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New Products .......................................................... 92
I assemble and sell PC clones. As an OEM dealer I have learned much of the trials and tribulations of dealing with clone component suppliers. (You think you have problems?)

First, one must learn to deal with manufacturers and distributors without developing ulcers. To my knowledge, the electronics industry is unique! When you are promised delivery on Wednesday, sure enough the shipment arrives on Wednesday. Unfortunately nobody remembers to tell you WHICH Wednesday.

In the music industry, arriving late once meant no more opportunities! If you didn’t deliver the goods that was also your last chance.

Finally, all the pieces have arrived. Now for the experience of assembling a computer. You unwrap the boxes, and there are quite a few per machine. Let’s count them:

1) Case
2) Power supply
3) Mother board
4) Disk drives (usually 2)
5) Video card
6) Disk controller card
7) Hard disk controller card
8) Hard disk
9) IO card
10) 256K memory chips
11) 64K memory chips
12) Speaker
13) Monitor
14) Keyboard

The case looks OK except for a scratch on the back. Maybe your customer, who has been calling daily, won’t notice. The keyboard looks fine, except it has two extra keys in the numeric pad and no 5-key. The drives are not the ones you ordered because XYZ company isn’t shipping this month. You have the distributors assurance that the drives you received are “every bit as good as...”. Then you notice that the memory chips are KOREAN at 200ns when you ordered JAPANESE at 150 or 200ns. Like “H E L P!” You begin assembly. It feels like the birth of a child, organizing this pile of inert electronic junk and beginning the creation of life(?). One by one you casually pop the 36 memory chips into place. In show business, “break a leg” brings good luck. In the computer-biz break-a-pin means a dead bug, or loosely translated, a broken chip. When this heroic feat is done, pat yourself on the back and think, “great, the hard part is over”

Next, install the little gold posts that hold the mother board to the case. This requires nine posts, (count ‘em, nine lovely posts), and eighteen insulated washers. (Total cost about 50 cents.) Terrific! You sent those clowns a few thousand dollars and received seven gold posts and three washers. So, run to the local hardware store (muttering curses and swearing never to do business with XYZ again), and buy the needed parts.

Now to screw the mother board into the case. OOPS, the holes don’t line up. Almost, but no cigar. Get out the drill.

Mother board now installed. Mission impossible almost accomplished. The power supply is next, (no problem). Now the time for groaning as you press a quarter inch piece of plastic into a space one eighth inch wide. You succeed the first time, except the wires are all backwards.

The moment of truth is approaching. The video card pops in nicely. Carefully remove the monitor from its box and attach it to the computer. The AC plugs go into the wall sockets. If everything works you should see a memory check. Bravely turn the on/off switch and voila...no video. Your response is immediate, quick thinking at its best. Turn the machine off.

Right! You forgot to set the switches on the mother board. Not trusting your memory, you check the mother board manual and set the switches. The computer is switched on again and “hooray,” it’s working. (Did the customer order amber or green?) You know the answer, whatever you haven’t received.

Did you ever look inside a PC? Check the drive cables...it’s a jungle in there. Why do they make cables that have to be bent backwards to make the top drive the (A) drive? Screwing the floppy and hard disk into the system is a study in itself. It comes pretty easily if you are by nature a pretzel.

The cards are put into the slots and the big minute arrives. A DOS disk is placed in the A-drive and the system boots. Now the debug ritual for setting up the hard disk. Only problem, the fella who shipped out the hard disk forgot to enclose the spec sheet. This problem can’t wait. A call is placed to the tech, who’s out to lunch. The promise is made that he will call back by two o’clock California time...nobody tells you which day!

Once passed the sub/formatting, we invoke the great god FDISK who partitions our fixed storage media. Formatting the hard disk and creating a few subdirectories for your customer is S.O.P. Everything works well. Button up the machine and call the customer with the news, “your computer is ready.” Everyone is excited.

Mr. Customer comes to pick up his computer and exclaims in delight “you know, it flickers.”

I hope you realize that much of this is tongue in cheek. What I am earnestly stating is, details don’t matter to the clone component makers. The consumer, or the dealer, becomes the testing ground. In the best situations, the dealer swallows all the grief prior to delivering the equipment. Occasionally, bad things happen later. It is usual for a retailer to test equipment from 5-10 days to prove it out. Don’t break his chops. More often than not, he is protecting you.
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- **Categorization of keywords** is accomplished by a variable one-character prefix on the keyword (any printable ASCII character).

- Search lists come in four types: MATCH, NONMATCH, GRTR/= and LESS/=. An item satisfies an ALL query if it satisfies all the lists (AND logic).

- Multilist queries come in two types: ALL and ANY. An item satisfies an ANY query if it satisfies any list (OR logic).

- A list may have any number of keywords, and any mix of categories.

- **Search output** is a list of "hits", the id numbers of the abstracts which satisfy the query, stored to a file.

### Resume Example

Categories are: T = title, F = function, G = year graduated, P = product area, $ = salary, D = degree, M = major, S = school

<table>
<thead>
<tr>
<th>Sample Abstract #43</th>
<th>Sample Queries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Id</strong></td>
<td><strong>keyword</strong></td>
</tr>
<tr>
<td>43</td>
<td>T_Assistant Director</td>
</tr>
<tr>
<td>43</td>
<td>F_Sales</td>
</tr>
<tr>
<td>43</td>
<td>G_73</td>
</tr>
<tr>
<td>43</td>
<td>G_73</td>
</tr>
<tr>
<td>43</td>
<td>G_71</td>
</tr>
<tr>
<td>43</td>
<td>G_76</td>
</tr>
<tr>
<td>43</td>
<td>$50000</td>
</tr>
<tr>
<td>43</td>
<td>S_Columbia U.</td>
</tr>
</tbody>
</table>

- Searching is fast because all entries across all categories are indexed simultaneously — all "search keys" are inverted at once.
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RUMORS & GOSSIP

At a recent meeting of the Wall Street Security Analysts, IBM publicly acknowledged that the PC is facing increasingly stiff competition from the clone market. IBM's Chairman of the Board, John Akers, said that IBM plans to respond by increasing its PC products and services. He warned that if this segment of the computer industry becomes "increasingly commodity like," with price as the controlling factor, "you will probably see the IBM company departing from those parts. We are in the business of high-margin sales."

According to reports from market-research firms, IBM's share of the PC-compatible retail market is now less than 40%, down from 55% in January of '85. IBM's leading competitors in this market are: Compaq, AT&T, Leading Edge, Epson, Zenith, Kaypro, and several Asian companies.

Shipments of IBM's new RT RISC desktop systems are reported to be slightly ahead of expectations, according to an unidentified IBM executive. Projections are for $800 systems to have been shipped by year's end.

Intel Corp. is rumored to be developing an 80386-based motherboard to replace the AT's 80286-based motherboard. (See the last part of this article for more on the 80386.) Also expected is a PC card with Intel's new video chip for high-resolution graphics.

Commodore International has decided not to introduce into the U.S., two PC-compatible machines currently marketed in Canada and Europe. Rumors are that they need to move a huge inventory of Amiga machines first.

The number of exhibitors at this year's National Computer Conference (once considered "THE" computer show of the year) dropped by over 20% from last year. With attendance down as well, the decrease in participants has been ascribed to computer conference "burnout" (there had been five major shows in the two months just prior to NCC '86), as well as competition from highly-specialized shows.

In the first quarter of '87, Microsoft is expected to release a new version of Windows which will operate under MS-DOS version 5. In addition to improved performance under DOS 5.0, new features, such as mouse macro's, will be included. There are also rumors that Microsoft will introduce its own super-high resolution, color-display, controller card for the PC based on the TI-34010 chip. The unit should provide 640 by 480 pixels (the EGA can give only 640 by 350) and will be much faster than the EGA card.

Datquest, a market-research company, estimated that worldwide sales of PC-graphics were $7.1 billion in 1985. This is predicted to rise to $9.5 billion in 1986.

It is rumored that Exxon is seeking to divest itself of its Zilog subsidiary and that AT&T and Honeywell are interested. Zilog, along with a dozen other companies, was bought during Exxon's high-tech buying binge fueled by the bullish oil market of the '70s. Most of these acquisitions have since been closed or sold. The pending sale of Zilog is ironic as the company has just recently gotten out of the red-ink area.

While Apple quietly dropped its plug-in LCD display for the IIC, IBM noisily introduced its laptop, the PC Convertible, which has a plug-in LCD display. Apple will continue to market a CRT display for the IIC. Future offerings from Apple include videodisk and CD-ROM products designed for school use. The National Geographic Society and Lucasfilm are helping Apple put together the digitized sound, graphics, and story segments. The disks are expected to operate on a new version of the Apple II that will have a high-resolution display and the 65816, 16-bit processor. An upgrade will be offered for existing Apple-II systems.

Speaking of Apple, it's been reported that MacDonalds Corp. is suing all Macintosh product developers (including Apple) over the use of the term "Mac" as a modifier in any product name, e.g. MacDraw, MacWrite, MacTutor.

George Morrow, who got his start making S-100 boards, is back in business. His new enterprise (Intelligent Access, Oakland, CA) will be producing PC-compatible boards.

Com and Codenoll Technology have joined forces to bring out a version of the popular Com Ethernet network which operates over a fiber-optic cable.

IN THE PUBLIC DOMAIN

PC-SIG (Sunnyvale, CA), a commercial distributor of PC/MS-DOS public-domain software, is now distributing their entire software library on a single Compact Disk (CD-ROM) for $195. The library was previously available as a set of over 500 floppy disks costing over $2000. PC-SIG is also selling the Hitachi CD-ROM reader drive with a PC-interface card for $995 (compatible CD-ROM readers with interface now sell for as little as $600). A menu-driven program is provided on-disk to assist in locating programs.

If you buy a CD-ROM and reader from Reference Technology Inc. (Boulder, CO), they'll give you a disk containing the PC-SIG library.

IBM EGA-II EXPECTED SOON

IBM recently released, at least to software developers, the specifications for the new version of their Extended Graphics Adapter (EGA) card, called the "EGA-II". The EGA is rapidly becoming the display standard for PC-compatible systems.

When IBM introduced the EGA, it got a cool reception. Its basic problems were high price (almost $1500 for the card and display) and the lack of software that could take advantage of its features. It took only about 9 months for the clone board makers to introduce EGA-compatible systems, for the display makers to introduce EGA-compatible displays, and for the software developers to add EGA drivers to their products. The competition has resulted in the EGA/display combo dropping to under $800 in price and becoming the new standard for high-resolution, color graphics. In addition, many of the clone boards offer features (e.g. Hercules emulation) surpassing the performance of IBM's EGA. This has caused a significant drop in IBM's share of the EGA market.

Now comes word that IBM's EGA-II will have a raft of new features including enhanced resolution, more modes, more colors, and an increased capacity to down-load fonts. It is also expected to require an analog display, whereas the current breed of EGA uses a digital display. The cost of the card and display will be in the $1500 to $2000 range.

I give the EGA clone makers about 6 to 9 months to catch up with this new IBM product, driving the price down under $1000. It will probably take a little longer for the software houses to meet the challenge. In the meantime, I expect the price of the EGA-I/display combination to drop below $600.

AT COMPATIBLES TAKE THE LEAD

Less than two years ago, IBM began shipping their AT machines. It is estimated that well over 500,000 AT's have already been sold. This has partially compensated IBM for the loss of its share of the PC-XT market. According to Future Computing, a market-research firm, the AT now accounts for 32% of IBM's desktop sales and will probably soon surpass their XT sales. Nevertheless, IBM has not achieved the market share with the AT that it once had.
with the PC-XT's. And, although IBM is still the market leader, its share of the AT-class market is eroding rapidly. It is estimated that over 1.2 billion AT-class machines will be sold this year, with IBM responsible for only 45% of the sales. In addition, the Japanese, Koreans, and Taiwanese have not only just recently begun to ship their versions of the AT. As a result, the single-unit price of a basic AT machine is already under $1500, with additional discounts for large-volume purchases. By this time next year, IBM's market share will probably be even less as AT-clone prices drop further.

There are already almost 40 AT-compatible vendors: Compaq, KayPro, NCR, HP, AT&T, Tandy, Wang, Sperry, and TI (listed in order of decreasing volume) are IBM's leading AT competitors. Virtually all of the clones have features not available on IBM's AT. It is surprising to find KayPro in the number three position, ahead of such heavy weights as HP, AT&T, and Tandy. By next year, the number of AT-compatible vendors will be even larger and the Far East suppliers will probably be major forces in the market.

Prices for the 8-MHz AT knockoffs equipped with 30-Mbyte hard disks are already nearing the $2000 level. IBM can be expected to cut prices to meet this competition. As the price gap between the XT and AT class machines is quickly narrowing, the AT market should continue to increase as PC-XT owners trade in their machines. The introduction of DOS 5.0 next year should also spur sales, as this version of DOS requires a 286-based system.

IBM LAPTOP ANOTHER LOSER?

IBM's new laptop machine, called the "PC Convertible," appears to be living up to one suggested interpretation of IBM's acronym, i.e. "Inferior But Marketable." But then again, it may not be living up to the manufacturer's part.

Its poor showing thus far is apparently due to IBM's late entrance into this emerging market with a product that has fewer features, lower performance, bigger size, and higher price than its competition. Unlike well-designed laptops, such as the Toshiba 1100, the PC-Convertible is unable to run some of the most popular programs, e.g. LOTUS 1-2-3. In addition, its built-in modem is not Hayes compatible and therefore will not work with most of the popular communications programs. The LCD display also leaves much to be desired. With the plug-in options attached, the size and weight are increased such that the unit can no longer be considered a laptop. There is no 5 1/4 disk option, so users must add an expensive 3 1/2 disk drive to their PC or AT. Adding in the cost of the options, the price of the PC-convertible is also substantially higher than that of its competition. Those same features are sold as standard equipment in the Toshiba and other laptops. Furthermore, high-performance 286-based laptops are already available.

SCSI STANDARD APPROVED

ANSI (American National Standards Institute) has given final approval to the SCSI standard (Small Computer Systems Interface). The SCSI is a high-performance bus designed to direct the use of several intelligent peripherals on a single CPU. If the bus is accepted by peripheral and system manufacturers, it will ease development of hard-disk, tape, and optical-disk drives, as well as other peripherals. (See the article in this issue.)

There are already a large number of products equipped with the SCSI, unfortunately some were made before ANSI began work on a set of common commands for controlling SCSI-interfaced, hard disks. This upgrade, which will be called "SCSI-II," is expected to be released in the next year.

Apple has announced that it will include an SCSI interface on its new version of the Macintosh. DEC, AT&T, Wang, Sun Microsystems, Hitachi, as well as several others, are also supporting the new standard. Though IBM has not as yet declared its intentions, there are rumors that the company plans to use the SCSI for a CD-ROM drive to be marketed by late next year. If IBM ignores the SCSI and goes its own way, this could eventually kill the standard.

ARE SOFTWARE WARRANTIES REALLY WARRANTED?

Doesn't it bug you to read the Software Warranty on a typical commercial software package? The supplier usually states that it "makes no warranty with respect to this software" and that the product is sold "as is" with "the licensee assuming the full risk as to quality and performance." When you get down to it, this is no warranty at all! Hopefully, this may soon change as ADAPSO, the industry association, is applying pressure to several of the larger software suppliers. They are proposing that the software makers offer a refund within 90 days for programs found to have a bug or if the product does not meet the maker's ad claims or specifications. According to ADAPSO MicroPro, Lotus and Ashton-Tate have already agreed to this.

200-MHz RISC CHIP SET BEING DEVELOPED

DARPA (Defense Advanced Research Projects Agency) is funding the development of the first gallium-arsenide, 32-bit, RISC (Reduced Instruction Set Computer) chip set. Contractors for the project are Texas Instruments and McDonnell Douglas with delivery slated for mid-'88. The chip set is expected to operate at a 200-MHz clock rate, executing most instructions within one clock cycle. Lower-performance

CMOS versions are expected to be made available as commercial products. Also funded was the development of an ADA compiler, Common LISP, and MACH (a new high-performance operating system compatible with UNIX).

AT CLONE COMPATIBILITY PROBLEMS

Some users are reporting compatibility problems with some AT clones. The primarily problems occur when the units are used in networking environments. Units that operate at 10 and 12Mhz with no wait states and are used with the IBM token Ring Network and Novell system appear to be among those with problems. In some cases the units simply do not work and in others have unexplainable crashes.

AMIGA AFTER ONE YEAR

The Commodore Amiga will be one year old this October. Commodore claims that by its first birthday it will have shipped 110,000 machines but industry pundits think it will be more like 30,000 units. The unit, which is actually made by Sanyo, is carving out a niche among users who do video production and simulation in real time, or near real time. It has a achieved quite a following in the TV broadcasting business. Graphics designers can easily synchronize, or genlock, external video signals to the machine.

However, in the larger personal computer marketplace its sales have proven a disappointment. Despite substantial price cuts (it now sells for under $1,000) it has not been able to compete against systems of lesser performance, such as the Macintosh, PC and Atari ST. There is no doubt that Commodore is yet to turn a profit with the system.

A second-generation Amiga, based on the 68020, with higher resolution and an internal 20Mbyte drive is expected to be introduced by year-end. However, Atari and Apple are also expected to introduce 68020 systems. All of these systems are expected to sell in the $3,000 range, allow execution of PC software and be usable as workstations on a networking system.

THE PC/MS-DOS/UNIX/80386 CONNECTION

With its virtual architecture, the 80386 will permit applications to be run concurrently under different types and copies of operating systems simultaneously. Three companies have already announced plans to release the first operating system for 80386-based machines. If IBM drops its feet in introducing its 386 system, one of those three just might beat them.

Interactive Systems has a contract with Intel Corp. and AT&T-IS to port the UNIX operating system to the 386. Interactive Systems has teamed up with Phoenix Software Associates to develop V-36/IX, UNIX
Does this look familiar? What if each change you made to your program was ready to test in seconds instead of minutes?

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- Supports math on externals
- Requires Z80 CP/M compatible systems with at least 32K TPA

System V Release 3.0. The system will enable several MS-DOS and UNIX applications to run concurrently. The MS-DOS emulation will be developed by Phoenix. The system will be made available to other OEM’s, with the single-user version promised by year’s end and the multi-user version by mid-’87.

Several PC clone and workstation makers are expected to announce 80386-based machines. Look for them to run MS-DOS in the 8086 emulation mode or under UNIX V 3.0 using a PC/MS-DOS emulator. Many manufacturers are hoping that this bridge between UNIX and DOS will finally bring UNIX into the business office.

Locus Computer is developing a version of its Multisystem Merge for the 80386-based UNIX V 3.0. This software will run PC/MS-DOS applications as a task under UNIX. AT&T-IS had acquired Multisystem Merge and offered it to users to aid them in running DOS programs under UNIX on AT&T’s 6300-Plus, 80286-based machines.

Softguard Systems, developer of a popular copy-protection system, has announced its VM/386 operating system which can run VM, UNIX, and DOS applications concurrently. And, Award Software (Los Gatos, CA), a DOS BIOS supplier, is promising a 386-based ROM BIOS.

Intel is boasting that it will ship over 25,000 of the 386 chips in the third quarter of this year, with over 100,000 by year’s end. This means that Intel is ramping up production of this chip at a much faster rate than was done with the 8088 or 80286 chips. If this is the case, 386-based systems may dominate the personal computer market by the end of the decade. In comparison, Motorola has shipped about 90,000 of the 68020 chips so far.

COMPUTER MAGAZINE BIZ UPDATE

Last year was a terrible year for computer magazines (in spite of it we started MSJ). Two of the top sellers (Creative Computing from Ziff-Davis and Popular Computing from McGraw-Hill) closed their doors. Circulation of the top-ten magazines dropped 6%, the number of ad pages dropped 20-25% and ad income dropped 10-20%. Since more magazines closed up than started there has been an overall decrease in the number of computer magazines published. As a large number of the remaining magazines are no longer profitable, we will probably see more close this year.

There has also been a shift in position. For example, BYTE magazine, the long-time circulation leader, no longer ranks in the top ten. Who is number one, you ask? Why it’s Family Computing, published by Scholastic’s Inc., with a circulation of 610,000. Second is Personal Computing, followed by Lotus, PC Magazine, and Run.

HINT OF THE MONTH

If you have an AST PC multifunction card and need to replace the clock-calendar battery (Matsushita BR2325) you will discover it is not a standard stock battery and is only available from AST for $10 plus shipping. But don’t fear, a Duracell Lithium DL2025 fits the holder, provides the same voltage, and is readily available in most parts stores at considerably less cost. Though slightly smaller in diameter than the original battery, it fits quite well in the holder.

NOTEWORTHY NEWSLETTERS & MAGAZINES

If you are into ZCPR3, check out the Z-NEWS newsletter, published every other week. It is devoted to supporting ZCPR3 and Z-System users. A subscription is $24 or send $1 for a sample issue. Echelon Inc., 101 First St, Los Altos, CA 94022.

Bruce Morgen, author of the Advanced User column in USER’S GUIDE magazine has started a newsletter for 8-bit system users called the NAOG Newsletter (North American One-Eighty Group). Cost is $15 a year for 12 issues. NAOG, Box 2781, Warminster PA 18974, (215)443-9031.

The Computer Journal is devoted to those who interface, build and apply micros. It appears to be oriented to S-100 and Apple-II users. A sample copy is $3.25; subscriptions are $14/yr and $24/2yrs and is published bimonthly. The Computer Journal, 190 Sullivan Cross­road, Columbia Falls, MT 59912.
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Please send your letters to: Micro/Systems Journal, Box 1192, Mountainside NJ 07092.

LIKES THE M/SJ EDITORIAL APPROACH

Dear Libes:

Thank you for continuing publishing the magazine which shows the best mix of articles on CP/M and PC/MS-DOS. Your editorial wisdom shines over several magazines I subscribe to. As an owner of both 8-bit and IBM PC/XT compatible machines, I straddle across information gap. Micro/Systems Journal is the one I use to go back and forth between the two worlds.

As a computer user (never an innova­tive one) who cut his teeth with CP/M, I deplore wholesale abandonment of CP/M world, but at the same time, I feel that our eyes should be on the future of the microcomputer world which appears to be moving toward multi-user, multi-tasking system of UNIX, Concurrent DOS, and MS-DOS. I am a type who feels very sad whenever I use MS-DOS version of WordStar 3.31. Being of CP/M heritage, WordStar 3.31 is not programmed to use a full capability (especially graphics) of MS-DOS. Because of CP/M constraints which are still visible in WordStar 3.31, WordStar loses its productivity edge to newcomers, such as Microsoft Word, and Word Perfect. I am happy to learn that MicroPro is coming up with WordStar II, which I suppose uses all of the MS-DOS advantages.

I have checked software which has both CP/M and MS-DOS versions, such as Turbo Pascal, Condor (database management program), dBASE II, Crosstalk, MITE, Milestone, SmartKey II, SuperCalc, and others. There are some improvements in productivity for the MS-DOS version, but they are not as impressive as the software written from scratch for MS-DOS. I wonder why. The only exception is dBASE which seems to be written fresh from the start (keeping, however, most of CP/M version's command structure) for MS-DOS.

In July/August issue, Steve Leon told us about his wishes for the types of CP/M software he wants to see. I really like to see along with Steve, "a way (will be found) to run a CP/M machine off PC serial port as a second console for the PC..." I really like Steve's thinking on how to use an 8-bit machine, perhaps 3-4 years old. These 8-bit machines will be worth only a few hundred dollars now, and they are destined to a junk pile without our tender, loving care. As a part of TLC to my 8-bit machine, I have installed R. Conn's Z-system, and I added RAM disk. I really appreciate reading articles in your magazine on how to use a 8-bit computer, once you get your own IBM PC clone!!

Please don't hesitate to include as many articles on 16-, 32-bit microcomputers in the magazine, as long as you have a few solid CP/M articles.

Sincerely yours,
Paul Naich
San Diego, CA

MORE CONCURRENT-DOS ARTICLES WANTED

Dear Sol:

I was pleased to read the first in­stallment of Alex Soya's articles on Con­current PC-DOS. The article was factual, interesting, and provided information on an operating system which has not received much attention from the PRESS. I am looking forward to reading upcoming parts of this series as Alex continues to explore Concurrent and provide systems development information.

