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Microsystems

January 1983

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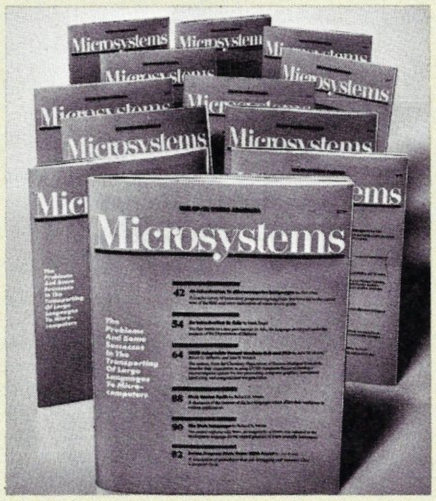

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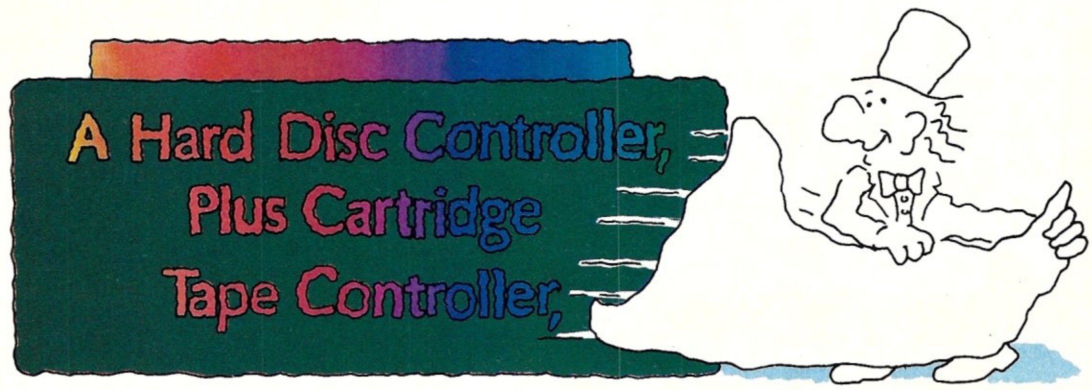

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- Controller communications with the host processor via 2K FIFO at any speed desirable up to the limit of 2 megabytes per second for a data block transfer. Thus the controller does not constrain the host processor in any manner.
- Two 28-pin sockets allowing the use of up to 16k bytes of on-board EPROM and up to 8k bytes of on-board RAM.
- Individual software reset capability.
- Conforms to the proposed IEEE-696 S-100 standard.
- Controller can accommodate two rigid-disk drives and one cartridge tape drive. Expansion is made possible with an external card.

Teletek's HD/CTC Offers A Hard Disc Controller, Plus Cartridge Tape Controller, All In One Board.

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Editor's Page

by Sol Libes

The primary emphasis of this issue is on the implementation of UNIX features on microcomputer systems. There is little doubt that UNIX-like operating systems will be very popular with purchasers of multiuser multiprocessing microcomputer systems, particularly those users doing software development.

UNIX offers many advanced features, and these are discussed in our lead-off article entitled "UNIX and CP/M."

This is followed by a tutorial on XENIX, a UNIX implementation that will probably be the dominant UNIX implementation on micros. We have also been fortunate to have had the loan of a multiuser UNIX-like system (*Ithaca InterSystems* running *Coherent*) for several weeks and have a very good review of it for you.

Also, CP/M-80 users can implement many of the advantageous UNIX features on their CP/M systems with software packages such as *Unica* and *MicroShell*; hence we have reviews of these packages.

Lastly, we have initiated a column for micro UNIX users that will appear every other month in *Microsystems*. Further, we have received some other UNIX-like products which we are checking out for reviews that will appear in print later this year.

We hope you enjoy this issue as much as we enjoyed putting it together for you.

This issue marks the beginning of our fourth year of publication. I can hardly believe that the time passed so quickly and that so much has happened. The most important recent occurrence is that with this issue *Microsystems* becomes a monthly publication. That's right, we are finally able to do what so many of our readers have been asking us to do for so long—publish monthly. So now you can expect to receive twice as much CP/M, S-100, and other sophisticated micro user material as in the past.

We have also increased the size of the magazine, in case you have not noticed. The first issue of *Microsystems*, published way back in January 1980, was a mere 56 pages. Gradually the size increased each year until in November of last year we reached our present size of 130 pages. We expect that *Microsystems* will continue to increase in size to match the increase in advertising. I am sure that you have already noticed the healthy increase in advertiser support.

The circulation of *Microsystems* is now over 40,000, up from about 23,000 at this time last year. We expect this to increase again substantially this year. This makes *Microsystems* one of the major publications in the microcomputer field.

We are working on special issues for this year, emphasizing the following topics. Although we already have some of the feature articles for these issues, we are looking for more. If you would like to write an article on any of these topics, let us know so we can send you a copy of our author's guide.

Special topics for 1983:

- CP/M-80 Version 3
- Word-Processing Software
- Micros in the Laboratory
- S-100 Standard & Components Directory
- Business Applications
- Graphics
- Local Networking Systems

Incidentally, both Chris Terry and I will be attending the CP/M '83 show (January 21-23) and the West Coast Computer Fair (March 18-20). Both will be held in San Francisco. If you would like to meet with us there, please let us know.

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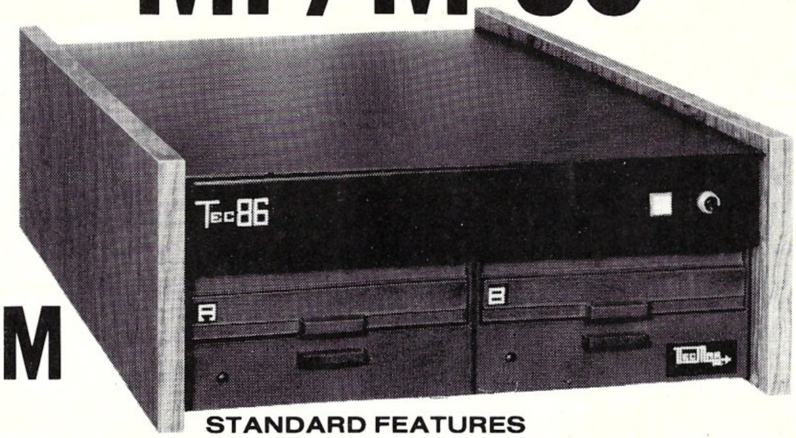

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News & Views

by Sol Libes

S-100 standard progress report

Mark Garetz, chairman of the IEEE-696 (S-100 bus) standard committee reports that the standard was mailed to members of the IEEE Computer Society Standards Committee (CSC) in early October. At the time this was written, the results of this ballot were just beginning to come in. The standard has already been approved by the 696 working committee and the IEEE microprocessor standards committee. After approval by the CSC it must still be approved by the IEEE Standards Committee before becoming an offical IEEE standard. This is not expected before the spring at the earliest. At that time we hope to either publish the entire standard or the changes from the proposed standard as previously published in *Microsystems* (January 1980).

SIG/M & CPMUG new releases

Both SIG/M and CPMUG were hard at work during the second half of last year, putting together several new volumes of public domain software. SIG/M and CPMUG are the two largest public domain software groups in the world. Although there are some other small groups, they are essentially local or specialized (e.g., the Pascal-Z software library) and tend to distribute their work outside of their immediate areas via organizations such as SIG/M.

CPMUG has announced the release of Volume 82 (North Star BIOS routines), 83 and 84 (Modem and XModem updates) and 85 (communication utilities and directory updates). For further information write: CPMUG, 1651 Third Ave., NY, NY 10028.

SIG/M has added 20 more volumes since I last reported on their activities, bringing their total to 75 volumes. It is not practical to report here on the contents of the new releases; rather, I recommend that one purchase a copy of their printed catalog ($1.50, $2 foreign): SIG/M, Box 97, Iselin, NJ 08830.

Digital Research news

Digital Research expects to start shipping copies of CP/M-80 version 3 this month. *Microsystems* was a Beta test site for it, and we hope to publish our first articles on it in next month's issue. CP/M-80 has been enhanced particularly for systems with memories greater than 64K and large disk storage. Many new features have been added to improve its power, user interface, and speed of execution. So look forward to next month's *Microsystems* for the full details.

DR reports that CP/M is now licensed to over 700 OEMs and is used on over 700,000 systems. Further, DR is working on versions for the Z8000, 16032, and 68000.

Zilog to begin sampling Z800

Zilog is expected to start shipping samples of its new Z800 8-bit microprocessor this month. The Z800 is object code compatible with the Z80 and provides a 3 to 5 times performance improvement. Its internal clock runs at up to 25 MHz. The Z800 can address up to 500K of RAM using a memory management circuit (dynamic page relocation) and memory protection. It has both modes for both system (used by programs performing OS functions can access all registers) and user (limits access to CPU registers and prohibits execution of instructions that alter system status). The Z800 has an expanded instruction set with multiply and divide (8- and 16-bit), handle strings up to 64Kbytes long, system calls, and lots more. It also has more addressing modes and features suited for multiuser and multiprocessing environments.

User groups & newsletters

A Seattle Computer Products User Group (SCP-UG) has been formed to support users of the SCP 8086-based S-100 system using MS-DOS. The group will make available public domain software, published a newsletter, and have a bulletin board system on-line. Membership is $10/yr. Contact: Joseph Boykin, 47-4 Sheridan Dr., Shrewsbury MA 01545; (617) 845-1074.

RR Software is publishing a newsletter for Janus users (Janus implements a subset of Ada). The first issue carried bug reports, versions changes, and general news, and was 4 pages long. Contact: RR Software, Box 1512, Madison WI 53701; (608) 244-6436.

A Nevada Cobol Users Group has been formed and is publishing a newsletter. For information contact: NCUG 5536 Colbert Trail, Norcross, GA 30092; (404) 449-8948.

Books & magazines

The S-100 Bus Buyers Guide is published twice a year ($25; add $10 outside U.S., each additional copy included in order, $9.95) by Ironoak Co., 3239 Caminito Ameca, La Jolla, CA 92037; (714) 450-0191. I ordered a copy, but as of this writing it still has not arrived, so I cannot comment on it.

Bits, Bytes and Buzzwords, a buyer's guide to business computers ($2.50) is being published by CompuPro, Oakland Airport, CA 94614; (415) 562-0638.

The User's Guide To CP/M Systems and Software is a new bimonthly magazine oriented to beginning CP/Mers. Individual copies are $4 yearly, subscription is $18 (ranking it as the most expensive CP/M magazine in publication). The first issue was 64 pages long, professionally done, contained several tutorials for beginners, and brief looks at three systems that run CP/M. Future issues

News & Views
continued . . .

will have articles on "word processing, financial modeling and forecasting, preparing taxes, multiple printing and mailing list operations, and managing a data base." TUG, 117 Ware Rd, Woodside, CA 94062.

Random news bits

Morrow Designs has expanded to a new 50,000-square-foot plant located at 600 McCormick St., San Leandro, CA 94577; (415) 430-1970. This is twice the size of their previous plant, which was in Richmond, CA. Good luck to them!

I also regret to report that TEI Inc., in Houston, Texas, which manufactured one of the best S-100 mainframes around, has gone out of business.

S-100 standard passes mail vote

The S-100/IEEE-696 proposed standard has moved one step closer to adoption. In May 1982 it was approved by the working committee and in June, by the Microprocessor Standards Committee of the IEEE. In September, a mail ballot was initiated to the IEEE Computer Standards Committee (CSC). By the end of October, sufficient ballots had been returned to show that the standard had passed its mail vote; it will be formally adopted at the December meeting of the CSC.

The remaining hurdle is approval by the IEEE Standards Group. Submission will be made after the first of the year, with final adoption of the standard expected by late spring.

Credit for the wrapping up of the S-100/IEEE-696 standard and piloting it through all the IEEE committees goes to Mark Garetz, Chairman of the S-100 Committee and President of CompuPro.

Coming in Next Month's Issue:
• Articles on the new version of CP/M • Three S-100 SBCs
• Build an EEPROM Board
• Triple-Density Floppies
• ADS PROM-Blaster
• Pascal MT+ • UCSD Pascal Disk Scanner

The S-100 Bus

by David J. Hardy

Strange S-100 Hardware Failures

This column is intended as a forum on S-100 topics. I encourage readers to send in any questions about the S-100 bus, which I will attempt to answer in this column. The questions should, in general, be directly related to the hardware structure and timing of the bus, though some software may also be involved. Questions could also be general ones about interfacing to the S-100 bus, or specific ones about problems encountered in trying to interface a specific product.

—David J. Hardy

This month's column is about a part of S-100 bus "technology" that is rarely discussed: repairs. More specifically, repairs for those really terrible unexplained problems that always seem to occur just before you finish typing in a 300K source file.

Repairing *major* breakdowns in an S-100 machine is usually simple. It's easy to find the parts that have just burst into flame, or the cables that have been cut in half, or the blown fuse that turns off your disk drives.

It's not so easy to figure out why your system blows a disk once or twice a week just as it's warm-booting back from your favorite screen editor. In fact, sometimes it's downright impossible.

Failures in outside sources

Some machine problems are caused by uncontrollable outside situations, like a power failure or a lightning strike. There really is very little you can do to protect your machine from those kinds of things. (*Nothing* can protect your computer from a direct lightning strike, although you can protect, to a certain extent, against transients induced by a lightning bolt.) Fortunately, these are not usually the troubles that cause those unexpected glitches in your otherwise smoothly operating machine.

From the outside, there are really only a few things that can cause your machine to take a premature vacation to the repair shop. Obviously, the computer's power source is an important outside influence on your machine's reliability. Voltage fluctuations like brownouts may actually have very little effect on the power supply that drives the S-100 bus, but brownouts can do other terrible things, like cause fans to burn up and air conditioners to shut off. Some S-100 frames have built-in constant-voltage transformers to prevent low voltage from causing your system's boards to "starve," but very few think about the fan motors, which could be destroyed by prolonged low-voltage conditions, or at least could be caused to stop working.

Power supplies with adjustable voltages may drift if the controls are not protected against vibration with "Locktite" (or even nail polish). A problem with Shugart 800 drives not finding the right track was traced to a +5V supply with an unsealed adjustment that had drifted down to +4.6V. As a result, the op-amp associated with the home sensor became unreliable, so that the controller sometimes did not receive a home signal and sometimes received one when the drive was not on track 0.

Another external influence to consider is temperature. Heat is a real enemy to S-100 cards because of their on-board regulators. A fan failure or blocked air vent can easily cause problems that seem to come and go at strange times. Static RAM boards are particulary susceptible to overheating, and probably cause many of the unexplained crashes in systems that use them. Bear in mind that *airflow*, not just cool air, is what's needed to keep your machine from overheating. The ambient air temperature can actually be quite high (maybe as high as 100 degrees), as long as the air is kept moving through the machine.

There are lots of other outside influences that could cause erratic problems, too. High-powered RF fields from local broadcast stations can do a pretty good job of messing up unshielded electronic devices (like computers with the covers removed, or long data lines). I have actually seen locations where the RFI is strong enough to cause drive malfunctions, and where modem communications are impossible because of the high-powered directional signal of a local radio station. In one case, I could scope the data lines on the machine and actually watch the announcer's voice dance across the (normally) TTL-level signals.

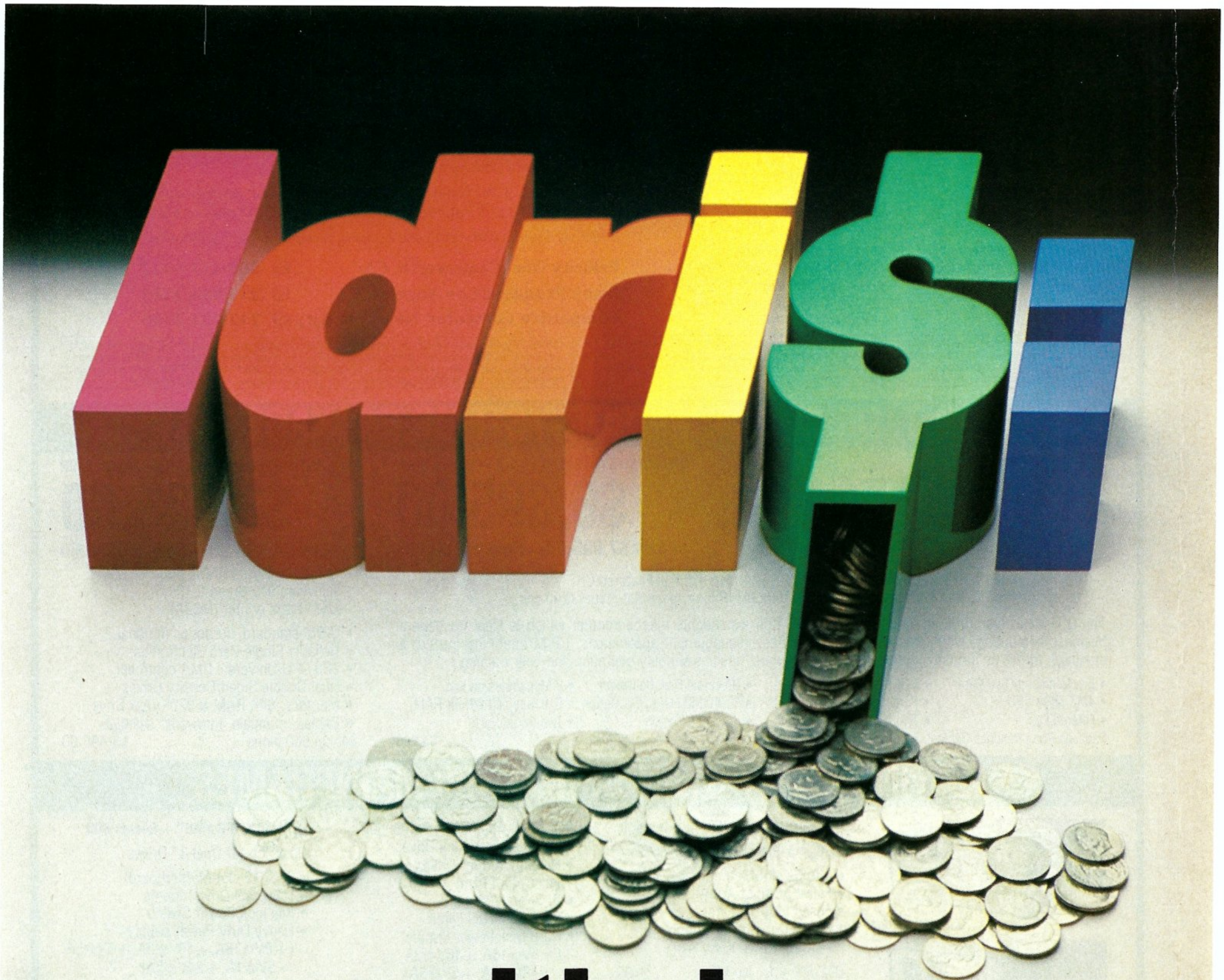
For the most part, "outside" problems are fairly difficult to solve. Sometimes, you can't solve them, so you have to just live with them.

Failures in inside sources

Inside problems are probably the most frequent cause of the subtle "once-in-a-while" glitches that make you want to ditch your machine and take up macrame. Connectors and cables are the frequently overlooked causes of this type of problem. You might be surprised to find out that most repair technicians spend a great deal of their time just removing and replacing the PC cards in S-100 frames to solve problems of all sorts.

Often, just reseating ICs that are mounted in sockets will solve problems that seem to be impossible to find or trace.

In fact, one of the biggest disadvantages of the S-100 bus



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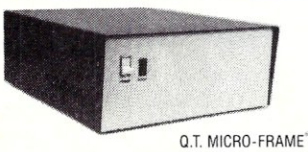

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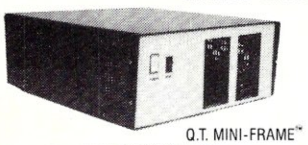

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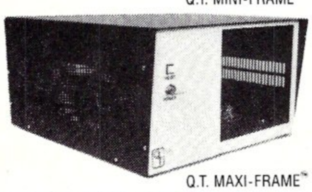

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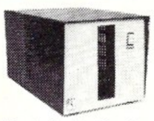
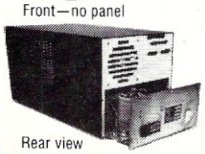


Front—Tandon Panel

Front—no panel



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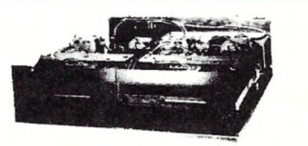

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is that it has 100 little connectors in each socket and on each board that are just waiting to catch the first piece of dirt or debris that comes their way. Usually, the connectors are plated with gold to insure a clean, low-resistance connection, but even gold can oxidize or pick up dirt. Just touching the edge connectors of PC board can contaminate its gold contacts.

You can clean edge connectors with isopropyl alcohol and a Q-tip, or even with TV tuner cleaner. You shouldn't try to clean them with an eraser, because it literally removes the protective gold plating, usually exposing the less protective solder plating beneath.

Small pieces of debris that get wedged into the S-100 sockets can also cause real trouble. They can get trapped between the PC board connector and the socket and cause intermittent connections. In commercial installations, the lowly sesame seed has probably been responsible for thousands of repairs of this sort of problem. Available on fast-food hamburgers around the world, this little invader is just the perfect size to slip unnoticed into a convenient vent on the side of a computer or into a keyboard to wreak havoc on an unsuspecting operator. Strangely enough, this kind of failure seems to occur most frequently just after lunchtime.

Cables

Another cause of intermittent, hard-to-find problems is often broken or poorly seated cables. Ribbon cables are very easy to bend and crease, and usually the wires inside them are small enough to be broken by a few tight creases, or excessive tension. It is sometimes very difficult to find a break of this type. Usually, the break can be found by flexing the cable while the machine is running, but the best solution to a suspicious cable problem is to just replace the cable. Ribbon cables can also be "scratched" by sharp edges, which may result in several bare wires across the ribbon that can be shorted together whenever they contact metal or the cable is flexed. Connectors on ribbon cables are also rather fragile, and are frequently the cause of this same kind of trouble. Again, replacement is the best procedure, if you can find where the problem is located.

Round cables are less likely to cause trouble, but are subject to the same kinds of problems as ribbon cables, especially at or in the connectors.

Disk drives

Disk drives are, by nature, the most common source of "unexplainable" problems. This is because they are the most mechanical part of your machine. They usually have all of the classic failure-oriented parts, like relays, servos, motors, etc., and are also subject to (and the source of) electromechanical interference like current hogging (for example, when the DC motors start up and the screen on your terminal gets smaller) and inductive transients. The head-load relay in most drives generates a dandy transient pulse that can easily change its supply voltage 50% for a very short time. Improper or faulty wiring in the supply of a drive could actually cause the drive to intermittently write as the head is loaded or unloaded. Also, because in a CP/M machine the R/W heads of a drive spend much of their idle time positioned over a directory track or a system track, an intermittent write could often cause a "mysterious" problem, like having the disk blow up just before a warm boot, or getting garbage from a DIR command.

Because they are mechanical (that is, they have moving parts), disk drives also require more frequent maintenance. In fact, most drives require alignment at least once very two years. A misaligned drive could cause frequent BDOS errors, and could even "hang" the system during disk I/O. This is probably the most common intermittent problem experienced by small system users. A worn disk or drive could also cause this type of problem. To make matters worse, most S-100 controllers are not designed to handle this type of problem. At best, they will report (via the BDOS) "BDOS ERROR on x: BAD SECTOR," (which is exactly what they are supposed to do) and at worst, the controller board will never return control to the system, causing the disk to run forever, with head loaded and motors spinning.

Floppy disk drive maintenance is fairly simple: Keep them clean and cool, don't bounce them around, and feed them ample power. Frequent BDOS errors are usually a good sign that they need repair or alignment. Hard disks (Winchester, fixed, cartridge) are a bit touchy and require more sophisticated maintenance, but are basically the same.

Board incompatiblities

A less frequent cause of mysterious system problems is often found in "mix and match" systems, where there are boards from several different manufacturers. Until recently (and even now, to a lesser extent) many "S-100" boards weren't really S-100 at all. Until the IEEE-696 standard, many manufacturers had a "fuzzy" view of S-100, often assigning unused S-100 lines for their own special purposes, and not properly producing or using the "standard" signals on the bus.

For example, early S-100 dynamic RAM boards were once notorious for working only with boards made by their own manufacturer, because of the strange schemes used to refresh the RAM chips. Anyone buying one of these boards to use with his own system was taking a real chance. Many of these boards would work great 99% of the time, and then just suddenly drop a bit here and there. Unfortunately, this is still true in many cases, due to the many S-100 manufacturers who are not yet using the IEEE-696 standard, and to the fact that old (non-IEEE-696) S-100 boards will be around for many years to come.

Non-IEEE-696 disk controller boards are also a common source of exotic problems in "mix and match" machines. Many of these boards can't run at more than 2 MHz, and some of them can't run at less than 3 or 4 MHz. Many also can't tolerate real DMA, even when it is being performed by other boards.

Unless you are a real hacker, and enjoy redesigning and rewiring old boards, the best thing to do to solve a board incompatibility problem is to replace the conflicting board. Although this solution can be very expensive, it is best in the long run, because the incompatibilities of the old board could also cause problems in any future enhancements to your system.

Component problems

The individual components on each S-100 card can also be a cause of erratic operation. Whenever a new board or component is added to the system, it should always be "burned-in" for several hours before being assumed to be OK. And good rule of thumb is to not trust any S-100 board until it has seen at least 10 or 20 hours of trouble-free operation. In fact, a more realistic view of component failure would dictate at least 200 hours of operation, but most failures would occur well before that time.

Component problems, at least those which are not obvious, usually cause the kind of problems that can't be exactly pinned down. For example, an intermittently bad RAM IC might cause a system to suddenly lock up after several hours of trouble-free operation, then not show up again for months. This is, by far, the hardest kind of problem to track down. Even changing a suspected board can't really tell you where the problem is, since you really can't say when the problem will next occur. Changing a suspect board in a case like this can really only

help if the problem shows up again *after* you've changed the board. Then, at least, you know where the problem isn't. If a spare board isn't available, then you could also try "shotgunning" the suspected board by replacing all of the suspected ICs. This is a rather clumsy way to troubleshoot, but is usually cheaper than buying enough test equipment to monitor an entire computer system.

When you remove ICs from a socket, use a proper removal tool (OKI makes a good one). And when you insert new ICs, *don't* bend the pins permanently inward to make them fit; that is a sure way to induce poor connections. Use an IC insertion tool; this temporarily compresses the pins so that they can be aligned with the socket receptacles. Then, when the IC is pushed straight home, the pins maintain their outward pressure to ensure a good contact.

The components that fail most often in S-100 systems are voltage regulator ICs, RAMs, and line drivers. It is usually a good idea to keep a few spares around just in case. Usually, this is less than 10 parts for an entire machine, so it's not really that hard to do.

System problems

System problems are those problems that occur due to an operator error, or by something that "messes up" an operator's normal procedure. These problems are usually basic procedural errors that result in the machine not doing what the operator thinks it should.

I have, on more than a few occasions, been asked to help someone repair a disk controller board, drive, system, etc., that was unable to read or write newly formatted disks, only to find that the operator had actually performed the format procedure on write-protected disks, which couldn't be read or written since they were never formatted.

The obvious way to avoid this sort of trouble is to think before proceeding. It is incredibly easy for an operator to make a mistake and then blame it on the system. This kind of problem is the hardest of all to pinpoint in a machine, because there is literally no machine problem to be found.

Erratic system problems can also be caused by faulty media, like a floppy disk with a blown system image. Magnets are obvious enemies to floppy disks. Many typists use small magnetic copy holders that can do a real good job of destroying the data on a floppy disk.

What to do about failures

Try to determine each time the failure occurs what *is* and *is not* causing the problem. This is a "process of elimination" method. It works very well for most intermittent problems, if you can keep from going crazy while you wait for the problem to recur so you can narrow the problem area down each time.

Bear in mind, when replacing suspected bad parts, that it is often easier to replace an entire group of parts than to replace them all one by one, each time the problem occurs. After replacing an entire section in ICs, if the problem goes away, you can always find the bad chip by reinserting the old chips back into your machine, if you want to spend the time. Meanwhile, your machine will be running, and you won't be pulling out your hair.

I hope this has given some idea of where to look when your machine suddenly "blows up." The subjects I've mentioned are really more of a "Top 10" sort of guide than an outline of how to repair or troubleshoot a machine with strange or intermittent failures. To cover all of the subjects related to troubleshooting and repairing an S-100 machine would take years. It is fortunate for all of us that the S-100 bus is so simple and reliable.

I would be interested to hear about any strange S-100 problems that might be of general interest, and also about their solutions. It might save someone from taking up macrame.

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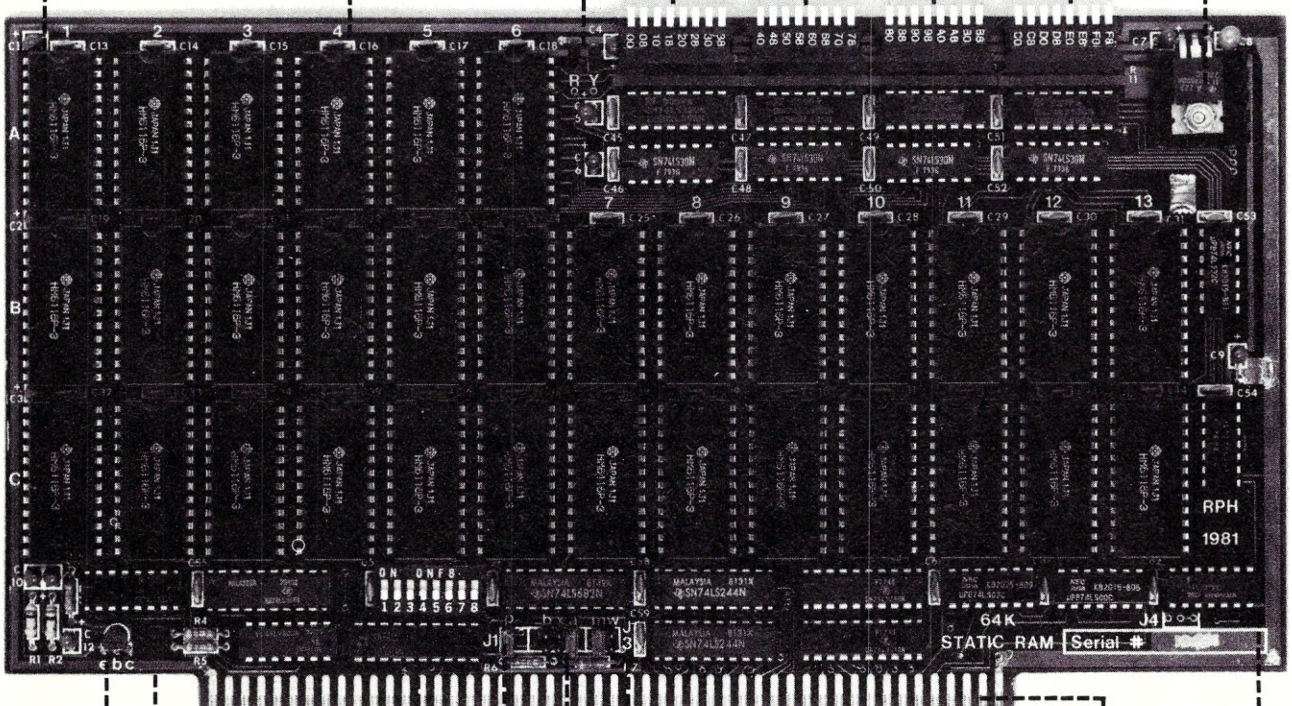

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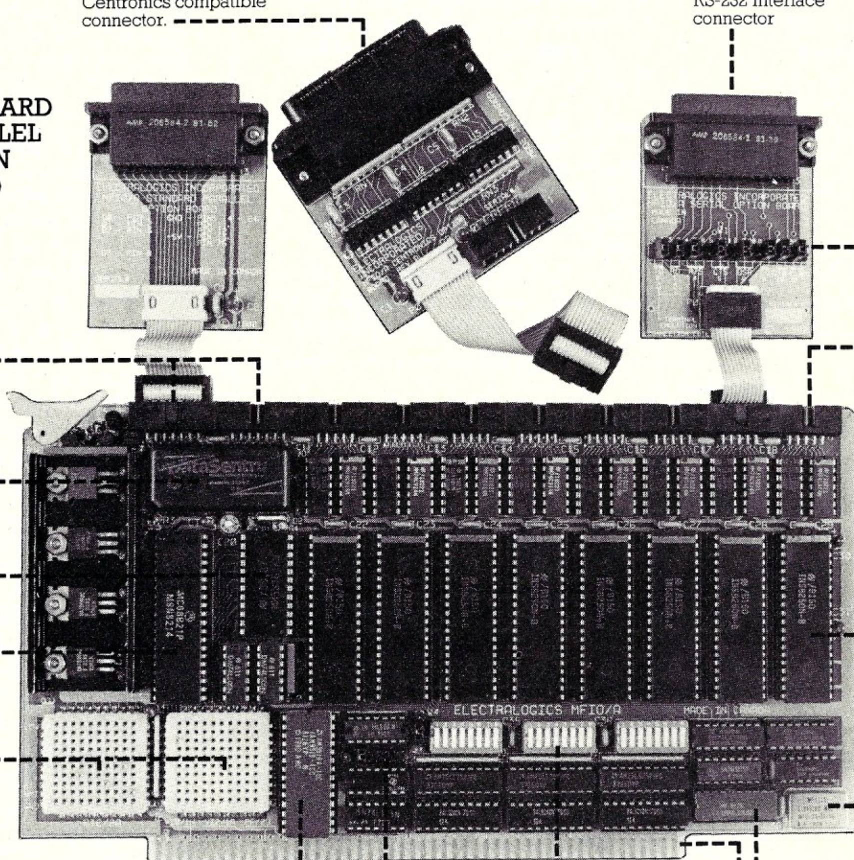

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Letters to the Editor

Dear Editor,

Re: North Star queueing

I refer to my original article on this subject published here in Jul/Aug 1981. Readers will recall that the purpose of queueing was to speed up data input by storing data in the queue while Basic was processing the last data input.

However, there is a further advantage of the DOS as described in that article. It is possible to FILL the queue from a Basic programme. This enables the programmer to EITHER set up a series of commands, which may confuse the novice operator (e.g., entering DOS for a DOS utility, such as GO CD), OR set up a series of commands that otherwise may be tiresome or just boring to do manually (e.g., obtaining a printout or listing of all Basic programmes on this disk).

Listings of these two examples are given below, but no doubt readers have needs of their own from time to time.

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Australia

Listing 1

```
10 Q1=10751  \REM LOCATION OF FIRST IN QUEUE - GOES DOWNWARDS
20 Q =10497  \REM LOCATION OF KEY - IS 255 WHEN QUEUE IS EMPTY
30 A$="BYE"       \GOSUB 60
40 A$="GO CD 1 2"\GOSUB 60
50 END \REM COMMAND TO START IT ALL OFF
60 REM SUBROUTINE TO LOAD QUEUE
70 FOR A=1 TO LEN(A$)
80 FILL Q1,(ASC(A$(A,A)))\Q1=Q1-1\       REM PUT ASCII IN QUEUE
90 V=EXAM(Q)\FILL Q,V-1\                 REM ALTER COUNT OF NUMBER IN QUEUE
100 NEXT A
110 FILL Q1,13\Q1=Q1-1\                  REM PUT CARRIAGE RETURN IN QUEUE
120 V=EXAM(Q)\FILL Q,V-1\RETURN\         REM ALTER COUNT OF NUMBER IN QUEUE
```

Listing 2

```
10 GOTO 30\REM MANUALLY START AT NEXT LINE AFTER THIS
20 A=0\FILL 100,A\    REM ANY SPARE RAM
30 DIM A$(20)\Q1=10751  \REM LOCATION OF FIRST IN QUEUE - GOES DOWNWARDS
40 Q =10497  \REM LOCATION OF KEY - IS 255 WHEN QUEUE IS EMPTY
50 OPEN #1,"<*>"\A=EXAM(100)\  REM DIRECTORY SPACE MUST BE NAMED <*> TYpe 3
60 READ #1%A*16+12,&C\        REM C IS FILE TYPE
70 IF C<>130 THEN A=A+1\       REM NOT A BASIC PROG FILE
80 IF A=128 THEN STOP\         REM LAST FILE ON DISK
90 IF C<>130 THEN 60\          REM GOTO NEXT FILE
100 A$=""\FOR B=0 TO 7\READ#1%A*16+B,&D\A$=A$+CHR$(D)\NEXTB\REM A$ IS FILENAME
110 A=A+1\IF A=128 THEN STOP\FILL 100,A\   REM SAVE COUNTER
120 A$="LOAD "+A$\ GOSUB 160
130 A$="LIST #7" \ GOSUB 160
140 A$="CHAIN"+CHR$(34)+"Z"+CHR$(34)\GOSUB 160
150 END \REM COMMAND TO START IT ALL OFF
160 REM SUBROUTINE TO LOAD QUEUE
170 FOR A=1 TO LEN(A$)
180 FILL Q1,(ASC(A$(A,A)))\Q1=Q1-1\       REM PUT ASCII IN QUEUE
190 V=EXAM(Q)\FILL Q,V-1\                 REM ALTER COUNT OF NUMBER IN QUEUE
200 NEXT A
210 FILL Q1,13\Q1=Q1-1\                  REM PUT CARRIAGE RETURN IN QUEUE
220 V=EXAM(Q)\FILL Q,V-1\RETURN\         REM ALTER COUNT OF NUMBER IN QUEUE
```

Dear Editor,

Since I have enjoyed receiving *Microsystems* this past year, I thought I would write to let you know what I would like to see in the magazine. My own background in brief: I am a navigator in the Air Force, I have owned a Vector Graphic MZ since 1979, which I use mostly for word processing (I edit a magazine for collectors of stamps from Thailand). I also do a bit of programming in Basic and hack around in assembly language when I have the time. I have been using the SOURCE for the past year and have recently discovered the bulletin board systems that we have in Hawaii. Computing will soon become a part of my job when my squadron receives a Cromenco System 2H, which will be my responsibility.

