS BASIC - $200. A full disk extended basic with random or sequential disk file handling and 12 digit precision (even for TRIG functions). Also includes PRIVACY command to protect source code, fixed and variable record lengths, simultaneous access to multiple disk files, global editing, and more!

ACCOUNTING PACKAGE - $300. Written in Business Basic. Includes General Ledger, Accounts Receivable/Payable, and Payroll. Set up for Hazeltine 1500 terminal. Minor modifications needed for other terminals. Provided in unprotected source form.

MACRO I - $80. A Z80/8080 assembler which uses CDL/TDL mnemonics. Handles MACROs and generates relocateable code. Includes 14 conditionals, 16 listing controls, 54 pseudo-ops, 11 arithmetic/logical ops, local and global symbols, linkable module generation, and more!

MACRO II - $100. An improved version of Macro I with expanded linking capabilities and more listing options. Also internal code has been greatly improved for faster more reliable operation.

MACRO III - $150. An enchanced version of Macro II. Internal buffers have been increased to achieve a significant improvement in speed of assembly. Additional features include line numbers, cross reference, compressed PRN files, form feeds, page parity, additional pseudo-ops, internal setting of time and date, and expanded assembly-time data entry.

DEVELOPER I

Includes: MACRO I ($80), DEBUG I ($80), ZEDIT ($50), TOP I ($80), BASIC I ($50) and BASIC II ($100)
$440 Value **NOW $150**

DEVELOPER II

Includes: MACRO II ($100), MACRO III ($150), LINKER ($80), DEBUG I ($80), DEBUG II ($100), BUSINESS BASIC ($200), QED ($150), TOP II ($100), ZDDT ($40), ZAPPLE SOURCE ($80), MODEM SOURCE ($40), ZTEL ($80), and DISASSEMBLER ($80).
$1280 Value **NOW $350**

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Includes: QSAL ($200), QED ($150), BUSINESS BASIC ($200), ZTEL ($80) and TOP II ($100)
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COMBO

Includes: DEVELOPER II ($1280), ACCOUNTING PACKAGE ($300), QSAL ($200) and 6502X ($150)
$1930 Value **NOW $500**

LINKER - $80. A linking loader for handling the linkable modules created by the above assemblers.

DEBUG I - $80. A tool for debugging Z80 or 8080 code. Disassembles to CDL/TDL mnemonics compatible with above assemblers. Traces code even through ROM. Commands include Calculate, Display, Examine, Fill, Goto, List, Mode, Open File, Put, Set Wait, Trace, and Search.

DEBUG II - $100. A superset of Debug I. Adds Instruction Interpreter, Radix change, Set Trap/Conditional display, Trace options, and Zap FCB.

6502X - $150. A 6502 cross assembler. Runs on the Z80 but assembles 6502 instructions into 6502 object code! Similar features as our Macro assemblers.

QSAL - $200. A SUPER FAST Z80 assembler. Up to 10 times faster than conventional assemblers. Directly generates code into memory in one pass but also to offset for execution in its own memory space. Pascal like structures: repeat...until, if...then...else, while...do, begin...end, case...of. Multiple statements per line, special register handling expressions, long symbol names, auto and modular assembly, and more! This one uses ZILOG Mnemonics.

QED - $150. A screen editor which is both FAST and easy to learn. Commands include block delete, copy, and move to a named file or within text, repeat previous command, change, locate, find at start of line, and numerous cursor and window movement functions. Works with any CRT having clear screen, addressable cursor, clear to end of line, clear to end of screen, and 80X24.

ZTEL - $80. An extensive text editing language and editor modelled after DEC's TECO.

ZEDIT - $50. A mini text editor. Character/line oriented. Works well with hardcopy terminals and is easy to use. Includes macro command capability.

TOP I - $80. A Text Output Processor for formatting manuals, documents, etc. Interprets commands which are entered into the text by an editor. Commands include justify, page number, heading, subheading, centering, and more.

TOP II - $100. A superset of TOP I. Adds: embedded control characters in the file, page at a time printing, selected portion printing, include/merge files, form feed/CRLF option for paging, instant start up, and final page ejection.

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S-100 BUS

Continued from page 18

Frequently, the solution to both problems is to terminate the S-100 backplane properly. Basically, what happens is this: when a signal is placed on a line in the S-100 bus, it travels down the entire length of its S-100 line, regardless of what is attached to that line. When the signal reaches the end of an *unterminated* bus line, it literally has no place else to go, and it is reflected back into the line like a rubber ball bouncing off of a wall. These reflections obviously occur more frequently as the frequency of the signal on the line increases, and, because they can effectively add together to become of greater amplitude, they can cause false signals to appear on the bus. These reflections are often called "ringing" and "standing waves" and can cause a great deal of frustration to any users whose systems they inhabit.

The solution to the problem of the unterminated line is to terminate it. Figure 3 shows two theoretical circuits that can be used to terminate S-100 bus lines

Ringing and standing waves cause a great deal of frustration to users whose systems they inhabit.

by dissipating the unused signals before they can reflect back into their lines.

As suggested in the IEEE-696 standard (Section 3.7.1), these two circuits provide a constant 2.6 volts into a resistive termination of not less than 180 ohms. The standard says that all S-100 bus lines, except power and ground lines, may be terminated by these circuits. The bottom circuit may be used with open collector lines that require a pull-up resistor, like PHANTOM* and INT*. The pull-up resistance should be 1.5 kilohms.

If your motherboard doesn't already have built-in bus line termina-

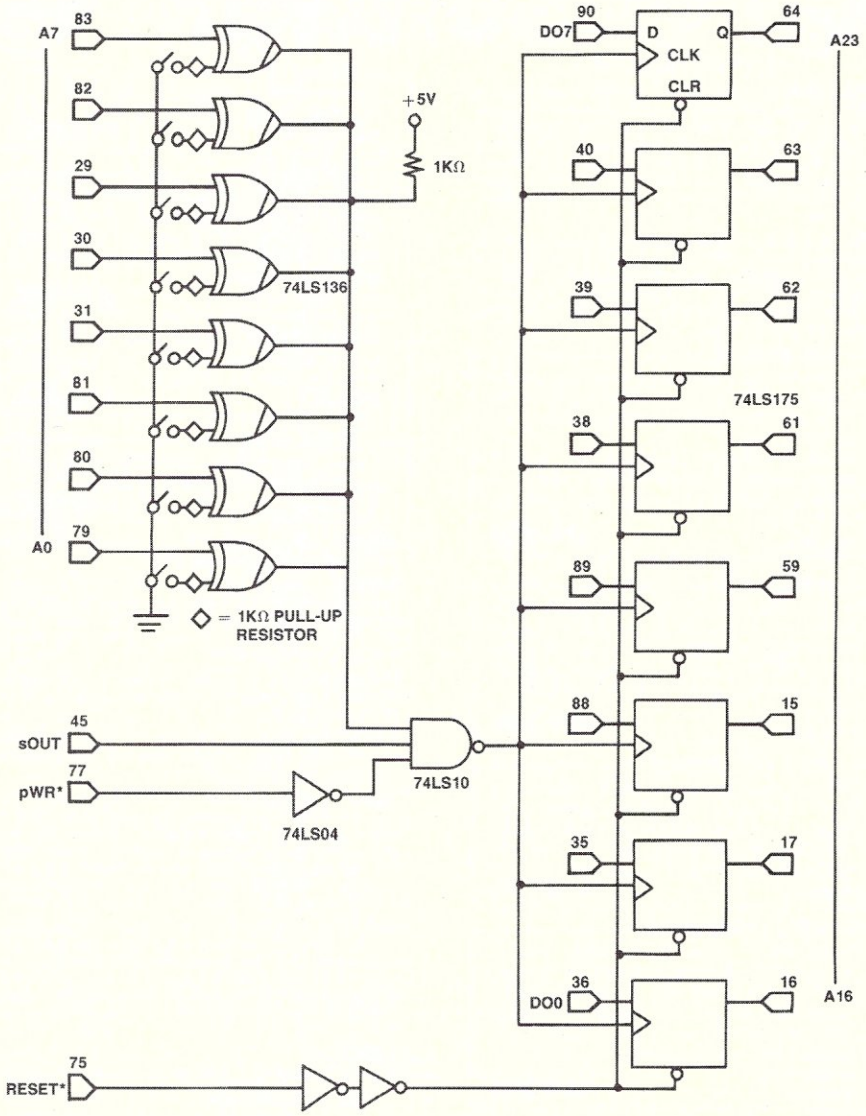

Figure 1. A simple bank switching system with reset control

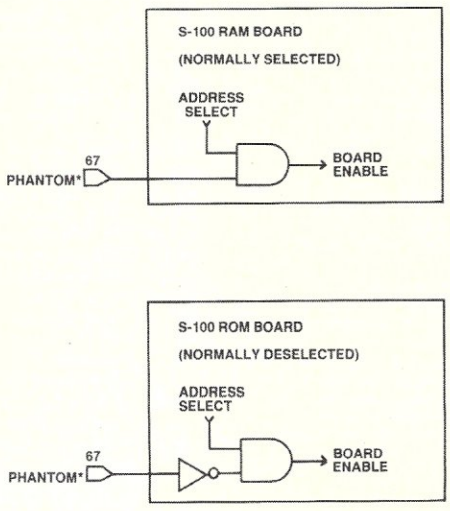

Figure 2. A typical phantom select circuit

tions, you should consider adding them. You could build your own board, but it would probably be easier (and more effective) to add a plug-in S-100-style termination board to your system. It only takes up one slot and is usually well worth the extra cost. CompuPro makes a plug-in active termination board, for example, that costs only $60.

In addition, it is also possible to replace an entire 20-slot motherboard in an old machine with a new, properly designed and terminated one for about $300. (That $300 only seems like a lot of money until the first time you lose a week's work from a system crash caused by a "ringing" glitch or a floating interrupt line.) Another advantage of having the new motherboard is that it is properly shielded to eliminate crosstalk between the bus lines, which even proper bus-line termination can't eliminate.

Incidentally, something to watch out for (especially in newer mainframes) when using many single-board S-100 computers is an improper termination voltage or resistance. One such problem existed in a local multiprocessor system that allowed only four processor boards to plug into a frame. When the fifth board was plugged in, the entire system either stopped working or worked very erratically. The problem was cleared up when a call to the frame manufacturer (who had seen the problem before) revealed that the single-board computer's manufacturer had used the wrong value pull-up resistors on the S-100 bus I/O lines. Rather than change all of the pull-up resistors, the user changed two regulators in the frame's terminator circuits, and now is running nine slave processors with no problems at all.

This column is intended as a forum on S-100 bus topics. Readers are encouraged to send in questions on the S-100 bus, which I will attempt to answer. Please write to: Dave Hardy, 736 Notre Dame, Grosse Pointe, MI 48203.

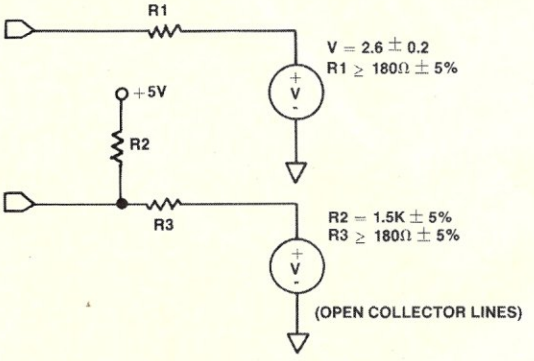

Figure 3. S-100 bus terminators

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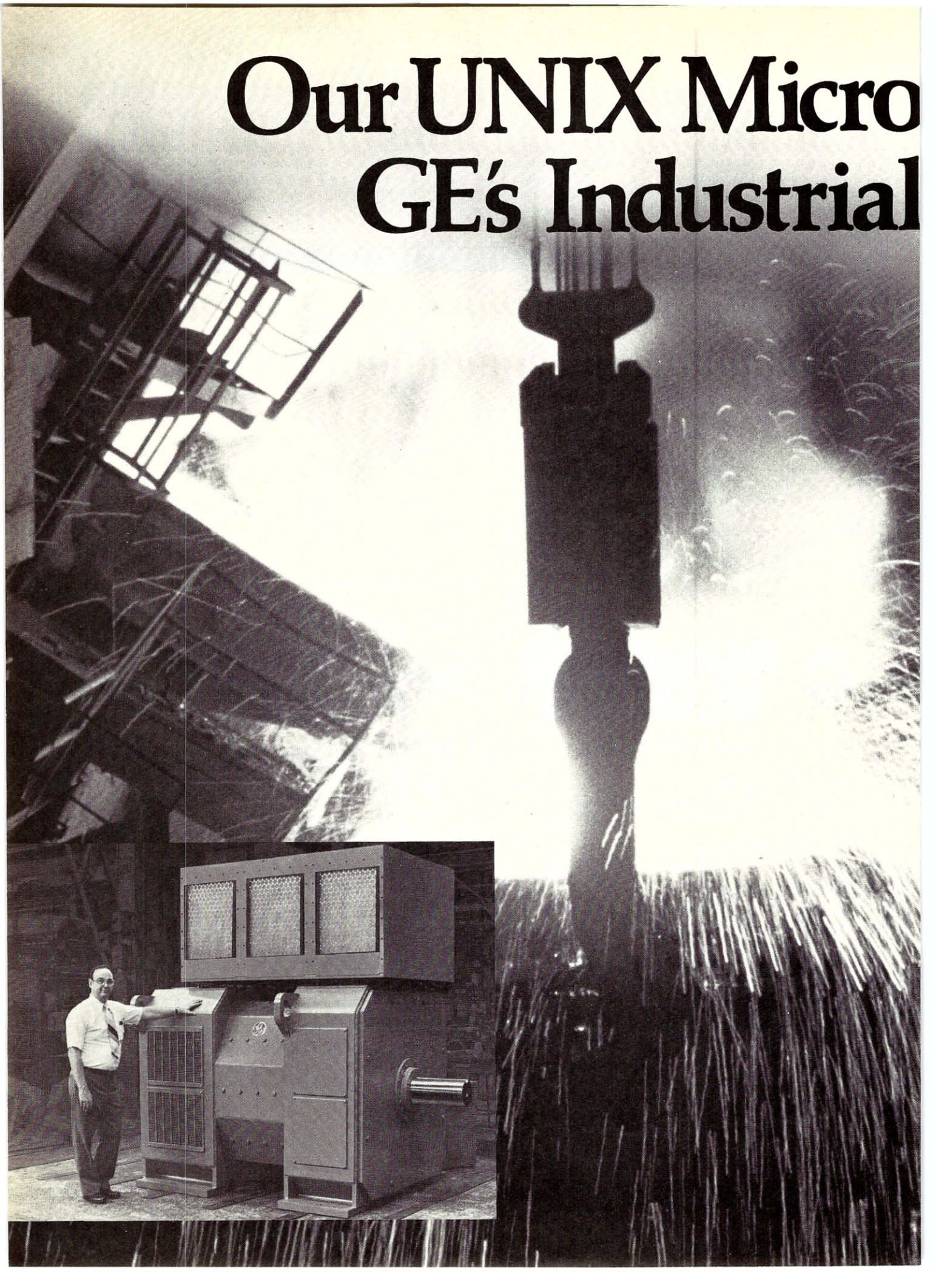

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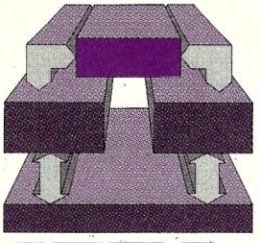

The UNIX File

Networking the UNIX way: how to access a network, and the services it provides

by Ian Darwin

First, a look at the UNIX Conference in January, 1984. Then, since there is a lot of information on UNIX applications software elsewhere in this issue, I thought I'd leave that topic and instead give some information about the wonderful computer network that has been accessible primarily to UNIX people. There's also a brief look at a few other topics related to UNIX.

UniForum, January 1984

Imagine 50 or so people wearing sneakers and jeans meeting in a university campus and going out to McDonalds for lunch. Then imagine two or three thousand people milling about the luxurious Continental Ballroom of the Washington Hilton and Towers, snacking on hors-d'oeuvres and downing thick slabs of prime beef, all courtesy of AT&T. That's a measure of how the UNIX conferences have changed in about eight years, during which time UNIX has been growing in recognition, in reputation—and in marketability.

Many of the 8,000 or so people who came to UniForum in Washington, D.C. during the January snow came to learn how to make money from UNIX and to learn about the system. But the techies were still there; three-piece-suits and formal dresses coexisted for a time with sneakers and jeans. Clearly UNIX is a force to be reckoned with, and a commodity to be marketed.

IBM helped contribute to UNIX's "legitimacy" by announcing a full UNIX implementation for the IBM PC-XT. Called "PC-IX," this product is a full UNIX system ported by Interactive Systems Corp. of Santa Monica, CA. Priced somewhat higher than Mark Williams' Coherent for the PC, PC-IX does have the support of the huge mainframe vendor. AT&T Western Electric's announcement of the second release of System V, (which people are calling "5.2" or "s5r2," sounding like something out of *Star Wars*), was accompanied by the announcement of a cooperative agreement with Digital Research to make software movable between UNIX and CP/M, and another agreement between DRI and Motorola to market the former's MS-DOS compatible operating system on Motorola hardware, and the release of Motorola's "official" port of System V to the 68000. Also announced were a cross C compiler for 68000 and Basic language. And of course there is yet another glossy UNIX magazine—this one called "*UNIX World.*" The masthead of this startup has many names that are well-known in the UNIX community.

Another significant announcement was the formation of a consortium called "ISIS," an industry interchange standard for passing structured data between database managers, spreadsheets, word processors, and the like. The intent is that you can be in the middle of a spreadsheet, and open up a new window and pass one section of data into a word processor. Any two programs conforming to the ISIS standard will be able to interact in this manner, regardless of manufacturer. ISIS was spearheaded by Jim Hutton of **Access Technology,** *6 Pleasant Ave., S. Natick, MA 01760; (617) 655-9191.*

Lou Katz of the USENIX Association announced that the membership had voted in favor of a series of changes that bring its bylaws up to date and change the membership structure so that all members (except student members) are allowed to vote. Their next technical meeting is planned for Salt Lake City, June, 1984.

The most obvious aspect of this show was the increase in size and the prosperity already alluded to. A related trend is the increase in the amount of business software being made available—see the special UNIX Software Survey in this issue. The percentage of nontechnical people attending continues to rise, to the delight of the many companies selling training and books (and the apparent chagrin of a few of the technical people). Another significant trend is the increasing number of software distributors who do not manufacture software but market others' products to distinct or specialized markets. Some of these have already been mentioned in this column; others will be listed in future.

The talks at the UniForum conference were divided into two streams. Officially called the "/usr/group" and "USENIX" streams, after the two organizations which co-sponsored the UniForum conference, the two were for the most part "nontechnical" and "technical" streams respectively. The nontechnical talks ranged from the future of UNIX to its suitability in certain markets such as desktop PCs. The technical talks covered a range of topics from communications and networking to compilers and languages to hardware speedups for particular systems. Many of the talks were recorded and are available during the next year from **Visual Aids Electronics,** *2831 15th Street NW, Washington DC 20009.* Write for a list of tapes available from UniForum, January 1984. For hardcopy of the papers

UNIX File

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presented, you should order the proceedings from /usr/group.

Services on the net

Customers of Dialog, CompuServe and The Source know the value of access to a huge network of human minds (and hands) strung together with telecommunications equipment. People on the UNIX network USENET know it too. Here's a look at a few of the services available to UNIX network users.

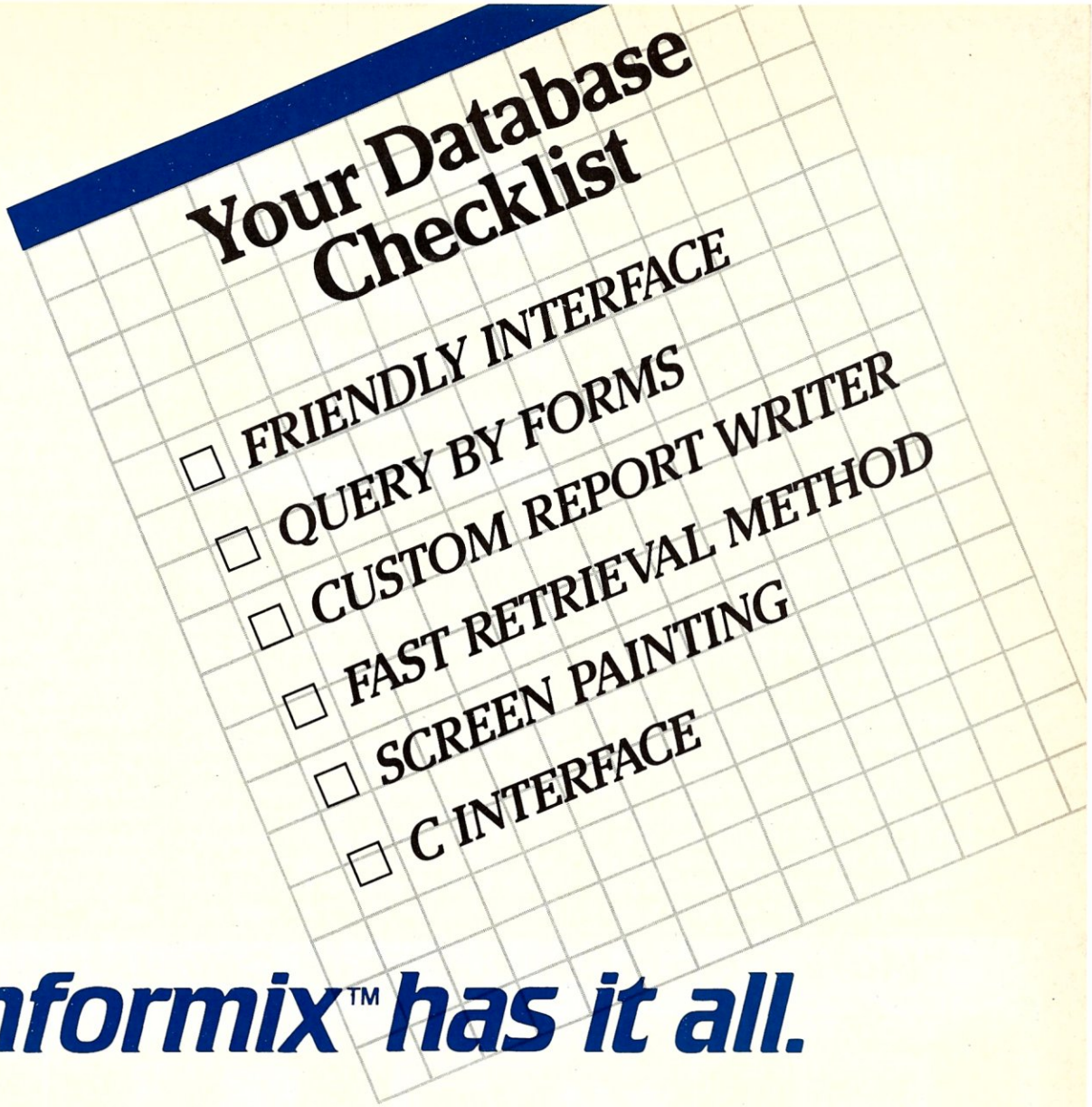
First, a bit of terminology. The standard communications protocol for UNIX computers is a program called **uucp**, the UNIX-to-UNIX Copy Program. One speaks of **uucp**-ing a file to another machine. One also speaks of "the **uucp** network," which is simply the sum of all the machines that connect together on a regular basis using **uucp**. Like the "modem" family of programs used in CP/M environments, the **uucp** family of programs talks between computers over serial lines, usually over the telephone network. **uucp** automatically dials another computer and logs in to exchange files, mail and news. **uucp** has had this capability since around 1978, when the papers describing Bell's original **uucp** were published. Unlike Modem, however, **uucp** is a spooling system. Thus, the system administrator can arrange that all the electronic mail going across the continent can be sent (without human intervention) after midnight, when long distance rates are cheaper (assuming that this still applies after deregulation).

Electronic mail is a term widely used with several different meanings. In the context of UNIX systems, the term refers to a facility for sending files of text from one person's account to another. The files usually contain short memo-like messages, but there is no arbitrary restriction on the content (except that you cannot mail "binary" files). The recipient (or recipients) and sender may be on the same computer or on different machines. The advantages of electronic mail, such as avoidance of "telephone tag" for people on different shifts or different time zones, are reasonably well known.

News is a more public system; the UNIX "network news" is a bulletin board facility on a grand scale. The UNIX-based mail and news facilities are layered on top of the **uucp** protocol, and some versions of mail can use other protocols. The term "USENET" refers to the subset of the **uucp** network which also gets the network news.

The USENET news is divided into almost two hundred "newsgroups," which are sent all over the free world, as well as many local groups which are only sent around within one organization or one geographical area. On any given day, if you read *all* the network news, you might expect to see a discussion on theology vs. rationality, facts about the next space shuttle launch, discussions about nuclear war, reviews of current movies and records, a large volume of technical queries and discussions on UNIX, CP/M and other computer systems, a used car ad, two job postings, notices about local seminars in computer science, announcement of a new site on the USENET network, and a dozen other topics, with complaints that three or four of these topics had been discussed in great detail on USENET six months previously.

To exploit the USENET news, you must have both a source of news, and the **uucp** and news software running on your UNIX system. A news feed is simply another computer system which is already on the net, and is willing to allow you to connect to them to get news. They may ask you to pay a portion of the long distance bills, but the service is otherwise free. Try your local Universi-



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UNIX File

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ty computer center's UNIX group. **uucp** should have been included with your computer (if not, you really didn't get a full UNIX system). The News software can be had from the place where you get your news feed. Once you have compiled and installed the news software, and read the "netiquette" documents included, you are ready to go "on the air" by posting a "new site announcement" to a newsgroup set up for this purpose. The "netiquette" or net etiquette is a set of rules for the social interactions on which the network is based. **Read and follow,** or your news feed may be cut off, since people on the net will generate large amounts of hate mail in your news feed's in-basket if you ignore the rules.

Most of the commercial service suppliers will require that you telephone them directly, rather than sending mail through other sites, in fairness to these other sites. You would arrange a "direct **uucp** connection" between your system and the vendor in question. Use of USENET for initial contact is generally regarded as fair play, but sending material through other sites to a site where it will be commercially processed is frowned upon.

Another service available on the network is typesetting.

In order to use the net effectively, you need a map of the network, or at least a general knowledge of its layout. The **uucp** network presently requires you to specify all the names of the computers through which your mail will pass. This is rather primitive, but works reasonably well, and there are several programs which provide some automation of addressing. A proposal to use "domain addressing" similar to that of the ARPAnet (or the phone companies' area codes) is being considered, and will likely be implemented. For now you should find out from your **uucp** feed what the path is to at least one well-known site such as decvax, ucbvax, or ihnp4. These are dedicated machines provided by Digital Equipment's UNIX Engineering Group in New Hampshire, The University of California at Berkeley, and one of the AT&T companies at Indian Hill, near Chicago. These major sites forward mail and news to a large number of other sites.

One of the more interesting services currently offered through the **uucp** network is Electronic Computer-Originated Mail (E-COM). You can compose mail at your terminal, and have it sent by the U.S. Post Office "E-COM" service in hardcopy form to any point in the U.S.A. or internationally. This service is offered by a company called Netword, Inc.; the contact person is **{ucbvax, decvax}!ihnp4!netword!dan,** *Box 444, College Park, MD 20737-1331, (800) 222-ECOM.* Unlike some other E-COM services, Netword's requires no special software on your UNIX site. Any standard text editor and a simple shell file, as well as **uucp** mail and a dial-out modem are all you need. Netword claims to have sent the "historic first E-COM in January of 1982, beating Western Union, the only other user on opening day."

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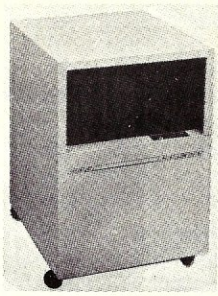

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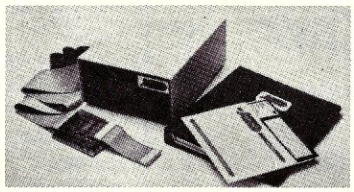

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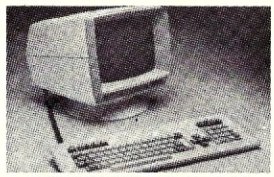

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UNIX File

Continued from page 28

Another service you can get through the network is typesetting. A number of suppliers will typeset manuscripts from material received by direct **uucp**. These include **Textware (decvax!genrad!wjh12!textware!brent,** *(617) UNI-TEXT,* **Technical Type and Composition** *(503) 371-8655, as well as* **UNICOMP** *(505) 662-3348,* **House of Equations** *(201) 579-1869,* and **The Image Network** *(408) 746-3754.* Some of these firms also sell software which you can run locally for typesetting or typeset simulation.

One of the major uses of the net is open discussion. If you have an idea, you can post it to the net, and get comments. With the large number of readers, there are likely to be some who think your idea is hare-brained, no matter how sound, and vice versa. Don't take it personally. Just regard it as the opportunity to get feedback from a large audience of computerists. You can also get more direct feedback from the experts by sending mail. There are people on the net who are known experts on certain topics, and you can send them mail to ask them questions. I send out parts of this column for comments before it goes to the publisher, and some very good people out there offer useful comments that make the final column much more readable to you. You can send mail to me, at **decvax!utcsstat!darwin!ian,** with comments on the column, suggestions for improvements or articles you'd like to see in the magazine, etc.

One service not found on USENET at present, but being considered by several suppliers, is the "name server" familiar to users of the Military/Research ARPAnet. A name server is like an online telephone directory, which will tell you a person's address, given her name, or vice versa.

There are other services out there; I've tried so far to give a glimpse of the kinds of things the net is used for. More on the net later; but now a technical tip for the small-system owner trying to make **uucp** work.

So you thought you had uucp...?

This section is addressed to those of you with small UNIX systems that include **uucp** but don't come with instructions on making **uucp** talk to your inexpensive autodial modem. **uucp** is the standard UNIX intersystem mail and file transfer program. Most versions of UNIX and UNIX-like systems support **uucp.** But historically **uucp** was written to control a PDP-11/VAX-11 "autodialer" (called a "DN-11") to connect to another UNIX system when it needed to talk to that system for mail or file transfers, or to see if the other system had any traffic for it. A **uucp** system can be either master or slave (or both at different times). The system which calls another is the master; the called system is the slave. But the DN-11 autodialer is only found on VAX/PDP-11 computers. Many readers of this column have small microcomputer-based UNIX systems, which have ASCII "autodial" modems (such as Hayes' "Smartmodem", U.S. Robotics, Novation, or similar boxes) connected over serial ports. And unfortunately, many vendors distribute a version of **uucp** configured for the DN-11! Several new versions of **uucp** know about many of these dialers, but these are not yet in widespread use on micro UNIX systems. If your version *is* configured for an ASCII modem, you won't need this hint. If not, however, this could be enough to get you going.

The trick is to use the "expect-send" sequences in the L.sys file (If you don't recall that L.sys is the file with system and connection information, you might reread the Bell documents, in

particular, *uucp Implementation*, by D.A. Nowitz). Normally **uucp** uses the L.sys expect-send sequences to hold a login dialog with the remote computer, but they can also be used to hold an initialization dialog with your local modem.

Normally UNIX uses the "newline" (line feed) character to separate lines of text. If you have to use actual <CR> characters in your send sequences (as with a PACX front-end switch), put question marks in the file, then

```
tr \? \015 <L.sys >J.sys
cp J.sys L.sys
```

to get actual <CR> characters into the file. This is not necessary if your **uucp** has been modified to know about \r and similar sequences; at present most small-system versions have not. For example, here is the **vis(1)** printout of an L.sys entry (The **vis** program is from the Kernighan and Pike book reviewed in February; it's a useful way of seeing control characters in a file).

```
utcsstat Any tty01 1200 tty01 ""
  \r class 70\r tart \r
      login: u_darwin password:
             XXXXXXXX
```

(Of course the XXXXXXXX would be replaced by the real password.) Note that the "\r" strings are single characters, entered as described above. On a modified **uucp** they could be entered as the two characters '\' and 'r'.

UNIX software catalogs

Seems everybody these days is scrambling to grind out a catalog of UNIX-based computer software. This issue contains our listing (page ???). I mentioned previously the listing included with Urban's "Leverage" mail list package. Urban is now distributing the updated listing as a separate document. Here are three more listings, one for public-domain software and two for commercial products.

I haven't yet seen the catalog of public domain software, the Winter 1983 Software Tools Catalogue. The following information is taken from a brochure produced, like the catalog itself, by Richard Kiessig of Intelligent Decisions in cooperation with the Software Tools Users Group. This 38-page listing contains sections on translators, Ratfor (Rationalised Fortran), macro proprocessors, new tools, shells, text formatters, translations, and more.