I have used several versions of Con­current PC-DOS in a software development environment to develop software for in­dustrial process control and instrumenta­tion applications. Concurrent DOS has performed quite well, and has done most anything which I have asked of it (including such diverse requests as deleting the Ter­minal Management Processes, handling interrupt driven processes, and providing access to the shadow memory regions which store information for virtual con­soles which are currently in the background).

DRI's documentation, however, al­lowed for much learning. I am hoping that Alex' experiences will ease that process.

Using an operating system that man­ages several virtual screens on one or two physical consoles (some projects have both a color and monochrome screen) has saved several months of development effort. It is designed as multitasking from the start, rather than for one of the com­mercially available oil slicks that attempts to convert a single tasking operating system into a multitasking environment.

Manx AZTEC-C86 provides an ex­cellent development environment for Con­current DOS. Their developer's systems allows a user to generate either .COM, .EXE, OR .CMD output files by simply setting a switch on the linker and using the correct run time library.

Jerry Jankura
Strongsville, Ohio

We are beginning to get the impression that DRI's Concurrent-DOS is gaining in popularity with more advanced users. It is regrettable that DRI is not doing a proper job of supporting this product. Therefore, we expect to carry more articles, from Alex Soya, on Concurrent in future issues of M/SJ.

FROM AN ENTHUSIASTIC CONCURRENT USER

Dear Sir:

This letter is to applaud your recent article on the Concurrent PC-DOS operat­ing system. I am a senior systems analyst and for the past two years have been in­volved in a project to develop a work sta­tion for the Air Force. We used the Con­current PC-DOS operating system...
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- 2 MHz digital scope software included free.
- Sampling rates to 500 kHz.
- Simple menu driven operation.
- Store/Retrieve/Print modes.
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This peripheral provides continuous measurement of up to four channels of data at a selectable rate, and the data may be put out to hard disk or floppy. The number of data points to be taken is selectable by time or number of samples. Additionally, Start may be driven by either time or event (an internal or external trigger).

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- Data acquisition setup utility.

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Major features:
- Digital oscilloscope software included free.
- Sampling rates to 2 MHz.
- Data transfer utility.
- Selectable gain/sampling rate.

ENHANCED DIGITAL OSCILLOSCOPE PERIPHERAL

The enhanced digital oscilloscope is a software enhanced digital scope. The major features of this unit are:
- Zoom mode.
- Active scrolling of the waveform.
- Transfer data to 123/spreadsheets, dbIII files, or spectrum analyzer.
- Assembly language speed.
- Printer drivers.

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because it provided such a rich set of professional operating system features rarely supported by other PC operating systems. I can also favorably compare Concurrent PC-DOS with UNIX since I have had 3½ years of professional experience with that operating system as well.

Of course, there are the legions of staunch PC-DOS users who will not take the time to learn about any other operating system even if that operating system provides nearly complete PC-DOS compatibility. Perhaps the ability to run multi-tasking PC-DOS applications does not appeal to them. Perhaps they would rather wait a couple more years for Microsoft to get it right. Or perhaps they should look at UNIX or (XENIX) and throw away their current PC-DOS software.

I can only say that this operating system has provided my project the ability to run nearly all PC-DOS software and provide background communications with a mainframe while providing foreground user functions for data base management and word processing. The Concurrent PC-DOS operating system has also provided a future for my project to grow to a multi-user/LAN cluster architecture with minimal effort.

Every operating system has its shortcomings, but for PC based systems development, the Concurrent PC-DOS operating systems is a very fine product and deserves more exposure.

Again, I want to thank your magazine for such a fine article and I look forward to the future installments.

Sincerely,
Brian J. Mullan
Lutz, FL

**MS-DOS CONFIG.SYS CAUTION**

Dear MSJ

Just a quick note re: "undocumented options" in the article on configuring MS-DOS (May/June 86).

Changing SWITCHAR value is much more dangerous than you indicate. Many programs assume the default value of "", and all kinds of things can fail in interesting ways. However, most dangerous of all are the BACKUP and RESTORE commands. BACKUP will happily make backups for you using whatever bizarre SWITCHAR you want. But when it comes time to restore anything, RESTORE goes down in flames if it comes across backup diskettes made with a nonstandard SWITCHAR. This is probably not what you want when you've lost a hard disk and your backup diskettes are the only thing between you and a nervous breakdown.

Tempting as it may be (especially for Unix people), it's best just to leave SWITCHAR alone. It's just not worth the possible problems later. Also, I've noticed that Microsoft people go into conventions whenever the subject comes up, which does not bode well for possible future support of this option.

Otherwise, keep up the good work. I enjoy the magazine, especially articles on CP/M, so I ignore all such articles.

THANKS,
Dave Lutz
Canoga Park, CA

**BACKUP POWER SUPPLY INTEREST**

Sol,

I would very much appreciate your running an article on backup power supplies and/or the real utility of surge protectors.

There is so much hype regarding these gizmos, and they are bloody expensive! In the square wave vs. sine wave situation, the sine seems to be better from two standpoints: (1) area under sine wave is less than square wave, and thus is less likely to overheat the DC motor on hard disk drives, and (2) the voltage at ramp up and ramp down on a square wave is infinite, and some say that this condition can continue on page 13.
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LOMAS DATA PRODUCTS, INC.
This column features tips and techniques for using Turbo Pascal productively on MS/PC-DOS and CP/M microcomputer systems. It discusses typical problems and their solutions. Reader suggestions, comments, and questions are encouraged. Address them to Turbo Pascal Corner, Route 5 Box 107K, Greenville, TX 75401 or through MCI mail, 289-6124.

Beginning with this installment, I am assuming the reigns of the Turbo Pascal Corner from Dave Carroll. Long time readers of Micro/Systems Journal may remember some of my earlier articles, but I should nevertheless introduce myself. I am a full-time software engineer, part-time hacker and part-time freelancer. I have about 10 years experience with microprocessors ranging from 8080’s to 68000’s in assembler, Pascal and C.

I first became excited about Pascal as a computer language in 1978, when all higher level languages were limited to mainframes and BASIC was still king of the micros. I regained interest in 1983 when Turbo Pascal was introduced, not because of the language itself this time, but because of the incredible working environment. More working code can be generated in less time in Turbo Pascal than any other language environment. From time to time, I will be making appeals to BASIC holdouts to drop their security blankets and join us in exploring this powerful language tool. I will also be prodming Borland International into providing this same environment for other languages, such as C.

In future columns, I would like to examine various aspects of Turbo Pascal which may not always be clear. Borland did a reasonably good job in writing the user’s manual for Turbo, but they could not include everything. Hopefully, I can explain and clarify aspects of the language not covered in the manual. Example topics we will examine are: interrupt handlers (such as for communications, mouse drivers, etc.), manipulating screen memory directly, linked lists, the heap and Pascal’s confusing file structure.

To be responsive to the reader’s needs, I need your help. If there is an aspect of Turbo Pascal which you find particularly confusing, drop me a line and I will try and address it. Usually it helps to explain concepts with examples, so I would also like to hear of projects you would like to see developed in future columns. I would like to hear from the CP/M Turbo users as well as the PC-DOSers (I have been watching for TURBO for the MAC and the Amiga; I will pass along anything I find out.)

Before we get started, however, you should be aware that there are several aids available to the PC-DOS Turbo Pascal programmer that you should not be without. (A list of commercial tools available was discussed in the January/February ‘86 column by Dave Carroll.) As mentioned above, the manual that came with your compiler disk is quite good, but there are some other quite useful manuals available on the market. The first comes from Borland itself, the Turbo Pascal Tutor. This book does not replace the original manual, rather it expands upon it by offering example programs of every possible Pascal construct. It is directed to the beginner up through the beginning expert and comes recommended for both groups. Although there is nothing in the Tutor which is not covered in the manual, seeing example programs worked out can save many a debug hour.

Another manual geared somewhat more towards the beginner is our very own Dave Carroll’s book, Programming in Turbo Pascal. One of the nicest features of Programming is an included diskette containing, not only every example program from the book plus some extra utility programs, but also a version of the Turbo compiler to compile them with (this compiler is a limited feature version). Besides books, software is also available in the public domain to help beginners and experts alike in their programming efforts. These tools are available free of charge (or nearly so) from your local Bulletin Board Systems and public domain libraries (such as PC-Blue or the Turbo Users Group). Following are PC-DOS compatible highlights from the Turbo SIG (Special Interest Group) maintained on the CompuServe network by Borland International (many thanks to Larry Kraft).

HELP: Being bound, the Turbo manual will not lie open on your desk. TurboHELP addresses this shortcoming by placing most of the manual on-line. THELP must be installed before entering Pascal. Once installed, THELP may be brought up at anytime by entering Alt-R (some versions have been modified to use other key combinations such as Alt-H). THELP opens a window in the middle of the screen and displays a menu, much like the menu in the Pascal manual. By depressing the desired selection the operator can vector down to an example of almost any aspect of Turbo Pascal. Everything from edit commands to variable declarations to run-time error numbers can be found within THELP’s menus.

HELP is not a replacement for the manual. It does not explain things to any level of detail; however, it is a tremendous supplement to the manual as it gives sufficient examples to jog the memory on most aspects of the language. It is interesting to note that THELP is written entirely in Turbo Pascal and that the source is also in the public domain. We will probably cover this topic again in a future column. (Dave Carroll’s book includes an expanded version of this utility.)

TDEBUG: One of the most important tools in the hacker’s toolkit is a decent debugger. Borland did not include a debug facility with Turbo, reasoning that since the compilations are so incredibly swift, it is sufficient to use the “Insert a WriteLn and Try Again” mode of debugging. Some problems just cannot be readily isolated this way. One of the most surprising finds in the public domain is TDEBUG (sometimes seen as DBGXX, where XX is a version number). TDEBUG is a simply incredible shell program which loads over TURBO.COM (or TURBO-87.COM). Once loaded, TURBO performs exactly as before except for the R(un) command, which now allows TDEBUG to take control, bringing up a debug screen.

TDEBUG divides the screen into two parts, with the source code listed above.
The currently executing line appears in high intensity. TDEBUG allows breakpoints to be set on source level statements and allows access to all currently defined variables. TDEBUG can also be run under an assembler debugger to allow breakpoints at the assembler level, if desired. TDEBUG only runs on IBM work-alikes and is specific to a particular version of TURBO 3.0 (that is, you must find the version of TDEBUG for your version of TURBO), but if you are serious about TURBO Pascal, this tool is simply too powerful to do without.

**BEGIN:** One of the most common errors in TURBO programs is mismatching BEGIN and END statements. By highlighting the beginning and ending of blocks clearly on the listings, **BEGIN** makes finding this class of error very easy indeed. Although fairly simple in design this little number could end up saving you lots of heart burn.

**INLINE:** For those familiar with assembler language, INLINE generates include files containing INLINE statements from an assembler source program. Although not identical, the syntax of INLINE is similar to that of the Microsoft MASM assembler. Best of all, this utility could end up saving you the expense of MASM.

**WIND2:** Another class of work savers is the subroutine library. This library of windowing routines (not in the Microsoft WINDOWS sense, more on this in future columns) is truly excellent. These routines are well documented for inclusion in any program, providing multiple, overlaying windows. These windows are much more powerful than Borland's half-hearted implementation.

**EXEC:** Executing one program from your own is another common function that is none too easy for the beginner. This library of DOS interface routines provides all of the most common DOS interface functions.

Although not absolutely necessary, any or all of these tools will aid the Turbo Pascal programmer. You might begin now looking for some of these if you plan to join us as we venture into some of the deeper and previously more confusing aspects of the language in future columns.

Another utility we will be examining in future columns is **ALICE**, a TURBO Pascal compatible interpreter. Interpreters, like BASIC, generally have superior debug and edit facilities. ALICE also has a context sensitive editor (that is an editor which understands Pascal). The programmer can develop his code using ALICE's Pascal editor and check his algorithms using ALICE's interpreter. Once the program is running correctly, it can be compiled and executed on the TURBO compiler directly from the ALICE environment. The result just might be drastically decreased debug times. I will be checking into this in a future column.

As a special incentive to send me your suggestions, I will send a disk containing the public domain programming tools listed above to anyone who submits a problem or topic for consideration which is good enough to be included in this column. I remain the final judge of what is worthy and what isn't, and mine is the final decision, but what do you have to lose? You just might get your problem solved and free software to boot, literally.

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**PC Construction Articles**

**Dear Mr. Libes:**

Like you, I have been driven to the conclusion that an IBM-PC (or clone) is a must nowadays. I hope that in your magazine you are able to get hardware articles on the PC. There seems to be a wall, built by Microsoft and the OEM, between the user and the inside workings of hardware/MS-DOS. Everything's OK as long as you can find/afford to buy the board that does what you want or you don't try to run 2 boards that conflict with each other.

I do not know how you were able to get such good construction articles for S-100 systems, but I hope you are able to do the same as we move through the IBM-PC age.

Denny Pistole
Port Hawemne, Ca

We are with Denny's sentiments and would like very much to publish construction type articles based on the PC bus. Anyone interested in writing such articles should contact us. We are also interested in publishing articles related to the PC bus and hardware.

---

Stephen Randy Davis is a senior systems programmer at a defense contractor in Greenville TX where he programs various microprocessors. He is also working on his Masters in Physics.
The C Forum

by Don Libes

Garbage In

This column discusses the problems of reading input.

scanf

scanf (format, arg1, arg2, ...) reads "stdin" (by default, the keyboard) interpreting characters according to the "format". The results are stored in arg1, arg2, etc. scanf() is just like scanf() except that it reads from the string given as its first argument rather than stdin. For example,

```c
char name[20], first_word[20];
int age;
double iq;
char string[10] = "Don 10 4.5 hello"
scanf(string, "%s %d %f %s", name, &age, &iq, first_word);
```

assigns the value "Don" to name, 10 to age, 4.5 to iq and "hello" to first_word. Just like printf(), there are three different variations of scanf. The third one, besides scanf() and sscanf() is fscanf() which reads from a stream specified by its first argument. One of the big differences between scanf() and printf() is that arguments must be passed by address. Look back to the example and you will see "&age" rather than "age". If you think about it, you will realize that this is necessary. In order to have a subroutine store anything into a random area of memory will be destroyed. Furthermore, this allows one to read other streams besides stdin, since fgets() takes a stream argument. Even if you are just reading stdin, fgets() is preferred to gets(), since, without any checks, long input lines can overflow the user-supplied buffer. You should not assume that a newline terminates each buffer. In this way, you will correctly handle the last line in the file whether or not it is terminated with a newline.

Also, don’t forget to check the return value from fgets(). If NULL is returned, the EOF was detected, and you should ignore anything in the buffer.

The current stdio definition, there is one drawback to using this approach over the original scanf(). That is, if scanf() can not interpret stdin according to the format, it will leave the pointer where things stopped making sense. This is not possible with fgets() and sscanf(). However, the draft C standard defines a new scanf format which places the number of characters scanned so far into the integer pointed to by the corresponding argument. Thus, in implementations conforming to X3J11/85-102, it will be possible to reparse data starting exactly from where the problem occurred.

Just for the record, none of these tips (or much of stdio) works on binary data. If you need to read a binary file, you should be using fread() for buffered input explicitly.

**HANDLING Arbitrarily LONG LINES**

But what if you don’t know how long input lines can be? What if there are no limits on the length of the input, and yet, you would like to be able to store each line in a buffer?

That is a common enough problem, and here is a simple subroutine that solves it. big_fgets() is just like fgets() except that it takes one argument, a pointer to a FILE. big_fgets() returns the address of malloc’d memory with the next line from the file. When you are done with it, don’t forget to free() it! Like fgets(), big_fgets() returns NULL upon EOF, and preserves newlines.

```c
#include <stdio.h>
define GROW_BY 256
char *big_fgets (fp)
FILE *fp
{
    int c;
    unsigned string_length = 0; /* including NULL */
    unsigned buffer_length;
    char *buffer, *malloc(), *realloc();
    if ((buffer = malloc(buffer_length = GROW_BY)))
        return (NULL);
    while (EOF != (c = getc(fp))) {
        buffer[string_length++] = c;
        /* if no more space in buffer for more */
        /* chars increase the size of the buffer */
        if (string_length >= buffer_length)
            buffer_length += GROW_BY;
        if ((buffer = realloc(buffer, buffer_length)))
            return (NULL);
    } if (c == '\n') break;
}```
The basic idea of big_fgets is that string space is allocated from memory in multiples of GROW_BY bytes. If more space is needed, the old buffer is reallocated by another GROW_BY bytes. Clearly, a careful choice of GROW_BY can be very important in terms of efficiency.

### WAITING FOR INPUT THAT MAY NEVER COME

The opposite problem of handling lines that are impossibly long is handling lines that are impossibly short. In other words, what happens if you read() but nothing is waiting. Unless you make other arrangements, a read() will wait until some number of characters are available.

If you are reading from a terminal, read() will return upon encountering newlines no matter what length you specified. If you put the terminal into raw mode, read() will return as soon as any characters are waiting. However, if no characters have been entered, read() will wait forever.

There are no system-independent ways of solving this problem; however, by creating modular subroutines it is possible to be reasonably portable. In addressing this problem, the first issue is that there are several styles of checking for input. Few systems implement all of them in their full generality.

### POLLED INPUT

Polling for input means that the program explicitly checks for input at certain times. It further implies that if no input is waiting, the program does something else rather than waiting for input to arrive.

BSD UNIX variants and many PC compilers support an ioctl (FIONREAD) that allows one to check for the number of characters pending. In CP/M, there is a BIOS call (CONSTR) that tells you if characters are waiting. In MS/DOS, there is a BIOS call that plays the same role. Many compilers provide special functions such as kbhit() (Microsoft) that return true or false depending upon if a character is waiting. In each of these cases, the style of solution is to check whether characters are waiting before issuing the blocking read().

Alternatively, the behavior of read() may be changed so that it does not block if no characters are waiting. System III, System V, and UNIX all support nonblocking reads. In the case that no characters are waiting, read returns -1, while errno is set to EWOULDBLOCK. Nonblocking I/O is set up with fcntl(). The parameters are typically system-dependent. Here is an example from 4.2 QBDOS:

```c
fcntl(fd,F_SETFL,FDELAY);
```

A more sophisticated technique supported directly by fewer systems is reading with timeouts. System III, System V and UNIX 4.2 support this kind of I/O. If the indicated time passes without the read() being satisfied, the read() returns. Reading with timeouts of less than one second can be done via ioctl() on System III and V and through select() on BSD 4.2 UNIX. Timeouts of greater than 1 second can be done portably between all UNIX systems with the following code:

```c
/*1*/ signal(SIGALRM,alarm_handler);
/*2*/ alarm(5); /* timeout after 5 seconds */
/*3*/ start_read() /*
 Briefly, this code does the following:
/*1*/ Registers a function to be called in the event of an alarm clock signal occurring.
/*2*/ alarm(5) sets up an interrupt 5 seconds from now. This signal will interrupt the read(), so that we can get control. In particular, the function registered at /*1*/ will be called when this happens.
/*3*/ setjmp() remembers where we are and what we are doing so that we can jump back to this point later. The first time we are here, setjmp() returns 0.
/*4*/ so that read() begins. If read() returns normally, we go to */
and turn off the alarm. However, if 5 seconds go by and read() has not completed, the alarm signal occurs and alarm_handler() is called.
/*5*/ If alarm_handler() is called, longjmp() resets the stack to the way it looked at /*3*/ and we find ourselves returning from setjmp(). What is returned is the second argument of longjmp(). Since the second argument of longjmp() is 1, we go to /*4*/ setting the appropriate variables to make it look as if read() has completed abnormally.

This is a good example of non-local goto's with setjmp/longjmp. If you have never used these functions before, let me point out the unusual side-effect of longjmp to unwind the stack. In this case, it caused us to forget that we were executing a read().

In a future column, I will talk more about setjmp/longjmp and show other useful applications of them.

### INTERRUPT-DRIVEN INPUT

Often polling for input is inconvenient. Polling can also be inefficient. For example, if you are monitoring 100 devices that do I/O infrequently, but have to be serviced quickly when input occurs, you are going to waste a lot of time checking for input. The potential exists to miss servicing a device because you are busy checking others. A better solution in this case is to generate an interrupt when characters arrive.

In BSD UNIX, this is done by calling fcntl() which arms the device driver. When input arrives, a SIGIO signal is generated starting a user selected routine for catching such signals (set up with signal()). Here is an example from 4.2 BSD:

```c
void (*sigio_handler)();
signal(SIGIO,sigio_handler);
fcntl(fd,F_SETFL,FASYNC);
/* direct Signals to this process */
fcntl(fd,F_SETOWN,SIGIO);
```

In MS/DOS or CP/M there are no system independent primitives with which to request interrupt driven I/O. Under MS/DOS, it is possible to write a device driver or interrupt handler, although it will not necessarily be portable from one version of MS/DOS to another.

As an example, consider the IBM PC. Interrupt 9 of the BIOS is called upon every keystroke. Thus, it is possible for the user to install a keyboard interrupt handler by placing its address in the appropriate interrupt table entry. Typically, your interrupt handler
will want to pass on characters it is not interested in handling by calling the original keystroke interrupt handler. The program should also clean up after itself at termination by restoring any interrupt vector entries that have changed.

Note that interrupt handlers must terminate with an IRET (return from interrupt) rather than a RET. Since the C compiler will generate RETs, if you wish to write the interrupt handler in C, you must code a small piece of assembler to do an IRET. Of course, you can’t call IT because this will generate a return, also!

One technique (suggested by Phil Nanzetta) is as follows: Write an assembler routine c_interrupt() which decides whether to jump to the old interrupt handler, or the new C interrupt handler. If the C function is invoked, it returns to c_interrupt() when it completes. c_interrupt() then concludes with an IRET.

In a future column, I will go into this last topic in detail and present some working examples.

CONCLUSION

Rather than providing the volumes of information that this material deserves, I have been intentionally sketchy in the attempts to touch all bases. I have discussed all of the portable techniques for getting input, and I have briefly mentioned all of the typical nonportable tricks for avoiding nonblocking input from just about every common operating system. With what I have presented here, you should be able to get input in just about every way imaginable.

I encourage readers to write to me about topics or problems that you want to know about. I want this column to be reader driven. Write to me care of M/SJ, Box 1192, Mountainside, NJ 07092.

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Control Systems Made Simple
by Lynwood H. Wilson

Computers are information handling devices. Typically, we feed them information. They process it according to some plan we have suggested to them. Then, we act upon the results. This is a good thing as it obviously benefits society and is one of the most complex and entertaining games yet invented. We can set up our own universes, our own rules and constraints, our own goals. We have the freedom to create anything we like. There need not be any particular correspondence with reality.

However, there is another mode. A computer can handle its own relationship with the real world, gather its own data, process it, make its own decisions, and produce whatever effect it has been told to consider desirable. We call such a system an intelligent controller. These systems vary tremendously in complexity. I will discuss a few of the simpler ways in which a computer can control a real world quantity. A temperature controller is considered here, but the principles will apply to almost any kind of control system.

Control systems are easy. You may not believe me, particularly if you have been corrupted by one of those enormously thick books on control system theory full of the most confusing kinds of mathematics, but it is true nevertheless. Laplace transforms indeed.

Don't misunderstand me. I approve of mathematics. I even like mathematics. I do not approve, however, of the philosophy that says "you can't do that unless you have these tools," or "without the proper background it would be foolish to attempt that." What is worse, those people admit in print that after you do your homework and figure everything out you still have to make a few adjustments at the end. I propose that it is possible to start at the end and perhaps make one or two extra adjustments before you are through.

BANG-BANG CONTROLLER

In the simple temperature control system, the temperature is regulated by a heater which turns on or off according to whether the sensed temperature is below or above a set point. This process is similar to the one that operates the thermostat in one's home and is called an on-off or bang-bang controller. It isn't very accurate, but neither is your ability to sense temperature so it all works out well. The lesson here is not to provide more accuracy than the situation contains a bit representing 100 degrees and a strobe.

Program I is a simple BASIC (Microsoft Basic-80 ver5.22) program which enables this system to act as a simple on-off controller. The function FNTemp defined in line 20 gets the temperature. It sends the BCD data from the thermometer through ports 0 and 1. The low nybble (four bits) of port 0 represents tenths of a degree; the high nybble is degrees. The low nybble of port 1 is tens of degrees, and the high nybble of port 1 (which we discard) contains a bit representing 100 degrees and a strobe.