Here is what I would like to see in *Microsystems*:

Hardware

1. A discussion of upgrading older S-100 systems with the new dual processor boards.
2. An article or review on the new large memory boards such as the Macrotech 256K board. The idea of implementing this type of board as a "virtual disk" has considerable appeal.
3. Reviews of the lowest-cost hard disk systems.
4. *Complete* construction articles. The real-time clock article in "The S-100 Bus" in the September/October issue is interesting, but there is not enough information for me to attempt to build it. I would suggest that in addition to the schematic, the article should include a parts list, recommended parts layout on the board, and enough software to fully implement the clock in a typical S-100 CP/M system.

Software

1. An article on MODEM programs. I discovered recently that what I have been doing with my Hayes S-100 Micromodem is called "informal" file transfer. I found this out since my MODEM program was unable to do the "formal" file transfer required to download a .COM file from our local CP/M bulletin board system.
2. Languages. Now this is not really intended as a criticism. Your magazine has had many articles on languages, but somehow my own questions have not been answered. I am looking for a language that I can use to write a navigation program, since I have not been satisfied with my efforts in Basic. I need a language that includes the ARCSIN and ARCCOS functions and makes the output of data in various formats easy. The MBasic "print-using" format is enough to drive me up a wall. Most of the comparisons I have seen recently concentrated on the structure of languages. I would like to see a review of their features. In other words, given an application, which language is best suited?

Count me as a loyal reader. It is great to read a computer magazine that is "Apple free."

Gary A. Van Cott
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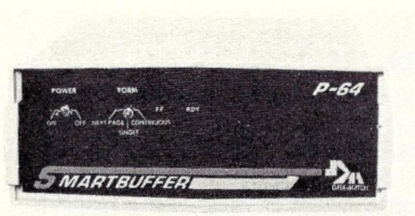

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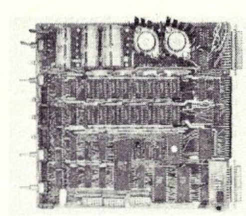

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CIRCLE 44 ON READER SERVICE CARD

UNIX and CP/M

A comparison, for those who are familiar with CP/M, of file system, I/O, command processing, and application processing

by Don Libes

This article is a comparison of CP/M and UNIX which will discuss the environments provided by each operating system and, to some extent, the underlying mechanisms in each system.

I will assume that all readers are familiar enough with CP/M that they have at least a vague idea of how it works internally. I won't assume that everyone is as familiar with UNIX, though, so I'll try to provide explanations where needed. Because of the emphasis on UNIX, then, this will be an introduction to the world of UNIX for many. Similar introductory material for CP/M may be found in "The CP/M Connection" by Chris Terry (*Microsystems* Vol. 1, Nos. 3, 4, 5; Vol. 2, Nos. 2, 3).

UNIX is a more sophisticated operating system than CP/M. Much more. While I would rather do my daily work with UNIX, CP/M has its place, however. CP/M is a low-overhead system that provides portability and structure at a minimum level. There is no question that it has become the standard operating system for 8-bit systems. It is estimated that CP/M has been implemented on over 700 different computer systems, totalling more than 700,000 CP/M systems in use. CP/M is also evolving towards more powerful and sophisticated performance, especially multiprocessing (MP/M), 16-bit microprocessing (CP/M-86), and multitasking (Concurrent CP/M-86).

On larger systems (16-bitters) that can handle the increased overhead of a larger command interpreter and the invocation of programs as system commands, I feel that UNIX is the system of choice. Indeed, the first multiprocessing UNIX was implemented on the PDP-11/45. The PDP-11 has a 16-bit internal data bus and 18 address lines. Briefly, the memory management unit on the PDP-11 provides the user with 16 segmentation registers, eight for data and eight for instructions. Segments are restricted to at most 8K in length. Another set of registers is available for the operating system itself. In contrast, the 8086 provides only one segment register each for data and instruction references, though the segments can be up to 64K in length. In the 8086, the memory space can be as large as 1M, four times that of the PDP-11.

UNIX has been ported (transported) from the PDP-11 to many other machines, most notably the VAX-11. The VAX is actually a successor to the PDP-11, incorporating virtual memory (theoretically 4 gigabytes) in a paged environment, hence the name VAX (Virtual Address eXtension).

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Preliminary comparison

One way to emphasize the difference in functional power between the two systems is to attempt to duplicate the services of one system on the other (at the user level). It is quite easy to make UNIX look like CP/M. Trivial one-line executable files (or aliases) can be set up so that "cat" becomes "type", "rm" becomes "erase", etc. Also, file names such as "/dev/tty" can be linked to their CP/M device counterparts ("CON:"). The prompt can also be changed.

On the other hand, it would be quite impossible to make CP/M mimic UNIX. The hierarchical file system, device independence, file protection, and other ideas cannot be easily integrated into CP/M. Major rewriting of substantial CP/M internals would be required.

Four-part comparison

To compare UNIX and CP/M in detail, I will divide the systems artificially into four parts that play similar roles in both systems. These are as follows:

Table 1. Characteristics

UNIX	CP/M
File system	File system
Shell	CCP
I/O	BDOS/BIOS
core/process	TPA

The file system

The UNIX file system has a hierarchical structure. This gives it a tree-like form that is very useful for keeping related work together and separate from other miscellany. Informally, a UNIX directory is a file that contains other files. More exactly, directories contain file names along with pointers to the files themselves. Thus it is possible for two directories to point to the same file, possibly using different names! The file is then said to have multiple "links." Files in such a directory may contain bytes of textual information, or they may be directories themselves, containing other files. Figure 1 is a graphical interpretation of part of a typical UNIX file system.

In comparison, the CP/M file system has one level. Though disks may be considered to give it a

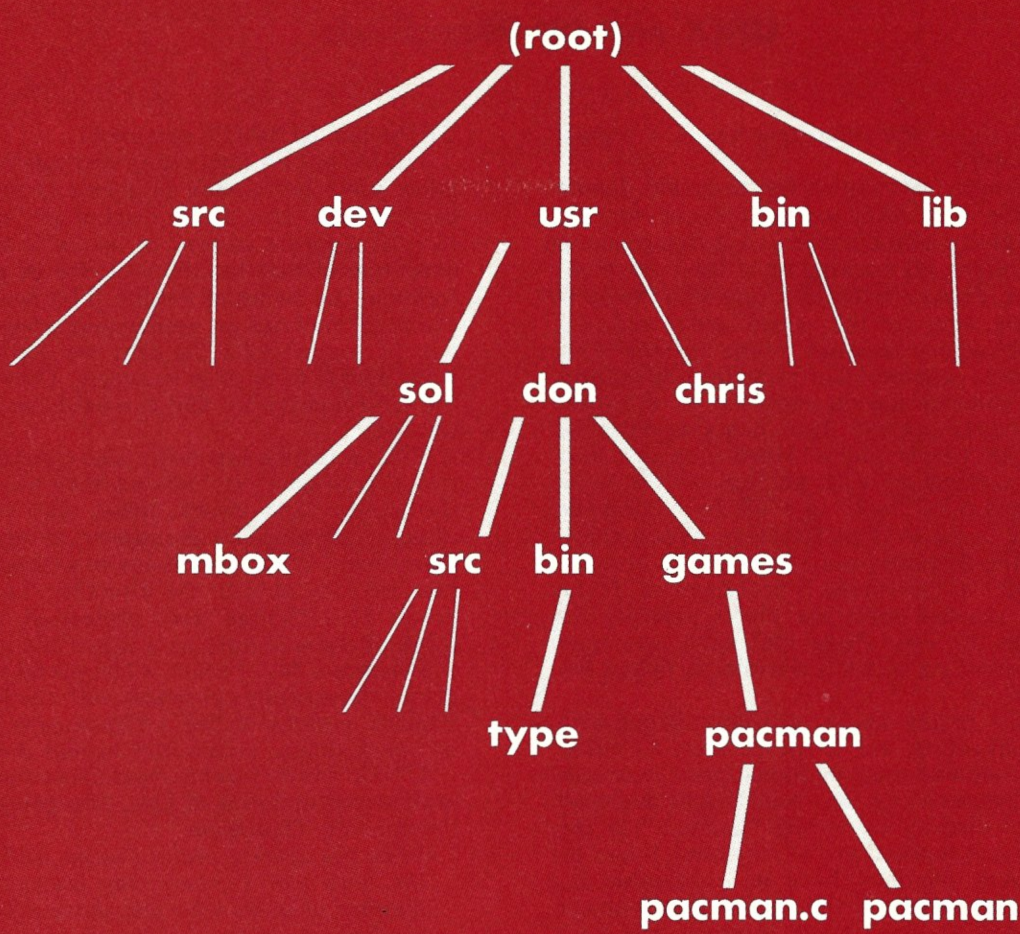

Figure 1. Hierarchical file organization in UNIX

second level, this is an illusion that would vanish if you ran CP/M off any nonremovable media.

Looking at Figure 1, we see that at the root of the file system are several directories: "src" contains the system sources; "dev" is a directory of devices; "bin" contains executable files or "binaries"; and the user files are to be found under "usr."

Let's take a look at a typical UNIX user's directory. "ls" will list the files in a directory. The "-1" specifies a "long listing", with more information than just file names. The "$" is the prompt.

```
$ ls -l
drwxr-xr-x 2 don          394 Jul 22 01:48 bin
drwxr-xr-x 2 don          384 Jul 10 10:10 games
-rw-r--r-- 1 don        42919 Jul 13 01:23 mbox
drwxr-xr-x 3 don          624 Jul 12 22:47 src
drwxr-xr-x 2 don         1232 Jul 12 22:48 tmp
```

From left to right are the protection attributes, the number of links, the owner, the length of the file in bytes, the date last modified, and the file's name. A "d" at the extreme left of each line denotes that the file is a directory and contains other files. Let's look at one of these. First, we'll change our working directory to "games."

```
$ cd games
$ pwd
/usr/don/games
```

The pwd command prints the working directory—the directory that all relative file names refer to. (In UNIX, all file names without a '/' in front refer to files in the working directory. This is akin to CP/M, where all file names not prefaced by a disk name refer to files on the logged-in disk.) Absolute file names are always referenced from the root of the tree, which begins with a '/'. In the example, we are in don's game directory. "don" happens to be a directory of the "usr" directory of the file system.

```
$ ls -l
drwxr-xr-x 2 don          8383 Apr 10 10:10 adventure
drwxr-xr-x 2 don           100 Jan  1 01:02 foobar
drwxr-xr-x 2 don          1233 Jul 23 23:23 pacman
$ cd pacman
$ pwd
/usr/don/games/pacman
$ ls -l
-rw-r--r-- 1 don          3590 Oct 10 04:19 eat.c
-rw-r--r-- 1 don           294 Jul 25 03:34 eat.o
-rw-r--r-- 1 don           900 Oct  9 12:19 monster.c
-rw-r--r-- 1 don           842 Jul 15 03:34 monster.o
-rw-r--r-- 1 don          5942 Oct 10 04:19 move.c
-rw-r--r-- 1 don           324 Sep 25 03:37 move.o
-rwxr-xr-x 1 don          7000 Jul 25 03:34 pacman
-rw-r--r-- 1 don          5300 Oct 10 07:19 pacman.c
-rw-r--r-- 1 don          1000 Jul 24 03:34 pacman.o
-rw-r--r-- 1 don          1002 Oct 10 04:29 score.c
-rw-r--r-- 1 don           402 Jul 25 01:34 score.o
```

The tree-like directory structure of UNIX allows related work to be kept together.

Figure 2 shows the interpretation of a typical directory entry.

The protection attributes for each file denote Read, Write, and eXecute permissions for the owner, the group, and all others. A group refers to a bunch of users, all working on at least one common project. These attributes, along with the owner, dates, etc. (but not the name), are stored in a disk-wide directory internal to the system. This disk directory is composed of "I-nodes," structures containing information on each file on the disk. The user's directory file itself contains only the name and an I-node index. More than one user may have a directory with pointers to the same I-node. Users may "link" to a file by adding the index and a name to their directory. When deleting a file, the directory entry is removed and the file link count in the I-node is decremented. If the link count reaches zero, the file is actually removed from the disk. Note that each user may have a different name for a file that is linked between them.

In the file listing above, all files ending with ".c", by convention, are C source files. ".o" files are object code and must be linked prior to execution. The "pacman" file has been linked and may be executed directly by typing "pacman" in the shell. Thus it is marked as "x", meaning it can be executed. Any file may have its executable bit turned on. If the shell is handed a file that is object code, but ASCII text, it will interpret the lines as shell commands. The process is transparent to the user whether he is executing a shell file or an object file, since both types are invoked simply by typing their name to the shell. There is no CP/M-like SUBMIT command.

UNIX has an interesting protection scheme to allow users permission to access ordinarily inaccessible files. If a file is marked as "set user id" (an "s" appears instead of an "x"), then during execution of that file the user will be granted the rights of the owner of the file. This enables us, for example, to write an application whose every use will be logged to a file that we don't otherwise want people to be able to access. Databases (e.g., the UNIX password file) can easily be maintained this way.

File protection attributes also extend to directories. If a directory is readable, then we may look at the names (and owner, links, etc.) of the files, though this gives no permission to open the files themselves. Write permission in a directory means that we may modify the directory, i.e., create or delete files, change their protection, etc. If you think of the directory as a file of file names, then this makes a lot of sense. (The protection mechanism is beautifully consistent with the file system.) Execute permission for a directory is interpreted as being able to access files in that directory.

UNIX has no locking mechanisms to control simultaneous updating of files. According to authors Ritchie and Thompson:

"The file system maintains no locks visible to the user, nor is there any restriction on the number of users who may have a file open for reading or writing. Although it is possible for the contents of a file to become scrambled when two users write on it simultaneously, in practice difficulties do not arise. We take the view that locks are neither necessary nor sufficient,

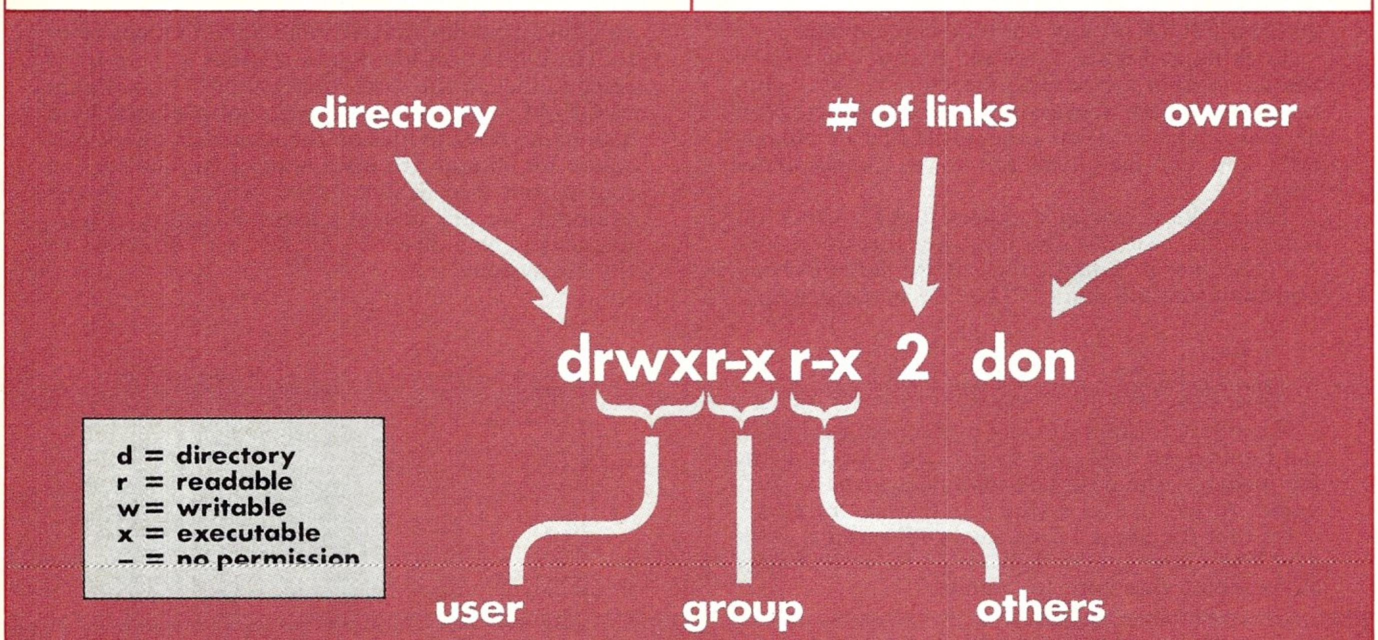

Figure 2. A typical directory entry

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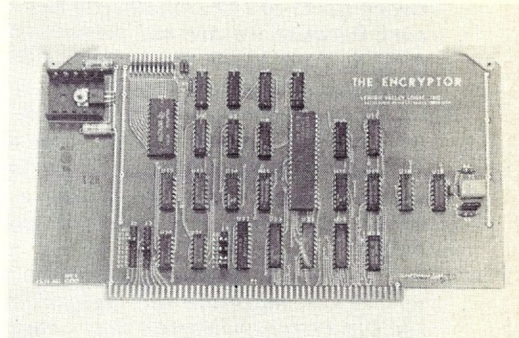

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CIRCLE 36 ON READER SERVICE CARD

in our environment, to prevent interference between users of the same file. They are unnecessary because we are not faced with large, single-file data bases maintained by independent processes. They are insufficient because locks in the ordinary sense, whereby one user is prevented from writing on a file that another user is reading, cannot prevent confusion when, for example, both users are editing a file with an editor that makes a copy of the file being edited.

"There are, however, sufficient internal interlocks to maintain the logical consistency of the file system when two users engage simultaneously in activities such as writing on the same file, creating files in the same directory, or deleting each other's open files."

Command interpreter (Shell vs. CCP)

In my opinion, the biggest sore spot in CP/M is its simple-minded "Command Processor." It is only recently that I have heard of people writing replacement CCPs (e.g., ZCPR). Perhaps they got that idea from UNIX. In UNIX, the command processor or "shell" is a program (or "process") just like any other program. Because is not part of the system kernel, it may be manipulated (or even replaced) as easily as any other program. A typical feature of many programs is to allow for an escape to the shell. How many times have you wanted to get a directory listing in the middle of some program, say, and you couldn't without halting the program? Thus we get all the power of the shell from any program without rewriting all of it into the program. In fact, we can do this recursively, thus getting a "stack" of shells.

The shell is a complete language in its own right. It has variables (unstructured), sophisticated parameter passing, and a powerful set of pattern-matching primitives. It has control structures such as if-then-else, while, case, etc., for handling program flow. Commands such as wait (wait for a process to die) and trap (set up interrupt routines) are available for handling asynchronous activities.

In fact, several shells have been written, the latest having come from the University of California at Berkeley. This one is called the C-shell (say it aloud) and is reminiscent of the C language in some ways. It allows control of a tree of processes along with a history mechanism that relieves the programmer of much redundant typing. This mechanism can be used to repeat previous commands or to correct minor typing mistakes in commands.

While the shell is oriented towards interaction (e.g., you can't compile shell procedures), it has most everything that you might want for using the tools of UNIX. It is surprising how much work you can accomplish without ever writing any C code. I know several engineers who write only shell procedures (admittedly, it's easier than learning C). Though doing so isn't efficient, it follows the general philosophy of UNIX: that the original designers wanted a good, friendly environment that was productive for people, not necessarily for machines.

Commands are invoked by name followed by any arguments. For example, the command

```
ls -l
```

prints a list of files in the current directory. "-l" is an argument requesting additional information such as the owner, length, etc., of each file.

A process may be started in the background by appending an ampersand at the end of the command. For example, we might start a server process:

```
$ server &
14627
$
```

Typically, a "process id" is returned in case we need to check up (or stop) the background process. The C-shell allows us to bring a background process into the foreground. (The ampersand is one of several "metacharacters" interpreted by the shell. These metacharacters are never seen by the application programs.)

Filters, pipes, and I/O redirection

Most commands produce only one stream of output. This is known as the "standard output" and is initially connected to the terminal. This output may be sent to a file ("junk"), as follows:

```
ls -l > junk
```

The shell interprets the ">" so that "ls" or any other program need not be concerned with where the output goes. Similarly, "<" redirects the standard input, which also defaults to the terminal. For example:

```
sort < junk
```

"sort" normally reads the standard input and writes sorted lines to the standard output. In this example, the standard input is taken from "junk", and the standard output remains connected to the terminal. The result is that the sorted lines of junk get printed out on the terminal.

Many commands take only one input and produce only one output. It is often the case that we want to string them together as follows:

```
ls -l > junk ; sort < junk
```

This occurs so often that the shell provides another shorthand: the "pipe" (written '|'). Using it, we can rewrite the above as:

```
ls -l | sort
```

The "|" (pipe) denotes that the output of "ls" is to be connected to the input of "sort". Programs such

The shell is a complete language in its own right. It has variables, sophisticated parameter passing, and powerful pattern-matching primitives.

as "sort" that take only one input and have only one output are called filters. Other examples are:

```
grep    - Return all lines matching some pattern
wc      - Count words (and lines and characters)
nroff   - Format text
pr      - Paginate and add headers
```

Some of these things are pretty simple in what they do, but thanks to the shell, they can be easily combined to do powerful jobs. For example, say we wanted to get a list of the four-letter words that we had used in a document. The easiest way to do that with CP/M would just be to write an assembler program, right? Similarly with UNIX. Big deal, right? Now, suppose that we wanted that list to be sorted? Or checked against a dictionary? I think you can see that to accomplish either of these tasks, we would have to write a fairly complex program, and we might run it only once—it's certainly not applicable to many other problems. And yet, there's a lot of good code in there. Sorting, pattern matching, word counting are all useful things that computers are good at. The UNIX solution is to pick up our simple tools and combine them in the right way to solve the problem quickly. In this case, we could say:

```
separate < doc | grep "^....$"
```

"separate < doc" reads input from doc and puts each word on a separate line. "grep" takes its input and searches for lines matching its pattern "∧. . . .$". The "∧" and "$" match the beginning and end of the line, respectively, while each "." matches any single character. Thus we match four-letter words on lines by themselves. "grep" can actually recognize any "regular expression" pattern, which is what the "rep" comes from in its name—the "g" comes from "global." (Etymology in UNIX is a fascinating subject in itself.) "grep" only delivers lines of its input that match this pattern.

Now we could sort the list and reduce it to a set of unique words by appending appropriate filters to the command:

```
separate < doc | grep "^....$" | sort | uniq
```

Finally we might like the list of words to be checked against an on-line dictionary for correctness. The UNIX filter "comm" is what is needed. In this case we append to the command, "| comm - dictionary". The hyphen is the standard way of telling a program that normally takes more than two files as input to take one input from the pipe (or "standard" input)—in this case, the first file. "dictionary" (the second input) is given as an argument to "comm". "comm" actually produces more information than we need. It returns three columns corresponding to lines found only in the first file, then lines found only in the second, and lines found in both files. To strike out the second and third rows, we use the argument "-23". Now the command looks like this:

```
separate < doc | grep "^....$" | sort | uniq | comm -23 - dict
```

While that example may seem slightly contrived (and it was), it demonstrates the ability to take simple tools and combine them in natural ways to get powerful results. We have used more than filters. For example, "comm" takes two inputs. The standard input and standard output are files automatically opened and available to all programs, while file names passed as arguments are unprocessed, and it is up to each program how arguments are to be interpreted. That's why using the standard I/O is especially easy.

Notice that none of the programs made any special prior arrangements in order to pass data through pipes. That's the beauty of it all. You will notice this consistency again and again in UNIX.

Pattern matching

In CP/M, "*" is a convention handled by each program. Though it may seem obvious what to do with "*", it is possible to create more sophisticated patterns. We don't want the programs to interpret these for several reasons. One is that they may do it differently (i.e., incorrectly). Another is that this takes up space in each program, and time is spent rewriting the code for each program. And if we suddenly decide that we want another pattern-matching feature, we would rather not have to recompile every one of our programs. UNIX pattern substitution occurs in the shell, so that the program never sees the "*". It sees only the final expanded form, no matter what program it is.

For programs that do pattern matching (grep, for example), the pattern may be quoted to prevent the shell from expanding it. The shell then simply strips off the quotes and passes the arguments, untouched, to the program.

I/O (Device independence vs. BDOS/BIOS)

The CP/M BDOS provides a set of system calls for I/O. They are predefined for a limited set of devices and device calls. Some are implemented with buffering (print string on the console) while some aren't (write a character on the punch). Some are defined logically (rename file), while others are defined physically (set DMA address). The CP/M user can also make BIOS calls directly at the risk of potentially losing system independence and portability.

UNIX also provides I/O via predefined device drivers. They interface at a much higher level than do CP/M's, however. Input and output buffering is handled by the system for all devices. For example, in C, we can perform I/O to any file, device or pipe as follows:

```
read(fildes, buffer, nbytes)
write(fildes, buffer, nbytes)
```

where **fildes** is a "file descriptor", **buffer** is a user

UNIX provides I/O via predefined device drivers. They interface at a much higher level than those of CP/M.

buffer, and **nbytes** is the number of bytes to be read or written. The file descriptor is an object given to the user when the file is initially opened. Other system calls exist to delete (actually "unlink"), link, rename, and otherwise manipulate files. A "seek" call allows random access by allowing the read/write pointer to be moved, relative either to its last position or to an absolute location in a file.

Normally, I/O is performed through functions provided by the "portable C library." These implement an even higher-level interface than the system's buffered I/O. In a similarly consistent fashion, functions such as **printf** (for output) and **scanf** (for input) implement formatted I/O operations, also in a device-independent manner. For example:

```
printf("Hello my name is %s\n",myname);
```

This prints out a welcome message to the standard output, normally the terminal. If the standard output has been redirected, perhaps to a file or through a pipe, the code remains the same. It does not have to be recompiled nor do device definitions (as in the CP/M I/O byte) have to be changed.

Thus we may write information to a device (or pipe) character by character or in blocks of any size. No devices impose structure restrictions or blocking characteristics upon the user, since the interface appears the same no matter what device is being used.

We may now contrast the "I/O byte" of CP/M against the device independence of UNIX. The high-level CP/M application uses the logical CP/M devices (such as LST: for high-speed listing). Before running the application, the user must redefine (if necessary) any pertinent devices. The I/O byte definitions may be changed or examined by the STAT command.

When we use a filter in UNIX, the pipe connects the output of one process to the input of the next process. For example, say we're interested in finding out how many times Fred has logged in since the beginning of the current log. We could do this as follows:

```
grep fred log | wc
```

Not only would something like this require a temporary file in CP/M, but the logical definitions that a filter might use would be absolutely meaningless in this context, where no real devices are involved. Since logical devices are built into programs in CP/M, we begin to see that forcing devices to carry a label such as CON: is quite artificial. In any case, there may be five CON:-like devices, or we may want to test the status of a logical device that the BDOS doesn't provide for. For example, a high-speed PUN: might need a status call, but none exists in CP/M. In short, for a system with more than the handful of devices, the "handful of I/O calls into the system" technique is neither easily extendable, nor is it at all clean.

A device *is* a file

UNIX devices appear as files in the file system. Though normally residing in the /dev directory, they may be linked, deleted, read, written, and otherwise manipulated just as regular text files. Devices differ from regular files in their side effects. For example, writing to the file /dev/tty would cause the output to appear on our terminal. Since things like disks and terminals don't do I/O the same way, buffering is handled by the system I/O routines automatically. In order to handle devices correctly, these special files have extra file attributes denoting I/O routines for them. This is in contrast to CP/M, where ersatz devices (i.e., CON:) have I/O routines associated with them.

In summary, the advantages in UNIX are that device and file names have the same syntax and meaning. Thus, to open and write a character to *any* file (whether it be a terminal, disk file, line printer, mag tape, etc.), we may use the exact same code (whether it is C or the shell) for one as for the other. Also, the protection system treats devices and files alike (see the section on the File System in this article).

TPA or the process, alias "core"

One of the more interesting ideas of UNIX is the implementation of the process itself. A process is created by the "fork" system call. This function makes a copy of the caller's process space (including open files), and both processes (the original and its copy) are then scheduled for execution. Each process can tell which is which, since fork returns the process id of the child process to the parent process, while the child process receives a null process id. This enables the parent process, for example, to initiate a process performing some subservient function and wait for its completion. The "wait" system call takes a process id as argument and suspends process execution until the death of that process as specified by argument.

An "execute" system call is available that more closely resembles a "jump" machine instruction. This simply takes a program name and arguments and gives control to it. The previous program is overwritten in memory.

This is, in fact, exactly what happens as the shell processes user commands. The shell reads a line of user input, puts it in a form appropriate for execute, does a fork and executes the process. The shell waits for the child process to complete. When the child process dies, the wait finishes and the shell continues execution. If an ampersand is appended to the command line, the shell does not execute a wait and simply continues execution,

UNIX peripheral devices appear as files in the file system. They may be read, written, linked, deleted, and otherwise manipulated just like regular text files, since device names have the same syntax and meaning as file names.

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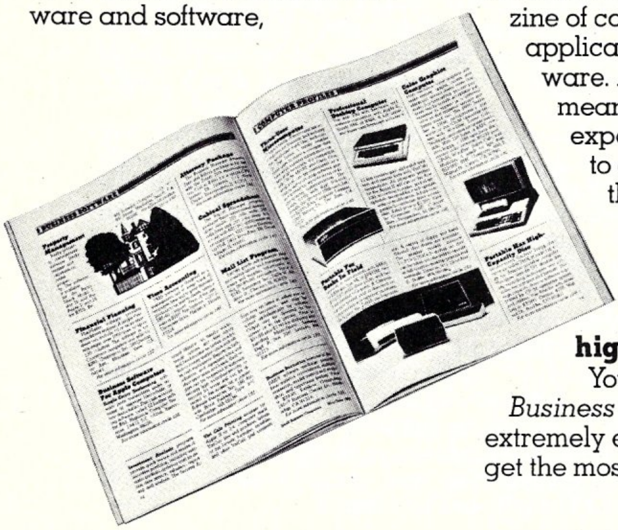

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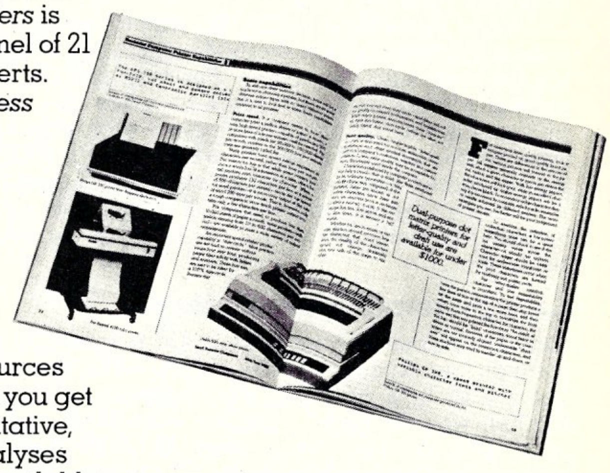

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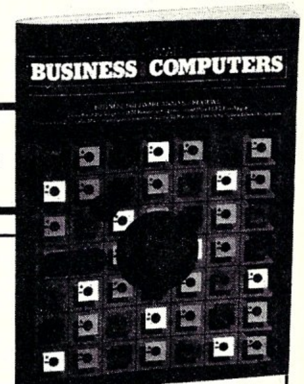

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8H11

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prompting the user for input as usual.

Certain events (such as hitting "interrupt", for example) cause signals that may be used for scheduling. Signals may also be generated by program faults. If a process executes an illegal instruction or some other program fault occurs, the process dies and the shell continues execution. Unless the process has made other arrangements, pressing an ASCII-FS (cntrl-?) will generate a "quit" signal that stops the process and produces an image of memory as a file called "core" (sic). This file may be examined with a debugger. Well-debugged programs may choose to catch signals and handle them rather than aborting to the shell. Interactive programs, like editors, for example, typically catch the "interrupt" signal and simply return to their top level.

This is in contrast to CP/M, which has no signals or synchronization methods other than checking for particular characters. For example, CP/M normally interrupts all programs when the user presses cntrl-C. If the user doesn't want this action, he has no choice but to write his own CON: input routine. Unless he programs such functionality, he can then no longer use CP/M niceties such as the functions of cntrl-R, cntrl-S/Q, or even backspace.

Lastly, some commentary

Let me summarize some important points: CP/M is much less expensive to run than UNIX. You can get a Z80 with 64K and dual floppies for under $2,000, while a 16-bit machine with 256K and a hard disk will run you at least $11,000. Almost any application is available for CP/M now. This is not the case with UNIX, as it has long been the interest solely of research institutions and universities. Thus there is a dearth of any business applications for UNIX. There are, however, excellent tools and other construction equipment such as "yacc" (an LR parser generator), "awk" (a pattern-based language), and "lex" (a lexical analyzer generator) for easily building your own applications. I anticipate, however, that within a year, you will be able to buy almost any application you like for a UNIX system. (The hardware prices will also fall to more earthly levels.) UNIX, however, will remain the "programmer's workbench." It is an environment meant for construction and research, not business or applications. It is enjoyed and appreciated most by system programmers, not the naive user or Basic programmer. I have been told that dealers will be selling some of the UNIX tools as if they were applications and not part of the UNIX system themselves. For example, **yacc** and **lex** might each cost $300 extra. This unfortunate step may make UNIX seem like a workbench without tools, but I hope this doesn't become a standard practice.

Although it should be clear that I see a great deal in UNIX that I like, it is not the last word in great operating systems. Indeed, many people (myself included) find much to complain about. One is the low level of the system. I find programming in C very primitive (you can imagine what I think of assembler!), and though the tools available in the shell are closer to what I find appropriate, the system can be used to its fullest extent only if one codes in C, just as one must use assembler at some point in CP/M no matter what high-level language is available.

I must also mention that UNIX often has been used as an example in portability experiments, having been implemented on most of DEC's machines, the Interdata 8/32, the IBM 370, the Honeywell 6000, and, most recently, the Motorola 68000. These machines have a variety of word sizes (16, 32, and 36) and character sizes (8 and 9). Clearly, the portability is in the C code (and tools). CP/M's portability comes from the same machine code running on Z80s for the most part while, infuriatingly, several different assemblers with different mnemonics exist for this one chip. We must expect that UNIX software houses will supply more source code rather than binaries as products (though this remains to be seen). I can only view this as a good by-product. I will gladly take the source over the binaries any day!

UNIX documentation is complete, precise, but very terse (which I like but many people do not). You will doubtless be getting direct copies of the original manual for most programs. I find the UNIX manuals and the readings, especially, among the most lucid technical manuals I have ever read. This precision, terseness, etc., are carried over into UNIX, for example, in the short command names in the shell (cd, mv, cc, and the infamous "rm *", which removes every file in your directory without saying a word). The original Digital Research manuals on CP/M are your typically mediocre manuals, missing or misstating vital information here and there. I don't know if they've changed, but one hopes.

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Don Libes recently received his M.S. in computer science from the University of Rochester and has a B.A. in mathematics from Rutgers University. Don is interested in high-level programming environments, including problems of natural language and graphics interfaces.

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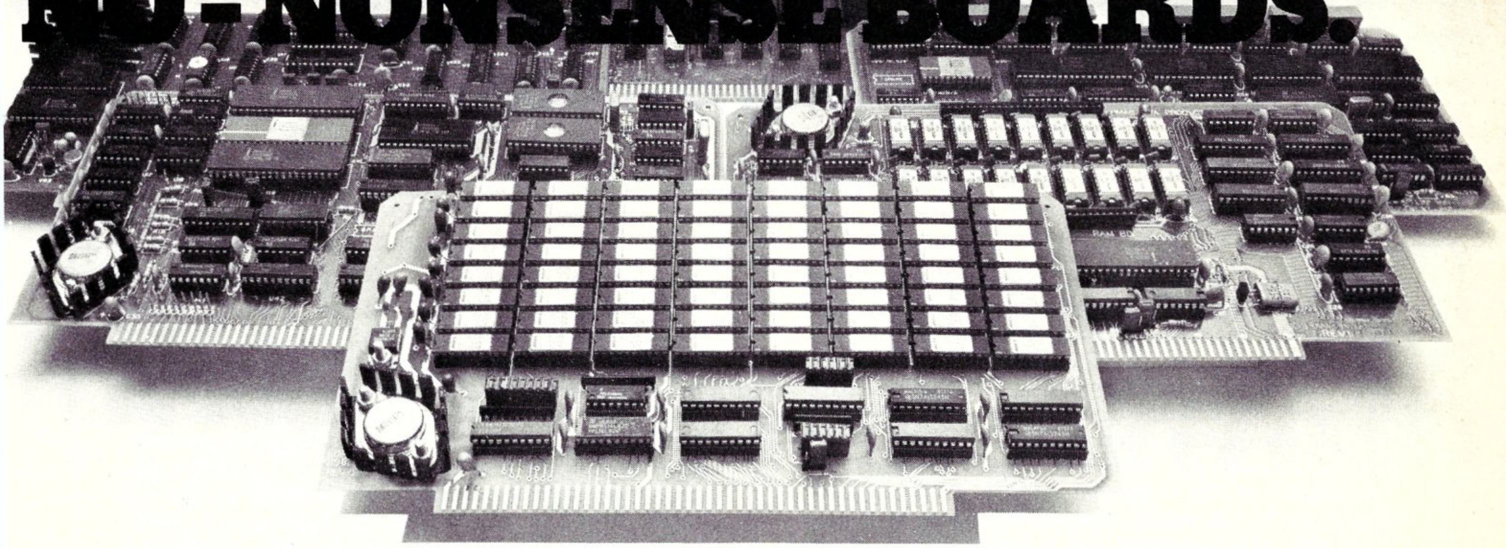

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Introduction to the XENIX Operating System

by Mark S. Ursino

It is an undeniable fact that the standard operating environment created by the emergence of the 8080 as the 8-bit chip standard, the evolution of CP/M-80 as the de facto standard operating system, the acceptance of Microsoft Basic as the de facto standard programming language and, later, the availability of ANSI standard language compilers, were together responsible for the explosive growth of the microcomputer in the small computer market. It is also clear that this explosion was touched off by a flood of applications software that depended on the existence of a standard operating environment. Because it created a broad base of machines over which to spread development costs, this standard operating environment made it possible for applications developers to distribute software at a cost consistent with the under-$10,000 price tag of the computers they were meant to run on.