The tools are based upon a set of programs written in Ratfor and later in Pascal, and published by Kernighan and Plauger in their book *Software Tools*. The tools provide UNIX-like functionality on a variety of machines (at least 35 different computer systems). Send $11, plus $1.75 handling ($4.00 overseas, $0.72 sales tax in California) to **Catalogue Order,** *Intelligent Decisions, Box 50174, Palo Alto, CA 94303.*

The UNIX products catalog is distributed by **/usr/group,** *Box 8570, Stanford CA 94305-0221.* This is one of the biggest and best of the UNIX catalogues. It lists applications, programming tools and compilers, UNIX ports and UNIX-alike systems, user groups, magazines, training, consultants, and just about everything else in the UNIXverse. If you've had to ask "is there a UNIX product to do this?" more than once, then you should consider getting a copy of the */usr/group UNIX Catalogue.* The catalog is free to full members, and $50 to others.

Digital Equipment is one of the largest suppliers of hardware for UNIX; and many of their VAX-11 computers are sold to run UNIX rather than DEC's own VAX/VMS operating system. So it's not surprising that DEC is active in UNIX; what is surprising is that it took them so long to admit it.

UNIX File

Continued from page 31

Now they have come out with their *UNIX Software Guidebook,* order code EJ-25541-20. Write to G. Deforge, **Digital Equipment Corp., Printing & Circulation Services,** *444 Whitney Street, Northboro, MA 01532.* Or contact your local DEC office for a copy.

Watch for my further comments on "shell programming" in the next issue, and some other interesting tidbits. Also, look elsewhere in the April issue for information on applications software for UNIX.

The UNIX File looks at many aspects of the UNIX operating system. If you have comments or questions about UNIX or this column, feel free to write to me, at the University of Toronto Computing Services (UTCS), 255 Huron Street, Toronto, Ontario, Canada M5S 1A1. If you have UNIX mail access to the uucp network, you can contact me at ***"decvax!utcsstat!darwin!ian"****. The opinions presented here are my own, and not necessarily those of the University of Toronto or of UTCS.*

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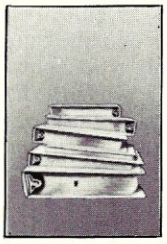

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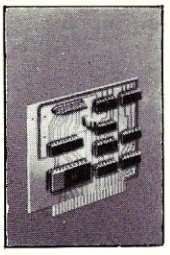

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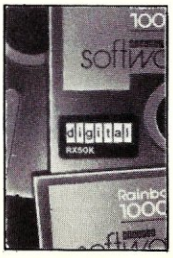

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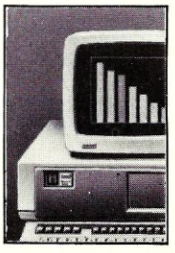

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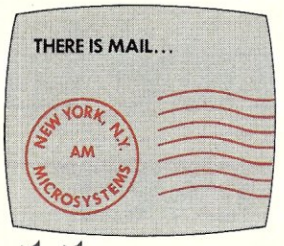

Letters to the Editor

This month... more about error handling in Nevada Fortran, plus corrections from our readers

Dear Mr. Terry,

I'd like to add a few details to my comments on the error handling in Nevada Fortran ("Letters," March '84, p. 44). The error handling is much better than I realized.

(1) One must add the statement $OPTIONS X as the first line in the Fortran program in order that runtime errors will give the offending line number. If a runtime error occurs, the statement "Pgm was executing line 0003 in routine MAIN", and the type of runtime error is noted, e.g., SQRT NEG. See the example in Listing 1.

(2) If a compile time or runtime error occurs, it is easy to pin down exactly which line caused the problem by simply typing out the filename .LST as shown in the listing below for a runtime error. For a compile-time error, a diagnostic is also printed out by the compiler, such as ERROR ** Syntax error, 2 operators in a row.

I wish all languages had error handling this explicit.

David L. DuPuy
Assoc. Prof., Physics
Virginia Military Institute
Lexington, Virginia 24450

Dear Mr. Terry,

We submitted material for the CP/M Software Directory in your December issue. Unfortunately an error seems to have occurred.

Upon examining the Directory, we found we were assigned reader service #684. Our product, VME-Forth, should have had the same reader service number but instead had #147, the number for Dantex Software. Perhaps there was also some confusion between our name, **Datentec**, and **Dantex**. Please inform your readers of this error by publishing this letter.

VME-FORTH is a 16-bit Forth for the MC68000 that includes a full-screen editor and an assembly language floating-point package. VME-FORTH runs stand-alone or under CP/M 68K and executes the *BYTE* sieve benchmark in 1.7 seconds on an 8 MHz CPU. It is available on various disk formats, and sources are included.

Christoph Kukulies
Datentec
Heider Hof Weg 15
Aachen, 5100, West Germany

Erratum

Our thanks to Peter McCarthy, who spotted an error in the Basic program at the bottom of page 71 of our Feb, '84 issue. Line 100 should read:

```
100 IF SPOT%>1 THEN F$(IL%)=
      LEFT$(F$(IL%),SPOT%-1)
```

The "greater than" sign in the first line was printed as a right paren ")" and the right paren at the end of the second line was omitted. We apologise for any inconvenience caused.

```
A>type t.for
$options x,q                          Program with error
        z=-5
        y=sqrt(z)
        type ´y = ´,y
        end


A>frun t

Runtime error: SQRT NEG, called from 1820H      Runtime

Pgm was executing line 0003 in routine MAIN     Remarks

A>type t.lst
*****NEVADA Fortran 3.0 (Mod 0) ** Compiling File: T.FOR *****

0001 $options x,q
0002          z=-5                        In list file,
0003          y=sqrt(z)                   number (0003) indicates
0004          type ´y = ´,y               line where problem occurred
0005          end
**Generated Code =   138 (Decimal) 008A (Hex) Bytes


        No Compile errors

                                          list file also shows
                                          location of statement
                                          with SYNTAX or other errors.
```

Listing 1

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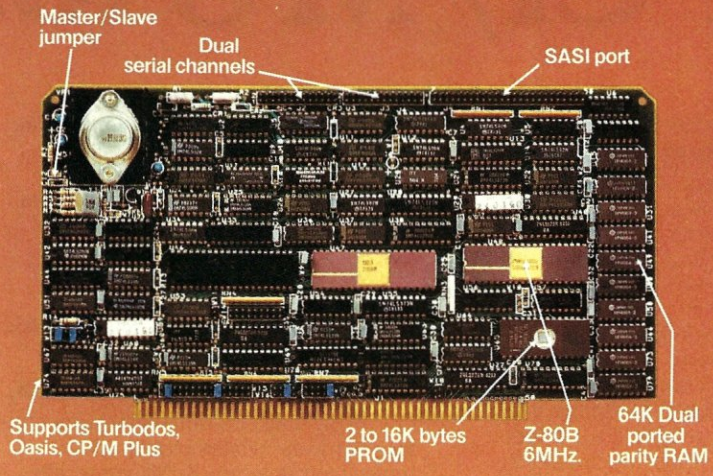

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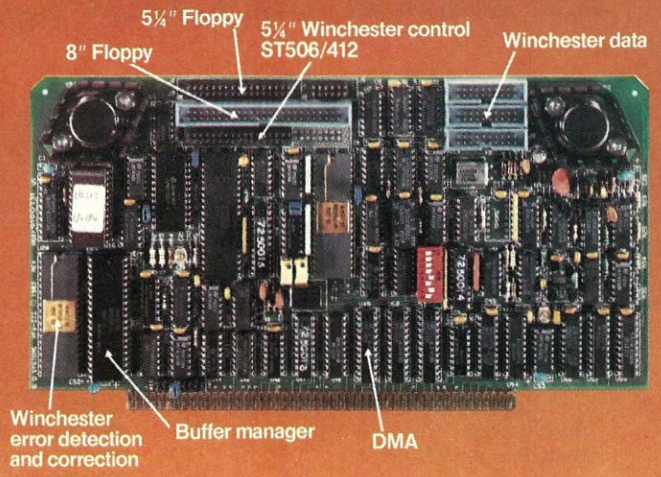
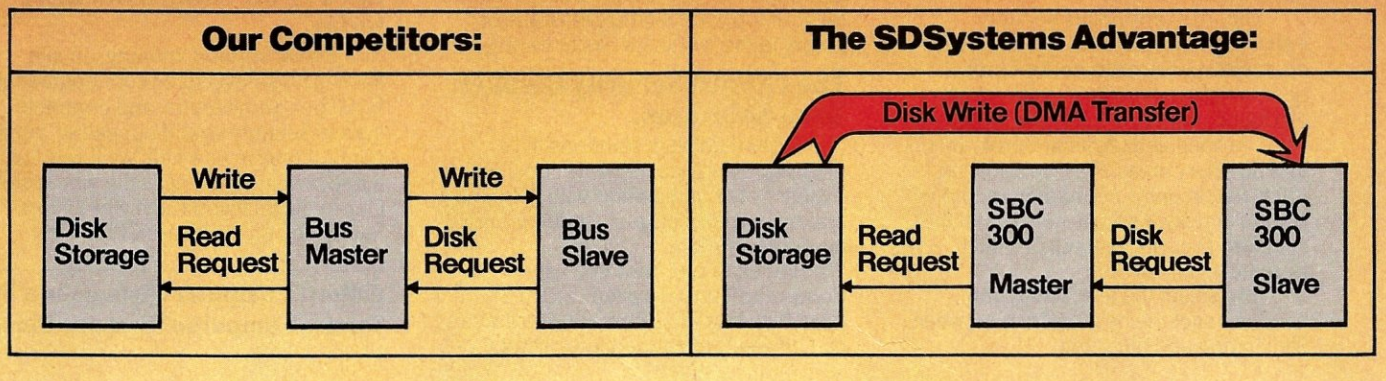


AND HERE'S WHY!



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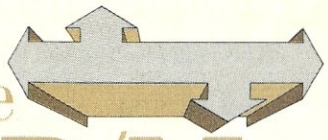

The CP/M Bus

A new Forth implementation has upgraded FIG-Forth to use BDOS and CP/M files

by Randy Reitz

Disk Parameters in CP/M Plus

While browsing through the SIG/M software library, I came across Forth-83 in volume 154. My interest in Forth doesn't allow me to pass up an opportunity to examine a new Forth implementation. So I loaded up Volume 154 and was pleasantly surprised to find a FIG-Forth-like implementation that has been updated to the Forth 83-Standard. I had read about the Forth 83-Standard; but this is the first implementation I have seen.

Further investigation revealed an 8080 assembler, a string implementation, a screen editor, file I/O for screens, and a Meta-compiler. All are in the public domain for the modest price of a SIG/M disk volume.

Of the many new features in this implementation, the storage of screens in CP/M files was the most interesting (the Meta-compiler will be a challenge for another day). Both the original CP/M version of FIG-Forth and the MPV-Forth (the 79-Standard) that I currently use do not use CP/M files for storage of screens. The FIG-Forth model is a language and an operating system of sorts. It allocates disk space according to its algorithm. FIG-Forth uses the CP/M BIOS only to access the disk; the BDOS is bypassed.

FIG-Forth's and MVP-Forth's disregard of the CP/M BDOS has always been a source of consternation to me. If a FIG-Forth disk (with its empty directory) happens to be left in a drive, the valuable data thereon is likely to get stepped on by the BDOS. Similarly, if a CP/M disk is written by FIG-Forth, some CP/M files will most likely be clobbered. So the use of the BDOS and CP/M files in this Forth-83 Model was most welcome.

A look at the Forth code revealed that CP/M random access is used to model a selected CP/M file as a sequential collection of Forth screens. The source code for Forth-83 is supplied in several files and, after entering Forth-83, these files can be examined. They can also be examined with the usual CP/M tools, but they do not contain the mandatory carriage-return line-feed pairs, so unexpected results abound.

I decided that the use of CP/M files in Forth-83 was reason enough to convert to the 83-Standard. So how do you get all those FIG-Forth diskettes into CP/M files? One possible answer to this question seemed to be in the file DIRECT.BLK that is part of SIG/M volume 154. Looking at this file, I found Forth words for accessing a disk in the old fashioned way—*sans* BDOS.

By this time I thought Forth-83 had everything. But wait! I have been using CP/M Plus for these past months. Looking more closely, I found direct BIOS calls. Oh boy! CP/M Plus does not support direct BIOS calls for anything other than console I/O and list functions.

CP/M Plus provides a BDOS function 50 for direct BIOS calls. The reason such a function is needed is obvious, considering the banked memory management CP/M Plus uses. The bulk of the BIOS code resides in bank 0 (called the system bank) and the TPA is always in bank 1. If you simply jump to the BIOS jump table that can be found in the usual way, you will end up back in the middle of the TPA! The BDOS function 50 is required to switch banks, make the BIOS call and then switch banks again.

By now I was making notes on the modifications required to the words in DIRECT.BLK in order to use the function 50 call. The function 50 call needs the contents of the 8080 registers that are desired on entry to the selected BIOS function. The registers are stored

```
BIOSPB:   db   FUNC      ; BIOS function number desired
          db   AREG      ; A register contents
          dw   BCREG     ; BC register contents
          dw   DEREG     ; DE register contents
          dw   HLREG     ; HL register contents
```

Listing 1

```
CREATE BIOSPB  8 ALLOT   \ space for the data structure
CODE DBIOS  ( parm func# -- 16-bit-return )
     BIOSPB H LXI D POP E M MOV
     H INX  H INX D POP E M MOV H INX D M MOV
     B PUSH BIOSPB D LXI 50 C MVI 5 CALL B POP HPUSH JMP C;
```

Listing 2

CP/M BUS

Continued from page 37

in a data structure called the BIOS Parameter Block (BIOSPB). The CP/M Plus programmer's guide defines this structure as shown in Listing 1.

The call to the BDOS requires that the address of this structure be in the DE register pair, and the value 50 be in the C register. The CP/M Plus programmer's guide says that function 50 returns with the machine registers as they are set by the selected BIOS function. This is not the case, at least with BIOS function 9 (select disk) as I will describe below.

All of the CP/M Forths I have used have a BDOS interface word, usually named **BDOS.** *(Author's note: Boldface is used to reference a Forth word in the text, to distinguish it from other acronyms.)* Typically, this word expects two arguments, the BDOS function number on the top of the stack and the BDOS parameter (i.e., the DE register pair) just below the function number. The Forth **BDOS** word could be used to call function 50; the problem is with the return value. The typical Forth BDOS word expects an 8-bit return in the A register. The 16-bit return value in the HL register is needed to get the addresses of an important data structure, so a new word—**DBIOS**—is needed that will make a function 50 call and return the 16-bit value in the HL register. Its definition shown in Listing 2.

This really isn't so bad. It's only five lines of Forth. The first line creates the name **BIOSPB** in the directory and then skips 8 bytes. This is a simple way to allocate space for the data structure required for the function 50 call. The second line starts the definition of the **DBIOS** word. The defining word **CODE** is used, since **DBIOS** will be an assembly language word (technically known as a primitive word). The usual FIG-Forth stack comment is used. It means that two 16-bit arguments are expected. On the top of the stack is the BIOS function number desired followed by the desired value of the BC register pair when the BIOS call is made. (The BIOS usually expects its parameters in BC, the BDOS in DE.) The third line above starts loading the **BIOSPB.** First the address of **BIOSPB** is put in HL (just read it backwards and you get LXI H, BIOSPB). The function number is POPed off the stack and put into **BIOSPB.** The fourth line completes the **BIOSPB** stuffing by moving HL to point to the BC register location, POPing the value off the stack and stuffing it into **BIOSPB.** Finally, the last line makes the BDOS function 50 call and puts the HL register return value on the Forth stack.

Now, I was about to simply replace all of the **BDOS** words with **DBIOS.** But I noticed one more clever item in the Forth-83 code. Since both FIG-Forth and MVP-Forth were too arrogant to use BDOS function calls, they also didn't want to use any of the BDOS parameter tables. The CP/M 2.x and CP/M Plus BDOS defines disk drive parameters in two tables. The disk parameter header (DPH) table is unique for each drive and contains pointers to two other tables—the sector translate table (XLT) and the disk parameter block table (DPB). These two tables are used to describe the disk currently loaded into the drive of the DPH and can be used in more than one DPH. MVP-Forth has these parameters specified internally, so that the user "configured" MVP-Forth matches the number of drives and densities supported. MVP-Forth is not smart enough to handle density changes if you change disks in a drive; it needs to be reconfigured whenever a density change occurs. FIG-Forth is even dumber—it just assumes everything is single density! (FIG-Forth can be "configured", but at the assembly language level).

Forth-83 continues to do it right by using the BDOS data structures to decide what the specifics are of the disk

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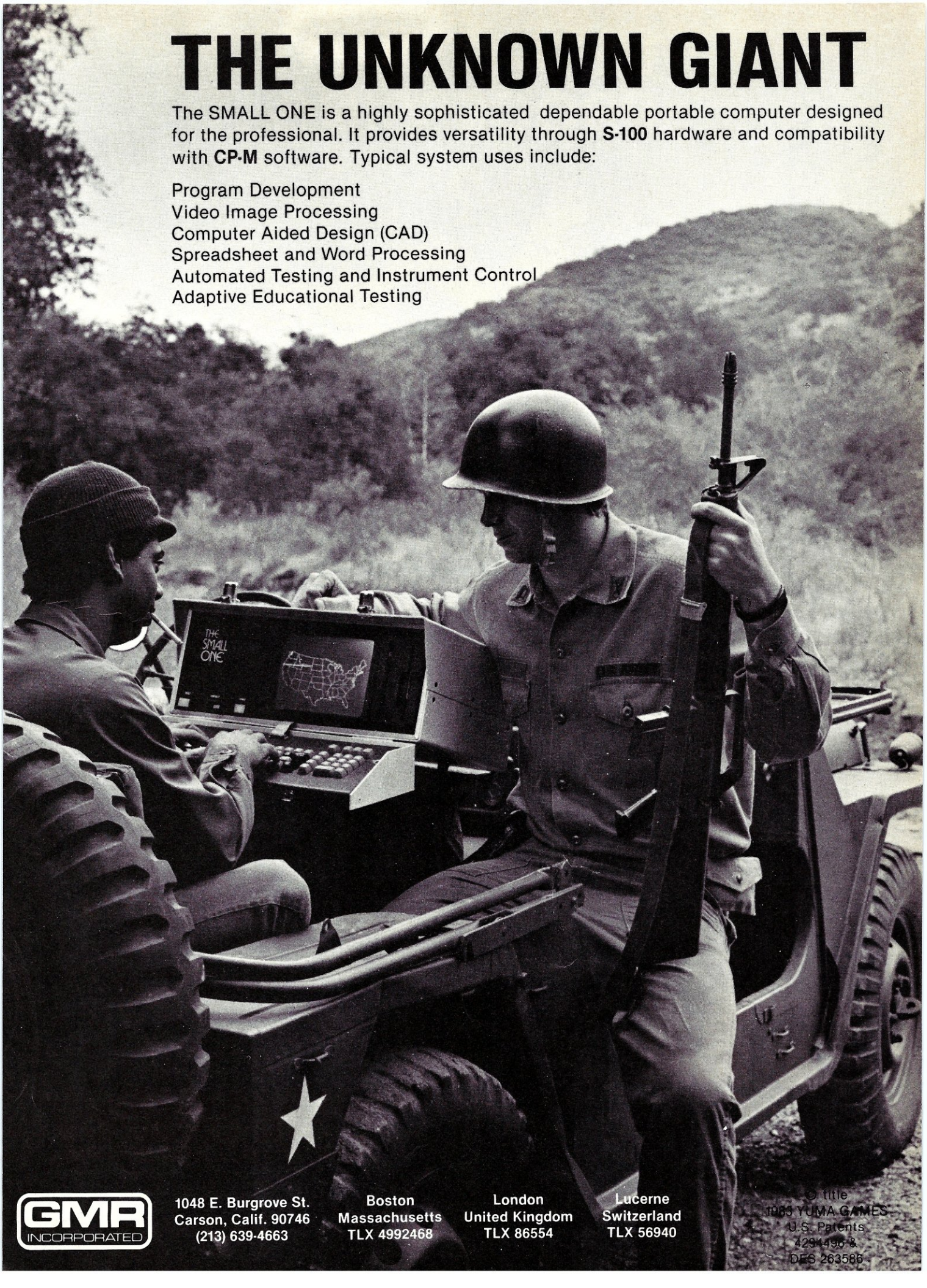

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CP/M BUS

Continued from page 38

currently logged in. I was really impressed. But wait, another CP/M Plus gotcha. The only CP/M Plus data structure required to be resident in common memory is the disk parameter block (DPB). Both the translate table (XLT) and the disk parameter header (DPH) can be loaded into the "banked" BIOS that resides in bank 0. What is a direct BIOS call requesting BIOS function 9 (select disk) going to return? It should return the address of the selected drive's DPH. But this address is in bank 0, and the TPA is always in bank 1. Oh boy! A quick look at the several thousand pages of CP/M Plus documentation leaves this a mystery. If you get a bank 0 address from a BDOS function 50 call to select a disk, how can an application running in bank 1 use it?

Forth's being an interpretative language makes it easy to check this out. Using the **DBIOS** word above, I tried:

```
0 BIOSPB 4 + !     1 9 DBIOS U.
```

The first part of this line simply stuffs a zero in the DE register part of the **BIOSPB** data structure. Then a 1 and 9 are pushed onto the stack and **DBIOS** called. **DBIOS** will prepare the **BIOSPB** with a request for BIOS function 9 (select disk) and a BIOS parameter of 1 (the value for the B: disk). The return value of BIOS function 9 (the DPH address) is then printed as an unsigned integer by the **U.** word. Much to my pleasant surprise, an address in common memory appears! I know this isn't the address of the DPH that I compiled into the banked BIOS. I used the Forth-83 built-in **DUMP** word (another convenience) and found a copy of the DPH! Apparently, the BDOS appreciates that some important information will be in banked memory and has made provision for copying this information to a temporary scratch area. I found that this is only a temporary copy, and this scratch area is reused when the

FIG-Forth was too arrogant to use BDOS function calls.

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CP/M BUS

Continued from page 41

BDOS needs it. This is not a problem, as I can get the two addresses I need and save them.

The contents of the first word in the DPH copy is the address of the sector translation table (XLT). The contents of the DPH copy at offset 12 is the address of the disk parameter block (DPB). Forth can retrieve these addresses with:

```
1 BIOSPB 4 + !    1 9 DBIOS DUP @
                  U. 12 + @ U.
```

This is similar to the above, only this time the value 1 is put into the DE register location of the **BIOSPB.** This tells BIOS function 9 that this drive has been selected before, so the BIOS doesn't need to access the disk in order to determine the density. The BIOS simply returns the DPH address and the BDOS makes a copy of the DPH contents before switching back to bank 1. The contents of the first word of the DPH is obtained with the Forth @ word. This value is printed as an unsigned integer with **U.**. It is the address of the XLT table and is in bank 0 (the system bank). The address of the DPH copy is now on the top of the Forth parameter stack since it was **DUP**ed before the @ word was used. The value 12 (decimal) is added and the content of this address is obtained with @ again. This value is printed and is the location of the DPB in common memory.

The XLT address cannot be used directly. But it can be saved and used for a BIOS function 16 to implement disk sector skewing. The DPB address can be used directly (since it's in common memory) to determine the disk drive capacity. The number of Forth screens contained on the drive can then be calculated.

This almost completes the conversion of DIRECT.BLK for CP/M Plus. One more big difference between CP/M 2.x and CP/M Plus remains to be accounted for. This has to do with physical sector deblocking. In CP/M 2.x, the disk was viewed by the BDOS as a series of logical records (sectors), each 128 bytes long. It was the job of the 2.x BIOS to convert reality (i.e., physical sectors) into logical sectors for the BDOS. The need for sector deblocking made the preparation of a CP/M 2.x BIOS more complicated when higher capacity disk formats were introduced.

CP/M Plus has grown up. It now "understands" that logical 128-byte sectors rarely exist on any physical disk. The CP/M Plus BDOS will accept physical sectors from the BIOS in whatever size they exist on the disk. The CP/M Plus BDOS will buffer and deblock these physical sectors into the same 128-byte logical records that application programs expect. This feature of CP/M Plus greatly simplifies the preparation of the BIOS. CP/M Plus provides a multi-sector I/O capability for "smart" application programs to take advantage of the greater disk I/O speed available by dealing in physical sectors. This is a topic for another column, however.

The big implication of BDOS deblocking rather than BIOS deblocking is that programs that use direct BIOS calls, such as direct I/O in Forth, must now handle a full physical sector's worth of data with one BIOS call. This important fact has prevented more than one of my favorite 2.x utilities from running on CP/M Plus.

Next month I shall discuss the detailed implementation of Forth words to handle disk I/O under CP/M Plus.

The "CP/M Bus" column will be written by Randy Reitz from now on. It is still planned as a forum on CP/M topics, and readers are encouraged to send in questions. Write to: Randy Reitz, 26 Maple St., Chatham Twp., NJ 07928.

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Microsystems

UNIX SOFTWARE DIRECTORY

by Ian Darwin

UNIX is by far the most comprehensive operating system I know; it includes a number of applications programs including sorting, pattern matching, compilers and even compiler generation tools. Most other operating systems require you to purchase these tools separately. Nonetheless, there are times when you want to buy something that goes beyond what UNIX provides, and there is no shortage of such software available.

This UNIX Software Directory will be an annual event in *Microsystems*. I have excluded products such as books, magazines and training services; as well as "ports" of UNIX to new hardware.

This survey is not as large as the CP/M Software Directory which appeared in the December issue. There are several reasons for this. First, a UNIX development system costs more than a CP/M development system, so there are fewer kitchen-table software houses. These costs are dropping, so the variety of vendors should increase with time. Second, a number of vendors did not respond to the survey: some claim not to have received it while others did not get around to replying. Unfortunately, the publishing deadlines did not allow for as comprehensive a follow-up as I'd have liked. Next year this will be handled better. Third, as has been mentioned, UNIX comes with a basic starter kit of tools and applications. The CP/M survey listed more than half a dozen sort programs one could buy for CP/M. Since UNIX comes with a good sort/merge program, there is little incentive to try selling sort programs to UNIX system owners. Even so, I believe this listing to be comprehensive enough to refute the ancient banality that "there is no software for UNIX."

Random remarks

Furthermore, anyone who attended the UniForum conference in Washington in January would know that UNIX is here. There is software—and a lot of it. What has not yet happened is the entrenchment of one or two products in each category, as has happened in the CP/M marketplace. This is partly because the market is new, but also because there are so many companies with good products. When the CP/M market became entrenched, there were few good full-screen word processors, and so (for example) WordStar was able to garner a large percentage of the market. There are already a dozen or so reasonably good full-screen word processors for UNIX, so the market will certainly take longer to settle on one, if indeed it does so.

Only one company (Touchstone) was sufficiently computerized in its thinking to use a computer to reply to the questionnaire which was mailed out. Everyone else used either pen or typewriter.

One of the difficulties in preparing this survey was the

tremendous number of UNIX variants in use. The three major versions of the software are the Seventh Edition (V7), the Berkeley software (4.1BSD, 4.2BSD) and the recent AT&T UNIX Group systems (System III, System V). There are also several UNIX-alike systems. Most of these can run on DEC PDP-11s and VAX-11s, Motorola 68000s, the Intel 8086 family, Zilog Z8000 or National Semiconductor 16032, and other processors. Most of the micro UNIX systems installed are 68000s, and the majority of these are UniSoft ports, but there are several others. Most of the 8086 ports are by Microsoft. Each system can be had in a myriad of configurations. There is no standard disk or tape interchange format for micros; the larger systems tend to use 9-track, ½" magnetic tape. The disk situation is comparable to the early days of CP/M. That's the bad news. The good news is that around 95% of the UNIX software can be moved from any of these systems to any other with a minimum of work, as it is written in high-level languages. Most is in C, with Fortran, Cobol, and other languages making up the rest. These languages can readily be compiled on most UNIX systems. Properly written software in any of these languages is *portable* and can be moved easily from one system to another. So, if you see a product you want, but it's not available for your system, take heart. Convince the vendor that he will sell many copies if he ports it to your particular hardware configuration, and he will be likely to do so.

The ancient banality that there's no software for UNIX isn't true—there *is* software, and lots of it.

Using the directory

The products are grouped into major categories such as Accounting Applications, General Applications, etc., and within each of these by minor categories. Within each minor category, the parts are listed alphabeticaly by the product name. For each product listed, the vendor number is given. This is the key to the alphabetical list of vendors, and also acts as a reader service number (use the special form provided—do not use the normal Reader Service Card).

The vendor listing contains name, address and contact information, as well as uucp mail addresses, to be especially useful to people already using UNIX (see comments in The UNIX File, page 24). Any company doing serious work in UNIX will be on the network, yet many did not provide network addresses for one reason or another. I suspect that this resource is not yet known to the marketing people at many of these companies.

Some of the products appear with multiple vendors. This is due to the diversity of UNIX configurations in use and the fact that some vendors only port software to particular configurations. One product may be ported by several vendors to different configurations.

The column SRC LANG names the source languages in which the application is written. INTERFACE is the type of user interface the program offers; *fs* is full-screen, *cmd* is a single command, and *is* in a line-at-a-time interactive subsystem. *f/s access* (for full-screen interface programs only) is the type of access method used to adapt to new terminal types. *curses* and *termcap* are widely used facilities that interface software to hundreds of common terminal types. *terminfo* is a new system designed to replace *termcap*. *custom* means that the software has some nonstandard way of adapting to new terminals, rather than using *termcap* or *terminfo*. BIN price and SRC price are pretty much self-explanatory—the cost of a binary (executable) license and the cost of a source license (if available). *o/r* means "on request"; *n/a* means "not available." "OEM only" means that this product is currently being sold only to other manufacturers by this vendor; look for another vendor or contact the people from whom you bought your system. VERSIONS lists the UNIX versions for which the software product is available from this vendor. To account for the many systems and formats mentioned above, we asked the vendors to indicate on which versions of which systems their products ran. As the replies came in, it became clear that there was no easy way to portray the version information in tabular form for each product. Instead, we have listed the information in text form, as provided by the software suppliers. MEM, DBIN, and DSRC are the main storage in megabytes for the binary and source distributions. MEDIA is the media on which this vendor distributes this product; *f5* and *f8* are 5" and 8" floppy; *9tr* is industry standard ½" mag tape; *cart* is some form of tape cartridge.

Although considerable effort and care were taken in compiling this directory, we cannot guarantee its accuracy. I hope, however, that it will prove useful in finding software for your UNIX system.