Program 1 Bang-Bang Temperature Control

10 setpoint=40
20 DEF FNtemp=(10*(INP(1) AND 15))+(INP(0) AND 240)\16+(INP(0) AND 15)/10
30 'function reads temperature from thermometer in BCD (ports 0 & 1) & translates it into decimal
40 IF FNtemp < setpoint THEN OUT 0,1 ELSE OUT 0,0
60 'port 0 bit 0 controls heater
70 GOTO 50

First, the tens digit is recovered with (INP(1) AND 15), which inputs the data at the port and discards the high nybble by ANDing with 15 (00001111). Then, the digit is multiplied by 10. (It is the tens digit, remember?) Next, the ones digit is recovered with (INP(0) AND 240), 240 (11100000) discards the high nybble. Dividing the result by 16, moves it to the low position. (Note that in this dialect of BASIC the backlash represents integer division and the slash represents floating point division.) Finally, the tenths digit is found with (INP(0) AND 15), discarding the high nybble. The result is divided by 10 and added to the other two numbers. The rest of the program is straightforward, merely turning the heat on if the temperature is lower than the setpoint, and off otherwise.

Because of the sensor temperature lag, chamber temperature can be several degrees ahead of the thermometer reading when it is changing rapidly. For instance, when the indicated temperature is 39.9°C and rising, the true temperature is 42°C and rising at about the same rate as the indicated temperature, and the heater is on. (Part of the reason for this lag is the extremely poor heat transfer between the probe and the still air in the chamber. System performance could be improved greatly by adding a small fan to stir the air. We did not do this since wanted to make our test conditions as difficult as any situation likely to be encountered.)

This situation is clearly not conducive to stability causing the thermometer to produce an oscillation between 39.4 and 41.0°C. The actual air temperature swings a good deal further and is one of the major causes of instability. Though it cannot be eliminated, we can program the control force to lead the signal so that this lag no
longer bothers us. (The high and low temperatures are not symmetrical about the setpoint because the heat is not the same. Ideally these two effects should be approximately equal.)

If I replace the temperature sensor with another that has its element deposited on a tiny ceramic chip exposed directly to the air, the thermometer will react much faster to changes in the test chamber and so Program I will work better, holding an indicated temperature of 40.0 with an occasional flash of 39.9°C.

See how easy it is? We have only started and already we can control the temperature as closely as we can read it. However, this is a special case where control is a simple task since the test chamber has very little thermal inertia and our measurement system has such a small lag time. In general, by keeping thermal inertia and the measurement lag to a minimum, control will be easier. It should also be noted that the faster responding sensor probably gets considerable infra-red radiation from the heater, which helps to increase its response speed, but does not help it follow air temperature. This effect is a kind of negative lag, as the sensor responds to the heat before it does to the air. This can be quite beneficial for stability as long as we are aware of the limitations. In an extreme case, this kind of situation can yield a correct and stable reading from the sensor while the actual quantity is stable at quite a different point. We must be sure that what we are measuring is really what we want to control.

PROPORTIONAL CONTROLLER

In order to more nearly approximate real world conditions, we will return to the stainless temperature probe. Its lag will give us a chance to find out whether we can control the temperature of a less than ideal chamber. As the first test showed, the bang-bang controller will not stabilize in this situation. Since the lag of the sensor is directly related to the rate of temperature change, we could improve stability by reducing the heater rate, but that would increase the time to get to the setpoint. We will try reducing the heat in proportion to the deviation from the setpoint, the error, which should improve stability without reducing rate of control at large errors. This approach is called a proportional controller.

Program II Proportional Temperature Control

```
10 setpoint=40
20 DEF FNtemp=(10*(INP(1)AND 15)+(INP(0)AND 240)/16)+((INP(0) AND 15)/10)
30 heat=10*(setpoint-FNtemp)
40 FOR I=1 to 100
50 IF heat > 0 THEN OUT 0,1 ELSE OUT 0,0
60 heat=heat-1
70 NEXT I
80 GOTO 30
```

This program is designed to turn the heater off if the temperature is above the setpoint, and turn it on if the temperature is more than 10°C below the setpoint. Between these two points, the heater turns on and off with a duty cycle (percentage of time turned on) that is proportional to the error, i.e. deviation from the setpoint.

In Program II the variable heat increases as the temperature falls farther below the setpoint, ranging from 0 at the setpoint to 100 at ten degrees below the setpoint. This represents the desired percentage of heater on-time. The heater is never turned on if heat is 0 or negative, which is to say if the temperature is greater than or the same as the setpoint. Otherwise, the heater stays on until the variable heat is decremented down to zero, taking more and more of the 100 iterations of the FOR loop as the temperature decreases. When the temperature is 10 degrees cooler than the setpoint, the heater stays on constantly. In the case of the program above with a setpoint of 40°C, the temperature is 42°C, heat will be -20°C (setpoint-FNtemp). Therefore, the heater won’t turn on since heat is not greater than zero at the first pass of the FOR loop. As the FOR loop goes through its 100 iterations, heat will be decremented each time, and the heater stays off. If the temperature drops to 37°C, the value of heat will be 30 during the first iteration of the FOR loop and the heater will be turned on at the first pass. Heat becomes 29. The loop continues forcing the heater on and de-ccrementing heat until it is zero which will occur during the thirtieth pass. On the thirty-first pass, heat will be zero and the heater will be turned off, having been on for thirty iterations. The loop continues with the heater off for 70 more iterations before it is done. If the temperature is less than 30°C, heat will be positive for all 100 iterations of the FOR loop, and so the heater will always be on. With a proportional controller, the heater remains on for a percentage of the time directly related to the heat value.

The range over which the heater is proportionally controlled is called the proportional bandwidth (pb). The following small modification to the previous program allows one to specify the proportional bandwidth directly in degrees.

Program III Proportional Bandwidth Control

```
10 setpoint=40
20 pb=10
30 DEF FNtemp=(10*(INP(1)AND 15)+(INP(0)AND 240)/16)+((INP(0) AND 15)/10)
40 heat=(100/pb)*(setpoint-FNtemp)
50 FOR I=1 to 100
60 IF heat > 0 THEN OUT 0,1 ELSE OUT 0,0
70 IF heat > 0 THEN OUT 0,1 ELSE OUT 0,0
80 heat=heat-1
90 NEXT I
100 GOTO 50
```

The change is in line 50 where 10 is replaced by 100/pb. The pb was there to give a reasonable proportional bandwidth for the last test. Now the proportional bandwidth is the number entered for pb. Remember that when heat = 0, the heater stays off; when heat = pb, the heater stays on. Thus, if pb = 5, heat will be 0 when the temperature equals the setpoint, and 100 when the temperature is 5 degrees below the setpoint. Thus, the proportional bandwidth is 5 degrees.

If you have a computer that can control something, try changing the proportional bandwidth. It is important to try these controllers as you go along because in the end, what we are going to substitute for all that odious mathematics, is your experience and intuition. Now is the time to get some.

OFFSET

My system finally stabilized at 37.5°C after quite a time of wandering aimlessly. It then started climbing slowly as the ambient temperature began to rise. Program III is closer to stable than the bang-bang type, but still isn’t stable enough; it doesn’t even oscillate around the setpoint when it oscillates. Not good.

We must find a way to get the temperature to the setpoint. Program III puts out no heat at the setpoint. Obviously it cannot maintain the temperature at that value. We must add an offset to move the temperature up to the setpoint. It can be done like this:

Program IV Proportional Bandwidth With Offset

```
10 setpoint=40
20 pb=10
30 OFFSET=50
40 DEF FNtemp=(10*(INP(1)AND 15)+(INP(0)AND 240)/16)+((INP(0) AND 15)/10)
50 heat=(100/pb)*(setpoint-FNtemp)+OFFSET
60 FOR I=1 to 100
70 IF heat > 0 THEN OUT 0,1 ELSE OUT 0,0
80 heat=heat-1
90 NEXT I
100 GOTO 70
```

In line 30 OFFSET is assigned the value 50. In line 50 it is added to the equation that gives a value to the variable, heat, effectively increasing its value by 50. This results in a 50% duty cycle for the heater at the setpoint, when setpoint-FNtemp = 0, 100% duty cycle at 5°C below setpoint, and 0% duty cycle at 5°C above setpoint. The bandwidth still equals pb, although now it has been moved to center about the setpoint.
Though Program IV is an improvement, it is still not terribly stable, but at least it hovers near the setpoint. This proportional controller does not hold the temperature at exactly the setpoint, however. The amount of heat supplied to produce an error of 0 is not exactly right to maintain the temperature. Even if we had been lucky and guessed exactly the right offset, it would only have worked until something such as the ambient temperature changed causing the system to drift away from the setpoint.

**RESET**

We need some sort of self-aligning force. We will take a portion of the error (deviation from the setpoint) and add it to the offset at each pass through the program. (We must ensure that the sign is correct: error above the setpoint is negative, below is positive.) The error used (line 70) is (setpoint–FNtemp), which is correct. This won’t be much at first, but as time goes on if the error persists, the effect of this offset will become greater until it finally reduces the error to zero. This is traditionally called reset and can be accomplished as follows:

**Program V And Reset**

10 setpoint=40
20 pb=2
30 offset=30
40 reset=5
50 DEF FNtemp=(10*(INP(1) AND 15)+INP(0) AND 240)/16)+INP(0) AND 15/10
60 heat=(100/pb)*(setpoint–FNtemp)+offset
70 offset=offset+(setpoint–FNtemp)/10)*reset
80 FOR I=1 to 100
90 IF heat>0 THEN OUT 0,1 ELSE OUT 0,0
100 heat=heat-1
110 FOR T=1 TO 0
120 NEXT T
130 NEXT I
140 GOTO 60

Lines 110 and 120 are merely a time delay. We will need it later and put it in here so we can keep the same numbers from here on. I have attempted to keep the weight variables, such as reset, between 1 and 10 for our convenience. Of course, there is no assurance that they will be the same for other systems.

In line 40, reset is given a value. In line 70, a small portion of the error is added to the offset each cycle. The constant, reset, controls the rate at which the offset is changed in response to a persistent error. Too much reset will cause instability, too little will increase the time required to reach the setpoint or to respond to a change. Once again, experiment with this new control algorithm.

My system isn’t very steady with Program V, but it does stay closer to the setpoint than previous tries. At least the system seems to know where the setpoint should be and hovers around it. However, if the system is initially very far from the setpoint, it will take quite a while to stabilize, swinging widely to either side. Even when the system appears to have settled down, movement will still occur for no apparent reason.

**RATE**

The instability above results largely from reset, which is a kind of positive feedback leading to oscillation. In order to damp the oscillation, negative feedback must be added. This will take the form of a function that opposes change, a force that resists in direct proportion to the rate of change. It is called rate or occasionally referred to as approach. It is no more difficult to implement than the others.

**Program VI With Rate**

10 setpoint=40
20 pb=2
30 offset=30
40 reset=5
50 ratewt=4
60 DEF FNtemp=(10*(INP(1) AND 15)+INP(0) AND 240)/16)+(INP(0) AND 15)/10
70 oldtemp=FNtemp
80 ratecorrection=(oldtemp–FNtemp)*100*ratewt
90 oldtemp=FNtemp
100 heat=(100/pb)*(setpoint–FNtemp)+offset+ratecorrection
110 offset=offset+(setpoint–FNtemp)/100)*reset
120 FOR I=1 to 100
130 IF heat>0 THEN OUT 0,1 ELSE OUT 0,0
140 heat=heat-1
150 FOR T=1 TO 100
160 NEXT T
170 REM 150-160 are just a time delay.
180 NEXT I
190 GOTO 60

Ratecorrection is a measure of the rate of change with the sign reversed, so that it opposes the change. Note that if we did not initialize oldtemp in line 80, we would have a nasty first-cycle glitch as the program reacted to the sudden jump in temperature from 0 (uninitialized variable) to whatever FNtemp gets read the first time around. Note also that the time delay controls the maximum effect of rate. Rate can only react to the temperature change since the last cycle, and can only effect the heat output during the current cycle. By lengthening the cycle, rate is given a longer time to hold the heat on or off in response to the rate of change. Once the proper interval is determined, it can be fixed and the constant, rate, used to vary the weight of the rate function.

Rate must also be corrected for the change in cycle time. When cycle time is increased, reset happens less often, and therefore has less effect. The other factors are largely insensitive to cycle length, unless it becomes so long that the thermometer can follow it.

**ANTI-WINDUP**

The system seems a great deal more stable now, but when approaching the setpoint from a great distance, reset can build up such an offset that the temperature overshoots the setpoint badly before settling down. In many cases, this can be an asset since the artifact being heated and cooled may lag the air temperature and come to stability at the new temp more quickly after a substantial overshoot. The lesson here is to be sure you know what you want, whether it be a number on a thermometer or the core temperature of a block of metal. If overshoot is not desirable, it can be reduced by increasing the rate factor, but that will slow all temperature change. Better to add another refinement to our program. One is called anti-windup and it has the effect of disabling the reset function when the temperature is outside the proportional band. In other words, when the temperature is so high that the heater is not turning on, or so low that it is not turning off, the offset does not change. This makes sense since nothing reset does can affect the speed at which the temperature approaches the setpoint under these conditions.

In systems relatively free from changes in ambient conditions, reset can be made very small. This is good for stability. An accurate temperature chamber is one which is built inside a well insulated chamber so that the inner chamber is not influenced by changes in ambient temperature.

**Program VII Featuring Anti-Windup**

10 setpoint=40
20 pb=2
30 offset=30
40 reset=5
50 ratewt=4
60 DEF FNtemp=(10*(INP(1) AND 15)+INP(0) AND 240)/16)+INP(0) AND 15/10
70 oldtemp=FNtemp
80 ratecorrection=(oldtemp–FNtemp)*100*ratewt
90 oldtemp=FNtemp
100 heat=(100/pb)*(setpoint–FNtemp)+offset+ratecorrection
110 IF (heat<100 AND heat>0) THEN offset=offset+(setpoint–FNtemp)/100)*reset
120 FOR I=1 to 100
130 IF heat>0 THEN OUT 0,1 ELSE OUT 0,0
140 heat=heat-1
In lines 120 and 130, the reset correction is only added to the offset if heat is between 0 and 100. This prevents large excursions of offset, while the error is great.

Once again play with the control numbers and get a feel for the effect of each of them. This program, with the proper constants, should control the temperature in most situations nearly as closely as it can be read. It is extremely useful to have a chart recorder or a program that can plot temperature as the constants are changed. Knowing where you have been is essential to knowing where you are going.

This program works well, but on a long approach to the setpoint, it still builds up sufficient offset to cause it to overshoot by half a degree or more. This may well be good enough, but in case it isn’t, I know one more trick. The offset should not be changed during the approach. To prevent this, we need only add a statement that prevents the operation of the reset feature when the temperature is changing. In this manner, the offset will remain constant until the temperature stabilizes. Reset will then begin to bring the temperature to the exact setpoint. This can be accomplished in the following fashion:

Program VIII Featuring Still More Anti-Windup

```
10 setpoint=40
20 pb=2
30 offset=30
40 reset=5
50 ratewt=4
60 IF (FNtemp=(10*(IN(1)AND 15))+(IN(0) AND 240)/16)+(IN(0)AND 15)/10
70 oldtemp=FNtemp
80 ratecorrection=(oldtemp-FNtemp)*100*ratewt
90 oldtemp=FNtemp
100 heat=(100/pb)*((setpoint-FNtemp)+offset+ratecorrection)
110 IF heat<100 AND heat>0 AND ratecorrection=0 THEN offset=offset+(setpoint-FNtemp)*reset
120 FOR '1'=1 TO 100
130 IF heat>0 THEN OUT 0,1 ELSE OUT 0,0
140 heat=heat-1
150 FOR '1'=1 TO 100
160 NEXT T
170 NEXT I
180 GOTO 60
```

The change was made in line 110 where reset only works when the temperature is within the proportional band and not changing, i.e. when ratecorrection = 0. I also deleted the division by ten in the calculation of the offset in line 110 since the restrictions placed on reset allow it to be more powerful without causing trouble.

This program does all one could want with the system I have described. It can come from ten degrees below the setpoint at full heat, shut off about two degrees away from setpoint, then go directly to the setpoint with perhaps one tenth of a degree of overshoot. But to do this each of the weight numbers, pb, offset, reset, and ratewt, must be adjusted to the correct values for the system involved.

**TUNING**

Rate is one of the reasons that it is desirable to size the heater so that at the setpoint, the heater is on about half of the time, i.e. a 50% duty cycle. Then, when approaching the setpoint from either direction, rate can apply the same control authority to slow the approach thereby preventing overshoot and oscillation. In the case of controlling to a temperature just above ambient, there is little control authority in the cool direction and much in the heat direction, thus maintaining a constant temperature becomes quite a difficult problem. If the temperature drifts higher, the program calls for less and less heat, but to no avail as the heat is already off. This kind of instability can be overcome to some extent in the programming, but the difference in weight between cooling and heating requires different constants for rate and reset depending on whether the temperature is above or below the setpoint. This can be done, but by far the easiest and most straightforward solution is to add a cooler which will operate at a constant rate such that the heater (under control from the computer) runs at a 50% duty cycle to maintain the setpoint. It is much easier to control a system balanced between two equally strong opposing forces. Increasing the control authority in this fashion is equivalent to reducing the thermal inertia of the system.

Now that the system is built and programmed, the constants for each portion of the program must be determined. There are, as I said earlier, ways of doing this mathematically which work pretty well. If your work demands great precision, I recommend the mathematical approach. Otherwise, let’s get on with tuning the controller.

First and easiest to determine is offset which should be set to the number that will hold the setpoint temperature. Once the rest of the constants have been set close enough to allow the system to stabilize, the value of offset can be read from the variable as follows: C to stop the program, then "PRINT offset" will give the current value of offset.

Next, the proportional bandwidth (pb) is tuned. As the pb is reduced, the system becomes more resistant to displacement caused by changes of any kind. For example, the temperature will not move as far from the setpoint as a result of a change in heat flow into the chamber which may be due to a change in the ambient temperature or a change in the heat produced in the chamber (you did intend to have something in there, didn’t you?). Since reducing the pb reduces the distance the temperature will swing, the effect of reset is reduced which gets stronger as the temperature gets further from the setpoint. This improves stability and accuracy, and is an unmitigated good thing unless the temperature swings out of the proportional band. When the temperature gets out of the
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Add A Command History Function

Imagine that you are working at your CP/M system and you type the following command:

A) pip lst: + some.fil, another.fil, and more.fil

and instead of hearing the printer start, you get:

INVALID PIP FORMAT: + SOMEJIL,ANOTHERFIL,ANDMOREJIL

A) Wouldn't it be nice to get that last line back to correct the typo? It's so tedious retyping the whole line again just for one small mistake.

Or imagine you are debugging a C program. Edit-Compile-Assemble-Link-Run-See errors. Edit-Compile-Assemble-Link-Run-See errors. Etc. etc. etc. ad nauseam.

It would be less tedious if you didn't have to retyping the same five commands over and over again. (Even using a submit file, I still count three commands repeated endlessly.) Somebody must have thought of this before.

Well, campers, they did. Several big name operating systems have a command history feature:

a. Berkeley Unix. The cshell is several years old and it allows execution and editing of commands executed earlier. I find its syntax painful, however.

b. VMS 4.x. When Digital Equipment Corp. upgraded VMS, they added command history. They only allow access to the last twenty commands, which is sufficient for most needs. I think the editing characters are somewhat arbitrarily chosen, (unless you have a VT-100 terminal, where the arrow keys work).

c. AT&T UNIX V. A new shell for AT&T UNIX is called K-shell (Korn authored it). I find K-shell's command history very nice. It allows you to choose your command editor to look like either emacs or vi, both very popular editors on UNIX machines. It keeps the command history in a file, and stores many more than I need.

HOW DOES CP/M COMMAND HISTORY WORK?

To be useful for a CP/M environment, I worked up these requirements:

a. The command history is kept in (banked) ram to keep the speed to access commands high. I didn't want to slow down an already slow machine.

b. Sparse but useful feature set so that code size would fit within a standard CP/M system size. I still wanted to be able to use SYSGEN to make a bootable single-sided single-density 8" disk.

c. Use editor commands of an editor I was familiar with. I would have liked to use vi, but requirement (b) above dictated emacs, which was easier to implement.

d. Some trick features of the public domain CCP I was using had to be sacrificed to make room for history. These, plus other little used features and commands that history needed, are or could be supported by transient programs.

The resulting history feature works in the following manner. When faced with the CP/M prompt:

A) you can type in a command just as before; however, the command line editing characters have changed and expanded:

A destructive backspace (delete left)
DEL destructive backspace (delete left)
A discard and erase entire line
X discard and erase entire line
B non-destructive move cursor left
F non-destructive move cursor right
A move cursor to beginning of line
E move cursor to end of line
D delete character under cursor (+ close up line)
L toggle printer slaved to console
C warm boot CP/M if typed as first char on line
M (carriage return) execute line
J (line feed) execute line
P discard command buffer, fetch previous command
N discard command buffer, fetch "next" command (not implemented)

Otherwise: insert the character into the command line. If not at the end of the command, do a real insert (i.e. move characters to the right over to make room.) Control characters not listed above are echoed just as CP/M used to (e.g. ctrl-Y is echoed "Y").

So now, fixing the command line offered at the beginning of the article would look like this:

A) pip lst: + some.fil, another.fil, and more.fil

A) INVALID PIP FORMAT: + SOMEJIL,ANOTHERFIL,ANDMOREJIL

A) P

A) pip lst: + some.fil, another.fil, and more.fil

Move the cursor to the "+" character. Use A to go to the beginning of the line. Type eight (8) F's to move right to the "+". Type D to delete the "+". Your cursor is under the "s" in some, and the line now looks like this:

A) pip lst: + some.fil, another.fil, and more.fil

Type an "=" to insert it in front of the "some". Type a (cr) (carriage return) to execute the line.

A) pip lst: + some.fil, another.fil, and more.fil

To make the edit-compile-run loop a little easier, you now need type the commands only once each:

A) edit foo.c
deating ...
A) submit cc foo.c
compiler runs ...
A) foo runs ...
Now, to re-edit, just type three (3) ‘P’s:
  A\t’ P
  Alfoo’ P
  Asubmit cc foo.c’ P
  Ajedit foo.c(c)

From now on, you need type only three ‘P’s to recover the next command in the cycle.

Some Transient Programs: Three transient programs are used to support history. INITHIST.COM clears the history buffer to the empty state. This is unnecessary, but nice. If you ‘P back to before you started the current session, the garbage in the history buffer can make a small mess on your CRT screen.

GETHIST.COM copies the history buffer to the CP/M transient area so it can be saved with the CP/M SAVE command. This command is good for debugging the history feature, but mainly used with:

PUTHIST.COM to allow keeping the history buffer on disk from one session to the next. This way, you need type a command only once, ever, ever, ever. (Well, almost).

SYSTEM REQUIREMENTS

The code presented here can be used with little change on CP/M 2.2 systems using a Z80 or 64180 CPU. I use a 64180, so only once, ever, ever, ever. (Well, almost).

SYSGEN’ing CP/M systems. I use SLR180 by SLR Systems in simplest instance, just a couple of pages of ram above the BIOS.

Pennsylvania. Microsoft’s M80 and L80 can be used just as well.

SYSTEM REQUIREMENTS

The code presented here can be used with little change on CP/M 2.2 systems using a Z80 or 64180 CPU. I use a 64180, so the memory management instructions reflect that. However, these can be easily changed to accomodate a typical Z800 bank select system.

The second requirement is some free ram that CP/M doesn’t use. This can be (as in my system) another 64K bank, or in the simplest instance, just a couple of pages of ram above the BIOS.

A third requirement is an assembler, and some experience SYSGEN’ing CP/M systems. I use SLR180 by SLR Systems in Pennsylvania. Microsoft’s M80 and L80 can be used just as well.

WHAT PARTS OF THE O.S. ARE MODIFIED?

Hold onto your hats. This job is most cleanly done by modifying both the CCP and the BDOS. Yes, I said BDOS, but its not as bad as it sounds. Honestly.

In order to shoehorn all this code into a nearly stock CP/M system, I had to scrap the BDOS system call 0AH, Get Line from CON:. The history line editor replaces this code completely, and there was no sense in wasting the ram occupied by the line editor built into the BDOS. There are two approaches to the BDOS mod: the patch and the gung-ho version. More about this later.

The actual command history buffer management is handled by the modified CCP. I have been using an old public domain CCP replacement for years, (like ZCPRI or something). I gutted out some functions in it that I never used to make room for the history buffer management code.