While 16-bit microprocessors have been available since Intel first introduced the 8086 in 1977, they are only now finding their way into the general systems marketplace. That is because they lacked the standard operating environment enjoyed by the 8-bit systems. Without a standard environment, cost-effective applications could not even begin to develop.

Two years ago, Microsoft became seriously concerned about the lack of a suitable operating system to form that portion of the standard operating environment it was envisioning for 16-bit machines. It seemed there was no good answer in sight. Digital Research was known to be translating CP/M-80 and MP/M-80 to run on the 8086. However, the fact that they were standards on the 8-bit machines did not automatically make them standards the 16-bit market, and they did not seem to provide all the facilities the emerging 16-bit technology would require.

The 16-bit market is unique

The 16-bit market is a whole new ballgame. Since the microprocessors themselves are totally incompatible with their 8-bit predecessors, nothing—not even a common operating system—will allow systems software written for an 8-bit microprocessor to run automatically on a 16-bit machine.

Application programs written in assembly language have to be rewritten, since those languages are totally specific to the instruction set of the chip they run on.

Application programs written in a high-level language port easily once the language has been re-hosted on the new machine. The language itself minimizes operating system dependencies on applications. As intimated earlier, the 8-bit OS's part in forming the standard operating environment on the smaller machines was to support the languages, and actually made little direct contribution to the susbstance of the application itself.

Since the languages provide the immediate foundation for applications software by isolating the application as much as possible from the operating system and specific hardware vehicle, software products such as those produced by Microsoft and similar software authors are dependent on the facilities provided by the operating system if they are to be extended to provide the human engineering current technology demands in any sort of machine-independent fashion.

In short, then, the advent of the 16-bit machines posed a whole new set of demands for operating systems. It was only natural that Microsoft seek to exert some control over the operating environment its traditional and emerging products would depend on.

The 16-bit microprocessor serves two distinct but merging markets

1. *Multiuser "mini knock-offs" (micro mainframes)*
   - *UNIX-derived OS's (e.g., XENIX, ZEUS, ONIX, IS-1)*
   - *UNIX-like OS's (e.g., Coherent, IDRIS, CROMIX)*
   - *MP/M-86*
   - *Oasis-86*
   - *RMX-86*
2. *Low-end personal computers for the home and office*
   - *MS-DOS/SB-86*
   - *CP/M-86*

The 8-bit microcomputers made several feeble attempts to challenge the low end of the multiuser minicomputer lines with the 8-bit versions of MP/M and Oasis, but it is really the advent of the 16-bit microprocessor and more sophisticated systems software that has signaled the beginning of the clash between minis and micros reminiscent of the mini/mainframe clash some 10 years ago. At the low end of the broadening 16-bit spectrum are the personal computers built as supercharged entries

Mark S. Ursino, Xenix Product Marketing Mgr., Microsoft Corp., 10800 NE Eight, Bellevue, WA 98004

into the market created by the Apple II and the TRS-80.

As shown in the box above, the high end of the range has already been heavily populated with contenders for the standard operating system. At the low end, there are really only two offerings: MS-DOS and CP/M-86.

Micro mainframes require a typical "mini" environment
- *Memory protection*
- *Dynamic memory allocation*
- *Powerful runtime facilities*
- *Sophisticated software development facilities*

—To challenge the minicomputer, the micro mainframe needs to be able to offer all the facilities the minis have evolved over the last 10 years.

—To support multiple users in a true timesharing environment, reliable memory protection must be provided to keep one errant user from disrupting or destroying the work of the other users on the system.

—Dynamic memory allocation gives each user access to the full memory capacity of the machine rather than segmenting each into an isolated partition as in the bygone days of IBM 360 DOS.

—Powerful runtime facilities such as multitasking, interprocess communications, electronic mail, and device independence give the applications developer capabilities never before realized in a computer system under $20,000—capabilities which allow these machines to solve application problems that their 8-bit predecessors could not begin to address.

These powerful new machines open the door to far more sophisticated applications than are available to the 8-bit world, and their low cost and high performance relative to their mini counterparts allow them to penetrate application areas that could not be economically served by the computer until now.

To develop all the new applications software needed to tap this capability quickly requires that a sophisticated software development environment be provided. This includes tools that enhance programmer productivity and utilities that allow programmers to create advanced and user-friendly applications in traditional microcomputer environments that are impossible with 8-bit technology.

Low-cost personal computers have simpler requirements
- *User-friendly OS environment*
- *Small, fast OS*
- *Expandable minimal configurations*
- *Reliable single-tasking facilities*

The importance of being user-friendly

The lower-cost personal computers that will find their way into both homes and offices need software capable of taking advantage of the 16-bit microprocessors' added horsepower, but their requirements are much simpler than those of the micro mainframe.

It is actually more important for the personal computer to have a user-friendly OS than it is for the micro mainframe, since personal computer users will be buying and installing more miscellaneous packages and actually writing more of their own programs than will users of the more expensive small business computers who generally purchase those machines as part of an integrated turnkey package. The personal computer is intended more as an individual tool that users can expand and modify themselves to suit their particular needs.

Although the requirements of personal computers are simple compared to those of micro mainframes, the 16-bit microprocessor does endow the PCs with the power to support operating software with superior capabilities in the areas of user interface and general flexibility—again, key areas that 8-bit software didn't address.

There *are* common requirements for both markets, though. Both markets require that operating systems more capable than the ones for the 8-bit machines serve as the foundation for the advanced languages and applications that will be built on top of them. Both markets require standardization of operating systems so that the software that *needs* to interact heavily with the OS will have a broad base of machines to move into. And both of these markets require standard languages and utilities to provide a large contiguous market for application software.

A look at UNIX

UNIX is the logical choice for the high end of the 16-bit microcomputer market. UNIX is portable, 90% of it being written in the C programming language. Its elegant simplicity in design makes for supreme flexibility. UNIX is well known for its extremely powerful software development environment. Moreover, UNIX has a fully tailorable user interface that allows persons building turnkey applications engines to provide a friendly profile without having to build the interface into each application. In fact, UNIX is so flexible that many engineers using UNIX for the first time are amazed to find they don't need to modify the operating system itself to tailor it to their applications environment—something they have been all too used to doing in the past.

UNIX owes its flexibility to its generalized and modular design. In its evolution, each of the tasks

UNIX was the logical choice for a high-end operating system. It is portable, highly flexible, provides superior software development tools, and has a fully tailorable user interface.

that the developers envisioned the operating system performing was broken down to its simplest form and implemented as a separate capability. Since UNIX has been endowed with totally device-independent I/O (that is, a program's source of input and destination of output can be dynamically changed without change to the program itself), all these various individual tasks can be linked together randomly and even recursively to allow the programmer to apply them to the task at hand totally at will in order to perform an operation that may easily have never been envisioned by the system's authors.

This generality is replicated throughout the system, and has stimulated the development of unusual yet useful utilities not found anywhere else—thing like "grep." Grep scans a source of input for any string fed to it on invocation and returns records containing matching strings, or, if you wish, a count of how many records contain the pattern. Grep obviously has much utility for programmers editing and modifying sources, but is useful for ordinary mortals, too. I have used grep to compile marketing tallies from information request coupons, and have built a file with the names and phone numbers of my frequent contacts. To make life simple, in using this phone directory, I have used another useful UNIX feature—the UNIX "shell."

One-line shell script in file named "phone."

```
            grep $* <directory
              |   |   |-> Name of File to Search for Pattern
              |   --> Shell Substitution Variable
              |--> XENIX Utility to Search a File for a Pattern

Contents of file named "directory":

Mark Ursino: Microsoft: 10700 Northup Way: Bellevue, WA 98004:
                        (206) 828-8080
Nigel Smith: Microsoft: 10700 Northup Way: Bellevue, WA 98004:
                        (206) 828-8080
Ronald Reagan:  U.S. Gov't: White House: Washington, D.C.
                        (202) 314-1000
```

Figure 1. Example of a shell script.

The shell is UNIX's command line processor. It is a powerful high-level programming language in its own right. The shell allows the user to put UNIX commands and control statements in a file and invoke those commands simply by using the filename. *Voilà!* you have a user-defined command. To make access to my phone directory convenient, I have "written" a one-line shell "script" (shown in Figure 1), that accepts an argument at execution and passes that argument to grep, which searches my phone file and returns the record or records containing that argument.

Sample execution using the "phone" shell script to find a given person is shown in Figure 2. To retrieve a phone number, then, all I need do is type the filename "phone" and someone's name, or a company name, or whatever else might identify the person I am interested in at that particular time.

Figure 2. Sample execution using "phone" shell script.

$ phone Ursino

```
| |     |
| |     -->Text String to Search for in the File Named "directory"
| --> Name of File Containing the Shell Script
|-->XENIX-Provided Command Line Prompt (Equivalent to: "A>" in CP/M)

String Returned:

Mark Ursino:  Microsoft: 10700 Northup Way: Bellevue, WA 98004:
              (206)828-8080

 Another Example to Find all Entries in Bellevue:

$ phone Bellevue

Mark Ursino: Microsoft: 10700 Northup Way: Bellevue, WA 98004: (203) 828-8080
Nigel Smith: Microsoft: 10700 Northup Way: Bellevue, WA 98004: (203) 828-8080
```

Actually, I could go on for pages giving examples of how UNIX, with very little effort, can be made into whatever it needs to be in an applications environment. As superior as UNIX is, however, it does have its failings when examined in its role as a commercial microcomputer operating system.

UNIX as supplied by AT&T is configured for use on the DEC-11 and the VAX lines of computers, and is aimed at your typical DP environment. Because of this, the system was implemented with the assumption that a systems programmer would be around to act as system administrator to boot the system up, take it down, etc.

The fact that UNIX was developed in a research environment also means that it was considered less important to worry about things like imperfect disk media (AT&T can afford to buy perfect disks), file system reliability (there will always be a systems programmer around to make things right), and extensive documentation, since everybody had access to the source code and knew what to do with it.

Implementation on micros

From the standpoint of the micro implementation of UNIX, there is an additional problem in that UNIX is tuned to the PDP-11 world, where disks are fast and processing power dear. On a micro, just the opposite is true—Winchester disks are fast compared to the familiar floppies, but crawl in comparison to the drives used on a PDP-11. Consequently, UNIX's scheduling and swapping mechansims are rather single-minded—when in doubt, they SWAP. UNIX's real-time limitations rarely interfere with normal processing, but in the

UNIX, as supplied by AT&T, lacks documentation and training suitable for the commercial environment; it is performance-tuned for the minicomputers it was developed on and has real-time limitations.

face of the increasing importance of communications, especially local networks, these deficiencies can become serious.

XENIX is *not* a UNIX look-alike, nor is Zeus (from Zilog), nor is ONIX (from ONYX), nor is IS-1 (from ISC). They are all UNIX-derived and AT&T licensed. AT&T requires that when a ported version of UNIX is sold, it *must* be sold under a trademark other than UNIX. Companies advertising UNIX on their machines are in violation of their agreements with AT&T.

The XENIXization of UNIX

Obviously, it takes a significant effort to take a research-oriented minicomputer operating system and turn it into a general-purpose commercially viable product—even if it is portable. That is Microsoft's value-added to UNIX.

The most obvious advantage to working with XENIX is that it has been ported. When doing XENIX on a Z8000, 8086, or 68000, the user will *start* with XENIX for Z8000, 8086, or 68000.

The first release of XENIX on a microprocessor was XENIX-8000 as configured around the Central Data CPU board with memory management. That was in May of 1981. Since that time, XENIX-8000 has been adapted to multiple systems using the same CPU board, and several systems incorporating different memory management. That was in May of 1981. Since that time, XENIX-8000 has been adapted to multiple systems using the same CPU board, and several systems incorporating different memory management. XENIX-8000 was the first, released over 10 months ago. There are currently about 2,000 XENIX-8000 systems in the field.

XENIX on the 8086 has entered field test on a system manufactured and sold by Altos Computers. This system went into production in April, 1982. There were several more XENIX-86 products announced at NCC in June, 1982.

XENIX on the Motorola 68000 was first demonstrated at Comdex in November. Microsoft is currently bringing XENIX up on three different prototype systems using the 68000.

Because Microsoft is porting XENIX to multiple processors and adapting XENIX to multiple memory management configurations, XENIX has been made more more portable. Therefore, companies planning to port UNIX from the PDP-11 to proprietary processors will find it easier to start with XENIX.

XENIX improvements

Differences between XENIX and UNIX are classified as either *improvements* or *enhancements*. Improvements consist of changes that are made to improve the reliability and performance of the OS, but which are transparent as far as user software is concerned.

In improving the UNIX file system, Microsoft has put in several features and utilities as well as general design modifications to allow automatic recovery of files after a crash, performing the functions that UNIX's designers assumed there would be a systems programmer around to take care of.

XENIX has been made more intelligent in its use of swapping, in recognition of the flip-flop of performance concerns between the PDP-11 environment and the typical micro environment.

So that OEMs can write diagnostic software to warn a user when the hardware's reliability is in question, XENIX has the ability to log hardware errors.

Again, recognizing that XENIX is going to be used in an environment devoid of systems programmers, it has been made easier to configure new versions of XENIX—something that's necessary when adding new devices or changing certain system parameters.

All previously known and some newly discovered bugs in UNIX have been fixed in XENIX. Many of these fixes came from sources external to Microsoft, but most were uncovered and fixed as part of the porting process. Also, since XENIX is being used extensively within Microsoft as a primary software development environment, it gets exercised by more than 60 systems programmers on a daily basis.

XENIX enhancements

While improvements make what's there work better, enhancements provide additional functionality that applications software can take advantage of. Microsoft is committed to continually develop and enhance XENIX in response to the needs of the commercial marketplace and our OEMs. (In fact, all the enhancements listed here have been made part of XENIX as a direct result of input from our customers.)

Enhancements that have been added to XENIX via input from customers:

- *Record and file locks*
- *Semaphores*
- *Improved priority assignments*
- *Scatter-loaded kernel*
- *Nonblocking "READS"*
- *Synchronous (blocking) "WRITES"*
- *Enhanced interprocess communications.*

XENIX has been ported to 16-bit microprocessors and enhanced for the commercial market. XENIX is not a UNIX look-alike, nor is Zeus (from Zilog), nor is ONIX (from ONYX), nor is IS-1 (from ISC).

Introduction to XENIX continued. . .

Without going into each one in detail, let me just state that this initial enhancement package was designed with the intent of improving XENIX's usability in the database and distributed computing environment. These features give XENIX greatly improved capabilities in the area of "traffic management" for database applications, and better real-time capabilities for communications-oriented applications.

XENIX support

Introducing these micro mainframes is highly complicated. Microsoft is gearing up to provide its OEMs with support through all stages of system development.

Hardware for these new systems is several orders of magnitude more complex than for the 8-bit systems, where a manufacturer could almost literally put a chip on a board with a bit of memory and call it a computer. The primary area of difficulty on the part of manufacturers migrating up from the 8-bit world is in the systems design. However, such topics as general systems performance considerations and hardware requirements are also areas where Microsoft provides consultation at the functional level.

For OEMs doing their own ports or adaptations, Microsoft provides the tools developed internally to assist in the process, including uploaders, downloaders, and a virtual disk driver that allows XENIX to be adapted to a target machine using the development system as the mass storage device. This allows the developer to make sure the OS itself has been adapted properly prior to integrating new device drivers.

Microsoft's publications department is working on a series of new documents for XENIX. All these documents will be available to XENIX OEMs. They range from educational seminars to marketing materials, system administrator's guides, and improved documentation for programmers.

Last but not least by any means, XENIX OEMs will gain the advantage of the continual maintenance and development that's being done at Microsoft.

The promise of XENIX

In summary, this is the promise of XENIX:

- Compatibility across processors and hardware produced by various computer manufacturers.
- Continued processor independence as XENIX is ported to new microprocessors as they become popular.
- OEM support (which translates into better user support) through technical consultation, maintenance, further enhancements, and additional documentation.
- Software support by providing a consistent software environment, including language tools for applications development and user tools to further advance the penetration of the microcomputer in the commercial marketplace.

UNIX on Microcomputers

A hands-off summary of UNIX implementations

by Don Libes

This survey was generated primarily through a questionnaire sent to 35 companies selling UNIX or UNIX-like systems. Additional information came from reviews, UNIX newsletters, and the like; data from these sources are not as complete (and are noted as such).

Systems that are described as "UNIX-like" as opposed to "UNIX" means that the company has not purchased the rights to either the source or binaries from Western Electric. It is true that dealers of "UNIX" systems have the boon of years of development that have gone into the original UNIX. However, one should not assume that such systems are therefore better. Besides granting a price differential, some "UNIX-like" systems have all of the essential parts of UNIX and were developed with the hindsight of being able to avoid the mistakes inherent in UNIX.

There is an undefined standard of what UNIX is, which unfortunately has been corrupted because Bell Telephone Laboratories have themselves produced five different versions. Of these, version 6, the first release outside the Labs, dates from about 1975. Substantially improved, UNIX version 7 was released in 1979. A short time later, Berkeley and Bell began collaborating on UNIX in a virtual environment. Bell called it V32. It was immediately seized by the University of California at Berkeley, which produced an enhanced version of V32 known as V7BSD (Version 7 Berkeley Standard Distribution), making available Lisp, Pascal, a screen editor, and network support. At the same time, Bell continued development, culminating in System III which, while substantially less rich in power than V7BSD, is a much more suitable system for commercial applications. The varieties of UNIX surveyed here all have their roots in some one of these four versions and, whether UNIX or UNIX-like, conform to the "undefined standard."

Don Libes, Box 1192, Mountainside, N.J. 07092

All the systems have four areas of commonality:

1) a hierarchical file system

			System Types								Hardware Facts											
			8-bit		16-bit										Support?							
OS Name	Company	Price ($)	Z80/8080	6809	8086	Z8000	68000	16032	other	Licensed?	Min. phys. mem. req.	Max. phys. memory	Virtual?	Min. hard disk req.	Hard disk	Bitmap tty	UDD	MP	Tape	Cartridge	Max # of tasks	Suspend task
XENIX	Microsoft	OEM			X	X	X		VAX, PDP-11	III V7B	192K	16M			X	X	X		X	X	C	X
XENIX	Central Data	920				X				V7	256K	1M		10M	X		X			X	?	
UNOS	Charles River	3000					X			No	256K	16M			X		X		X	X	256	X
UNISIS	Codata	1200					X			V7B	320K	1.5M		10M	X		X		X	X	40	
VII WB	Wollongong	25000							VAX, PE	V7B	512K	16M		67M	X	X	X	X	X		1024	X
UNIPLUS	Unisoft	OEM					X			III V7B	256K	8M	X	5M	X	X	X		X		UL	
OS-9	Microware	200-500		X						No	16K	2M			X	X	X	X	X		256	X
UNITY	Human Computing	4000 & up			X	X	X	X	Perq	III V7B	128K	?	X	10M	X	X	X		X	X	200	X
UNIFLEX	Technical Systems	550/650		X			X			No	96K	?			X	X	X	X	X	X	UL	X
IS/1 IDEA	Interactive Sys.	2500				X			VAX, PDP-11	III V7	256K	?		10M	X				X	X	?	
MICRONIX	Morrow	495	X							No	256K	1M		5M	X		X				17	X
ZEUS	Zilog	BWS				X				III V7	256K	5M		14M	X		X		X	X	C	
UNIQ	Uniq Computer	Request					X		LSI-11/23	III	512K	16M		10M	X				X		200	
UNIX	Wicat Sys.	850 & up					X			III	512K	1.5M		15M	X		X		X	X	50	X
MARC	Vortex Tech.	250	X							No	48K	64K			X		X				1	
CMS 16	Cosmos Sys.	15-20K					X			V7B	320K	16M		10M	X		X		X	X	40	X
IDRIS	Chromatics	2000					X			No	384K	8M		10M	X	X			X		?	X
COHERENT	Ithaca Intersys.	13K-50K				X				No	256K	16M		5M	X		X		X	X	UL	X
COHERENT	Mark Williams	Request			X	X	X		PDP-11	No	128K	?			X			X	X	X	UL	X
UNISTAR	Callan Data	9450					X			III	256K	1.75M		10M	X	X	X	X			40	X
UNIX	Concurrent	850 & up					X			V7B	512K	1.5M			X							X
XENIX	Forward Tech.	1000					X			V7	256K	8M		10M	X	X	X	X	X	Y	C	X

BWS = Bundled with system PE = Perkin-Elmer UDD = User device drivers MP = Multiple processors UL = Unlimited C = Configurable CR = Critical regions PCS = Process code sharing

2) compatible file, device and interprocess I/O
3) the ability to manipulate multiple, sequential, and asynchronous processes
4) the ability to tailor the system command language to the individual user.

The implementation of these areas varies from system to system, as indicated in this survey. For example, some systems allow only 20 processes per user, while others have no such limitation or are configurable.

What one may expect a system to include

UNIX systems typically have good program development and text processing support. However, one may have to pay extra for anything more than the minimum. Reviewing the responses from our surveys, we noted that almost everyone was charging extra fees for languages (Basic, Pascal, Fortran, and Cobol). Three companies even charge extra for C! Doing without sources is another thing that may disturb old UNIX hands. None of the systems reviewed here distribute their sources.

You will notice that no one is offering a high-level debugger (sdb) that is the UNIX programmer's handy diagnostician for C programs. I'm somewhat amazed at their gall, but I'm not mystified. Even though UNIX is highly portable at the source level, the C compiler (especially during code generation) and hence the debugger are two products that need time-consuming and sophisticated skill at rewriting to adapt to a new system. I suppose these companies are betting that this "deletion" is the last thing that you'll be looking for in evaluating a package. In fact, getting a system without a good debugger can well cut your productivity in half. For example, imagine not being able to tell what line your program bombed out on, or trace your program, or set a breakpoint!

Some but not all systems include advanced facilities of UNIX that enhance productivity and would be missed by habitual users of UNIX. These features are:

lint: a C program checker. It catches all sorts of mistakes that the C compiler is notoriously lax about noticing.

make: a manager for programs that depend on multiple source files and libraries.

lex: a program that produces lexical analyzers.

yacc: a program that produces parsers based on BNF specifications.

uucp: a program that provides UNIX-to-UNIX communication over hardwired and telephone links.

eqn, typo, tbl, spell, nroff, troff: utilities for text processing.

C shell: a command processor more flexible and powerful than the standard UNIX shell.

Process Management						Memory Management					Utilities: Program Development										Utilities: Text Processing				Utilities: Libraries				Utilities		Network Support	
Messages	Shared mem.	Max. # of online users	Semaphores	Monitors	CR	Paging	Segmentation	Swapping	DR	PCS	make	yacc, lex	C compiler	lint	x-compiler	Pascal	Fortran	Basic	Cobol	CP/M	Line ed.	Screen ed.	eqn, tbl, spell, type, nroff	Other	stdio	terminal	math	database	C shell	uucp	other	Reader Service Card No.
X	E	UL	X			X	X	X	X	X	✓	✓	✓	✓		E	E	E	E		✓	✓	✓		✓	E	✓	E	✓	✓	UNET	180
		?				X	X	X			✓	✓	✓	✓				$780			✓	✓	✓		✓	✓		$1K	✓	✓	UNET	181
X	X	64	X	X	X	X	X		X	X	✓	E	$500	E		$950	$950	$800	3rd		E	✓	E	✓	✓	✓	✓		E	E	RS232	182
		16	X				X	X	X	X	✓	✓	✓	✓		E	E	E	E		✓	✓	✓		✓	✓	✓		✓	✓		183
X	X	?	X			X	X	X	X	X	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	IP/TCP on Ethernet	184
	X	UL	X					X	X	X	✓	✓	✓	✓		$600	✓	$200		$600	✓	✓	✓		✓	✓	✓	3rd	✓	✓	UNET	185
X	X	32			X		X		X	X			$400			$400		$200	$900		$125				✓	✓	✓	✓		U	Hooks for any	186
		?				X			X	X	✓	✓	✓	✓		E	✓	E			✓	✓	✓	E	✓	✓	✓	3rd	✓	✓		187
X	X	?				X	X	X			150				68K	$300	$450	$200	$750		✓			$150	✓							188
X		8						X	X	X	✓	✓	✓	✓	Z80		E				✓	✓	✓	E	✓	✓	✓	✓		✓	INNET	189
		6					X	X	X		✓		E		CP/M	E		✓		✓	✓	✓		✓	✓		✓	✓				190
		24	X				X	X	X	X	✓	✓	✓	✓		$3K	$2K	$1K		$1K	✓	✓	✓		✓	✓	✓		✓	✓	UNET/ZNET	191
		16					X	X	X	X	✓	✓	✓				✓				✓	✓	✓		✓		✓			✓		192
	X	?	X		X		X	X	X	X	✓	✓	✓								✓	✓	✓		✓		✓		✓			193
		1									✓		✓							✓	✓	$100		✓	✓							194
	X	8					X	X		X	✓	✓	✓	✓		$600	$600				✓	✓	✓		✓	✓	✓		✓	✓		195
		1						X								$1K	$2K				✓			✓	✓							196
X	X	24	X				X	X	X	X	✓	✓	✓	✓		E		E	E		✓		✓		✓		✓	✓				197
X	X	UL					X	X		X	✓	✓	✓	✓		$1000	$700				✓	✓	✓		✓		✓					198
X		10	X			X	X	X	X	X	✓	✓	✓			$750	$750	$750	$1150	E	✓	✓	✓	E	✓	✓	✓	✓	✓	✓	Ethernet	199
		6						X					✓							E	✓		✓					E	✓			200
X	X	16	X								✓	✓	✓	✓		$750	$750	$750			✓	✓	✓	✓				✓	✓	✓	UNET	201

DR = Dynamic relocation ✓ = Included with package 3rd = Available through 3rd party
X = Built-in features E = Available at extra cost U = Free through user group

Vendors

Central Data Corp.
1602 Newton Drive
Champaign IL 61820
(217) 359-8010

Charles River Data Systems, Inc.
4 Tech Circle
Natick MA 01760
(617) 655-1800

Codata Systems Corp.
285 N. Wolfe Rd.
Sunnyvale CA 94086
(408) 735-1744

Human Computing Resources
10 St. Mary St.
Toronto, Ontario, Canada
(416) 922-1937

Microsoft Corp.
10700 Northup Way
Bellevue WA 98004
(206) 828-8080

Microware Corp.
5835 Grand Ave.
Des Moines IA 50312
(515) 279-8844

Morrow Designs
600 McCormick
San Leandro CA 94577
(415) 430-1970

Interactive Systems Corp.
1212 7th St.
Santa Monica CA 90401
(213) 450-8363

Technical Systems Consultants Corp.
111 Providence Rd.
Chapel Hill NC 27514
(919) 493-1451

Uniq Computer Corp.
28 S. Water St.
Batavia IL 60510
(312) 879-1566

Unisoft Systems Corp.
2405 Fourth St.
Berkeley CA 94710
(415) 644-1230

The Wollongong Group
11350 San Antonio Rd
Palo Alto CA 94303
(415) 962-9224

Zilog Inc.
1315 Dell Ave
Campbell CA 95008
(408) 370-8000

WICAT Systems, Inc.
POB 539, 1875 South State St
Orem UT 84057
(801) 224-6400

Vortex Technology
POB 2284
Culver City CA 90230
(213) 645-7200

Cosmos Systems, Inc.
525 University Ave
Palo Alto CA 94301
(415) 326-9150

Chromatics, Inc.
2558 Mountain Industrial Blvd
Tucker GA 30084
(404) 493-7000

Callan Data Systems
2645 Townsgate Road
Westlake Village CA 91361
(805) 497-6837

Ithaca Intersystems, Inc.
1650 Hanshaw Rd., P.O.B. 91
Ithaca NY 14850
(607) 257-0190

Mark Williams Co.
1430 West Wrightwood
Chicago IL 60614
(312) 472-6659

Forward Technology, Inc.
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Santa Clara CA 95050
(408) 988-2378

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SOFTWARE/SYSTEM REVIEW

The InterSystems DPS-8000 and Coherent

A UNIX-like multiuser multitasking operating system on the S-100 bus

by David Fiedler

With all the hoopla about subjects such as 16-bit microcomputers, UNIX-like operating systems, and the quest for high performance, it's nice to find a real live piece of hardware that *works*. In the past few years, many manufacturers have announced computers with these catch phrases as a large part of their product description. In some cases, delivery of a working product with complete software as announced is still pending. Not so with Ithaca InterSystems.

InterSystems (once well known in the hobby world as board-maker Ithaca Audio) is a company that has made a name for itself as a manufacturer of high-quality packaged computers, with extensive support software for developers and OEMs. Its Cache BIOS® line of CP/M systems have provided fast access times for several years before anyone ever dreamed of CP/M 3.0, and their front panels of a few years back made serious hackers drool. Now their high-end machine, the DPS-8000, is available for even more serious work—either software development of the best kind, or business use under real-life conditions.

Running under the Coherent operating system (a UNIX version 7 look-alike from the Mark Williams Company), the DPS-8000 as supplied by InterSystems included 512K of RAM (on two boards), DMA controllers for both the 10 megabyte 8" Winchester and 1.2 MB quad-density 8" floppy disk drives, the 4-MHz Z8000 CPU board, and a memory management card (with a battery-backup clock that automatically keeps Coherent up to date). Serial I/O is handled by a VIO board with two ports and their newest creation, an ISIO (Intelligent SIO) board with four serial ports and its own processor. This last was so new that no documentation was ready for it, but they were eager to see if the system performed noticibly better using it, so they sent it with my concurrence. List price for the system as tested is around $17,500.

Initial impressions

Quality material is used throughout this machine. From the top-name disks (Quantum and Shugart) to its classy little touches here and there (Allen screws on the cabinet, sure to warm the hearts of BMW lovers everywhere), the DPS-8000 feels solid. Not made of the structural foam that we've all come to know and love (?); heavy-gauge aluminum and steel are the order of the day. InterSystems' manufacturing procedure includes 100% testing of all chips used (not just the LSI chips), 24 hours burn-in at 100° Celsius, then retest of the chips. In addition, each board is tested after assembly, then systems are burned in and tested for 72 hours.

The day the truck pulled up outside with the computer was memorable. The truck was longer than my house! However, fears were quieted once the beast was unpacked—while larger than an Apple, each of the two computer cabinets is "large desktop" size, or about as large as an Altair. Unpacking took about 15 minutes, and another 20 minutes were necessary to install the individually packaged boards and hook up the disk cables.

It might be pointed out that since I am familiar with S-100 systems in general, I did not attempt to do more than glance over the basic setup instructions. These were clear, well illustrated, and comprehensive without offering too much information to confuse rather than enlighten. I felt they were adequate for an OEM, dealer, or very serious hobbyist (the market to which the machine is targeted), but a person totally unfamiliar with computers would have had a hard time—not due to any fault of the instructions, but because there is a good deal of setting up to do.

Documentation for the system consists of two manuals, each about two inches thick, which are divided into logical sections with real Tables of Contents where appropriate. The hardware manual was created by InterSystems, while the software documentation seems to have been supplied by Mark Williams as a generic manual for any of its implementations (included are instructions on how to boot Coherent on a PDP-11, for example) with system-specific pages relating to the InterSystems machine. My biggest objection to the Coherent manual is that it does not credit UNIX (or its designers, Thompson and Ritchie) with being the original inspiration for Coherent.

In any case, I had to guess about the connections to the serial boards because of not having the documentation (a phone call would have been use-

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ful but less exciting). Dyed-in-the-wool computer hobbyists may not believe this, but the system came up instantly, figured out how much RAM it had, and sat waiting for my next instructions. No jumpers, DIP switches, header changes or the like were necessary. Even the baud rate was correct for my terminal, though I found out later that this was due mostly to luck (I take credit for the informed guess as to which of the six RS-232 ports to use, however).

With the hardware running, it was time to check the software. A friend of mine with 8 years' UNIX experience had managed to wipe all the software off his brand new 68000 UNIX computer the week before, and I didn't want to do something equally embarrassing. Also, this was Coherent, not UNIX; even though I am quite familiar with UNIX as both a programmer and administrator, it made sense to read the manuals carefully before doing anything.

Naturally, I ignored all such caution. This was a review, right? If Coherent wasn't like UNIX, now was the time to find out. Go wild, son!

Everything worked fine. Except for some slight differences in some command sequences and a few things that were missing from UNIX (and some that were added to Coherent), the user interface is almost exactly like UNIX's. That's the good news. The bad news is that a few things that were mentioned in the documentation just weren't on the system, and several things had to be fixed up or worked around.

Running for real

On initial boot the sign-on message was not quite the same as expected from reading the manual. Hitting return loaded Coherent and presented me with the "root", or "super-user", prompt character #. Not stated in the manual (but you will learn it soon enough, hopefully not the hard way) is the fact that you can get into trouble quite easily at this point if you are not fairly experienced with UNIX-like systems. In fairness, it must be restated that this system is targeted towards experienced OEMs and not beginning hobbyists.

Past experience told me the first thing to do was check the file system for consistency. The built-in "check" program found a missing block almost immediately, and just as rapidly fixed the problem. Two points for Coherent's utilities! Next, I figured I would install some accounts. Normally on UNIX, this is a strictly manual task, involving editing of files, making up new directories, setting mode bits, and the like. Coherent's shell program **newusr** promised to take care of all of this for me. Only one problem: It wasn't there.

Similarly missing, but promised in the manual, were entire directories like **/usr/adm** (preventing administrative records of system use from being kept) and **/usr/games** (preventing me from having fun when there was nothing else to do). A bit more serious was the impossibility of running the printer spooler without its directory.

The directories are easily set up as super-user, though the permission bits, file ownership, and even lack of a printer device entry are things that required UNIX administrative experience to make them work. The printer device /dev/lp was made simply by linking, in software, a spare serial port device (**/dev/tty1**) to the new name **/dev/lp**, and plugging a serial printer into the port. But you had to know how. . . .

While most UNIX commands are available (including **yacc**), the most noticeable exceptions are the communications tools, **cu** and **uucp**. These programs allow you to dial other systems and exchange files, either by command or automatically at a preset time. I have always found it important to be able to use modems to transfer information, and the lack of this capability on such a powerful machine frustrated me. I even toyed with the idea of taking one of the public domain communications programs written in C, putting it on the DPS-8000, and seeing if it would run my PMMI modem board. (Why not? It's S-100—I would have taken the time if I were keeping the machine permanently.) However, I *was* able to easily plug a Hayes Smartmodem 1200 into one of the ports and allow people to log in at 300 or 1200 baud (both the modem and the software are able to switch speeds). Messages left at only five bulletin board systems had people calling in from all parts of the country last October, trying the system out. (The usual reaction from most people was, "Wow! Nice machine!")

The commands worked for the most part just like their UNIX counterparts. Differences in operation were largely annoying, as was the lack of proper behavior on the part of the shell in various instances. Programs like **nice** and **nohup** were missed; some of the Coherent commands added were good to have but not essential. InterSystems' own programs included a screen editor, spelling checker, and file comparison utility transported from CP/M—nice, but hardly needed with the Coherent utilities available to perform essentially the same functions.

One serious problem I had here was while printing: Escape sequences were sent to the printer (without my asking for them), causing it to go into "wide mode" and thereby wrap some long lines around to the left edge of the sheet. The **mail** program did not delete mail after saving it into a file, leading me to save the same mail several times, and insisted on telling me **You have m.** while I was logging on, rather than the more correct **You have mail**. While these are not serious problems in themselves, they would concern me if I had to be absolutely sure that Coherent was *exactly* like UNIX for purposes of writing large programs.

I had planned to actually try transporting some programs written for UNIX, but didn't think I

The commands worked for the most part just like their UNIX counterparts.

This system is targeted towards experienced OEMs and not beginning hobbyists.

could do it without the communications capabilities. Then I remembered another InterSystems utility called **ipret. ipret** reads and writes standard CP/M diskettes on Coherent. So I logged on to the UNIX system with the programs I was looking to use with my CP/M system, downloaded the files to disk, brought the disk over to the DPS-8000, and read in the files. Perfect! There were two programs, one which used a few normal system calls, and one much larger one that did all sorts of tricky things with directories. The smaller one compiled and ran fine on Coherent, but the larger one couldn't compile, due to some problems with standard header files. This program didn't compile on the UNIX system either (for the same reason), so I felt that Coherent had done pretty well.

Performance

The benchmark program in *Byte* magazine (September 1981, p. 180) was run several times under various system loadings. In the original reporting format, here are the results:

Table 1. Benchmark timings

Compiled bytes	Total size	Compile and load (sec)	Execute (sec)	Ratio to PL/I-80
394	5342	26.0	9.7	.69

For the record, this was done in C on a 4-MHz Z8002-based computer running Coherent version 1.2 in single-user mode. Using the optimizing option of the C compiler dropped 6 bytes from the code size and 0.1 second from the runtime, while taking 2.1 seconds longer to compile. When all six ports were enabled for log-ins, it took 28.8 seconds to compile the unoptimized version, but only 9.4 seconds to execute. With one other user on, and receiving a continuous stream of data at 1200 baud (on the "nonintelligent" serial board), compile time went to 33 seconds and execution time to 12 seconds—not a large degradation in performance. In comparison, the fastest C compiler listed in the *Byte* article, on a 4-MHz Z80-based computer, took 242 seconds to compile and 15.6 seconds to execute. Further, another Z8000-based computer, running UNIX, took 54 seconds to compile and 3.2 seconds to execute—indicating that its clock speed was probably much higher, but the system performance itself (measured by the compile time) was much lower. All this illustrates that this machine is quite usably fast. Perceived performance in single-user mode is about equal to a PDP 11/70 running UNIX with about eight users on—very nice for a machine of this price.

Reliability

I suffered no failures of any kind that were not due to various mistakes I made until I tried to run InterSystems' InterEdit program, a full-screen editor. Because I did not have one of the terminals listed in the configuration file (actually, only the H19 was supported), I had to run their **termset** program. I spent 20 minutes laboriously typing in all sorts of control sequences for my terminal. When the program attempted to write the file out, the message I/O ERROR appeared on the screen, and the entire operating system crashed. No file damage was done, but I did not feel like trying that again!