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PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
ACCOUNTING APPLICATIONS										
Integrated Accounting										
ACUITY Accounts Payable	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
ACUITY Customer Order Processing	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, UniSoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
ACUITY Fixed Assets	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
ACUITY General Ledger	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
ACUITY Inventory Management	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
ACUITY Labor/ODC Projections	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	2	f8, 9tr
ACUITY Payroll	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, UniSoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
ACUITY Project Management	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
Integrated Accounting GL/AR/AP	29	C		1650		PDP-11 V7, UniSoft, XENIX, Onyx	196			f5, f8, cart
MBSI RealWorld Applications	30	Cobol		n/a	1K	IBM PC (SriTek XENIX), Onyx, CIE, Altos				
MBSI RealWorld Software	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Manufacturing Inventory w/Full Accounting	86	Cobol	fs, curses	8K	13K	XENIX, Onyx	64	1	2	f5, f8
The Leonardo System	7	C, sh	fs, custom	5K	n/a	Venix	256	2		f8
Total Accounting	29	C		3930	25K	UniSoft, XENIX, Onyx	196	1.0		f5, f8, cart
General Ledger										
ACUITY General Ledger	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
CP—Ledger	24	Cobol		2K		XENIX	128			f5, cart
General Ledger	101	Cobol	fs, termcap		1950	NCR Tower				f5
Integrated Accounting GL/AR/AP	29	C		1650		PDP-11 V7, UniSoft, XENIX, Onyx	196			f5, f8, cart
MBSI RealWorld Applications	30	Cobol		n/a	1K	IBM PC (SriTek XENIX), Onyx, CIE, Altos				
MBSI RealWorld General Ledger	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Software Fitness—General Ledger	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
UniCount Accounting	95	C	fs, cmd, is, curses, termcap			UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
Payroll										
ACUITY Payroll	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Unisoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
CP—Payroll	24	Cobol		2.K		XENIX	128			f5, cart
MBSI RealWorld Applications	30	Cobol		n/a	1K	IBM PC (SriTek XENIX), Onyx, CIE, Altos				
MBSI RealWorld Payroll	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Payroll	101	Cobol	fs, termcap		1950	NCR Tower				f5
Software Fitness—Payroll	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
Accounts Payable										
ACUITY Accounts Payable	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple LIsa	160	1	3	f8, 9tr
Accounts Payable	101	Cobol	fs, termcap		1950	NCR Tower				f5
CP—Payables	24	Cobol		2K		XENIX	128			f5, cart
Integrated Accounting GL/AR/AP	29	C		1650		PDP-11 V7, UniSoft, XENIX, Onyx	196			f5, f8, cart
MBSI RealWorld Accounts Payable	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Software Fitness—Accounts Payable	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
Accounts Receivable										
ACUITY Accounts Receivable	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
Accounts Receivable	101	Cobol	fs, termcap		1950	NCR Tower				f5
CP—Receivables	24	Cobol		2K		XENIX	128			f5, cart
Credit Receivables System	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Integrated Accounting GL/AR/AP	29	C		1650		PDP-11 V7, UniSoft, XENIX, Onyx	196			f5, f8, cart
MBSI RealWorld Accounts Receivable	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Software Fitness—Accounts Receivable	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
Inventory										
ACUITY Inventory Management	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
CP—Inventory	24	Cobol		2K		XENIX	128			f5, cart
MBSI RealWorld Order Entry/ Inventory	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Retail Appliance Inventory	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Software Fitness—Inventory	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
Order Entry										
ACUITY Customer Order Processing	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
MBSI RealWorld Order Entry/ Inventory	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Software Fitness—Purchase Order Processing	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
Software Fitness—Sales Order Processing	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
Sales Journal										
MBSI RealWorld Sales Analysis	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Job Costing										
ACUITY Project Management	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
CP—Job Cost	24	Cobol		2K		XENIX	128			f5, cart
Job Costing	101	Cobol	fs, termcap		1950	NCR Tower				f5
Job Costing	29	C	termcap	600		UniSoft, XENIX, Onyx, PDP-11 V7	196			f5, f8, cart
Software Fitness—Job Cost System	63	B.Basic	fs, termcap	695		XENIX 2.3 on Altos 8086, Apple Lisa	100	3		f5, f8
Fixed Assets Accounting										
ACUITY Fixed Assets	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, UniSoft (RM Cobol), Apple Lisa	160	1	3	f8, 9tr
CP—Fixed Assets	24	Cobol		2K		XENIX	128			f5, cart
Fixed Assets Accounting	101	Cobol	fs, termcap		1950	NCR Tower				f5
Software Fitness—Fixed Assets	63	B.Basic	fs, termcap	695		XENIX 2.3 on Altos 8086, Apple Lisa	100	3		f5, f8
Spreadsheet										
20/20	4	C	fs, termcap	395, 4800		VAX 4BSD, various others	192	0.5		f5, f8, 9tr, cart
ACUITY Labor/ODC Projections	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	2	f8, 9tr
CALC-11 3D Spreadsheet w/Encryption	26	C	fs			PDP-11 3B20, XENIX, Venix, Plexus: portable				

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
D-Calc Financial Analysis	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Handle Calc	37	C	fs, termcap		n/a	Ported to specific microsystem				f8, 9tr
Horizon Spreadsheet	39	C	termcap	245	n/a	VAX 4BSD, PDP-11 V6, UniSoft, XENIX, IDRIS, Coherent, Onyx	128			f5, f8, 9tr, cart
Multiplan Spreadsheet	55			OEM only		XENIX				
Multiplan	59		fs, termcap			NCR Tower				f5
Multiplan	78					Various				
Q-Calc	72	C	fs, curses, termcap	550		VAX 4BSD, UniSoft (Callan, Codata)				9tr
SUNCALC	84	C	fs, termcap	950	n/a	PDP-11 V6, V7; VAX 4BSD, Sun				9tr
Supercomp/Twenty	4	C	termcap	395-4800		PDP-11 V7, VAX 4BSD, SGS, WE, Zilog, CRDS, Plexus, PE	192	0.5		f5, f8, 9tr, cart
The Horizon Software System	39	C	termcap	595	n/a	VAX 4BSD, PDP-11 V6, UniSoft, XENIX, IDRIS, Coherent, Onyx	128			f5, f8, 9tr, cart
UltraCalc	45		fs, custom		n/a	UniSoft Sys III, IS 68K CPU		0.5		f8, 9tr
UltraCalc	62	C	fs, termcap	395-2795	50K	UniSoft, XENIX, Onyx	128	0.5	2	f5, f8, 9tr, cart
ViewComp	96	C	fs, termcap	400-800	o/r	PDP-11 V6, V7; VAX 4BSD, UniSoft (all), XENIX, Onyx, IS/1, etc.	128	0.1		f8, 9tr, cart
ViewComp	45		fs		n/a	UniSoft Sys III, IS 68K CPU		0.18		f8, 9tr, cart
vc	83	C	fs, cmd, curses, termcap	149	1490	PDP-11 V7, VAX 4BSD, UniSoft (Pixel), most UNIXes (V7 or later)	64	0.15	0.3	9tr, cart
Other										
CAMIS	203	Fortran		3K		UniSoft				
CP—Job Estimating	24	Cobol		2K		XENIX	128			f5, cart
CP—Time Accounting	24	Cobol		2K		XENIX	128			f5, cart
GENERAL APPLICATIONS										
Communications										
B-Net	98	C		400/node		UniSoft	70	0.6		
Fusion	60	C	cmd	750-3K	25K	PDP-11 V7, VAX 4BSD, Sun, Unisoft, XENIX	128	0.5	2.5	f5, 9tr
NU-11/XNS	5	C		4.5K	50K	PDP-11 V7, Sys V; VAX 4BSD, Sys V				
Office Automation System	95	C	fs, cmd, is, curses, termcap	1.5K		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
PCworks—UNIX-to-PC Asynch Network	93	C, Asm	fs, termcap	495	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	64	0.2		f5
RCMP/RCAF UNIX RT-11 Network Software	40	C	cmd	200-400		PDP-11 V7, VAX 4BSD	<1			f8, 9tr
TCP/IP	109	C				Eunice, VAX/VMS				
Unet Communications (uucp SNA X.25 2780 RBS)	59		is			NCR Tower				f5
Calendar/Scheduler										
Q-Date	71	C	fs, custom	145-955		portable				
Electronic Mail										
COSY	102	C			1.5K	HCR, Unity, and others	64			9tr
Fusion	60	C	cmd	750-3K	25K	PDP-11 V7, VAX 4BSD, Sun, Unisoft, XENIX	128	0.5	2.5	f5, 9tr
Office Automation System	95	C	fs, cmd, is, curses, termcap	1.5K		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
PCworks—UNIX-to-PC Asynch Network	93	C, Asm	fs, termcap	495	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	64	0.2		f5
Q-Mail	71	C	fs, custom	145-995	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS	128	1.3		f5, f8, 8tr, cart
Financial Planning										
20/20	4	C	fs, termcap	395-4800		VAX 4BSD, various others	192	0.5		f5, f8, 9tr, cart
Supercomp/Twenty	4	C	fs, termcap	395-4800		PDP-11 V7, VAX 4BSD, SGS, WE, Zilog, CRDS, Plexus, PE, etc.	192	0.5		f5, f8, 9tr, cart
UltraCalc	62	C	fs, termcap	395-2795	50K	UniSoft, XENIX, Onyx	128	0.5	2	f5, f8, 9tr, cart
Visual/Calc	27		fs, termcap	295-1495		IBM PC, SERIX on IBM Series/1, VAX 4BSD				f8
Graphics										
GSS-Drivers	36	C	fs		n/a	Ported to specific microsystem	128			
GSS-Solutions	36	C	fs		n/a	Ported to specific microsystem	128			
GSS-Toolkit	36	C	fs		n/a	Ported to specific microsystem	128			
General Purpose Plotting Package	84	C			600	PDP-11 V6, V7; VAX 4BSD				9tr
Handle Business Graphics	37	C	fs, termcap		n/a	Ported to specific microsystem				f8, 9tr
Minitab Data Analysis Software	56	F	is	1K-1.2K	n/a	VAX 4BSD	5MB	1.5	3.5	9tr
PAWS	94	C	fs, curses, termcap	6K		XENIX	2.5	32	3	f5
SB Graph	18	C	fs			V7, Sys III, VAX, Onyx: portable				
Siggraph CORE Standard Graphics Library	34	Fortran	fs, custom	550	n/a	XENIX 2.3	356	0.1		9tr, cart
Statistics										
BMDP Statistical Software	11	Fortran	cmd, is	2900/yr	11.6K	VAX 4BSD, BMDP StatCat	600	7.5		9tr
Minitab Data Analysis Software	56	Fortran	is	1K-1.2K	n/a	VAX 4BSD	5MB	1.5	3.5	9tr
The Statistician	73	Basic	fs, terminfo, custom		400	XENIX	60	0.25		f5, f8
Other										
Computer Managed Instruction	52	C	fs, termcap		n/a	UNIX V7, Sys III; TNIX, XENIX, Onyx, Eunice	64	0.1	n/a	f8, 9tr
PCworks—UNIX-to-PC Asynch Network	93	C, Asm	fs, termcap	495	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	64	0.2		f5
Q-Call Online Phone Directory	71	C	fs, custom	115-695	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS	128	1.3		f5, f8, 9tr, cart
Q-Math Calculator	71	C	fs, custom	145-995		PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS	128	1.3		f5, f8, 9tr, cart
Q-Note Electronic Notepad	71	C	fs, custom	115-695	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS	128	1.3		f5, f8, 9tr, cart
Q-Office	71	C	fs, custom	1860-9.2K	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS	128	1.3		f5, f8, 9tr, cart
The Bridge CP/M, MS-DOS Emulator	107	C	cmd	1600-3.5K		PDP-11 V6, V7; VAX 4BSD, UniSoft, XENIX, Onyx	64			f8, 9tr
DATABASE PROGRAMS										
Database Manager										
/rdb: relational DBMS	58	C, sh	fs, cmd, is, curses, termcap	500	10K	All	32	0.3	1	f5, f8, 9tr, cart

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
DATA ACE multiuser RDBMS and applications creation	25	Poly-Forth	fs, custom	995	n/a	Tandy, XENIX	380	0.6		f8
Data Base Management System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
FilePro	81	C	fs, termcap	995	n/a	NCR Tower		1.5		f5
Ingres DBMS	209	C	fs	40K	n/a	VAX 4BSD, UniSoft (Dual, Callan, Codata, Pixel), CCI, NCR, etc.	450	2		f8, 9tr
informix	78					Various				
Ingres	59		is			NCR Tower				f5
LOGIX Relational DBMS	50	C	fs, cmd, termcap	varies	30K	PDP-11 V7, VAX 4BSD, UniSoft, XENIX, Onyx, IS/1	128	1.2	0.5	f5, f8, 9tr, cart
MDBS III	207	C, Asm	cmd, is			XENIX	128			
MDBS-EDA Educational Aid	207	C, Asm				PDP-11 V7	128			
MRS Database	99	C	cmd, is			PDP-11, VAX 4BSD				9tr
Mistress Plus	76	C	fs, termcap, terminfo	o/r	o/r	UniSoft, XENIX, Onyx, IS/1, Sys III/V, 4BSD	512	3	5	f5, f8, 9tr, cart
Mistress/32	76	C	fs, termcap	o/r	o/r	UniSoft, XENIX, Onyx, IS/1, Sys III/V, 4BSD	512	3	5	f5, f8, 9tr, cart
Mistress	76	C	fs, termcap, terminfo	o/r	o/r	UniSoft, XENIX, Onyx, IS/1, Sys III/V, 4BSD	512	3	5	f5, f8, 9tr, cart
ORACLE Relational DBMS	64	C	is	600-48K		XENIX 2.3, Bell Sys V	512	10		f5, f8, 9tr
PHACT-dbrm	66	C	cmd, is	450-950	5K	PDP-11 V7, VAX 4BSD, UniSoft, XENIX, IDRIS, Onyx, IS/1, etc.	64	0.25	0.75	f5, f8, 9tr, cart
personal informix	75	C	fs	495	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	24	350		f5, f8, 9tr, cart
Profile-16	81	C	fs, termcap	499	n/a	TRS-XENIX	256	1.5		f8
RUBIS Rel DBMS / Prefix Applications Generator)	210	C	fs, curses, termcap	1495	n/a	UniSoft, Xenix, Fortune, Altos, Convergent				f5, f8, 9tr
SPEED I Applications Development & DBMS	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Screen-Master Screen Mgt Sys	207	C, Asm	fs, custom			XENIX	192			
The Leonardo System	7	C, sh	fs, custom	5K	n/a	Venix	256	2		f8
UNIFY Data Base Management System	34	C	fs, curses, termcap, terminfo	2750	n/a	XENIX 2.3	256	3		9tr, cart
UNIFY	27			5K		SERIX on IBM Series/1				f8
Unify	45		fs		n/a	UniSoft Sys III, IS 68K CPU		2.25		f8, 9tr
informix	75	C	fs, termcap	1.6K up	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	128	0.6		f5, f8, 9tr, cart
Data Entry										
/menus—Menus and Forms Development System	93	C, Asm	fs, termcap	1295	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
Data Base Management System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
personal informix	75	C	fs	495	o/r	XENIX, Onyx, UniSoft Sys III/V, etc.	24	350		f5, f8, 9tr, cart
VISUAL/pc	27	C		345		IBM PC-DOS—front end to UNIX host				f5
Viking Forms Manager	106	C	fs, custom	600-10.5K	n/a	VAX 4BSD	64	2		f5, f8, 9tr, cart
Visual/Menu	27	C	curses, termcap	295-1495		VAX 4BSD, Onyx, Venix, Serix (IBM Series/1)	128			f5, f8, 9tr
XDE	23	C	fs, custom			Sys III/V, UniSoft, XENIX: portable				
informix	75	C	fs, termcap	1.6K up	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	128	0.6		f5, f8, 9tr, cart
vf	83	C	fs, cmd, curses, termcap	249	1490	portable	64			
Keyed Access										
/menus—Menus and Forms Development System	93	C, Asm	fs, termcap	1295	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
Data Base Management System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
UniFile	95	C	fs, cmd, is, curses, termcap	4.5K		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
UniMerge	95	C	fs, cmd, is, curses, termcap	950		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
c-isam (subroutine package)	75	C		450 up	o/r	XENIX, IDRIS, Onyx, IS/1, Sys III/V, Unity, Unisoft, etc.	24	0.8		f5, f8, 9tr, cart
Input Forms Generator										
/menus—Menus and Forms Development System	93	C, Asm	fs, termcap	1295	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
Data Base Management System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
E-Z SPEED Record Mgt System	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Forms-2 Screen Generator	54	Cobol	fs, termcap	OEM only		UniSoft, PDP-11 V7, VAX 4BSD, XENIX, Onyx	160	0.75		
Handle List	37	C	fs		n/a	Ported to specific microsystem				f8, 9tr
Leverage	104	C	curses, termcap	385	3,750	PDP-11 VAX 4BSD, Sun, UniSoft, XENIX, Onyx, IS/1, Fortune				f8
MENUPRO, Cobol MENU Processor	13	Cobol	fs, termcap	250	n/a	UniSoft, XENIX	64	0.25	none	f5, f8, 9tr, cart
personal informix	75	C	fs	495	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	24	350		f5, f8, 9tr, cart
Q-Form	71	C	fs, custom	395-2K	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS, etc.	128	1.3		f5, f8, 9tr, cart
Q-Menu	71	C	fs, custom	395-2K	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS, etc.	128	1.3		f5, f8, 9tr, cart
UniMerge	95	C	fs, cmd, is, curses, termcap	950		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
VISUAL/pc	27	C		345		IBM PC-DOS—front end to UNIX host				f5
Visual/Menu	27	C	curses, termcap	295-1495		VAX 4BSD, Onyx, Venix, SERIX (IBM Series/1)	128			f5, f8, 9tr
XDE	23	C	fs, custom			Sys III/V, UniSoft, XENIX: portable				
informix	75	C	fs, termcap	1.6K up	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	128	0.6		f5, f8, 9tr, cart
Mail List Manager										
Data Base Management System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
Handle List	37	C	fs		n/a	Ported to specific microsystem				f8, 9tr
Leverage	104	C	curses, termcap	385	3750	PDP-11, VAX 4BSD, Sun, UniSoft, XENIX, Onyx, IS/1, Fortune				f8
personal informix	75	C	fs	495	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	24	350		f5, f8, 9tr, cart
The Horizon Software System	39	C	termcap	595	n/a	VAX 4BSD, PDP-11 V6, UniSoft, XENIX, IDRIS, Coherent, Onyx	128			f5, f8, 9tr, cart

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
Report Generator										
Data Base Management System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
PHACT-dbrm	66	C	cmd, is	450-950	5K	PDP-11 V7, VAX 4BSD, UniSoft, XENIX, IDRIS, Onyx, IS/1, etc.	64	0.25	0.75	f5, f8, 9tr, cart
Software Fitness—Team Manager Report	63	B.Basic	fs, termcap	695		XENIX 2.3, Altos 8086, Apple Lisa	100	3		f5, f8
informix	75	C	fs, termcap	1600 up	o/r	XENIX, Onyx, UniSoft, Sys III/V, etc.	128	0.6		f5, f8, 9tr, cart
Other										
Customer Response Center	43	Cobol	fs, termcap			UniSoft, XENIX, Onyx, IS/1	20	0.5	1.5	f5, f8, 9tr, cart
Handle Access	37	C	fs, termcap		n/a	Ported to specific microsystem				f8, 9tr
Screen-Master Screen Mgt Sys	207	C, Asm	fs, custom			XENIX	192			
UniGen	95	C	fs, cmd, is, curses, termcap			UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
Computer Assisted Self Training	52	C	fs, termcap	495-2K	n/a	UNIX V7, Sys III; TNIX, XENIX, Onyx, Eunice	64	0.25	n/a	f8, 9tr
TEXT PROCESSING										
Text Editor										
CCA EMACS	204	C	fs, termcap, terminfo	475-850		VAX 4BSD, Sun, Unisoft Sys III	500	2	2.5	f5, 9tr
FSE Full Screen Editor	109	C	fs, curses, termcap			Eunice				
HCR/Edit	41	C	curses	750		PDP-11, VAX, 68000, 16032, Sys III				9tr
SERIX/vi	27	C	fs, termcap	995		SERIX on IBM Series/1				f8
XED Document Preparation System	23	C	fs, custom			Sys III/V, UniSoft, XENIX: portable				
Text Output Formatter										
Tplus	91	C	fs	500-900	o/r	portable	32	0.25		f5, f8, 9tr, cart
Tpost	91	C	cmd	1.5K-2250	o/r	PDP-11 V6, V7 VAX, Sun, UniSoft (Pixel, Dual, etc.), XENIX, etc.		36	0.3	f5, f8, 9tr, cart
Xroff—Typesetting & Laser Printing	42	C	cmd	3.8K	n/a	UniSoft, VAX 4BSD, XENIX, Onyx	128			9tr
Word Processor										
CP-Office	24	Cobol		2K		XENIX	128			f5, cart
Crystalwriter	87	C, Pascal	fs, termcap	1K		UniSoft V7, Sys III/V	250			f5, f8, 9tr, cart
DATA 3500 W.P.S.	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Handle Writer	37	C	fs		n/a	Ported to specific microsystem				f8, 9tr
Horizon Wordprocessing	39	C	termcap	245	n/a	VAX 4BSD, PDP-11 V6, UniSoft, XENIX, IDRIS, Coherent, Onyx	128			f5, f8, 9tr, cart
LEX-11	89		fs, curses	4K	n/a	IDRIS				f5, 9tr
Lex	45					UniSoft, Sys III, IS 68K CPU				
Office Automation System	95	C	fs, cmd, is, curses, termcap	1.5K		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
Q-One	71	C	fs, custom	595-3K	n/a	PDP-11, UniSoft, XENIX, IDRIS, Coherent, UNOS	128	1.3		f5, f8, 9tr, cart
R Word	74	Asm	fs, termcap	895	n/a	UniSoft, XENIX (68000 only) Altos 68K, Sys III	200			f5, f8, cart
The Horizon Software System	39	C	termcap	595	n/a	VAX 4BSD, PDP-11 V6, UniSoft, XENIX, IDRIS, Coherent, Onyx	128			f5, f8, 9tr, cart
UniPlex	78	C	fs, termcap			Various				f5, f8, cart
UniRite	95	C	fs, cmd, is, curses, termcap			UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
Word Marc	59		fs			NCR Tower				f5
XED Document Preparation System	23	C	fs, custom			Sys III/V, UniSoft, XENIX: portable				
Typesetting										
TYXSET 1000	94	C	curses, termcap	18K		PDP-11 V7, VAX 4BSD, UniSoft V7, XENIX (IBM, Victor 2.5)	32	2		f5, 9tr cart
TYXSET 100	94	C	fs, curses, termcap	5.5K		XENIX 2.5	32	2		f5
Tplus	91	C	fs	500-900	o/r	Portable	32	0.25		f5, f8, 9tr, cart
Tpost	91	C	cmd	1.5K-2250	o/r	PDP-11 V6, V7, VAX, Sun, XENIX, UniSoft (Pixel, Dual, etc.)				f5, f8, 9tr, cart
XED Document Preparation System	23	C	fs, custom			Sys III/V, UniSoft, XENIX: portable				
Xroff—Typesetting & Laser Printing	42	C	cmd	3.8K	n/a	UniSoft, VAX 4BSD, XENIX, Onyx	128			9tr
Spelling Checker										
Handle Spell	37	C	fs, termcap		n/a	Ported to specific microsystem				f8, 9tr
Office Automation System	95	C	fs, cmd, is, curses, termcap	1.5K		UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
The Horizon Software System	39	C	termcap	595	n/a	VAX 4BSD, PDP-11 V6, UniSoft, XENIX, IDRIS, Coherent, Onyx	128			f5, f8, 9tr, cart
Other										
EMACS	45		fs, curses			UniSoft Sys III, IS 68K CPU				
On-Line Manual Maintenance (MainMan)	52	C	fs, termcap	195-495	n/a	UNIX V7, Sys III, TNIX, XENIX, Onyx, Eunice	64	0.1	n/a	f8, 9tr
SAMOA	88	C	fs, custom	5K	n/a	VAX 4BSD, Sun, UniSoft				9tr
Xroff—Typesetting & Laser Printing	42	C	cmd	3.8K	n/a	UniSoft, VAX 4BSD, XENIX, Onyx	128			9tr
INDUSTRY APPLICATIONS										
Accountant										
Public Accountant Business Management System	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
The Statistician	73	Basic	fs, terminfo, custom		400	XENIX	60	0.25		f5,f8
Agriculture										
The Statistician	73	Basic	fs, terminfo, custom		400	XENIX	60	0.25		f5,f8
Circuit Design										
CADAT	38	C	fs	20K-75K		VAX 4BSD, Apollo, any 32-bit UNIX-based system	1000			
Timing Verifier w/ Interactive Advisor	84	Pascal			850	VAX 4BSD				9tr
Construction										
CPM Job Scheduling	101	Cobol	fs, termcap		2495	NCR Tower				f5

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
Commercial Contractor Business Mgt Sys	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Equipment Control	101	Cobol	fs, termcap		1950	NCR Tower				f5
Estimating	101	Cobol	fs, termcap		2495	NCR Tower				f5
Residential Contractor Business Management System	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Dental										
Medical and Dental package	22	Cobol				IBM PC, Seiko UNIX in progress				
Patient Data Tracking System	14	Cobol		6K	n/a	XENIX Tandy				f8
Education										
MDBS-EDA Educational Aid	207	C, Asm				PDP-11 V7	128			
Engineering										
CADAT	38	C	fs	20K-75K		VAX 4BSD, Apollo, any 32-bit UNIX-based system	1000			
Civ Eng/Land Survey Library, CADD	28	C		10K-30K		VAX 4BSD				cart
The Statistician	73	Basic	fs, terminfo, custom		400	XENIX	60	0.25		f5,f8
Insurance										
The Statistician	73	Basic	fs, terminfo, custom		400	XENIX	60	0.25		f5,f8
Manufacturing										
Manufacturing Inventory & Business System	3	C		12K up		PDP-11 V7, UniSoft, XENIX, IDRIS, Coherent (most 68000s, 16032s)	256	5		9tr cart
Manufacturing Inventory w/ Full Accounting	86	Cobol	fs, curses	8K	13K	XENIX, Onyx	64	1	2	f5, f8
The Statistician	73	Basic	fs, terminfo		400	XENIX	60	0.25		f5,f8
Medical										
CP—Physician	24	Cobol		9.5K		XENIX	128			f5, cart
MDX	17	C	fs, termcap			XENIX, Onyx, Altos 586, Fortran, Pixel, IBM-XT				
Medical and Dental package	22	Cobol	2K-10K		n/a	IBMPC, Seiko UNIX in progress	512		2	f5, f8, cart
Mirage	53	C	fs, termcap, terminfo	3K	30K	VAX 4BSD, PDP-11 V7	128	2.5	5	9tr
VET-CMS Veterinary Clinic Mgt	68	Cobol	fs, curses	3.5K	4.2K	UniSoft (Wicat)		0.75	3	f5
Pharmacy										
CP-Pharmacy	24	Cobol		8K		XENIX	128			f5, cart
Project Management										
ACUITY Labor/ODC Projections	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	2	f8, 9tr
ACUITY Work Breakdown Structure Reporting	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1		f8, 9tr
ACUITY Project Management	19	Cobol	fs, curses	1.5K	2.5K	VAX 4BSD, Sun, UniSoft (RM Cobol), Apple Lisa	160	1	4	f8, 9tr
Property Management										
CP—Property Management	24	Cobol		2K		XENIX	128			f5, cart
Property Management Business Management System	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Property Management	101	Cobol	fs, termcap		2495	NCR Tower				f5
Restaurant										
Restaurant Management Information System	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Retail										
Chain Retailer & Mail Order Business System	3	C	termcap	17K up	n/a	PDP-11 V7, VAX, UniSoft, XENIX, IDRIS, Coherent (most 68000s, 16032s)	256	5		9tr, cart
Real Estate Office										
Real Estate Management	101	Cobol	fs, termcap		1950	NCR Tower				f5
The Statistician	73	Basic	fs, terminfo, custom		400	XENIX	60	0.25		f5,f8
ABS Accounting Plus	1	C		n/a	4.7K	PDP-11 V7	256	10	10	f5, f8, 9tr
AWSOM—Automated Warehouse Sales Order Mgt	10	Cobol	is	7.5K	n/a	XENIX	128	1		f5, f8, cart
Other										
BSO/MLIB Microprocessor Program Librarian	12	Asm					128			f8, 9tr, cart
CP—Hospital	24	Cobol				XENIX	128			f5, cart
Distribution Inventory & Business System	3	C	termcap	12K up		PDP-11 V7, UniSoft, XENIX, IDRIS	256	5		9tr, cart
Distributor Business Mgt Sys	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
General Business Mgt Sys	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Not-for-Profit Operations Management System	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
OfficePolicy	61	C	fs, custom	5K	n/a	PDP-11 V7, VAX 4.1BSD, Microsoft, Sys V, Zeus	512			9tr, cart
The Leonardo System	7	C, sh	fs, custom	5K	n/a	Venix	256	2		f8
OPERATING SYSTEM										
Operating System										
C Executive (ROMable real-time monitor)	206	C	cmd	300	3K	PDP-11, VAX 4BSD, UniSoft, XENIX, IDRIS, Coherent				f8, 9tr
DNIX UNIX-like Real-time OS	100	C		3K	20K	16032, 68010				9tr
RT/EMT O/S Emulator	41	C		1750		PDP, VAX Sys III				9tr
System Utility										
HCR/Menushell	41	C		750		PDP, VAX Sys III				9tr
XLPAK	35			99.95						
System Extension										
/menus—Menus and Forms Development System	93	C, Asm	fs, termcap	1295	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
B-Net	45		cmd		n/a	UniSoft Sys III, IS 68K CPU		0.4	0.516	f8, 9tr
Driver	69	C	fs, curses, termcap	OEM only		portable				
HCR/Menushell	41	C		750		PDP, VAX Sys III				9tr
NOS	67	C	cmd	1.5K	n/a	Plexus, UNIX Sys III	80	1		9tr
PCworks—UNIX-to-PC Asynch Network	93	C, Asm	fs, termcap	495	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	64	0.2		f5
Softshell	50	C	fs, cmd, termcap	varies		PDP-11 V7, VAX 4BSD, UniSoft, XENIX, Onyx, IS/1	128	0.3	0.1	f5, f8, 9tr, cart
UniRite	95	C	fs, cmd, is, curses, termcap			UniSoft, XENIX, any genuine UNIX	45	0.5		f5, f8, 9tr, cart
System Enhancement										
User Application Shells	59	C, Asm	is			NCR Tower				f5

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
SOFTWARE DEVELOPMENT										
Development System										
/menus—Menus and Forms Development System	93	C, Asm	fs, termcap	1295	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
AVL	83	C	fs, cmd, is, termcap	1.2K	o/r	PDP-11 V7, VAX 4BSD, Onyx, IS/1, HP9000	128	0.25	1	9tr, cart
Application Development System	29	C	fs, termcap	1995	n/a	PDP-11 V7, UniSoft, XENIX, Onyx, Fortune, Tandy, Altos	196			f5, f8, cart
BSO/Assemble Microprocessor Relocating Assemblers	12	Asm					128			f8, 9tr, cart
BSO/C C Compiler	12	C,Pascal, Asm					128			f8, 9tr, cart
BSO/DEBUG Microprocessor Symbolic Debugger	12	Asm					128			f8, 9tr, cart
BSO/MLIB Microprocessor Program Librarian	12	Asm					128			f8, 9tr, cart
BSO/MLink Microprocessor Program Linker	12	Asm					128			f8, 9tr, cart
BSO/OBJCNV Format Conversion program	12	Asm					128			f8, 9tr, cart
BSO/TEKLD Tektronix Emulator Loading Program	12	Asm					128			f8, 9tr, cart
Ci-C86 C Compiler	21	C		395		CP/M-86⇔MS-DOS	96	256		f5, f8
DATA ACE multiuser RDBMS and applications creation	25	Poly-Forth	fs, custom	995	n/a	Tandy, XENIX	380	0.6		f8
LILA (Language Implementation Laboratory)	44	Pascal		60K	n/a	Any system with standard Pascal compiler	128			f5, f8, 9tr, cart
MIMIX—CP/M (Z80) Emulator	93	C, Asm	fs, termcap	495	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
Mirage	53	C	fs, termcap, terminfo	3K	30K	VAX 4BSD, PDP-11 V7	128	2.5	5	9tr
SPEED I Application Development & DBMS	92	C	custom	o/r	n/a	UniSoft, XENIX	100			f5, f8, 9tr, cart
Safe C Runtime Checkout Compiler	15	C	cmd	400-6K	n/a	All	64	50		f5, f8, 9tr, cart
The Officesmith	61	C	fs, custom	5K	n/a	PDP-11 V7, VAX 4.1BSD, Microsoft, Sys V, Zeus	512	2		9tr, cart
Unify	97	C	fs, termcap	1495 up	50K	PDP-11 V7, VAX 4BSD, UniSoft, XENIX Coherent, Onyx	256			f5, 9tr, cart
Viking Forms Manager	106	C	fs, custom	600-10.5K	n/a	VAX 4BSD	64	2		f5, f8, 9tr, cart
Code Translator										
BASTOC Basic-To-C Translator	206	C	cmd	350	15K	PDP-11, UniSoft, XENIX, IDRIS, PC-DOS	64	0.25	0.5	f5, f8, 9tr
BASTOC: A Basic-to-C Language Transformer	213	C		350	3K	IBM PC under PC-DOS	64	0.5		f5, f8, 9tr
BSO/OBJCNV Format Conversion program	12	Asm					128			f8, 9tr, cart
BSO/TEKLD Tektronix Emulator Loading Program	12	Asm					128			f8, 9tr, cart
EDL to C Translator	27		cmd	6K		EDX or SERIX on IBM Series/1				f8
LILA (Language Implementation Laboratory)	44	Pascal		60K	n/a	Any system with standard Pascal compiler	128			f5, f8, 9tr, cart
Safe C Runtime Checkout Compiler	15	C	cmd	400-6K	n/a	All	64	50		f5, f8, 9tr, cart
ctoe C to English Translator	15	C	cmd	100	n/a	All	64	50		f5, f8, 9tr, cart
etoc	15	C	cmd	100	n/a	All	64	50		f5, f8, 9tr, cart
Cross-Assembler										
BSO/Assemble Microprocessor Relocating Assemblers	12	Asm					128			f8, 9tr, cart
Cross Assemblers	46	C	fs, termcap	5K	varies	VAX 4BSD	128			9tr
LILA (Language Implementation Laboratory)	44	Pascal		60K	n/a	Any system with standard Pascal compiler	128			f5, f8, 9tr, cart
MC68000 Cross Assembler	215	C	is	3K	10K	PDP-11 V7, VAX 4BSD, IDRIS	128			9tr
MIMIX—CP/M (Z80) Emulator	93	C, Asm	fs, termcap	495	n/a	PDP-11 V7, UniSoft, XENIX, Onyx	128	0.3		f5, f8, 9tr, cart
Cross-Compiler										
BSO/C C Compiler	12	C,Pascal, Asm					128			f8, 9tr, cart
C Compiler, cross-development for 68000	202	C	cmd	1295	10K	VAX UNIX, PDP-11 UNIX, Exormacs hosts, generates 68000 code				f5, f8, 9tr, cart
Cross C Compiler VAX to 68000	100	C		6K	n/a	VAX 4BSD, VAX/VMS				9tr
C Cross Compiler for NS/6000 Family	213	C	cmd	2.5K		VAX/VMS, UNIX, IDRIS	64	0.15-0.17		f8, 9tr
InterC 68K	46	C	fs, termcap	5K	varies	VAX 4BSD	128			9tr
InterC 8086 C Cross Compiler	46	C	fs, termcap	5K	varies	VAX 4BSD	128			9tr
InterPas 68K Pascal Cross Compiler	46	C	fs, termcap	5K	varies	VAX 4BSD	128			9tr
LILA (Language Implementation Laboratory)	44	Pascal		60K	n/a	Any system with standard Pascal compiler	128			f5, f8, 9tr, cart
NS16032 C Cross Compiler	206	C	cmd	2.5K	n/a	PDP-11 V6, V7; VAX 4BSD, IDRIS				f8, 9tr
NS16032 Cross Compiler	41	C	termcap	3750	n/a	VAX Sys III				9tr
Safe C Runtime Checkout Compiler	15	C	cmd	400-6K	n/a	All	64	50		f5, f8, 9tr, cart
Z80 C Cross Compiler	105	C	fs, is, cmd, curses, termcap, terminfo	3K	12K	PDP-11 V6, V7; VAX 4BSD, UniSoft, Pixel, XENIX, IDRIS, Onyx, RSX, Zeus, Codata				f5, f8, 9tr, cart
Debugger										
Animator source level debugger	54	Cobol	fs, termcap	OEM only		UniSoft, PDP-11 V7, VAX 4BSD, XENIX, Onyx	160	0.75		
BCC-A Runtime Checker for C Programs	33	C, sh	cmd	700-3K	n/a	VAX 4BSD, UniSoft	200	0.4		f5, cart
BSO/DEBUG Microprocessor Symbolic Debugger	12	Asm					128			f8, 9tr, cart
CDB Source Debugger	100	C	fs, is	OEM only	20K	VAX 4BSD, Sun, Regulus, Sys III	60			9tr, cart
SVS Symbolic Debugger	79	Pascal	is			(included with SVS languages) same versions				
Safe C Runtime Checkout Compiler	15	C	cmd	400-6K	n/a	All	64	50		f5, f8, 9tr, cart
Assembler										
ASM 68	45		cmd		n/a	UniSoft Sys III, IS 68K CPU				
Loader										
BSO/TEKLD Tektronix Emulator Loading Program	12	Asm					128			f8, 9tr, cart