INSTALLING THE CODE

Modifying the BDOS: The BDOS change is the first to go in, and gives you a good command line editor right away, without fixing the CCP.

I disassembled my BDOS, and then made room by changing most of the absolute jumps to relative jumps. When I then excised the existing Get Line function code, I had just enough room for the new line editor (Listing 1). I also needed to add a second entry point for the getline function, to allow editing of a line already in the line buffer. I stole the unused CP/M function 26H. This function has never been used, in CP/M 2.2, CP/M 3.0 (Plus), or even MS-DOS (which copied CP/M’s BDOS function calls.)

Public domain disassemblers are available to disassemble the BDOS, or you can buy the product advertised as a source code generator for CP/M and do it automatically.

If disassembling the BDOS seems like too much work, the other way is to patch the BDOS to call an external routine that you locate in high ram above the BIOS. This could be loaded at cold boot time or kept in a BIOS ROM that is resident at all times.

To facilitate the patch technique, some useful locations in a standard CP/M 2.2 BDOS are shown in Listing 2.

Modifying the CCP: First, you need the source to your CCP, either the disassembled Digital Research CCP, or one of the public domain CCP replacements. I use an old public domain CCP. (It’s so old, it doesn’t have wheel bytes or named directories).

Next, you need to decide which features you will sacrifice to make room for the history code. I took out LIST (TYPE to printer) since I always use PIP for that, and JUMP (to start execution at an arbitrary memory location) since I use DDT if I need something like that.

Now the code in Listing 3 can be merged with your CCP source. It fits in just after the code to print the CP/M prompt “),”, and replaces the code from there until the code to convert the command line to upper case.

As an aside, I also added code to toggle on/off the lower to upper case conversion of command lines. This allows you to use the PIP Start and Quit flags with lower case strings.

The only hardware dependent parts of the code are the pointers to where the history buffer is kept in memory. If you have a 64180 and more than 64K, then the code will run as supplied. I keep a copy of the CCP and BDOS from 10000H to 115FFH for warm boots from ram. The history buffer is kept from 11600H to 12000H. Subroutines BANKO and BANK1 do what you’d expect, respectively disabling and enabling the memory from 10000H to 1CFFFH. When enabled, that memory resides at logical addresses 0000H to 0CFFFH.

If you have only 64K of ram, another possibility is to configure your system size to 60K, which will leave some ram above the BIOS that CP/M doesn’t know about. The history buffer can be kept there just as well.

After you have made your decisions concerning history buffer location, modify your source code and get it to assemble without errors. Then make up a new system with DDT:

A)SYSGEN
SYSGEN VER 2.0
SOURCE DRIVE NAME (OR RETURN TO SKIP)A
SOURCE ON A, THEN TYPE RETURN
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)cr
A)SAVE 38 CPM.COM
A)BDT CPM.COM
I)NEWBDOS.HEX
r[offset]
I)NEWCCP.HEX
r[offset]
A)SAVE 38 NEWCPM.COM
A)SYSGEN NEWCPM.COM
SYSGEN VER 2.0
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)B
DESTINATION ON B, THEN TYPE RETURN
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)cr

Now the moment of truth. If you now reset and cold boot off your new system track (on the B diskette in this case) and get the A) prompt, congratulations. If “DIR” still works, a standing ovation. If “P(c) does a DIR again, then it’s ticker tape parade time.

For the rest of you, I would suggest putting the BDOS mod in without changing the CCP right away. Everything should still work like a box-stock CP/M system, without history, but with a really fine command line editor facility.

Once the new BDOS (of BDOS patch) is in, the new CCP can go in. In order to help debugging the CCP mods for history, you may want to put in the transient programs GETHIST, PUTHIST, and INITHIST. (Listings 4, 5, and 6).

Another debugging trick for this is to temporarily put the history buffer into ordinary transient area ram, say at 8000H. This will allow you to examine the history buffer with DDT without having to worry about the complication of dealing with banked ram with DDT.
HOW IT WORKS

GETLINE function: The line editor in the BDOS follows closely the model of the original Digital Research code. Relative jumps are used to keep the code size down (they are slower than absolute jumps but speed is unimportant here). Some cleverness was required to make the routines for deleting and inserting characters work properly on any CRT with backspace the only cursor positioning sequence allowed. The temptation to use CRT escape sequences was immense, but the fact that I own two radically different CRT's forced me to do it right.

Backspaces are used to move the cursor left. To move the cursor right, the characters on the line are retyped. To erase, spaces are output, and then backspaces used to recover the cursor position.

The normal entry point, BDOS function 0AH, works as before, that is, the line buffer is cleared before the first character is gotten from the console in routine.

The second entry point, BDOS function 26H, (formerly unused) prints the current contents of the line buffer on the CRT, leaving the cursor at the end of the line, and then goes for an input character.

The CCP needs to know how the line was terminated, for if a carriage return or line feed was typed, the line is to be executed. If however, a 'P' or 'N' was typed, the line in the buffer is to be discarded and the previous or next line in the history buffer is to be fetched.

For this reason, BDOS function 0AH and the new function 26H now return the last character typed to the caller in the Accumulator (and the L register). CP/M applications that don't need this information are unaffected since the accumulator is expected to be clobbered by the BDOS call.

CCP History Function: When the CCP is first entered, it calls CP/M function 0AH to get a command line. If the call returns with a value of carriage return or linefeed, the command in the buffer is to be executed. When a command is executed by the CCP, it is first put into the history buffer. The history buffer is designed as a combination fifo (first in first out) buffer and a doubly linked list.

The exact layout is as follows:

```
cbuff0: dw len?h ;pointer to previous command length byte
len0h: db len0 ;length of first command
com0: ds len0 ;first command
len0b: db len0 ;length of first command
len1h: db len1 ;length of second command
com1: ds len1 ;first command
len1b: db len1 ;length of second command
```

To copy a command into the history buffer, first the existing commands in the buffer are moved up in the buffer to make room at the input end. The new command is then copied into the buffer beginning, with a byte representing its length at each end of the command copy in the buffer. Finally, the previous command buffer pointer is reset to point to the most recent command in the buffer.

The copying of the latest command into the history buffer is done so that the history buffer never expands beyond its defined limits. The limits must be on page boundaries.

When the CCP gets a return value of 'P' from the BDOS getline call, it goes to the fifo for the previous command. The command pointer is always pointing to the length byte for the previous command in the history buffers. That command is copied to the CCP command line buffer, and the previous command pointer is incremented by the length byte plus two so that it points to the next command back in the fifo (back in time).

The CCP now calls BDOS function 26H to edit the command which is in the command line buffer. Then, depending on the return value, the CCP either saves and executes the command, or fetches the previous command for editing again.

BUGS & NOTES

The only known bug is that command lines with embedded control characters are displayed incorrectly when editing. This means that when editing those lines, it is necessary to keep the real cursor position in your head. Another way is to always move using 'A' and 'F's, so that the line characters will be echoed properly. I wanted to use the code, and not be debugging it for the rest of my life, so I decided to just use the code this way. If anyone fixes this bug, I'd like a copy of the fix.

The 'N' command to get to the next command in the history buffer was not implemented due to lack of space in the CCP. If you overshoot the command you want with an extra 'P', the only way to recover is to send an empty line with a carriage return to the CCP, which will reset the command pointer to the beginning of the buffer.

VMS is a trademark of Digital Equipment Corp. M80, L80, and MSDOS are trademarks of Microsoft. SLR180 is a trademark of SLR Systems.

Bill Dudley is a Member of Technical Staff at AT&T Bell Laboratories in New Jersey, where he designs hardware for Cellular Mobile Telephone Service. He has a BSEE and M.Eng. from Cornell University. When not hacking his CP/M system or justifying why he hasn't got an MS-DOG system yet, he can be found riding his motorcycle.

Listing 1

```
; GETLIN.RNC
; bdos getline replacement
; entry point to allow editing of line already
; in the buffer.
;
; William F. Dudley
; Dec. 22, 1985
;
; boot0 equ 0
; if eq 10
; cr eq 13
; bs eq 8 ;delete previous char
; ctrlb eq 2 ;emacs back char <-
; ctrlf eq 6 ;emacs fwd char ->
; ctrln eq 06h ;emacs next line
; (returns to caller if typed)
; ctrla eq 1 ;emacs begin line <-
; ctrlr eq 06h ;echo to lst: (replaces ^p)
; ctrlp eq 10h ;emacs prev line
; (returns to caller if typed)
; ctrlf eq 6 ;emacs end of line
; (returns to caller if typed)
; ctrla eq 5 ;emacs delete char
; ctrlc eq 3
; ctrlh eq 18h
; ctrlu eq 15h
; del eq 26h

;erra> buffer input from console
; buffer format: m,n,c,c,c,c \n
; m= size of buffer
; n= # of characters entered
; c= characters
; special characters:
; rub/del = remove and echo last character
; ctrla = emacs move cursor to beginning of line
; ctrlb = emacs move cursor left one character
; ctrlc = reboots system if typed at start of input
; ctrld = emacs delete character under cursor
; ctrle = emacs move cursor right one character
; ctrlf = remove and do crt rubout
; ctrlg = (line feed) end of input
; ctrlh = (return) end of input
; ctrlj = toggle list device slave
; ctrlk = scratch input buffer after new line
; ctrlm = scratch input buffer & back up to
; start of line

code0a: ld hl,(userde) ;buffer pointer
;ld h, size of the buffer
;inc hl
;push hl ;save pointer to $ of characters
;ld b,0 ;clean character counter
;ld a,(curcol) ;get current column position
;jr consent ;common entry point
```

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code26:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ld</td>
<td>hl,(userde) ;hl= buffer pointer</td>
</tr>
<tr>
<td>inc</td>
<td>hl</td>
</tr>
<tr>
<td>push</td>
<td>hl</td>
</tr>
<tr>
<td>ld</td>
<td>b,(hl) ;b=no. of chars in buffer already</td>
</tr>
<tr>
<td>ld</td>
<td>a,(curcol)</td>
</tr>
<tr>
<td>push</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>time</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>af</td>
</tr>
</tbody>
</table>

comment:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ld</td>
<td>(col.sav),a ;save it</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>gconch</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>consave</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>time</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>movlin</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>bskspc</td>
</tr>
<tr>
<td>ld</td>
<td>a,d</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>call</td>
<td>movlin</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
</tbody>
</table>

; backup chars

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>pop</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>bskspc</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
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<tr>
<td>push</td>
<td>bc</td>
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<tr>
<td>call</td>
<td>bskspc</td>
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<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
</tbody>
</table>

; print line to end of line omitting current char

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>call</td>
<td>time</td>
</tr>
<tr>
<td>call</td>
<td>pchar</td>
</tr>
<tr>
<td>call</td>
<td>pchar</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>inc</td>
<td>b</td>
</tr>
<tr>
<td>inc</td>
<td>b</td>
</tr>
</tbody>
</table>

; backup space

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>call</td>
<td>bspcc</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>bskspc</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>bskspc</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
</tbody>
</table>

; move chars in buffer to close up gap

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bdir</td>
<td>pc</td>
</tr>
<tr>
<td>bdir</td>
<td>bdir</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>af</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>movlin</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>ld</td>
<td>b,a</td>
</tr>
<tr>
<td>sub</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>eolch</td>
</tr>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>time</td>
</tr>
</tbody>
</table>

; print (move) 'a' chars forward

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>foward</td>
<td>pc</td>
</tr>
<tr>
<td>foward</td>
<td>b</td>
</tr>
<tr>
<td>foward</td>
<td>d</td>
</tr>
<tr>
<td>foward</td>
<td>d</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>time</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
</tbody>
</table>

; backup chars

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>hi</td>
</tr>
<tr>
<td>push</td>
<td>de</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>push</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
<tr>
<td>call</td>
<td>time</td>
</tr>
<tr>
<td>pop</td>
<td>bc</td>
</tr>
</tbody>
</table>

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The text in the image appears to be a program listing in assembly language, likely related to a CP/M system. The text includes various assembly language instructions and comments, and it seems to be discussing the setup of various registers and the handling of characters in a buffer. The code is written in a style that is typical of early CP/M systems, with references to the BDOS (Basic Disk Operating System) and various other system services.

Listing 2

Listing 3

Title: 'enhanced z80 ccp for 2.x 3/18/82'

William F. Dudley
Dec. 06, 1985 - modified for last command memory.

Equates
include listing.4a ; global equates for history

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Listing 4

Title: 'Get history buffer into save image'

GetHist.mac

; Get the start of the history buffer
ld hl, (hdptr), hl ; Get the start of the history buffer
ld bank0
ld a, 0
ld (rcmd), a ; Runpatch so normal cp/m getlin invoked

; Capitalize string (ending in ' ') in buf

convert: ld hl, buf
ld b, hl ; Get char in b
inc b ; Move to next char
chl: inc hl ; Get character
ld a, (hl) ; Get character
ucase: eq $ + 1 ; If greater than lower-case z? 
ld (hl), a ; Store character
djnz chl ; Write command line
ld (hl), b ; Get ending null (b=0)
ld hl, cibuff ; Set cbuf and ptr to list char
ld (cibptr), hl
;
This ret needs to be ahead of ucase for CASE to work

; Convert char in a to upper case
ucase: cp a, 'a' ; Less than lower-case z?
cp c, 'a' ; Yes
rnc ; Yes, true
res 5, a ; No, clear lower case bit
ret
;
form case: ex (mp), ix ; Get exit address on stack

castag eq $ + 1 ; Overwritten, initialized to ucase
xor @ caspat
ld (castag), a
ld a, low (ucase)
ld b, '1'
ir caspat
dec a ; Points to the return before ucase
dec b
jis '0' now caspat

; Make the second bank active

bank2: ld 1600h, bank2 equ
ld 1600h, second 64k bank
bc, pend-pstart
;
; Make the first bank active

bank0: xor a
obr: out 0, bx
ret

Listing 5

Title: 'Put history buffer from save image'

PutHist.mac

; To use:
; A>get 100 histname.ext
; A>puthist
; or if using CP/M without GET command
; A>get histnam.com
; A>puthist
;
for z80 with simple bank select

; include listing 4a ; Global includes for history

asseg org tpa

; Copy real program up to NONBNK above bank selected memory.
ld hl, mstart
ld de, nonbnk
ld bc, pend-pstart
dir jsr

mstart: .phase nonbnk

; Phase pseudo-op causes assembler to generate

; Code for different run location when load address

pend: empty: ds 1
.dephase
end

Listing 6

Title: 'Clear history buffer'

ClearHist.mac

; To use:

continued on page 85
A First Look At The 80386

By Michael Weinreich

Last October, Intel announced their 32-bit microprocessor, the 80386. This is the next generation in the evolving 8086 family of microprocessors which includes the 8086 used in the IBM PC and XT, and the 80286 used in the IBM PC AT.

A review of the specifications for the 80386 shows greatly increased power over what we have seen before from Intel, and power that (depending on your viewpoint and your biases) is either almost comparable to, or reasonably in excess of, that of competing 32-bit microprocessors. The 80386 will have a great impact not only because of this power, but because it is a convenient upgrade path from the present IBM PC family and clones. Although the benefits of the 386 are somewhat tempered compared with what Intel would have us believe, they are still very impressive.

WHAT THE 80386 IS SUPPOSED TO BE

Perhaps the best place to start is with the best news of all, that is, the claims that Intel makes for their chip:
- The highest performing commercial microprocessor ever designed.
- Clock speed of 16 MHz.
- Computational performance of 3-4 MIPS with a 32MB/sec bus bandwidth. With an 80387 numeric coprocessor, it can achieve 1.8M Whetstones/sec.
- Hardware support for multitasking, multiluser operating systems.
- Excellent compatibility with the 8086 family, including the 8088 used in the IBM PC.

This all sounds great, but then...

IS THIS BELIEVABLE?

It may in fact be the highest performing commercial microprocessor ever designed, where commercial means that it is a single-chip CPU priced low enough to use in garden-variety commercial desk-top computers. But a chip that has been designed doesn’t do us any good. Rumors of initial commercial availability vary from mid 1986 to early 1987, and there are many difficulties which may be encountered to delay whatever schedule is intended. The claim of the 16MHz clock rate is similarly impressive but sufficient yield for commercial availability at this speed is as yet unproven.

What Will The 80386 Do For Us?

The claim of 3-4 MIPS is impressive, and is believable given the specs for the chip. But it depends on the availability of the chip at the promised clock rate, and a high-performance memory system as well. The floating-point performance given by the 1.8M Whetstone/sec rating depends on the 80387 numeric coprocessor, for which we have only a vague promise of sampling (or is it just announcement) in late 1986.

The claim of multitasking and multiluser capabilities is true, in that the 80386 has an excellent set of instructions and features that make it relatively easy for writing of an appropriate multitasking operating system. But users are not going to write their own. We will have to wait for one to become commercially available.

The 386 is indeed more compatible with the 8088 than the 286 is, and this will be the biggest key to its success. This is also what makes it a kludge. A competent chip designer with a clean piece of silicon could easily come up with a much more consistent and organized design, and perhaps even with greater capability as well, if he did not have to work around the existing architecture of the 8088.

WHERE DOES THE TRUTH LIE?

Although not yet in mass production, the 80386 has been sampled and is running successfully in early prototypes at various facilities. It is not unreasonable to expect commercial availability soon (perhaps even by the time that this article is printed in a few months). Given the high-speed CMOS technology being utilized, clock rates can be expected to be substantially higher than were achieved with earlier processors in the family, even if the stated goals are not immediately reached.

For those who are looking for floating-point performance, the delay in availability of the 80387 is unfortunate. However, an adequate stopgap measure will be to run 80287 numeric coprocessors on small daughterboards in the 387...
ning only at a clock speed increase of 26% (6 MHz vs 4.77 MHz), executes that code about four times faster. This is because of the fewer clock cycles needed for each instruction, and also because the memory bandwidth is 16 bits rather than 8 bits. This makes the IBM PC AT a very valuable PC clone. Most ATs and clones are now sold at 8 MHz, and some are now available at up to 12 MHz, making them even more valuable PC clones. But they are still just PC clones.

THE 80386 AS YET ANOTHER CLONE

So will the 80386 be used in the same way, simply as a souped-up PC running the same old software? It could be, but it would be crippling the 386 just as the 286 has been crippled, and we would not see much of the real power of the 386.

The 80386 could have a faster clock speed, but we are now looking at only a 33% increase over the new 12 MHz AT clones. And for a 16 MHz 386, we will either need a reasonably expensive (for a desktop PC) memory system, or we will have to allow the memory system to slow down the CPU. The 386 can execute some instructions in fewer clock cycles (especially multiply and shifting instructions), but its improvement over the 80286 is much smaller than the 286's improvement over the 8088. The expansion of the memory bus to 32-bit doublewords is impressive, but no present programs can use this feature directly, since there are no 32-bit load or store instructions in existing IBM PC code.

We may conclude that if an IBM PC clone were to be built with a 386, and used to run the same software with the same PC-DOS operating system, the improvement of speed over a fast 286 machine would perhaps be 50% to 100%. But the price of the machine would be much higher, perhaps comparable to the increase in power. The performance improvement is impressive, but probably won't make waves in the present microcomputing world. Advances by factors of two are only impressive these days if they come bundled with a lower price as well! Including an 80387 provides greater benefits, but only for floating-point applications.

WHAT THE 80386 CAN BE

But do not despair! There is hope! Intel has provided in the 80386 a new mode referred to as "protected virtual 8086 mode", a feature which should have been provided in the 80286. With this mode, the 386 is able to run old PC-DOS software, and also run new software taking full advantage of the 386, under the control of a multitasking operating system.

The appropriate operating system for the 80386 may be a very extensive upgrade of PC-DOS, and if it isn't it will probably be made to look like it was. After all, there are multitudes of users who have never used anything but PC-DOS (and would rather fight than switch). The multitasking capability will allow old PC-DOS software to run as tasks in the new virtual mode, and will also allow new 386 tasks to run with full utilization of the capabilities of the 386. This environment where old PC-DOS applications and new 386 applications can co-exist is the migration path to true 386 power. Users will at first use much of their PC-compatible software, while slowly introducing the new 386 software.

One of the most valuable advantages of the advanced OS will be the protection provided by the true multitasking capabilities of the 386. Tasks will be protected from each other, and the OS will be protected from the tasks. This may provide great safety, or it can allow riskier operation without sacrificing safety. For example, we can utilize a riskier disk caching algorithm, deferring storing sectors from RAM onto the disk even until after an application crashes.

There is even compatibility for old PC-DOS applications that use the L/I/M Expanded Memory Specification (EMS). They will run without EMS memory, because the modified operating system can emulate the EMS standard using virtual memory paging.

Some old PC-DOS software may even be slightly modified to take advantage of some of the 386 capabilities, while still running in the virtual mode. For example, many programmers now purchase hardware debuggers, which assist them with aids such as trapping on access to data at a particular memory location, while the application otherwise runs normally. Some modification of software available with existing hardware debuggers will allow it to run using the 80386 internal hardware debugger, providing this feature at much lower cost than for existing systems.

While the user will still be able to run his old PC-DOS software, he will also be slowly converting over to new 386 software as it becomes available, and we may expect that the applications that can best take advantage of the power of the 386 will be the first to convert. The important features of the 80386 when running software written specifically for it are summarized in Figure 1. Many of them need no further explanation, but some deserve discussion:

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Figure 1. Summary of the features of the 8088, 80286, and 80386.

The 8086 family processors have partitioned memory into address spaces called segments. Segmentation is a valuable capability for memory management, but unfortunately it has gotten a bad reputation because of the limited size of the segments in the 8088 and 80286 (only 64 KB). Having increased the maximum segment size to 4 GB in the 386, this bad reputation should be forgotten. Meanwhile, the 8086 family has not utilized memory paging, a very valuable technique especially in a virtual memory system. Paging allows control of memory in small (in this case, 4 KB) pages. Both segmentation and paging are very valuable techniques, and neither is sufficient alone. Having both in the 386 is a great asset.

The 80386 includes, even more so than the 286 before it, a very valuable set of instructions and capabilities that make it very easy for a powerful true multitasking operating system to be written for it. (These are hardware support for multitasking, and virtual memory paging).

The 386 can therefore be expected to give superior multitasking performance, with less effort needed to write the multitasking operating system than would be required for other 32-bit microprocessors.

WHAT OS WILL WE USE?

We are not assured that a suitable OS will be available immediately, and at a reasonable price, to make available to us all of the benefits summarized above. We can of course continue to use our present version of PC-DOS, with the attendant limitations. We might also consider using DOS 5.0 if it is then available, but this is little better. It still limits us to running 286 code, barring us from the many added features of the 386, such as larger segments and 32-bit operations. Also, it keeps our old PC-DOS applications running in unprotected mode.

WHAT HARDWARE PRODUCTS WILL WE SEE?

One of the first products to appear will be 80386 accelerator boards for the IBM PC AT, and perhaps for the PC and XT as well. With a 386 alone, we will obtain some increase in power for old PC-DOS applications, and the advantages of the new operating system with its ability to run new 386 software with yet greater power. Provision of even an inexpensive cache memory on the accelerator board will provide substantially greater throughput. And when 80387's are available, very substantial improvements in floating point performance will be obtained.

There will also be desktop PCs provided with 80386's. Very few will probably attempt to harness the maximum power available from the 386, because of the costs involved. Considering that most of the advantages of the 386 are separate from the increased clock speed, I would not be surprised to see machines running as slow as 10 to 12 MHz. This will provide a majority of the maximum power at the lowest cost.
Another approach is to put additional expense into a cache memory that will allow the CPU to operate at near full speed, and then saving this expense by providing a very inexpensive memory system that would seriously degrade the 386 performance if the cache were not present. For example, the current IBM PC AT expansion cards could be used, providing 16-bit memory (half the 386 bus size) at 8 MHz (half the 386 clock speed) with a wait state. This not only provides very good average performance; it provides the best possible performance for benchmarks that can be used to advertise the machine.

**LOOKING BEYOND THE 80386**

Intel has already indicated that they are planning for the next-generation microprocessor (at least in between their hints that the 80386 is more than we could ever want for years to come). They tell us it will be called the 80486, but they provide very little in the way of details. But we may make some educated guesses (and in some cases, better than guesses, given the scraps of evidence available):

On-chip access time is always fastest, so on-chip caches can be very effective even when they are small. Therefore, there may be a code cache on the chip, but more likely there will be an enhanced instruction prefetcher which prefetches code along both paths following each conditional branch. There will likely be a data cache on the chip (perhaps 8 or 16 32-bit words, fully associative), and perhaps a stack cache as well. The stack caching could of course be handled within a data cache, but a stack cache is so much easier to implement that it may be worthwhile to keep it separate.