On another occasion, one of the people who called in (who may not have used a system of this kind before) managed to leave his shell in an unbreakable loop, preventing other people from logging in. This problem would have been avoided if I had used an RS32 cable with enough wires to tell the computer that the caller had hung up in frustration; then the system would have killed his shell process and reset properly. It is mentioned only because it happened: This is a fairly common occurence on UNIX systems, and it affects no other user nor locks up the system.

The other problem cropped up after I had transported the machine in my car for about 75 miles (with the mainframe sideways). After setting it back up, the system began acting funny and had to be rebooted several times. Then a PARITY ERROR message appeared, and another crash occurred. I removed the RAM boards, reseated all the chips, and everything was fine again. The two things to remember about this incident are: 1) Pack and transport computers carefully, and 2) Without the parity check, the system might have run for a much longer time before crashing, permanently snarfing all my files. The lack of recovery from the parity error (as PDP-11s can do under Bell UNIX) doesn't bother me because this was obviously *not* a *real* parity error. Except for the error found in **termset**, then, the system performed as expected, which included the hazards of being left on 24 hours a day and subjected to inexperienced users.

Conclusions

As a long-time home computer addict who still owns a MITS Altair, it was quite an experience to test a state-of-the-art multiuser, multitasking ma-

The DPS-8000 is well-designed piece of quality equipment, using an industry-standard bus. Perceived performance in single-user mode is about equal to a PDP 11/70 running UNIX with about eight users on—very nice for a machine of this price.

chine with 512K of RAM. Nevertheless, it was comforting to find that all the boards for the InterSystems could fit into the Altair box, if necessary. That fact alone should be enough to sway someone towards the S-100 bus if they are considering buying a system that they might have to upgrade and add to later on.

The DPS-8000 is a well-designed piece of quality equipment, using an industry-standard bus and an (almost) industry standard operating system. It works, and works well. It should be considered by those in the market for a three- to six-user UNIX machine, especially those who have need for the flexibility and options available for S-100/IEEE-696 equipment.

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David Fiedler is the president of InfoPro Systems, a UNIX/C consulting firm specializing in technical and market research services. Mr. Fiedler is also the editor of *The UNIX Software List*® (a monthly newsletter covering the industry) and frequently comments on UNIX-related issues in the press.

SOFTWARE REVIEW

UNIX Facilities on CP/M: MicroShell

by David Fiedler

While CP/M 2.2 is generally acknowledged to be the most widely used operating system around, most serious computer users have complaints about it. These usually range from the whining "It's not UNIX" to the more reasonable "Why don't the standard utilities have a little more intelligence?" Actually, CP/M isn't that bad for a system that wasn't intended to be much more than a program load-and-go facility. A few brave souls have ventured to bring some of the flavor of their favorite operating system (UNIX) to the CP/M world.

MicroShell is a product of New Generation Systems, Inc., 2153 Golf Course Drive, Reston, VA 22091, (703) 476-9143, and costs $150. A brief overview of this package should prove useful. MicroShell is a single program that actually replaces the CCP (Console Command Processor, or user interface portion) of CP/M to provide I/O redirection, pipes, and a variety of automatic file search conventions that can be used with any program that runs under CP/M. It runs on any CP/M 2.2 system with at least 32K of memory. MicroShell also implements pipes with temporary files, allows redirection of console output to either a disk file or the printer, and provides for "appending" output in chunks.

I received MicroShell a little while after I received Unica (see review, page *59*), which also emulates many UNIX utilities and performs redirection and piping as well. After about two weeks of playing around with Unica, I began slipping into the habit of trying to redirect output of non-Unica programs by mistake. Not realizing how much I missed running UNIX, I began to be unhappy because all my programs did not work the same way. Right about then, I received the review copy of MicroShell, and all my problems were over (all *those* problems, anyway). MicroShell makes *all* your programs look like they were on UNIX, and eliminates all that code you would otherwise have to write to make them device-independent.

Operation

MicroShell loads in like any other program, but then "takes over" and replaces the CCP. All the normal CCP functions are present (DIR, ERA, SAVE, TYPE, REN, and USER), as well as the redirection and piping mentioned earlier. The redirection is clever enough to handle programs that perform direct BIOS calls, and numerous options are available to allow operation with almost any program. Output redirection allows you to take the output of any program and send it to a file (or the printer) by an option on the command line. Input redirection, on the other hand, lets you write a script of commands into a file and give the file to another program as input. The program then thinks the commands were typed at the console. This is especially handy for working with editing programs for repeated operations on a series of files, for example. Redirection is specified by the < and > characters, so:

```
% stat >statfile
```

sends the output of the **stat** command to a file (created automatically if necessary) called **statfile,** and:

```
% ed <edscript
```

will make the editor do whatever commands you left in the **edscript** file. In addition, files can have their contents added to by redirecting subsequently with the double >> character. Another useful feature is the ability to specify multiple commands per line, so:

```
% a: ; dir >dirfile ; dir b: >>dirfile
```

is a perfectly legal command line under MicroShell, giving the expected result of all filenames on both a: and b: disks into the file **dirfile.** The % character is the default MicroShell prompt (copied from UNIX version 6). The prompt can be customized easily; mine prints the current disk and user number in high intensity. Even the Berkeley C-shell is emulated a bit; typing "!" will repeat the previous command.

Pipes were mentioned also. Let's say you wanted to remove a series of files, and were using a file erasing program **rm** together with another program **ls** that listed file names. One way to do this would be through redirection:

```
% ls >temp ; rm <temp
```

Piping lets you send the output of one command directly to the input of the next command, without having to specify or worry about temporary files. That would look like this:

```
% ls  rm
```

which is not only easier to understand, but closer to the way you might think of performing the function. On UNIX, which is a multitasking operating system, both the **ls** and **rm** programs run *simultaneously*, and UNIX takes care not to lose the output. Execution time is much faster than if temporary files were used. On CP/M, temporary files

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are created and automatically erased by MicroShell while piping.

A "path" facility is also provided, whereby you may specify disk drives to be automatically searched for files or commands. The latest version of MicroShell (rev. 1.2) allows redirection of output to the printer, or alternatively redirection of printer output to a file (I use this for spooling later on). In fact, a new mode of input redirection was added to make MicroShell more compatible with the Unica programs.

Command performance

Of course, like any program worthy of the name "shell", command files can be readily executed. Like "submit" files under normal CP/M, MicroShell command files (let's call them shell files) can consist of any normal command line that could be typed by the user. Also, argument substitution is supported, so that parameters named on the command line may be passed to the shell file.

But shell files have several more features. A total of 18 arguments (named as \$1, \$2, etc.) may be passed to the file, and the argument \$0 will be recognized as the name of the shell file itself. Further, a null argument may be passed, so that a shell file that is written to accept arguments will not "blow up" if none are specified. Comments, control characters, redirection and piping are also acceptable in shell files. One of the cleanest features is the way shell files are used: simply type the name of the file and any arguments, and it executes. The file is "marked as executable" by its file type, and this can also be specified by the user.

Here is a good example of how MicroShell can be used with the help of some Unica utilities. While this shell file could have been made shorter with the help of more pipes and multiple commands/line, this would have obscured the meaning of the individual commands. This program, which is named on my system **sync.sh** (after the UNIX command used when shutting down a system), performs an "incremental backup", or a backup of just the files that have changed since the last backup. In use, it looks on my A: and B: drives (separate logical sections of my hard disk), determines which files must be copied, and creates the backup files. The command takes, as a single parameter, the floppy drive to send the backup to. So a typical command line looks like:

```
$ sync c
```

The entire program, with comments where appropriate, is shown in Listing 1. The Unica commands used are all the ones between the **−m** and **+m** used to change modes in MicroShell, except for "date" and "type".

Listing 1.
Program To Create Incremental Backup Files

```
echo Beginning backup on drive $1 -- press DELETE if wrong or another key
to start
wait 1 <$T                                # get actual console input
user 0
reset                                     # system-dependent command to
                                          # initialize floppy disk density
a:
-f                                        # turn off automatic file search
-m                                        # change to UNIX-style input mode
rm b:?files.old                           # erase oldest log files
mv b:?files.new b:?files.old              # most recent log files now become
                                          old
ls -laf "a:*;*" > b:afiles.new            # store full info. on all disk
                                          files
ls -laf "b:*;*" > b:bfiles.new
diff b:afiles.old b:afiles.new >temp      # see what files have changed
diff b:bfiles.old b:bfiles.new >>temp     # add to temp file
grep -r "files." temp >temp1              # take out Unica header lines
cut -15 temp1 >temp2                      # extract file names from listings
srt -iu temp2                             # sort and throw out repeated
                                          lines
grep -r database temp2 >temp1             # remove references to "database"
                                          and
grep -r hashtab  temp1 >temp2             # "hashtab" files as saved
                                          separately
type temp2  cp -n @- $1:;0                # pipe final file to file copier
date >> $1:files.all;0                    # keep date record...
cat temp2 >> $1:files.all;0               # ...of what files were backed up
rm temp temp?
+m                                        # restore original MicroShell
                                          settings
+f
```

Interaction with other programs

MicroShell generally works with all CP/M programs, including those that "fool around" with address jumps in low memory, except if they expect the regular CCP to be there. The only two known incompatible programs are SUBMIT.COM (which MicroShell replaces anyway) and MOVCPM.COM, which is used for modifying your system size and not run very often anyway. I have a relatively small memory size and run some big programs, and find that MicroShell (which takes up 9.25K) sometimes gets in the way. This can be worked around by a special shell file that removes MicroShell and automatically reloads it after running my big program.

A problem found while using Unica is the fact that the Unica expect to do their own redirection and piping, while MicroShell handles this for all programs run while it is in control. This sometimes causes unexpected (and sometimes no) results when piping programs into each other. The solution is generally to surround the Unica commands by double quotes, again similar to the way UNIX handles things. Unless you're trying something fairly tricky, however, usually everything works as you would expect it to.

Documentation

The manual gives lots of information, is well-organized, has a good index and table of contents, and even tells you how to get started without reading the manual. A textbook case with nothing to complain about.

Updates

New Generation Systems promises to announce

MicroShell is a single program that actually replaces the CCP of CP/M to provide I/O redirection, pipes, and a variety of automatic file search conventions that can be used with any program that runs under CP/M.

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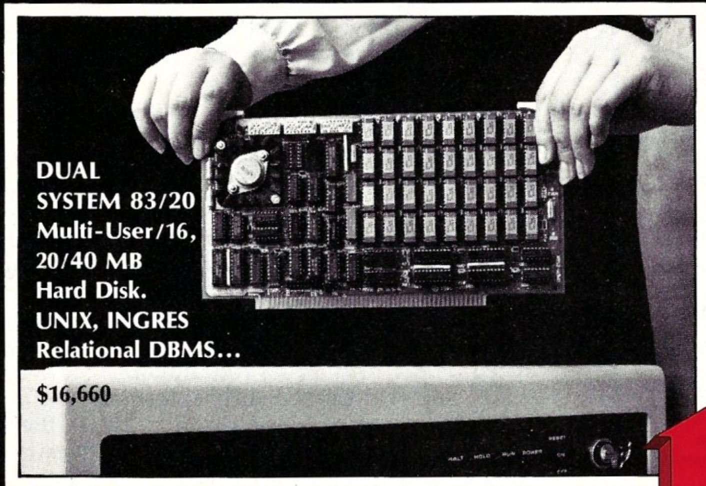

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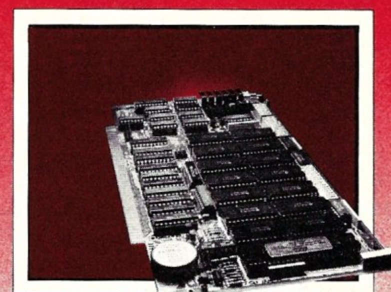

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new versions and bug fixes to registered customers. I have received one new version of MicroShell after having it for six months (how many other software houses really do this?), which fixed a few bugs, added a great many features, and actually reduced the program's size.

The charge is $25 for an update fee, including postage, handling, a new disk, and addenda to previous documentation.

Conclusions

The MicroShell package delivers, as advertised, some UNIX-like features to CP/M 2.2 systems. It is invaluable for and recommended to serious software developers. If I had to make a choice between MicroShell and Unica, I would get Unica only if I had a hard disk (due to its user area support and the large size of the individual programs) and MicroShell only if I had floppies (due to the ease and speed of performing its functions).

Of course, MicroShell is extremely useful with a hard disk also, especially due to its file/command search capabilities. MicroShell in particular might be good for use in turnkey operations, where it is not necessary that a customer know the difference between a shell and an executable program.

Other programs and patches are available which accomplish some of the functions of this package, but this is the cleanest, best integrated, and most usable implementation I have seen yet.

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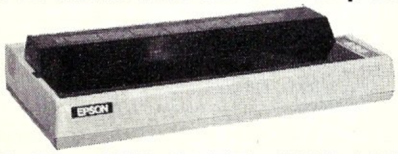

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Dual 8" Sub-Assembly Cabinet

END-000420 *Bare cabinet* **$59.95**
END-000421 *Cabinet kit* **$225.00**
END-000431 *A & T* **$359.95**

8" Sub-Systems - Single Sided, Double Density

END-000423 *Kit w/2 FD100-8Ds* **$695.00**
END-000424 *A & T w/2 FD100-8Ds* **$795.00**
END-000433 *Kit w/2 SA-801Rs* **$999.95**
END-000434 *A & T w/2 SA-801Rs* **$1195.00**

8" Sub-Systems - Double Sided, Double Density

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END-000427 *A & T w/2 DT-8s* **$1424.95**
END-000436 *Kit w/2 SA-851Rs* **$1274.95**
END-000437 *A & T w/2 SA-851Rs* **$1474.95**

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IBM PC Accessories

512K PC/RAM STACK - Hammond

A high quality, high density memory expansion board for your PC, cool-quiet-reliable operation, full parity checking, unique stacking sockets, expandable from 256K to 512K, MDRIVE high speed RAMdisk software only $25.00 with 256K or 512K board purchase.

MEX-25600A *256K assembled & tested* **$795.00**
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256K PC/RAM - Hammond Engineering

* *User expandable from 64K to 256K, same high quality standards as the RAM Stack above, designed for medium memory expansion requirements.*

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MEX-256000A *256K assembled & tested* **$569.95**

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Three boards in one, 256K of RAM, RS-232 asynchronous serial interface, and a SASI (Shugart Assoc Standard Interface) hard disk interface.

IOX-6000A *PC/SASI RAM* **$1095.00**

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TSX-300A *A & T with connectors* **$42.95**

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THE BUS PROBE - Jade

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So your computer is down. And you don't have an oscilloscope. And you don't have a front panel... You're not alone - most computers have their occasional bad days. But without diagnostic equipment such as an oscilloscope (expensive!) or a front panel (expensive!), it can be very difficult to pinpoint the problem. Even if you have an extender board with a superfast logic probe, you can't see more than one signal at a time. You're stuck, right?

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TSX-200B *Bare board* **$59.95**
TSX-200K *Kit* **$119.95**
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Sophisticated direct-connect auto-answer/auto-dial modem, touch-tone or pulse dialing, RS-232C interface, programmable
IOM-5400A *Smartmodem* **$224.95**
IOK-1500A *Hayes Chronograph* **$218.95**
IOM-2010A *Micromodem II* **$328.95**
IOM-2012A *Terminal program for MMII* **$89.95**
IOM-1100A *Micromodem 100* **$368.95**

APPLE-CAT - Novation
Software selectable 1200 or 300 Baud, direct connect, auto-answer/auto-dial, touch & pulse dialing, auxiliary 3-wire RS-232C serial port for printer
IOM-5232A *Save $50.00* **$324.95**

1200 BAUD SMARTMODEM - Hayes
1200 and 300 baud, all the features of the standard Smartmodem plus 1200 baud, 212 compatible, full or half duplex.
IOM-5500A *Smartmodem 1200* **$599.95**

1200 BAUD AUTO CAT - Novation
212 Auto Cat, 1200 & 300 baud, auto dial/answer/disconnect, LED readout displays mode, analog/digital loop-back self tests, usable with multi-line phones.
IOM-5231A *212 Auto Cat* **$649.95**

Video Monitors

HI-RES 12" GREEN - Zenith
15 MHz bandwith 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.
VDM-201201 *List price $189.95* **$129.95**

12" GREEN SCREEN - NEC
20 MHz bandwidth, P31 phosphor ultra-high resolution video monitor with audio.
VDM-651200 *Deluxe model* **$199.95**
VDM-651260 *Economy model* **$149.95**

12" COLOR MONITOR - NEC
High resolution color monitor with audio.
VDC-651212 *Color monitor* **$389.95**
NEC-1202D *RGB color monitor* **$999.95**

13" COLOR MONITORS - BMC
18 MHz RGB & composite video color monitors.
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VDX-420090 *RGB card for Apple* **$149.95**

COLOR MONITORS - Amdek
Reasonably priced color video monitors.
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VDC-801320 *13" Color II* **$894.95**
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High resolution 18 MHz compact video monitors.
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VDM-751220 *12" Green phosphor* **$139.95**
VDM-750910 *9" Amber phosphor* **$149.95**
VDM-750920 *9" Green phosphor* **$139.95**

EPROM Erasers

ULTRA-VIOLET EPROM ERASERS
Inexpensive erasers for industry or home.
XME-3100A *Spectronics w/o timer* **$69.50**
XME-3101A *Spectronics with timer* **$94.50**
XME-3200A *Economy model* **$39.95**

CP/M 3.0 Upgrade

NEW CP/M 3.0 - Digital Research
CP/M 3.0 is Digital Research's latest version of the industry standard disk operating system. It features many performance improvements such as intelligent record buffering, improved directory handling, "HELP" facility, time/date stamping of files and many more improvements. AND A TREMENDOUS INCREASE IN SPEED !!!, it is fully CP/M 2.2 compatible and requires no changes to your existing application software. Available only to Versafloppy II owners with SBC-200 CPU's
SFC-55009057F *CP/M 3.0 8" with manuals* **$200.00**
SFC-55009057D *CP/M 3.0 manual set* **$30.00**

Apple II Accessories

APPLE DISK DRIVE - Fourth Dimension
Totally Apple compatible, 143,360 bytes per drive on DOS 3.3, half-track capability - reads all Apple software, plugs right in to Apple controller as second drive, DOS 3.3, 3.2.1, Pascal, & CP/M compatible.
MSM-123200 *40 Track add on Apple drive* **$289.95**
MSM-123200 *Controller with free DOS 3.3* **$99.95**

16K RAM CARD - for Apple II
Expand your Apple II to 64K, use as language card, full 1 year warranty. Why spend $175.00 ?
MEX-16700A *Save over $100.00* **$69.95**

Z-80 CPU CARD - for Apple II
Two computers in one, Z-80 & 6502, more than doubles the power and potential of your Apple, includes Z-80 CPU card CP/M and complete manual set.
CPX-62800A *A & T with software* **$249.95**

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IOM-5232A *Save $50.00!!!* **$325.95**

8" DISK CONTROLLER - Vista
New from Vista Computer, single or double sided, single or double density, compatible with DOS 3.2/3.3, Pascal, & CP/M 2.2, Shugart & Qume compatible
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2 MEGABYTES for Apple II
Complete package includes: Two 8" double-density disk drives, Vista double-density 8" disk controller, cabinet, power supply, & cables, DOS 3.2/3.3, CP/M 2.2, & Pascal compatible.
1 MegaByte Package *Kit* **$1495.00**
1 MegaByte Package *A & T* **$1695.00**
2 MegaByte Package *Kit* **$1795.00**
2 MegaByte Package *A & T* **$1995.95**

VISION 80 - Vista Computer
80 column x 24 line video card for Apple II, 128 ASCII characters, upper and lower case, 9 x 10 dot matrix with 3 dot descenders, standard data media terminal control codes, CP/M Pascal & Fortran compatible, 50/60 Hz
IOV-2400A *Vista Vision 80* **$299.95**

CPS MULTICARD - Mtn. Computer
Three cards in one! Real time clock/calendar, serial interface, & parallel interface - all on one card.
IOX-2300A *A & T* **$179.95**

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Single Board Computer

SUPERQUAD - Adv. Micro Digital
Single board, standard size S-100 computer system, 4 MHz Z-80A, single or double density disk controller for 5¼" or 8" drives, 64K RAM, extended addressing, up to 4K of EPROM, 2 serial & 2 parallel I/O ports, real time interrupt clock, CP/M compatible.
CPC-30800A *A & T* **$724.95**
IOX-4232A *Serial I/O adapter* **$29.95**

Z-80 STARTER KIT - SD Systems
Complete Z-80 microcomputer with RAM, ROM, I/O, keyboard, display, kludge area, manual, & workbook.
CPS-30100K *Kit with workbook* **$299.95**
CPS-30100A *A & T with workbook* **$469.95**

AIM-65 - Rockwell International
Complete 6502 microcomputer with alphanumeric display, printer, keyboard, & instruction manual.
CPK-50165A *1K AIM-65* **$424.95**
CPK-50465A *4K AIM-65* **$474.95**
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4K AIM-65, 8K Basic, power supply, & enclosure
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S-100 EPROM Boards

PROM-100 - SD Systems
2708, 2716, 2732 EPROM programmer with software.
MEM-99520K *Kit with software* **$189.95**
MEM-99520A *A & T with software* **$249.95**

PB-1 - SSM Microcomputer
2708, 2716 EPROM board with on-board programmer.
MEM-99510K *Kit with manual* **$154.95**
MEM-99510A *A & T with manual* **$219.95**

EPROM BOARD - Jade
16K or 32K uses 2708 or 2716 EPROMs, 1K boundary.
MEM-16230K *Kit w/o EPROMs* **$79.95**
MEM-16230A *A & T w/o EPROMs* **$119.95**

S-100 Video Boards

SPECTRUM COLOR - CompuPro
Full-function color graphics board, up to 8 colors, 256 x 192 graphics, parallel I/O port, 8K RAM.
IOV-1870A *A & T* **$348.95**
IOV-1870C *CSC* **$398.95**

MICROANGELO - Scion
Ultra-high-resolution 512 x 480, 256 color or black & white S-100 video board
IOV-1500A *A & T* **$799.95**

S-100 MotherBoards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard

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MBS-061A *A & T* **$69.95**

12 Slot (9¾" x 8⅝")
MBS-121B *Bare board* **$34.95**
MBS-121K *Kit* **$69.95**
MBS-121A *A & T* **$109.95**

18 Slot (14½" x 8⅝")
MBS-181B *Bare board* **$54.95**
MBS-181K *Kit* **$99.95**
MBS-181A *A & T* **$149.95**

ACTIVE TERMINATOR - CompuPro
A true mother's helper.
TSX-100A *A & T* **$59.45**

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Free CP/M 3.0* !!!

S-100 CPU Boards

8086/8087 - CompuPro
16 bit, 8 or 10 MHz 8086 CPU with provisions for 8087 & 80130.

CPU-70520A	*8 MHz 8086 A & T*	$624.95
CPU-70520C	*8 MHz 8086 CSC*	$764.95
CPU-70530A	*with 8087 A & T*	$1224.95
CPU-70530C	*with 8087 CSC*	$1455.95

8085/8088 - CompuPro
Both 8 & 16 bit CPUs, standard 8 bit S-100 bus, up to 8 MHz, accesses 16 Megabytes of memory.

CPU-20510A	*6 MHz A & T*	$398.95
CPU-20510C	*6/8 MHz CSC*	$497.95

CPU-Z - CompuPro
2/4 MHz Z80A CPU, 24 bit addressing.

CPU-30500A	*2/4 MHz A & T*	$279.95
CPU-30500C	*3/6 MHz CSC*	$374.95

SBC-200 - SD Systems
4 MHz Z-80A CPU with serial & parallel I/O, 1K RAM, 8K ROM space, monitor PROM included.

CPC-30200A	*A & T*	$329.95

THE BIG Z - Jade
2 or 4 MHz switchable Z-80 CPU board with serial I/O, accomodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600.

CPU-30201B	*Bare board w/manual*	$35.00
CPU-30201K	*Kit with manual*	$149.95
CPU-30210A	*A & T with manual*	$199.95

CB-2 - SSM Microcomputer
2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K	*Kit with manual*	$229.95
CPU-30300A	*A & T with manual*	$274.95

2810 Z-80 CPU - C.C.S.
2 or 4 MHZ Z-80 CPU with serial I/O port & on-board monitor PROM, front panel compatible.

CPU-30400A	*A & T with PROM*	$289.95

2820 Z-80 DMA CPU - C.C.S.
4 MHz Z-80 CPU board with 2 serial I/O ports & Centronics parallel I/O port, separate data & status ports, DMA daisy chain compatible.

CPU-30420A	*A & T with manual*	$569.95

S-100 Disk Controllers

DISK 1 - CompuPro
8" or 5¼" DMA disk controller, single or double density, single or double sided, 10 MHz.

IOD-1810A	*A & T*	$449.95
IOD-1810C	*CSC*	$554.95
SFC-52506580F	*8" CP/M 2.2 for Z-80*	$174.95
SFC-52506586F	*8" CP/M 2.2 for 8086*	$299.95
SFO-54158000F	*Oasis single user*	$499.95
SFO-54158002F	*Oasis multi-user*	$849.95

VERSAFLOPPY II - SD Systems
Double density disk controller for any combination of 5¼" and 8" single or double sided, analog phase-locked loop data separator, vectored interrupts, CP/M 2.2 & Oasis compatible, control/diagnostic software PROM included.

IOD-1160A	*A & T with PROM*	$359.95
SFC-55009047F	*CP/M 2.2 with VF II*	$99.95

2242 DISK CONTROLLER - C.C.S.
5¼" or 8" double density disk controller with on-board boot loader ROM, free CP/M 2.2 & manual set.

IOD-1300A	*A & T with CP/M 2.2*	$399.95

DOUBLE D - Jade
High reliablity double density disk controller with on-board Z-80A, auxiliary printer port, IEEE S-100, can function in multi-user interrupt driven bus.

IOD-1200B	*Bare board & hdwr man*	$59.95
IOD-1200K	*Kit w/hdwr & sftwr man*	$299.95
IOD-1200A	*A & T w/hdwr & sftwr man*	$325.95
SFC-59002001F	*CP/M 2.2 with Double D*	$99.95

S-100 Memory Boards

256K RAMDISK - SD Systems
ExpandoRAM III expandable from 64K to 256K using 64K x 1 RAM chips, compatible with CP/M, MP/M, Oasis, Cromemco, & most other Z-80 based systems, functions as ultra-high speed disk drive when used with optional RAMDISK software.

MEM-65064A	*64K A & T*	$474.95
MEM-65128A	*128K A & T*	$574.95
MEM-65192A	*192K A & T*	$674.95
MEM-65256A	*256K A & T*	$774.95
SFC-55009000F	*RAMDISK sftwr CP/M 2.2*	$44.95
SFC-55009000F	*RAMDISK with EXRAM III*	$24.95

128K RAM 21 - CompuPro
128K x 8 bit or 64K x 16 bit static RAM board, 12 MHz, 24 bit addressing.

MEM-12810A	*A & T*	$1609.95
MEM-12810C	*CSC*	$1794.95

64K RAM 17 - CompuPro
64K CMOS static RAM board, 10 MHz, low power less than 4 watts, DMA compatible, 24 bit addressing.

MEM-64180A	*64K A & T*	$549.95
MEM-64180C	*64K CSC*	$698.95

64K RAM 16 - CompuPro
32K x 16 bit or 64K x 8 bit low power static RAM board, 10 MHz, 24 bit addressing.

MEM-32180A	*RAM 16 A & T*	$598.95
MEM-32180C	*RAM 16 CSC*	$698.95

64K STATIC RAM - SSM
IEEE 696/S-100 standard, up to 6MHz/8 Bit, 12MHz/16 Bit, 24 Bit extended addressing, disable-able in 2K increments

MEM-64300A	*A & T*	$499.95

64K STATIC RAM - Mem Merchant
64K static S-100 RAM card, 4 to 16K banks up to 8 MHz.

MEM-64400A	*64K A & T*	$499.95

64K STATIC RAM - Jade
Uses new 2K x 8 static RAMs, fully supports IEEE 696 24 bit extended addressing, 200ns RAMs, lower 32K or entire board phantomable, 2716 EPROMs may be subbed for RAMs, any 2K segment of upper 8K may be disabled, low power typically less than 500ma.

MEM-99152B	*Bare board*	$49.95
MEM-99152K	*Kit less RAM*	$99.95
MEM-32152K	*32K kit*	$199.95
MEM-56152K	*56K kit*	$289.95
MEM-64152K	*64K kit*	$299.95
Assembled & Tested		add $50.00

2066 64K RAM - C.C.S.
64K RAM board with bank and block select switching functions for Cromemeco Cromix & Alpha Micro.

MEM-64566A	*64K A & T*	$424.95

64K EXPANDORAM II - SD Systems
Expandable RAM board from 16K to 64K using 4116 RAM chips.

MEM-16630A	*16K A & T*	$344.95
MEM-32631A	*32K A & T*	$364.95
MEM-48632A	*48K A & T*	$384.95
MEM-64633A	*64K A & T*	$399.95

MEMORY BANK - Jade
4 MHz S-100 bank selectable expandable to 64K.

MEM-99730B	*Bare board w/manual*	$49.95
MEM-99730K	*Kit with no RAM*	$179.95
MEM-32731K	*32K kit*	$199.95
MEM-64733K	*64K kit*	$249.95
Assembled & Tested		add $50.00

16K STATIC RAM - Mem Merchant
4MHz lo-power static RAM board, IEEE S-100, bank selectable, addressable in 4K blocks, disable-able in 1K segments extended addressing.

MEM-16171A	*16K A & T*	$149.95

Free CP/M 3.0 Offer

THREE BOARD SET - SD Systems
S-100 board set with 4 MHz Z-80A, 64K of RAM expandable to 256K, serial and parallel I/O ports, double-density disk controller for 5¼" and 8" disk drives, new and improved CP/M 3.0 manual set, system monitor, control and diagnostic software. Includes SD Systems SBC-200, 64K ExpandoRAM III, Versafloppy II, and FREE CP/M 3.0 - all boards are assembled & tested.

64K Board Set with FREE CP/M 3.0	$1195.00
256K Board Set with FREE CP/M 3.0	$1395.00

S-100 I/O Boards

SYSTEM SUPPORT 1 - CompuPro
Real time clock, three 16 bit interval timers, dual interrupt controllers(15 levels), up to 4K EPROM/RAM, RS-232C serial channel, provision for 9511A/9512 math chip.

IOX-1850A	*SS1 A & T*	$359.95
IOX-1850C	*SS1 CSC*	$459.95
IOX-1855A	*with 9511 A & T*	$554.95
IOX-1855C	*with 9511 CSC*	$654.95
IOX-1860A	*with 9512 A & T*	$554.95
IOX-1860C	*with 9512 CSC*	$654.95

INTERFACER 1 - CompuPro
2 serial I/O ports 50-19.2K baud.

IOI-1810A	*A & T*	$218.95
IOI-1810C	*CSC*	$288.95

INTERFACER 3 - CompuPro
5 or 8 channel serial I/O board for interrupt driven multi-user systems up to 250K baud.

IOI-1835A	*5 port A & T*	$558.95
IOI-1835C	*5 port CSC*	$628.95
IOI-1838A	*8 port A & T*	$628.95
IOI-1838C	*8 port CSC*	$749.95

INTERFACER 4 - CompuPro
3 serial, 1 parallel, 1 Centronics parallel.

IOI-1840A	*A & T*	$314.95
IOI-1840C	*CSC*	$414.95

MPX - CompuPro
Multi-user I/O multiplexer & interrupt controller with on-board 8085A-2 CPU & 4K or 16K of RAM.

IOI-1875A	*4K MPX A & T*	$444.95
IOI-1875C	*4K MPX CSC*	$534.95
IOI-1880A	*16K MPX A & T*	$584.95
IOI-1880C	*16K MPX CSC*	$674.95

I/O-8 - SSM Microcomputer
Eight software programmable serial I/O ports, 110 -19.2K Baud, ideal for multi-user systems

IOI-1018A	*A & T*	$469.95

I/O-5 - SSM Microcomputer
Two serial & 3 parallel I/O ports, 110-19.2K Baud

IOI-1015A	*A & T*	$289.95

MPC-4 - SD Systems
Intelligent 4-port serial I/O card, on-board Z-80A, 2K RAM, 4K PROM area, on-board firmware, fully buffered, vectored interrupts, four CTC channels, add to SD Board set for powerful multi-user system

IOI-1504A	*A & T w/software*	$495.00

I/O-4 - SSM Microcomputer
2 serial I/O ports plus 2 parallel I/O ports.

IOI-1010B	*Bare board w/manual*	$35.00
IOI-1010K	*Kit with manual*	$179.95
IOI-1010A	*A & T with manual*	$249.95

2710 4 PORT SERIAL - C.C.S.
Four RS-232C serial I/O ports with full handshaking.

IOI-1060A	*A & T with manual*	$319.95

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SOFTWARE REVIEW

UNICA: A UNIX-like Utility System for CP/M

by Anthony Skjellum

The Unica/XM-80 package provides a new dimension in programming for the CP/M environment. I will discuss the Unica utilities and XM-80, a Z80 assembly preprocessor, separately. Those who have followed my "CP/M Bus" column during the last year will remember that I talked about enhancing CP/M 2.x to include new features for greater programming power. The Unica/XM-80 package meets or exceeds most of my proposed enhancements. Many other features not proposed were also included in the Unica.

The Unica system

The Unica utilities require a Z80 system running CP/M 2.x with at least 32K of RAM (more is strongly recommended). The cost is $95 or $15 for the documentation alone.

The Unica system consists of a set of 12 utility programs, each of which is called a "Unicum," that fall into two categories: file maintenance and file manipulation. The Unica system supports all forms of CP/M 2.x file references including wildcards (where appropriate) and, importantly, user number specifications. User specifications are appended to standard file names by a semicolon followed by the user number. The ability to make full use of the 32 user areas provided by CP/M 2.x is not trivial, as this permits far better organization of files on the disk than the single directory. Since files may be moved or copied between users (by the **mv** and **cp** Unica respectively), the cumbersome PIP limitation is circumvented. Link files may be created by the **ln** Unicum; these allow a single copy of a file to be accessible from two or more user areas. Without these links, multiple copies of the same program on a disk would be required (one for each user needing that file). Furthermore, the Unica supports redirection of input/output (I/O) as well as pipes. These features, first used in the UNIX operating system, make the job of programming much more pleasant.

I/O redirection and pipes

The piping concept allows a string of programs to act upon a single input source and produce a single output. The idea behind using pipes is that it promotes modular software tools that may be strung together in various ways via a pipe to effect different types of operations on data. Under UNIX (and the Unica), all programs normally read from a "standard input" and write to a "standard output," which default to the console input and output respectively. However, the pipe structure can connect the standard output of one program to the standard input of another, thus allowing data transmission between the two. In the following example, the **cat** Unicum (a file catenator) provides data to an imaginary file formatter called **pr** (as in Unix):

```
cat *.txt *.ws | pr
```

This example causes all data contained in ***.txt** and ***.ws** to be sent to **pr** as standard input for further processing. Under UNIX these programs would run simultaneously, but under CP/M piping is accomplished via a temporary file and the programs run sequentially.

The Unica also support redirection of input/output to and from files and CP/M peripheral devices. Thus, a program **pgm** could be made to read the file test.fil via the '<' input redirector by giving the command **pgm** <test.fil, or to read from the CP/M reader device by the command **pgm** <rdr:. Likewise, the standard output of a Unicum can be redirected via the '>' output redirector to write to a disk file (**unicum** >output.fil) or to the CP/M LST: device (**unicum** >1st:).

Anyone who has written programs under UNIX will appreciate the usefulness of pipes and I/O redirection, which are extremely convěnient features not to be taken lightly.

Unica filename notation

The standard Unica file name has the form **d:xxxxxxxx.yyy;zzz** where **d:** is the optional drive name, **xxxxxxxx** is the main part of the file name, **yyy** is the file type and **zzz** is the optional user area specification. Note that standard CP/M notation does not permit user area specification.

Enhanced wildcard capability

In addition to supporting wildcards, the Unica supports a new type of wildcard known as the indirect wildcard. An indirect wildcard consists of an at-sign @ followed by a filename: e.g., **@filename.** When this is encountered, the file is used as a source of further file specifications. This is useful for repeated operations that include complicated file specifications. Finally, there is a special indirect wildcard, @-, which specifies the standard input as the source of file specifications. This allows one member of a pipe to send file specifications to the next program in line. This can be useful when one program selectively determines files to use and

Anthony Skjellum, 1695 Shenandoah Rd., San Marino, CA 91108

then another program acts upon those files.

Utility descriptions

The following paragraphs outline the Unica features, and include a limited amount of my reactions as a user. My overall rating of the Unica package follows the descriptive paragraphs.

The Unica comes with full source code for the utilities discussed below, which are written in the XM-80 language. Those purchasing XM-80 will be able to recompile and modify the Unica system to their liking.

File maintenance Unica

cp (file copy utility) provides a much more general file copy utility than the standard PIP program provided with CP/M. Since user area specifications are permitted, files may be copied between user areas at will, whereas PIP only allows copying into the *current* user area, which is inconvenient. Options allow or prevent the overwriting of destination files that already exist, retention of file attributes, reconfirmation requests before performing an operation, and announcements of operations as they are performed. **cp** is also designed to minimize the number of disk accesses.

dm (disk map utility) is an enhanced disk map utility that can present information about disk allocation in three ways. First, a quick summary of disk space may be printed (default); second, disk block ("cluster") allocation may be displayed; or, third, a detailed summary of allocation including breakdown by user may be printed. **dm** is also capable of creating disk maps that show each block, indicating whether it is part of the directory, free, user R/W or R/O, or system R/W or R/O.

I found the default mode especially helpful. Once the Unica are used extensively and user areas are fully exploited, information concerning free directory slots is essential to normal operation.

fid (CRC [cyclic redundancy code] generation) is a straightforward CRC code generator useful for verifying that two files are identical. As stated in the manual, if two files have the same CRC, the probability is 99.9984 percent that the files are identical. Thus, when you're transferring files by telephone, this program could be used on both the sender's copy and the received version to ensure data integrity.

ln (a link forger which makes file aliases) is exceptionally useful because it enables one file to have several names, even in different user areas. Using only the CP/M facilities, each user who wanted to run WordStar would have to have a separate copy of WS.COM and the overlays in his own user area—and that would eat up large amounts of disk space. But with the aid of **ln**, each user could be given access to a single copy of WordStar in, say, user area zero.