PRODUCT	VEN-DOR	SRC LANG	INTERFACE	PRICE ($) BIN	PRICE ($) SRC	VERSIONS	MEM	DBIN	DSRC	MEDIA
Program Generator										
COGEN, Cobol Program Generator	13	Cobol	fs, termcap	1250	n/a	VAX 4BSD, UniSoft (various), XENIX, Onyx	256	0.5	none	f5, f8, 9tr, cart
LILA (Language Implementation Laboratory)	44	Pascal		60K	n/a	Any system with standard Pascal compiler	128			f5, f8, 9tr, cart
Viking Forms Manager	106	C	fs, custom	600-10K	n/a	VAS 4BSD	64	2		f5, f8, 9tr, cart
etoc	15	C	cmd	100	n/a	All	64	50		f5, f8, 9tr, cart
Other										
BSO/MLIB Microprocessor Program Librarian	12	Asm					128			f8, 9tr, cart
BSO/MLink Microprocessor Program Linker	12	Asm					128			f8, 9tr, cart
Floating Point Instruction Set	80	C, Pascal	cmd		100	UniSoft, IDRIS	4			f8
MENUPRO, Cobal MENU Processor	13	Cobol	fs, termcap	250	n/a	UniSoft, XENIX	64	0.25	none	f5, f8, 9tr, cart
Progress Application Development Tool	31	C	fs, termcap	2K	n/a	UniSoft, XENIX, Cadmus, Fortune	256	0.5	0.5	
Smart-C	201	C	fs, termcap			IBM PC-DOS, VAX/UNIX (shortly)				
C Checker Compiler Evaluation System	38	C	cmd		8K	Any C environment				9tr
SDE-ADA (Syntax-directed Editor—ADA)	88	C	fs, custom	3K	12K	VAX 4BSD, Sun				9tr
SDE-MOD (Syntax-directed Editor—Modula)	88	C	fs	2.2K	12K	VAX 4BSD, Sun				9tr
LANGUAGES										
ADA										
ADA	98			3.5K		UniSoft 80				
SDE-ADA (Syntax-directed Editor—ADA)	88	C	fs, custom	3K	12K	VAX 4BSD, Sun				9tr
APL										
APL Language System	34	C	cmd, is	3K	n/a	XENIX 2.3	0.25			9tr, cart
APL*PLUS/UNIX	85	C	fs, termcap	o/r	n/a	XENIX				
Basic										
Basic	59		is			NCR Tower				f5
Basic Compiler	55			OEM only		XENIX				
Basic +	45					UniSoft, Sys III, IS 68K CPU		0.095		
Basic-L	83	C	cmd		400	UniSoft, XENIX, all UNIX systems V7 or later				cart
DBasic	100	C		2.5K	o/r	VAX 4BSD, portable				9tr
HCR/Basic	41	Asm	curses	1K		PDP-11 Sys III				9tr
SVS Basic-Plus	79	Pascal		OEM only		UniSoft, XENIX, IDRIS—all 68000 UNIX ports		0.25	1	f5, f8, 9tr, cart
C										
BCC-A Runtime Checker for C Programs	33	C	sh, cmd	700-3K	n/a	VAX 4BSD, UniSoft	200	0.4		f5, cart
BSO/C C Compiler	12	C, Pascal	Asm				128			f8, 9tr, cart
C Compiler	108	C	cmd			Various				
C Compiler	59		is			NCR Tower				f5
Globally-optimizing C Compiler	100	Pascal		2K	25K	Portable—for 68000 systems				9tr
SVS C Compiler	79	Pascal	cmd	OEM only		UniSoft, XENIX, IDRIS—all 68000 UNIX ports		0.25	1	f5, f8, 9tr, cart
Safe C Runtime Checkout Compiler	15	C	cmd	400-6K	n/a	All	64	50		f5, f8, 9tr, cart
Z80 C Cross Compiler	105	C	cmd	3K	12K	PDP-11 V6, V7; VAX 4BSD, Sun, UniSoft XENIX, IDRIS	64	1	3	f8, 9tr, cart
Cobol										
Cobol Compiler	55			OEM only		XENIX				
Compact Level II Cobol Compiler	54	Cobol	fs, is, termcap			UniSoft, PDP-11 V7, VAX 4BSD, XENIX, Onyx	160			
High Performance Level II Cobol Compiler	54	Cobol	fs, is, termcap	OEM only		UniSoft, PDP-11 V7, VAX 4BSD, XENIX, Onyx	160	0.5		
Level II Cobol	78					Various				
RM Cobol	59		is			NCR Tower				f5
RM/COBOL	27		cmd	4.5K		SERIX on IBM Series/1				f8
Fortran										
Absoft Fortran-77 for 68000	2	Asm	fs, cmd							
Fortran 77 Compiler	34	Pascal	cmd	880	n/a	XENIX 2.3	356	0.5		9tr, cart
Fortran 77	45		cmd		n/a	UniSoft Sys III, IS 68K CPU		0.362		f8, 9tr, cart
Fortran Compilers	55			OEM only		XENIX				
Fortran	59		is			NCR Tower				f5
SVS Fortran Compiler	79	Pascal	cmd	OEM only		UniSoft, XENIX, IDRIS—all 68000 UNIX ports	160	0.25	1	f5, f8, 9tr, cart
Pascal										
HCR/Pascal	41	C		750		PDP-11, VAX Sys III				9tr
Pascal Compiler	34	Pascal	cmd	880	n/a	XENIX 2.3	356	0.5		9tr, cart
Pascal Compiler	55			OEM only		XENIX				
Pascal-2 UNIX/68	65	Pascal	cmd	600-3450	30K	PDP-11 V7, Sun, UniSoft V7, Sys III/V, XENIX Sys III/V	256	1		f8, 9tr
Pascal	45		cmd		n/a	UniSoft Sys III, IS 68K CPU		0.361		f8, 9tr, cart
Pascal	59		is			NCR Tower				f5
SVS Pascal	79	Pascal	cmd	OEM only		UniSoft, XENIX, IDRIS—all 68000 UNIX ports	160	0.25	1	f5, f8, 9tr, cart
Other										
Concurrent Euclid	99	Con.Euclid	cmd	300-3K		VAX 4BSD, PDP-11 V7, VAX-VMS				9tr
Icon language	205	C, Asm	cmd	10		VAX 4BSD, PDP-11 V7 (public domain)				9tr
Q'NIAL (Nested Interactive Array Language)	70	C	cmd	1595-8K	25K	VAX 4BSD, XENIX, Sritek, Unity	512			
SDE-MOD (Syntax-directed Editor—Modula)	88	C	fs	2.2K	12K	VAX 4BSD, Sun				9tr
Toronto Euclid Compiler	48	Euclid	cmd	100	100	PDP-11 V6	128	0.6	2.6	9tr
Turing	99	Con.Euc	cmd	1.5-3K	5-11K	PDP-11, VAX 4BSD, micros in process				9tr
UTILITIES										
Hardware Diagnostics										
Hardware Diagnostics	59		is			NCR Tower				f5
System Usage Accounting										
USAX System Accounting for UNIX	88	C	cmd	1K	3K	VAX 4BSD				9tr
Other										
AIM Portable UNIX Benchmarks	6	C, sh	cmd	n/a	1650	PDP-11 V7, VAX 4BSD, Sun, UniSoft, XENIX, Onyx: portable	200	0.3		9tr
Fusion	60	C	cmd	750-3K	25K	PDP-11 V7, VAX 4BSD, Sun, Unisoft, XENIX	128	0.5	2.5	f5, 9tr

Microsystems

Unix Vendors Directory

1 **ABS Associates, Inc.**
22 Witt Rd.
Barrington, IL 60010
Thomas L. Mitchell, President
(312) 381-2004

2 **Absoft**
4268 N. Woodward Ave.
Royal Oak, MI 48072
(313) 549-7111

3 **Absolut Systems Corp.**
2001 Beacon Dr.
Boston, MA 02146
(617) 277-0610

4 **Access Technolgy**
6 Pleasant St.
South Natick, MA 01760
Susan Hewett
(617) 655-9191

5 **Advanced Computer Communications**
720 Santa Barbara St.
Santa Barbara, CA 93101
Bill Mason
(805) 963-9431

6 **Aim Technology**
3333 Bowers Ave., #199
Santa Clara, CA 95051
Jamie Mendez
(408) 727-3711

7 **Albermarle Fine Art Retrieval Guild, Inc.**
Box 3116
Charlottesville, VA 22903
Margaret Jensen, Pres.
(804) 296-0534

8 **AT&T Bell Laboratories**
600 Mountain Ave.
Murray Hill, NJ 07974
Gary Perlman
(201) 582-3624
uucp address:
ucbvax!ulysses!gsp
(public domain)

9 **Bibliographic Retrieval Services**
1200 Route 7
Latham, NY 12110
R. Daniel Robinson
(518) 783-1161

10 **BLT Business Systems, Inc.**
1902 Central Dr., #D
Bedford, TX 76021
George Lass
(817) 267-4196

11 **BMDP Statistical Software**
1964 Westwood Blvd., #202
Los Angeles, CA 90025
Lynda Kern
(213) 457-5700

12 **Boston Systems Office, Inc.**
469 Moody St.
Waltham, MA 02154
Joanne Drawson
(617) 894-7800

13 **Bytel Corp.**
1730 Solano Ave.
Berkeley, CA 94707
Ruth Deiches
(415) 527-1157

14 **Cardinal Systems, Inc.**
17 Partridge Rd.
Lexington, MA 02173
Contact: Peter Miller
(617) 862-0058

15 **Catalytix Corp.**
55 Wheeler St.
Cambridge, MA 02138
Contact: Donald French
(617) 497-2160

16 **CIE Systems**
2515 McCabe Way
Irvine, CA 92713
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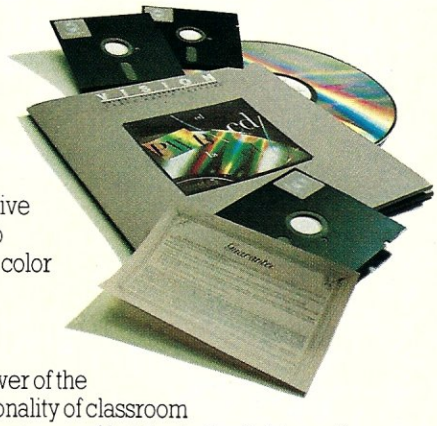

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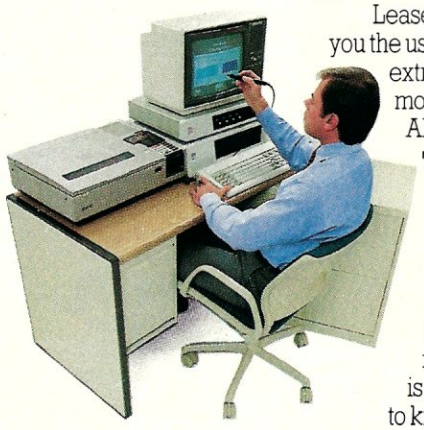

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Upgrading to IEEE-696 Compatibility

How to bring the North Star ZPB board up to modern standards

by Leonard Moskowitz

Back in 1978, I was still in college working towards my degree in electrical engineering. The microcomputer revolution was picking up steam. I labored over the E&L (of Bugbook fame) 8080-based micro in the IEEE student branch lab, spending weeks learning its deepest secrets. The teletype and paper tape reader clattered away for long hours while I slowly realized the power of the plastic and silicon sitting beside me.

That first micro was primitive compared to the IMSAI system sitting in the EE department microcomputer lab. That one was locked up most of the time and in use the rest of the time. Once in a while I'd beg some time on it and try to fathom the mysteries of CP/M 1.3 and EBasic.

Although I was the typical penniless engineering undergraduate, I decided then and there that I would build a computer. It would be modelled on the IMSAI and be able to accept all the boards meant for it. The S-100 bus, the first stab at assuring compatiblity between products from different manufacturers, would make the task easy.

Since North Star was known for its good user support and the Horizon as a solid machine, I bought a North Star ZPB-A1 processor board in kit form. (Alas, since then, North Star has grown. It no longer sells kits, and only talks directly to its dealers).

Over the years, I accumulated a Morrow motherboard and DMA disk controller, and Ithaca InterSystems I/O and 64K dynamic RAM boards. These were all designed to the proposed IEEE-696/S-100 standard (which I'll call "the standard"), so I expected that integration with the North Star board would be a piece of cake. So much for the idealism of youth.

While the Morrow and InterSystems boards had common pinouts and timing requirements, the all-important North Star board was different. Despite being S-100, it was nonstandard. A few calls to North Star, and I concluded that they would be no help. They referred me to local dealers who didn't know a pSYNC from a kitchen sink! I was left to my own resources.

I went to work with a logic analyzer and an oscilloscope. After carefully studying the North Star schematics and timing, I gradually detailed the changes required to bring the board into closer compliance with the standard. The

changes fall into three groups:

1. Modifying the active state and timing of the North Star version of pSYNC.
2. Making sure that those signals which should be disabled during a TMA (formerly called DMA) operation are disabled.
3. Removing signals on pins that were reassigned by the standard.

While doing the detective work, an invaluable reference was *Interfacing to S-100/IEEE 696 Microcomputers* by Sol Libes (the editor of *Microsystems*) and Mark Garetz (of CompuPro). This book describes all of the bus signals and timing in great detail. It also includes a copy of the proposed (now official) standard.

pSYNC

I found only one signal with the wrong state and timing: pSYNC. This signal is found on pin 76 of the bus. The standard describes pSYNC as the control signal defining the beginning of a new bus cycle. It closely follows the rising edge of the system clock which is found on pin 24. pSYNC is high (2.4 to 5.0 volts) when active. It sets just before the address and status buses are stable and remains active for approximately one clock cycle (250 nanoseconds for a 4 MHz Z80A). pSYNC is often used ANDed with pSTVAL (pin 25) to create a valid status strobe.

The North Star pSYNC circuit is shown in Figure 1a. The Z80A has two status outputs, MREQ* and IORQ*. One or the other goes active early in every bus cycle. (The asterisk in MREQ* and IORQ* means that the active state of the signal is low—between 0.0 and 0.7 volts.) They stay set for longer than one clock cycle. The North Star board inverts and ORs these two signals in IC 5F, and clocks the resultant into D flip-flop 5G on the next positive going edge of the system clock. This delays the signal significantly. North Star takes the inverting output of the flip-flop (pin 11) and sends it to a bus driver (7B) for use as the pSYNC signal. So the North Star version of pSYNC is late, too long, and inverted.

The new pSYNC circuit is shown in Figure 1b. I took the ORed output of 5F and routed it to pin 3 of a 74LS122 monostable multivibrator (otherwise known as a one-shot). The one-shot outputs a pulse when either MREQ* or IORQ* goes active. The width of the pulse is determined by Cl. I selected the capacitor to give a pulse width of nominally 250 nanoseconds. To get the proper active state I used the noninverting output (pin 8). For best results use a mica polyester or polystyrene capacitor.

I mounted the new IC in the existing socket 1G. The socket is meant to receive signals from an IMSAI-like front panel. My system doesn't have a front panel, so I cut all eight printed circuit traces going to the socket and used it for the one-shot. The capacitor was soldered on the back of the card between the appropriate pins of the one-shot.

A jumper was added from the output of the OR gate (5F pin 6) and the input to the one-shot (1G pin 3). I cut the trace going from the flip-flop (5G pin 11) to the bus driver (7B pin 6) at the bus driver. I put a jumper between the output of the one-shot to the input of the driver. Make sure to tie pins 4, 5, 9, and 14 to V_{CC} (5 volts) and pins 1 and 7 to ground to enable the one-shot. This completes the pSYNC modification.

TMA signals

During a TMA operation the temporary master floats four buses belonging to the permanent master. The four are the address, data out, status and control output buses. On the North Star board two control output bus signals, pSTVAL and pHLDA, can't be floated. Their bus drivers are always enabled. This can be corrected with a few well-placed cuts and jumpers.

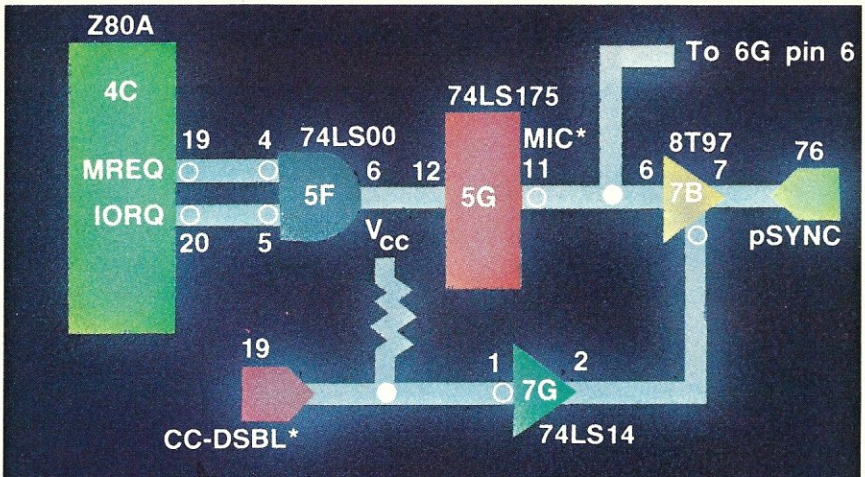


Figure 1a. North Star pSYNC circuit

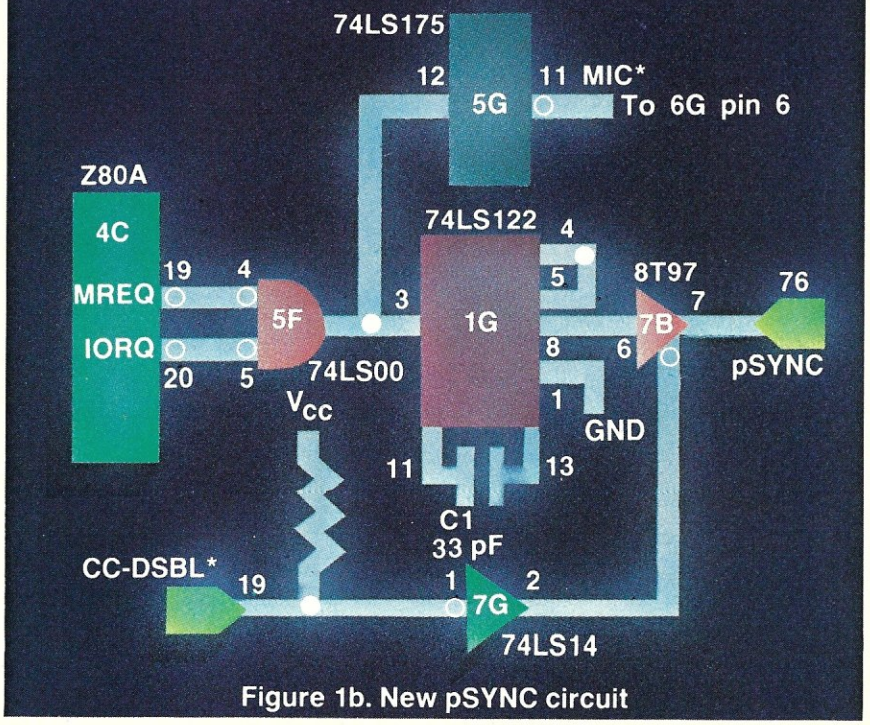


Figure 1b. New pSYNC circuit

N* ZPB

Continued from page 63

The TMA signal modifications are shown in Figure 2. The CDSB* signal, which is used to float the control output bus, disables only one IC, an 8T97 located at position 7B. Luckily, of the six signals assigned to this chip, two are not designated by the standard. Pin 27, which North Star called PWAIT, is an RFU (Reserved for Future Use) line. Pin 65, PMREQ*, the standard calls NDEF (Not to be Defined). To free the drivers used for these signals, the traces going to pins 2, 3, 11 and 12 are cut. pHLDA, which went to 6C pin 6, is jumpered over to 7B pin 12, the bus driver input. The output, 7B pin 11, is jumpered over to pin 26 of the S-100 card edge connector. The signals at pins 6 and 7 of 6C are cut. pSTVAL, which North Star called PHASE 1, is rerouted from 6B pin 12 to a bus driver input 7B pin 2. The bus driver output (7B pin 3) is jumpered to pin 25 of the S-100 card edge connector. The signals at pins 12 and 11 of 6B are cut.

The only other TMA signals unaccounted for are sXTRQ* on pin 58, and the TMA0 1, 2, and 3 lines on pins 55, 56, 57, and 14. These pins are not used on the North Star board and are left floating.

Reassigned signals

A summary of the reassigned signals and the actions required is shown in Table 1.

Some of the signals that North Star assigned are showstoppers. If these signals are not disabled, your computer will not run. One of these is on pin 53. North Star called this signal SSW DSBL*. It was used to disable the input data bus coming from the S-100 bus. It forced the Z80A to take data from the switches on the front panel. As its name implies, it was low when active. The standard defines pin 53 as GND, a primary ground reference. Leaving SSW DSBL* connected to pin 53, the North Star board ignores the S-100 data input bus. Cut it and solder a jumper from pin 53 to pin 70.

Another potentially serious problem is caused by the SSTACK signal on pin 98. North Star tied this line to ground. The standard assigns this pin to the ERROR* signal. Left uncut, this condition would look like a permanent error condition. If your software traps this condition, you would have a most challenging debug session. Needless to say, cut the trace running to pin 98.

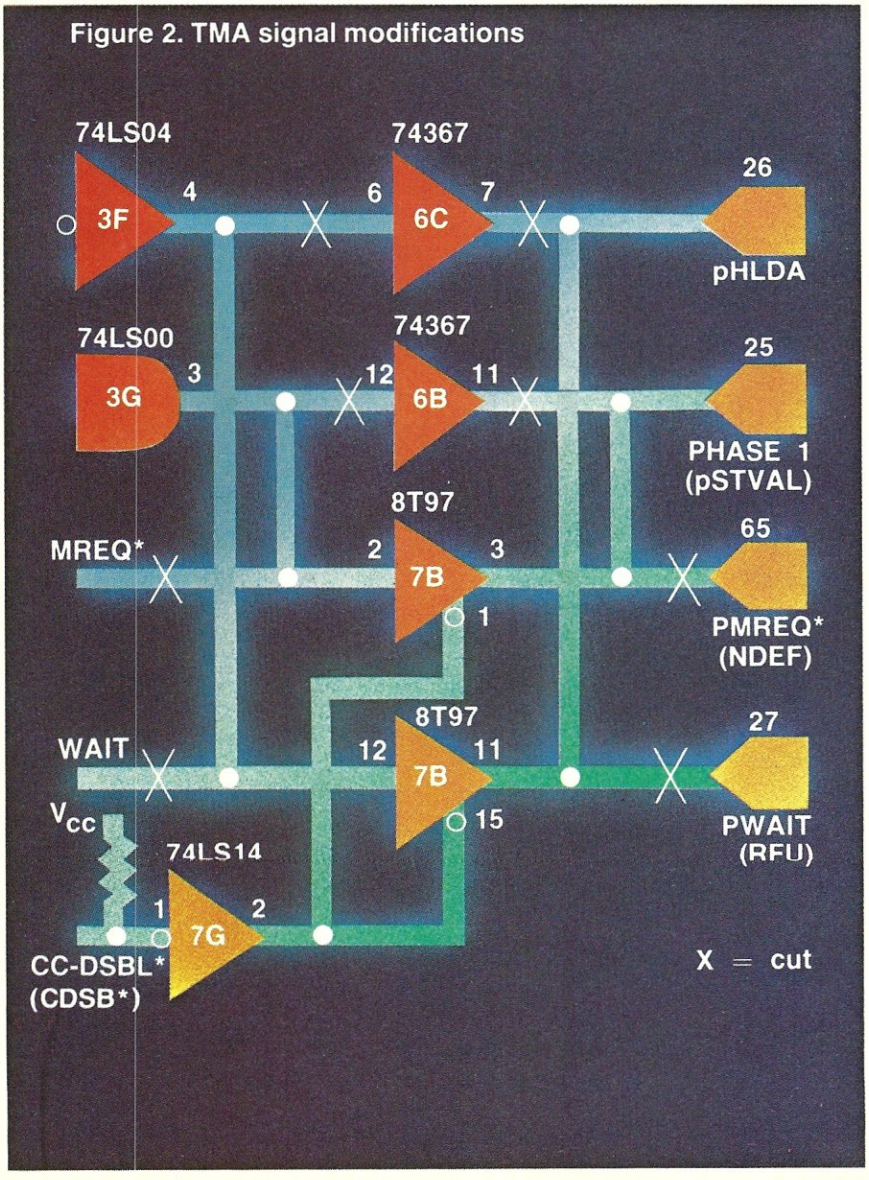
North Star recommends that pins 20 and 70 be used as grounds. The standard requires this, so install the two jumpers that the board provided for. North Star also used pin 61 as a ground. The standard assigns this pin to A20, address bit 20 of the 24 bit address bus. Cut the trace running to pin 61.

Pin 71 has the RUN signal on it. Pin 28 has the PINTE signal on it. The standard reserves both of these for future use (RFU). Cut the traces running to pins 71 and 28.

I cut the trace running to pin 27 as part of the TMA modification. North Star called this PWAIT while the standard reserves it too, for future use.

The signals on pins 21, 65 and 66, the standard calls NDEF. This means that the standard does not define their properties. They may be used by manufacturers as they see fit. The manufacturer must document how the lines are

Figure 2. TMA signal modifications



The teletype clattered away while I slowly realized the power of the plastic and silicon beside me.

N* ZPB

Continued from page 64

used and provide jumpers to disconnect them. The North Star board uses these lines for the SS, PMREQ*, and PRFSH signals. I cut the PMREQ* line as part of the pSYNC modification. The others don't cause any trouble where they are, so I left them as is.

Conclusion

At first the probability of getting my system running with a mix or pre- and post-standard boards seemed nil. Like any tough job, now that it's done, it doesn't seem like it was so hard. The key to success was paying attention to one problem at a time, until they were all whittled away. Best of all for me, the goal set by that engineering undergraduate back in 1978 was finally achieved!

Table 1. Reassigned signal modifications

Pin	North Star signal name	IEEE 696 signal name	Action Required
20	optional ground	GND	install jumper
27	PWAIT	RFU	cut trace to pin 27
28	PINTE	RFU	cut trace to pin 28
53	SSW DSBL*	GND	cut trace to pin 53 and solder jumper from pin 53 to pin 70
61	ground	A20	cut trace to pin 61
70	optional ground	GND	install jumper
71	RUN	RFU	cut trace to pin 71
98	SSTACK	ERROR*	cut trace to pin 98

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Sol Libes and Mark Garetz: *Interfacing to S-100/IEEE 696 Microcomputers,* Osborne/McGraw-Hill, Berkeley, CA, 1981.

North Star Computers Inc.: *Z80A Processor Board ZPB-A Manual,* North Star Computers Inc.: San Leandro, CA, 1980.

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The Engineering Staff of Texas Instruments Inc. Semiconductor Group: *The TTL Data Book for Design Engineers,* 2nd edition, Texas Instruments Inc., Dallas, TX, 1981.

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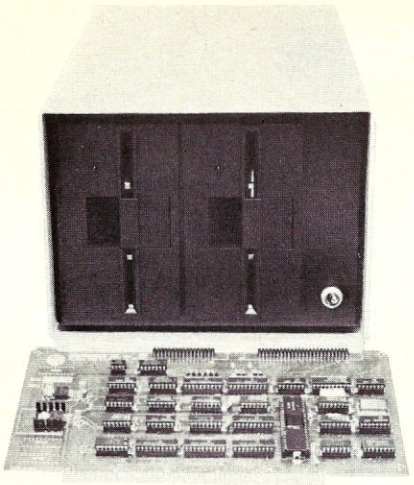

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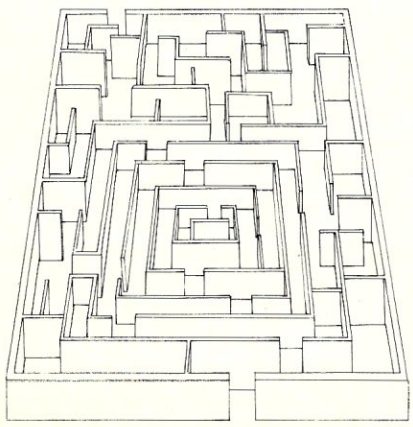
MS-DOS 2.0: An Overview, Part 2

Details of system service requests and error messages



by William G. Wong

MS-DOS 2.0 has many facets. Part 1 described some of the interesting new additions made to the user side. Part 2, which concludes this series, will describe program development under MS-DOS. The three areas covered in this part are the programmer's interface to MS-DOS, program file structure, and field-installable device drivers.

Those familiar with CP/M will see a number of similarities between MS-DOS and CP/M. In fact, MS-DOS 1.x was so close to CP/M-86 that the differences were almost negligible. However, MS-DOS 2.0, although compatible with 1.x, moves towards XENIX—Microsoft's UNIX implementation. To show the major additions in the area of XENIX, the programmer's interface section will describe the CP/M-style function calls separately from the XENIX-style function calls. Although both can be used from within any program, compilers and programmers typically use one set or the other.

The program file structure remains essentially the same as that of MS-DOS 1.x, and is different from that of CP/M. Although programmers let the assemblers, compilers, and linkers build program files, it is often useful to know how a program is stored on disk as well as in memory.