On-chip caching could seriously degrade the 386 performance; it provides the best possible performance for benchmarks that can be used to advertise the machine.

**AND FURTHER INTO THE FUTURE**

We will be ready for the next generation of hardware after the 80486 in about 5 years. At that time, our stock of 8086 family software will fall into three categories:

First, there will be old PC-DOS programs which were never converted to 286 or 386 code. This implies that performance considerations are not important. Such applications can be run under an emulator; i.e., a supervisor program that can inspect and effectively execute object code for a foreign machine. This is inefficient, but sufficient.

Second, there are the applications now available, and yet to be written, which are developed in high-level languages. These can easily be re-compiled for any new CPU architecture.

Third, we have the programs that have been converted to 386 code (or at least to 286 code), and which require too much computational power to run effectively under emulation, but which cannot simply be re-compiled. Luckily, these programs are generally well-behaved. The 286 and 386 environments free one from techniques such as self-modifying code, and prohibit manipulation of segment register addresses without the cooperation of the OS. This promotes clean object code, compared with the dirty object code common in old PC-DOS applications. While this clean code is being developed over the next few years, we may expect that other chip manufacturers will be copying many of the important features of the 8086 family, such as segmentation of memory with a few segment base registers as part of the CPU. This will leave us with an environment in which conversion of object code to run on a foreign machine will be feasible, especially given the incentive for competing manufacturers to develop better conversion aids in order to make 8086 family software available on their CPU architectures.

Compatibility with the 8086 family on a hardware level will therefore become relatively unimportant. Unnecessary compatibility will not be allowed to interfere with progress. We may expect that even Intel will not be overly concerned with 8086 family compatibility after the 80486. (2)
PC-PRO

by Alex K.H. Soya

Many S-100 computer owners feel left out these days because most new software is aimed at PC-DOS/MS-DOS systems. Today's computers must be able to provide some degree of PC compatibility to take advantage of software written for PC-DOS. Fortunately for owners of CompuPro S-100 systems, PC-DOS is no longer a foreign operating system.

PC-PRO, a Computer House product, is an implementation of IBM PC-DOS versions 2.10 and 3.10 designed to run on CompuPro S-100 hardware. PC-PRO is not based on a Microsoft generic version of PC-DOS (MS-DOS), but on the IBM specific version, as supplied by IBM, for the IBM-PC computer. The evaluation copy used for this review of the CompuPro implementation is based on the PC-PRO BIOS version 2.42 and PC-DOS 3.1.

INSTALLATION

PC-PRO is shipped with the original IBM DOS 3.1 manuals and diskettes as supplied by IBM. Also included are an 8" disk containing the operating system as implemented on the CompuPro, an EPROM (Eraseable Programmable Read Only Memory) for the floppy-disk controller board, and the PC-PRO User Guide, a manual written by Computer House.

The user guide is well written and explains in detail how to use the utilities provided with PC-PRO to configure the operating system for a particular hardware environment. Hardware switch settings for some of the I/O boards are also briefly discussed. The manual gives several explanations as to why certain programs will or will not run with PC-PRO. Though earlier versions of PC-PRO included much of the source code for the BIOS, version 2.42 includes only some minimal parts of the source code.

Before the operating system can be booted, the supplied new EPROM, containing a special boot loader, must be installed on the DISK1 or DISK1A floppy-disk controller card. Some switch settings must also be changed on the DISK1A controller as the supplied EPROM is a 24-pin device rather than a 28-pin EPROM as supplied by CompuPro originally. The manual states that the EPROM must be installed in the lower 24 pins of the socket, however a diagram may make this point more obvious and easier for those not familiar with handling chips on a daily basis.

Unfortunately the routines in the EPROM no longer allow the system to boot from the DISK3 hard-disk controller. I usually run the Concurrent DOS 4.1 operating system and boot directly from the hard disk. With the replacement EPROM, I had to boot from a floppy disk. Concurrent DOS 4.1, CPM-80, and CPM-86 will boot normally from the floppy.

To boot the out-of-the-box PC-PRO configuration, it is necessary to have a console connected to the serial port of the System Support Board. The system booted at the first attempt, which delighted me as I usually have to experiment with different switch configurations when installing new operating systems.

The first thing to do, after booting PC-PRO, is to make a backup of the master disk by executing a provided batch file. The batch file will format a new disk and copy the entire master disk, including a bootable system. This operation is straightforward and almost automatic.

CONFIGURATION

The next step in bringing up PC-PRO is to configure the operating system for the machine's particular hardware environment. A utility program called CONFIGIO.EXE is supplied for this purpose. CONFIGIO is an interactive program which allows the user to configure character devices such as terminals, printers, communications ports, floppy-disk drives and controllers, clock support and timer, interrupt controllers, IBM-PC ROM BIOS emulation, and some other miscellaneous options.

Character devices can be configured according to baud rate, stop bits, parity, and handshaking parameters. In addition, port addresses, bit-masks, initialization bytes, device redirection, and interrupt specifications can be selected. Six different I/O boards are currently supported: CompuPro System Support 1, CompuPro Interfacer 3 or 4, CompuPro Interfacer 2, Lomas Hazitall, Macrotech ADIT I/O, and Fulcrum VIOX-2. Other boards could be installed by selecting an unspecified type and defining the various port addresses, masks, and initialization bytes.

Floppy-disk drives and controllers can also be selected with a wide range of parameters for various types of drives. I used this option to install a 5¼", 48-TPI drive on the DISK1A floppy-disk controller. Both 48 and 96-TPI, 5¼" and 8" single or double-sided drives are supported. Also the new IBM-AT high capacity 5¼" drives rotating at 360 RPM, rather than 300 RPM, can be used with PC-PRO.

For each of the drives, it is possible to select the various drive parameters such as seek step rate, head unload time, and head load time. Two floppy-disk controllers are supported by the standard BIOS: CompuPro DISK1A and Lomas LPD72. Other options allow the user to enter the port addresses to locate the controller at various I/O ports.

Clock support and timers can be configured to use either the internal tick count or the System Support clock to keep the time and date. Selecting the System Support clock enables PC-PRO to boot with the correct time and date, whereas using the tick count option forces the user to enter the current time and date when booting the system. Again, port addresses and other hardware dependent values can be selected.

Interrupt controllers can be installed and their parameters modified to suit particular hardware configurations. As with the other devices, port locations and initialization bytes may be user defined.

The IBM-PC ROM BIOS emulation is performed in the PC-PRO BIOS and can be configured to handle various serial terminals. The BIOS emulation allows programs, which control the various screen attributes through software interrupt calls, to handle various serial terminals. Computer House points out that the emulation
From the Editor:

Owners of CompuPro systems who are running MS-DOS or Concurrent-DOS, or are planning to run these operating systems, will find it advantageous to join the C-PRO National User Group, Box 2146, Woodbridge VA 22193. They publish a quarterly journal containing a great deal of information for CompuPro system owners, many of whom are now running MS-DOS and Concurrent. The most recent copy of their journal carried an excellent article on modifying the CompuPro PC video card to get Hercules high resolution and IBM color graphics compatibility.

is by no means perfect and thus makes no assurance that it will function correctly. This did not bother me, as I was using the CompuPro PC-VIDEO board rather than a serial terminal.

CONFIGIO is one of the most versatile hardware configuration utilities I have ever encountered on a microcomputer system. With a bit of thought and planning a wide variety of configurations could be supported. Though some of the options are rather technical and require knowledge of the hardware, the technical nature of these options is what makes the CONFIGIO utility so useful.

HARD DISK DRIVES

PC-PRO supports hard disks running with the CompuPro DISK3 and DISK2 hard-disk controller cards. The drivers for the DISK3 are built into the BIOS and are thus always present. The DISK2 drivers must be read in at boot time as specified in the CONFIG.SYS file. As I do not have a DISK2 controller, the following pertains only to the DISK3 card.

A utility called HDMAINT is provided to partition the hard disk into DOS and CP/M media. DOS-media formatted partitions are available to PC-PRO. CP/M partitions are available to either CP/M-86 or Concurrent DOS-86. HDMAINT allows the user to specify which tracks on the hard disk are to be partitioned as DOS media. For those who intend to use only PC-PRO as their operating system, the entire hard disk may be used as DOS media. However, if the hard-disk drive is to accommodate two operating systems, as in my case, only part of the drive may be used by PC-PRO.

HDMAINT also allows the user to specify the structure of the directories used on the DOS partition. As I already had DOS partitions on my hard disk from Concurrent DOS 4.1, I attempted to duplicate my drive configuration to allow PC-PRO to access the existing DOS partition. Unfortunately, the attempt destroyed the DOS partition instead. PC-PRO does not seem to know about Concurrent DOS 4.1 DOS-media support and assumed the drive to be CP/M media. After installing the DOS partition using HDMAINT under PC-PRO, I was able to modify the DOS-media DPBS of Concurrent DOS such that I could create a DOS partition which could be read by both operating systems.

HDMAINT is a well thought out program and is of great value when installing DOS partitions. It is essential, however, to backup any previous files on the hard disk as they could easily be destroyed if a mistake is made while assigning partitions.

The DISK3 hard disk performs very well with PC-PRO. The access speed is very fast and smooth. Commands seem to load and execute almost immediately. The performance improvement compared to an IBM-PC is very noticeable. Though the manual does mention support for booting from the hard disk, a special ROM is required which was not available at the time of this review.

OTHER UTILITIES

Computer House provides some other utilities with PC-PRO. DISKBPP is used to display the BIOS Parameter Block (BPB) of a specified floppy or hard-disk partition. REFORM allows the user to reformat the hard disk without destroying any of the existing data. The major reason for using REFORM is to apply a new skew on the hard disk to take advantage of the maximum possible speed of the DISK3 controller. The new format is transparent to all existing software.

HDVERIFY is used to verify the integrity of the data on the hard disk controlled by the DISK3 card. This utility reads every track on the hard disk and reports any errors. The verification is noticeably fast so that the entire hard disk can be verified in a few minutes.

With FIXBOOT, the system can be booted or rebooted from the hard disk. This utility requires a boot ROM which is capable of booting from the hard disk.

Instead of the IBM-PC format utility, Computer House supplies its own FORMAT program. This utility supports single and double-sided 8" and 5 1/4" disks. For the 5 1/4" disks, both 48 and 96-TPI drives are supported as well as the IBM AT 360 RPM high-density (1.2M) drive.
A PC-PRO version of the MODE command allows dynamic configuration of various serial devices. VOLUME can be used to change the volume label on a diskette. A very useful utility for those who are changing from CP/M to PC-DOS is INTERDOS. With this utility, users can transfer files from CP/M-media to DOS-media floppy disks. Supported CP/M media disks include 8", 128-byte sector and 1024-byte sector disks with CompuPro format, as well as 5¼" disks as per IBM-PC Concurrent CP/M specifications. All of the above utilities work well and are easy to use.

PC-VIDEO SUPPORT

To install routines which support the CompuPro PC-VIDEO board it is necessary to edit the CONFIG.SYS file with the specifications of the device driver containing the PC-VIDEO routines. The device driver, VIDEO.SYS, is read into memory and executed when the system boots and provides support for standard video I/O and various ROM BIOS interrupt calls.

The PC-VIDEO support is limited by hardware compatibility with the PC-VIDEO card. Computer House states that programs which access either IBM-PC timers or sound generation support may not function correctly. There also seems to be a compatibility problem with the keyboard port location which could be overcome by a hardware change. Since many public domain programs access IBM-PC hardware directly, they may not run correctly or might hang up the system. Pressing CTRL-ALT-DEL causes a special interrupt routine to be executed which prompts the user to either resume running or to abort the program and return to the system prompt. This feature is very useful in recovering from hung programs without having to reboot the entire system.

The PC-PRO User Guide lists the following programs as known to work correctly: Lotus 1-2-3, SuperCalc 2 and 3, dBase-II, File Master (Schuler and Associates), Mainstreet Filer (MainStreet Software), Wordstar 3.2, 3.3 and 2000, PC-WRITE (Quicksoft), Maxx Software’s C Compiler and the Z editor, List (public domain, by Vernon D. Buerg), and ANSI.SYS from the IBM master diskette.

I tried many graphics-oriented, public domain programs with the PC-VIDEO card under PC-PRO. While some ran without any problems, others did not run correctly when either sound was generated or access to particular hardware ports was attempted. I did notice that the screen image on a color monitor was shifted to the left when high-resolution graphics or 40-character alphanumeric mode. This is not the case if the same programs are run under Concurrent DOS 4.1, suggesting there may be a problem in the PC-VIDEO driver routines.

I also noticed that screen scrolling is accompanied by an annoying flash on the upper quarter of the image. I have observed this flash on the IBM-PC; however, it does not occur when running Concurrent DOS 4.1.

SYSTEM BEHAVIOR

In general, the system behaves very well. Floppy disk accesses are noticeably fast, compared to CP/M-86 or Concurrent DOS 4.1. Most of the programs I ran worked fine. Care must be taken to avoid compiled programs which try to access the BASIC ROMS on an IBM-PC or, as already mentioned, try to manipulate hardware directly.

I was disappointed to find that TURBO PASCAL Version 2.0 by BORLAND, as implemented for the IBM-PC, would not run the provided sample program, ART.PAS. The program crashes with the message "Unexpected interrupt 01h trapped" followed by a register dump. This program works fine under Concurrent DOS 4.1. Again, this indicates a problem with the Video drivers rather than the hardware.

SUMMARY

PC-PRO by Computer House is an excellent implementation of PC-DOS on the CompuPro S-100 system. The configuration utility, CONFIGIO, allows the system to be tuned over a wide range of hardware selections with relative ease. Support is provided for various types of floppy disk, hard disks, and the CompuPro PC-VIDEO board. All of the supported devices worked flawlessly.

If an application can run on an MS-DOS generic system, it should perform well with the PC-PRO system. Programs written specifically for the IBM-PC should be tested carefully before purchasing to ensure that they will function correctly. Copy protected programs require a 5¼" floppy disk to load and even then may not load as they use other hardware specific items, such as timers, in their copy protection procedures.

Considering that the architecture of the CompuPro system is completely different than the IBM-PC’s, Computer House has performed an excellent job in porting
PC-DOS. In future releases I would like to see a new version of the EPROM so that my usual operating system can boot directly from the hard disk. I would also like to see some improvements in the PC-VIDEO drivers to solve the non-hardware related problems.

As We Go To Press

After this review of PC-PRO was completed, and set in type, Computer House sent me a new boot ROM (Version V4-1A) for the DISKIA controller and a updated BIOS version 2.50.

The new ROM allows booting of 8" and 5¼" floppy disks, as well as the DISK3-controlled hard disk drive. The new ROM is similar in operation to the original ROM supplied by CompuPro. However, I did experience some difficulty in booting the system with a Macrotech MI-286 CPU board. The system would ignore the floppy disk controller and always try to boot from the hard disk. This problem did not appear with the older CompuPro 85/88 CPU card. The MI-286 would boot fine with the original CompuPro ROM. The difference between the ROMs, according to Computer House, is that PC-PRO boots from a double density 8" disk, while CompuPro boots Concurrent CP/M from a single density track.

It seems that the higher density selection during the boot cycle is more sensitive to noise on the bus with faster CPU speeds. In any case, the new ROM is invaluable if a hard disk is attached to the system.

The new BIOS also fixes several bugs and introduces some new features and enhancements. The serial drivers have been enhanced to allow more flexible use of dumb terminals. It is now possible to map function and control keys to IBM-PC keyboard codes. This feature allows software, which expects IBM-PC keyboard codes, to run with ordinary serial terminals.

A "Visual Bell" has been added to the PCVIDEO drivers to make up for the absence of any bell circuitry on the PCVIDEO card. When a bell character is sent, the screen flashes brightly to alert the operator.

Other enhancements and bug fixes have been made to the video drivers, the MODE command, HDVERIFY and M-Drive/H drivers.

The Turbo Pascal graphics demo still crashes with the message "unexpected interrupt 06h" followed by a register dump.

Alex Soya has been involved with CP/M for over 9 years. His interests include operating systems, data communications, system utilities, real time and scientific programming. He is currently a senior in computer science at Florida Institute of Technology.
BSW-Make

A practical and efficient software configuration manager for MS-DOS, VAX/VMS, and VM/CMS

At The Boston Software Works, we routinely work with a number of different operating systems and development environments. One tool we have found to be indispensable is BSW-Make. BSW-Make is a complete implementation of the UNIX make utility. It automates the tedious task of rebuilding your software product after an editing session; BSW-Make does only the minimum work required to update your product after a change, saving time and preventing missed compiles.

We carefully constructed BSW-Make to be portable, and have used it successfully under MS-DOS, PC-DOS, VAX/VMS, and VM/CMS. We wouldn't want to start a major software project without it, and we think you won't either, once you've tried it.

Highlights of BSW-Make:
- Works with any compiler, assembler, linker, or text processor
- Not copy protected
- Indirect command file generation facility overcomes operating system command length limitations
- Macro facility for parameterized builds
- Syntax compatible with UNIX make
- 30-day unconditional money-back guarantee

<table>
<thead>
<tr>
<th>MS-DOS</th>
<th>VAX/VMS</th>
<th>VM/CMS</th>
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<tr>
<td>$89.95</td>
<td>$495.00</td>
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BSW-Make for MS-DOS runs on any MS-DOS machine. It requires MS-DOS or PC-DOS version 2.00 or later, and is shipped on IBM PC 5¼ inch diskettes or IBM PC Convertible 3½ inch diskettes.

BSW-Make for VAX/VMS runs on any VAX or MicroVAX running VMS version 4.0 or later. It is shipped on 9-track magtape or RXX0 diskette.

BSW-Make for VM/CMS runs on any IBM 370-series, 3xx, 308x, or 309x system running VM/CMS. It is shipped on 9-track magtape.

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The Business Board System (BBS) provides a dial-up information center that can be accessed 24 hours a day via modem at 300/1200/2400 baud. The multi-level menu system is easily customized with no programming required. An unlimited number of data entry forms are user configurable and can be presented to callers based on their menu selections. The business applications are unlimited! This package is written in compiled BASIC and includes CONSOLEX for remote PC operation and BORDM our data base Board Manager.

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Interfacing Using The SCSI Bus

by Hul Tytus

Several years ago I installed a large capacity hard disk (65 Mbytes formatted) on a Radio Shack Model 2. Within a few months I had to switch to an S-100 setup using MS-DOS with an 8086. The Z80 and CPM-80 didn’t provide the software or speed the application needed. Due to a lucky selection of components, the same disk, the controller and software, or nearly so, fit onto the new system with a minimum of trouble. Sound like magic? After all, those are two different architectures. Well, it is a bit of magic, and all due to the “Small Computer System Interface” (SCSI, pronounced “scuss-ee”) bus with some help from the easily ported C language. The total cost, not counting some upgrading done at the same time, was $200. Not bad.

The SCSI bus was first introduced with the acronym SASI by Shugart Associates to tie peripherals and one or more hosts together on small computer systems. It allows controllers to be mounted in the same external housing as the drives rather than on the host’s bus. Consequently a new controller needn’t be purchased for the new system. A host multi-tasking or multi-user system, an old printer and terminal can simply be unplugged from the old and plugged into the new. With the SCSI bus, the same is possible with tape and disk drives and their controllers. Of course nothing involving computers is quite that simple, as a look at the following software driver proves. But the job is much simpler and much cheaper than working with proprietary interfaces.

A LITTLE SCSI & SASI HISTORY

SASI originally stood for Shugart Associates System Interface until an ANSI committee formalized the standard and gave it the name “Small Computer System Interface” (SCSI). The committee also added a few extra features that allow, say, a read sectors command to be started on one device disconnecting that device before completion, and then starting another task on another device, a tape drive for example. When the read sectors command is completed, that device can be reconnected to read the data from the controller’s buffer.

The term SCSI has come to imply the ability to handle all features of the standard, including disconnect and reconnect, while the term SASI usually indicates only a subset of the commands are available. The scope of this article is limited to the subset of commands loosely defined by the term SASI.

The ANSI standard comprises two sections. The first is the SCSI bus hardware specification. The second is the protocol which defines the way commands, data, status, and messages are sent between the host and the controller, or, in SCSI lingo, the initiator and target. This protocol enables a driver, written in C (Listings 2 and 3), to be used with slight modification, on a wide variety of hosts. Between the portability of the C language and the portability of the SCSI protocol, the likelihood is that a driver need only be written once. The driver presented here was designed for a single user machine and is not interrupt driven. If ever install a multi-tasking or multi-user system, an interrupt driven driver will have to be written. Maybe I should say there is hope it need be written only once.

INTERFACING TO THE BUS

The bus is simple, using a 50 pin ribbon cable to interconnect the disk drives, tape drives (if used), and the host(s). Eight leads are used for data with parity. Some controllers and host adapters utilize parity checking, others don’t. Nine lines are used for control signals (select, busy, request, acknowledge, control/data, input/output, message, reset and attention). All control and data lines are biased at a positive voltage by terminating resistors and are considered to be asserted (logical 1) when pulled low to ground.

The sequence for the host to, for example, read a logical sector on a disk is divided into several phases. The selection phase requires the host to assert one of the data lines to identify which controller or target is desired and then assert the select line. The target addressed then asserts the busy line to indicate it has recognized its selection. As the SCSI idiom goes, it has been awakened.

In the command phase, the target unasserts the input/output line to indicate a block of six or ten bytes of command information should be outputted by the host to the target. The target asserts the request line for the first byte until the host asserts the acknowledge line to indicate the byte is on the data lines. When the target has read the byte, the request is unasserted. The host then unasserts the acknowledge line and the handshake sequence continues until all bytes of the command are transferred to the target.

Next, in the data phase, once the controller has read the sector(s) on the disk into a buffer, it will unassert the control/data line and assert the input/output line to indicate that the host can now input the data. This is done with the request/acknowledge handshake as before.

When all data is transferred, the status phase is entered and the controller asserts the control/data line to indicate the status byte may be input by the host. The status byte will indicate if all is well.

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<td>Acknowledge</td>
<td>Reset</td>
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<td>Select</td>
<td>Control/Data</td>
<td>Request</td>
<td>Input/Output</td>
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</table>

![Figure 1. SCSI connector pins](image-url)
A SCSI DEVICE DRIVER

The software shown in Listings 1 through 3 are the modules of an installable MS-DOS driver for a Priam 72 megabyte disk using an Adaptec 4000 or 4070 controller and a Data Technology Corp DTC 10-1 host adapter. Thanks to SCSI's hardware and software standards, the controller and host adapter can be replaced by units from other manufacturers with only minor modifications.

The first listing is the interface using the MS-DOS installable driver protocol and SCSI commands. It is written in 8086 assembly code and is compatible with the OBJ code produced by the Lattice C compiler. The second listing comprises the basic SCSI commands in C and is the principal object for any modifications that would be required for different components when using an MS-DOS operating system. If a different system is used, Listing 1 would have to be rewritten. Listing 2 could be largely deleted if only a basic driver is desired. Since it provides allocation of alternate sectors on the fly, it increases the effective reliability of the disk and simplifies the original formatting task at the same time. Without such a capability, the disk must first be formatted and then all sectors read to search for faulty sectors and a record kept. Then the disk must be reformatted with the location of the defective sectors furnished to the controller.