The **ls** (directory lister) Unicum handles the management of directory listings. Not only can it handle variable column output, but it can also display file attributes, and restrict file listing by attributes. **ls** is often used to create a list of files for piping to another program, which in turn may perform some operation on those files. For example,

```
ls -w a:*.*;* | sr "SYM" >word.lst
```

lists the names of all writable (i.e., R/W) files on the A drive. This list is then piped to the **sr** Unicum. **sr**, described below under file manipulation, searches for the pattern "SYM" in these file names and places the matching names on the standard output, which is redirected to the file word.lst. Upon completion, word.lst will contain those file names which were writable and contained the pattern "SYM." For simple operations I prefer DIR to **ls**, since DIR requires no program load time and is therefore faster. The delay may be less noticeable on a hard disk.

mv (file rename (move) utility) is the extended file rename function of the Unica system. **mv** provides the capability to rename across user boundaries and with wildcard notation not possible with the CCP command REN. For example, it is possible to rename all files of type .ASM to type .MAC as follows:

```
mv *.asm *.mac
```

Furthermore, one or more files may be moved across user boundaries as follows:

```
mv  *.com;0 ;1   # move all .COM files in 0 to 1
```

Along with **ln**, **mv** is a Unicum which will be immediately incorporated by the Unica user. This Unicum permits reorganization of disks to place common files in the same user areas. With the help of **ln**, any new areas created may be equipped with links to the .COM files needed in that area.

As with the CCP ERA command, **rm** (file remove utility) accepts wildcard notation. However, **rm** accepts the Unica extended notation, which includes user areas. Of course, **rm** accepts multiple arguments. It can also be made to verify each operation to prevent accidental erasure. **rm** can also erase R/O files in a single operation, where CP/M would require two steps to be repeated for each file—STAT to change the file attribute, and ERA to erase the file. **rm** makes such operations far less tedious.

sfa ("set file attributes" utility) replaces the STAT function of setting and resetting file status bits. Operation is straightforward—for example:

```
sfa  s *.COM;4     # make all user 4 .COM files SYS files.
sfa  rs  *.SYS;*   # make all .SYS files R/O and SYS.
```

File manipulation Unica

bc (binary file comparator) compares two files in binary mode. Binary mode means that all characters in the file are significant and the soft end-of-file (^Z) is ignored. **bc** displays differences in the files and also handles files of unequal length.

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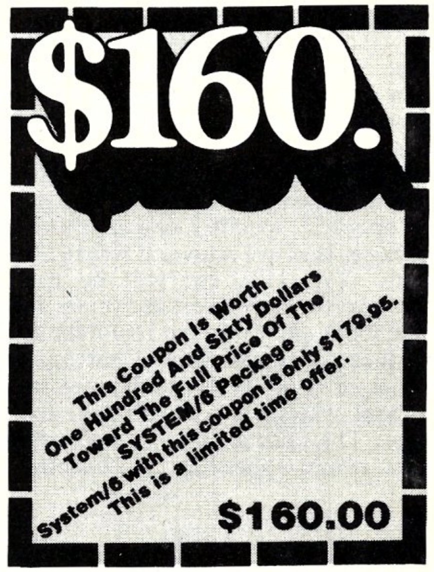

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```
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   00 00 00 01 18 00 00 00 00 00 00 00 00 00 00 00
```

The third line in the group is the exclusive OR of the above two lines; thus, nonzero values in the third line indicate differences.

sc (source file comparator) compares two source files. It automatically resynchronizes and hence is useful for comparing two versions of a document or program to see the changes between them.

cat (catenate files (vertically)) is very similar to the standard UNIX facility of the same name. The operator specifies one or more wildcard file sequences that are read and written to the standard output. Typically, **cat** will be used to concatenate two or more files. However, it is often used as the front end of a pipe structure to provide data for other programs. The following example reads all files of type .WRD and pipes them to the **srt** Unicum, which does an alphabetical sort on the names. The output of **srt** is not redirected, so the output would appear at the console.

```
cat *.WRD | srt
```

hc is particularly convenient for displaying two or more files side by side, for expanding tabs to spaces, and for compressing spaces to tabs.

```
hc (horizontal concatenator).       A number of different formatting ef-
This utility allows two or more     fects are possible, and this makes
files to be horizontally concaten-  the program useful for certain types
ated on a line-by-line basis.       of "cut-and-paste" operations.
```

sr (search for pattern utility) is patterned after the UNIX facility "grep." It handles a limited form of regular expression search and may be used as a filter in a piping sequence. The expression matching includes the single-character wildcard '**?**', as well as '*****', which matches a string of zero or more characters. Normally, each matching line is echoed to the standard output. However, the various flags allow alternative output, including all lines not matching the required specification string. For example, the following extracts all lines containing ".." from the files *.TXT:

```
sr -o ".." *.TXT >lst:          # -o --> omit file names, just
                                # print matching lines on LST:
```

Output is redirected to the CP/M list device.

srt (in memory data sorter) is used to sort data, usually for processing by other programs in a pipe. **srt** can also do an in-place sort when disk space is short. Reverse-order sorts are also possible.

tee ("pipe fitting") is used in piping sequences to allow data flowing through the pipe to be sent to a device or file(s) as well. For example,

```
cat *.bas | tee lst:
```

lists all files *.bas at the console and also on the CP/M LST: device

wc (word counter) counts the number of characters and words in a text file. It is also capable of ignoring lines that begin with a period for compatibility with editors that use such lines for control functions ("dot commands").

wx (word extractor) extracts words from files and produces an output containing one word per line. This is useful as a preprocessor for programs such as a spelling checker like **sp**, which is described next.

sp (spelling error detector) is a nice bonus to the Unica package. **sp** compares files against a 23,000 word dictionary. However, it is neither as fast nor as sophisticated as packages such as "The Word." It does not handle plurals, so most output consists of correctly spelled plurals, etc. Nevertheless, Knowlogy promises "more mature" spelling detection in the future. It states that it is also trying to obtain a better dictionary from a publishing company. I left discussion of **sp** for last since it exemplifies the amount of software provided with this package. On top of all the above utilities, a spelling checker is also provided!

Commentary on the Unica

My reaction to Unica is most definitely positive. Unica without the XM-80 assembly preprocessor costs $95, which I think is a fair price. A definite must for all CP/M 2.x users, it provides the features necessary to support the full capabilities of CP/M 2.x and also permits piping and redirection of input/output between Unica. All of these make programming easier and help users to organize their data and work on the microcomputer system. Unica would be even more essential for a hard-disk system where user areas are a must for data organization. MP/M systems would also benefit if relocatable versions of the Unica became available. I look forward to the CP/M-86 version of the Unica, and I can imagine that the Unica utilities will become synonymous with CP/M operation.

I continue to use ERA and DIR for simple operations, even though the Unica provide enhanced facilities. There is a certain overhead for the operation of Unica; Unica are typically at least 14K .COM files, whereas many CP/M facilities such as PIP and STAT are less than 8K long. However, this should be almost unnoticeable on double-density and hard-disk systems where transfer rates are higher than for standard disk systems. Furthermore, Unica are comparable in size to programs produced with the BDS C 1.4x compiler used with the DIO package, which provides redirection of input/output.

It is unfortunate that the Unica are not re-executable via the "zero program technique" (see *Microsystems,* Vol. 2, No. 2, "The CP/M Bus"). This would make the disk load time less annoying

Anyone who has written programs under UNIX will appreciate the usefulness of pipes and I/O, which are extremely convenient features not to be taken lightly.

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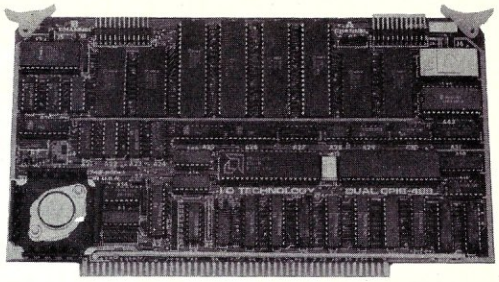

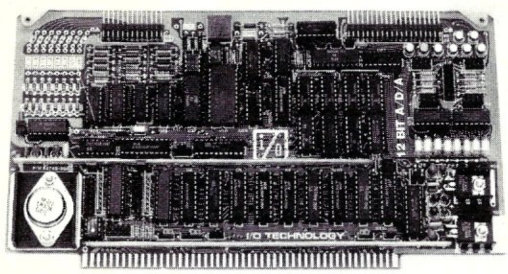

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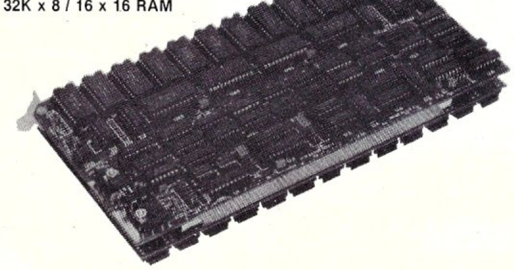

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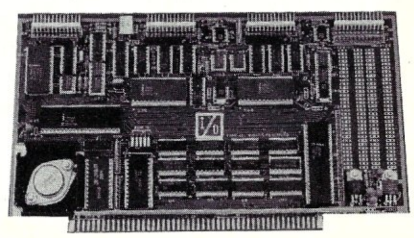

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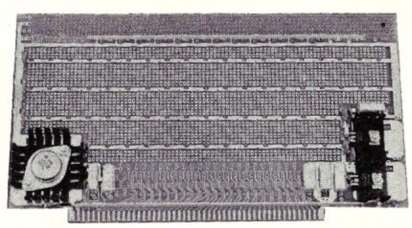

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on standard systems. Evidently, the Unica modify themselves in such a way that they crash upon reexecution.

Unica may be obtained from Knowlogy, P.O. Box 283, Wilsonville, OR 97070.

XM-80

XM-80 is a preprocessor for Z80 assembly language that permits software generation in a modular fashion. It encourages the creation of reusable modules that will help to free programmers from "reinventing the wheel" for each software project encountered. With XM-80 comes a powerful support library supplied in object form. The cost is $195 with the Unica utilities (documentation alone for Unica/XM-80 is $25). XM-80 is not available separately, but owners purchasing the Unica may upgrade as described below under "Upgrading Policy."

XM-80 provides the capability to use redirected input/output, pipes, dynamic allocation of memory, and buffered file I/O. XM-80 also provides a large support library with many functions including subroutines such as wildcard filename handlers, numerical conversion subroutines, and command line parsers. XM-80 is definitely a superior alternative to straight assembly language for those applications which can support the additional overhead (mostly spatial) required to provide the UNIX-like environment. XM-80 is also required for modifying the Unica utilities. Therefore, the end user may modify the Unica at will to make any changes or enhancements that he desires. Adequate knowledge of assembly language will be required to effect such changes.

Using XM-80

Compiling a program under XM-80 requires a three-step process. First, the XM-80 processor is invoked as follows:

```
XM =PROGNAME
```

where the file type, .XM, must be omitted due to a documented bug that causes the source file to be deleted if the file type .XM is included on the command line. XM-80 reports diagnostics and error messages and returns to CP/M or chains to the MACRO-80 (M80) assembler if no fatal errors occurred. (The temporary assembly source file, XM80TMP.MAC, is available for inspection to the programmer, should this be necessary.) The assembly is then performed and control is returned to the CCP. If no errors occurred in either XM-80 or MACRO-80, the user then must link the program with LINK-80 (L80) as follows:

```
L80 PROGNAME,LIB/S,PROGNAME/N/E
```

provided no additional libraries need to be referenced. The result of this process is the executable program PROGNAME.COM. Since XM-80 processing, assembly and linkage can be time consuming, it may be useful to make a SUBMIT process for this operation.

Commentary on XM-80

I think that both experienced and novice assembly language programmers should invest in the XM-80 system. Despite some small bugs present in the current version (which are documented and avoidable), I believe that XM-80 is a viable development system and certainly much more convenient than simple assembly language programming.

The documentation for Unica/XM-80 is fine. It includes a tutorial introduction and noncryptic examples for the Unica utility programs. The support library provided with the XM-80 system is carefully documented and includes strict specifications on memory consumption, stack use and heap (dynamic) memory use. Programmers should have no trouble using this system after studying the documentation.

Besides its reasonable pricing policy, Knowlogy has an enlightened licensing policy. The purchase price entitles the user (and anyone else) to use Unica/XM-80 on any machine which the purchaser owns. Furthermore, the purchaser may use the software on any other system. Finally, there is no fee for using the XM-80 library in original software produced with the package for commercial sale. I believe that this policy will help promote sales for Knowlogy.

The current update fee is $10. The user must return the original distribution diskettes, which will be updated or replaced at Knowlogy's discretion. This seems particularly inexpensive for updating software. Furthermore, those purchasing Unica only may upgrade for the difference in price between the Unica and both packages (plus the update fee of $10). Such an upgrade would also entitle the purchaser to the latest release of the Unica as well.

Conclusion

The Unica is a comprehensive utility package that helps the CP/M2 user make the most of his system. XM-80 allows the user to work in a UNIX-like environment and enjoy the piping structure used with UNIX. The added generality allows the development of software tools and software components that may be used again and again instead of for a single application. I think that everyone should look into this system. Those on a tight budget may want to buy the Unica first and upgrade later.

I would enjoy hearing from Unica/XM-80 users about programs developed with the system. I expect to mention developments in Unica/XM-80 software in my column, "The CP/M Bus."

I think that both novice and experienced programmers should invest in XM-80. . . . It allows development of software tools and components that can be used again and again.

SOFTWARE REVIEW

Small-VOS and Small-Tools

Two programs to add some UNIX-like features to a North Star computer system

by Randy Reitz

VOS is an acronym for "Virtual Operating System." The idea of such a system is to provide a "standard" interface for program development that can be ported to any desired system. The feature of a standard interface available on any desired system simplifies the problem of writing software for the variety of computers and operating systems currently available. The software portability technique provided by a VOS is described in the article "A Virtual Operating System" by Dennis E. Hall, Deborah K. Scherrer, and Joseph S. Sventak (*Communications of the ACM*, September 1980, Vol. 23, No. 9).

Jim Hendrix has prepared a VOS interface for the North Star DOS. It consists of three parts:

1) The lowest level is the interface to the real machine that is called Small-VM (for Virtual Machine, not to be confused with virtual memory operating systems available on the big mainframes). This is the nucleus of the VOS and was described in *Dr. Dobb's Journal*, No. 61, November 1981. The VM for N*DOS is written in assembler and provides a collection of primitives for handling program control, memory management, and file management functions.

2) The next level is the command processor that is called the Small-Shell. The Small-Shell program is also written in assembly language and was described in *Dr. Dobb's Journal*, No. 63, January 1982. It provides a more friendly user interface than unadorned N* DOS.

3) The top level is the program development system. Mr. Hendrix has chosen the Small-C compiler by Ron Cain (described in *Dr. Dobb's Journal*, Nos. 45 and 48, May and September 1980). The Small-C compiler has been modified to use the features of Small-VM. The compiler generates assembly code that is specifically tailored to Allen Ashley's PDS assembly language development package.

The Small-VOS and Small-C have been used to implement a collection of 14 text-processing programs inspired by the book, *Software Tools*, by Kernighan and Plauger. This collection of programs is called Small-Tools and is distributed as a separate package. The Small-Tools package includes a text editor, a text formatter, a sort program, a program to find a regular expression pattern in text, and more. The source code for all of the Small-Tools programs is provided; the installation requires all the programs to be compiled and linked before use.

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As noted above, detailed descriptions of Small-VM and Small-Shell are available in *Dr. Dobb's Journal*. Below are brief descriptions and my observations on installation.

Small-VM

This program provides the interface to the operating system (ultimately, North Star DOS) for application programs. The program supports the I/O functions of device open, close, read, write and seek. These I/O functions are made to appear "device independent," since all I/O is treated as a stream of bytes whether the source/destination is a character or block I/O device. This is the UNIX style of I/O, and redirection is an integral part.

Briefly, UNIX I/O redirection works as follows. Each open I/O channel (or device) is accessed in the application by using the file descriptor (called the **fd** and represented as a small integer) that is returned by the open system command. The usual default file descriptors (i.e., available to every program without any action to open the channel or device required) are 0 for input (called **stdin**), 1 for output (called **stdout**) and 2 for error output. File descriptor 2 is usually associated with the console device, so error messages written to file descriptor 2 will appear on the console no matter where file descriptor 1 is redirected.

The easiest way to implement I/O redirection is to close a file descriptor (say **stdin**) and immediately request an open of a channel for some device (like a disk file). Since file descriptors are always assigned by using the lowest available fd number, the same fd number of the last closed channel will likely be reused. This means that programs designed to get input from **stdin** (fd=0) and generate output on **stdout** (fd=1) can easily have their I/O redirected to devices other than the usual console device. I/O redirection is one of the most powerful features of UNIX and is highly desirable to have on any system.

I/O redirection is implemented in Small-VM, but in a slightly different way from the description that has been given above. The North Star DOS has always had a provision for supporting up to eight devices (numbered 0 to 7). Device 0 is always assumed to be the console terminal. Typically, device 1 is assigned to the printer. The implementation of Small-VM believes these device numbers should be used as file descriptors. However, since the console device needs three file descriptors (0, 1 and 2), the N* DOS devices 1 to 7 are offset to fd numbers 3 to 9. All of these file descriptors (0 to 9) are always available, i.e., they do not have to be opened.

The file descriptors used for disk files begin with number 10 and go up to 17. Only file descriptors 0 and 1 in this scheme are redirectable. If your program accesses the printer on fd 3 (which is where the printer ends up if N* DOS accesses the printer as device number 1) and you want to capture the printer output in a disk file, Small-VM does not provide any way to redirect fd number 3. This is the price to pay for having fds 0 to 9 always available. I think the UNIX style is preferable, since all file descriptors are redirectable.

Another feature of Small-VM is the memory management feature offered by system calls to allocate and free blocks of memory and determine the maximum amount of available memory. This dynamic memory management feature can be used to reduce the size of a program's object code as well as defer until execution time the determination of the size of the storage required. The Small-VM implementation of memory management is straightforward. All memory from the end of the currently executing program up to the top (lowest address) of the machine stack is considered available. Memory is allocated in blocks of the size requested until this available pool is exhausted. Similarly, memory is freed by chopping off the block at the highest addresses allocated. This scheme is simple and easy to implement, but suffers from the major defect of not being able to be used to pass data between programs (as with a chain). I have seen another scheme that moves the machine stack down in order to make memory space available between the bottom of the machine stack (highest address) and the topmost available RAM address. This method of dynamic memory allocation can be used to pass data between chained programs.

The final feature that Small-VM provides is program management. This refers to the ability to interrupt and serially reuse programs. The ASCII character control-C is reserved for program interruption. Small-VM intercepts this character and returns to the Small-Shell (if loaded) or to the North Star DOS. So long as the interrupted program's memory image is not disturbed, it can be restarted by typing a control-R. This is a handy feature, since the disk directory can be searched and files created or destroyed to make room. The action taken on a control-C can be controlled with the POLL system call. Control-C can be ignored to disable this interrupt feature.

Small-VM, along with the specially modified Small-C, provides an excellent program development system for North Star. Small-VM is only 3K bytes long and can be used by assembly programs as well as C language programs. The features of Small-VM (most notably the I/O redirection) are only available to application programs that use the Small-VM entry points. This means that the application programs you currently have running on North Star cannot benefit from I/O redirection without being recoded. This is impossible for North Star Basic, for example. Although it would be a kludge, Small-VM could have intercepted the North Star DOS character I/O (CIN and COUT) transfer vector so that all I/O could be redirected.

Small-Shell

This is a "no frills" command interpreter for North Star DOS. It is written in assembly language, is only 2K bytes long, and does not need any other programs (i.e., Small-VM) to run. Small-Shell provides a CP/M-like command intrepreter by loading and executing a program when its name is typed as the first token on a line. This eliminates the "GO" command required by North Star DOS. Small-Shell is transparent to North Star DOS commands (they are accessible by using the prefix "+") as well as to programs run under DOS.

Small-Shell provides a simple procedure capability (i.e., a prerequsite of command interpreters is that they can be programmed). Procedure files have a file type of 11; whenever a file name with this type is the first token on a line, the Small-Shell remembers the file name and proceeds to execute each line in the file. The procedure files are passed parameters so the action can be altered depending on the specific parameters given. Prompts can be displayed on the console and the next command line can be skipped, depending on the response to the prompt. Small-Shell tests the return code from Small-VM programs only. A nonzero value causes the command procedure to be terminated immediately.

The procedure programming capability allows the easy development of a turnkey system. The auto-load feature of N* DOS can be used to load and start the Small-Shell. The Small-Shell always executes the command *BOOT when it is first invoked. If *BOOT is a procedure file, the Small-Shell will then execute the commands stored in the file. These commands can load other programs (e.g., Small-VM) and then start an application program.

Small-Shell is slick and packs a lot into 2K. I feel that the I/O redirection should be included in the Small-Shell rather than in Small-VM. I/O redirection more appropriately belongs in a command interpreter rather than in an operating system interface. The Small-Shell is the appropriate place to intercept all character I/O between N*

These two packages—Small-VOS and Small-Tools—represent a significant capability that can be added to your North Star.

DOS and the application program. Although application programs executed by Small-Shell and using the Small-VM can redirect I/O, I think it's only a small change to move the redirection to the shell, and then *all* programs will have access to this capability.

Installation of Small-VM and Small-Shell

These programs are well documented. The installation procedure is 18 steps (about 6 or more pages long). Although the procedure is straightforward, it is tedious and requires pre-existing development tools (such as a text editor and assembler). All the assembly source code is provided and must be edited to include the addresses chosen for the location of all the parts and then assembled. The source is provided in a format compatible with Allen Ashley's PDS. Although other assembly development systems can be used (how many are there for North Star DOS?), I would not recommend trying anything other than the PDS.

Small-C

The Small-C compiler that implements a subset of the C Programming Language was described in the article "A Small C Compiler for the 8080" by Ron Cain (*Dr. Dobb's Journal*, No. 45, May 1980). The compiler supplied by Mr. Hendrix is essentially the same as the one presented by Mr. Cain, and the runtime library has all the fixes described in subsequent articles. The interface with Small-VM provides for all parameters to be specified on the command line; this avoids the question and answer interface used in the CP/M version of Small-C (distributed by the Code Works). The major contribution of Mr. Hendrix is the Standard I/O Library supplied with Small-C. The file "stdio.c" contains functions written in C that constitute a partial implementation of the standard I/O Library available with full C. The compiled I/O Library as well as the runtime library are installed in a file STDIO that can be automatically loaded by the Small-Shell boot procedure (contained in file *BOOT). With Small-VM and STDIO resident with Small-Shell, program development with Small-C is simplified. The I/O Library is available to any Small-C program by including "#include stdio.h" in the source file. The header file "stdio.h" contains the assembly EQUs for the addresses of the Standard I/O library routines. These EQU pseudo-ops are sandwiched between the #asm and #endasm statements available in Small-C. The STDIO and Small-VM modules may be loaded and linked together with an application program, or they may exist coresident with the DOS. The first approach results in a standard North Star DOS program, while the second approach produces shorter object code.

An auxiliary library is included that contains functions for integer-to-character conversions and for formatting output. Another header file "lib.h" is used to cause the linker to pull the requested functions from the compiled auxiliary function library. This technique uses the linker available in Allen Ashley's PDS to reduce the compile time.

Program development with Small-C requires the execution of the compiler, followed by running the assembler on the compiler output and then finally linking the assembler output. All these steps slow down development, and make changes to large programs costly. For example, running through this process on the source code for the Small-C compiler itself takes about 40 minutes. I understand that a second version of the compiler is now being distributed with Small-VOS. It is a major enhancement to the original compiler and includes the "extern" modifier for global declarations, making it possible to compile large programs in parts. The compiler itself may now be compiled in four parts.

Small-Tools

This package of 14 text-processing "tools" demonstrates the capabilities of the Small-VM, Small-Shell, Small-C and Standard I/O Library combination. All the programs are supplied in source code with appropriate header and include (common functions) files. It took me about 2½ hours to install (compile, assemble and link) all of the tools. As with Small-VM, the installation procedure is straightforward and well documented.

The major tools in the package are the editor, text formatter and sort program. Other tools find lines that contain a pattern (specified using regular expressing notation—UNIX style), replace occurrences of a pattern, count characters, words, etc. The power and flexibility of these tools is demonstrated by a 31-line procedure file supplied that implements a rudimentary spelling checker. The spelling checker works by taking a text file that you want to check spelling on and uses the transliterate tool to generate another file with each word on a line by itself, and with each letter converted to lower case. This file is sorted and then merged with a dictionary using an option that yields only differences, i.e., only words not in the dictionary. The editor is invoked on the difference file to allow you to note and delete any mispellings, and then the file may be merged into the dictionary. Each time the spelling check procedure is used, the dictionary grows larger. A 2,600-word seed dictionary is supplied with the spelling checker procedure. I was amazed as I watched the proce-

Small-Shell is slick and packs a lot into 2K. The programs are well documented and source code is supplied. The installation procedure is straightforward.

Small-VOS continued . . .

dure run: Temporary files are created (using I/O redirection) to hold the intermediate results, and the procedure cleans up after itself by using North Star DOS commands to delete the temporary files. Amazing!

These two packages (Small-VOS and Small-Tools) represent a significant capability that can be added to your North Star. By this time, you should expect a price of a couple hundred dollars for these packages, since you get an enhanced operating system (UNIX-like), a program development system, a word processing system and spelling checker to boot. I saved the best part for last: Mr. Hendrix is *giving* away this software—$45 for Small-VOS (includes Small-VM, Small-Shell and Small-C), and $45 for Small-Tools. So for $90 you get the whole thing! There are still bargains in software. However, you do have to put in a few hours to install it all. Again, I recommend Mr. Ashley's PDS (another $99). As I mentioned above, Mr. Hendrix is working on enhancements as well as an assembler and linker (written in Small-C) so that eventually he will have a stand-alone package available. Why wait?

Where to buy the packages mentioned here:

J. E. Hendrix
Rt. 1. Box 74-B-1
Oxford MS 38655

Allen Ashley
395 Sierra Madre Villa
Pasadena CA 91107
(213) 793-5718

HARDWARE REVIEW

Four S-100 RAM Cards

by Bill Machrone

The 2K by 8-bit low-power memory chip, both CMOS and NMOS, as offered by Hitachi, Toshiba, and others, has wrought a revolution in S-100 memory systems. It made the 64K, low-power *static* card possible. Static memory is important for two major reasons. The first is compatibility with various DMA schemes and the second is speed, translated as unrestricted CPU access. The infinitesimal power requirement of the CMOS chips compares favorably with that of dynamic RAM counterparts, although dynamic RAM density is still an order of magnitude greater. The drop in prices of thse chips (and the subsequent drop in board prices) has put multipage memory systems within reach. The multiuser operating systems and the pseudo-disk and track buffering schemes benefit directly.

The four boards reviewed here are representative of the new breed. They are: CompuPro's RAM 17, CompuPro's RAM 16, Fulcrum's Omniram 64K, and Electronic Control Technology's 64K board. Two of the boards are straight 64K by 8 bit, and two can also be configured as 32K by 16. All of them support IEEE-696 24-bit extended addressing. All can disable pieces of memory in 2K blocks for disk controllers that use a portion of high memory. They also provide IMSAI-style front panel compatibility, albeit at reduced speed. The two 16-bit boards perform the proper IEEE handshaking to permit 16-bit data transfers.

The boards

Godbout's CompuPro RAM 17 was the first of the 64K static cards to hit the market. It was actually designed before the chips were available, then released when the price of the chips was about $40 apiece. It has come down steadily in price as the chips have become more available. Board selection was well thought out from the beginning, permitting boards addressed as "global" and those addressed for individual pages of memory to be intermixed. This, combined with the high-memory deselect, makes it easy to use multiple banks of the boards to support MP/M or Oasis. The board operates solely as a 64K-by-8 memory. As with all CompuPro equipment, the board is very well made, with easily read silk-screened legends. The manual tells you just what you need to know to use the board, and no more.

The CompuPro RAM 16 is a close kin to the RAM 17, the chief difference being that it can operate as a 32K by 16 memory. The additional circuitry for a 16-bit operation necessitated a new layout of the board. A unique feature of the layout is the location of the extended addressing dipswitch. It is at the top center of the board, making it accessible without removing the board. Sixteen-bit data transfers are actually a complex issue. The board has to tell the requesting bus master whether it is capable of handling 16-bit transfers. When the transfer is made, the board must know which is the low byte and which is the high byte and route them onto the proper internal bus. The logic is handled by a PLA and a few extra TTL chips. This feature carries a slight speed penalty, which will be discussed below.

Fulcrum's new Omniram 64K memory board is the most flexible S-100 memory card I have yet seen. It does everything and does it well. Some of the features that it implements are still on other designers' wish lists: 64K-by-8 or 32K-by-16 operation, IEEE extended addressing, bank select, IMSAI front panel compatibility, MP/M-Oasis-Cromix compatibility (the Omnicram splits into 16K + 48K or 32K + 32K), and fast, cool, low-power operation.

The board itself is well made with clean, if somewhat thin, traces, premium bypass capacitors, SIP resistor packs and sockets. Address and mode selection are done via a custom PROM, which results in high speed and a low parts count. The entire set of chips that implement bank select can be removed resulting in a power savings of several hundred milliamps from your 8-volt line if you do not require the feature. The options are selected by a combination of dipswitches and shorting jumper pins. One interesting feature of the board is that in the 16-bit mode, it will refuse transfers that begin on an odd (A0 = 1) boundary. This is not part of the IEEE specifications for the bus. Granted, the 8086 will not make such a request, but this may not be the case with other 16-bit processors that will be emerging for the S-100 bus.

ECT's 64K board, the fourth board tested, is also the newest. It is an analog to the CompuPro RAM 17. As in the others the board layout and construction are excellent. It uses premium-grade dipped bypass capacitors instead of the more conventional disk capacitors, and includes a kludge area large enough for a 20-pin DIP, should you have the need. It also has an LED at the top edge that tells you when the board is selected. This can be fun to watch in a multipage system, and is helpful in verifying that the board is addressed properly. The early version that I tested had a short run of wire-wrap wire running between two return (ground) points, evidently to prevent glitching. It was equipped with Mitsubishi 2K-x-8 chips, which are NMOS parts with automatic power-down. These parts did not pass even some of the simplest

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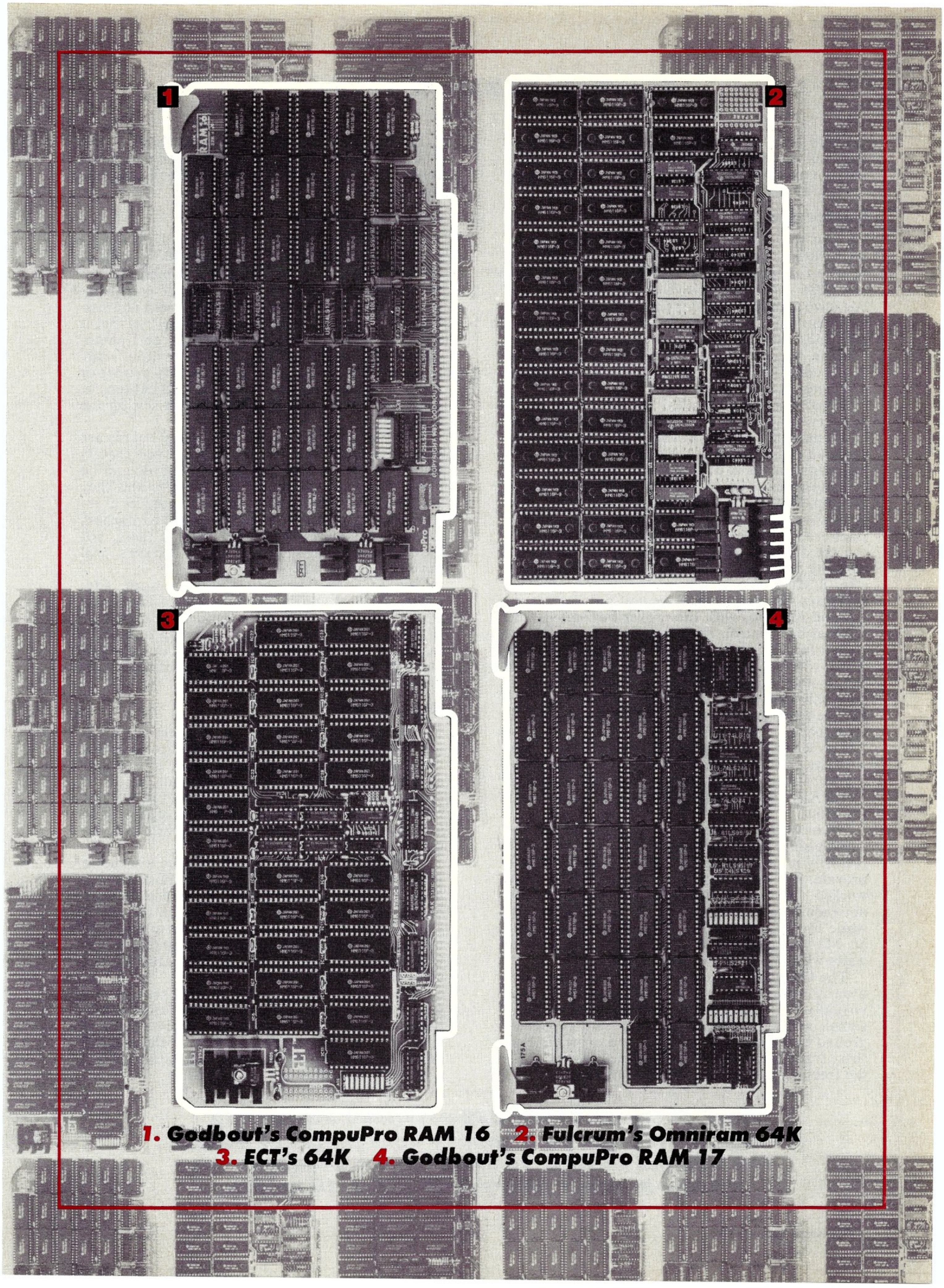


1. Godbout's CompuPro RAM 16 2. Fulcrum's Omniram 64K
3. ECT's 64K 4. Godbout's CompuPro RAM 17

memory tests, and I exchanged the board for an identical one with 200-nsec Hitachi chips. I also tested a newer revision of the board, one with larger return traces and 150-nsec Hitachi parts.

Performance

I tested the boards in every conceivable environment with a CompuPro 6MHz Z80 card and two Seattle Computer Products 8086 cards. The second 8086 was souped up to run at 10 MHz. The bus environments varied from unshielded and unterminated to fully shielded and terminated at both ends. None of the boards were sensitive to the bus environment. I used byte-transfer and DMA disk controllers with the boards and found no problems in either case.

Several of the currently available dual-width memory boards are limited in their speed when handling 16-bit transfers. This is generally due not so much to the speed of the chips as to the decoding requirements in detecting a valid memory read or write cycle on the S-100 bus. As processor speed goes up, the "window" for enabling the proper internal bus (for even- and odd-byte transfers) gets smaller and smaller. The Omniram won the speed contest. It ran at 10 MHz, needing no wait states, with the 8086, while the CompuPro RAM 16 quit after 8 MHz. Fulcrum's custom PROM takes the necessary bus lines (there are half a dozen) as input and responds with the proper bus signals and internal bus control. Even Bob Snider, a principal at Fulcrum, was surprised that the board ran at 10 MHz without wait states. The difference in the test system's performance was negligible, as it took only one wait state for the RAM 16 to run, but the speed attests to the good design of the Fulcrum board.

The RAM 17 ran at 6 MHz with no wait states with the Z80, and at 8 MHz with the 8086 doing 8-bit transfers. It required a wait state at 10 MHz. The RAM 16 required a wait state at 6 MHz with the 8086.

As mentioned above, the ECT board with the Mitsubishi NMOS devices did not operate satisfactorily in any of the environments I was able to provide, but the same board with CMOS chips worked well. The board with 150-nsec parts did not require wait states in any mode of operation, while the board with the 200-nsec parts required an M1 wait state with the 6 MHz Z80 and no waits with either of the 8086 boards.

The CompuPro boards are constructed with unusually wide power and return traces, such that virtually any area of the board that is not carrying signal or control lines is covered with copper at ground or five volts potential. I had expected that these large traces would reduce the amount of radio frequency emissions radiated by the board, but if there was a difference, it was not measurable. There were, however, fewer and smaller noise spikes on the power traces of the CompuPro boards.

Documentation

The documentation that I received with the Omniram was preliminary. It was complete in terms of the topics covered, and it included numerous sample pin and switch settings for specific configurations such as Cromix and IEEE extended addressing. The documentation was not "pretty" in that it was printed on a dot matrix printer and photocopied. The content, however, will be quite satisfactory when printed on a letter-quality printer or typeset. Neither an experienced S-100 hacker nor a neophyte will have any difficulty in setting the board up.

The manuals for the two CompuPro boards are similar to each other in that they tell you exactly what you need to know to use the boards and no more. There are precious few examples and they are "dense," in that several important pieces of information may be contained in a single paragraph, without emphasis. The information is there, but inexperienced CompuPro manual readers will have to ferret it out.

The ECT documentation is, in a word, adequate. There are no illustrations, but the manual is well organized and all of the options are explained in detail. A new engineering drawing and schematic are in preparation for revision 2 of the board and will be available by the time this article is published.

Conclusion

The Fulcrum Omniram is a state-of-the-art product for the S-100 bus. It is refreshing to see such a "mature" product introduced by a relatively new company. It packs more features than any of its competitors and is priced attractively. I would recommend it to anyone who is thinking of moving to a 16-bit system in the near future, or who is building one now.

The RAM 17 and RAM 16 are true workhorse memory boards. There are probably more of them in service than all other 64K static boards combined. They are the standard by which the others are to be compared, both for features and performance. The RAM 16 compares favorably to the Omniram if you don't need all the features available on the latter.

The ECT 64K has come on the market at a very good price and promises to give the more established boards some competition. Although there are copies of this board in use with the NMOS parts that are apparently operating satisfactorily, I would recommend the CMOS parts.

They all support IEEE-696 extended addressing and can disable 2K blocks to accommodate ROM. The CompuPro RAM 16 and Fulcrum Omniram can operate in either 64K-x-8 or 32K-x-16 modes.

Four RAM Cards continued . . .

The reliability of these new memory chips and boards is legendary. Once you have found the features your system requires, shop for price. You won't go wrong with any of the ones reviewed here.

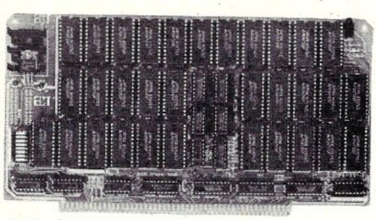
Prices

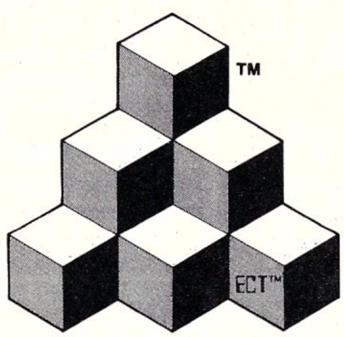
RAM 16 A&T, $650
RAM 17 48K, $549; 64K, $599 A&T
CompuPro Division,
Godbout Electronics
Oakland Airport, CA 94614
(415) 562-0636

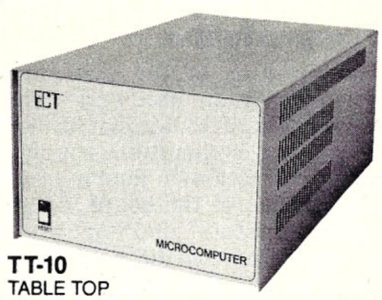
Omniram 64K, $425
Fulcrum
1771 Junction Ave.
San Jose, CA 95112
(408) 295-7171

ECT 64K RAM, $399
Electronic Control Technology
763 Ramsey Ave.
Hillside, NJ 07205
(201) 686-8080

Bill Machrone is a systems designer with wide experience in putting business applications on mainframes, minis, and micros. His special interest is database management systems for micros—doing a big job on a small machine.







HARDWARE REVIEW

The Memory Merchant 16K Static RAM Board

by Andrew L. Bender

I had always been bothered by the fact that my home system had a 2K area of unaddressable memory because the Micromation Doubler (double-density disk controller) was memory-mapped and occupied the entire upper 2K of memory. This left me with 2K of memory below the Doubler which I couldn't address because none of my 16K boards could be configured to fill this space. Others, I know, have similar problems.

Flipping through one of the computer magazines, I spotted a full-page advertisement for the Memory Merchant 16K Static RAM. Reading on, I noted that the board comprised four 4K blocks and that one of those blocks could have single or multiple 1K segments disabled at any time. I felt this would be a good solution.

I called a WATS number and ordered the board, which arrived a couple of weeks later. The board came packed in an outer wrapping of sealed-air material and an inner sleeve of plastic. There was a buff-colored manual that pronounced, in typical salesperson terms, that the board was "without a doubt the most versatile board on the market today." Several more paragraphs of sales pitch formed the introduction to the manual, but the last was the most important, because it said that for six months there was a "no hassle, warranty exchange program designed to keep your system running." Recent advertisements indicate that the warranty program has been extended to 18 months, which makes it one of the best in the S-100 line at this time and the best for this price.

Documentation

Documentation of the features of the board is based heavily on hardware diagrams, so if you don't have a little familiarity with hardware you will find the explanations rough going. As an example, the section on memory addressing uses the logical design of the board, complete with talk of "pull-up resistors" and "open-collector wired-OR circuitry," to describe how the address switches should be set. But once you get the manual decoded, you will be rewarded by seeing that the board is quite flexible—if you don't speak TTL, find someone who does and get him to help you. The example of memory addressing on page 6 and the table on page 5 are helpful in setting the address switches.

Unfortunately, although the legend "IEEE-696/S-100" appears on the top of the cover page of the manual, no reference to the standard is made in the manual, nor are any timing diagrams included that would allow anyone to determine if the board is in strict compliance with the standard. However, I can tell you that it will work in an Altair 8800b, IMSAI 8080, or an IMSAI with an Ithaca Intersystems Rev. 1.4 Z80 CPU card running either at 2 MHz or at 4 MHz.

Andrew L. Bender, M.D., Neurological Services, Inc., 336 Center Avenue, Westwood, NJ 07675

Bus control options

The memory board can be made to disappear from the address space if the PHANTOM* line on the S-100 bus (pin 67) is pulled low. This phantom feature is necessary with certain bootstrap hardware which requires that the hardware seize control of the address space where RAM would normally be present. Examples of this are the Tarbell or Cromemco disk controllers.

Another feature allows the board to generate its own MWRITE signal. In the older, front-panel S-100 computers, PHANTOM* was generated by the front-panel logic and fed onto the bus. The newer computers may or may not generate this signal, so Memory Merchant farsightedly included the logic for generating it right on their memory board. The switch position for MWRITE is labeled "STROBE," which I don't care for; it should be called MWRITE because that is what it is. Another option, switch-selectable, allows the board to disappear from the address space on power-up. This is a special kind of phantom which is selected when the PWRSET switch is on. If normal operation is desired, PWRSET should be off and PWRCLR should be on.

Extended addressing operation

The board contains the logic to allow for the first-generation type of extended addressing known as "bank select." In this technique, the board is selected by means of an output operation that puts on the data bus a byte with one bit (selected by the user) set; the board recognizes this bit as a "select" for the 64K bank containing the board. In order to accomplish this, the board contains a row of eight select lines and a jumper plug to allow the jumpered bit to be the select code for this board. Another DIP switch sets the I/O address for the board.

Bank select was the extended addressing technique prior to the advent of the IEEE-696 standard, but now there is a new method of address selection—we just add more lines to the address bus. If you are using the extended lines, you must remove two chips from one area of the board and insert them in another. This disables the bank-

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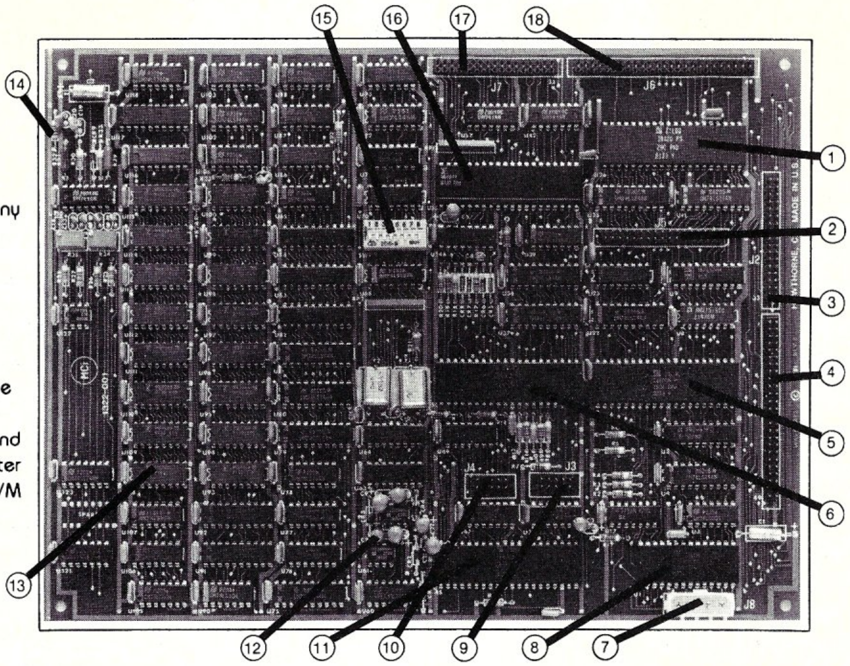

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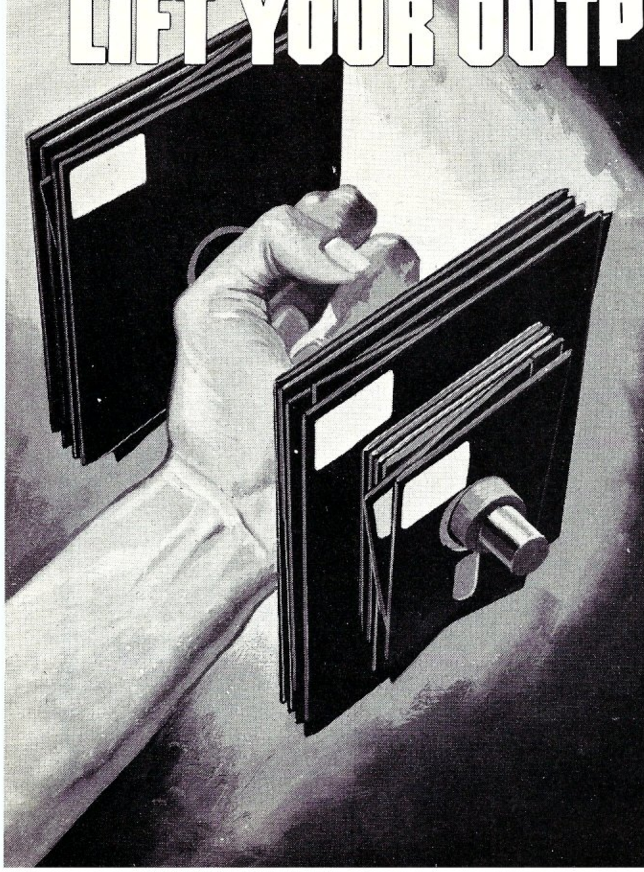

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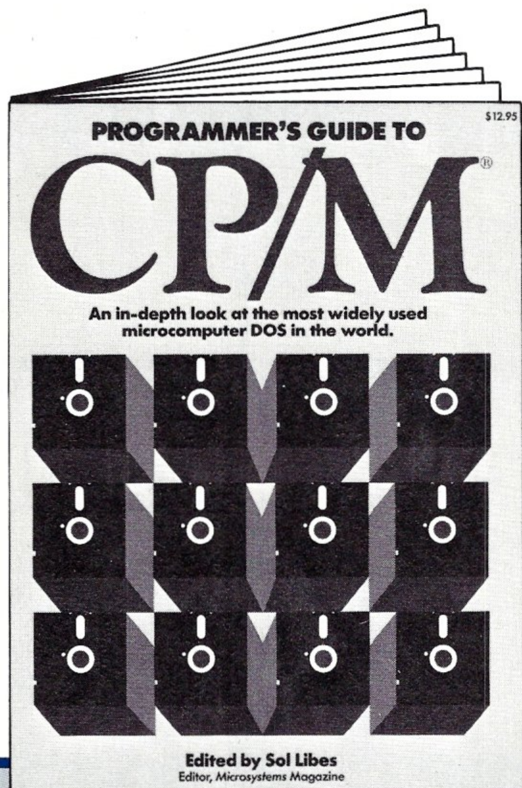

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select feature and enables extended addressing according to the IEEE-696 standard. I couldn't test either feature, since I have a single-bank system.

Segment selection

One 4K block can be disabled in 1K segments by means of a DIP switch that enables or disables any 1K segment in this particular block. Since each 4K block can be located on any 4K boundary in memory, having only one block that can be disabled in 1K segments is no drawback. I used this feature and it worked properly.

Physical construction

The board is neatly constructed with a recent generation of TTL logic. It's nice to see all the part numbers silk-screened on the board, which is uncluttered in layout and, with the exception of incorrect silk-screen part numbers in two locations, well done. Unfortunately, there are no card ejectors on the board, and I consider this a drawback. Card ejectors add little to the cost of a board. They are a big help in getting a board out of a crowded cabinet, making it easy on my fingers, which are easily torn up by the soldered leads on the pc side of the board. Most of the chips on the board were manufactured by American semiconductor firms—a departure from the past.

Conclusion

The Memory Merchant MM16K14 static RAM board is a bargain-priced board that performs well at 4 MHz and 2 MHz. The documentation is not sufficient to allow a total novice to use every feature of the board easily, but does explain in great detail exactly how the board works. With a little study and some help, anybody could learn to use the board. The principal features are extended or bank-select addressing, phantom capability on power-up or phantom line assertion, optional onboard MWRITE signal generation, and a 4K block with individually controlled 1K segments.

Statements regarding compliance with the IEEE-696/S-100 standard are notably absent from the text. The advertisements do not state that the board is compatible or include any of the other euphemisms for "Well, it looks like it, but it really isn't it." Since the board will operate only up to 5 MHz it is, in this aspect alone, not in compliance. The warranty is excellent.

The board is manufactured by Memory Merchant, 14666 Doolittle Drive, San Leandro, CA 94557. It is distributed and discounted by a large number of retailers, judging from recent advertisements in several popular computing magazines. The price is $169 and the company will ship within 48 hours after receipt of order.

Andrew L. Bender is a practicing physician specializing in neurological diseases. He has over 20 years' experience in assembly language programming, and is designing a database for seizures and epilepsy. He likes kids, cats, and Bach, but not necessarily in that order.

HARDWARE REVIEW

Semidisk

Eliminate those disk access delays with a virtual disk system

by Bill Machrone

Semidisk is an S-100 card with 512K of dynamic RAM, specifically designed to emulate a CP/M disk drive. It comes with support software, including a self-installing driver that relocates itself under the CCP. The driver software can also be built into your current BIOS, which offers several advantages.

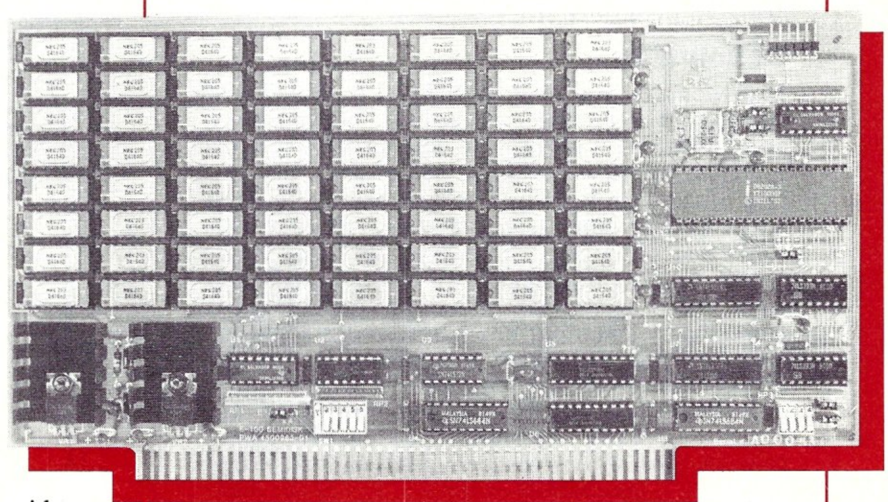
Experience may not be such a good teacher, for when I received the Semidisk I immediately plugged the card into my system, put the software disk into my B drive, and looked at the directory. I found a file called "SEMIDISK.COM" and executed it. The program announced that it was clearing memory and that I had a new drive E. I did a STAT on it and found that I had 504Kbytes free. Nothing could have been easier. By all past experience, plugging in a foreign card and running unknown software should have crashed the machine, wiped out the system tracks on my A drive, and run the head into the stops for good measure. So much for past experience. Sometimes it pays to live dangerously.

I then PIPed a few files to the Semidisk and got my kicks watching them execute instantly. Next, I popped Semidisk's floppy out of my B drive and put in one of my double-density disks with a big file on it that I would try sorting in Semidisk for a speed comparison. I typed ^C and went to read the directory. "BDOS ERR ON B: BAD SECTOR," said my system. I stopped to look at the manual.

It turned out that the Semidisk software running at the top of my TPA was blocking the warm boot action so that it would not be overwritten and disconnected from my BIOS. In my reading, I also found that I could disable this feature and enable the Semidisk software to reread itself from my A drive each time I warm-booted. For that matter, I could also set a whole host of options that I didn't understand, considering that I hadn't read the manual thoroughly.

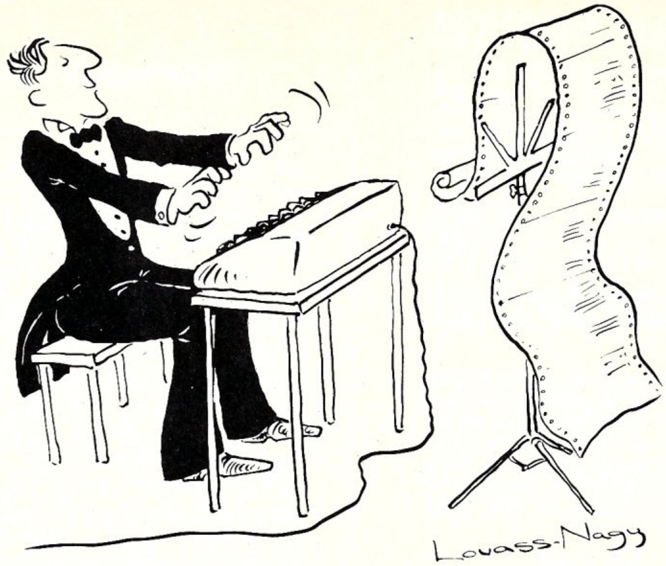
As I read more about it, I was at first disappointed to learn that the Semidisk's 512K is not in the processor's memory map and that data to be stored or retrieved are passed through a port. I had been running the CompuPro/G&G Engineering Warp Drive whenever I had a few spare 64K boards sitting around, and the drivers were already in my BIOS. The Semidisk, I thought, would make a nice addition to what I already had. As it turns out, there is no need for the 512K to be memory resident and, indeed, the port-addressed design is a wiser choice. It robbed me, however, of the ability to brag that I had a half-megabyte system on my desk.

As I continued to read, I found all manner of nice surprises. The software drivers are utterly configurable, so that they can be located above CP/M or integrated into the BIOS. All source code is provided on the disk that comes with Semidisk. There are suggestions on how to make it faster(!) using Z80 block I/O instructions. There is also a nice discussion of why the design choice was made to access the memory through I/O ports rather than extended addressing. After comparing the Semidisk with the extended-address based Warp Drive, I agree with their choice. Port I/O is just plain faster than selecting alternate pages of memory and flipping bytes back and forth through the processor's registers. It is also easier to implement on most machines. Finally, the dynamic RAM chips that make up the 512K are much more compact and cheaper than the equivalent static chips that would be necessary for a Warp Drive implementation. Just in case you were going



S-100 Semidisk 512K dynamic RAM card, serving as a virtual disk. (Photo courtesy of Semidisk.)

Bill Machrone, P.O. Box 291, Fanwood, NJ 07023



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You don't realize, though, just how fast a Z80 can move data around until you PIP a big file from one virtual disk to another. In this case, I went from the Warp Drive (CompuPro calls it M-Drive) to the Semidisk and back again. Both appeared as fast to the naked eye, but the Semidisk won out in objective, timed comparison tests. Also, normally disk-intensive operations like full file sorts become trivial, dropping from minutes to mere seconds in execution time. Even if you count the time it takes to load and unload the Semidisk and store things permanently on a floppy, you are still miles ahead. Even hard disk cannot match it in speed. It was a joy to do binary searches in Basic and indexed searches as with dBASE II: the results were instantaneous. Similarly, having WordStar's overlay and message files on the Semidisk made it seem as though all of WordStar was memory resident. (I guess it was.)

You may have noticed that there were only 504K free of the 512K on the card. In addition to the reserved "tracks" for the directory (128 entries) there is a reserved area for checksum bytes, one per "sector." The checksums work exactly the same way they would on a disk and offer the same protection against soft errors and, in this case, failing memory chips. One of the software utilities supplied with the Semidisk is a memory test, again, with source code. The Semidisk I used remained solid throughout the test period. There is also a battery backup connector on the board, with provisions to trickle-charge a nicad or gel cell battery whenever the system is on.

The Semidisk memory board also has a lot of potential that is unrealized at this point. It would be a good track-buffering host for TurboDos or one of the other "high speed" CP/M lookalikes. MP/M could also benefit from its speed, but the routines would have to be incorporated into the system's XIOS, unless some software wizard can figure a way to put its driver software into an RSP.

In summary, there was nothing I didn't like about the Semidisk except, perhaps, the price. Not that $1,995 is too much for a 512K disk that does everything instantly, but I hope that falling component prices and free market competition bring the price down so that it will be in reach of more people. This kind of performance is addictive.

Available from: **Semidisk**
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Bill Machrone is a systems designer with wide experience in putting business applications on mainframes, minis, and micros. His special interest is database management systems for micros—doing a big job on a small machine.

A DMA Adapter

by John M. Potochnak

Type-ahead is a birthright. One of my first modifications to CP/M was to implement it. Type-ahead requires processing the console key-pressed interrupts and buffering the characters received. Unfortunately, my disk controller is of the programmed I/O variety, in which the disk controller software disables interrupts during transfers to avoid overruns. A full rotation of the diskette could be required before the desired sector was over the read head. For 8″ diskettes, as much as one-sixth of a second could lapse with interrupts off. If more than one character was typed during this interval, those additional characters would be lost.

I lost about one character out of six if I typed while disk I/O was in progress. Clearly something had to be done. One possibility was to type slowly during disk accesses. I found this frustrating. Another was using a separate S-100 board to handle the disk controller. I dismissed this as excessively expensive both in design time and materials. The solution I chose was to have a small adapter board with a Z80 CPU chip, a Z80 DMA chip, and one 74LS09. This board would plug directly into the Z80 CPU chip socket on my processor board.

This solution has a very low cost factor (very important), and since the CPU and DMA chips were designed to work together, it was easy to design and build. This design also permits the DMA controller to use on-board memory mapping hardware and I/O devices.

The adapter board I built is designed to work with an SD Systems SBC-200 CPU board. It makes use of an I/O device select signal that is unused by the SD hardware. If you want to use this adapter on another CPU board, you may have to include additional hardware to decode the I/O port address of the DMA chip.

The adapter has four wires that connect it to the CPU board. One is device select (CE), another is the ready line (RDY) from the DMA chip, the last two link the DMA chip into the interrupt chain so that vectored interrupts are possible. All other connections are made through the CPU socket.

On the right side of the schematic, the four wires at the top are the ones that come from the adapter board and go to points on the CPU board. The IC numbers and pins specified there are for the SBC-200 CPU board. These connections will allow for vectored interrupts and will give the DMA chip the I/O port address 70H. Actually, the chip will respond to addresses 70H through 73H, since I did not bother to discriminate further in addressing.

John M. Potochnak, 106 Birchwood Terrace, Wayne, NJ 07470

Building the DMA adapter

I made the adapter using a small piece of perf board on which I glued three wire-wrap sockets: two 40-pin sockets for the CPU and DMA chips, and one 14-pin socket for the 74LS09. I then wire-wrapped as many of the connections as possible. From the schematic you can see that most of the Z80 CPU's pins go straight through to the S-100 board's socket. I cut those of the CPU's wire-wrap socket pins which did not go through and then soldered the rest to a 40-pin DIP plug. The three connections that did not go through were then soldered in place.

After the board is constructed, but before any of the four wires have been connected, the board can be tested. Tie the DMA's RDY line to +5 V. Plug in the board in place of the CPU chip. Make sure your machine performs properly with the board in place.

Obtain a copy of the Zilog document entitled "Z80-DMA Direct Memory Access Controller." This document has a good example in it. Use the document to program the DMA chip to do a memory transfer. I transferred 1K of data from my BIOS to low memory. If this works, you are probably all set. Connect the four wires from the adapter to the appropriate points on your CPU board. I soldered the wires in place on my S-100 board and terminated them in a 4-pin socket. The mating plug is mounted on the adapter board. This makes it easy to remove the adapter board.

I connected the RDY line to V7 on the S-100 bus. I then connected DRQ (data request) ANDed with INTR (interrupt request) on my disk controller to VI7*(pin 11). This allowed the DMA to respond in byte-at-time mode to the floppy disk controller's data requests. Now it is no longer necessary to turn off interrupts during floppy disk I/O, and consequently I no longer lose typed-ahead characters.

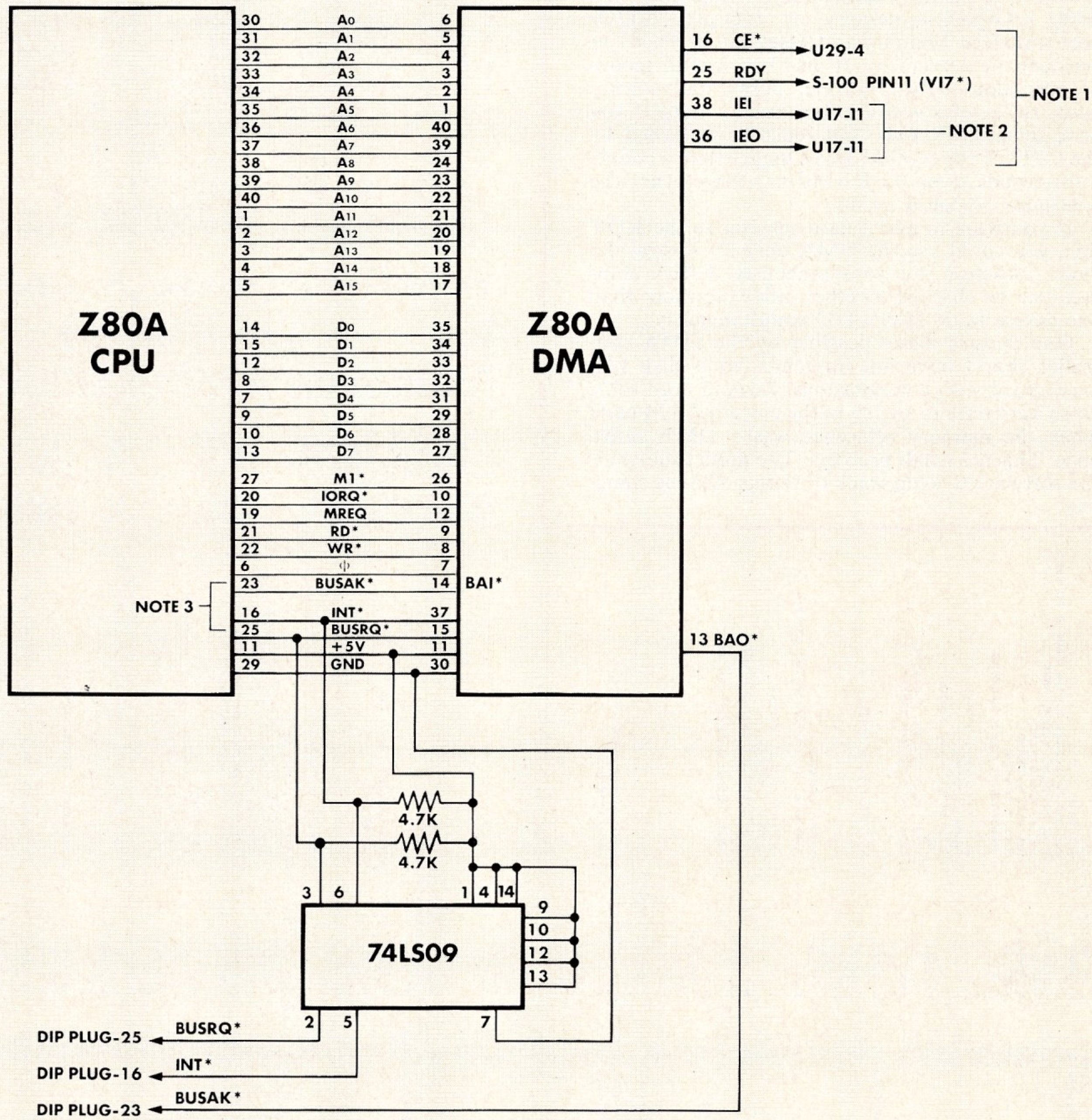
I have included code segments that show the with/without DMA portions of my BIOS. Start at the label RDSC to read a sector or WRSC to write a sector. The code in the DODMA conditionals is assembled and reflects the use of the DMA adapter. Where DODMA = 0 appears, you can see how the I/O would be done without the adapter.

One problem I ran into was that I could not read status from the DMA chip while it was transferring without messing it up. This means that you must implement end-of-block interrupts so you can tell when the transfer is complete. I used a very simple scheme where a byte was set nonzero and the I/O was started. The code then loops, waiting for that byte to go to zero. The vectored interrupt on end-of-block from the DMA simply zeros the byte.

The schematic (see Figure 1) shows all the parts I used: three chips, two resistors, three wire-wrap sockets, and one dip plug. I measured the current being drawn by the SBC-200 CPU board in stock form; its regulator had plenty of reserve capacity to support the two additional chips. You should probably check this for other CPU boards, as the Z80A-DMA chip draws 200 ma.

Be sure to get the right part. The Z80A-DMA is required if you have a 4 MHz CPU—the "A" indicates 4 MHz. Shop around for the DMA chip. I found that prices ranged from about $15 to almost $50. I spent less than $30 for everything. That's quite cheap for the functionality you get.

I got a copy of the Z80-DMA document from a



NOTE 1: Off-board connections shown for SD SBC-200 CPU board.
NOTE 2: IEI—pin bent out on U17 and connected to IEI.
IEO—connected to empty slot caused by bent-out pin above.
NOTE 3: Not through on dip plug.
NOTE 4: On Versafloppy II—U16-8 connected to S-100 PIN11 (VI7*).

Figure 1. Z80 DMA Adapter Circuit For SD Systems SBC-200 CPU Board

friend who has a TRS-80 Model II. This machine uses several of the Zilog LSI chips and therefore includes the spec sheets for those chips in the back of its technical manual.

You should realize that this DMA controller is not restricted to doing only disk I/O. The Z80-DMA has the ability to simulate a memory or I/O port reference on either of its two ports. This allows it to do memory-to-memory, memory-to-I/O-port, I/O-port-to-memory or I/O-port-to-I/O-port transfers. Memory addresses can be fixed, increment, or decrement. It also has several modes of operation: byte-at-a-time, burst, and continuous. Be careful with the continuous mode if you have dynamic RAMs that must be refreshed by the CPU. If the transfer takes longer than a couple milliseconds, dynamic RAMs may forget when the continuous mode is used.

If you were to add a data selector to the RDY line, you could use the DMA chip for several devices, although not simultaneously. DMA chips can also be chained together, allowing more than one device to do DMA I/O simultaneously.

One feature made possible by the DMA controller that I have not implemented is disk I/O overlapped with computations. I would need some extra hardware to switch in the correct RAM bank when the memory reference was a DMA reference. This is a small problem. The main problem is the software to keep track of things. Maybe someday. . . .

```
                 DO DISK IO INTO THE APPROPRIATE RAM BANK

                  IF DODMA=0        ; IF NOT DMA DISK IO
                 RDSCCB: LD         A,(BANK)          ; GET BANK
                         DI                           ; MAY NOT HAVE IRPS DURING PROG'D IO XFER
                         LD         (CBANK),A         ; NOTE REIGNING MEMORY BANK
                         OUT        (MB),A            ; SET AS APPROPRIATE
                         LD         A,(CMDSV)         ; THE READ COMMAND
                         OUT        (CMD),A           ; OUTPUT COMMAND
                         LD         A,B               ;; REMEMBER 512 BYTE SECTORS
                         JR         2
                         JR         2                 ; WAIT FOR STATUS UPDATE
                         INIR                         ; INPUT A SECTOR
                         OR         A                 ;; SEE IF 512 BYTE SECTORS
                         JR         NZ,RAM1           ;; NO
                         INIR                         ;; YES, READ ANOTHER 256 BYTES
                         JR         RAM1              ; DONE, BACK TO RAM BANK )

                 WRSCCB: LD         A,(BANK)
                         DI                           ; NO IRPS DURING XFER
                         LD         (CBANK),A
                         OUT        (MB),A
                         LD         A,(CMDSV)
                         OUT        (CMD),A           ; OUTPUT COMMAND
                         LD         A,B               ;; REMEMBER 512 BYTES/SECTOR (MAYBE)
                         JR         2
                         JR         2                 ; WAIT FOR STATUS UPDATE
                         OTIR                         ; OUTPUT A SECTOR
                         OR         A                 ;; CHECK FOR 512 BYTE SECTORS
                         JR         NZ,RAM1           ;; NO
                         OTIR                         ;; YES, OUTPUT ANOTHER 256 BTES
                 RAM1:   LD         A,1
                         LD         (CBANK),A
                         OUT        (MB),A
                         EI
                         RET
                  ENDIF             ; END IF DODMA=0

                 ; XFER DATA FROM/TO DE-BLOCKING BUFFER TO/FROM BANK 0 RAM
F73B  AF         DOLDIR: XOR        A                 ; SET MEM BANK 0
F73C  F3                 DI
F73D  32D9FC             LD         (CBANK),A
F740  D3FF               OUT        (MB),A
F742  FB                 EI
F743  EDB0               LDIR                         ; MOVE DATA
F745  3E01               LD         A,1               ; BACK TO BANK 1
F747  F3                 DI
F748  32D9FC             LD         (CBANK),A
F74B  D3FF               OUT        (MB),A
F74D  FB                 EI
F74E  C9                 RET

                  IF DODMA          ; IF DMA DISK IO
                 ; HERE ON END-OF-BLOCK INTERRUPT FOR DMA DISK IO
F74F  F5         DMAINT: PUSH       AF
F750  AF                 XOR        A
F751  32D5FC             LD         (DMAFLG),A        ; SET END-OF-BLOCK SEEN
F754  3EC3               LD         A,0C3H            ; STOMP DMA
F756  D370               OUT        (DMA),A
F758  F1                 POP        AF
F759  FB                 EI
F75A  ED4D               RETI                         ; RETURN TO MAINLINE

                 ; USE DMA TO DO DISK IO INTO APPROPRIATE MEMORY BANK
F75C  3AD8FC     DOIOCB: LD         A,(BANK)          ; RAM BANK TO DO THIS IO INTO
F75F  32D9FC             LD         (CBANK),A         ; REMEMBER CURRENTLY REIGNING RAM BANK
F762  D3FF               OUT        (MB),A            ; SET RAM BANK
F764  3ACDFC             LD         A,(CMDSV)         ; GET DISK CONTROLLER COMMAND
F767  D364               OUT        (CMD),A           ; START THE DISK CONTROLLER
F769  FB                 EI
F76A  210000             LD         HL,0              ; LONG TIME OUT
F76D  3AD5FC     DMAWT:  LD         A,(DMAFLG)        ; NON-ZERO IF END-OF-BLOCK INTERRUPT
F770  B7                 OR         A                 ;  HAS NOT OCCURRED YET
F771  2818               JR         Z,ENDRM1          ; INT ON END-OF-BLOCK OCCURRED
F773  2B                 DEC        HL
F774  7C                 LD         A,H
F775  B5                 OR         L                 ; ELSE DECREMENT TIMER FOR IO OPERATIONS
F776  20F5               JR         NZ,DMAWT
F778  3E01               LD         A,1               ; BACK TO RAM 1 ON TIMEOUT
F77A  F3                 DI
F77B  32D9FC             LD         (CBANK),A         ; REMEMBER CURRENT RAM BANK
F77E  D3FF               OUT        (MB),A
F780  FB                 EI
F781  CDCCAB             CALL       $STOMP            ; INSURE DMA CHIP IS DEAD ON TIMEOUT
F784  AF                 XOR        A
F785  32DBFC             LD         (DOSTAT),A        ; JUST NIX STAT LINE ON ERROR
F788  C3FCAA             JP         TIMOUT            ; TIME OUT ERROR
```

```
F78B  3E01       ENDRM1: LD         A,1               ; BACK TO RAM 1
F78D  F3                 DI
F78E  32D9FC             LD         (CBANK),A         ; REMEMBER CURRENT RAM BANK
F791  D3FF               OUT        (MB),A
F793  FB                 EI
F794  3ADBFC             LD         A,(DOSTAT)        ; SEE IF MUST DO DELAYED STAT LINE
F797  B7                 OR         A
F798  CA7EAA             JP         Z,END             ; NO, JUST DO END-OF-XFER PROCESSING
F79B  E5                 PUSH       HL                ; ELSE PRESERVE HL AND
F79C  CD2DA2             CALL       $STATLN           ;  DO STATUS LINE
F79F  FB                 EI                           ; $STATLN DISABLES INTERRUPTS
F7A0  E1                 POP        HL
F7A1  AF                 XOR        A                 ; STAT LINE OUTPUT, CLEAR REQUEST FOR IT
F7A2  32DBFC             LD         (DOSTAT),A
F7A5  C37EAA             JP         END               ; PROCESS END-OF-XFER
                  ENDIF             ; END IF DMA DISK IO

                 ; READ A SECTOR
AA41  CD30AB     RDSC:   CALL       DRINIT            ; INITIALIZE DRIVE
AA44  3E88               LD         A,RDCMD           ; READ COMMAND
AA46  CD54AA             CALL       STSDBT            ; SET SIDE BIT
AA49  2A82AC             LD         HL,(DDADDR)       ; SET TRANSFER ADDR
AA4C  32CDFC     RDSC0:  LD         (CMDSV),A         ; NOTE COMMAND TO PERFORM
                  IF DODMA=0        ; IF NOT DMA DISK IO
                         CALL       RDSCCB            ; GO TO TOP 16K IN CASE RAM BANK 0 READ
                         JR         END
                  ENDIF             ; END IF NOT DMA DISK IO
                  IF DODMA          ; IF DMA DISK IO
AA4F  CDA9AB             CALL       SETDCP            ; DO COMMON SETUP OF DMA FOR READ/WRITE
AA52  1820               JR         DOIO              ; START IO AND WAIT FOR END-OF-BLOCK
                  ENDIF             ; END IF DMA DISK IO

AA54  67         STSDBT: LD         H,A               ; SET UP SIDE BIT IN COMMAND
AA55  3AC8FC             LD         A,(SIDE)          ; SIDE WE WANT
AA58  E601               AND        1                 ; CHECK FOR SIDE 2
AA5A  7C                 LD         A,H               ; GET BACK COMMAND
AA5B  C8                 RET        Z                 ; IF SIDE 1, JUST RETURN
AA5C  CBCF               SET        1,A               ; ELSE SET SIDE 2
AA5E  C9                 RET
```

DMA Adapter continued . . .