One new advance in MS-DOS 2.0 is the field-installable device driver. This was mentioned in Part 1 in the discussion of the CONFIG.SYS file. CONFIG.SYS is a text file that specifies the system configuration when MS-DOS is initialized. One of the options is to add device drivers; the section on device drivers presented here describes how one can be written.

Programmer's interface

When interfacing to an operating system, one of the first things to examine is the memory layout when a program is running. MS-DOS has the very simple layout shown in Figure 1. This differs from that of CP/M-80 2.2 in that the operating system is located in the lowest portion of memory, not the highest. The advantage is that the system is always in the same place—adding more memory does not require the user to relocate the system. MS-DOS includes the interrupt vectors, the Basic Input/Output System (BIOS) which is customized for each different machine, and the Disk Operating System (DOS) which is the same for each machine.

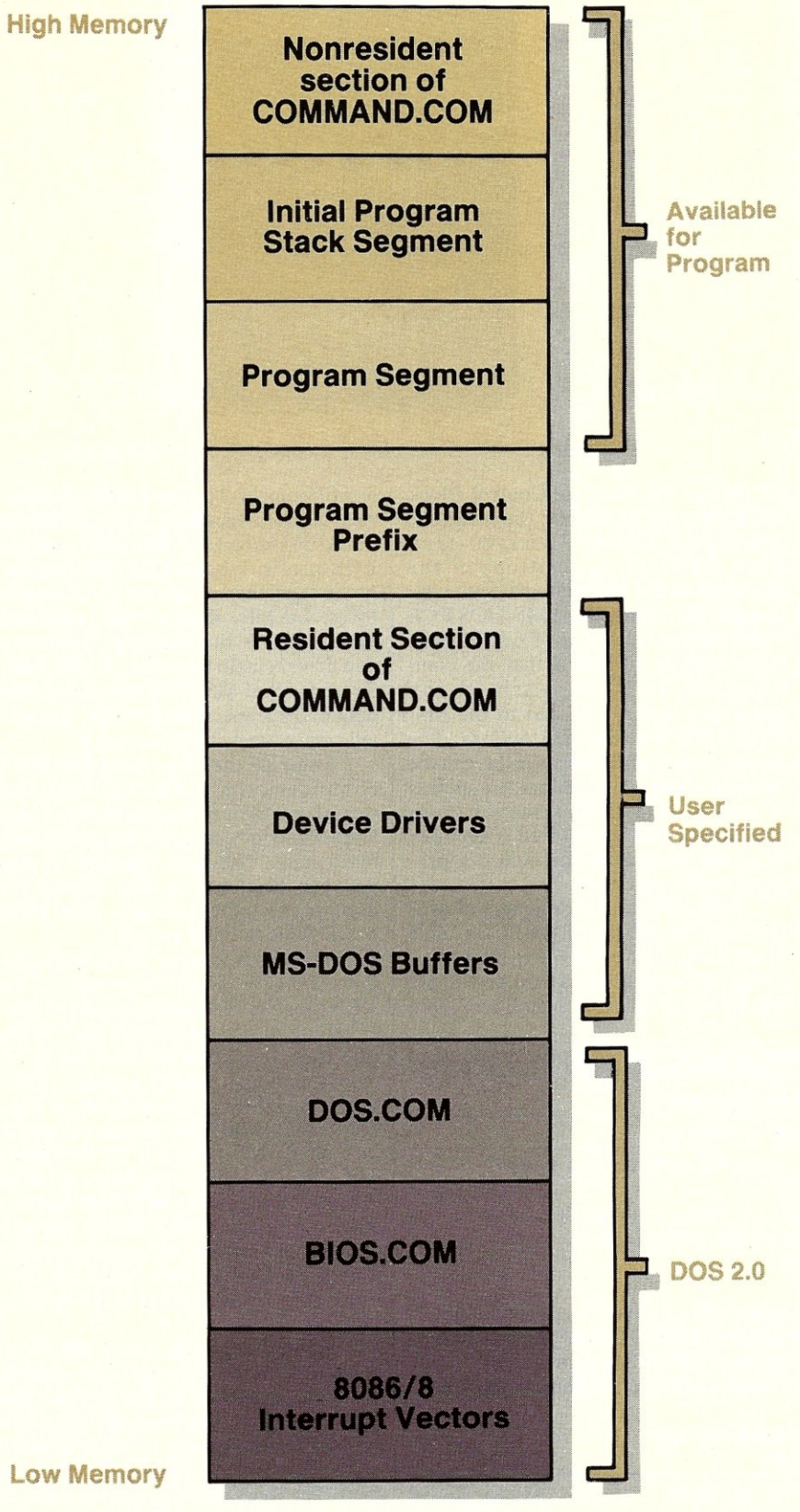


Figure 1. MS-DOS 2.0 memory layout.

DOS is essentially the core of MS-DOS 2.0. The buffer areas and device drivers are also part of MS-DOS 2.0, but are specified by the user with the aid of the CONFIG.SYS file.

Above this comes the resident section of the console command processor (CCP)—the program which presents you with the system prompt, accepts commands from the keyboard, and loads and runs other programs in response to keyboard commands.

The MS-DOS 2.0 CCP (COMMAND.COM) is divided into two sections to increase the amount of memory available to a transient program that is started by the CCP. The resident section is loaded in low memory, the nonresident section in high memory. When the transient program terminates, the CCP regains control. At this time, the resident portion of the CCP checks to see if its nonresident portion is intact, using a checksum process. If the transient program used any space allocated to the nonresident portion of the CCP, the resident portion loads a new copy of the nonresident portion from the system disk.

MS-DOS 1.x was so like CP/M-86 that differences were almost negligible.

In the middle is the program segment and prefix. Note that "program segment" does not refer to the 8086/8 memory segment (which is limited to 64K), but to the transient program that is loaded from a disk file by the CCP or by a program that previously occupied the program segment.

The program prefix section is initialized by the CCP when it loads a program; it contains useful information about the operating system linkages and the command line entered to start the program. Table 1 shows the layout of this area of memory. Notice how closely it matches the first page of a CP/M 2.2 memory map. For example, offset 0 contains an INT 20 instruction which, if executed, terminates the program. This is similar to the CP/M jump to the termination routine (warm boot). Like-

MS-DOS, PT. 2

Continued from page 69

wise, location 5 (the normal CP/M BDOS entry point) can be used as an entry to MS-DOS, but only for the CP/M-like functions (0-24H).

This is actually a very peculiar entry point because it is called using an 8086/8 intrasegment (short) call. The location contains an intersegment (long) call with no return following it. This may seem strange, but stack manipulations replace the long return offset by the return offset from the short call. MS-DOS then does a long return to the calling program when the processing of the function is complete. Why it only works with some functions is a mystery.

In MS-DOS 2.0, the OS is located in the lowest part of memory, not the highest.

MS-DOS also has a long call entry point at offset 50 (hex). This can be used with *all* MS-DOS functions. This was not supported in MS-DOS 1.x, so any use of this entry point makes downward compatibility difficult.

The other three areas which match CP/M are the two File Control Block (FCB) areas at 5C and 6C (hex) and the default Disk Transfer Area at 80 (hex). Even the relative positions of the filenames in the FCBs are the same, although other parts of the MS-DOS FCB format differ from that of CP/M. One other item of interest is that the command line/FCB setup excludes any characters that are related to the MS-DOS 2.0 I/O redirection options. The default input and output files can be designated using pipe characters such as < and >. MS-DOS removes these characters and associated filenames from the command line before a program begins execution.

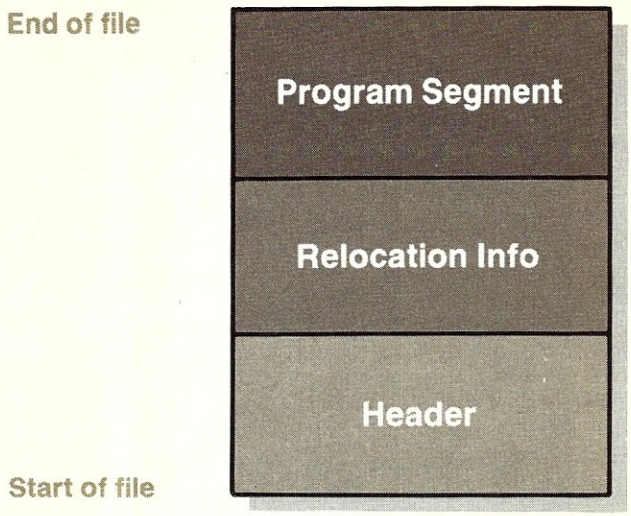


Figure 2. MS-DOS .EXE program file structure.

FCB layout. The designers of MS-DOS deliberately made the FCB (Table 2) similar to that of CP/M to allow easy program migration from the 8-bit CP/M world but, as we shall see, there are differences. The most striking difference is in the handling of file attributes in the disk directory: MS-DOS uses the FCB prefix, whereas CP/M uses the most significant bits of the filetype bytes. Luckily, most of the important items such as the filename, extension, and drive remain the same. Another difference is that MS-DOS will change the default drive specification (0) to the specific drive when a file is opened.

Some of the important MS-DOS enhancements to the FCB are the record and file size specifications. These allow a file to be an arbitrary number of bytes long. The date function is also very beneficial, but usually requires the user to enter the time and date when MS-DOS is initially started.

The FCB is used only with the CP/M-style file functions. The XENIX-style file functions, on the other hand, can also perform all the CP/M-like functions, but without an FCB. This functional duality assists in program portability, allowing both MS-DOS and XENIX programs to coexist in a single MS-DOS 2.0 environment. The XENIX-style functions use a 16-bit "handle" assigned by MS-DOS to keep track of a particular file. MS-DOS keeps an internal FCB for each unique handle. The XENIX-like functions are discussed in more detail later in this section.

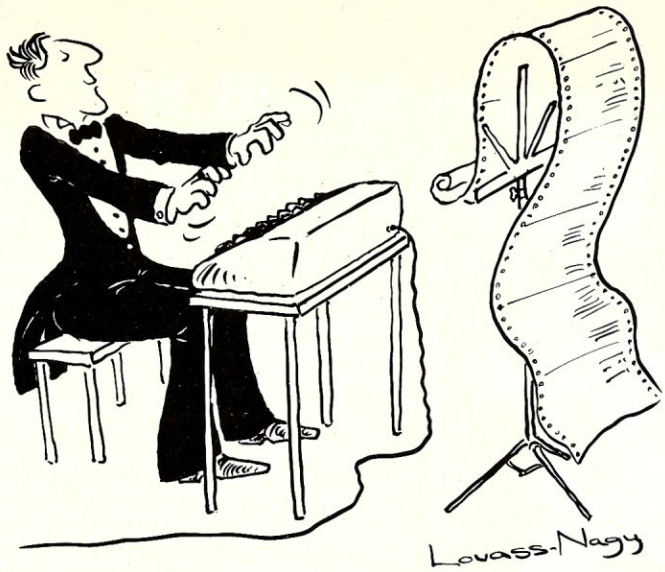
Service requests. There are three ways in which a program can request service from MS-DOS. The first two use entry points in the program segment prefix (Table 1) with an 8086/8 short call (offset 5 hex) or long call (offset 50 hex). The third method uses the 8086/8 interrupt structure. MS-DOS supports a number of program interrupts as well

Table 1. Program segment prefix

Offset	Size	Description (Offset and sizes in hex)
80	80	Default disk transfer area with inital command line
7C	4	Reserved by MS-DOS
6C	10	FCB with second filename from command line
5C	10	FCB with first filename from command line
2C	30	Reserved by MS-DOS
16	16	Unused by MS-DOS
12	4	Critical error exit address (8086/8 Offset/Segment Value)
E	4	Control-BREAK exit address (8086/8 Offset/Segment Value)
A	4	Termination address (8086/8 Offset/Segment Value)
5	5	Long call to MS-DOS function dispatcher (functions 0-24)
3	2	Reserved
1	2	Top paragraph of available memory
0	1	INT 20 hex instruction

Offset 50 (hex) is a long call entry to the MS-DOS function dispatcher for all functions. This is not compatible with MS-DOS 1.x.

A program should not modify any locations below 5C (hex).



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as the hardware interrupts; these are shown in Table 3a. INT 20 and 21 are the ones of interest at this time. The others allow access to the BIOS routines. Tables 3b and 3c show some of the additional error codes associated with some of these routines (INT 24). Most programs will deal with the BIOS through the MS-DOS function call via INT 21.

These function calls are normally used by a program to access any device or service supported by MS-DOS. Although some programs may access I/O ports directly, these operations are normally restricted to special communications equipment or special hardware added from a vendor. Typical system devices such as disks, keyboard, and the display are handled directly for a program by MS-DOS.

Table 4 shows the grouping normally used with the MS-DOS function codes. Each of these functions is described in more detail later in this section. In addition, Table 5 shows the general error response codes for these functions. Table 6 shows the default XENIX-style file handles, which are predefined whenever a program is running. These can be used only with the XENIX-style functions. The CP/M-style functions will be discussed first, since their function code numbers come first.

MS-DOS keeps an internal file control block (FCB) for each unique handle.

Calling sequence. Before describing the MS-DOS functions, we need to look at exactly how the functions can be invoked. To use the entry point in the program segment prefix at offset 5 (functions 0-24H only), place the function code in the CL register. Both the entry point at offset 50H and the INT 21 entry method require the function code in the AH register. Some functions use other registers as well; the function descriptions that follow will indicate

Table 2. MS-DOS FCB format

Offset	Size	Description	Modified by
-7	1	0FF hex	program
-6	6	Reserved (must be zero)	program
-1	1	File attribute	program/MS-DOS 2.0
0	1	Drive number (0-16)	program/MS-DOS 2.0
1	8	File or device name	program
9	3	File extension	program
12	2	Current block	program
14	2	Record size in bytes	program
16	4	File size in bytes	MS-DOS 2.0
20	2	Date	MS-DOS 2.0
22	10	Reserved	MS-DOS 2.0
32	1	Current record	program/MS-DOS 2.0
33	4	Random record number	program/MS-DOS 2.0

Offset and size are in decimal.

Fields with negative offsets are only used with specific MS-DOS directory functions.

Table 3a. MS-DOS interrupt table

Interrupt (hex)	Description
20	Terminate program; the CS segment register should point to the program segment prefix
21	MS-DOS function calls
22	Copy of the terminate address in the program segment prefix
23	Copy of the control-BREAK exit address in the program segment prefix
24	Critical error handler AH bit 7 is 0 for disk-related error DI bits 0-7 are the error code Stack is set for IRET instruction Return function in AL is: 0 = ignore error 1 = retry operation 2 = terminate program by INT 23
25	Absolute disk read AL is disk drive number (A=1, B=2) CX is the number of sectors DX is the first logical sector number DS:BX is the memory buffer address
26	Absolute disk write (like disk read)
27	Terminate program but stay resident
28-3F	Reserved by MS-DOS

Table 3b. INT 24 error codes (decimal)

Error code	Description
0	Write to write-protected disk
1	Unknown unit (device)
2	Disk drive not ready
3	Unknown command
4	Data error (usually bad CRC)
5	Bad request structure length
6	Seek error
7	Unknown media type
8	Sector not found
9	Printer out of paper
10	Write fault
11	Read fault
12	General failure

Table 3c. INT 25 and 26 error codes (decimal)

Error code	Description
0	Error other than one listed in table
2	Address mark not found
3	Write to write-protected disk
4	Requested sector not found
8	DMA overrun
16	Bad CRC on read
32	Controller failure
64	Seek failed
128	Device failed to respond

The above error codes are returned in AH if CR is 1. AL has an error code found in Table 3b.

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which additional registers are used and what function information they must contain.

Table 7 shows the CP/M-style character (and some file) functions. These are almost identical to their CP/M counterparts, right down to the parameter passing and buffer formats. Anyone who is used to CP/M will feel right at home with these functions. The file functions use the FCB format described before. Table 8 shows the rest of the CP/M-style file management functions that use an FCB. These functions differ from the XENIX-style functions described later in that files named in an FCB refer to the current directory on the specified drive. Changing the current directory after a file is opened does not change the file being referred to. Most of the initial MS-DOS programs used these functions exclusively.

MS-DOS FCBs are similar to CP/M's to allow easy program migration from the 8-bit world.

Table 9 shows the functions that are unique to MS-DOS. Some deal with aspects of the 8086/8 such as the interrupt vectors. There are also some enhancements such as the block read and write functions. These allow multiple records to be read from anywhere in the file. Parsing the filename is a function that has always been used by CCPs on many systems, and MS-DOS brings this function out so programs do not have to duplicate it. The rest of the functions deal with the time and date kept by MS-DOS.

The control system support functions listed in Table 10 extend the functions shown in Table 9. Many of these functions simply allow a program to find out the current status of such items as the current Disk Transfer Area (DTA) address. This is called the DMA address in CP/M, but is not directly available from CP/M-80 2.2. It is also possible to get at the interrupt vectors and the free space on a disk. There are not many surprises in these functions, although they are very useful. One useful item, which allows customization of programs at runtime from the operating system, is the function (38H) that returns country-dependent information. Spreadsheet or accounting programs can easily adjust to the user without having to ask them their preferences.

The new and interesting functions are the XENIX-style functions. Table 11 shows a few of the file management functions. The hierarchical directory structure is one of the XENIX/UNIX trademarks, and MS-DOS 2.0 inherits this. These new functions allow access to and modification of this new directory structure, and provide a new method of indicating what file is being used.

The new file indicator is just 16 bits (one word) long and is referenced in a register the same as the FCB index for the CP/M-style file functions. Filenames are also stored differently. Instead of a fixed format in the FCB, the XENIX-style functions use a zero-terminated string (ASCIIZ) up to 64 bytes long, which contains a list of directory names and a filename separated by a backslash. These "path" names, described in Part 1 of this series, are identical to the ones used in the ASCIIZ strings.

Table 4. MS-DOS function groups

Function (hex)	Description
0-12	CP/M-style character device support
12-24	CP/M-style file management support
25-2E	MS-DOS system support
2F-38	MS-DOS control system support
39-47	XENIX-style file management support
48-4B	XENIX-style memory management support
4C-57	XENIX-style file management support

Table 5. MS-DOS function error result (decimal) table

Error code	Description
1	Invalid function number
2	File not found
3	Path not found
4	Too many XENIX-style files open
5	Access denied
6	Invalid XENIX-style file handle
7	Memory control blocks destroyed
8	Insufficient memory
9	Invalid memory block address
10	Invalid environment
11	Invalid format
12	Invalid access code
13	Invalid data
14	Reserved
15	Invalid drive
16	Attempt to remove the current directory
17	Same device not specified
18	No more files

Code contained in AX if carry flag (CF) is set.

Table 6. Predefined default XENIX-style file handles

Handle (hex)	Description
0000	*Standard input device
0001	*Standard output device
0002	Standard error output device
0003	Standard auxiliary device (input/output)
0004	Standard printer output device

**Can be redirected from console by command line parameters.*

This approach greatly simplifies file access. To open a file you only need the filename in a simple string format; no parse function is required. You give this to MS-DOS and you get back a "handle." All future references to the file are done using the handle. It is fast, efficient, and easier than having to allocate and keep track of an FCB.

But what is MS-DOS really doing? Well, it has a set of FCBs of its own, which it uses as a program opens files. The handle is the method by which the proper internal FCB is accessed. MS-DOS handles all the internal FCB support. In fact, the internal FCB format does not have to match the FCB format used by CP/M-style function. Actually, the internal FCB format is not described in the documentation and is not really necessary.

In any case, the XENIX-style file access functions also differ in that the buffer size and location is not set up separately using the CP/M-style DTA address and FCB fields. Instead, these parameters are passed as part of one function. There is now no confusion as to what value the DTA has or should have, since each file access function call passes this information at the time the call is made.

One difference between CP/M- and XENIX-style functions is that XENIX-style I/O is done via the file system.

Hiding the internal FCBs also allows two other very useful functions. The first (function 45 hex) lets you take one file and refer to it with two handles. This means that you can open a file, let one procedure work with a copy of it, and still retain a separate reference to it without having to control who has access to the internal FCB. MS-DOS takes care of it.

The second function (46 hex) does just the opposite. Given a file handle which is already set up, you can redirect transfers to a new file simply by giving MS-DOS both handles. Any procedure already using the changed handle will see the new file. No need to tell it.

Another difference between the CP/M-style and XENIX-style functions is that all XENIX-style I/O is done through the file system. Console and printer I/O is done through files using device names or default handles that are predefined for these devices. This uniformity really helps when trying to develop generic programs, since all I/O is done through the file system. If you want to use a device instead of a file, just change the filename or handle. This is easier than having to support different access methods for devices and files, as is done with the CP/M-style functions.

XENIX/UNIX is closely tied to the C language, which supports dynamic memory allocation, chaining and overlays. Other languages also support these features, so MS-DOS was designed to include this support in a fashion easily integrated into these compilers. The functions listed in Table 12 are

Table 7. CP/M-style MS-DOS 2.0 functions 0-12 (hex)

Function code	Description
0	Terminate program (same as INT 20)
1	*Return keyboard character in AL after displaying the character on the console
2	*Display character in DL on the console
3	Return character in AL from auxiliary device
4	Output character in DL to auxiliary device
5	Output character in DL to printer
6	Direct console I/O with DL as follows: 0FF hex: return keyboard input or 0 0-0FE hex: display character on console
7	Direct keyboard input to AL without displaying the character on the console
8	*Return keyboard input to AL without displaying the character on the console
9	*Print string indexed by DS:DX until a dollar sign (24 hex, $) is encountered
A	*Buffered keyboard input; DS:DX indexes the buffer *Buffer offset:* 0 = maximum string size 1 = size of string entered 2 = first character of the string
B	*Return keyboard input status in AL: 000 hex indicates no character available 0FF hex indicates a character is available
C	Clear keyboard input buffer and execute keyboard input function in AL (1,6,7,8, or A)
D	Disk reset, flush all file buffers, no result
E	Select disk in DL (A=0, B=1, etc.). Returns the total number of drives in AL.
F	Open file, DS:DX indexes a CP/M-style FCB; returns 0 in AL if file opened, otherwise 0FF (hex). An opened file has the drive code set; the current block is zeroed; the record size is set to 80 hex; and the file size and date are set
10	Close file; DS:DX indexes a CP/M-style FCB. Returns 0 in AL if the file was closed and 0FF hex if an error occurred.
11	Search for the first filename matching the unopened FCB indexed by DS:DX where a "?" matches any character. The results are placed in the disk transfer area if AL is 0 upon return, indicating success. A 0FF hex is returned in AL if no file is found.
12	Search for the next matching filename starting from the last one found by the last MS-DOS function 11 or 12. The results are the same.

**The control-BREAK routine is called if that character is entered.*

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the MS-DOS memory management support functions. Memory blocks in MS-DOS are allocated in terms of 8086/8 paragraphs; a paragraphs is 16 bytes, and all 8086/8 segments are aligned to a paragraph boundary. The functions are designed with this in mind.

A memory block is some integral number of paragraphs. A block has a starting address and size, which is kept by MS-DOS. Multiple blocks of memory can exist. When a program is started, it is allocated all free memory from its base to the top of memory. A program doing memory allocation should adjust its initial memory block size to the minimum, thus freeing up space. Subsequent allocation can then be done from this space. The free space can be broken into smaller blocks, depending upon the allocation requirements.

The CP/M-style functions do not give you full control over the advanced MS-DOS directory system.

This set of MS-DOS functions also includes a method to load and possibly execute a program from a file. The function (4B hex) operates in either mode, depending upon its parameters. Loading overlays can be done without executing them at that time, in which cases the file is usually loaded into the current memory block. Loading and executing a program is normally done in another block allocated from free space. This keeps the loaded program within a manageable area. Unfortunately, there are no guarantees that the program stays in this space, since the 8086/8 has no memory management hardware. In any event, this protocol is still very useful.

Table 13 wraps up the XENIX-style functions and the MS-DOS 2.0 functions. These are primarily file management support functions which match operations in the CP/M-style

Table 8. CP/M-style MS-DOS 2.0 functions 13-24 (hex)

Function code	Description
13	Delete file using the FCB indexed by DS:DX. Returns 0 in AL if delete succeeded and 0FF hex if the file does not exist.
14	Read the next sequential record from the file using the FCB indexed by DS:DX into the disk transfer area. Returns result in AL. 0 = operation successful 1 = end of file, no data record 2 = disk transfer area too small 3 = end of file, partial record read
15	Write the next sequential record in the file using the FCB indexed by DS:DX from the disk transfer area. Returns result in AL. 0 = operation successful 1 = disk full 2 = disk transfer area too small
16	Create new file using FCB indexed by DS:DX. Returns 0 in AL if the file is created and 0FF hex if there is no free directory entry
17	Rename file. DS:DX references an FCB that contains the old filename. The new filename is located 6 bytes after the end of the old file extension. Returns 0 in AL if the rename succeeded and 0FF hex if it fails.
18	Reserved
19	Returns the current disk in AL (A=0, B=1, etc.)
1A	Set the disk transfer address to DS:DX
1B	Returns the default drive allocation table information. DS:BX references the FAT identification byte DX = number of disk allocation units CX = physical sector size in bytes AL = number of sectors/allocation unit *Note: 2.0 does not keep the FAT resident.*
1C	Identical to function 1B, except DL contains the drive number to be used
1D-20	Reserved
21	Random read from the FCB referenced by DS:DX into the disk transfer area using the random record number. Same results as function 14.
22	Random write to FCB referenced by DS:DX from disk transfer area. Similar to function 21.
23	File size for the file indicated by the FCB referenced by DS:DX is placed into the random record number of the FCB depending on the record size. Returns 0 in AL if file exists, otherwise 0FF hex.
24	Set random record number in an opened FCB referenced by DS:DX depending upon the current record number and record size

functions but use the new handles and ASCIIZ strings. Note that the parameters for a particular function include all necessary information for its operation. Although some function operations are paired, like the Search First (4E hex) and Search Next (4F hex), these are really not operations that require multiple function calls to get a job done.

You can use any mix of MS-DOS functions when writing programs, but it is best to stick to either the CP/M style or XENIX style. Using both can be confusing at best. The two actually contain the same functionality, so using one or the other should not be too much of a burden. However, the CP/M-style functions do not give you full control over the advanced MS-DOS directory system. Only the XENIX-style functions let you change directories and move (rename) filenames between directories—so use the XENIX-style functions if you want these capabilities.

Many of these concerns are restricted to the portability and functionality for assembly language routines. Portability is a two-edged sword: It depends on where you want to go. Moving to CP/M is obviously easier

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using CP/M-style functions; likewise, moving to XENIX/UNIX works best with XENIX-style functions. All bets are off if you want to go to IBM's VM. If you are writing just for the MS-DOS world, then functionality is the issue. Many existing applications do not completely support the more complex MS-DOS directory system, yet still provide excellent support to the user. There is much to be gained by supporting multiple directories, and new applications are doing so. In any case, it is best to consider these questions before writing the program.

Program file structure

MS-DOS programs are stored as files with either an .EXE or a .COM file extension. The major difference between the two is that the .EXE files are completely relocatable, while the .COM files have been set up to load into a fixed segment area. The other difference is that the .COM files are more limited in terms of memory space. For example, a .COM file does not specify a stack segment. Instead, the default stack segment set up by MS-DOS is used.

The .COM files are like the .EXE files, except that all relocation information has been removed. A .COM file can be created directly from some linkers, or by processing an .EXE file, using the program EXE2BIN. This program performs the required relocation and removes relocation information from the resulting file—thus the .COM file is smaller than the corresponding .EXE file. The reduction in file size also reduces the loading time. Note, however,

Portability is a two-edged sword: It depends on where you want to go.

that the maximum file size is 64K. Although the .COM file is smaller and can be loaded into any segment of the 8086/8, the .EXE files are more flexible.

Figure 2 shows the overall structure of the .EXE file. The two leading sections make the difference between it and the .COM file. The program segment is what is actually loaded into memory, and the relocation information is used to modify this image before running the program. This allows a program to be placed anywhere in memory, adjustments being made at load time. This relocation also means that a file can be much larger than the .COM version and contain separate sections for each segment.

Table 14 shows the header in a .EXE file. This specifies where the program is to start and where the program stack is located. The .COM version must execute the first instruction loaded, and it uses the default stack set up by MS-DOS. The .EXE file also indicates what amount of memory is needed over and above the program itself. This allows the system to determine if sufficient memory is available before a program is loaded instead of having the program do this after it is running.

The relocation process done at load time is fairly simple. First the file header is read and its information is saved where it will not be overwritten when the program is loaded. This information is used to locate the program segment. This section of the file is then loaded into the appropriate area in memory. The relocation information is then read and processed entry by entry. Each relocation entry is four bytes: two of these specify a segment (paragraph) offset; the other two, the offset within the segment. This value is used to index a word in the program segment which is to be adjusted. The adjustment is to add the load segment value to the word.

The program is loaded and ready to run at this point. The file is closed and control returns to the appropriate point. Although the CCP (or another program) can load and run a program, the .EXE file allows a more complex setup process that is better suited to handling

Table 9. MS-DOS 2.0 functions 25-2E (hex)

Function code	Description
25	Set the interrupt vector number specified by AL from DS:DX
26	Create a new program segment prefix at the segment referenced by DX. The information is taken from the current program segment prefix (superceeded by function code 4B hex).
27	Random Block Read using the FCB referenced by DS:DX for CX records into the disk transfer area. Results are the same as function 14.
28	Random Block Write using the FCB referenced by DS:DX for CX records from the disk transfer area. If CX is 0, then the file size is set to the size indicated by the random record number and space is freed if the file is made shorter.
29	Parse filename from string referenced by DS:SI into an FCB referenced by ES:DI using the parameters indicated in AL as follows: *Bit* 0 = 1; skip leading separators 1 = 1; set drive number only if specified 2 = 1; only change file name if one is found 3 = 1; only change extension if one is found *Results are:* DS:S1 references the next character ES:D1 references the FCB AL is 000 if file parsed 001 if file parsed and a ? or * was found 0FF if the drive specified is invalid
2A	Get date; returns with CX:DH:DL as year:month:day
2B	Set date where CX:DH:DL has date as in function 2A and returns with 0 in AL if set and 0FF if the date is not set because it is invalid
2C	Get time; returns with CH:CL:DH:DL as hours:minutes:seconds:(seconds/100)
2D	Set time using function 2C format. Returns 0 in AL if time set and 0FF if invalid
2E	Set disk write/verify switch to value passed in AL (0=off, 1=on). DL must be 0.

large and sophisticated programs.

Device drivers

Device drivers have always been the system integrator's headache—their integration is part of a system generation process which is usually left to an expert. Unfriendly operating systems require new device drivers to be patched into the existing operating system; this is usually accomplished by changing absolute locations in the operating system so that the new device driver will be recognized and supported. This integration requires intimate knowledge of the operating system. The problem comes when a new version of the operating system is released; if the absolute locations change, the device driver no longer works. Worse yet, putting two different drivers in at the same time can cause a conflict, because both will try to change the same locations.

Device drivers are separate program files similar to .COM files.

MS-DOS 2.0 solves these problems by allowing "field installable" device drivers. These drivers are essentially separate programs with a fixed interface to MS-DOS. The standardization allows a new piece of hardware to be supported by a single device driver. This driver can be included in the system by having the program file on the boot disk and placing a DEVICE command in the CONFIG.SYS file, which MS-DOS inspects when the system is first initialized. The device driver is loaded by MS-DOS, and MS-DOS, not the device driver, makes the appropriate linkages so programs can access the driver.

Moving this linkage process into MS-DOS allows multiple drivers from different vendors to be used at the same time. They may coexist since there is a standard interface to MS-DOS, controlled by the operating system, which keeps them from stepping on each other's toes. It does not prevent multiple drivers from using the same interrupt hardware, but properly written drivers should not do this.

By now you may be wondering why in the world we would want to add device drivers at will. Doesn't MS-DOS 2.0 have everything you would ever want? Well, not quite. For example, hard disk drives, tape backup units, communication ports and local area network interfaces are just a few of the useful items that are available from other sources. Also, putting every option in the world into MS-DOS 2.0 would lead to an extremely large system. Forget the 128K memory—you might use up to 512K for such a monster. Instead, the field-installable device drivers let you add what is required. Now that this has been cleared up, we can examine how one of these drivers is put together.

Field-installable device drivers let you add what options are required.

Device drivers are separate program files similar to .COM files except that the program base should be 0 (instead of 100H as it is for .COM files). This is because device drivers do not have a program segment prefix. However, at the start of the program segment is a special device header used by MS-DOS to link the device driver to the operating system at load time. This linkage is used when the driver is accessed. Table 15 shows the format of the device header.