Before saying anything about Listing 1, it should be mentioned that the logical sector size used is 2K, which can cause trouble unless the system is booted from a drive with the same or larger size sectors. By altering the driver for the disk on which the system is booted, MS-DOS can be fooled into thinking that 2K sectors are used. This means some fiddling with another driver however. The simplest method I found was to patch MS-DOS with a new Maximum Sector Size Word (MSSW). That location on MS-DOS version 2.11 is 101h. Listing 4 shows some code within the operating system that will point to the MSSW. To find the MSSW on versions other than 2.11, I suggest searching for a portion of the code shown and then disassembling around that address in order to read the location of the MSSW. This has been done on version 2.10 effectively but not on any of the 3.xx versions. Also, note that version 2.10 has

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pop es
pop si
call setcnt

skpinit:
mov al,es:[si+2] ; check for legal command
cmp al,0ch
jnc lastxx
shl ax,1
mov bx,offset cs:jmpth1
add ax,ax
mov cx:[bx] ; call command
mov bx,word ptr cs:[error],ax ; save error code
or al,al
mov cx,10h
jx lastxx
call seterr

lastxx:

mov word ptr es:[si +3],cx ; with status code
cli
mov ax,word ptr cs:[savess] ; reload stack pointer
mov es,ax
pop ds
pop si
pop bp
pop bx
pop cx
pop ax
pop dx
pop cx
pop bx
pop ax
ret

; Come here to abort

hinit:
push si
push es
push ds
pop es
call init ; initialize
pop es
pop si
push ax
mov al,byte ptr cs:[unitc] ; load reg head with # of logical drives
mov ax,word ptr cs:[savess] ; get pointer to BPB pointer tbl
mov bx,word ptr ds:[drive] ; figure which BPB tbl
shl bx,1
mov word ptr es:[si+12h],ax ; load reg head with pointer to
mov ax,cs
pop cx
mov word ptr es:[si+14h],ax ; to BPB pointer
mov bx,word ptr cs:[bx] ; logical drive
mov word ptr cs:[si+10h],ax
mov ax,word ptr es:[si+12h],ax ; load reg head with address of
mov ax,seg buffer ; end of driver
mov bx,cs
add ax,bx
mov word ptr es:[si+10h],ax
pop ax
push ax
mov bx,offset cs:jmpth1
mov word ptr es:[si+31],cx
cli
mov ax,word ptr cs:[savess] ; print install notice only once
pop bx
mov bx,offset cs:jmpth1
mov word ptr es:[si+31],cx
inc al
inc al
mov byte ptr cs:[first],al
inc al
mov byte ptr cs:[first],al
push ds
push es
push si
push cs
pop ds
pop es
pop ds
mov dx,offset cs:jmpth1
int 21h
pop si
pop es
pop ds
push cx
push dx
mov dx,ax
mov ax,word ptr [maxblk] ; get # of physical sectors
mov bx,word ptr [maxblk+2] ; change to logical sectors
shr bx,1
crx ax,ax
loop setcntl
or dx,ax
jmp setcntfin
mov bx,TOTALSECNT+33
sub ax,bx
shl bx,1
and ax,OfffOh ; make sure there is no partial cluster
mov word ptr cs:[totstbl],ax
mov bx,offset cs:jmpth1
mov ax,cs
mov bx,offset cs:jmpth1
mov bx,cs
and bx,ax
mov word ptr cs:[bx] ; logical drive
mov dx,offset cs:jmpth1
add dx,ax
mov bx,offset cs:jmpth1
add bx,ax
mov bx,word ptr cs:[bx] ; logical drive
mov ax,byte ptr cs:[bx] ; media byte
cmp al,01
jnc medial ; if MSDOS matches driver's media byte
mov al,01 ; set no change status
mov al,0ffh ; else media changed status
mov word ptr cs:[savess],ax
xor ax,ax
ret

blpdb:
mov bx,offset cs:jmpth1
mov word ptr es:[si+40h],ax ; load req head with media status
xor ax,ax
ret

hwrite:
push es ; pass arguments to diskw
push si
push bp
push ax
mov ax,word ptr es:[si +12h] ; count
push ax
mov ax,word ptr es:[si +10h] ; transfer seg
push ax
mov ax,word ptr es:[si+0eh] ; transfer byte
xor ax,ax
push ax
mov ax,word ptr es:[si+14h] ; sector MSW
push ax
mov ax,word ptr es:[si+14h] ; sector LSW
push ds
pop es
call diskw
mov bp,sp
pop si
push es
or bx,ax
jx hwrite1
xor cx,ax ; if error, tell MSDOS 0 sect's read
mov word ptr es:[si+12h],cx
hwrite1: ret

hinitl:
xor ax,ax
pop ax
ret

setcnt: ; sets number of sectors in logical drive 2
push cx
push bx
mov bx,offset cs:jmpth1
mov word ptr es:[si+12h],ax
mov ax,word ptr es:[si +12h] ; count
push ax
mov ax,word ptr es:[si +10h] ; transfer seg
push ax
mov ax,word ptr es:[si+0eh] ; transfer byte
xor ax,ax
push ax
mov ax,word ptr es:[si+14h] ; sector MSW
push ax
mov ax,word ptr es:[si+14h] ; sector LSW
push ds
pop es
call diskw

media:
mov word ptr es:[si+40h],al ; load req head with media status
xor ax,ax
ret

sigmon: db 'HD.sys version 2.11.03 installed.',0dh,0ah,05h

mov ax,word ptr cs:[error]
or ax,ax
mov ax,word ptr ds:[drive] ; correct BPB table
shl bx,1
add bx,ax
mov word ptr cs:[bx]
mov bx,word ptr cs:[bx]
mov al,byte ptr cs:[bx]
mov bl,es:[si+0ch]
anp al,bl
mov ax,word ptr es:[si+14h],ax
xor ax,ax
ret

setcnt1:
shr bx,1
crx ax,ax
loop setcntl
or dx,ax
jmp setcntfin
mov bx,TOTALSECNT+13
shl bx,1
and ax,OfffOh
mov bx,offset cs:jmpth1
mov ax,word ptr cs:[si+40h]
and ax,ax
mov word ptr cs:[totstbl],ax
mov bx,offset cs:jmpth1
mov ax,cs
mov bx,offset cs:jmpth1
mov bx,cs
and bx,ax
mov word ptr cs:[bx]
mov ax,byte ptr cs:[bx]
cmp al,01
jnc medial ; if MSDOS matches driver's media byte
mov al,01 ; set no change status
mov al,0ffh ; else media changed status
mov word ptr cs:[savess],ax
xor ax,ax
ret

hinit:
push si
push es
push ds
pop es
call init ; initialize
pop es
pop si
push ax
mov al,byte ptr cs:[unitc] ; load reg head with # of
mov byte ptr cs:[si+0dh],al ; logical drives
mov ax,word ptr cs:[savess] ; get pointer to BPB pointer tbl
mov bx,word ptr ds:[drive] ; correct BPB tbl
shl bx,1
mov word ptr es:[si+14h],ax ; load reg head with pointer to
mov ax,cs
pop cx
mov word ptr es:[si+12h],ax ; to BPB pointer
mov word ptr cs:[si+10h],ax
mov ax,word ptr cs:[si+12h],ax ; load reg head with address of
mov ax,seg buffer ; end of driver
mov bx,cs
add ax,bx
mov word ptr es:[si+10h],ax
pop ax
push ax
mov bx,offset cs:jmpth1
mov word ptr es:[si+31],cx
cli
mov ax,word ptr cs:[savess] ; print install notice only once
pop bx
mov bx,offset cs:jmpth1
mov word ptr es:[si+31],cx
inc al
inc al
mov byte ptr cs:[first],al
inc al
mov byte ptr cs:[first],al
push ds
push es
push si
push cs
pop ds
pop es
pop ds
mov dx,offset signon
int 21h
pop si
pop es
pop ds
push cx
push dx
mov dx,ax
mov ax,word ptr [maxblk] ; get # of physical sectors
mov bx,word ptr [maxblk+2] ; change to logical sectors
shr bx,1
crx ax,ax
loop setcntl
or dx,ax
jmp setcntfin
mov bx,TOTALSECNT+33
sub ax,bx
shl bx,1
and ax,OfffOh
mov bx,offset cs:jmpth1
mov word ptr cs:[totstbl],ax
mov bx,offset cs:jmpth1
mov ax,cs
mov bx,offset cs:jmpth1
mov bx,cs
and bx,ax
mov word ptr cs:[bx]
mov bx,word ptr cs:[bx]
mov al,byte ptr cs:[bx]
mov bl,es:[si+0ch]
anp al,bl
mov ax,word ptr es:[si+14h],ax
xor ax,ax
ret

dbldpb:
mov bx,offset cs:jmpth1
mov word ptr es:[si+40h],al ; load req head with pointer to
mov ax,word ptr ds:[drive] ; correct BPB table
shl bx,1
add bx,ax
mov word ptr cs:[bx]
mov bx,word ptr cs:[bx]
mov ax,cs
mov word ptr es:[si+14h],ax
xor ax,ax
ret

hread:
push es ; pass arguments to diskr in 1st #2
push si
push bp
push ax
mov ax,word ptr es:[si +12h] ; count
push ax
mov ax,word ptr es:[si +10h] ; transfer seg
push ax
mov ax,word ptr es:[si+0eh] ; transfer byte
xor ax,ax
push ax
mov ax,word ptr es:[si+14h] ; sector MSW
push ax
mov ax,word ptr es:[si+14h] ; sector LSW
push ds
pop es
call diskr
mov sI?,bp pop Sl pop es
or ax,ax
jx hread1
xor cx,ax ; if error, tell MSDOS 0 sect's read
mov word ptr es:[si+12h],cx
hread1: ret

hwrite:
push es ; pass arguments to diskw
push si
push bp
push ax
mov ax,word ptr es:[si +12h] ; count
push ax
mov ax,word ptr es:[si +10h] ; transfer seg
push ax
mov ax,word ptr es:[si+0eh] ; transfer byte
xor ax,ax
push ax
mov ax,word ptr es:[si+14h] ; sector MSW
push ax
mov ax,word ptr es:[si+14h] ; sector LSW
push ds
pop es
call diskw
mov sI?,bp pop Sl pop es
or ax,ax
jx hread1
xor cx,ax ; if error, tell MSDOS 0 sect's read
mov word ptr es:[si+12h],cx
hread1: ret

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stituted with alternates. Unfortunately, first ascertaining and then transferring the defect list to the controller is a cumbersome operation which complicates the original formatting of the disk.

This would not pose a problem if a disk could be relied upon to never develop unusable sectors, after formatting. Such perfection, however, is not possible. Listing 2 handles a fault occurring in the middle of an operation without causing a halt in the operation. In other words, degraded sectors are given alternates on the fly.

127 physical sectors are set aside as alternates. Before a read or write operation (diskw() or diskr()) is started, the function trans( ) is called to provide the correct address and make sure that all the sectors required in the operation are in their natural location. If not, that is, if one or more is defective and has been assigned an alternate, each physical sector is read or written individually by the function dfix( ). Dfix() is also used if a new defective sector is discovered.

If, in a read operation, the error correction code must be used, an alternate sector will be applied even if the correction is successful. The idea is to keep error correction in reserve to be used only as a last resort. If the sector is bad, avoid it.

Two arrays of addresses are maintained, both on the disk and in RAM. The first array contains the natural addresses of unusable sectors and the second holds the locations of the alternates. When a sector is assigned an alternate, the arrays in RAM are set to provide the proper addressing and then written to the disk. Two copies are made for safety. The string “BADBLK” directly precedes the alternates. Unfortunately, first controllers with the exception of the DTC 10-1.

Getcon() handles the selection phase by first checking the busy line to be sure there is no activity on the bus. Then it sets the appropriate bit on the data bus to identify the target, or addressed controller.

Listing 2
int dfix(blockk, src, cmd) /* cmd = 1 for write, 2 for read */;
long blockk, src;
int cmd;
{
    long block, check;
    int x, y, z;
    start:
        y = 2;
    while(y--)
        /* try y times to get it right */
        block = trans(blockk, 1); /* get correct block number */
        if ((block & badblk[altflg])
            return BADblk; /* 0 return means illegal block number */
        if (cmd == WRITE)
            x = dwrite(block, src, 1);
        else x = dread(block, src, 1);
        if (!x)
            return 0; /* if no error, return error */
        if (x == BADblk)
            return 0; /* drive not ready, return */
        return x;
        /* figure a block in next cylinder */
        check = block - CYLSIZ;
        if (check < 0)
            check = block + CYLSIZ;
        if (check == block - 1)
            return 0; /* wiggle head */
    }
}

trans(block, cnt) /* translates logical to physical sector */
    /* returns 0 for error */
    /* okcount = 1 if all sectors are natural */
int cnt;
long block;
{
    int x, y;
    block = block + FSTBLK;
    if (block > maxblk)
        altflg = 0;
    return 0;
}
    x = place(block); /* assign alternate block */
    if (x)
        return x; /* return if error */
    okcount = 1;
    /* write RAM alternate tables to disk */
    /* if ECC error on read, write alt block w/ corrected data */
    if (z == ECCERR && cmd == READ)
        return 0; /* illegal block number */
    block = trans(blockk, 1);
    x = dwrite(block, src, 1);
    if (!x)
        return 0;
    goto start; /* now try again with alternate block */
    return x;
}

When the selection line is asserted, the target acknowledges its ID number by asserting the busy line. A timeout is provided in case the controller is not present. The selection phase ends by the host unasserting the select line.

The request( ) function waits for the request line to be asserted by the target. As described previously, this is the start of the handshake for transmission between host, or initiator, and the target.

Putcmd( ) transmits the six or ten byte command string to the controller to complete the command phase. Each byte is not counted, rather the routine is allowed to send the command bytes until the control lines change to indicate a new phase should be entered. This allows the controller to abort at any time without befuddling the host.

Putdat( ) and getdat( ) take care of the data phase. These routines are used when the command requires more data than is included in the proper command string. Notice these do not count the number of bytes but continue to transmit until the controller indicates otherwise.

Status( ) does just what the name suggests; it returns the status or check byte. Along with providing the status phase, the message byte is also read and discarded. The message phase is not used in this driver except to terminate an operation.

Sense( ) is actually a complete command that uses all of the phases mentioned to sense the condition of the controller and drive. This is necessary because the check byte only indicates if an abnormality has occurred. Sense() returns the specific error code.

The remaining functions use those basic functions already mentioned to fully execute the ANSI standard commands. There are two exceptions. Both dread( ) and dwrite( ) use the dmaio() function which is special to the DTC 10-1 DMA circuitry. For other host adapters with no DMA, putdat() and getdat() could be mimicked in assembly code to handle the full address range required by the system.

After about six months in service, this driver has proved to be quite adequate. Unfortunately, in a backwards way of speaking, the 5" Primm disks have also proved to be quite reliable. This means that the drivers have not had a truly exhaustive test. Such a situation was anticipated in the design considerations leading to the belief that a simple scheme for allocating alternate sectors would not impair the speed of the disks in any significant way. Such is the case.

A small C program, written to check the read and write throughput, indicates about 300K bytes per second for reading and about half that for writing, using Adaptec’s 4070 controller. The reduction continued on page 67
long block;
{
    int x, y;
    long block;
    block = blockk;
    /* check to see if an alt block is available */
    if (newadd[0] >= ALTCNT)
        return NOSPC;
    if (altflg)
        /* block is already marked bad */
        goto lump;
    block = blockk;
    /* increment length of array */
    x = 1;
    while (block > badblk[x] && badblk[x] != 0 && x < ALTCNT)
        ++x;
    if (y > x)
        { badblk[y] = badblk[y - 1];
          newadd[y] = newadd[y - 1];
        y; }
    badblk[x] = block; /* insert new bad block */
    altflg = 0; /* block is now marked */
    x = newblk(altflg); /* get new alternate sector */
    return x;
}
}

int newblk(arynum) /* gives new block 
# to newadd[altflg] */
{
    int arynum;
    if (newadd[0] >= ALTCNT) /* return error if table is full */
        return NOSPC;
    newadd[arynum] = newadd[0] + ALTBLK;
    ++newadd[0]; /* increment total number of alternates */
    return 0;
}

int putary() /* puts both arrays to the disk */
{
    int x, y, ds;
    long block;
    char *sourc;
    ds = dsget(); /* get current ds register */
    block = ARYBLK;
    x = 2; /* remember badblks are duplicated */
    while (x--)
    { sourc = &badblk[0];
      y = BADCNT;
      while (y--)
      { /* sourc & ds simulate a long that holds segment & pointer registers */
        dwrite(block, sourc, ds, 1);
        sourc = sourc + BLKSIZ;
        block = badblk[0];
      }
    }
}

int getary() /* moves array from disk to ram */
{
    char *dest;
    int y, x, ds;
    long block;
    ds = dsget(); /* get current ds register */
    dest = &badblk[0]; /* get current ds register */
    block = ARYBLK;
    x = 2; /* remember badblks are duplicated */
    while (x--)
    { dest = dest + BLKSIZ;
      block = badblk[0];
      while (y--)
      { /* dest & ds simulate a 32 bit pointer */
        x = dread(block, dest, ds, 1); /* if error, get from second disk copy of tables */
        if (x)
        { if (y)
          { x = dread((block + BADCNT), dest, ds, 1);
            if (x && x != ECCERR)
                return x;
          }
        }
      }
      dest = dest + BLKSIZ;
      ++block;
    }
    return 0;
}

int init() /* initialize driver and controller */
{
    int x;
    reinit();
    if (x) return x;
    lstblk = readc();
    maxblk = lstblk - FSTBLK;
    if (lstblk < 256)
    { lstblk = 1;
    } else
        lstblk = lstblk - FSTBLK;
    if (error is reported)
    { lstblk = lstblk;
    }
int getcon ()
{
    unsigned x, time;
    x = 1;
    time = 65000L;
    while (x)
    {
        x = in (STATP );
        x = x & BUSY;
    }
    out (DATAP, TARG );
    out (SELP, SEL );
    while (x == 0 && (time >
    {
        time,
        x = x & BUSY;
    }
    if (!time)
    {
        out (DATAP, 0 );
        out (SELP, 0 );
        return (DONE);
    }
    out (SELP, DATABL );
    return (0);
}

int putcmd (cmd)
char *cmd ;
{ 
    register int x;
    start:  
    x = request ( );
    x = x & CMD ; /* make sure target is expecting a command byte */
    if (x != CMD )
    return (x );
    out (DATAP, *cmd ); /* send byte of command string */
    ++cmd ;
    goto start; /* once again */
}

int status ()
{ 
    register int x, y;
    x = in (DATAP) ;
    request ( );
    y = in (DATAP );
    return (x);
}

int putdata (str)
char *str ;
{ 
    register int x;
    
}
start:
  x = request(); /* make sure target is still expecting data */
  if (x != wr)
    return (x);
  out(DATAP, *str); /* send data */
  if (x != wr)
    return (x);
  goto start; /* once again */

int getclat(str) char *str;
{
  register int x;
  start:
    x = request(); /* make sure target is still expecting data */
    if (x != wr)
      return (x);
    out(DATAP, *str); ++str; /* move data from controller to str */
  goto start;

int request() {
  register int x, z;
  x = 0;
  while (!x)
    { x = in(STATP); z = x; x = x & REQ; } return (z); }

int sense() /* get error code */
{
  register int x;
  static char cmd[6] = {3, 0, 0, 0, 0, 0};
  static char res[6];
  x = getcon();
  if (x)
    return (x);
  putcmd(&cmd[0]);
  x = getclat(&res[0]);
  status();
  x = res[0] & 0x7F; return (x); }

int placef(num, dest) /* places long at dest in msb first order */ char *dest; long num;
{
  register int x; dest = dest + 3; x = 4;
  while (x)
    { x = in(STATP); x = x & REQ; return (x); }

long readc() /* get capacity of drive */
{
  static char cmd[10] = {0x25, 0, 0, 0, 0, 0, 0, 0, 0, 0};
  static char res[8];
  register unsigned x;
  long size;
  x = getcon();
  if (x)
    { size = x; return (size); }
  putcmd(&cmd[0]);
  getclat(res[0]);
  x = status();
  if (x)
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---

```c
{ 
    x = sense(); 
    return (0); 
} 

size = 0;
while (x < 4) /* convert SCSI MSB first format to Intel format */
{ 
    size = size >> 8;
    size = size + res[x];
++x;
}
return (size);

int vfy(sect, cnt) /* verify cnt sector(s) - used to wiggle head */ long sect;
unsigned cnt;
{ 
    register int x;
    static char cmd[10] = {0x2f, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
    cmd[0] = sect & 0xFF;
    cmd[7] = cnt >> 8;
    placef(sect, &cmd[2]);
    x = getcon();
    if (x)
        return (x);
    putcmd(&cmd[0]);
    x = status();
    if (x)
        x = sense();
    return (x);
} /* move head to track specified in mode select */ 

park()
{ 
    register int x;
    static char cmd[6] = {0x1b, 0, 0, 0, 0};
x=getcon();if(x) return(x);
    putcmd(&cmd[0]);
x=status();
    if (x)
        x = sense();
    return (x);
} /*

int erropt()
/* set error handling options to indicate when the ECC is used */
{ 
    register int x;
    static char cmd[6] = {0x16, 0, 0, 0, 4, 0};
    static char qrp[4] = {0x65, 0, 1, 0};
x = getcon();
    if (x)
        return (x);
    putcmd(&cmd[0]);
x = putdat(&qrp[0]);
x = status();
    if (x)
        x = sense();
    return (x);
} 

int reinit() /* tell controller to reinitialize */
{ 
    register int x;
    static char cmd[6] = {0x16, 0, 0, 0, 4, 0};
    static char qrp[4] = {0x60, 0x30, 0, 0};
    x = getcon();
    if (x)
        return (x);
    putcmd(&cmd[0]);
x = putdat(&qrp[0]);
x = status();
    if ((x & 0x80) /* if check byte busy bit is set, try again */
    goto start;
    if (x)
        x = sense();
    return (x);
} 

int test() /* see if drive is ready */
{ 
    register int x;
    static char cmd[6] = {0, 0, 0, 0, 0};
x = getcon();
    if (x)
        return (x);
    putcmd(&cmd[0]);
x = status();
    if (x)
        x = sense();
    return (x);
} 
```
int dwrite(sect, point, seg, cnt) /* write cnt sectors via DMA from seg:point */
unsigned point, seg;
unsigned cnt;
{  
    register int x;
    static char cmd[10] = {0x28, 0, 0, 0, 0, 0, 0, 1, 0};
    placef(sect, &cmd[2]);
    cmd[8] = cnt & OxFF;
    cmd[7] = cnt >> 8;
    x = dmaio(point, seg, &cmd[0]);
    return (x);
}

int dmaio(bpoint, seg, cmd) /* read or write data from/to seg:bpoint via DMA */
unsigned bpoint, seg, cmd;
{  
    register int x, z;
    char c;
    long add;
    x = getcon();
    if (x) return (x);
    out(SELF, DMAEFL); /* enable DMA */
    add = seg; /* convert 2 register format to 24 bit pointer */
    add = add << 4;
    add = add + bpoint;
    c = add >> 16;
    out(DMARAD, c);
    c = add >> 8;
    out(DMBRAD, c);
    c = add & OxFF;
    out(DMBRAD, c);
    z = 10;
    while (z--)
    {  
        x = request();
        x = x & CMD;
        if (x != CMD)
            break;
        out(DMASP, *cmd);
        ++cmd;
    }
    x = 0;
    while (1x) /* wait till DMA is done */
    {  
        x = in(STATP);
        x = x & DONE;
    }
    /* get status byte from host adapter - another DTC quirk */
    x = in(DXCCS);
    if (x)
        x = sense();
    return (x);
}

Listing 4

*** MS/OS code that points to Maximum Sector Size Word ***

int dread(sect, point, seg, cnt) /* read cnt sectors via DMA to seg:point */
long sect;
unsigned point, seg;
unsigned cnt;
{  
    register int x;
    static char cmd[10] = {0x2e, 0, 0, 0, 0, 0, 0, 1, 0};
    placef(sect, &cmd[2]);
    cmd[8] = cnt & OxFF;
    cmd[7] = cnt >> 8;
    x = dmaio(point, seg, &cmd[0]);
    return (x);
}

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---

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Transfer Protocol: Modem?/CRC Packet Size: 128
Files: 1

<table>
<thead>
<tr>
<th>Block #</th>
<th>of</th>
<th>Kbytes</th>
<th>%</th>
<th>Time Remaining</th>
<th>Consec</th>
<th>Errors</th>
<th>File</th>
<th>Total</th>
<th>Kbytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>522</td>
<td>3</td>
<td>5</td>
<td>5:06</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Errors:"
Status: Transfer in progress
Sending: ANYFILE.AQC

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This article presents a character device driver which replaces the DOS printer device driver. The driver assumes ROM BIOS support of interrupt 17 (hex) for printer output. The driver replaces the standard DOS printer device named PRN. It can be accessed by any program which normally uses the PRN device for printer output including the DOS COPY and PRINT commands.

Unfortunately, this replacement will not be used by all programs because some go directly to the ROM BIOS by passing both DOS and the device driver. You may be surprised which programs do perform such nefarious tasks. It is possible to interpose a driver-like program between the ROM BIOS driver and any program which would access the driver directly but this is not within the scope of this article.