```
                       ; WRITE A SECTOR COMMAND
AA5F  CD30AB     WRSC:    CALL   DRINIT             ; INITIALIZE DRIVE
AA62  3EA8                LD     A,WRCMD            ; WRITE SECTOR COMMAND
AA64  CD54AA              CALL   STSDBT             ; SET SIDE BIT IN COMMAND
AA67  2A82AC              LD     HL,(DDADDR)        ; SET XFER ADDRESS
AA6A  32CDFC              LD     (CMDSV),A
                  IF DODMA=0     ; IF NOT DMA DISK IO
                          CALL   WRSCCB             ; WRITE SECTOR FROM APPROPRIATE
                                                      MEMORY BANK
                  ENDIF          ; END IF NOT DMA DISK IO
                  IF DODMA       ; IF DMA DISK IO
AA6D  CDA9AB              CALL   SETDCP             ; SET UP FOR DMA XFER
AA70  0602                LD     B,2                ; SWAP DIRECTION FROM READ
AA72  EDB3                OTIR                      ;  BY SENDING MORE GOODIES TO DMA CHIP
AA74  3E87       DOIO:    LD     A,87H              ; ENABLE DMA
AA76  32D5FC              LD     (DMAFLG),A         ; NON-ZERO SAYS DMA BUSY
AA79  D370                OUT    (DMA),A            ;  (INT ON END-OF-BLK WILL CLEAR DMAFLG)
AA7B  C35CF7              JP     DOIOCB             ; DO IO INTO CORRECT RAM BANK
                  ENDIF          ; END IF DMA DISK IO

                 ; END OF COMMAND PROCESSING FOR SEEK/READ/WRITE
AA7E  CDEDAA     END:     CALL   WAIT
AA81  DB64                IN     A,(STATUS)         ; UNIT STATUS
AA83  57                  LD     D,A
AA84  3A88AC              LD     A,(ERMASK)         ; THESE ARE ERRORS TO WATCH FOR
AA87  A2                  AND    D                  ; CHECK FOR ERRORS
AA88  C8                  RET    Z                  ; NO ERRORS, GOOD RETURN
AA89  7A                  LD     A,D
AA8A  3289AC     END2:    LD     (ERSTAT),A         ; SAVE ERROR BITS
AA8D  CDDDA9              CALL   DELAY
AA90  F601                OR     1                  ; SET NO GOOD
AA92  ED7B8AAC            LD     SP,(SPSV)
AA96  3EFF                LD     A,0FFH
AA98  3291AC              LD     (UNITCK),A         ; FORCE DRIVE SETUP
AA9B  C9                  RET

                 ; DO COMMON DMA SETUP FOR READ/WRITE
                  IF DODMA
ABA9  F3         SETDCP:  DI                        ; NO IRP HERE
ABAA  22BBAB              LD     (DMABA),HL         ; STORE XFER ADDRESS
ABAD  ED43BDAB            LD     (DMABC),BC         ; STORE BYTE COUNT
ABB1  21BAAB              LD     HL,DMAINI          ; STANDARD INIT BYTES FOR DMA
ABB4  017010              LD     BC,DMALEN*100H+DMA ; B:=COUNT OF BYTES, C:=DMA
                                                      PORT ADDRESS
ABB7  EDB3                OTIR                      ; INITIALIZE DMA CHIP FOR THIS XFER
ABB9  C9                  RET

                 ; DMA INITIALIZATION BYTES
ABBA  79         DMAINI:  DEFB   79H                ; BLK ADDR UPPER/LOWER, BYT CNT
                                                      U/L FOLLOWS
ABBB  0000       DMABA:   DEFW   0                  ; BLOCK ADDR U/L
ABBD  0000       DMABC:   DEFW   0                  ; BYTE COUNT U/L
ABBF  8B                  DEFB   8BH                ; CLEAR END-OF-BLOCK STATUS
ABC0  14                  DEFB   14H                ; ADDR INCREMENTS, 'A' PORT IS MEMORY
ABC1  68                  DEFB   68H                ; SET CYCLE LEN, 'B' PORT IS IO,
                                                      FIXED ADDR
ABC2  C4                  DEFB   0C4H               ; NORMAL TERMINATIONS, LONG IO
                                                      CYCLE LENGTH
ABC3  95                  DEFB   95H                ; BYTE MODE, INT CONTROL, IO ADDR
ABC4  67                  DEFB   DATA               ; THE FLOPPY'S DATA PORT
ABC5  12                  DEFB   12H                ; VECTOR, INT ON END-OF-BLOCK
ABC6  50                  DEFB   IVCTC.AND.0FFH     ; LSB DMA INT VECTOR
ABC7  82                  DEFB   82H                ; RDY ACTIVE LOW
ABC8  CF                  DEFB   0CFH               ; LOAD ADDRESSES, RESET COUNTER
ABC9  AB                  DEFB   0ABH               ; ENABLE INTERRUPTS
>0010            DMALEN   EQU    $-DMAINI           ; THIS MUCH REQUIRED FOR READ
                                                      FROM FLOPPY
ABCA  05                  DEFB   05H                ; SWAP XFER DIRECTION FOR FLOPPY WRITE
ABCB  CF                  DEFB   0CFH               ; LOAD ADDRS, RESET COUNTER
                  ENDIF          ; END IF DMA DISK IO

                 ; MAKE SURE DMA CHIP IS IDLE
>ABCC            $STOMP:
ABCC  3EC3                LD     A,0C3H             ; RESET DMA CHIP
ABCE  D370                OUT    (DMA),A            ; MAKE SURE CHIP IS GOOD AND DEAD
ABD0  D370                OUT    (DMA),A            ;  COULD BE IN FUNNY STATE,
ABD2  D370                OUT    (DMA),A            ;  SO WE MUST ASSUME WORST CASE
ABD4  D370                OUT    (DMA),A
ABD6  D370                OUT    (DMA),A
ABD8  D370                OUT    (DMA),A
ABDA  C9                  RET
```

What To Do about CP/M's "Syncronization Error"

SYSGENing CP/M version 2.2 from version 1.4

by Kelly Smith

Question: How in the #*@%! do I SYSGEN CP/M version 2.2 on my CP/M 1.4 system when using its MOVCPM (to generate a new system image), and the &%#"*@ thing keeps coming back with SYNCRONIZATION ERROR, and then promptly HALTS!"

The problem

Those clever people at Digital Research have embedded the serial number (issued to *you*, I hope!) in MOVCPM.COM, to discourage the "rip-off" of CP/M by someone other than the rightful owner. . . . When MOVCPM is executed, it looks for a match of its serial number to that of the host system (your CP/M version 1.4) as it appears in your system memory, detects that a "mismatch" has occurred, and promptly locks up your computer. . . . *Argh!* "You mean I have to write that crummy "GETSYS" and "PUTSYS" stuff to SYSGEN from 1.4 to 2.2 ???" we ask ourselves. . . .

The solution

Fake-out #1 . . . Your CP/M version 2.2, as supplied by Digital Research, is SYSGEN'd for a 20-kilobyte Intel MDS 800 system. . . . So, write a 20-kilobyte BIOS (and BOOT loader), then do as follows to get a 20-kilobyte CP/M 2.2 system image:

A>B:<cr> <--- Switch from A (CP/M 1.4) to B (CP/M 2.2)
B>SYSGEN <--- Use CP/M 2.2's SYSGEN to get a system image
SYSGEN VER 2.0
SOURCE DRIVE NAME (OR RETURN TO SKIP)B<--- Get it . . .
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)<cr> <--- Return
A>SAVE 34 B:CPM20.COM <--- Save the CP/M 2.2 system image

OK, now SYSGEN normally on the B drive, with your 20-kilobyte BIOS (and BOOT loader, of course).

Fake-out #2 . . . Ah hah, so this is *not* your copy (I know, you're doing this for a friend . . .) of CP/M version 2.2, and it's been SYSGEN'd for something *other than* a 20-kilobyte system. . . . Double *argh!* All is not lost, however. Just follow the (less than simple) sequence that follows using the MOVPATCH.ASM file that is listed after the SYSGEN sequence. . . . A word of *caution*, however! Some implementations of MOVCPM.COM *not directly supplied* by Digital Research have been "fiddled" . . . . The address referenced in MOVPATCH.ASM that follows *will not* be the same. . . . Lifeboat Associates has modified *most* versions of MOVCPM.COM that I have seen for particular applications (i.e., double density, etc.).

A>DDT B:MOVCPM.COM<cr> <--- Get the CP/M 2.2 MOVCPM in . . .
DDT VERS 1.4
NEXT PC
2800 0100
-IMOVPATCH.HEX <--- Set-up the MOVCPM patch
-R<cr> <--- Read it in
NEXT PC
2800 0000
-XP<cr> <--- We need to reset the program counter
P=0000 100<cr> <--- Set it back to address 0100 Hexadecimal
-G<cr> <--- Go execute MOVCPM . . .

CONSTRUCTING 56k CP/M VERS 2.2 <--- Making my system size . . .
READY FOR "SYSGEN" OR
"SAVE 34 CPM56.COM"
A>B: <--- It was faked-out, switch to drive B
B>SAVE 34 CPM56.COM<cr> <--- Save the CP/M 2.2 system image
B>DDT CPM56.COM<cr> <--- Bring in the new system image
DDT VERS 2.2 <--- The "new" DDT announcing itself . . .
NEXT PC
2300 0100
-ISBOOT5.HEX<cr> <--- My BOOT loader
-R900<cr> <--- Offset required for BOOT loader position
NEXT PC
2300 0000
-ICBIOS56.HEX<cr> <--- My 56 Kilo-byte BIOS
-R4580<cr> <--- Offset for 56 Kilo-byte BIOS position
NEXT PC
2300 0000

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```
-G0<cr> <--- "Warm boot" your CP/M 1.4
system . . .
B>SYSGEN<cr> <--- Use CP/M 2.2 SYSG-
EN to generate the system
SYSGEN VER 2.0 <--- The "new" SYSGEN
announcing itself . . .
SOURCE DRIVE NAME (OR RETURN TO
SKIP)<cr> <--- Return
DESTINATION DRIVE NAME (OR RE-
TURN TO REBOOT)B <--- Put on B
DESTINATION ON B, THEN TYPE RE-
TURN<cr> <--- Return
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RE-
TURN TO REBOOT)<cr> <--- Return
A> <--- Return to your "old" CP/M version
1.4 . . .
```

OK, now remove the CP/M 1.4 disk from the A drive, then remove the CP/M 2.2 from the B drive, insert it in the A drive, and do a cold boot. Hereafter, MOVCPM will operate normally, so there's no need to go through the MOVPATCH routine . . . .

MOVPATCH.ASM for MOVCPM.COM CP/M version 2.2.

(**Note:** you *must set* "msize" for your intended system memory size to make this work. . . . Assemble normally with the CP/M version 1.4 "ASM.COM" file. MOVPATCH.ASM may not work with copies of MOVCPM.COM that are *not supplied* by Digital Research.)

```
msize   equ   56            ; put your memory
                            ; size here . . .
        org   05ch          ; absolute file control
                            ; block address
        db    20h,'0'+msize/10,'0'+msize
              mod 10,20h
        org   232h          ; serial number string
                            ; length check
        xra   a             ; set flags
        org   2c4h          ; serial number match
                            ; check
        lxi   h,1200h       ; force movcpm to
                            ; look at its own
                            ; serial number
        end
```

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Interfacing with the BSR X-10 Home Control System

by D. M. Gualtieri

It is uncommon today to find a computer hobbyist who does not have an older, single-board development system that is now sitting unused on the shelf. A good use for such a board would be as a dedicated controller for a home alarm or automatic lighting system. The problem exists as to how to interface a computer to the outside (115 VAC) world. One convenient starting point would be the BSR X-10 Home Control System. This system, also sold by Sears as the "Sears Home Control System" and Radio Shack as "Plug 'N Power," allows wireless remote control of lamps and appliances through the combination of a command console carrier current transmitter and various receiver modules. The command console allows individual on/off control of up to 16 devices connected to wall switch replacement modules or plug-in lamp and appliance modules. The plug-in appliance modules can handle up to 15 amps of on/off control. The wall switch and plug-in lamp modules can handle 300-watt incandescent lamps with an additional brightness control feature. A technical summary of the BSR system was given by Steve Ciarcia in a recent article in *Radio-Electronics* magazine ("Plug-in Remote Control System," Sept. 1980, p. 47).

Since the X-10 console has a built-in ultrasonic receiver that detects command signals from a separately sold hand-held command unit not unlike a television remote control unit, many computer interfaces to this system have taken the form of ultrasonic synthesizers that produce the same codes as the hand-held command unit (see, for example, Steve Ciarcia's article, "Computerize a Home," which appeared in *Byte*, Jan. 1980, p. 28). This interfacing method has the advantage of complete isolation between the command console, which is not isolated from the AC power line, and the computer. It also eliminates having to dig into the command console circuitry. Several manufacturers produce computer interfaces that are based on this ultrasonic technique. For example, Mountain Hardware, Inc., 300 Harvey West Blvd., Santa Cruz, CA 95060, produces an ultrasonic control card for the Apple II.

A more direct approach to computer control of the X-10 modules is to directly synthesize the carrier current signal and inject it into the AC power line. This method is potentially less expensive than the ultrasonic method, since it would eliminate the need for a command console. The obvious difficulties with this approach involve isolation from the AC power line and impedance-matching the carrier current signal to the AC power line for effective power transfer. A less obvious but important problem is generating a carrier current signal without transmitting objectionable radio frequency interference (RFI). Scitronics, P.O. Box 5344, Bethlehem, PA 18015, was the first to offer an S-100 compatible interface that controls the X-10 modules by the direct synthesis method.

Although there are several commercial interface units on the market, many computer hobbyists are still motivated enough by cost, and the challenge, to try to do it themselves. The homebrewer's viewpoint of the X-10 computer interface problem can be summarized as follows:

1) Commercial units are nice, but they're too expensive.
2) The ultrasonic method would require a command console, another expensive item.
3) The direct synthesis approach is nice, but it should be implemented mostly in software to reduce hardware costs.
4) The hardware must be designed around common components that can be obtained locally, off-the-shelf.

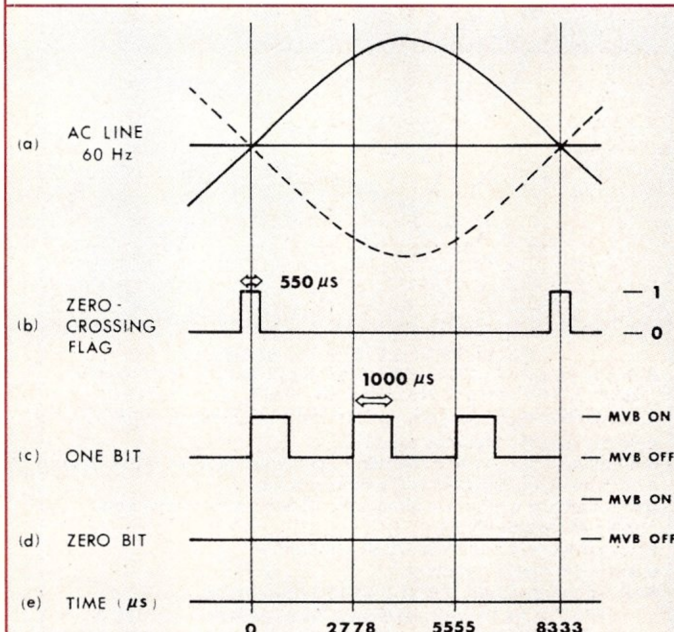

Figure 1. *Timing diagram for the X-10 command signals. The command bits are synchronized with the AC power line (a). The interface circuit of Figure 2 generates the flag bit (b), which triggers the software generation of the sequence of command bits (c) and (d). The command bits (c) and (d) duplicate the timing of the signals from the X-10 command console and control the 120-Hz multivibrator (MVB) of the interface.*

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Table 1. House codes

House symbol	House code h_1	h_2	h_3	h_4
M	Ø	Ø	Ø	Ø
E	Ø	Ø	Ø	1
C	Ø	Ø	1	Ø
K	Ø	Ø	1	1
O	Ø	1	Ø	Ø
G	Ø	1	Ø	1
A	Ø	1	1	Ø
I	Ø	1	1	1
N	1	Ø	Ø	Ø
F	1	Ø	Ø	1
D	1	Ø	1	Ø
L	1	Ø	1	1
P	1	1	Ø	Ø
H	1	1	Ø	1
B	1	1	1	Ø
J	1	1	1	1

Now let's see if the AC carrier current command signal can be generated cheaply.

The signal

Each of the X-10 carrier current commands is a 22-bit code that is synchronized to the AC waveform. This code modulates a 120-kHz carrier signal. A "1" bit consists of three 120-kHz mark pulses, each 1 msec wide, in a half-cycle of the 60-Hz AC waveform. A "0" bit is represented by the absence of the 120-kHz carrier during an AC half-cycle (see Figure 1).

A command message consists of a four-bit preamble (1 1 1 0), which sets the modules to a "listen" state, followed by a house code and a device or function code. The house and device codes specify one of 16 possible devices in one of 16 possible homes and correspond to the settings of the two 16-position rotary switches contained in each module. These codes, when taken together, allow control of 256 modules. These codes are listed in Table 1 and Table 2. Table 2 also lists the six codes (clear, all on, on, off, dim, and bright) that specify the module function. To turn module 3 on, you would first transmit the 22-bit code for device 3, then the 22-bit code for the function "on".

As mentioned earlier, the preamble is 4 bits long, and the house code and the device/function codes combined are an additional 9 bits. Where are the other 9 bits of the 22-bit command code? These extra bits are a consequence of the particular transmission method used by the X-10 command console. Instead of just transmitting the 9-bit house-plus-device/function code after the preamble, the command console interleaves the complement of these codes in the command message, so that a "1" is always followed by a "0", and a "0" is always followed by an extra "1". The command message, therefore, is transmitted as:

$$p_1\ p_2\ p_3\ p_4\ h_1\ \bar{h}_1\ h_2\ \bar{h}_2\ h_3\ \bar{h}_3\ h_4\ \bar{h}_4\ d_1\ \bar{d}_1\ d_2\ \bar{d}_2\ d_3\ \bar{d}_3\ d_4\ \bar{d}_4\ f\ \bar{f}$$

where (p_1 p_2 p_3 p_4) is the (1 1 1 0) preamble; h, d, and f are the codes listed in the Tables; and the bar signifies the complement of the bit.

Since these timings can be easily handled by software, the hardware requirements are simple:

1) A method of detecting the zero-crossings of the AC power line.
2) A gateable 120-kHz carrier current transmitter.

The circuit

The X-10 interface circuit, developed around a minimum cost/easiest construction criterion, appears in Figure 2. Isolation from the computer is provided by two optical isolators, OP1 and OP2. OP1 transmits the zero-crossing information to one bit of an input port. OP2 accepts a TTL gating bit from a computer output port to turn on the carrier-current transmitter, a simple multivibrator. This bus-independent design, which uses I/O ports, is easily interfaced to any computer.

The zero-crossing detector is extremely simple. The bridge rectifier, which supplies DC power to the circuitry, produces a 120-Hz waveform that goes to zero volts at each zero-crossing of the AC line (assuming, of course, that there is no phase-shift through the power transformer). At this zero voltage point the Darlington transistor Q1, which can be any NPN Darlington meeting the V_{CE} requirement, or even two NPN transistors, such as 2N3904, Darlington connected, is switched off, causing the collector of the phototransistor in OP1 to go high. A 550-microsecond pulse is produced at the computer input port centered around each zero-crossing. This is the time when the voltage at Q1's base is less than the V_{BE} of the Darlington, about 1.3 volts.

Table 2. Device/function codes

Device/ function	Device/function code d_1	d_2	d_3	d_4	f
1	Ø	1	1	Ø	Ø
2	1	1	1	Ø	Ø
3	Ø	Ø	1	Ø	Ø
4	1	Ø	1	Ø	Ø
5	Ø	Ø	Ø	1	Ø
6	1	Ø	Ø	1	Ø
7	Ø	1	Ø	1	Ø
8	1	1	Ø	1	Ø
9	Ø	1	1	1	Ø
1Ø	1	1	1	1	Ø
11	Ø	Ø	1	1	Ø
12	1	Ø	1	1	Ø
13	Ø	Ø	Ø	Ø	Ø
14	1	Ø	Ø	Ø	Ø
15	Ø	1	Ø	Ø	Ø
16	1	1	Ø	Ø	Ø
CLEAR	Ø	Ø	Ø	Ø	1
ALL ON	Ø	Ø	Ø	1	1
ON	Ø	Ø	1	Ø	1
OFF	Ø	Ø	1	1	1
DIM	Ø	1	Ø	Ø	1
BRIGHTEN	Ø	1	Ø	1	1

This bus-independent design, which uses I/O ports, is easily interfaced to any computer.

The 120-kHz carrier-current transmitter is a simple multivibrator composed of transistors Q3 and Q4, which are cross-coupled by the 680 pF capacitors and buffered by the Q2 and Q5 emitter followers. The buffered signals at points "X" and "Y" are coupled to the AC line. The 10-kilohm base resistors and the two 680-pF capacitors set the coarse frequency of the multivibrator, which is fine-tuned by the 100-ohm trimpot.

Gating of the multivibrator is accomplished by a simple technique. The bases of Q3 and Q4 are diode-connected to the collector of Q6. When Q6 is off, these diodes are reversed biased, and the multivibrator behaves as if they weren't in the circuit. When Q6 is on, however, these diodes steal the base drive currents from Q3 and 4, and the multivibrator is shut down. The multivibrator is on when there is TTL drive to the diode in OP2, and off when that output port bit is zero.

Note the separate "ground" points in the circuit. The triangular ground symbol specifies a floating ground which connects circuitry that is not isolated from the AC line. This ground should *never* be connected to the computer ground, which is specified by the conventional ground symbol. The optical isolators OP1 and OP2 keep these two grounds isolated and provide data exchange from one side of the circuit to the other.

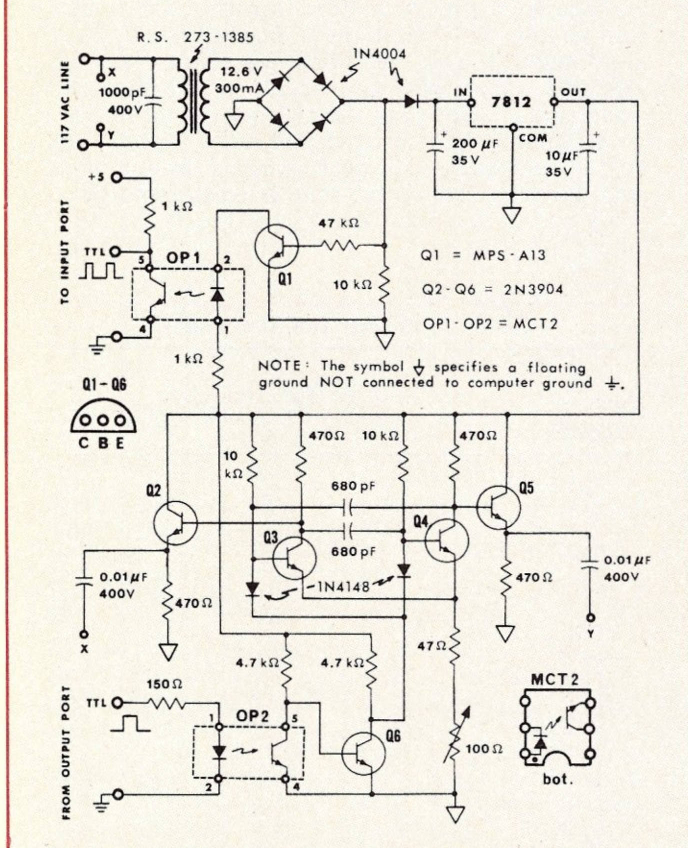

Figure 2. Circuitry for the X-10 interface. Note the floating ground and the three 400-volt capacitors.

Calibration

Calibration of the multivibrator is easy. Although the usual test instruments cannot be connected to the circuit because of the floating ground, the square wave generated by the multivibrator has harmonics that appear in the AM broadcast band. These harmonics occur at 600, 840, 1080, 1320, and 1560 kHz. Although these harmonics are sharply attenuated by the 1000-pF capacitor, the capacitance of the AC line, and the balanced line configuration of the circuit which drives each side of the AC line equally, an AM radio placed near an unshielded multivibrator will detect these harmonics. Don't tune for just one harmonic, but check the others also. You could be tuning for the seventh harmonic of 154 kHz, or the eleventh harmonic of 98 kHz, instead of the desired ninth harmonic of 120 kHz.

Not surprisingly, I've found that the X-10 modules are very tolerant of frequency error, but it's best to tune well now to avoid problems later. If there's not enough range on the 100-ohm pot to accurately set the multivibrator frequency with your particular component values, decreasing the 10-kilohm resistors by adding resistors in parallel will increase the frequency; and increasing the 680-pF capacitors by adding capacitance in parallel will decrease the frequency.

Component substitutions can be made almost everywhere. As mentioned earlier, the Q1 Darlington can be replaced by two Darlington-connected NPN transistors. Q2-Q6 are "garden-variety" NPN transistors, and their exact type is not too critical. The MCT2 optical isolator, manufactured by Monsanto, is pin-compatible with the Litronix ISO-LIT 1, or the 4N25. Other NPN phototransistor optical isolators should work.

If you have trouble getting the circuit to operate, disconnecting points "X" and "Y" from the AC line will allow you to use an oscilloscope and voltmeter to troubleshoot the circuit. Remember that the frequency of the multivibrator will be slightly shifted when the AC line is disconnected, so use a radio instead of a frequency counter to adjust the trimpot. Note the 400-volt rating on three of the capacitors. My unit was assembled in one evening on a four-inch-square piece of perforated circuit board, with room to spare.

The software

Listing 1 is the PRN listing of an 8080 assembly

The width of the first mark pulse is important. Lengthening it beyond a certain point results in no operation.

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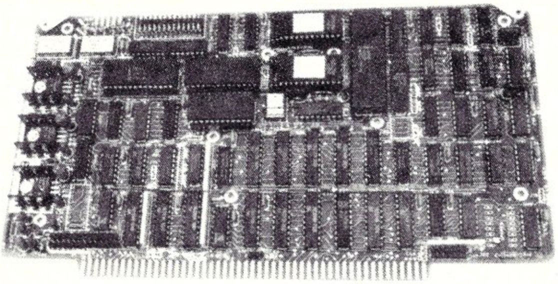

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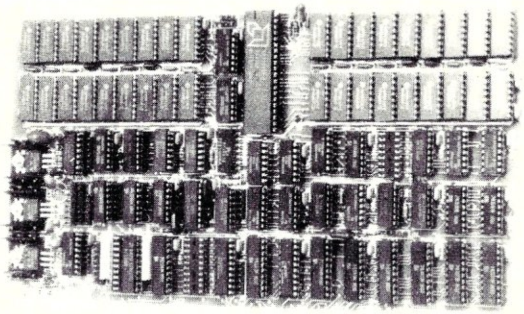

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language routine developed to drive the X-10 interface. For my application, this routine was ROMed at origin (0200)H, and is part of a home alarm/lighting control system that is slaved to my S-100 computer. The slave computer includes nonvolatile RAM, a real-time clock with battery back-up, and a serial interface to the master computer. The slave accepts updates of its nonvolatile scratchpad RAM from the master computer, and operates on a stand-alone basis when the master computer is off.

The routine takes as its argument the contents of register A, as passed from the main program, and returns to the main program after the X-10 code has been transmitted. A 2-MHz clock is assumed for the timing loops. Register A is assumed to contain 3 bits of a house code as its most significant bits (the most significant bit of the 4-bit house code is assumed to be zero), and the 5-bit device/function code as its least significant bits. Although this coding scheme allows access to only half the maximum number of devices, this number is still very large (128), and the simplicity of keeping everything in one byte was irresistible.

My slave computer, a Z80 single-board computer from Miller Technology, 16930 Sheldon Road, Los Gatos, GA 95030, uses an INS8154 memory-mapped I/O port chip. All I/O calls are to memory locations, and the INS8154 also allows you to set or clear specific bits by an STA instruction to a specific address. For conventional I/O, replace the LDA <addr> and STA <addr> statements with IN <port> and OUT <port> statements. Set and clear are implemented with MVI <a,ddd> followed by OUT <port>.

Further explorations

Now that you know the right way to generate the command signal, what about the easy way? My experiments indicate that the second and third mark pulses in the "1" bit are not required! These pulses may implement some error correction scheme in the modules, but whenever I transmit the first mark pulse only, the module operation is unaffected. The width of the first mark pulse, however, is important. Lengthening it beyond a certain point results in no operation.

I'm certain that other experimenters will have fun exploring the full timing specifications of the X-10 modules. A better understanding of these specifications might allow the development of new types of modules not commercially available.

Devlin M. Gualtieri received a Ph.D. in Solid State Science from Syracuse University in 1974. He is now Senior Research Physicist at Allied Corporation, Morristown, New Jersey, doing work on electronic materials. His hobby is electronic music synthesis, and he is an author of more than 20 technical articles, many of which involve circuit design.

LISTING I

```
                                        ;BSR DRIVER ROUTINE
                                        ;ARGUMENT IN REGISTER A
                                        ;TIMING LOOPS ASSUME 2-MHZ CPU
                                        ;
                                        ;INPUT/OUTPUT VIA INS8154 MEMORY-MAPPED
                                        ;I/O PORT CHIP WHICH ALLOWS SET AND
                                        ;CLEAR OF INDIVIDUAL OUTPUT PORT BITS
                                        ;BY THE STA INSTRUCTION TO A SPECIFIC
                                        ;ADDRESS.  DATA DIRECTION REGISTER OF
                                        ;INS8154 SET BEFORE ENTRY.
                                        ;MODIFY FOR YOUR OWN PORT CONFIGURATION.
                                        ;
0200                    ORG     200H    ;ORIGIN OF BSR ROUTINE IN ROM
                                        ;
4007 =        ZCFLAG:   EQU     4007H   ;ZERO-CROSSING FLAG INPUT PORT
4010 =        XON:      EQU     4010H   ;ADDRESS TO SET OUTPUT PORT BIT TO TURN
                                        ;TONE BURST ON.
4000 =        XOFF:     EQU     4000H   ;ADDRESS TO CLEAR OUTPUT PORT BIT TO TURN
                                        ;TONE BURST OFF.
                                        ;
0200 5F       BSR:      MOV     E,A     ;REGISTER A HAS ONE OF EIGHT HOUSE CODES IN
                                        ;A7-A5, AND THE DEVICE/FUNCTION CODE IN
                                        ;A4-A0.
                                        ;
0201 CD5302             CALL    MARK    ;SEND PREAMBLE
0204 CD5302             CALL    MARK
0207 CD5302             CALL    MARK
020A CD8C02             CALL    SPACE
020D 0E04               MVI     C,004Q  ;SET UP TO SEND FOUR BIT HOUSE CODE
020F 7B                 MOV     A,E     ;RECALL ARGUMENT
0210 0F                 RRC             ;PRODUCE FOUR BIT HOUSE CODE WITH MSB=ZERO
0211 E67F               ANI     177Q

0213 F5       HCODE:    PUSH    PSW     ;EXAMINE HOUSE CODE BIT-BY-BIT
0214 47                 MOV     B,A     ;AND TRANSMIT
0215 E680               ANI     200Q
0217 C44502             CNZ     ONE
021A 78                 MOV     A,B
021B E680               ANI     200Q
021D CC4C02             CZ      ZERO
0220 F1                 POP     PSW
0221 07                 RLC
0222 0D                 DCR     C
0223 C21302             JNZ     HCODE
                                        ;
0226 0E05               MVI     C,005Q  ;SET UP TO SEND FIVE BIT DEVICE/
                                        ;FUNCTION CODE
0228 7B                 MOV     A,E

0229 F5       DCODE:    PUSH    PSW     ;EXAMINE DEVICE/FUNCTION CODE BIT-BY-BIT
022A 47                 MOV     B,A     ;AND TRANSMIT
022B E610               ANI     020Q
022D C44502             CNZ     ONE
0230 78                 MOV     A,B
0231 E610               ANI     020Q
0233 CC4C02             CZ      ZERO
0236 F1                 POP     PSW
0237 07                 RLC
0238 0D                 DCR     C
0239 C22902             JNZ     DCODE
023C C9                 RET             ;RETURN TO MAIN PROGRAM
023D 00                 NOP
023E 00                 NOP
023F 00                 NOP
                                        ;
0240 15       DELAY:    DCR     D       ;DELAY ROUTINE, ARGUMENT IN REGISTER D
0241 C24002             JNZ     DELAY   ;THIS ROUTINE TIMES TONE BURSTS
0244 C9                 RET
                                        ;
0245 CD5302   ONE:      CALL    MARK    ;GENERATE BSR COMPLEMENT SEQUENCE FOR
0248 CD8C02             CALL    SPACE   ;A LOGICAL ONE MESSAGE
024B C9                 RET
                                        ;
024C CD8C02   ZERO:     CALL    SPACE   ;GENERATE BSR COMPLEMENT SEQUENCE FOR
024F CD5302             CALL    MARK    ;A LOGICAL ZERO MESSAGE
0252 C9                 RET
                                        ;
                                        ;MARK GENERATES THREE TONE BURSTS IN AN
                                        ;AC HALF-CYCLE
0253 3A0740   MARK:     LDA     ZCFLAG  ;LOOK FOR ZERO-CROSSING FLAG AT BIT 7 OF
0256 E680               ANI     200Q    ;FLAG INPUT PORT
0258 CA5302             JZ      MARK    ;WAIT FOR FLAG=1
025B 163E               MVI     D,076Q  ;DELAY TO FIRST TONE BURST
025D CD4002             CALL    DELAY
0260 321040             STA     XON     ;SET BIT 0 OF OUTPUT PORT TO TRANSMIT
0263 1684               MVI     D,204Q  ;TONE BURST
0265 CD4002             CALL    DELAY
0268 320040             STA     XOFF    ;CLEAR BIT 0 OF OUTPUT PORT TO TURN
026B 16D1               MVI     D,321Q  ;OFF TONE BURST
026D CD4002             CALL    DELAY   ;WAIT FOR NEXT TONE BURST SLOT
0270 321040             STA     XON     ;START SECOND TONE BURST
0273 1684               MVI     D,204Q
0275 CD4002             CALL    DELAY
0278 320040             STA     XOFF
027B 16EC               MVI     D,354Q
027D CD4002             CALL    DELAY
0280 321040             STA     XON
0283 1684               MVI     D,204Q
0285 CD4002             CALL    DELAY
0288 320040             STA     XOFF    ;END OF THIRD AND FINAL TONE BURST
028B C9                 RET

                                        ;SPACE KEEPS AC HALF-CYCLE CLEAR OF
                                        ;TONE BURSTS
028C 3A0740   SPACE:    LDA     ZCFLAG  ;LOOK FOR ZERO-CROSSING FLAG, ALLOW
028F E680               ANI     200Q    ;SUFFICIENT TIME FOR FLAG TO PASS,
0291 CA8C02             JZ      SPACE   ;AND RETURN. NO TONE BURSTS.
0294 16FF               MVI     D,377Q
0296 CD4002             CALL    DELAY
0299 C9                 RET
029A 00                 NOP
029B 00                 NOP
029C 00                 NOP
029D 00                 NOP
029E 00                 NOP
029F 00                 NOP
02A0                    END

A>
```

Low Hotel Rates

CP/M '83's Show Management has made special group discount arrangements with several of the hotels closest to Moscone Center. The unbelievably low discount rates are available at such luxurious facilities as the Hyatt on Union Square, and at modest priced accommodations, including the Pickwick Hotel and Holiday Inns.

The Hyatt on Union Square—415-398-1234—345 Stockton St.—new, modern, and four blocks from Moscone. CP/M '83's discount rates are $75 per night single, $85 per night double, versus their regular rates of $95 to $130 single and $130 to $165 double.

The Sheraton Palace Hotel—415-392-8600—639 Market St.—elegantly refurbished fine older hotel, and the closest hotel to Moscone—only one block. CP/M '83's special rates are $70 single and $80 double, versus their regular rates of approximately $90 single and $100 double.

The San Francisco Hilton & Tower—415-771-1400—333 O'Farrell St.—a modern facility located three blocks from the Show. CP/M '83's special rates are $75 per night single and $95 double, versus this Hilton's regular rates of $66 to $127 single, and $86 to $147 double.

The Holiday Inn on Union Square—415-398-8900—480 Sutter St.—a modern facility with all the conveniences, and located in the heart of San Francisco. This facility offers CP/M '83 attendees accommodations for $70 per night single and $80 per night double.

The Holiday Inn Financial District/China Town—415-433-6600—750 Kearny St.—this high rise Inn is six easy blocks to Moscone and offers CP/M '83's attendees single or double accommodation at $55 per night versus their regular rates of $78 to $92.

The Pickwick Hotel—415-421-7500—85 5th St.—Just two blocks from the Show, this fine hotel has clean modest accommodations, and is offering CP/M '83's attendees rates which are lower than motel rates. The rates are $30 per night single and $35 per night double, and can't be beat anywhere in town.

Make your reservations today. Over 20,000 are expected to attend CP/M '83.

Hotel Reservation Request

How to Make Your Hotel Reservations

1. For you to receive CP/M '83's special discount convention rates, all reservations must be made on this form, or a facsimile. The form must be completed in detail, including date and hour of arrival, date of departure, and names and addresses of all persons who will occupy the room. Reservations can not be processed without this information.

2. Indicate at least three choices of hotels and rates. Requested rates cannot be guaranteed, but the Housing Bureau will make every attempt to assign rooms as near as possible to the requested rate.

3. The Housing Bureau requires written reservations. Only late requests, after Friday, January 7, will be accepted by telephone. After Friday, January 14 try to make your reservations directly with the hotel, but be advised that the hotels are expected to be full by that time. The Housing Bureau telephone number is 415-626-5500.

4. Mail this hotel reservation request directly to CP/M '83 Housing Bureau, P.O. Box 5612, San Francisco, CA 94101, and *not* to National Computer Shows.

5. Confirmations will be sent from the Housing Bureau up to two weeks prior to the event. Allow up to two weeks for processing.

6. Cancellations. Notify the CP/M '83 Housing Bureau of all cancellations up to Friday, January 7. After January 7, make cancellations directly with the hotel.
   Changes. All other changes, such as arrival or departure times or changes in type of accommodations required, should be made directly with the hotels at all times.