Device drivers can be distinguished and associated by the name contained in the device header. The header also contains information describing the type and mode of operation of the device. There are two types of device drivers: character and block. Character devices are for units like the keyboard, console,

Table 10. MS-DOS 2.0 system control functions 2F-38 (hex)

Function code	Description
2F	Get Disk Transfer Address (DTA) in ES:BX.
30	Get DOS version number in AL:AH (2:0)
31	Terminate process and remain resident
32	Reserved
33	Set or return control-BREAK check status AL = 0; return current state in AL AL = 1; set current state from DL 0 = off 1 = on
34	Reserved
35	Return interrupt vector whose number is given by AL in ES:BX
36	Return disk free space for the disk specified by DL (0=default, 1=A, 2=B, etc.) in: AX = sectors/cluster or 0FFFF hex for invalid drive BX = cluster that are free CX = bytes/sector DX = total number of clusters on drive
37	Reserved
38	Return country-dependent information. AL must be 0 and DS:DX references a 32-byte block which receives the following information: *Offset* *Bytes* *Description* 0 2 Date/time format 0 = USA h:m:s m/d/y 1 = Europe h:m:s d/m/y 2 = Japan h:m:s d/m/y 1 1 Currency symbol 2 1 Thousands separator 3 1 Decimal separator 4 27 Reserved

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and communication ports. Block devices include disk drives and possible LAN interfaces.

After the device driver is installed, MS-DOS communicates with it, using the strategy and interrupt routines referenced in the device header. These routines are accessed using a long call instruction. The routines must preserve all registers, initially using the system stack; but a device driver must switch to an internal stack if more space is needed.

Access to a device is started by placing a reference to a Request Header block in ES:BX and then calling the strategy routine. The device driver must save this index and return using a long return instruction to match the corresponding call. A subsequent call to the interrupt routine with no parameters is made. The device driver must then examine the request block whose index was saved by the previous strategy routine call and process it accordingly. The interrupt routine will then return, also using a long return instruction.

WINDOWing adds multiple programming via nonoverlapping windows.

That is all there is to the linkage process. Obviously the actual device support can be much more complex. The device can be accessed any number of times, and the driver remains resident all the time. Keeping the process simple and constant alleviates many of the problems normally encountered when implementing a device driver. Although most of the work deals with the device, the interrupt routine and request header support may be a significant part.

Table 16 shows the basic request header format. The additional information at offset 13 varies depending upon the command code. The various options can be found in the MS-DOS documentation. Essentially, the command-specific information provides details need-

Table 11. XENIX-style MS-DOS 2.0 functions 39-47 (hex)

Function code	Description
39	*Create subdirectory (MKDIR) using the string referenced by DS:DX. The path must exist; there must be sufficient directory space; and duplicates are not allowed.
3A	*Remove directory (RMDIR) using the string reference by DS:DX if found. It must not be the current directory.
3B	*Change current directory (CHDIR) using the string reference by DS:DX. The directory is not changed if the new one is not found.
3C	*Create a file (CREAT) using the string referenced by DS:DX and the file attribute contained in CX. Returns the file "handle" in AX with CF reset if file created.
3D	*Open a file using the string referenced by DS:DX where AL contains the access code: 0 = open file for read operations only 1 = open file for write operations only 2 = open file for read and write operations
3E	*Close file whose handle is in BX
3F	*Read from file whose handle is in BX for CX bytes into buffer referenced by DS:DX. Returns CF reset and the number of bytes read in AX if no error occurs.
40	*Write to file whose handle is in BX for CX bytes from the buffer at DS:DX. Similar to function 3F.
41	*Delete (UNLINK) file named in string referenced by DS:DX
42	*Move file read/write pointer (LSEEK) for the file whose handle is in BX to a new position depending the on function code in AL. *Function codes are:* 0 = relative to start of file 1 = relative to current position 2 = relative to end of the file where the offset is contained in CX:DX. The new location is returned in DX:AX.
43	*Change file mode (CHMOD) for filename in the string referenced by DS:DX to that contained in CX if AL is 1. Returns the current file mode in CX if AL is 0.
44	*Device I/O control (IOCTL). Execute function contained in AL on the file whose handle is in BX. Returns with AX set to the number of bytes transferred. *Function codes are:* 0 = DX gets device information word 1 = set device information word from DX 2 = read CX bytes to buffer at DS:DX 3 = write CX bytes from buffer at DS:DX 4 = same as function 2 with drive number in BL (0=default, 1=A, etc.) 5 = same as function 3 with drive number 6 = return input status 7 = return output status
45	*Return duplicate file handle of BX in AX
46	*Make file whose handle is in CX refer to the same file whose handle is in BX. The file referred to by CX is closed if it had been opened.
47	*Get current directory for drive specified in DL (0=default, 1=A, etc.) into 64-byte buffer referenced by DS:SI.

**Result from Table 5 is returned in AL if the carry flag (CF) is set, indicating an error occurred. All strings used are terminated with a zero.*

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ed by the command, such as output buffer location and size.

MS-DOS sets up the request header before calling the interrupt routine. The accessing method is the same for both block and character mode devices; only the command codes change. Some codes are used by both block and character modes; others are used exclusively by one or the other.

Block mode devices can be used as directory file units and are typically disk drives. Designation is by unit number, which corresponds to the driver letter normally used with filenames. Character devices, on the other hand, have filenames and are accessed a character at a time.

MS-DOS 2.0 is a bridge between CP/M and UNIX.

Designing and implementing an MS-DOS 2.0 device driver is not very difficult for anyone familiar with device drivers and assembly language. It is definitely not a first project for novice programmers, but MS-DOS reduces the integration process to a manageable problem. Designing a device driver to handle interrupts and device-related items still takes a good bit of work, but at least MS-DOS will help you, not put obstacles in your path.

Summary

MS-DOS 2.0 has many features not previously found on microcomputers. The addition of the XENIX-style functions and hierarchical disk directory structure will lead to more powerful and flexible applications. Although the number of system functions is quite large and somewhat redundant, it represents a good compromise because of compatibility.

MS-DOS 2.0 is a bridge between CP/M and XENIX/UNIX. It is not completely compatible with either, but is close enough to make the movement of applications to or from either a palatable job. Most programs that ran on MS-DOS 1.x will work with 2.0, which is commendable. The next question is: What is coming up?

Table 12. XEXIX-style MS-DOS 2.0 functions 48-4B (hex)

Function code	Description
48	*Allocate memory. BX contains the number of 8086/8 paragraphs required. Returns with the first allocated paragraph in AX if successful; otherwise, BX contains the size of the largest free block.
49	*Free allocated memory block whose first paragraph is referenced by ES.
4A	*Modify allocated memory block referenced by ES to contain BX paragraphs which may be larger or smaller than the existing block size. Returns with maximum block size in BX if the operation fails.
4B	*Load or execute a program from the file named in the string referenced by DS:DX using the parameter referenced by ES:BX depending upon AL: †0 = Create program segment prefix, load, then execute a program. Control is returned when the program terminates. *All* registers are modified. **Environment segment address (WORD) Address of command line to copy (DWORD) Address of first FCB to copy (DWORD) Address of second FCB to copy (DWORD) †3 = Load file without creating program segment prefix. Parameter block is: Load segment address (WORD) Relocation factor (WORD)

** Result from Table 5 is returned in AL if the carry flag (CF) is set, indicating an error occurred. All strings used are terminated with a zero.*

† The program loader in the nonresident portion of COMMAND.COM is used. It is reloaded if required, assuming the area used for COMMAND.COM is free. An insufficient memory error occurs if the loader cannot be loaded.

***The environment segment address may be zero to indicate that the current environment is to be used; otherwise, the reference is to a set of zero-terminated strings containing environment parameters. An empty string terminates the set.*

Table 13. XENIX-style MS-DOS 2.0 functions 4C-57 (hex)

Function code	Description
4C	Terminate program using the return code contained in AL. This function does not return to the program, and all files are closed.
4D	*Returns the return function code in AL. *AH contains:* 0 = normal termination 1 = control-BREAK termination 2 = critical device error 3 = function 31 (hex) termination
4E	*Find first occurrence of file named in the string referenced by DS:DX. The last filename may contain global filename characters. CX contains the file attribute. The disk transfer area (DTA) contains the following items if successful: *Bytes* — *Description* 21 — Reserved 1 — Attribute of file found 2 — Time word of file found 2 — Date word of file found 4 — File size of file found 13 — Filename and extension

**Result from Table 5 is returned in AL if the carry flag (CF) is set, indicating that an error occurred. All strings used are terminated with a zero.*

(Table continued on page 84)

MS-DOS, PT. 2

Continued from page 83

Part of this question is already being answered by Microsoft. The new MS-WINDOWS package for MS-DOS 2.0 is one of many enhancements released, being developed or planned. The WINDOWS package adds a multiple program facility through multiple non-overlapping windows on a single console display. WINDOW support must be customized for each machine much as the device drivers are customized, but applications should be transportable among machines that have MS-DOS 2.0 with WINDOWS. Movement of data between windows is also part of the package, but a complete description of the window system must be left to another article. Even so, the multiple programming environment represents a significant addition to MS-DOS.

MS-DOS 3.0 will have real-time multitasking and Concurrent CP/M-like features.

What will MS-DOS 3.0 look like? Only time will tell, but look for Concurrent CP/M-like features in addition to the WINDOW support. Real-time multitasking is becoming more important, especially with local area networks (LANs). Network support is another feature that may be added in this advanced version. Right now LANs are implemented like the old device drivers—not very cleanly. Functions such as file and record locking need to be added in a standard way, so applications can take advantage of these features on all MS-DOS machines without regard to whose hardware is being used.

All this sounds exciting, and the surprises will probably be for the best. MS-DOS 3.0 is supposed to be in beta testing and may even make it out in 1984—it is to be hoped that most of the bugs will be out of the system by then.

William G. Wong, Logic Fusion, Inc., 902B Merritt Drive, Somerville, NJ 08876

Table 13. XENIX-style MS-DOS 2.0 functions 4C-57 (hex) *(continued)*

Function code	Description
4F	*Find next occurrence of file named in the disk transfer area (DTA). Must be preceded by a function 4E (hex).
50-53	Reserved
54	Get verify status. Returned in AL.
55	Reserved
56	*Rename file. DS:DX refers to the string containing the filename and ES:DI refers to the string containing the new filename.
57	*Get/set date and time for a file whose handle is in BX depending upon AL: 0 = Return date:time in DX:CX 1 = Set date:time from DX:CX

**Result from Table 5 is returned in AL if the carry flag (CF) is set, indicating that an error occurred. All strings used are terminated with a zero.*

Table 14. MS-DOS .EXE program file header

Offset	Bytes	Description
0	1	4D hex; program file signature byte 0
1	1	5A hex; program file signature byte 1
2	2	Length of image module 512
4	2	Size of file, including this header in pages (512 bytes/page)
6	2	Size of relocation table in entries. Table follows header.
8	2	Size of header in paragraphs (16 bytes/paragraph)
10	2	Minimum number of paragraphs required past the end of the program when loaded
12	2	Maximum number of paragraphs required past the end of the program when loaded
14	2	Initial SS register paragraph offset in load module
16	2	Initial SP register value when .EXE file is loaded
18	2	Negative checksum (including overflow) of all words in file (load error check)
20	2	Initial IP register value when .EXE file is loaded
22	2	Initial CS register paragraph offset in load module
24	2	Offset of first relocation item in file
26	2	Overlay number (0 is resident part)

Table 15. MS-DOS device header format

Offset	Bytes	Description
0	4	Offset to next device header in the device driver program segment. The last header offset should contain -1.
4	2	Device attribute word *Bit* — *Description if bit is 1* 0 — current standard input device 1 — current standard output device 2 — current NUL device 3 — current clock device 4-13 — reserved 14 — IOCTL function supported 15 — character device (0=block)
6	2	*Strategy routine entry offset
8	2	*Interrupt routine entry offset
10	8	Device name (character) or unit number (block)

**Procedure entry offsets within the same segment as the device header.*

Table 16. Device driver request header

Offset	Bytes	Description
0	1	Length of request header plus any data
1	1	Unit code (block device only)
2	1	Command code *Code* — *Function* 0 — INIT 1 — Media check (block only) 2 — *Build BPB (block only) 3 — IOCTL input 4 — READ 5 — Nondestructive no-wait input (character only) 6 — Input status (character only) 7 — Input flush (character only) 8 — WRITE 9 — WRITE with verify 10 — Output status (character only) 11 — Output flush (character only) 12 — IOCTL output
3	1	Error code if status indicates an error. (See codes listed in Table 3b.)
4	1	Status *Bit* — *Description if bit is 1* 0 — Done operation 1-6 — Reserved 7 — Error has occured
5	8	Reserved
13	—	Additional information depending upon the command code

**BIOS Parameter Block (BPB). Contains information about the block device such as sector size, allocation size, FAT size, and number of directory entries.*

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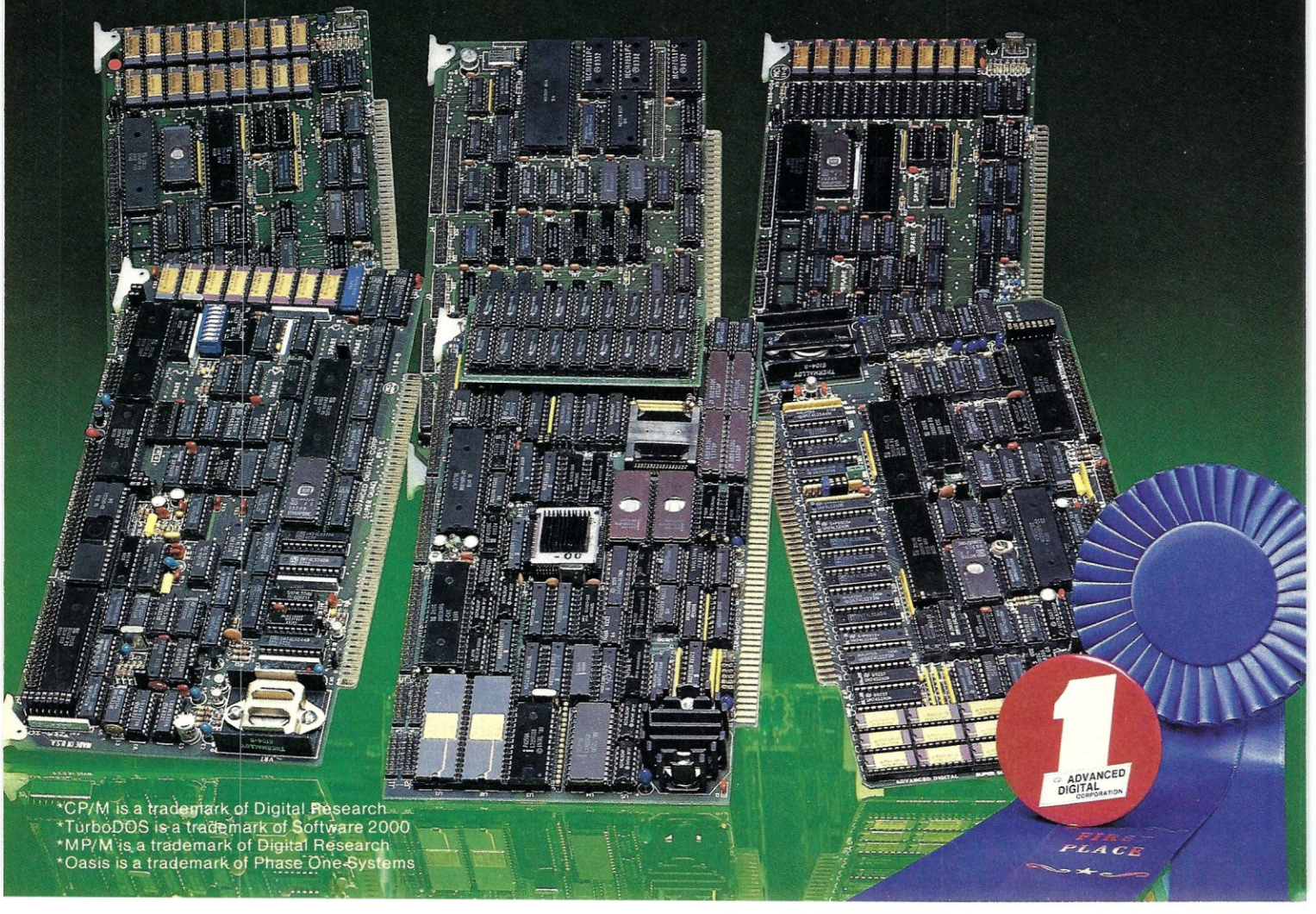

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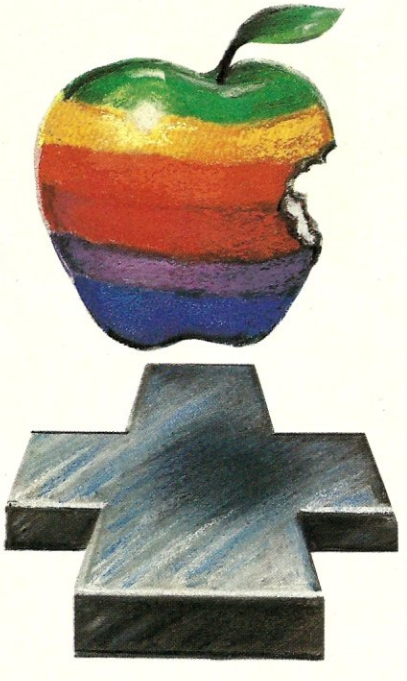
UniPlus+ on the Apple LISA

A UNIX System III ported to the LISA by UniSoft



by Randy Reitz

There is a lot of interest today in the UNIX operating system for 16-bit micros. UniSoft Systems has developed several UNIX ports* for various micros. UniPlus+/LISA is a UNIX port for the Apple LISA. UniPlus+ is a generic name used by UniSoft for UNIX ports to several different micros. UniPlus+ is vanilla System III UNIX with Berkeley enhancements (hence the Plus+ in the name). Some of the enhancements included are the "vi" screen editor and C shell.

UniSoft Systems developed UniPlus+/LISA with the cooperation of the Apple technical staff and delivered it to Apple over a year ago. Although UniPlus+/LISA has undergone intensive testing and use, Apple has decided not to market UniPlus+/LISA at this time. UniPress Software, Inc. Highland Park, NJ is the distributor of UniPlus+/LISA.

UniPress Software markets and supports UniPlus+/LISA. UniPress is offering a multitiered pricing for UniPlus+ so that an inexpensive "entry level" is available with several extra-cost option packages.

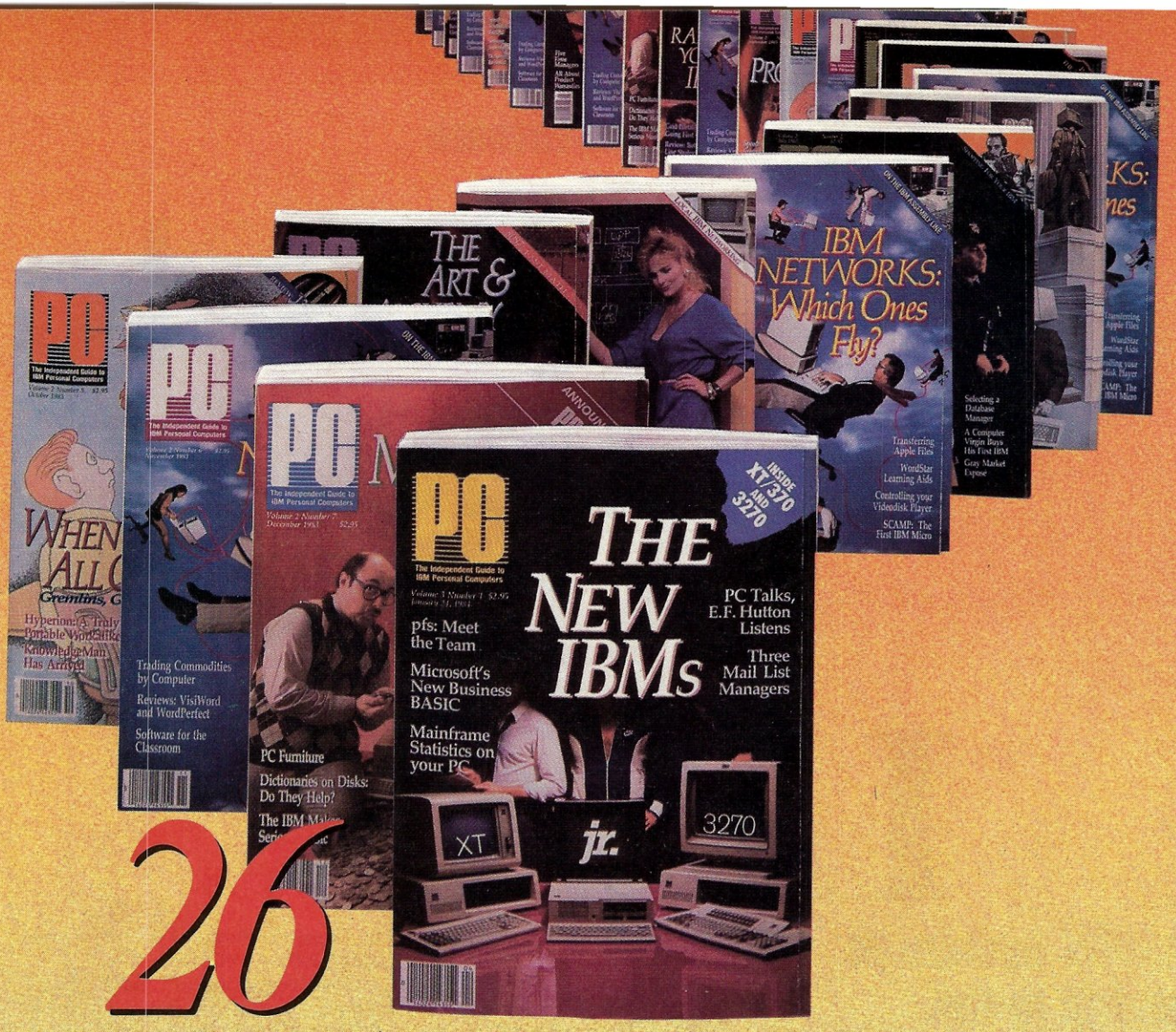
A UNIX "port" is the term used to refer to an installation of UNIX on another type of processor. One of the major features of UNIX is its portability, hence whenever UNIX is moved to another system, this is called a port.

UNIX and LISA

UNIX is a large system, designed for minicomputers that have substantial amounts of memory and mass storage. UNIX includes the source code for itself and its tools as well as all of the documentation on-line. The complete UNIX system requires just under 10 MB of mass storage.

Although today's micros are as large as some of yesterday's minis, some adjustments to UNIX were required to get a good "fit" for the LISA. The main limitation of the LISA is the 5 MB Apple ProFile hard disk. The ProFile was originally marketed for the Apple III when 5 MB was a respectable amount for a hard disk. Now this size leaves a lot (about another 12 to 15 MB) to be desired.

About 60% of the ProFile is reserved for UNIX code and another 25% is reserved to system swap space. This leaves approximately 15% (750 K) available for user programs and data. I think that this limitation is a motivation



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UniPlus+/LISA

Continued from page 87

for the multitiered pricing scheme offered by UniPress.

Due to the size of UNIX, UniPress conveniently delivers the basic UniPlus+/LISA on a ProFile disk. Since the LISA Office System application software also resides on a ProFile, another ProFile is required to run UNIX. UniPress can supply this additional ProFile with UniPlus+/LISA installed, or another ProFile can be purchased and sent to UniPress for installation. In the case of the recently announced hardware-only LISA (the LISA application software has been unbundled), the ProFile supplied can be used to hold the UniPlus+/LISA software. Floppy disks (called "twiggies" in LISA hardware terminology) can be used to load UniPlus+/LISA; but this is a cumbersome way to go.

The response of UniPlus+/LISA was comparable to a loaded mini running UNIX.

The tiered pricing of UniPlus+/LISA provides for selected UNIX tools to be sold separately and distributed on twiggy diskettes. The basic single-user system that "fits" on the ProFile is $495. The additional packages are each $495; they are 1) C-language tools, 2) document preparation tools, and 3) multiuser UNIX and **uucp** (UNIX-to-UNIX Communication). All of these (the basic system plus the three packages) are available for $1,495. Even if all of the packages are purchased initially, they are still distributed on twiggies due to the size limitation of the ProFile. This isn't so bad, since you probably won't require all of these packages to be available simultaneously. The packages can be accessed as mountable file systems on the twiggy drives or copied to yet another ProFile disk.

By the time you read this, larger hard disks will very likely be available for the LISA. There will be 10, 20 and 40 MB versions. These will not be Apple products initially, as third-party vendors will be filling in the "gap" before Apple introduces a larger disk.

Booting UNIX

The UniPlus+/LISA software has been copy protected in an unique way. A twiggy diskette is used to boot UniPlus+/LISA. The boot diskette undergoes a serialization process as follows. When the new boot disk is first used, several serial numbers within the LISA are displayed on the screen. These numbers are unique to the particular LISA being used. UniPress is contacted and given the serial numbers. An authorization number is then supplied and typed into the LISA. This number is retained on the boot diskette, and now this diskette will boot UniPlus+/LISA only on this LISA machine. The software on the ProFile and the boot twiggy can be freely copied for backups; but since a boot twiggy is required to boot UNIX, the UniPlus+/LISA software is effectively copy protected.

After this serialization process (this is done only once), the boot procedure is straightforward. After about 20 seconds and several questions (to define the boot and swap devices, default values are selected simply by hitting the RETURN key) the "#" prompt appears, indicating that single-user UNIX is operational. To bring up multiuser UNIX (assuming this extension has been purchased) requires one more command.

UniPlus+/LISA interfaces to all the hardware capabilities of the LISA. The built-in twiggy floppy disks and the ProFile hard disk(s) (one or more may be used) are accessible as mountable file systems. The UNIX mount command is used to access these mass storage devices, the device drivers for all of the LISA hardware are stored in the directory /dev under appropriate names. For example, the device driver for the mouse is called /dev/mouse.

Performance

I found the reponse of UniPlus+/LISA to be comparable to a loaded mini (e.g., 50 simultaneous users) running UNIX. I did not run any benchmarks—this opinion comes from my experience with everyday use of a mini-based UNIX.

For example, writing a simple loop in the shell language that prints the date (and current time) and then sleeps for 15 seconds produces time stamps that are separated by 18 to 19 seconds. This indicates that it takes an average of 3 to 4 seconds to load and execute the date program. Another example is the first C language program in the Kernighan and Ritchie *"C" Programming Language* book that simply prints "Hello world." This program took about 45 seconds to compile and 5 seconds to load and execute. The compiled program size was about 8,600 bytes. Finally, I tried formatting a one-page letter with **nroff**. This took about 1 minute and 20 seconds to produce output on the screen. All of these times are reasonable to me for the loaded mini system that I use daily. However, I expect a single-user desktop UNIX to be faster.

Although I don't have any evidence, I suspect that the worst speed bottleneck is the ProFile disk. It is connected to the LISA via a parallel port, and the ProFile probably doesn't drive this port at full speed. I understand that the larger disks mentioned above will be faster.

It's real UNIX

As far as ease of use is concerned, I really can't tell the difference between UniPlus+/LISA and the mini-based UNIX that I use everyday. That is because there *is* very little difference. The only consideration is that the UniPlus+/LISA user must know more about UNIX system administration than an everyday user is likely to know. I consider myself an experienced UNIX user, and in the several hours I played with UniPlus+/LISA I was exposed to three new commands (**mount**, **fsck** and **sync**). For a first-time UNIX user, this just means that there are a few more commands to master.

To avoid the boot procedure, the LISA can simply be left on at all times. When it is time to leave the machine unattended, the intensity of the display is simply turned down. UNIX wasn't designed to be continuously powered up and down; the file system access is optimized so that writes to the disk are held in RAM buffers until it is necessary to

I formatted a letter with nroff. It took 1 minute and 20 seconds to produce output on the screen.

UniPlus+/LISA

Continued from page 89

update the disk. Hence, these buffers must be flushed (UNIX **sync** command) before powering down. The LISA hardware is designed to interrupt whenever the power switch is turned off. UniPlus+/LISA catches this interrupt and will flush the file system before powering down. Of course, this won't happen if you pull the power cord out of the wall or your power simply fails. In this case, the file system integrity can be restored with **fsck**; but some data may be lost.

As a user I can't tell the difference between UniPlus+/LISA and mini-based UNIX.

The boot procedure will need to be done each time you want to switch between the LISA Office System applications and UNIX. One potential problem is that although UniPlus+/LISA, using raw mode access, can read a twiggy or ProFile that is formatted for the Office System software, no conversion software is available at the present time to allow sharing of data between the two different file systems.

Another minor annoyance is the LISA keyboard. Not all of the ASCII characters are displayed on the keycaps, so some "mapping" is required. For example, the control key is the "apple" key (the key with the picture of an apple on it), the ASCII DEL character is the key marked CLEAR, and the ASCII ESCape character is the key marked OPTION. Paste-on labels are recommended to overcome this problem.

The high-resolution bit-mapped LISA display appears to UNIX as an ADM-3A. UniSoft is working on a DEC VT-100 driver for the LISA display. This will provide graphics as well as ANSI 3.64 compatibility. The LISA mouse is dead (not used); but UNIX has the **/dev/mouse** device driver mentioned above.

Communications

One of the big strengths of UNIX is its communications software. The two serial ports on the back of the LISA are available for communications. The port labeled "Serial Device A" is named /dev/tty1 to UNIX and can be used to plug in another terminal. The port labeled "Serial Device B" is named /dev/tty0 and is typically used to communicate with other computers via a modem or direct connection. The UNIX communication programs **cu** or **uucp** can be used.

cu (call UNIX) is the simplest program to use; the command

```
cu -s 1200 -l /dev/tty0 dir
```

is used to start the **cu** program and access whatever is connected to serial device B. If a smart autodial modem is attached, commands can be typed to dial another system.

The **uucp** (UNIX-to-UNIX Communication) program allows unattended file transfer and makes the UNIX machine part of a network. This program is more complicated than **cu**, and some installation software work would be required to have it use a smart autodial modem.

Another advantage in having a modem connected and the LISA left powered up at all times is that the system can be accessed remotely. Dialing the telephone number of the line connected to the modem will allow a remote user to login and use UniPlus+/LISA. This means that you don't have to leave your work at the office—you can work with UNIX at home as well.

Documentation

As I have said, UNIX is a large system, and so is its documentation. Three volumes of documentation are supplied with UniPlus+/LISA. This documentation is the Western Electric supplied UNIX stuff. UniPress supplies a six-page writeup (quite a contrast!) that explains some of the UNIX features unique to UniPlus+/LISA. I think this explanation could be a little more detailed. For example, I tried the command

```
od < /dev/mouse
```

which will take the output of the mouse and feed it into the octal dump (**od**) program. As you move the mouse, the screen fills with numbers that are the coordinates of the mouse. I would like documentation for interpreting these numbers.

Another example is the caveat in the six-page notes concerning a **cu** peculiarity that requires the speed specified in the file **/usr/lib/uucp/L-devices** to agree with the speed given as an option on the **cu** command. This is probably because UNIX was developed before multispeed modems were available. Therefore UNIX expects a modem to have only a single speed given by its entry in the **L-devices** file. The speed on the **cu** command is used to search this file for a match, and the corresponding device driver is used. I suspect that multiple entries could be made in the **L-devices** file for each desired speed and have each entry point to the same device driver (namely **/dev/tty0**). I didn't have time to try out this theory.

Summary

UniPlus+/LISA is an exciting product that adds value to the LISA hardware. The LISA hardware is well engineered and looks good sitting on any desk. I don't agree with the mass storage decisions that Apple made with LISA; I expect that Apple will be announcing new mass storage options in the future.

The highest compliment that I can pay to UniPlus+/LISA is to say that I can't tell the difference between UniPlus+/UNIX and the Western Electric UNIX Release 5.0 that I use daily. Since the basic UniPlus+/LISA is so inexpensive and provides greater functionality for the LISA hardware, it deserves serious consideration as part of a LISA purchase decision. In fact, with the new unbundled price for the LISA hardware and the basic UniPlus+/LISA, a very high quality low-cost full UNIX System III can be placed on your desktop.

UniPlus+/LISA adds value to the LISA hardware.