The printer driver is very simple since it is an output only device which essentially translates DOS requests to ROM BIOS calls. Even so, a very simple twist has been added which may prove useful for some and can be extended in a variety of ways. The example also translates easily into other character oriented device drivers.

Normally, a printer driver accepts characters from DOS and sends them to the printer interface. This driver also performs a very simple translation. Any tildes, ~ or `7E hex, are converted to the escape (ESC) character, `1B hex. The purpose of such a translation is to allow text files to be generated by a text editor which may not be able to print the ESC character. Text files may also be displayed using the DOS TYPE command. Embedding ESC characters within a text file which is displayed on the main console can have interesting effects, especially if ANSI.SYS is loaded.

A sample text file for an Epson LQ-1500 printer is:

```
~MELITE text
~PPICA text
~4Italic text
~5Normal text
```

where each line is proceeded by a two character escape sequence, such as ~M, which is printed as an ESC character followed by the letter M. This is not actually printed by the printer but rather tells it to print subsequent text using the ELITE font. The control sequences may appear at any point within the text.

Although some text editors allow imbedded control characters, these tend to display each character as two characters, normally an up arrow (↑) followed by the corresponding control character. The ESC character comes out as "^[. However, some text editors also convert the character to the two character display sequence when the file is printed thereby defeating the imbedded character usage.

The tilda character was chosen because it is not often used, although some language implementations use it as an operator. This would probably obviate the use of this device driver, although another could easily be implemented with other characteristics.

In fact, this approach can be used for some interesting applications. For example, instead of just translating the tilda character to an ESC character, how about translating the control sequences for a standard printer, like the FX-80, into corresponding control sequences for another printer. This allows a new printer to be supported by an application even though the application does not support such a device. Although this requires the creation of a device driver, it may be a viable alternative in many situations. It is also a more general solution to the question of customizing applications.

The implementation of such a device driver is relatively straightforward but may take a great deal of program code and table space. Such a driver was not presented because the translation mechanism would probably be more complex than the printer driver presented here.

In general, such a driver can be implemented as a co-routine or by a table driven state machine. A co-routine requires a separate stack which is used by the translation process. A stack switch is performed with each character to be printed. The process then continues based upon the sequence of characters received. This approach has the advantage of being easy to understand and extend, once the stack switch mechanism is in place. A table driven state machine takes each character and indexes a table of characters. The entry which has a matching character indicates the next state and a possible set of operations to be performed. For example, the corresponding control sequence could be sent to the real printer after the proper untranslated control sequence is received from DOS.

In either case, certain control sequences are translated while other characters, usually displayable text, are sent to the printer without translation. The possibilities are endless.

This approach is not restricted to printer drivers. Any character device can be developed in a similar fashion including input devices. Translation of function keys using a resident programming facility are also possible as well as communication drivers which can guarantee error free transmission between devices. In this case, characters are normally buffered into a packet which is sent to the other computer along with error detection information. The packet is re-sent until the other computer verifies proper reception. This is similar to file transfer protocols used by communication programs.

**THE PRINTER DEVICE DRIVER**

But back to the device driver at hand. The source code for this sample driver is included at the end of the article and is very similar to the one described in the prior article which presented a memory disk block device driver. The source code is divided into four sections. The first contains constant definitions including offsets to various structures and values which may be placed into these structures. This information is device independent. The second section defines common structures and variables used by all device drivers. The Bios Parameter Block (BPB) structure used in the prior article is removed since the printer driver is a character device. The third section contains source code which is common to all device drivers. The first three sections have been extracted from the memory disk device driver with the exception of the changes to the device header which is changed to reflect a character de-
vice (a_character) instead of a block device (a_block). Also, the name field is now used for the name of the printer (PRN) instead of containing the number of block devices. The fourth section contains device specific code which is described in the following section.

**PRINTER DEVICE SPECIFIC CODE**

The device specific functions supported by the printer driver are:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>init</td>
<td>setup printer</td>
</tr>
<tr>
<td>write</td>
<td>write characters</td>
</tr>
<tr>
<td>write_verify</td>
<td>write and verify operation</td>
</tr>
<tr>
<td>output_status</td>
<td>check output status</td>
</tr>
<tr>
<td>output_flush</td>
<td>flush output (null operation)</td>
</tr>
</tbody>
</table>

The functions not supported by this driver are:

<table>
<thead>
<tr>
<th>Function</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>build_bbp</td>
<td>block device only</td>
</tr>
<tr>
<td>media_check</td>
<td>no purpose</td>
</tr>
<tr>
<td>ioctl_read</td>
<td>input character device only</td>
</tr>
<tr>
<td>ioctl_write</td>
<td>input character device only</td>
</tr>
<tr>
<td>input_status</td>
<td>input character device only</td>
</tr>
<tr>
<td>input_flush</td>
<td>input character device only</td>
</tr>
</tbody>
</table>

The "initialize" function is much shorter than the corresponding memory disk function since there is no device or internal parameters to initialize. There is no computation of the size of the device driver resident code since the printer driver is fixed unlike the memory disk driver.

The 'write' and 'write_verify' functions are identical since there is no verification using a printer. Also, the latter is not accessible in normal operations since the verify mode is normally reserved for block devices. Direct access to the device driver is necessary for a program to access this function.

The 'output_status' function simply converts the results from the ROM BIOS status call into the corresponding status word required by DOS. This is normally used in an application which polls a device so it will not lock up if the device is not ready.

The 'output_flush' function performs no operation because the ROM BIOS printer interface has no corresponding operation. This function normally clears any buffer or stops any control operation. For example, an interrupt driven print spooling device driver would have an internal buffer which might be relatively large.

The 'read', 'check_input', 'input_status' and 'input_flush' functions were not implemented because the printer does not act as an input device. A communications device would need these functions to be implemented within the device specific section.

**MAKING CHANGES**

Adding single character translations similar to the idle/ESC character conver-
Fusion, Inc., a development firm. Moon Drive, Yardley, PA 19067, a systems software development firm.

The next article will discuss the changes and additions between DOS 2.x and DOS 3.x.

Some of the additions relate to device drivers. Having a device driver shell makes it much easier to develop a device driver. Separating the device specific code into a separate file and linking the driver together leads to the possibility of creating a separate front end to test new device specific functions. This front end would call the initialization function and then call the initialization function assuming the support functions work properly since they are already available. The results could be copied after the application is finished running.

**SUMMARY**

The character device driver is a simple entity to build assuming the support functions are already available. Like any device driver, the hardest part is making sure these support functions work properly before integrating them into the system, since it is almost impossible to debug new drivers interactively in the same sense that normal programs run using a debugger such as DOS DEBUG.

Having a device driver shell makes it much easier to develop a device driver. Separating the device specific code into a separate file and linking the driver together leads to the possibility of creating a separate front end to test new device specific functions. This front end would call the initialization function and then call the initialization function, possibly using an interactive user interface.

This wraps up device drivers. The next article will discuss the changes and additions between DOS 2.x and DOS 3.x. Some of the additions relate to device drivers.

---

Bill Wong is the President of Logic Fusion, Inc., 1333 Moon Drive, Yardley, PA 19067, a systems software development firm.
```
write_loop:    push  si    ; save parameters
             push  cx
             push  ds
             call  write_char    ; ah := write result
             pop  cx
             pop  si
             test  ah,29h    ; zero := no timeout, no error, paper
             jnz  translate_error    ; skip if error occurred
             inc  si    ; index next character
             loop  write_loop    ; loop if all characters transferred
             mov  ax,s_done    ; ax := transfer done
             ret
write endp

; Write character to device after translation
write_char proc  near
    cmp  al,0h    ; zero := translate ' ' to ESC
    jnz  output_char    ; skip if no translation
    mov  al,1bh    ; al := ESC character
    mov  dx,printer    ; dx := printer number
    int  printer_interrupt    ; ah := result
    ret
write_char endp

; Return output status
output_status proc  near
    mov  ax,esDone    ; ax := operation done
    ret
output_status endp

; Translate error value
translate_error proc  near
    test  ah,01h    ; zero := no timeout
    jnz  err_timeout    ; skip if timeout
    test  ah,06h    ; zero := not general error
    jnz  err_write    ; skip if general error
    test  ah,20h    ; zero := not out of paper
    jnz  err_paper    ; skip if out of paper
    mov  ax,s_done    ; ax := operation done
    ret
err_timeout:    mov  ax,e_not_ready    ; device not ready
    ret
err_write:    mov  ax,e_write    ; general write error
    ret
err_paper:    mov  ax,e_paper    ; out of paper
    ret
translate_error endp

; Flush output buffers
output_flush proc  near
    mov  ax,s_done    ; ax := operation done
    ret
output_flush endp

; Support Functions
unimplemented proc  near
    mov  ax,e_command
    ret
unimplemented endp

write verify    equ   write with verify
media_check    equ   media check
build bpl    equ   build BPS
ioctl read    equ   IOCTL read
check input    equ   unimplemented non-destructive read/status
input status    equ   input status
input flush    equ   unimplemented flush input buffers
ioctl write    equ   IOCTL write
read    equ   unimplemented read

; End of Driver
last equ $

; End of Memory Disk Device Driver
```

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Using SYMDEB with NMI Breakpoints

by James G. Owen

“NMI” stands for “non-maskable interrupt”. The 8088 - like other microprocessors - has a pin with this name. When it sees a low-to-high transition on this pin, it will immediately stop what it’s doing, save the flags and the current address on the stack, go directly to segment 0, offset 8, get the segment/offset address stored there, and start executing code at that address. It will do this no matter what it was doing when the NMI occurred, and regardless of whether interrupts are enabled or disabled.

SYMDEB (“Symbolic Debugger”) is Microsoft’s latest, new-and-improved version of the DEBUG program that comes with MS-DOS. I received it when I upgraded to the latest revision of the Microsoft assembler. SYMDEB has a number of enhancements, notably the symbolic reference capability (which works with Microsoft language products), but it also has the ability to use NMIs as an aid to debugging. If the application program has decided to stop doing anything - the machine is “hung up” - a debugger that uses NMI can break out of the hung-up state. Without such a feature, as most programmers know to their sorrow, the only way out is the reset button (or, on IBM computers, various mysterious key combinations and/or the AC power switch).

There are hardware parts available from IBM and elsewhere that provide access to the NMI in the IBM PC. To use SYMDEB’s NMI facility, one is supposed to obtain one of these. I don’t own an IBM PC (I couldn’t get security clearance); there may be two or three others like me out there, and some PC users might like the NMI feature to work correctly. This article describes the minimal hardware, and provides a fix for SYMDEB’s inept approach to the NMI handler.

Curing The NMI Problem In The MS-DOS Symbolic Debugger

SYMDEB NMI PROBLEMS

In a previous incarnation of Micro/Systems Journal I had a short piece about using NMIs with DDT in CP/M-80 computers. It appears, however, that the Microsoft programming staff did not pay careful attention. You can demonstrate SYMDEB’s difficulties by appropriately invoking SYMDEB with NMIs enabled and some application program that, like most applications, calls the operating system for input from the user. Wait until the program is waiting for input. Actuating the NMI trigger at this time will probably get you into SYMDEB; using the “G” command to return to the application program will probably crash the system. On my computer (a Kaypro 4 with a Co-Power MS-DOS card) many amusing things are written all over the screen.

What went wrong is that the NMI occurred while the microprocessor was executing code in the operating system. As it says somewhere in the DEBUG manual, you can’t trace or breakpoint inside MS-DOS - because MS-DOS isn’t re-entrant, nor is DEBUG or SYMDEB - and doing so is likely to cause a crash. The NMI handler in SYMDEB should check for this; it doesn’t.

The listing accompanying this article, MODNMI.ASM, is a fix for this; it checks the code segment of the program being NMled, and does an IRET if it decides execution is inside the OS or SYMDEB itself. MODNMI is invoked from inside SYMDEB, it overlays SYMDEB’s sign-on message and alters the NMI vector to point to the new code. After the new code checks the segment of the interrupted program, execution is transferred to SYMDEB’s existing NMI handler if all is well; otherwise, control is returned to the interrupted program through an IRET.

USING MODNMI

MODNMI was created with SYMDEB version 3.00. Before it overlays the sign-on, it checks to see that the NMI vector is pointing where it expects it to point; if it isn’t, it prints an error message and departs. With non-IBM computers, this could happen if the user forgot to use the NMI “n” switch when invoking SYMDEB (SYMDEB always uses the NMI option in IBM computers). The error could also occur if the version of SYMDEB is different from the one I worked with.

Follow these steps to assemble and use MODNMI:

1) Enter source from listing and assemble with MASM: “A>MASM MODNMI;”.
2) Link result (producing standard “no stack segment” warning): “A>LINK MODNMI;”.
3) Convert .EXE file to a .COM file: “EXE2BIN MODNMI”. Exe2bin will produce MODNMI.BIN.
4) Invoke SYMDEB with NMI option and load MODNMI.BIN: “A=SYMDEB /N MODNMI.BIN”. When SYMDEB prompt appears, enter “G” command to execute MODNMI.BIN.
5) The application program has to be loaded explicitly with “N” and “L” commands.

When MODNMI.BIN is active, using the NMI trigger will sometimes have no effect. If, for instance, the program has called the operating system for keyboard input, execution will be looping inside the operating system. Whenever an NMI occurs under such conditions, the MODNMI code will correctly conclude that a breakpoint is inadvisable. This is good; breakpointing at such a location will result in a crash when an attempt is made to continue execution (as described previously). Programs do frequently call the operating system for input, but usually the programmer knows what’s going on at this point, since typing a key or a return will cause program execution to continue. Usually, programs hang-up elsewhere.

TRIGGERING NMI

Different computers will have different approaches to NMI; on the Co-Power board in my Kaypro, the signal was connected directly to ground, so all I had to do was slice the trace and connect the little circuit depicted in Figure 1. Different computers would very likely require different values than those shown in Figure 1; it’s pretty much a cut-and-try sort of thing.

For various complicated reasons having to do with other functions, I wanted my NMI trigger signal pulled high, even though the 8088 NMI input is high-to-low sensitive. Note, however, that the transition must occur to produce an NMI; the circuit shown in Figure 1 works because the 8088 remains reset as power comes on and NMI goes high, so it doesn’t see the transition. When the momentary switch is pressed, NMI is brought low, but it immediately starts charging back to high through the 10k ohm pull-up. The 390 pF capacitor is small, so this positive-going signal is reasonably speedy. The 10M ohm charge path around the capacitor ensures that a re-trigger will not occur for a while (i.e., it debounces the switch).

It is very important in any NMI scheme to avoid noisy re-triggering. The processor has no way of turning NMI off; a noisy switch connected directly to NMI could cause many triggers to occur so rapidly that available stack depth is exceeded (i.e., system crashes). A better circuit than that shown in Figure 1 would use active gates to implement a debouncing flip-flop.

Indeed, the best NMI triggering circuit would consist of a 555 timer or CMOS oscillator arranged to send a 1 KHz, or so, square wave to NMI when the switch is pressed. Figure 2 shows such a circuit. Programs can get hung-up in loops that include calling the operating system, filling the screen, say, with “@” signs, or smiling faces. With the circuit shown in Figure 1, one has to keep pressing the switch repeatedly to “catch” the program outside the operating system. The Figure 2 oscillator approach, on the other hand, will get the program “while you wait”. The oscillator shouldn’t be too fast or the problems described above with re-triggering will occur. (The oscillator’s period should be long enough to allow execution of the NMI handler code in MODNMI.BIN. So long as this limit is observed, there will be enough time between one NMI and the next for the NMI handler to do the segment compares and exit with an IRET.)

IBM

I haven’t tested MODNMI on an IBM computer; people are touchy about tearing down their computers and hooking things up to NMI. I did simulate an NMI (with an INT 2) on a PC, and nothing caught on fire. The MODNMI code does include a test to avoid interrupting execution in a PC BIOS in high memory.

An examination of PC schematics shows a number of things hooked up to NMI: the 8087 numeric processor, parity check, and something called I/O CH CK (presumably input/output channel check). I don’t know what the PC and SYMDEB do about these things, since I don’t have a PC with NMI trigger at my disposal. If SYMDEB checks for parity errors or other NMI sources, then adding the MODNMI patch might suppress such events under the wrong conditions. I doubt it’s a serious threat; certainly nothing compared to crashing at program re-entry.

James G. Owen designs equipment that sprays ink onto corrugated boxes for the Loveshaw Corporation on Long Island.

SCSI BUS INTERFACING continued

for writing is due to verifying every write operation. If each sector were not checked, there would be no way to recognize when an alternate sector should be allocated. Also, I am a cautious fellow and don’t want to suffer the consequences of incorrectly written sectors, especially when it occurs in someone’s file filled with treasured data.

Note that the 4070 controller uses a run length limited encoding scheme which increases the capacity of an ST506 drive by a factor of 1.5. The bit rate is boosted to 7.5 Mb/s from 5 Mb/s. This has been very successful in the Priam V170 drives which use plated media. The plated media seems to be a requirement for RLL encoding on the ST506 type drives. Since the software for the 4000, which uses MFM encoding, and the 4070 are practically the same, upgrading from one to the other is simple.
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title modnmi.asm 5/9/85c jgo
page ,132 right margin is 65 w/ elite type.

block group theseg,thedata ;everything will fit into
 ;block segment.

theseg segment public 'code'

assume cs:block, ds:block, es:block, ss:block
org 0
zer0:
org 100h

;1. get existing nmi vector, check that it's pointing to SYHDEB
 ; NHI handler.
 ;2. Using segment obtained from vector, overlay SYHDEB sign-on
 ; with our NHI handler.
 ;3. Replace existing nmi vector with vector to our handler.

signonat equ 137h ;in SYHDEB, signon's at CS:137h.
oldnmiat equ 1eb9h ;SYHDEB's nmi handler is at CS:1eb9h.

start: push
xor ax,ax ;save es.
lea di,es:[8] ;get the nmi vector in es:di.
cmp di,oldnmiat ;pointing right?
 ;(user maybe forgot to do "In" when
 ; invoking SYHDEB.)
je domov ;it's ok.
jz ; no good.
pop es ;suppose we ought to restore es?
mov dx,offset badstr
mov ah,9 ;write string.
int 21h ;print the message.
jmp zero ;depart

badstr: db 'no NHI handler (*/n)'
domov: ;continue.
mov di,signonat ;we'll put our code at the
 ;sign-on.
mov cx,nmicount ;how many bytes to move.
mov si,offset ournmivec
rep movsb ;OK, handler in place.
xor ax,ax ;clear es again.
mov es:ax,di ;point at new code.
pop ax ;restore regs.
jmp zero ;back to SYHDEB.

onmi20: pop ax
jae onmi40 ;not ok. return harmlessly.
onmi40: iret

n micount equ $-ournmivec

theseg ends

thedata segment word public 'data'

;actually there's no data in this program, but changing
 ; HASH mumbo-jumbo is treacherous, so I try to leave things
 ; the way they worked the last time.

thedata ends

end start ;this MUST be here to make com file.
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The New ZCPR3 Libraries

The foundation of ZCPR3 and the Z System is a set of three software component libraries. This set of libraries consists of SYSLIB, a general-purpose library of over 200 routines, Z3LIB, a ZCPR3-specific library of over 100 routines, and VLIB, a ZCPR3-specific terminal interface library of over 10 routines. Each program in the ZCPR3 toolset is written in assembly language, and these libraries are used extensively throughout all the programs.

ASSEMBLY LANGUAGE AND HIGH-ORDER LANGUAGE PROGRAMMING

A purpose of high-order language programming is to raise the programmer to a higher level of abstraction, reducing the need to pay attention to implementation details and increasing his productivity. A simple equation in a high-order language like,

\[ \text{COST} = \text{PRICE} \times \text{QUANTITY} \]

expresses the meaning in terms a human can deal with easily, while a set of assembly language instructions like,

```
LOAD PRICE, B ; Load register B with PRICE
LOAD QUANTITY, A ; Load register A with QUANTITY
MULT B, A ; A = A \times B
STOR A, COST ; Store product (in A) to COST
```

produces a similar result but is written in a language which is harder for the human to understand. The tradeoff lies in the reduced programmer overhead associated with using the high-order language versus the reduced computer overhead (smaller code size and faster execution speed) associated with using a lower-order language.

The users of the Z System typically do not care what language the Z System tools are written in; the users are mainly interested in programs that run quickly and reliably with little overhead. With this in mind, the 70+ programs supplied with the Z System are written in assembly language.

The hundreds of subroutines in these libraries can be grouped into two categories:

1) functions like sorting and multiplication, which are needed time and again. Rather than writing the same code over and over (reinventing the wheel), the code is written once in a general-purpose form, documented for future reference, and reused as the need arises.

2) functions like testing the wheel byte or looking up a directory name to see what disk and user area it references, which require intimate knowledge of the internals of the Z System. Rather than remembering specific details, the programmer merely makes a subroutine call which tests the wheel byte or looks up a directory name for him and returns well-defined values that indicate the result of the operation.

The tradeoff between assembly language programming with and without the libraries is that the library routines, as a result of their general-purpose nature, are slightly less efficient than customized assembly language routines which perform similar functions. The result of using the libraries in assembly language programming is typically far more efficient than using a high-order language, and, if the need exists due to time or memory constraints, the programmer can take the source code of the library routines and customize it to make the code for his application more efficient.

I have been a fan of programming in high-order languages, such as Ada and C for many years, and a primary goal in creating the ZCPR3 libraries was to receive the benefits associated with the use of high-order languages (more structured code, improved maintainability, improved readability, and reduced programmer effort) while simultaneously realizing the speed and efficiency of assembly language. I believe this is a fundamental requirement in eight-bit systems. In more sophisticated systems like a 32-bit VAX 11/780 running UNIX, the advantage of using assembly language over C is negligible, and I don't consider using any languages other than C or Ada in these environments.

THE SYSLIB LIBRARY

SYSLIB is the general purpose library, and it can be used to create programs for use under normal CP/M or under a Z System. The current version of SYSLIB generates code for a Z80 or instruction-set compatible (eg. HD64180) microprocessor. Earlier versions of SYSLIB generated code for an 8080 or instruction-set compatible microprocessor. SYSLIB may be used by the MACRO-80/LINK-80 assembler and linker, the ZAS/ZLINK assembler and linker, or any other assembler and linker that can work with object files in the Microsoft REL format. SYSLIB Version 3.6 (the most recent version) is written in the ZAS assembler language and can only be assembled by the ZAS assembler (SYSLIB.REL is provided in the distribution, so it is not necessary to be able to assemble SYSLIB in order to use it). SYSLIB's routines fit into nine categories:

1) character input/output
2) string input/output
3) numeric input/output
4) file manipulation
5) directory manipulation
6) user area and disk control
7) branching
8) mathematical functions
9) collections of reusable utilities

The character, string, and numeric input and output routines provide functions such as obtaining a character from the console, outputting a string to the console, inputting a line from the console with editing (backspace, etc.), outputting an 8- or 16-bit number in a variety of forms, and converting the ASCII text representation of a number into a 16-bit number. As with all SYSLIB routines, unnecessary side effects have been eliminated, so the programmer does not have to worry about effects on registers not directly used by the routines. In Listing 1, for instance, the PRINT routine in SYSLIB outputs the string The value of HL is to the console and does not have any effect on the value in HL itself. A second example, showing how numeric input, output, and processing can be done, is presented in Listing 2.