7. Hotels will hold reservations only until 6 pm unless otherwise requested. If you are delayed in transit, phone ahead and advise the hotel of your arrival time. Reservations can be guaranteed to assure a room regardless of arrival time. However, if you do not pick up or cancel the reservation, you will be billed for one night's room rate. If you make a reservation, even a guaranteed reservation, it will be held only for that night. Thus, if you designate a Monday arrival and do not arrive until Tuesday, you will not have a room unless you notify the hotel beforehand.

A. Please make the following hotel reservations
Hotel Choice

1st ______________________________

2nd ______________________________

3rd ______________________________

B. Please enter my reservation at the hotel for

______ single room(s) at $________/ day

______ double room(s) at $________/ day

______ twin room(s) at $________/ day

______ one bedroom suite(s) at $________/ day

______ two bedroom suite(s) at $________/ day

C. Arrival date ________ time ________ ☐ am ☐ pm

Departure date ________ time ________ ☐ am ☐ pm

Occupant ______________________________

Share With ______________________________

D. Mail my confirmation to

Name ______________________________

Firm (if any) ______________________________

Address ______________________________

City ____________ State ________ Zip ________

Telephone (Area Code) ______________________________

E. Complete this form and mail to CP/M '83 Housing Bureau, P.O. Box 5612, San Francisco, CA 94101

CIRCLE 86 ON READER SERVICE CARD

The UNIX File

by Ian F. Darwin

What is UNIX?

The Unix File is scheduled to appear every other month. It will focus a spotlight on important aspects of UNIX. If you have questions about UNIX, send them in and I will attempt to answer them.

UNIX is a trademark of Bell Laboratories. The name of the system is owned by the employer of its developers. In the late sixties Kernighan and Ritchie developed the system using a spare PDP-11 in a back room at Bell Labs. They chose the name UNIX apparently in reaction to MULTICS, a large time-sharing system whose security features (still advertised in some computer magazines) make it difficult for users to share files. In eliminating many of the security features, Kernighan and Ritchie made a small, easy-to-use operating system, but one lacking the serious protection mechanism of large-scale OS's such as MULTICS and later MVS. When Bell found out that the system was usable, they trademarked the title, copyrighted the code, and started selling the system. Being a public organization, Bell sold UNIX at cost to universities, whence derives the current groundswell of UNIX popularity.

A family of systems

The term "UNIX," although a trademark of Bell Laboratories, refers to a family of systems even within Bell. UNIX version 6, version 7, and System III have been distributed to the outside world. Systems IV and V apparently exist within Bell somewhere. "Berkeley UNIX" is the enhanced UNIX from the University of California at Berkeley. BSD (Berkeley System Distribution) 2.8 is for PDP-11's; BSD 4.1 and 4.2 are for VAX machines. UNIsoft UNIX is Berkeley UNIX ported to the 68000, available on the S-100 in DUAL Systems' "System 83." And there are non-Bell implementations of UNIX-like systems.

The first independent UNIX -alike is IDRIS, from Whitesmiths in New York (home of the Whitesmiths C compiler). IDRIS corresponds to UNIX version 6, and is available on the S-100 in the Empirical Research Group 68000 system. There is also apparently an IDRIS for the 8080/Z80 with Cromemco hardware, and there are PDP-11 versions. From Chicago comes "Coherent," Mark Williams' imitation of UNIX version 7. It is available for a number of machines, including the IBM-PC. There are numerous other systems which bear some similarity to UNIX but are not exactly like it.

A mystery

Mystery shrouds UNIX from the uninitiated. Some UNIX fans do nothing to blow away the mist. A few UNIX people can be arrogant (to the point of offense) about "their" system; one such person actually told me that UNIX was the only operating system ever written! This attitude is a pity, as it prevents many people from taking an interest in the system.

Mystery can also surround UNIX when you need to know quickly how to do something beyond the obvious. The documentation is well organized but not overly well written, and is very short of examples. Poor manuals are apparently acceptable within the phone company but not in private industry, so several firms are now developing completely new documentation for UNIX.

A programming environment

Programmers like UNIX because it provides a reasonably consistent and quite effective development environment. Almost all files (text files, program sources, data) are stored in a single format on disk, and can be readily accessed by a standard I/O library. Almost all the utilities work on data stored in this format, and almost all the commands accept the same syntax for file names and parameters. Programs can be connected together in sequences to build productive new tools. There are sophisticated program development programs including a very concise programming language called "C," a high-performance file editor, a fast C-like command language, a lexical analyser for parsing input, a compiler or pre/post-processor generator, powerful text formatting (and typesetting) programs, a report writer, a debugger, a general macro processor, and others. All this combines to give the programmer a comfortable environment in which to build and document programs. Parts of this environment have been exported to other operating systems; see the books *Software Tools* or *Software Tools in Pascal* by Kernighan and Plauger for discussion and source listings of some of the more common tools. (Kernighan has been mentioned as one of the developers; Plauger is the president of Whitesmiths.)

A standard article

To the editors of computer magazines, UNIX is the system about which everybody writes those pre-programmed articles telling how great it is that you can pipe the output of "who" or "ls" into "wc." I'm sure that if I got this all the time I too would start to associate UNIX with trips to the W.C. Fortunately, there's a lot more about UNIX which deserves explanation, else I'd be out of luck—and material—as far as the future of this column goes.

An enigma

To the computer hobbyist, UNIX is the stuff that drooling is made of. He's been reading for two years about how great UNIX is, but nobody would let him at it. UNIX was originally available for PDP-11's, but was to have been moved to the new 16-bit micros. Microsoft contracted with Bell to provide it on these machines, amid much early fanfare, and didn't produce much of what they'd promised. Having lost touch with their roots in the hobbyist field, Microsoft, influenced by Bell's licencing policies, made the system available only to OEM's—i.e., those with more money than the hobbyist. And so UNIX did not come to the hobbyist via Microsoft. The cheapest UNIX-alike that I am currently aware of is Coherent for the IBM-PC, at $500. Coherent costs several times that for many other machines, IDRIS costs four times that. UNIsoft UNIX costs around $750 for a single-user version, but you seem to have to buy somebody's hardware to get it. And don't bother going to Bell for UNIX; they want a bundle for the executable form, and $43,000 (forty-three thousand dollars) for the source. One Z80-based system that is similar to UNIX, called MARC, has the promise of being the closest many hobbyists will get to UNIX for a long time to come. But there is no word as to when, if ever, it will be released.

A standard product

To the OEM manufacturer of hardware, UNIX is a good way to sell hardware, since if you put something out with UNIX on it, people will buy it. To the software manufacturer, UNIX has a chance to become the "software bus" for 16-bit machines, just as CP/M is for 8-bit machines. With the variety of UNIX systems out there, however, there will be difficulties, unless somebody does what Lifeboat did for CP/M, that is, adapt software to the range of different disk formats and processors available. Is there an entrepreneur in the house?

Companies referred to:

Empirical Research Group
28206 144th Ave. SE
Kent, WA 98031
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Whitesmiths, Ltd.
Box 1132
Ansonia Station
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CIRCLE 203 ON READER SERVICE CARD

Unisoft Systems Corp.
2405 Fourth St.
Berkeley, CA 94701
(415) 644-9224
CIRCLE 204 ON READER SERVICE CARD

Mark Williams Co.
1430 West Wrightwood
Chicago, IL 60614
(312) 472-6659
CIRCLE 205 ON READER SERVICE CARD

Software Directory

Program name: Master Catalog
Hardware system: North Star—CP/M
Description: A Master Catalog system that keeps track of all the files on all the diskettes. It produces a listing of file names, in alphabetic order, with the name of the disk containing that file. Selective listings may also be made in a manner similar to that used by the CP/M 'DIR' command. The 'SUBMIT' command may be used to list the directories of selected diskettes. In addition, the diskette contains a program that sorts the directory on a diskette in alphabetic order and gets rid of non-'ERA'able files. Also included are directory listing programs that lists out the directory in alphabetic order, three or four columns wide, with the file size. One program handles double density disks.
Release: February 1981
Price: 10 plus $1.50 (shipping)
Included with price: 5¼" North Star Disk (contains both source and object programs)
Where to purchase it:
Elliam Associates
24000 Bessover St.
Woodland Hills, CA 91367
CIRCLE 206 ON READER SERVICE CARD

Program names: Small/C & Small/VM
Hardware system: North Star MDS or Horizon (SD/DD/DQ)
Minimum memory size: 40K Bytes
Language: C and 8080 Assembler
Description: Small/C is an enhanced version of Ron Cain's compiler described in *Dr. Dobb's Journal,* No. 45. This self-compiler translates an integer subset of standard C into 8080 assembly language. Small/VM is a virtual-machine interface to North Star DOS (*Microsystems,* this issue, p. 66). It provides program control, file management, and memory management services for Small/C and assembly language programs. Small/VM supports the following UNIX-like features: standard I/O with redirection, command-line argument passing, automatic file creation and random file access. This package is supplied with source code and is intended for use by experienced assembly language programmers. It is written for use with Allen Ashley's PDS assembler and linking loader. Adaptation to other support software is not difficult.
Release: April 1981
Price: $45 Two diskettes; $10, documentation only (credited toward purchase); see page 69.
Included with price: Diskette(s) with source and object code for Small/C, Small/VM, standard I/O library, and auxiliary function library; 58-page user's manual. Specify single or double density, documentation & license agreement shipped first.
Author: J. E. Hendrix
Where to purchase it:
Oxford Computer Services
Rt. 1, Box 74-B-1
Oxford, MS 38655
CIRCLE 207 ON READER SERVICE CARD

Program name: FORTRAN
Hardware system: CP/M-80, 8080/Z80 system
Minimum memory size: 32K RAM
Language: Object code
Description: A subset and a superset of ANSI 1966 Fortran. Extensions include: IF-THEN-ELSE constructs, TRACE-style debugging, COPY statement, arrays up to seven dimensions, and random access file support. Dynamic object module loading and chaining takes place in seconds. Uses same fast loader as the Nevada Cobol compiler.
Release: August 1982
Price: $199.95
Included with price: Disk and manual (199 pages)
Where to purchase it:
Ellis Computing
600 41st Ave.
San Francisco, CA 94121
(415) 751-1522
CIRCLE 208 ON READER SERVICE CARD

Program name: EPM version 1.1
Hardware system: CP/M version 2.X
Minimum memory size: 24K
Language: Source code
Description: Permits programming of EPROMs directly from CP/M disk files and allows existing EPROMs to be read directly to a disk file for archiving or duplication. Configurable to virtually any hardware, and can interface with a wide variety of common EPROM programming systems including SD Systems PROM-100 board, Cromemco Bytesaver, and Pro-Log. EPROM Programmer I/O routines are provided in source form for custom interfacing to EPROM programming hardware. By using a control block to identify particular type of EPROM to be programmed, EPM completely eliminates need for address and length calculations and provides flexibility to adapt to future EPROM developments.

Program is menu-driven and requires a minimum of user interface. Automatically verifies EPROM erasure prior to programming. After programming, provides positive confirmation of successful program transfer and reports any discrepancies directly to operator. HEXROM utility is included for hex file conversion. Also contains an expert mode for faster operation.
Release: September 1982
Price: $75
Included with price: Disk and manual
Where to purchase it:
Dantek Software Inc.
4550 Schoolhouse Rd.
Batavia, OH 45103
(513) 752-1921
CIRCLE 209 ON READER SERVICE CARD

Program name: COMSTAR BASIC Compiler
Hardware system: North Star double quad DOS at 100 or 2000
Minimum memory size: 24K
Language: Assembler
Description: Translates North Star type 2 (program) file into assembly language program

and then into a fully operational machine language program. Resulting programs run faster than their Basic equivalents and as machine code fully protect the original source Basic program. Variable dimensions and disk file numbers must be decimal constants. Thus DIM A(N) and READ #K are illegal constructs. Compiled programs can use either software floating point functions of the North Star floating point board (very substantial increase in computational speed). Programs generated by COMSTAR perform all their I/O through the N* DOS.
Release: December 1980
Price: $400.00
Included with price: Compiler, relocating macro assembler, linking loader, text editor, command processor. Complete documentation is included and full user support is provided.
Author: Allen & David Ashley
Where to purchase it:
Allen Ashley
395 Sierra Madre Villa
Pasadena, CA 91107
CIRCLE 210 ON READER SERVICE CARD

Program name: Quick Check. Money Management Series.
Hardware system: Any CP/M system. Printer recommended.
Minimum memory size: 56K
Language: None reqd. CB80 native code. B Tree Access
Description: Several easy pieces to help you manage your money. They are: Check Book—Prints checks and keeps up with your checking account. Book Keeper—Check Book plus income and expense summary, pay records, income tax report • Quick Check—Book Keeper plus bills to pay and the addresses printed on the checks • Quick Look—Plots the records from Quick Check for easy understanding • Quick Pay—Calculates deductions and net pay • Quick Check Plus—Keeps up with who owes you money, and prepares statements.
Release: Available now
Price: Demonstration disk, Guide, and Check Book Program, $19.95; Book Keeper, $99.95; Quick Check, $199.95; Quick Check Plus (Includes Quick Look and Quick Pay) $299.95; Printed Guide for any of the above, $2.95 (applies to purchase).
Where to purchase it:
Chuck Atkinson Programs
Route 5, Box 277-C
Benbrook, Texas 76126
(817) 654-2011
CIRCLE 211 ON READER SERVICE CARD

Program name: FILEFIX
Hardware system: CP/M 2.2 system
Language: Object code.
Description: FILEFIX is a program for recovering erased files, protecting, deleting and renaming files, as well as forg-

Software Directory
continued . . .

ing multiple-user links to a single CP/M file. With FILEFIX you may: View CP/M directory block allocation map; display files in short form, including erased files; display files in long form with block and sector status; and display a disk's status completely.

FILEFIX is menu-driven. Several utilities are provided that allow you to SCROLL or SHOW textfiles one screenful at a time, ENCRYPT files with a one- or two-letter password, COPY files, RENAME files, VERIFY files and determine the CPU processor type in your computer. DUMP includes both HEX and ASCII values. GO is used to branch to any memory location and IOBYTE allows the user to reassign the four logical/physical devices.
Release: August 1982
Price: $100
Included with price:
Where to purchase it:
Digital Marketing
2670 Cherry Lane
Walnut Creek, CA 94596
(415) 938-2880
CIRCLE 212 ON READER SERVICE CARD

Program name: Wiremaster
Hardware system: Any Z80 CP/M system
Minimum memory size: 48K
Language: ZSPL (Pete Ridley Software)
Description: Wiremaster is a software design tool to aid in the design, layout and construction of electronic hardware. Its inputs are easily derived from the schematic diagram and fed to Wiremaster in a CP/M text file. Outputs include a network map graphically showing all pins and wires, a wirelist sorted by lengths and levels, a parts list, and checklists that detect all wiring errors. The resulting information is then used for layout, error checking, wiring, component stuffing, and system debugging. Together with the schematic, this forms a complete and easily updated documentation package for an electronic product, and results in substantial savings of time.

Software Directory
continued . . .

Release: November 1980
Price: $150 (manual only, $5)
Included with price: Manual, object and sort programs, FIX (a disk utility for marking bad spots), example files, various utilities.
Where to purchase it:
Afterthought Engineering
7266 Courtney Drive
San Diego, CA 92111
(714) 279-2868
CIRCLE 213 ON READER SERVICE CARD

Program name: DMM-1 Utilities
Hardware system: CP/M 2.X or MP/M
Language: Object code
Description: The disk contains the following utilities: XDIR displays disk directory file names in alphabetic order, showing file size for each file name. A disk usage summary is provided, reporting number of bytes on disk, number of file names in use, and space used. Also reports number of available file names and space. Works on single-density and double-density floppy and hard disks. EXTRACT lists a portion of a file between two label names. STRIP removes hex code from a PRN file and turns it back into an ASM file. SORT creates a symbol table from an assembly done with ASM that can be listed or used with the Digital Research debugger SID. CONVERT changes all uncommented lower case characters to upper case. Handy for assemblers that will not accept lower case. STATUS provides information about current operating system, such as memory available, TPA size, top of memory address, I/O assignments, and more.
Release: August 1982
Price: $35 & $1 for shipping/handling
Included with price: 8″ single density or North Star 5¼″ disk
Where to purchase it:
Elliam Associates
24000 Bessover St.
Woodland Hills, CA 91367
(213) 348-4278
CIRCLE 214 ON READER SERVICE CARD

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (*Required by 39 U.S.C. 3685*)

1. Title of Publication: *Microsystems.*
   a. Publication No. 01997955
2. Date of filing: October 1, 1982
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   a. No. of issues published annually: 6.
   b. Annual subscription price: $12.49
4. Complete mailing address of known office of publication *(not printers)*: 39 E. Hanover Avenue, Morris Plains, New Jersey 07950.
5. Complete mailing address of the headquarters or general business offices of the publishers *(not printers)*: 39 E. Hanover Avenue, Morris Plains, New Jersey 07950.
6. Full names and complete mailing addresses of the publisher, editor, and managing editor: Publisher, None. Editor, Sol Libes, 39 E. Hanover Avenue, Morris Plains, New Jersey 07950. Managing Editor, None.
7. Owner: AHL Computing, Inc., 39 E. Hanover Avenue, Morris Plains, New Jersey 07950; Ziff-Davis Publishing Company, One Park Avenue, New York, New York 10016; Ziff Corporation, One Park Avenue, New York, New York 10016.
8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None.
10. Extent and Nature of Circulation

	Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A. Total no. copies *(net press run)*	14,345	20,564
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	2,977	3,606
2. Mail subscriptions	9,964	13,098
C. Total Paid Circulation *(sum of 10B1 and 10B2)*	12,941	16,704
D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies	778	2,200
E. Total distribution *(sum of C and D)*	13,719	18,904
F. Copies not distributed		
1. Office use, left over, unaccounted, spoiled after printing	597	1,659
2. Returns from news agents	29	1
G. Total *(sum of E, F1, and 2—should equal net press run shown in A)*	14,345	20,564

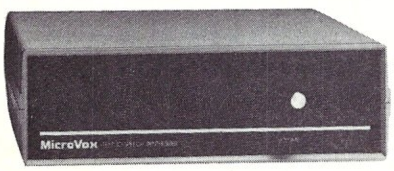
11. I certify that the statements made by me above are correct and complete.

WILLIAM L. PHILLIPS,
Assistant Treasurer

New Products

Second-generation text-to-speech synthesizer

The new Microvox text-to-speech synthesizer incorporates all of the features users of earlier synthesizers have requested. Microvox translates ASCII characters into speech with an advanced text-to-speech algorithm and provides a real-time audio interface for applications in data processing, telecommunications, automation, education, or handicapped markets. It can annunciate data transmitted at high baud rates over telephone lines or serve as an unlimited vocabulary audio interface for telephone transaction applications. With 64 digitally programmable levels of inflection, Microvox offers a unique high-fidelity professional voice quality.

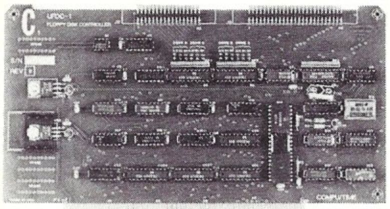


Attached to a terminal keyboard, Microvox can function as a typewriter for the blind or as a communicator for the vocally impaired. Every ASCII character is recognized (including punctuation) as it is typed and can be echoed automatically. ASCII code is sent to Microvox through either the RS-232C or parallel interface. The English text is stored in a 750-character buffer until the processor commands it to be automatically translated into electronically synthesized speech.

Price: $295. The Micromint, Inc., 917 Midway, Woodmere, NY 11598; (516) 374-6793.
CIRCLE #215 ON READER SERVICE CARD

S-100 Floppy Disk Controller I

The Compu/time Universal Floppy Disk Controller I (UFDC-I) is an S-100/IEEE-696 board capable of connecting up to 4 floppy disk drives,



connected in any combination of 5¼″ or 8″ with ANSI standard interfaces, single/double-density formats and single/double-sided drives. Based on the Western Digital 1795 Floppy Disk Controller chip, the UFDC-I synchronizes the processor to disk transfers by means of wait states. Data transfer, status checking, drive select, density, disk side, and wait-state circuitry are all selected by means of external I/O control and status ports.

The UFDC-I also uses the 9216 digital data circuitry for write precompensation and read data separation. A synchronous clock distribution scheme is employed so that the 1795 and all data circuitry clocks are derived from the same source.

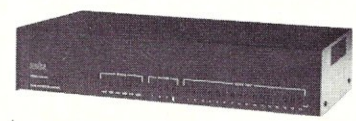
A unique feature of this S-100 bus controller is its ability to read and write different-size and formatted disks. This is accomplished by placing the CP/M boot program in ROM and the CP/M disk translation tables on the disk sector normally containing the boot program. This allows the automatic mixing of disk densities and the ability to read various types of formatted disks no matter how they are formatted. There are presently 5 different disk formats for 5¼″ disks supported from the 40-track single-sided single-density to 96-track double-density double-sided 512-byte sectors, and 8″ formats from the single-sided single-density format to double-sided double-density 1024 bytes per sector. There is also the capability of creating your own types of formats, as the source listing is included.

Supplied with the UFDC-I is a User's Manual and an 8″ single-sided single-density CP/M disk containing the Monitor/BIOS and Disk Formatter source listings.

Price: A&T $325; kit, $295; bare board $68. GSR Computers, 60-10 69th St., Maspeth, NY 11378; (212) 476-2091. NYS residents add 8¼% tax; add $5 shipping/handling.
CIRCLE #216 ON READER SERVICE CARD

Code-activated device switches 16-64 RS232 ports

A code-activated RS232 asynchronous terminal switching device is now available from Western Telematic, Inc. When connected to a modem or CPU, it can switch between any one of 16 ports by using a two-character user-selectable



ASCII code sequence. It is field expandable to 32, 48, or 64 ports by attaching additional switching modules. Optional 19″ rack mounting brackets are also available.

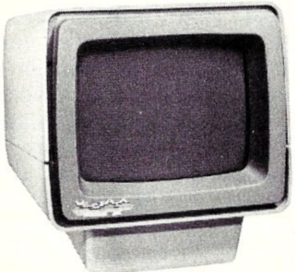
Price: Basic 16-port unit, $800; 16-port add-on modules, $550 each. Dave Shumway, Western Telematic Inc., 2435 S. Anne St., Santa Ana, CA 92704; (714) 979-0363; (800) 854-7226.
CIRCLE #217 ON READER SERVICE CARD

High-resolution graphics processors

Vectric Corp. has announced the VX series high-resolution computer graphics processors. Priced at $1995 without monitor, the VX128 Graphics Processor features 672 x 480 resolution, 8 simultaneous colors, and high-level graphics commands for easy creation of 3-D vector images—with rotation, translation, scaling, and automatic polygon fill; also interfaces to most color printers.

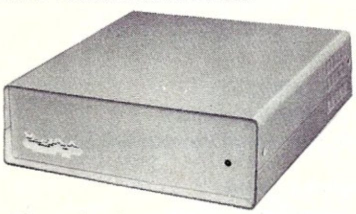
The VX128 translates commands via RS-232C serial or parallel ports. The new NEC PD7220/GDC chip is used for high-speed generation of lines and arcs in a variety of dot-and-dash patterns and 1600-nsec pixel update; and 128K RAM frame buffer with 3-bit planes for individual pixel addressability in any of 8 colors.

The VX128 allows the user to load any text font, with variable zoom factor, slant, and spacing, or to use a built-in character set. Characters can be mixed with graphic images.



The Vectrix VXM 13″ diagonal high-resolution RGB monitor is recommended and is available for $1295.

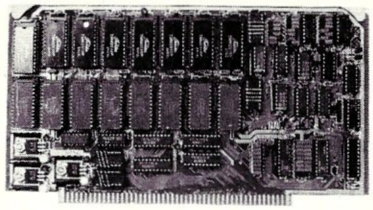
Vectrix also announced the VX384 Graphics Processor, an advanced version of the VX128, priced at $3995. The VX384 allows for 512 simultaneous colors from a palette of 16 million for subtle shading of solid model objects. The VX384 features a 384KB frame buffer with 9-bit planes, color look-up table, and 8-bit digital-to-analog converters, allowing for high-speed pixel color manipulation and bit plane-based animation.



Vectrix Corp., 700 Battleground Ave., Greensboro, NC 27401; (919) 272-3479 or (800) 334-8181.
CIRCLE #218 ON READER SERVICE CARD

S-100 memory card (128K static RAM, 512K ROM)

The "Memorizer" memory card features two banks of eight sites, allowing you to have from 32K to 128K of RAM

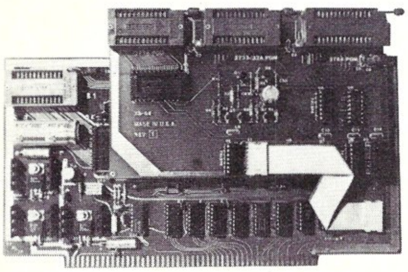


(using the 16K 6116s or 64K 6264s RAMs) and/or up to 512K ROM (using 27256s). Board takes any 1K × 8 to 32K x 8, single supply part, RAM or ROM. Each bank is independent of part size and type. The Memorizer supports extended memory address or pre-IEEE-696 bank select with from 0 to 5 wait states for each bank. LED's show which bank has been selected.

Price: $219.95 A&T, without memory. Ackerman Digital Systems, Inc., 110 N. York Rd., Suite 208, Elmhurst, IL 60126; (312) 530-8992.
CIRCLE #219 ON READER SERVICE CARD

EPROM programming board for 32K/64K ROMs

The Extek XB-64 is an adapter for the SSM PB-1 EPROM programming board. It expands the programming capability of the PB-1 from 2716, 2708 to 2764, 2732, 2732A, 2716 and 2708 EPROMs. The XB-64 allows board deselect via software-controlled bank switching, useful for 64K memory systems. The board contains separate zero insertion force sockets for each EPROM type; these are raised above the plane of the standard S-100 boards for easy access. Dual-programming voltages are provided for 2732A and 2764 under software control.



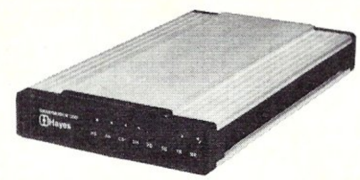
The XB-64 comes with menu-driven software under CP/M including disk and source program to copy, check erasure, program, and verify all EPROM types listed. Price: $106 kit, $125 A&T. Extek, 881 Cumberland Dr., Sunnyvale, CA 94087.

CIRCLE #220 ON READER SERVICE CARD

1200 baud, 212A modem

Hayes Microcomputer Products, Inc., has introduced the Hayes Stack® Smartmodem 1200, a Bell 212A compatible modem that lets RS-232C compatible computers or terminals communicate over telephone lines at 1200 bps.

The Smartmodem 1200 is approved by the FCC for direct connection to any U.S. telephone system for both pulse and Touch-Tone dialing. Both types of dialing may be combined in a single command.



The Smartmodem 1200 operates at either 0-300 bps or 1200 bps. It is an intelligent system that executes user commands and responds with either decimal digit or English word result codes. The modem can be controlled by any programming language, and it includes all circuitry for auto-dial and auto-answer. Indicator lights on the modem's front panel allow a visual check of its operational status.

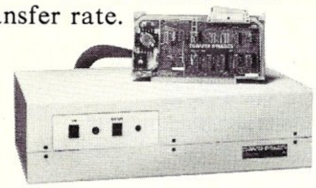
Options include full or half duplex, enable auto-answer, result code type. "Set" commands allow selection, change of additional parameters.

New Products
continued . . .

The Smartmodem 1200 has a two-year limited warranty. Included are a power pack, one modular telephone cable to connect the unit to the telephone, and an owner's manual. Suggested retail price is $699. Hayes Microcomputer Products Inc., 5835 Peachtree Corners East, Norcross, GA 30092; (404) 449-8791.
CIRCLE #221 ON READER SERVICE CARD

5MB hard disk expansion for S-100 bus systems

The WIN 5-S100 is a complete high-reliability, high-performance, low-cost, 5MB hard disk subsystem ready to operate with S-100 bus systems under CP/M. This unit features an environmentally sealed, high-reliability Winchester drive with error detection and correction and a 4.3MB data transfer rate.



The WIN 5-S100 is a self-contained subsystem that requires one interface slot on the S-100 motherboard. The drive is manufactured and serviced worldwide by Shugart.

The WIN 5-S100 is priced at $1695 in single quantities. Kits are available from $950 for the "do-it-yourselfers" or OEMs. Club and dealer discounts are available. The WIN 5-S100 is expandable to a total of 20MB. Computer Dynamics, Inc., 105 S. Main St., Greer, SC 29651; (803) 877-7471.
CIRCLE #222 ON READER SERVICE CARD

S-100 sound board

The sounding board is a combination voice and sound output board for S-100 computers. Based on the Votrax SC-01A phoneme synthesizer chip and the TI 76489 sound generator, this board is fully S-100 compatible and uses the wait line for synchronization. It occupies four I/O addresses that may

New Products
continued . . .

be user-selected by on-board switches.

Software is provided for both sound and voice generation in CP/M-compatible single-density disk format. All software is provided in both COM and PASCAL MT+ source format. Speech software includes a dictionary of approximately 300 words along with programs necessary to create, add, and make use of the dictionary. Also included is a text-to-speech program based on the Naval Research Laboratory algorithm that generates speech without the limitation of dictionary look-up.

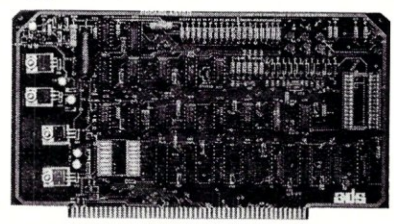
Sound generation software includes programs for creation of electronic music, Morse code training, and various demonstration programs.

Price: $450. Cygnus Systems, 1245 Columbine #402, Denver, CO 80206; (303) 393-6526.

CIRCLE #223 ON READER SERVICE CARD

S-100 EPROM programming card

Programming 1K/2K/4K and 8K EPROMs (single and three supply parts), the ADS Promblaster is controlled by software running under CP/M, or ADSmon MC6809 monitor (used in the ADS MC6809 single board computer). Total software control gives widespread versatility and ease of use, ability to update software as new EPROMs appear on the market.



The Promblaster appears as an IEEE-698/S-100 I/O device on the S-100 bus. Thus the Promblaster does not take up memory locations and fits easily into most systems without hardware conflicts. Further features include: on-board wait states, extended device option and switch-selectable device addressing.

New Products
continued . . .

Prices: Kit, $199 (includes software), and $299 A&T (includes software). Ackerman Digital Systems, Inc., 110 N. York Rd., Suite 208, Elmhurst, IL 60126; (312) 530-8992.
CIRCLE #224 ON READER SERVICE CARD

4- to 20-user system

The SYSTEM 2900 is a multiuser computer system for 4 to 20 users. A 20-user SYSTEM 2900 can be purchased in OEM quantities for between $8000 and $13,000. SYSTEM 2900 is available with a wide selection of disk drives.

BUSINESS EXPRESS, an application system created by Systems Group, provides the operating power to transform the 8-bit SYSTEM 2900 into a machine with true minicomputer performance. It integrates a very sophisticated database manager, a multiuser executive, and an application processor into a stand-alone application system. The result is a business development and operating system optimized for data retrieval and designed with user-friendly interfaces.

The BUSINESS EXPRESS system supports 10 users simultaneously and offers all the hardware expandability needed to support any combination of 20 user consoles and/or printers and 80 megabytes of fixed hard disk storage. A 15MB tape drive, or optional floppy disk drive, supplies fast and efficient hard disk backup.

Prices: Business Express, 20-user, $18,770; Multiuser OASIS software package, $995; MP/M, $435-585 depending on configuration. Systems Group, 1601 Orangewood Ave., Orange, CA 92668; (714) 633-4460.
CIRCLE #225 ON READER SERVICE CARD

classified ads

CLASSIFIED RATES: Per Word, 15 Word Minimum. REGULAR: $1.00. EXPAND-AD®: $1.50. GENERAL INFORMATION: Prepayment discounts available. Payment must accompany order except credit card—Am. Ex., Diners, MC, VISA (include exp. date)—or accredited ad agency insertions. Copy subject to publisher's approval; must be typewritten or printed. First word set in caps. Advertisers using P.O. Boxes MUST supply permanent address and telephone number. Orders not acknowledged. They will appear in next available issue after receipt. Send order & remittance to: Classified Advertising, MICROSYSTEMS Magazine, 1 Park Avenue, New York, NY 10016. Direct inquiries to (212) 725-3927.

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MISCELLANEOUS

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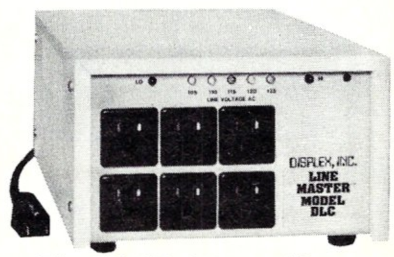
New Products continued . . .

A.C. line conditioner

Displex Inc. has announced the new DLCA-8 and -16 automatic line conditioners. These units have over 97% efficiency and effectively block RF noise and voltage surges while automatically monitoring and maintaining power line voltage—even with "brownouts" down to 80 VAC on nominal 115 VAC lines (160 VAC on 220 VAC lines).

The DLCA line conditioner is a smaller, lighter, more effective and less expensive replacement for older designs using either ferroresonant transformer voltage regulators or "tap-switching" regulators with an isolation transformer • Using a tap-switched 20% "boost buck" autotransformer, the DLCA units can deliver the high surge currents necessary for starting large disc memory systems and still remain small for the average power loads.



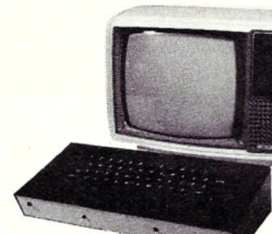
The DLCA-8-1 provides 8 amps regulated output at 115 VAC ± 10%; price: $535. The DLCA-16-1 provides 16 amps; price: $795. The 8-amp/1 KVA unit weighs 15 lbs and has case dimensions of 5″ x 8″ x 11″. The 16-amp/2 KVA unit weighs 25 lbs and is 5″ x 10″ x 14″. 1 KVA and 2 KVA units at 220 VAC (50/60 Hz) are also available in the same case sizes.

Displex Inc., 79 Hazel St., Glen Cove, NY 11542; (516) 671-4400.

CIRCLE #226 ON READER SERVICE CARD

Low-cost video terminal

The LCT-100 is a "dumb" terminal featuring a full ASCII keyboard in standard typewriter format, 24 x 80 display, 7 x 9 dot matrix characters with true descenders, 31 special graphics symbols, and an RS-232C interface (110 to 9600 baud). Packaged in a keyboard enclosure with standard video



output, the LCT is available with a separate 12″ green phosphor video monitor or alone to connect to any standard monitor. Price: $275; with monitor, $350.

Low Cost Peripherals, P.O. Box 1773, Corrales, NM 87048; (505) 294-2857.

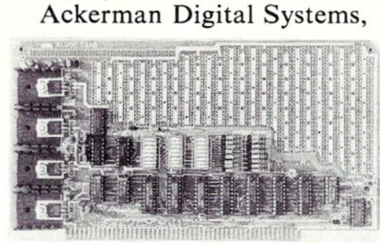
CIRCLE #227 ON READER SERVICE CARD

S-100 prototyping card

Designed for S-100 prototyping, the ADS Kluge Card has built-in much of the logic needed to interface to the S-100 bus. It has bidirectional data and address bus buffering, buffered control lines, wait states, extended device and/or memory select, address decoding, and more.

The bread-board area of the card, consisting of multiple rows of holes on 0.10″ spacing, has four power supplies bussed to it by the on-board power supply. The user has a choice of jumpering for ±5V and/or ±12V. Up to three of the supplies may be +5V, the fourth the user's choice of −5V or −12V. Available as a bare card for $39.95, kit for $149.95, A&T for $199.95.

Ackerman Digital Systems,



Inc., 110 N. York Road, Suite 208, Elmhurst, IL 60126; (312) 530-8992.

CIRCLE #228 ON READER SERVICE CARD

Microsystems Mart

CompuPro

SYSTEMS!

System 816A $5495.00
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System 816C $8995.00
(415) 453-0865

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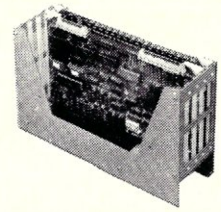
P.S. We also offer programmer tools in forms of developed and debugged Basic functions and subroutines.

*CBASIC, CB-80 are ™ of Digital Research, Inc.

EDGE-86

AN INDUSTRIAL QUALITY 8086 OEM SYSTEM



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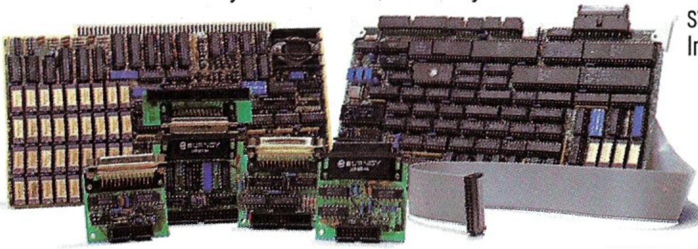

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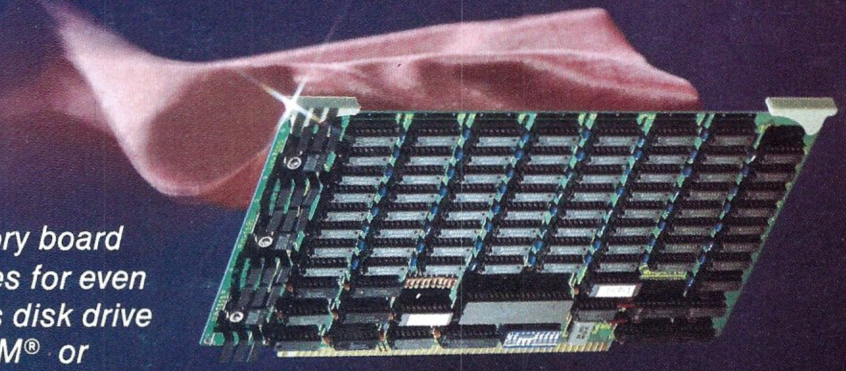

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