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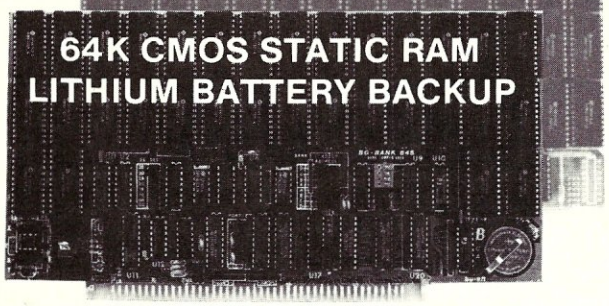

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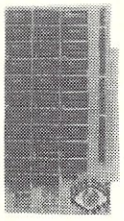

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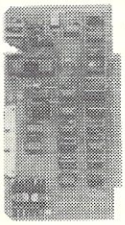

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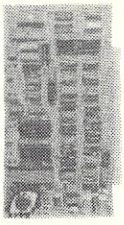

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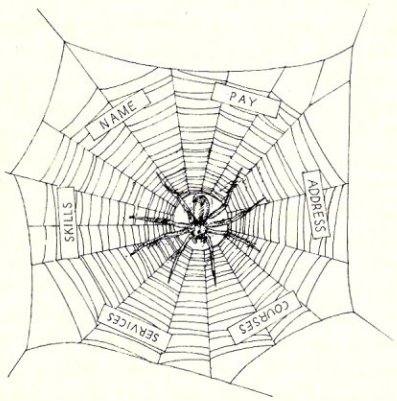
Informix: A Database Manager for UNIX

A relational database system with features that are normally found only on mainframes



by Bill Machrone

One of the impediments that many 8-bit users face in moving to 16-bit systems is fear of not having their favorite utilities and system programs available under a new operating system. "How will I live without dBASE II?" they wail. Well, fear no more, intrepid application designers, here is a brand-new old favorite database program.

Informix is a database management system for the UNIX environment. Written in C, it transports to virtually any UNIX or XENIX system. It is a relational database system in the true sense of the word. That means that information is stored in records organized as rows and columns. Different records can be associated with one another through "joins" on common data items and through indexes. It is inherently multiuser. Record locking and multiple access are handled smoothly and unobtrusively.

Informix itself is just a menu program that calls in any of five other programs. The database compiler is called **dbbuild.** You create a description of the database, feed it to **dbbuild** and it creates the necessary files after checking your work. **dbstatus** is another utility program that allows you to create indexes for fast inquiry into a database. It also prints a summary of the active files and indexes in each database, including the number of records in each. There are two data entry and inquiry programs, **Enter1** and **Enter2.** They are functionally identical, except that **Enter1** is intended for use on a printer/terminal or other noncursor-controlled device, while **Enter2** works with UNIX's termcap feature to provide screen editing of data files. The final program in Informix is INFORMER, a query language.

The authors of Informix, Relational Data Systems, sell and support the product on over 35 micro- and minicomputers running UNIX, as well as the IBM PC and XT running PC-DOS. Informix is shipped as a system consisting of three programs: Informix, ACE, and PERFORM.

ACE is a full-featured report generator that picks up where Informer leaves off. PERFORM is the utter, unquestioned star of the show. It is a full-screen data entry system combined with a screen generator and query language. Best of all, it automatically maintains relationships among "master" and "detail" records, based on the specifications that you give it.

INFORMIX

Continued from page 93

I programmed a real-life system with Informix, a candidate selection system for a management recruiting/placement firm. I had originally intended to do it with MDBS III, but concerns about an appropriate operating system and compiler, combined with being uncomfortably close to MDBS's projected release date for the mutliuser 16-bit version, caused me to look elsewhere. Furthermore, Informix was a mature product, having been run on UNIX systems for about three years. Relational Data Systems' demo policy was quite attractive, too: For $150, I could try the entire system. The demo version limits the size of the database, but is functionally identical to the production version.

The recruiter's database consists of three major record types: a "person" record and multiple job and salary records for each person. There are three additional files that serve as edit control lookup files to ensure consistent coding of job titles and the like. Use of the system is broken down into two major elements: research and counsellors. The research unit enters all new candidates into the system, with appropriate coding. The counsellors primarily use the system's query capability to find out, for example, "Who have we got with corporate merger and acquisition experience in the consumer field, willing to relocate to the Sunbelt?" The system will hold 10,000 candidates for the immediate future, with expansion planned to perhaps 50,000 after more disk and memory are added. Each candidate has one or two education entries and, usually, the last three positions held. The system places no restriction on the number of occurrences, they're just practical limits.

My estimate for implementing this system in a high-level language (compiled Basic or C) was about six to eight weeks of programming and testing. With Informix, I knocked it off in a week, including writing shells for the users.

Informix in detail

I ran Informix on an Altos 586 with 10 megabytes of hard disk and Microsoft's XENIX. Installation was a snap. Since the Altos treats the floppy disk as the UNIX tape device, a simple "**tar xv**" was all it took to load the files. (**Tar** is short for "tape archive" if you're new to UNIX.) A word of caution, however. Informix is supplied with a very complete **termcap** (UNIX's terminal capabilities definition file). You have to take care not to overwrite your existing **termcap** file if you've customized it at all.

Perform has its own syntax and "compiler" to take the fields that you want and display them.

Designing a database schema is simple enough: you use any of the available UNIX text editors to create a data definition file (see example). Once you have completed it, **dbbuild** processes it and informs you of any errors. If you change your mind, **dbbuild** accepts your modified schema description, compares it to that which is already in use, warns you about changes to existing fields, then rebuilds the database with the changes. It does not destroy the existing data. This is probably **dbbuild's** single best feature, one that sets it above most other database managers in any operating system environment. We programmers and users are, after all, merely mortal and don't often get a design right the first time. Or the requirements change. With Informix, it's no problem.

Version 2.08 of Informix requires you to build your indexes separately from the creation of the database. The newly released version 3 allows indexes to be specified in the schema and invokes **dbstatus** automatically to build them. This is a useful enhancement, as it permits the schema to be more descriptive for system documentation. The major output from **dbstatus,** however, is its "print status" option, which gives you a handy snapshot of the database, including fields, records and indexes (see illustration). The other important thing that **dbstatus** does is to turn audit trails on and off. By the way, your indexes are automatically maintained throughout all database operations. Once established, you never have to think about them again. Which, of course, is the way it should be.

Enter2 is handy for entering records into the database. As in dBASE II and many other products, the entry screen is built automatically from the schema or file specification. It allows you to search for any value in any field in a record and will automatically use an index for fast retrieval if one exists. You can then add, change or delete that record to your heart's content. You can also browse forward and back in the file.

Informer is the query system, well suited to the relational data model. It searches one file at a time in the data base, performing joins as you specify them or storing the results in temporary files. You can then use the "assign" feature to produce the sum, intersection or difference of the temporary files. It is inherently slower than navigating the structure of a hierarchical or network database, but has the advantage of being simple. Furthermore, you don't need to have decided in advance what the relationships among records will be. True, the search will go faster if you've indexed the data base, but you can essentially see anything by anything if you don't mind a small wait. You break down each search into its smallest components, regardless of its complexity. You can use the partial results of one search in another to avoid duplicative searching. Other than page breaks and automatic column headings, Informer has no ability to format the output. You can run "boilerplate" searches created with a text editor and stored on disk.

ACE is the heavy-hitting report generator. It has all the search capabilities of Informer and adds to that a complete syntax for output format control. Report formatting is as simple as "Move 10 spaces and skip 3 lines." Your ACE-produced reports can combine fields from any of the files in the database and fill out custom forms in addition to printing on stock paper. It provides full calculation capabilities using database fields and local variables. Advanced features include WHILE loops, FOR loops, calling subroutines written in C, and linking to UNIX utility programs. I can't think of a report that you can't generate with ACE.

As I said before, PERFORM is the real star of the show. It has its own syntax and "compiler" to take the fields you want and display them on the screen (see example). There are no limitations in the number of fields or the records to which they belong. PERFORM handles paging automatically if your specification is larger than your terminal screen. It reserves the top line of the screen to display the options (single-key instructions) available to you. The bottom line is reserved for comments and error messages. Comments that you define in PERFORM's screen definition are displayed when the cursor is positioned to the field with which the comment is associated. Thus, your entry/inquiry screens can have nearly as much "flavor" as a custom-programmed application. In fact, the only weakness that PERFORM has is an inability to do field-to-field calculations

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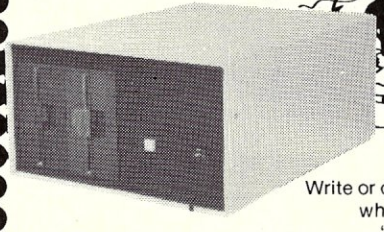

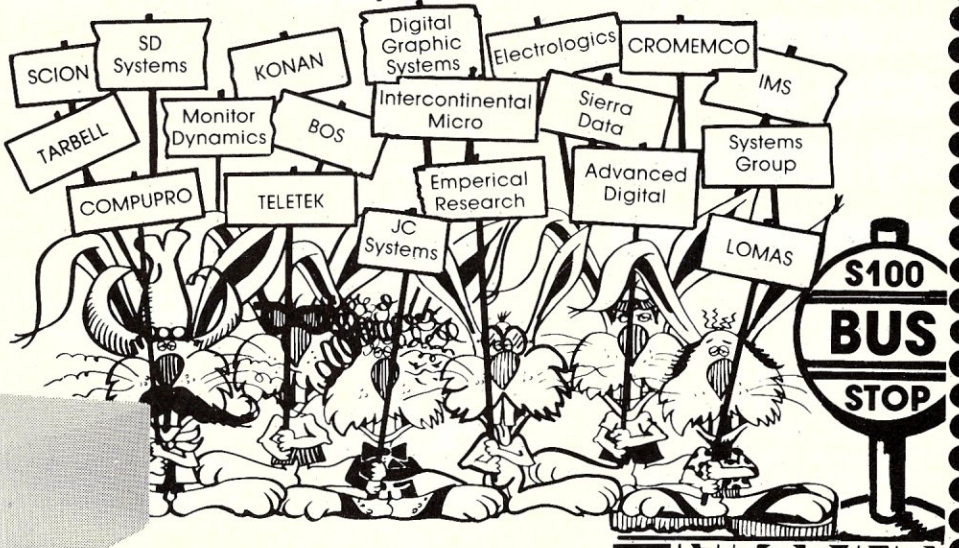

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INFORMIX

Continued from page 94

and comparisons. It will, however, do indexed lookups in other files as long as they are part of the database. This is ideal for validating data where the user's entry must exactly match one of a (perhaps long) list of possible entries.

You have complete editing available to you before you release the record for entry or update. The ability to specify "master" and "detail" records takes PERFORM a giant step ahead of relational database programs available for the CP/M environment. When you locate a record that you have defined as a master, its detail records are automatically associated with it through the fields you have defined. It actually does a "join" on the fly via indexed searches. I mentioned earlier that PERFORM is a combined query language and entry/update system. In order for PERFORM to do its thing, you have to put it in query mode and specify one or more "mask" values. This is done by entering the search criteria right in the fields on the screen. You can specify OR values for individual fields and there is an implied AND between fields. If the selection statement is too large for the field a larger space automatically opens up at the bottom of the screen. If a record's fields agree with the "mask" values you have specified, it is included in the "list" of records for display. Mask tests include greater, less than, and range tests, in addition to equal and not equal. If you want to browse the entire database, you just omit the mask tests and all records are accepted into the list. Even though PERFORM can display and associate multiple files from a database on the same screen, it can only apply masked record selection to one file at a time. When performing a query, you must take care to take the biggest cut at the file first, then browse through the associated records.

Informix offers the last word in convenience in its ability to modify databases.

```
PRINT SCHEMA

database candidates

file person

field p_number                  type integer
field enterdate                 type character  length 8
field changedate                type character  length 8
field name                      type character  length 20
field city                      type character  length 15
field state                     type character  length 2
field homephone                 type character  length 10
field workphone                 type character  length 10
field birthdate                 type character  length 6
field marstatus                 type character  length 1
field spouseocc                 type character  length 10
field own_rent                  type character  length 1
field mortgage_rate             type double
field equity                    type double
field base_salary               type double
field bonus                     type double
field salary                    type double
field review_date               type character  length 8
field relocate                  type character  length 1
field supervises                type integer
field reports_to                type character  length 5
field comment                   type character  length 40

file jobs

field j_number                  type integer
field category                  type character  length 6
field employer                  type character  length 10
field title                     type character  length 10
field product_line              type character  length 10
field corp_div                  type character  length 1
field volume                    type double
field fromdate                  type character  length 6
field todate                    type character  length 6
field order                     type integer

file jobclass_edit

field job_category              type character  length 6
field job_description           type character  length 30

file edlevel_edit

field edlevel                   type character  length 10

file education

field e_number                  type integer
field level                     type character  length 10
field school_code               type character  length 2

file prodline_edit

field prodline                  type character  length 10
field prod_description          type character  length 30

PRINT STATUS

database candidate

file person

data record length     191
number of records       28
number of indexes        3
key                duplicates not allowed
name               duplicates allowed
salary             duplicates allowed

file jobs

data record length      61
number of records       58
number of indexes        3
jobkey             duplicates allowed
product_line       duplicates allowed
category           duplicates allowed

file jobclass_edit

data record length      36
number of records       17
number of indexes        1
job_category       duplicates not allowed

file edlevel_edit
```

INFORMIX

Continued from page 96

Getting back to the candidate system, PERFORM is the ideal tool for the counselors. Say, for example, they are looking for candidates with manufacturing management experience in heavy machinery. They enter the appropriate codes into the job and industry fields and press Escape. Seconds later, PERFORM tells them how many records that match the search criteria are in the list. By moving the cursor to the "person" portion of the screen, they can browse through all of the individuals whose credentials match the search criteria. They then make additional determinations on salary, ability to relocate, etc.

In conclusion

Informix is a well-rounded, mature product. It has convenience features that are usually considered the province of microcomputer database managers, and operating features (such as query-by-example) that are normally found only on mainframe systems. Its relational data model is easy to understand, and it offers users and programmers alike the last word in convenience in its ability to modify databases easily and rapidly. An added bonus is the ability to call its file management and indexing routines from your own programs. So, if you have a need that transcends Informix's capabilities, you can manipulate its files and indexes in programs written in the compiler of your choice. Another important thing about Informix is that it's for real. It has been in active use for at least three years, has been continually upgraded, and is due for even more enhancements in the near future, including a command language modelled on dBASE II. The documentation is clear and extensive. It includes examples, but could benefit from more of them. It is fast, even on a multiuser micro and does not appear to have any bugs. In short, I am as impressed with Informix as with any software product I have ever encountered.

The price of Informix, ACE, and PERFORM is $1500. For $150, a demo version with manual is available. Informix has recently been comverted to run on the IBM PC and compatibles uner MS-DOS. Although it is a single-user version, it offers all the power and convenience of the UNIX version.

For more information on Informix, contact **Relational Data Systems, Inc.,** *1208 Apollo Way, Suite 503, Sunnyvale, CA 94086.*

CIRCLE 301 ON READER SERVICE CARD

Bill Machrone, c/o Ziff-Davis, One Park Ave., New York, NY 10016

```
data record length      10
number of records       14
number of indexes        1
edlevel              duplicates not allowed

file education

data record length      14
number of records        4
number of indexes        2
edkey                duplicates allowed
level                duplicates allowed

file prodline_edit

data record length      40
number of records       19
number of indexes        1
prodline             duplicates not allowed

database candidates

screen
{

Number      [p1    ]                    Education Level [e1         ]
Entry Date  [p2       ]                 School Code     [e2]
Chg Date    [p3       ]
Name        [p4                  ]       Job Category    [j1     ]
City        [p5              ]           Employer        [j2         ]
State       [p6]                         Title           [j3         ]
Home Phone  [p7         ]                Product Line    [j4         ]
Work Phone  [p8         ]                Corp/division   [e]
Marital St  [a]                          Volume          [j5       ]
Spouse Occ  [p9         ]                From Date       [j6     ]
Own/Rent    [b]                          To Date         [j7     ]
Mort. Rate  [p10 ]                       Order           [j8]
Equity      [p11     ]
Base Sal    [p12     ]                   Counsellor      [f ]
Bonus       [p13     ]                   Supervises      [d ]
Total Sal   [p14     ]                   Reports to      [p16  ]
Review Dt   [p15     ]                   Comment         [p17
Relocate?   [c]                                          [p18
}

end

attributes

p1  = key = jobkey = edkey, reverse;
p2  = enterdate, default = today "m/d/y", reverse;
p3  = changedate, default = today "m/d/y", reverse;
p4  = name, reverse;
p5  = city, reverse;
p6  = state, upshift, reverse;
p7  = homephone, reverse;
p8  = workphone, reverse;
a   = marstatus, include = (M,m,S,s), upshift, reverse;
p9  = spouseocc, reverse;
b   = own_rent, include = (O,o,R,r), upshift, reverse;
p10 = mortgage_rate, reverse;
p11 = equity, reverse;
p12 = base_salary, reverse;
p13 = bonus, reverse;
p14 = salary, reverse;
p15 = review_date, reverse;
c   = relocate, include = (Y,y,N,n), upshift, reverse;
f   = counsellor, reverse;
d   = supervises, reverse;
p16 = reports_to, reverse;
p17 = comment[1,20], reverse;
p18 = comment[21,40], reverse;

e1  = level = *edlevel, reverse;
e2  = school_code, reverse;

j1  = category = *job_category, reverse;
j2  = employer, reverse;
j3  = title, reverse;
j4  = product_line = *prodline, reverse;
e   = corp_div, upshift, reverse;
j5  = volume, reverse;
j6  = fromdate, reverse;
j7  = todate, reverse;
j8  = order, reverse;

instructions

person master of education;
person master of jobs;
education master of person;
jobs master of person;

end
```

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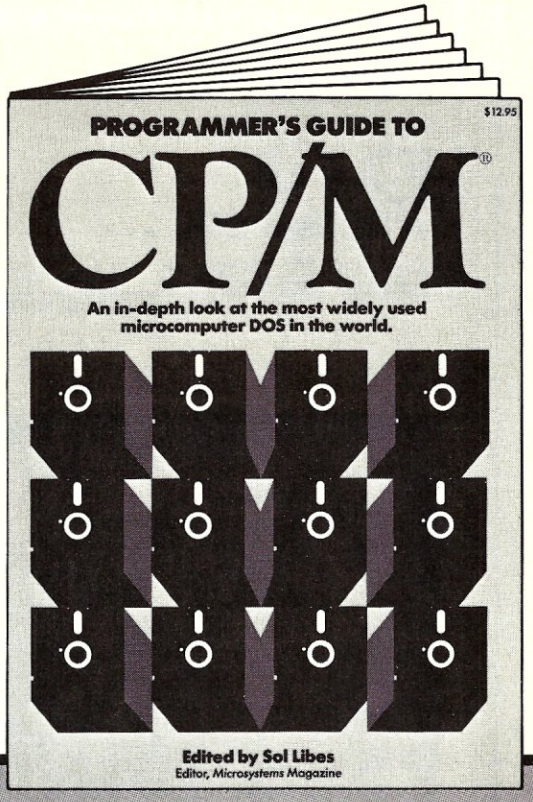

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MICROSYSTEMS REVIEWS

C Compiler from Digital Research

A package that brings the full features of UNIX V7 to CP/M-86

by Bruce Hunter

The C programming language was developed at Bell Labs by Dennis Ritchie and others for the UNIX operating system. C is a "full" language supporting a multitude of data types and storage classes ranging from automatic short unsigned integers to static, double-precision, floating-point decimals. The standardized C library has a wealth of library functions for raw (primitive) file access, buffered file access, string functions, memory management functions (to allocate and free "the heap" like based storage in PL/I), system functions, double precision math functions, and of course the inevitable group of miscellaneous functions. With the power derived from its library and the vast number of C operators available, C is a formidable force in the computer industry, and versions are available for just about any processor from 8-bit to 32-bit.

Implementations of the C language for micros have been proliferating since the late 70's when BDS C, Tiny-C, and Small C were initially written. Most of the 8-bit C's have all the C operators, but they lack the niceties that make C so versatile and flexible, such as typedef, casts, initializers, parameterized defines and so on. Only Whitesmith's C has been close to a full set from the beginning. As software began appearing for the 8086 so did 8086 versions of C. By and large these versions are "full" versions supporting float, double, initializers and all the other wonders for which C is famous. Prominent among the 16-bit C's is George Eberhard's CI-C86 by Computer Innovations; this is very close to UNIX 7 C, is fast, and is fully CP/M, MP/M compatible.

Digital Research recently released version 1.0* of their version of C called DRC, announced at CP/M-83 in January of last year, and it looks very promising indeed. The C package created by the innovators of CP/M is claimed to be the closest thing to UNIX 7 C this side of Bell Labs. Their aim was to achieve as close to total compatibility as they could within a CP/M environment—function for function, operator for operator and result for result. They have come very close to UNIX 7 C, with no excuses. Over 90 functions are documented. In other versions of C, extra functions unique to those compilers are often included with the straight C functions. While these are interesting and frequently useful, they preclude portability from compiler to compiler. DRC's functions are straight C, so you have

DRC COMPILER

Continued from page 101

across-the-board portability. DRC omits only those functions which are UNIX-only functions and are thus meaningless to CP/M. No feature of the language has been overlooked. It is interesting to note that the UNIX V7 compatibility is not just academic. In its development stages, the fledgling DRC compiler was repeatedly tested against the UNIX 7 C running on a DEC PDP 11 series minicomputer, until DRC ran with identical results. DRC was developed by Michael Lehman, creator of Pascal MT/+, and architect of DRI's Commercial Systems Division.

The distribution package provided with DRC reflects DRI's continuing efforts to provide high quality documentation. The manuals are clear and easy to read. New packaging has been provided as well. Manuals are now printed on a 9 by 7 cut and are packaged in an attractive and durable ring binder, which is in turn housed in a matching box, about the same size as an 8" diskette box. While the size of the new manual makes it more difficult to Xerox copies (not that anyone would do that sort of thing), it does make the box easy to store upright on your desk for easy reference. The manuals are printed on high-quality coated paper in a two-color format to emphasize programmatic constructs. They are profusely illustrated, clearly written and well indexed (they include cross-indexing, a much appreciated feature). Three manuals are included with the C package. Listed in order of increasing difficulty, they are: the Programmer's Guide, the Programmer's Utilities Guide, and a manual-sized copy of "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie (Prentice-Hall, 1978). They run about 200 pages each.

The package contains four distribution disks. One contains programmer's utilities: LINK-86 (the linker for CP/M-86 and MP/M-86 languages), RASM-86 (the 8086 relocating assembler), XREF-86 (an assembly language cross reference utility to cross reference symbol use), and LIB-86 (the librarian that creates and maintains the language library). These constitute a very complete and useful set of utilities for C and for any other development language, including 8088/8086 assembly and anything that produces it. All of the programmer's utilities are well developed and documented and easy to use. LINK-86 does a thorough job of reaching for individual functions, and you can link with this small invocation.

```
A> LINK86 MYPROG
```

Not the fastest linker in the world, it may well be the most thorough, supporting complex linkage including tree-structured overlays. The remainder of the utilities are of equal usefulness, and the documentation is ample, clearly written and well illustrated. The linker is compatible with PL/I-86, CBasic-86 and RASM-86.

The remaining three disks hold the C package, consisting of the compiler, libraries, header files, overlays, and so forth. The compiler package is well managed. The simple but complete compilation is invoked with:

```
A> DRC MYPROG
```

DRC.CMD is the compiler supervisory module that automatically invokes the program loader R.CMD; this in turn brings in the preprocessor, parser and code generator, listing/disassembly file merge utility, compiler error message library and reverse preprocessor program. Thus a *single* command brings up the entire program, and all of the modules, overlays and managers are completely transparent to the user, as they should be. Switches are available for such things as 8087 support, memory models and all sorts of drive, message, display and file options. I have reviewed eighteen C compilers in the last six months for two C books I'm writing for Sybex, and about half of those C packages require the console operator to invoke the preprocessor, compiler and optimizer separately. Granted, this can be done with a SUBMIT file, but SUBMIT doesn't always do what it is intended to do. It also complicates the command line invocation. Some compilers make a SUBMIT file an absolute necessity, but there is no such problem with DRC because the loader, R, takes care of it all. For those of you on MP/M, if you have to abort the compilation from another terminal, remember it is R and not DRC that is the resident process.

The DRC compiler handles errors with a good degree of reliability.

No less than four library versions are part of the distribution package. They are labeled small, medium, compact and big, and these system subroutine libraries are provided to match the memory requirements of the finished object program. The extended addressing of the 8086 family has brought unlimited possibilities for memory usage, as well as a few problems. If a library is written to make full use of the 8086 addressing, it will be somewhat larger than would be needed for object files having smaller memory requirements. To cover the full range of memory modules, DRC provides a library for almost any combination of memory allocation. The smallest library version is automatically requested by the compiler unless a switch is set to do otherwise.

In practice, the package is easy to use. Once the source program has been created, the entire compilation takes place from a single command line invocation. Error reporting is good, with the pre-processor and compiler listing a line numbered error message (not just a code number, but a message as well). The DRC compiler handles errors with a good degree of reliability as well, especially for version 1.0. I'm referring to the fact that some compilers go into an infinite loop if too many errors are detected or if they are not ready to deal with a particular error. As a result, these compilers seem to "lock up" and "go away," forcing you to reboot the system. This poses only a minor inconvenience to CP/M users, but MP/M users can hardly afford to have the entire operating system lock up, because the other users on the system would lose their data. MP/M users can rely on DRC to be relatively stable in this regard. Once the program has been compiled, the linker quickly merges the program with the system library and any other modules, overlays and so forth that the programmer may want.

I mentioned at the beginning of the article that DRC is fast. To date it is the fastest C by far, of the dozen and a half I have tested. Jim Gilbreath's impressive benchmark articles in *Byte* magazine ("A High-Level Language Benchmark," 6(9):180-198, September, 1981 and "Eratosthenes Revisited: Once More Through the Sieve," 8(1):283-344, January, 1983) have established the Sieve of Eratosthenes as the de facto benchmark for computational speed. I ran the sieve on a few of my favorite C compilers to give you an idea of how Digital's C compares to some of the best competition, my criteria for choosing these compilers being reliability and ease of use. The data were obtained on our Gifford Computer System 421 (which uses a CompuPro 8/16 with a hard disk and runs under MP/M using

Continued from page 102

a CompuPro 8085/8088 coprocessor running at 8 MHz). Running under MP/M tends to slow down processes because the CPU is multitasking and doesn't devote full attention to the task presented by the operator. Nevertheless, the times are very fast (see Table 1).

All of the versions of C seen in Table 1 ran the same sieve program, and little or no modification was needed to port the sieve from one to the other. That illustrates another important consideration to look for in a C compiler—cross-compatibility. In addition, all but BDS C were run with the redirection package intact. The runtime package size can be reduced by unloading the front end of the C package, because it takes a lot of overhead to provide the command line redirection. Ten iterations were done for each test to insure accurate timing. (For example, DRC ran 6.0 seconds for 10 iterations.)

Let's briefly discuss the other compilers in this test to give you a basis for comparison with DRC. BDS C, as compiled, did not have the redirection package invoked. BDS C is included in this list as a representative of the 8-bit C's, it is one of the fastest of the 8-bit C's and is well known by C afficionados. DeSmet C is surprising in just how compact its code is, even with the redirection package intact. In fact, DeSmet C is surprising in many other respects; it provides a great deal of power, stability, speed and ease of use at a very low cost (it is inhibited only by a small library). Computer Innovations C86 is the most direct competitor of DRC because of its nearly total UNIX V7 compatibility.

Now let's examine DRC's results and compare them to the other compilers. DRC's time of 0.6 seconds to find all the primes from 1 to 8180 is nothing short of phenomenal (the 6-second figure is for 10 iterations). The size of the generated code is interesting in that DRC generated a whopping 25,587 bytes (11,710 bytes for the data area and 13,877 bytes for the code area). While not a surprising figure for version 1.0, it is so much larger than the others that it deserves some discussion. Most of the object code size is a result of what Mike Lehman calls "interwoven calling" of functions, where one function calls another function which in turn calls another function, and so forth. Also not to be overlooked is the cost in bytes for the redirection features; we all want these but we are shocked when we see what it has cost us in size of generated code. Regardless of the stature of the house that writes a new language compiler, nothing close to optimization can be reached on the first try. It takes time and many versions to get the solid, tightly optimized and totally reliable compilers we all like to see. Tighter code generation will undoubtedly be seen in future versions of DRC. The object code of George Eberhard's (CI-C86) code comes out at a slim and trim 12K, while DeSmet's generated code size in unbelievably small, considering that it also includes redirection. Also noteworthy is BDS C's lightning compilation and link time. All of this notwithstanding, if we are going to compare apples with apples, we should look at versions of C that are closest to UNIX 7 C for direct comparisons with DRC, and that means comparing DRC against CI-C86. Digital is faster to run, CI faster and tighter to link and compile. It speaks well of both DRC and CI-C86 to see the ease with which programs can be ported from one to the other with *no* changes in the source code. With most programs, the same source code produces virtually the same results (results of complex expressions are the same, feature for feature they are the same, and so forth). Cross-compatibility is a definitive clue as to the excellence of a C compiler, and it should never be taken for granted.

Table 1. Sieve Benchmark Timings for Ten Iterations

	Run Time (secs)	Object Code (size)	Compile and link (secs)
BDS C	31	3.918 K	9
DeSmet	10	8 K	44
DRC	6	25.587 K (11.7 K data)	55
CI-C86	10	12.032 K	34

C allows easy portability from machine to machine.

A software review is not complete without an analysis of the significance of the product in the current industry environment. To do that, we really need to discuss the significance of the C programming in today's computer industry. C can now be found on all of the major operating systems, and it is the language in which most of the newer ones are written. Naturally, C is the systems level language of choice for Bell Labs where it was developed, but many others in the industry (including Gifford Computer Systems and Digital Research) are incorporating C as their systems and applications language as well.

What separates C from the other productivity languages is the fact that C is a mid-level language. It is not a low-level language like assembly, nor is it a high-level language like PL/I, Cobol, BASIC, Pascal and so forth. By being able to function at the systems level, C allows easy portability from machine to machine, and you have a great deal of power over the workings of your computer because of C's systems level capabilities as a language. It generates some of the most efficient, compact code available in today's languages, and thus C is very fast. What this boils down to is that C takes very little source code to accomplish a great deal while generating very little object code. In addition, C can also perform the functions of a high-level language, so all of these advantages can be brought into play in use with general applications programs.

C's ability to perform efficiently at the systems level makes it the prime candidate for systems-level programmers wanting to obtain maximum portability. For this reason, it is ideal for companies like Gifford Computer Systems. The quality of DRC is indicated by the fact that until the introduction of DRC, Gifford Computer Systems had been using CI-C86 for the development of their very fine modified CP/M 8/16 and MP/M 8/16 operating systems. (Gifford has ingeniously incorporated many UNIX-like features in their MP/M 8/16, and it probably is as close as you will get to UNIX and still be in CP/M for awhile). Since the beta test version of DRC has been available, they have been using DRC as well, a tribute to both C compilers.

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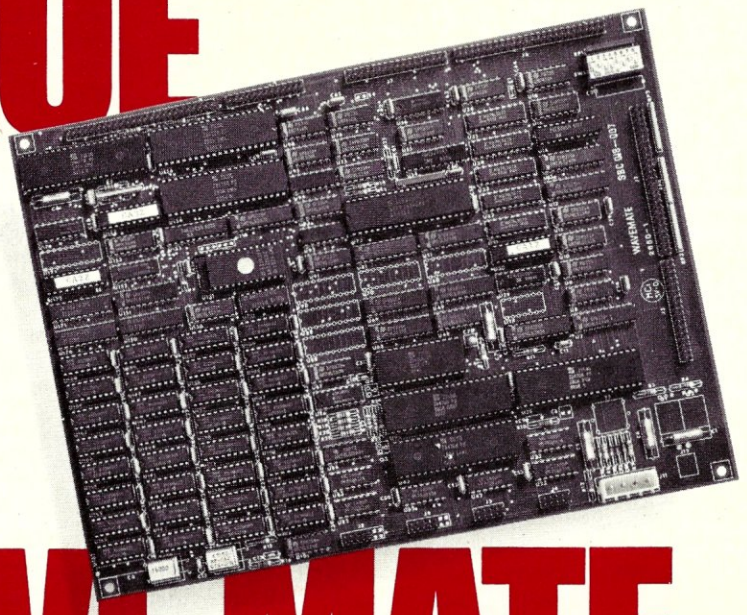

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DRC COMPILER

Continued from page 104

house as Digital Research to C is also indicative of the importance C in the 1980s. "We have identified C as the vehicle for portability in the microcomputer industry," Gary Kildall wrote in Digital Research News, Vol. 3, No. 2. That statement, considered along with such developments as CP/M-68K (CP/M for the Motorola 68000 chip) where DRC is included with the package, and Digital's recent decision to use C as their in-house systems language, is indicative of the current importance of the C language.

I've talked a lot about C, but a program is worth a thousand words. Here is a program in DRC to show what C looks like. Consider the following microscopic program to push a page eject to the line printer:

```
/*
        FF.C

 puts one or two formfeeds to the
 listing device depending upon
 whether a command line argument
 is present or not

        by Bruce H. Hunter
             6/15/83

*/

#define FF__bdos(5,0x0c)

main()
{
     if (--argc)
          {
          FF; FF;
          }
          else
               FF;
}
```

This miniscule marvel demonstrates the systems level capabilities of C, and it shows you how much C can do with very little code. This program outputs one or two formfeeds, depending upon whether a second command line argument was present or not. The argument count (argc) is decremented and tested by the if statement. If only one argument is present (the command line FF), the value becomes 0 and the argument (__argc) becomes 0 or false. Therefore the else statement is executed. If any command line arguments, other than the prime invocation itself, are present, the **if** condition is true and a double page eject is performed. C programs do not have to be this cryptic. In fact, it is much better practice not to write what my friend Dr. Hogan calls "write-only code" where everyone other than the original writer of the code has difficulty figuring out what the heck the program does. But the point is, C can be cryptic, and this option can save you a lot of programming time.

At this writing, using version 1.0, DRC had a bug in the floating-point entry routines under **scanf**. It can easily be circumvented by the following kludge:

```
char n[12];
double n1, atof();

     n1 = atof (gets (n));
```

Don't forget to declare the function atof() double. Digital assured me that this bug would be fixed in version 1.1. Digital has a good reputation for bulletproofing their compilers, and by the time you are reading this article this bug should be fixed. I have been using DRC rather extensively for program development in the last month, and I've found no other major problems. A minor problem involves the fact that, being a full set of C, DRC is more fussy about declaring function datatypes than an integer-only version of C, but this is to be expected.

The only fault I can find in DRC is that the source code for the function library is not provided. The library source code is traditionally provided with the other files in the distribution package of almost every other version of C. The reason for this is to allow the programmer to make modifications to the function source code if need be, and it allows the programmer to find out exactly what the function does and what it returns, which is invaluable in deciphering the more abstruse functions. Being able to examine the source code for a particular function leaves no question as to datatypes coming or going, what needs or does not need a pointer, and which functions need to be declared. The obvious disadvantage to this is that the library source code can be plagiarized. Leor Zolman, creator of BDS C, has contributed significantly to the increased public interest in and use of C today by generously making not only his library source public domain, but many many other C programs he has written as well. He aptly stated his frustration with his personal experiences with plagiarism: "I don't mind being ripped off so much as I resent not being given credit for what I have contributed." Nevertheless, C function libraries are still primarily in the public domain, and functions have been published in the *The C Programming Language* by Kernighan and Ritchie, the CPMUG Library, *Dr. Dobbs Journal*, The C Users Group and in myriad other places and special interest group (SIG) publications, including bulletin boards. In spite of the inherent risks involoved, I hope this trend continues. There is much to be gained by making the library source code public because it makes C more accessible and understandable to the user.

DRC features direct portability to CP/M 68K and the 68K C.

When compared to other versions of C available today, DRC comes out right at the top of the list. 8-bit integer-only C programmers will still find packages like BDS C faster to compile and link, and BDS C has very few weaknesses, so it is very stable (Leor Zolman has groomed it continually since 1978). If you are willing to live with a somewhat limited library, DeSmet is very hard to beat at the price because it is extremely fast and very reliable, and it's easy to compile and link. On the other hand, if you want it all and want it under CP/M-86 and MP/M-86, the best shows in town are CI-C86 and DRC. One possible advantage of CI-C86 is that it is the cheaper of the two. One possible advantage of DRC is the fact that it can be used with all DRI programming tools such as SID (Symbolic Instruction Debugger), Access Manager, and Display Manager, and that is a powerful combination for applications programs.

Digital Research C, priced at $350, is in the reach of noncommercial programmers. It is as strong a package as a programmer is likely to encounter, giving the full features of UNIX version 7 to CP/M. Direct portability is guaranteed to CP/M 68K and the 68K version of C. Of equal importance is the direct portability to any full UNIX V7 compiler, including UNIX 7 System III or V.

For more information contact Digital Research, Inc., P.O. Box 579, Pacific Grove, CA 93950.

Note

**V1.1 is now released with numerous bug fixes and changes to the memory models, now having only two memory models: small and big. It will also interface with DRI Fortran-770.*

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Requirements: any Z80 microcomputer running CP/M 2.2
Miniumum memory: 32K
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P.O. Box 41436
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Order line: 1-800-821-6010
Technical: (602) 327-4305

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Program name: EUREKA!
Requirements: any microcomputer running CP/M 2.2, with 2 or more disk drives and a CRT width of at least 50.
Miniumum memory: 48K
Language: 8080 assembler
Description: EUREKA! is a menu-driven disk cataloging program that allows the user's files to optionally include key information, such as the purpose of the file, when it was last edited, who edited it, etc. When present, this information is taken from the file and automaticaly entered into the catalog database, so the user does not have to key it in each time the disk is cataloged. A file may be located by its name, by the disk it is on or by any of its key information; wildcards may be used in any or all of these specifications. Disk usage data is also included in the catalog. The various reports may be sent to the printer in addition to the CRT. EUREKA! supports CP/M user areas and hard disks, and is designed for quick response as well as ease of use. It is available in 8″ and most 5″ formats.
When released: October 1983
Price: $50 suggested list.
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Available from:

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Program name: Order Entry/Inventory Package
Requirements: any microcomputer running PICK, UNIX, or having a standard C Compiler.
Miniumum memory: 128K
Language: C or Databasic
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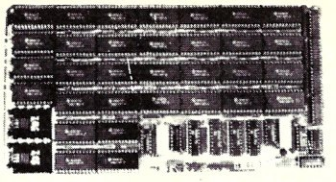

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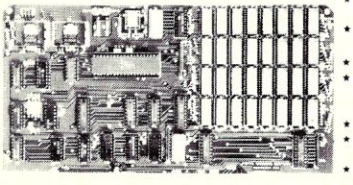

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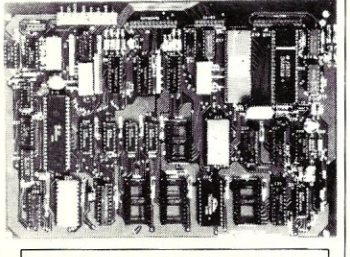

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SOURCE DISKETTE - ADD $10

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WITH 8 IN. SOURCE DISK! (CP/M COMPATIBLE) **$129.95** # ZRT-80 (COMPLETE KIT, 2K VIDEO RAM)

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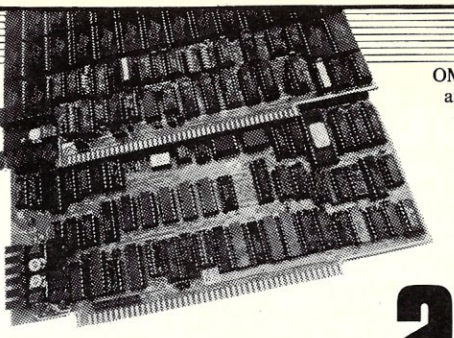

OMNIRAM (top), and OMNIDISK

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*CP/M *2.2 configured for OMNIDISK $60. *Trade mark of Digital Research. FREE U.P.S. ground shipping on prepaid orders. Shipping is added to VISA, M/C, and C.O.D. orders. CA residents, please add sales tax.

CIRCLE 63 ON READER SERVICE CARD

Software

Continued from page 108

of sales and marketing efforts. With this system, key files are updated as operator entries are made, so the current invoicing, inventory and sales analysis information is available when needed.
Price: $1,200 (quantity discounts available)
Included with price: 9 track tape, documentation
Available from:
The Software Express, Inc.
10103 Fondren, #220
Houston TX 77096
(713) 270-5218
CIRCLE 323 ON READER SERVICE CARD

Program name: UniFLEX Basic 68000 Precompiler
Requirements: UNIX
Miniumum memory: 128K
Language: 68000 assembler
Description: The UniFLEX Basic 68000 Precompiler accepts an expanded, improved syntax of Basic source code and converts, or precompiles the source to a standard syntax acceptable to the UniFLEX Basic 68000 interpreter. It also allows the use of variable names of unlimited length: these names can include letters, numbers, and the underscore character. All Basic line numbers are optional, and can be replaced with line labels, which can be of unlimited length and can include any character. "String/macros" permit the definition of a string of text that can be given a name, which, when later referenced in the source, is replaced by the entire defined string. Several conditional compilation commands permit various portions of a source program to be conditionally precompiled. Other features include the following: a single Basic statement, or logical line, can extend across multiple physical lines; comments can be imbedded within Basic lines or can stand alone on separate lines; variable types can be defined so that suffixes need not be appended to each variable; and the user has complete control over the printed source listing that the Precompiler optionally outputs. The output of the UniFLEX Basic 68000 Precompiler is a compressed program that the UniFLEX Basic 68000 interpreter can run. The precompiled program cannot be listed or edited while in Basic so that proprietary Basic programs may be developed and distributed without the need to divulge the source code.
Available from:
Technical Systems Consultants, Inc.
111 Providence Road
Chapel Hill, NC 27514
(919) 493-1451
CIRCLE 324 ON READER SERVICE CARD

Program name: General Ledger Package
Requirements: any microcomputer running PICK, UNIX, or having a standard C Compiler.
Miniumum memory: 128K
Language: C or Databasic
Description: The General Ledger Package provides current and comprehensive financial reporting capabilities with easy-to-use menu-driven software. A statement generator with maximum flexibility allows the user to design and implement custom financial reports. Income statements and balance sheets for present or any previous periods are available upon request. Comparatives, budgets and variances are also standard capabilities. Special statements such as Supporting Schedules or Statement of Change in Financial Condition can easily be created by the user.
Price: $1,200 (quantity discounts available)
Included with price: 9 track tape, documentation
Available from:
The Software Express, Inc.
10103 Fondren, #220
Houston TX 77096
(713) 270-5218
CIRCLE 325 ON READER SERVICE CARD

Program name: Professional Time Reporting Package
Requirements: any microcomputer running PICK, UNIX, or having a standard C Compiler
Miniumum memory: 128K
Language: C or Databasic
Description: The Professional Time Reporting Package has been designed specifically for professional organizations tracking personnel time and expenses on a client or project basis for billing and analysis purposes. The system provides a complete set of Reporting/Tracking functions and assures the user total visibility and control of time and expense accounting.
Price: $1,200 (quantity discounts available)
Included with price: 9 track tape, documentation
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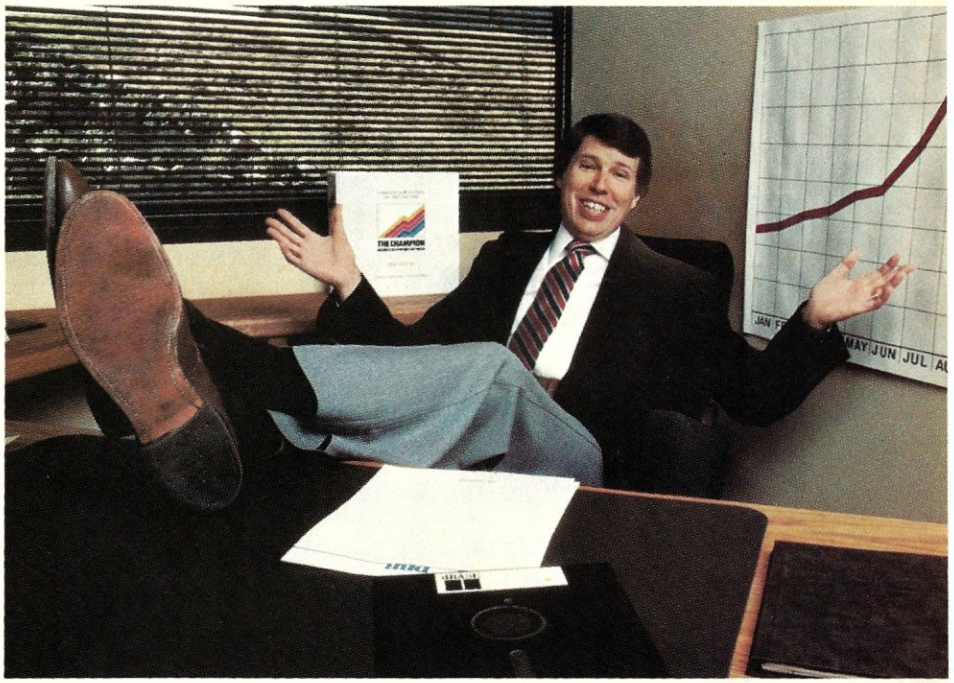
Rusty Fraser
President
Data Base Research Corp.



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For more about dBASE II and RunTime, contact Ashton-Tate 10150 West Jefferson Boulevard, Culver City, CA 90230, (800) 437-4329, ext. 217. In the U.K., call (0908) 568866.

For more about The Champion, call Data Base Research at (303) 987-2588.

ASHTON·TATE

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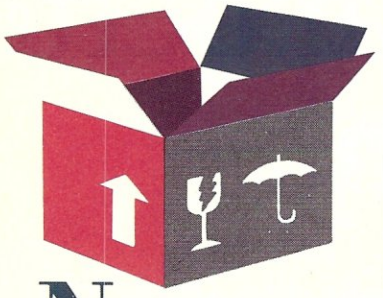


New Products

What's new: a quick roundup of recent innovations and improvements

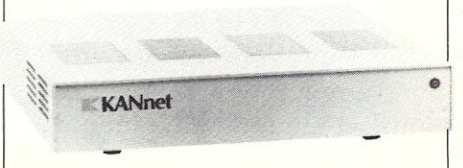
Intelligent LAN

Kantek, Inc. has announced the first local area network with real onboard intelligence. Dissimilar computers now become compatible when connected through KANnet, Kantek's totally new concept in local area networking. Fully transparent format translations make it appear to each computer that all other computers are the same type. Supported operating systems include MS-DOS, IBM PC-DOS, CP/M-86, and CP/M-80. All may concurrently reside on the same network.

Multiuser data integrity is assured. Single user programs can now operate in a multiuser environment without software modification. Access rights are controlled and passwording is supported at the file level.

The KANnet onboard processors execute nearly all network overhead functions preserving full individual computer performance. Network communication rate is 2 megabits per second over video grade coaxial cable between computers up to 2000 meters apart. Up to 254 computers may exist in one network.

Price: $1,295 for each computer.



Kantek, Inc., *13730 NE 20th, Suite J, Bellevue, WA 98005; (206) 644-2970.*
CIRCLE 311 ON READER SERVICE CARD

Line conditioning systems

Sinusoidal Ferroresonant Regulator line conditioning systems for computers and other sensitive equipment are now being offered by Hitran Corporation in new, free-standing, desktop housings or in rackmount assemblies. Load capacities in these configurations range from 0.5 to 5 KVA.

The Hitran SFR series of regulators is designed for use with computer, communication, process control or alarm systems that might be affected by power line disturbances such as electrical noise, brownouts, or lightning spikes. Hitran SFR series units provide complete isolation from line noise as well as $\pm 1\%$ power regulation over -20% to $+10\%$ input voltage variation. Special circuits are incorporated that ensure continuous power during short power breaks up to 25 ms.

An important feature of the Hitran SFR series is the high degree of protection it provides for computers and other sensitive equipment at very low cost. Costs are typically one-seventh that of an equivalent sized UPS battery-backed power system: yet, except for prolonged blackouts, the SFR series provides the same degree of power protection.

Desktop units are available with 0.5, 1, and 2 KVA load ratings. Rackmounted assemblies are available up to 5 KVA. Other SFR series floor or wall-mounted units are available with load ratings up to 60 KVA.

Hitran Corp., *Route 31, RD 5-65, Flemington, NJ 08822; (201) 322-1500.*
CIRCLE 312 ON READER SERVICE CARD

Microprocessor viewer for debugging

If you program or engineer microprocessor devices, you can now debug quickly, completely, and inexpensively with a new tool called Micro View from Micro Logic Corp. It lets you debug quickly and thoroughly by giving you a unique view of microprocessor activity on a screen of 256 LEDs. The LEDs show you extensive real-time information (instead of four-digit hexadecimal values) through changing patterns. And because you rapidly associate these patterns with their system function, you often fix bugs in minutes instead of hours (studies have confirmed this). Also, because of the large amount of information you see on the display, you can find and fix problems you were not even looking for.

Various modes let you select address or data; read and/or write; input/output or memory; detailed or overview modes; and one, several, or all pages of memory. The display shows you program flow, memory references, port activity, and hardware—software interaction. You see the program stack as a moving bar graph. You see unstable electronics and intermittant activity directly. And you see code hot-spots for program optimization.

As a programmer using Micro View, you can debug, optimize, and analyze software. As an engineer, you can verify and troubleshoot new microcomputer circuits. Field service technicians benefit from its portability ($10 \times 8 \times 2$ inches).

The simple 16-switch console is easy to use and lets you give full attention to your microprocessor system. Although Micro View is completely self-sufficient, you can also use it with other devices. Using it as a supplement, you get another point of view on those hard-to-fix bugs; you get a better overview of activity; and you free up time on more expensive equipment.

Personality packs let you use Micro View with the 1802, 2650, 6502, 6512, 6800, 6802, 6803, 6808, 6809, 8035,

NEW PRODUCTS

Continued from page 112

8039, 8085, 8088, INS8060, INS807X, NSC800, Z80, Apple, IBM-PC, STD-BUS, and the TRS-80. There is also a user-definable pack.

Like the oscilloscope, Micro View gives you a new vision with which you clearly see activity that is normally invisible and quite intricate, saving time, money, and effort.

Price: $749, including all accessories.

Micro Logic Corp., *P.O. Box 174, 100 Second St., Hackensack, NJ 07602; (201) 342-6518.*

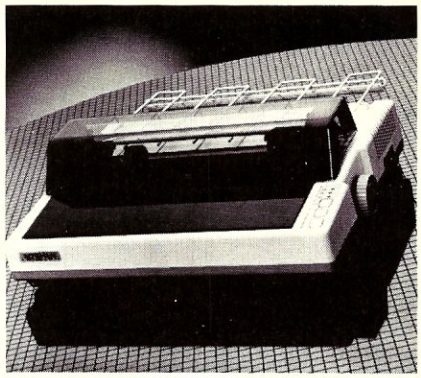
CIRCLE 313 ON READER SERVICE CARD

Inforunner's Riteman printer

Inforunner, Japanese manufacturer and worldwide distributor of the new low cost 10", 120 CPS personal printer, has announced the introduction of their product line to the U.S. market.

The Riteman printer is a high-quality dot matrix printer compatible with most existing software. It offers a fast, small, and lightweight printer with an easy-to-change ribbon cassette guaranteed for one million impressions.

Other important features included at no additional cost are a tractor feed unit with a custom smoked plexiglass cover, printing starting at 1" from the top of the page, plus upper-and lower-case characters with descenders.



Price: $499 retail.

Inforunner, *1621 Stanford St., Santa Monica, CA 90404; (213) 453-8731.*

CIRCLE 314 ON READER SERVICE CARD

From the Sidelines

Building a PC clone

by Hank Kee

Back in the very recent "old" days before the greenhouse effect, it was quite fashionable to build your own personal computing system from component parts. Computer flea markets were a gathering place for ham radio operatives offering power supplies to terminal outlets specializing in rejuvenated Teletype printers. Each Trenton Computer Festival was eagerly awaited. A list of things to shop for was dutifully prepared. However, we also knew we would buy other things not on the list, such as a vintage fixed disk drive system cannibalized from a minicomputer because the bargain could not be passed up. Getting the unit into the house and explaining it to your wife was always a challenge. How to stick an extra S-100 board into the system wasn't always obvious either. Many of the parts or components were purchased as add-ons to a dream system. Now it is much more difficult to locate even common TTL chips. With the advent of the IBM PC, TTL chips seem to be in short supply. The cost of many support chips has actually risen. This may account for the present scarcity of kits in personal computing.

There were many reasons for putting together your own system. The primary reason was that the hobbyists were in the forefront of personal computing. It was not uncommon to design and build your own S-100 system, writing customized drivers for CP/M. It gave one an emotional high to be one of the few kids on the block with an expensive "toy". Personal computing was not the "appliance" business that it is today.

At present, building your own system is much rarer. However, there are many people in the hinterlands who do design their own systems. The reasons are varied. The first is that the sum of the experience is far richer than going into a department store to purchase an "off-the-shelf" unit. The second is that the total cost of the components is less than the cost of the whole system, so the savings can be substantial. An example of this is the cost of $529 from IBM for a double-sided double-density disk drive. These drives may be bought at substantially reduced prices. Finally, for equal cost, the value to the user of such a system is greater than that of a the purchased system. Building a unit from parts is not all that difficult. It is even possible to put together a perfect clone of the IBM PC without too much effort.

A perfect PC clone

What makes the IBM PC unique? It is certainly not Blue Magic. You can substitute the disk controller card with a Maynard controller and find that there is no difference either in performance or in operation. The same can be said of using AST or Seattle Computer multifunction memory boards. There are many other fine memory cards on the market that will do equally well.

Perhaps it is the display? No, a substitute Princeton Graphics System RGB monitor or Sony Profeel display wouldn't make a difference. There are also many monochrome displays, available at substantially lower cost than the IBM display, that will function properly. Likewise, you can substitute a Keytronics keyboard with LEDs for the alpha and numeric key locks. Substituting any double-sided double-density 48 TPI $5\frac{1}{4}$" disk drive will not present difficulty. There are display adapters that are the duplicate in performance to the IBM display adapter boards.

Take away all the trappings, and you come up with the real difference, which is located on the IBM systems board. With all the clones in the marketplace, it is the proprietary ROMs on the IBM system board that make the difference. The Basic interpreter supplied with PC-DOS is dependent on the ROM. Some of the independent software vendors had cleverly made use of these ROMs. Many IBM clones come very close to being 100% identical in function to the IBM PC—close but not exact.

IBM now makes the systems motherboard available. It is intended as a replacement part. The cost of this board is $625. It is a fully socketed systems board with all the ROMs, supporting 8088 MPU, and associated support chips, and has 64K of populated memory. For those who wish to put together an IBM XT with or without the hard disk drive, that is also possible. The IBM XT systems board comes populated with 128K and costs $750. Both of these boards are available from IBM. For the purists, this may not necessarily be considered a clone. But at least it is legal. If you have difficulty in obtaining any of these parts, contact their parts department in Green Castle, Indiana: The phone number is (317) 658-2022.

Now, if any IBM-clone manufacturers want to make a system 100% compatible, all they have to do is offer a system in which the independent's motherboard need not be purchased. The purchaser then has the option of installing his own "perfect clone" systems board. The other requirement is that the clone system housing must be able to accommodate the same board size and connector placement as the IBM sys-

tems motherboard. This is exactly the case with Colby.

Colby offers a PC with or without the systems board. The Colby PC-1 includes a 9″ high-resolution amber CRT with antiglare screen, power supply, 15″ × 17″ × 8½″ high-impact case, and a tilting stand. This unit is listed for $899. What would be needed would be the IBM system motherboard, monochrome display adapter, floppy disk controller, half-height floppy disk drives and keyboard equivalent. The same unit packaged with a Colby keyboard, called PC-2, is priced at $1,188. If it is desirable to use IBM parts, they are listed as follows:

IBM Systems Motherboard—
part no. 8654213, $625
IBM XT Systems Motherboard—
part no. 8529254, $750
Top Cover for PC/XT—
part no. 8529162, $39
XT Base Assembly—
part no. 8529161, $62.75
XT Power Supply—
part no. 8529247, $290
PC Power Supply—
part no. 8529155, $266
Speaker—part no. 8529143, $8.15
Miscellaneous Kit—
part no. 8529165, $4.95
(screws, plastic standoffs, etc.)

Contact the parts center for other items not normally listed as available in the IBM product centers.

There are many people in the hinterlands who design their own systems.

For the company that originated unbundling, they have extended this to the PC environment. For hackers who want to put together a system of their own that is 100% compatible with the PC, this is now fairly simple. I just hope this column does not cause Big Blue to withdraw the system boards.

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

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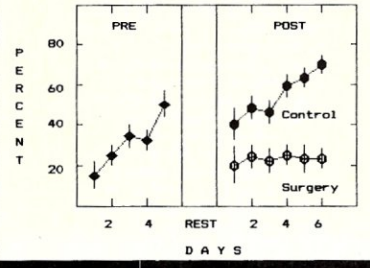

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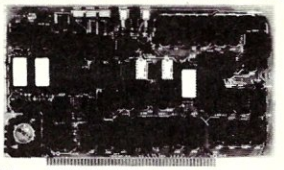
80 CHARACTER VIDEO BOARD – S-100



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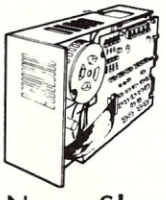

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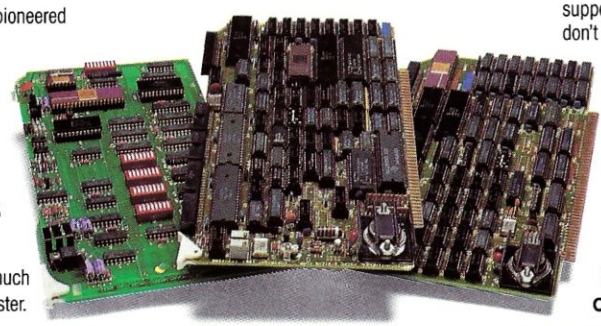

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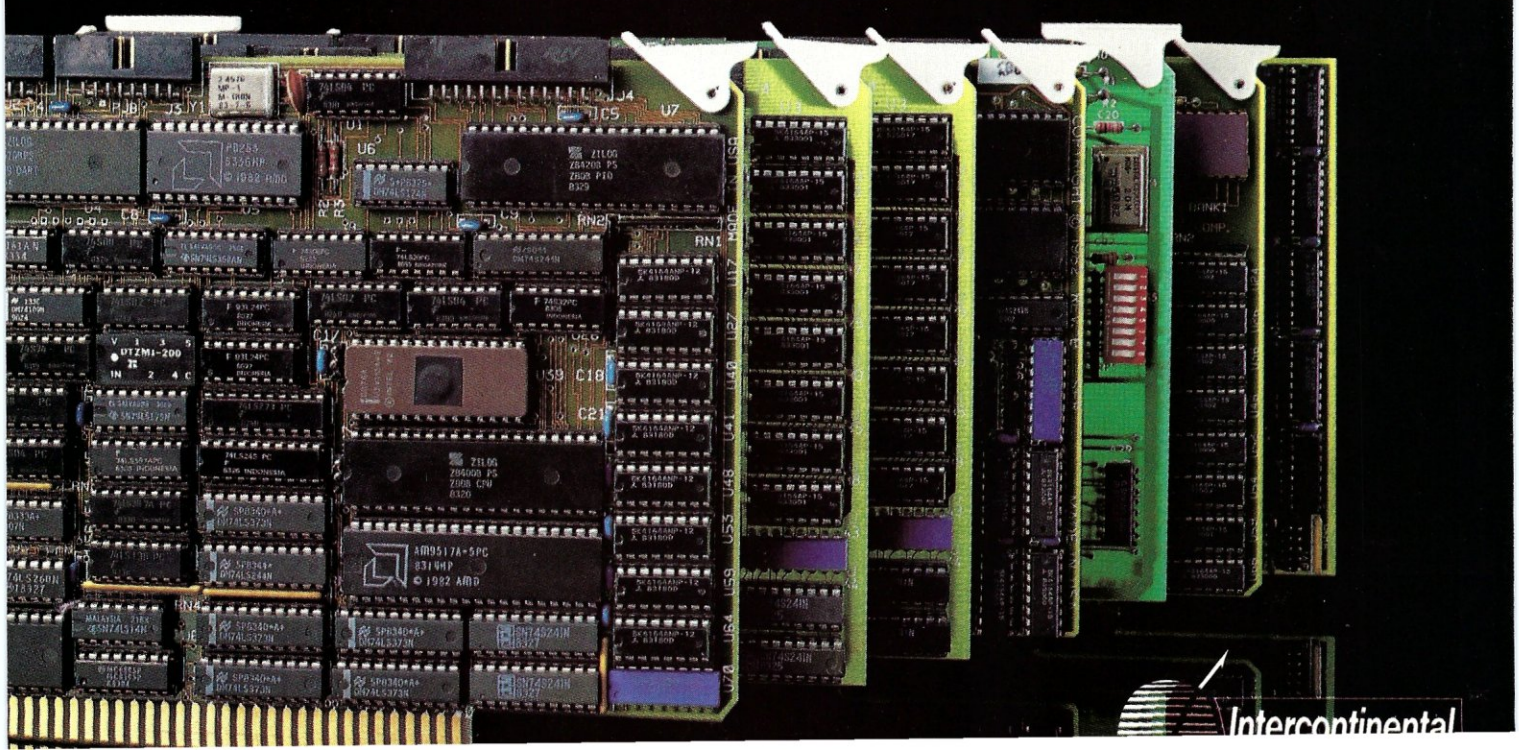

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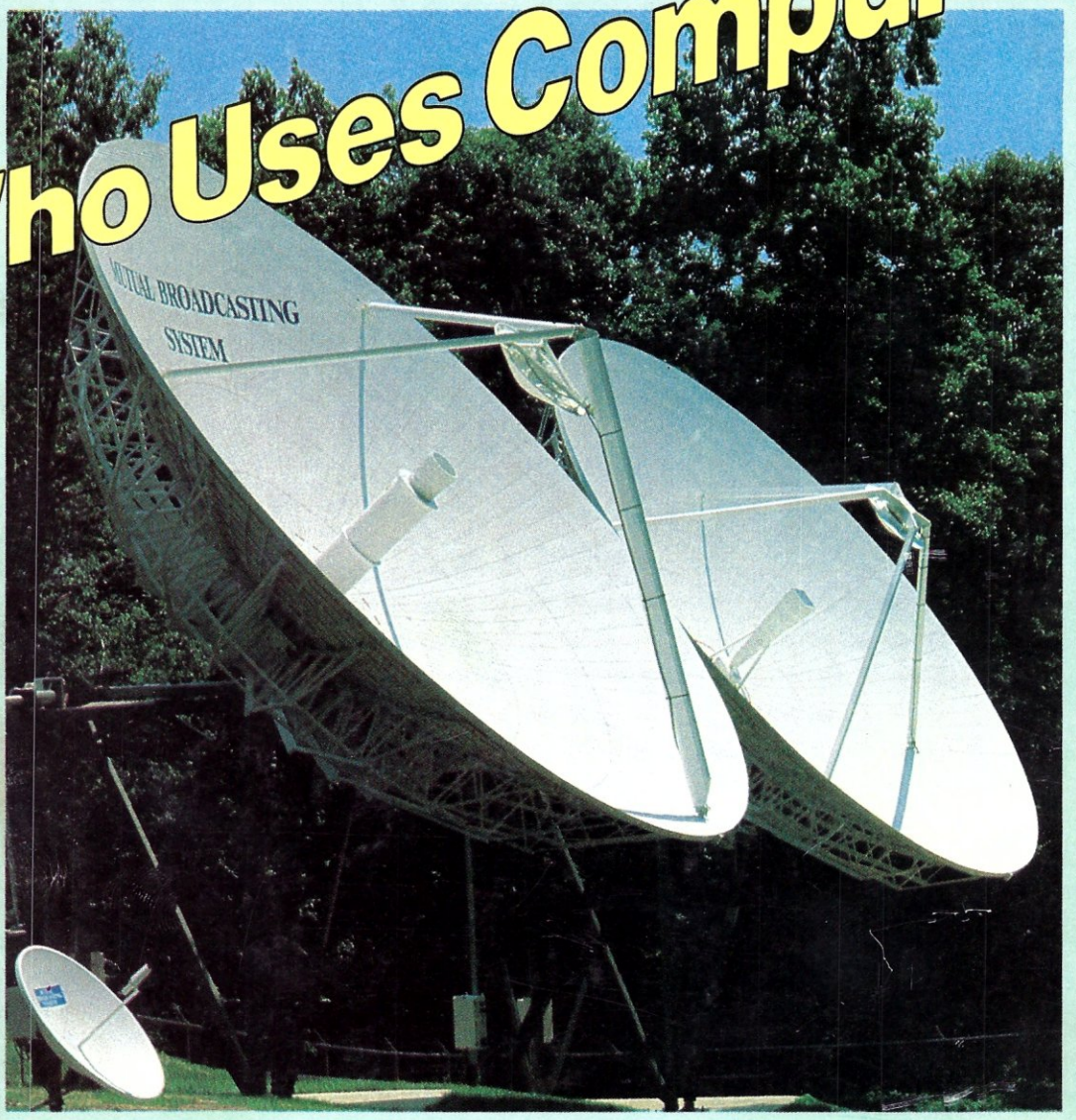

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