In contrast, similar programs were written using the Turbo Pascal high-order language (Listings 1P and 2P). The two pairs of programs (Listings 1 and 1P, 2 and 2P) exhibit several common characteristics: they produce similar results, they are relatively easy to read, and they are small and efficient. The sizes of their object (COM) files, however, are quite different: Listing 1 assembled into a 3 record file and Listing 1P compiled into a 65 record file, while Listing 2 assembled into a 7 record file and Listing 2P compiled into a 66 record file. The assembler programs were on the order of 1K bytes in size, while the Turbo Pascal programs were on the order of 9K bytes in size.
The file manipulation routines of SYSLIB provide functions for working with disk files, such as:
1) appending to the end of an existing file
2) creating, opening, closing, deleting, and renaming files
3) testing for the existence of files
4) computing the sizes of files
5) reading from and writing to files sequentially or randomly
6) reading from and writing to files a byte at a time
7) scanning and extracting components from LBR files
The directory manipulation routines provide functions for:
1) loading a disk directory into memory
2) sorting a disk directory in memory
3) selecting file entries from a disk directory
4) computing the sizes of files from their entries
5) computing the amount of free space left on disk
The user area and disk control, branching, and mathematical routines include functions for:
1) logging into a directory
2) saving your current directory location and returning to it later
3) implementing case, computed gototo, and arithmetic IF branching
4) performing arithmetic, logical, rotate and shift, random number generation, and CRC calculation operations
Finally, the reusable utilities include functions for:
1) memory allocation
2) parsing, including a UNIX-style ARG/C/ARGV parser
3) in-memory sorting
4) string and vector comparison
5) determining the end of code

THE Z3LIB LIBRARY
Z3LIB is a ZCPR3-specific library which provides a variety of routines useful to the assembly language programmer who is writing on a utility to run under ZCPR3. The current version of Z3LIB generates code for a Z80 or instruction-set compatible (eg, HD64180) microprocessor. Z3LIB may be used by the MACRO-80/LINK-80 assembler and linker, the ZAS/ZLINK assembler and linker, or any other assembler and linker that can work with object files in the Microsoft REL format. Z3LIB Version 1.3 (the most recent version) is written in the ZAS assembler language and can only be assembled by the ZAS assembler (Z3LIB.REL is provided in the distribution, so it is not necessary to be able to assemble Z3LIB in order to use it).
Listing 3 illustrates some of the routines available in Z3LIB. Note that the routine Z3INIT must be called before any other Z3LIB routine. The address of the Z3LIB Environment Descriptor (a data buffer which contains details on a specific ZCPR3 system) is passed to Z3INIT in the HL register pair, and Z3INIT makes this address available to all routines in Z3LIB. Z3LIB makes it quite easy to determine useful information on the particular ZCPR3 system under which the program is running. The program in Listing 3 accesses the speed of the processor and other attributes of the ZCPR3 System.
The functions provided by Z3LIB include:
1) modification and examination of all aspects of the ZCPR3 environment
2) manipulation of the IF/ELSE/FI flow control facility
3) manipulation of the ZEX memory-resident command file processor
4) named directory and user/disk conversion
5) command line and token parsing
6) timing routines
7) path search for files

THE VLIB LIBRARY
VLIB is a ZCPR3-specific library that serves to provide the user with routines for screen manipulation through the ZCPR3 TCAP (terminal capabilities data base). The current version of VLIB is 1.1. By using VLIB, the ZCPR3 system utility programmer can write transportable, screen-oriented software which runs on any of the 60+ terminals supported by the
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ZCPR3 TCAP. The functions provided by VLIB include:

1) clear screen
2) cursor positioning
3) erase to end of line
4) highlighting

Listing 4 illustrates some of the VLIB routines. Note that the routine Z3VINIT is used to provide the address of the environment descriptor to the VLIB routines, and Z3VINIT also provides this information to Z3LIB routines (Z3INIT is not needed if Z3VINIT is used).

**THE LIBRARIES & THE NEW ZCPR 3.3**

The first step in creating the new ZCPR 3.3 system involved the redesign of the environment of the system and an extensive review and redesign of the libraries. The first redesign of the libraries is complete, and the source code, online documentation, and REL files which comprise the three ZCPR3 libraries, SYSLIB, Z3LIB, and VLIB, have been released through Echelon and SIG/M (Volumes 261-264 of SIG/M). Now that the ZCPR 3.3 command processor is finished, a second redesign of the libraries is in order. The internals of the library routines, especially those routines in Z3LIB, will be changed extensively, while the interfaces (the input and output parameters especially) will stay the same. Once the new Z3LIB is complete, all that needs to be done to the 70+ programs of the Z System is to reassemble them using the new Z3LIB, and they will continue to function under the new ZCPR 3.3 as they did under the old ZCPR 3.0.

**THE LIBRARIES DOCUMENTATION**

The libraries are fully documented in a loose-leaf book, ZCPR3: The Libraries, published by Echelon, Inc. In addition, the distribution of the libraries includes a number of help (HLP) files which can be read and displayed by the HELP and HELPPR programs of the ZCPR3 toolset. Both the book and the HLP files document every routine in the libraries, giving the name of the routine, its function, its input and output parameters, and other information of interest to the programmer. As the libraries change, the insert pages for ZCPR3: The Libraries will be sent out by Echelon. The price of ZCPR3: The Libraries is $30.95, and it can be ordered from Echelon, Inc. (see ad in this issue) or through Micro/Systems Journal (see Book Mart section).

ZCPR3: The Libraries is over 300 pages in size, and is divided into five sections: an introduction, SYSLIB, Z3LIB, VLIB, and a user’s guide. All routines in the libraries are described, and the user’s guide provides style of use with many examples. Three appendices include nine sample programs, a listing of all files, and update notices. A comprehensive 5-page table of contents and an extensive 12-page index provide efficient access to the information.

**GETTING THE LIBRARIES**

The source code, REL files, and HLP files of libraries can be obtained from three sources:

1) Echelon, Inc. ($69.00)
2) SIG/M (Volumes 261-264)
3) RCP/M and Z-Node Electronic Bulletin Boards

Richard Conn is both a computer professional and a computer "fan." Rick holds a Master of Science degree in Computer Science from the University of Illinois at Urbana, and has been working in the computer field since 1978 on items ranging from embedded computers in satellite systems to the design and implementation of microcomputer-based operating systems. He is probably best known as the creator of SYSLIB, Z3LIB, VLIB, ZCPR2, and ZCPR3. Rick currently runs the DoD Ada Software Repository on the Defense Data Network and continues to work on the evolution of ZCPR3.

Listing 1

```pascal
ext print,phldc  ; Reference SYSLIB Routines
db hl,340 ; Store a value into HL
call print ; Print a string
call phldc ; Print HL as decimal characters
ret
end
```

Listing 2

```pascal
print,phldc ; Reference SYSLIB Routines
eval10,cr1f
sect
mulh

call eval10 ; Convert the number pointed to by HL into a value in DE
ld (valuel),de ; Store the first value

call print ; Prompt for the second number
call bbline ; Same as before
call cr1f ; Output a new line to the console
call eval10 ; DE now contains the second number
ld hl,(valuel) ; Get the first value into HL
call mulh ; HL = HL * DE
call print ; The product of these numbers is ',0
call phldc ; Print the product
ret

valuel: ds 2 ; Buffer for storing VALUCEL
```

Listing 3

```pascal
z3init ; Z3LIB References
getspeed ; Returns the processor speed
getsw ; Returns the wheel byte
getquiet ; Returns the quiet flag

db hl,0f400h ; Address of the ECFR Environment
call z3init ; Descriptor
call getspeed ; Get speed in Register A
call getsw ; Get speed as decimal

db 'The speed of your processor is ',0
call print ; Print Register A as decimal

call print
```

Listing 4

```pascal
z3init ; Reference VLIB Routines
tinit,dinit ; Terminal initialization/deinit
stdout,stderr
cls,at ; Clear screen, position cursor
print ; From SYSLIB

db 'The wheel byte is ',0
call getsw ; Get wheel byte
call print ; Print On/Off
call cr1f ; Print a string
call print ; Prompt for the second number
call bbline ; Same as before
call cr1f ; Output a new line to the console
call eval10 ; DE now contains the second number
ld hl,(valuel) ; Get the first value into HL
call mulh ; HL = HL * DE
call print ; The product of these numbers is ',0
call phldc ; Print the product
ret
```

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A Look At Some Of The New Public Domain Software Releases

PC-RIM (Vols. 204-206) is a full relational DBMS based on the popular public domain RIM-5 DBMS written several years ago. RIM-5 is the basis of a very popular commercial product. PC-RIM will run in a 512K PC and a hard disk is a practical necessity. Complete sources are presented so you can add to it, use its B-tree code (BT*.FOR), or whatever else you desire. It will run with or without an 8087, or 80287. This is basically a mainframe class DBMS.

Mr Bill and CK (vols. 207 - 210) are 2 diskette sets. Mr Bill is a billing system. CK is an income and expense tracking system. Each program consists of input preparation and report generation. ANALYTICALC version X20.04D (Vols. 211-213) is the latest version of an integrated system. It includes all the basic functions of spreadsheet, database manager, and word processor. It is very complete in functionality. The registered version runs significantly faster. This is a state-of-the-art integrated system.

REC, Regular Expression Compiler (Vols. 214-215) is a very powerful symbolic manipulation language with some arithmetic capabilities; it is designed for the creation of compilers and operating systems. It has a very simple control structure consisting of four symbols: the two parentheses, the colon, and the semicolon. It is an attempt to reduce computer programming to its barest essentials. The resulting language is very concise, not unlike APL or TECHO. There is a strong resemblance to TECHO. The REC processor is remarkably compact, fitting into about 5Kbytes of memory in many machines (7.5Kbytes when floating point arithmetic operations are included), exclusive of working storage.

PIANOMAN (Vol. 216) is a program that allows you to play the keyboard of a PC (or close compatible) like a piano. Since the keys are in two banks, it’s more like an organ. The keys sound a tone as long as you hold them down, and stop when you release them. If you press the Record key, the tone you play gets saved in memory, and you can play it back at will.

Once you’ve recorded a tune, you can go into editing mode. In this mode you have a variety of editing commands, much like those of a word processor. You can insert and delete notes, adjust pitch and length, make global changes, and save/ retrieve files. You can even mark blocks of notes to delete, copy, or move. Playing a tune with PIANOMAN is simple. You’ll see a picture of the keyboard on your monitor, with the NOTES written on the keytops, instead of the normal letters. There are three octaves available at a time, and you can shift those octaves up or down using the up and down arrow keys.

PC-KEY-DRAW (Vol. 217) is a very advanced text and graphics generator. The supplied demo is a graphics show in itself. The litany of functions available are very impressive. This sophisticated program is a challenge to many commercial offerings.

The ever popular GENEALOGY on DISPLAY is now into release 4.0 (Vol. 218). This is a very popular program for keeping records of your family tree.

PC-HAM (Vol. 219) is a set of DATA BASE Amateur Radio programs including logging, dx’ing, simulation and model-

Editor’s Note: Hank Kee is the librarian for the PC/Blue public domain software library. He is the person who collects, assembles, and checks all of the software issued by PC/Blue and then compiles and edits them into the released volumes.

Copies of the PC/Blue printed software directory can be ordered from Micro/Systems Journal, Box 1192, Mountainside NJ 07092 ($4 U.S., Canada & Mexico; $6 foreign).

PC/Blue disks are available from the New York Amateur Computer Club, Inc., Box 106, Church Street Station, NY NY 10008. Price is $7 per volume which includes media, postage, and handling. On foreign orders, please add $2 per disk.
ing, and antenna positioning. The dBASE
2 programs perform database operations
on logbook information.

TOXIC (Vol. 220) is a query system
of a vast variety of chemicals indicating
minimum toxic levels and remedies. A
must for every nervous person living near
industrious sites.

BLAQUE BOOK is a Database limi-
ted to Name, Address and Phone number.
Its forte is in the printed output which is
formatted in mini, alphabetized pages
which you can assemble into a pocket
sized address book. There is extra room
under each letter for additional entries
which you can later enter into your
database. When you are ready for an up-
dated address book, just print one.

The PC/Blue Library has now grown to
220 volumes. Recent releases include the
following:

Volume 201
Still River Shell v1.21
- file & directory management
  by Bob Howard
Wagner File Utility v1.88
- hierarchical file management
  by Butch Wagner
Calc2
- extended precision calculator
  by Frank R. Webb
Volume 202
PC-Write version 2.6 word processor
  by Bob Wallace/QuickSoft
Volume 203
Reliance Mailing List version 2.0
  by Wm Meacham
GW Turbo - name and address database
  by Gary Wooden
Volumes 204-6
PC-RIM database management system
Volumes 207-8
Mr BILL - billing system
  by David M Alexander
Volumes 209-10
CK - income and expense tracking
  by David M. Alexander
Volumes 211-13
AnalyCalc version X20.04D
  integrated system
Volumes 214-15
Regular Expression Compiler
  by Gerardo Cisneros & H.V. McIntosh
Volume 216
PianoMan version 3.0
  by Neil J. Rubenking
Volume 217
PC-Key-Draw version 3.0
  Keyboard to Screen Graphics
  by Edward H. Kidera IV
Volume 218
Genealogy ON Display version 4.0
  by Melvin O Duke
Volume 219
PC-HAM Ham Radio Package
  by Joe Kasser
Volume 220
TOXIC Gas Emergency Program
BlackBook N/A mini-database system
  by Martin C Beattie

Are you still using a prehistoric Make? Now, step up to PolyMake, the most powerful
and flexible Make utility available for programmers using MS-DOS. PolyMake is like
an intelligent assistant that remembers how to rebuild a program when you change one
part of the program. PolyMake will automatically invoke your compiler, assembler, linker,
librarian or other tools to update a single program or entire software systems when you
type — MAKE. PolyMake comes with built-in rules for rebuilding programs but you can
also teach it new rules so you don’t have to remember the file dependencies in your
program. Advanced programmers prefer capabilities like fully recursive makefile
processing and the ability to invoke PolyMake with special “flags” and macros that au-
tomate a whole range tasks. New Make users appreciate the Step-By-Step tutorial and
intuitive commands. Handles source files written in any language. Requires DOS 2.0
& higher. Compatible with LANs, the IBM PC, XT, AT and other MS-DOS
PCs. For complete details write for the POLYTRON Programmer’s Catalog. $99

The POLYTRON Version Control System (PVCs) allows programmers, project
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revisions and versions of source code in software systems and products. PVCs is a superb
tool for programmers and programming teams. (A special LAN version is also available.)
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new revision. If changes conflict, the user is notified. Powerful capabilities include: Stores
and retrieves multiple revisions of text; Maintains a complete history of revisions to act
as an “audit trail” to monitor the evolution of a software system; Maintains separate
lines of development or “branching”; Provides for levels of security to assure system
integrity; Uses an intelligent “difference detection” to minimize the amount of disk space
required to store a new version. Requires DOS 2.0 or higher. Compatible with the
IBM PC, XT, AT and other MS-DOS PCs. Single User version $395.
5-station LAN version $1,000, add $500 for each additional 5 stations. $395

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Software Review

The CompuMagic Utility Package

by Joseph A. Sabin Jr.

The CompuMagic Utility Package for CP/M-80, consists of 20 utilities and two installation programs. These utilities are a combination of unique user tools and simplifications of existing CP/M-80 commands/utilities. Each tool does what it is suppose to, and does it well. Following is a brief description of each tool in the package.

CMCOPY: This is an advanced copy program. It handles all the required functions of a copy utility as well as verbatim file overwrite, if requested. However, its best feature is undoubtedly its ability to use a source file for the file names you want copied.

COMPARE: I must say this is a disappointment. COMPARE checks two files for differences and tells you if they are different or the same. It works as promised but, if there were differences, I would like to see it report on the differences in content.

DS: Takes a document file and expands from single spaced to double spaced. It is designed to work with WordStar document files as well as standard ASCII.

ERASE: ERA for use from inside WordStar (or other programs that can call a program for execution). It works just like ERA with a few added features.

RENAME: REN for use from inside WordStar. It also is very similar to REN. These are nice to have and can prove a time saver.

SORT: Takes a text file and sorts the lines, placing the sorted text back into the same file or into a new file. The time for sorting 1000 names in a 12K file is 64 seconds; MicroPro’s SuperSort needed 32 seconds. Timings were on an Altos 5-15 with dual 5¼” floppies with 4 Mhz Z-80. The size of the file to be sorted is limited by the system memory. As I tested the sorting program, I realized the limitations of the system.

DISTR: This is a directory listing of *.BAK saving 3 keystrokes.

DIRSPACE: How many directory entries are remaining on a disk? A client of mine kept crashing a program with a disk full error; yet there was always at least 100K of space remaining. This was due to the absence of any remaining directory entries. DIRSPACE would have informed her of that immediately. Indeed she had no idea how many files she could have on a disk.

UDIR: Ever misplace a file? If you have a hard disk and take advantage of the user areas, I am sure you have. UDIR will not only find it for you (i.e. which user area) but will tell you all the file names ambiguously by user area.

DINSTALL: All the directory tools list 24 lines by 80 columns before pausing. My TRS-80 has only 16 lines by 64 columns; DINSTALL allowed me to change the default size and all works well, no more wrapped lines of display and non stop scrolling off the screen.

A: When A.COM is placed on the B: drive and A:SC2 is typed instead of A:SC2, A.COM is run (CP/M thought that is what you meant). It then reads the command line and executes A:SC2 just as desired (NICE!).

CMAUTO: The program that creates programs to call other programs. Yes indeed, you can now create a program to directly begin a submit file from the command line. The created program is a .COM file and executes like any other except it calls the program specified when it was interactively created.

MINIERA: A small version of ERASE.COM for those strapped for disk space.

MDIR & MDIRS: These programs are very similar utilities and are paired together in CompuMagic’s documentation. MDIRS returns the size of the file in Kbytes and the MDIR will list all directory entries in a sorted order which is under user control: by Extension, Size, User area.

DISKDIF: One disk has 65 files another has 63 files; which two are missing from the one? DISKDIF knows. This is most helpful for archiving or backing up a disk full of letters or other such electronic stuff that changes too often for the user to track. DISKDIF lists what is missing on the one disk, which can then be copied from the other.

DIRBAK: This is a directory listing of *.BAK saving 3 keystrokes.

STAT FILENAME.EXT SR/O. Instead you type R/O FILENAME.EXT. It will accept ambiguous file names.

R/W: The inverse of R/O.

SCREEN: This is great! SCREEN.COM sets up a file to grab all that is sent to the screen via BIOS or BDOS function calls. The screen is updated as normal and a copy is sent to the file specified.

TYPIT: This is a typewriter like program; it is also a disappointment. It buffers all input until a return is hit. This allows you to edit the line, but a typewriter’s major advantage over a word processor is the ability to fill in forms. If the carriage does not move character by character you still cannot fill in a form except by trial and error. Change that and I think it will be a hit.

CONCLUSION

A well formed package of useful tools, some more so than others and some you may never use. The documentation covers all aspects of the tools to the extent of a reference manual. The beginning, however, is a tutorial. An important design feature of these tools is a unified set of command line parameters, one set of parameters for the programs. All things considered, this is a fine example of a compact tool kit.

CompuMagic will call you back if there is no one there to help when you call. In fact, I received a call back in fifteen minutes — after five O’Clock! In my conversation with the programs’ author he told me the programs are written in hand optimized C, the very small programs, however, are straight 8080 assembler.

There are many disk formats available. CompuMagic uses Uniform (a disk formatting/copying utility with 96+ disk formats) to offer the maximum support for CP/M computers. Without question this is $45.00 worth of software, and if you own a CP/M-80 machine, let’s support those companies supporting us!

Joseph A. Sabin Jr. is President of MicroFrame Associates, Inc. a company involved in semi-custom software design. He works primarily with financial & accounting data base software programmed in C, Pascal and assembler for CP/M-80 & 86 and MS-DOS.
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In the SIG/M Public Domain

by Stephen M. Leon

Steve Leon is the SIG/M Disk Editor. In other words, he is the person who assembles, compiles, and edits all of the SIG/M public domain software disks. Thus, he speaks with the greatest authority as to what is going on in the SIG/M public domain software area.

The car was in the shop waiting for new brakes, and so I wound up in the apartment building lobby about 6:30 AM waiting for a lift to the office. About five of us were sitting around talking and waiting, when the conversation turned to computers.

Seems one of my fellow tenants had just returned from a Taiwan business trip. While there he picked up copies of Wordstar 2000, Javelin, Lotus version 2 and Framework II. His total outlay for software (without copy protection) including manuals was less than $50.00.

He described a bazaar-like building with about a hundred booths. What you wanted was made for you on the spot. You also could have custom programming or customized standard programs. For the most part, customers were local people.

What has Chinese software piracy got to do with SIG/M and public domain software? What they were doing in Taiwan apparently is legal under their copyright laws. Likewise, there are ads in all of the magazines for commercial operators who are selling or renting the SIG/M, and other public domain libraries. We could easily take either side of whether or not what these commercial seller/renters are doing is in violation of the copyright laws. Likewise, there are ads in all of the magazines for commercial operators who are selling or renting the SIG/M, and other public domain libraries. We could easily take either side of whether or not what these commercial seller/renters are doing is in violation of the copyright laws.

A good deal of the material in the SIG/M library is copyright-protected and released only for non-commercial use. As a practical matter, however, what these seller/renters are doing serves a useful purpose in that it makes public domain software more readily available.

What really irks, however, are classified ads we see in some magazines from people selling one or more public domain programs as their own. It also irks to see people putting together collections of public domain programs from a variety of our volumes and selling them at $25 per disk.

Both practices violate author rights and the concept of making your programs available for public use.

We tip our hats to the renters and the reasonable price sellers. They provide a service that benefits all. Watch out, however, for anyone who asks more than $10 per disk or sells single programs that you know are available in the library. They both fit into the ripoff category.

In going through the overseas libraries to gather material for new SIG/M releases we note that they also include MS-DOS programs. Previously, we included only CP/M software in the SIG/M library. However, now that we have made it available in a variety of formats we are going to include some of MS-DOS programs in future releases.

What we will be releasing will be public domain programs with source code. Our primary interest will be in the utility category. The material we really like is the kind of short, practical programs that PC magazine publishes and we will see if we can get permission to release that code. We will release applications with source code too, such as the dBASE III version of the SIG/M Property Manager and Dr. Andy Bender's promised medical office package in Knowledgegram.

There will not be any begware in this material. There also should not be any conflict with the PC/BLUE library. In fact, it seems to me that Hank Kee is so swamped with begware that the person who really wants to make a contribution to the public domain has no place to go. Therefore, if you have something to donate, even if it is PC/MS-DOS, consider the SIG/M library.

We finally released Irv Hoff's Improved Modem Program. It took three disks to hold IMP and all of its overlays, but we think it well worth it. We still prefer MEX, but IMP is a strong contender. Irv is also readily available for help on the CompuServe CP/M-SIG.

One of the nice things about IMP is the broad range of overlay files available for it. The release includes overlays for just about every computer, including some that are hard to come by, such as the Apple 2e and Apple 3. Included in the release (Volumes 272 to 274) is KDM17, Irv's version of XMODEM.

The only suggestion we would make, is to rename it XMODEM. Everyone expects to have to key in XMODEM to get a file downloaded, but not KDM.

Irv also contributed a nifty little program (Volume 279) called XIZI. It translates 280-to-8080 and 8080-to-280. He also updated FINDBAD, which we should soon have in the library.

The new releases also include three volumes of extracts from the Tesseract Library of the Tesseract RCPM +, Dural, New South Wales, Australia (Volumes 275-277). There is some interesting material on these disks including a Z80 assembler and a program to read MS-DOS disks in CP/M and CP/M +. We have put out several of these programs. The problem is everyone has slightly different hardware. With a little luck, one of these MS-DOS readers will work on your system.

Another SYSOP program, RQ, (Volume 275) keeps a record of requests to put programs on the System. Also of interest, for those just getting a modem system working, is TINYTERM, a quick and dirty way of getting a modem operational.

Volume 276 contains a collection of ZCPR3 utilities from Australia. Volume 277 includes a backup program, a full screen editor and a telephone list program.

The featured program on Volume 278 is ZSODIS, a Z80 disassembler written in Turbo Pascal by Kenneth Gielow. Unfortunately, he has not released the source code, but we released it because of its many features. The program does an extensive analysis of the disassembled program's memory use and produces a break table based upon this memory usage analysis. It also gives you an address listing which itemizes all addresses referenced by the code, distinguishes types of label references, marks subroutines and jumps and produces a fully annotated cross-reference table. It is an interesting program well worth checking out.

Volume 279 is for those cataloging their disks. My favorites on the floppy, however, are LABEL, which prints a label for the disk, and TAIL, which shows the last few lines of a file.

Volume 280 contains some of Jon Dart's Turbo Pascal programs. You might find a use for his French and German vocabulary tests.

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MICRO/SYSTEMS JOURNAL SEPTEMBER/OCTOBER 1986

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CP/M SOFTWARE Price List/Order Form

We recently acquired 80% of Osborne Computer Corp.'s Software stock, in a liquidation auction and can offer regular commercial grade software at prices far under usual wholesale. Many programs are copiable, and are in Osborne SD format, which we understand is readable by Commodore 128, Kaypro, Zorba and many others. Some of this software may be licensed for use on the Osborne Computer; you may want to obtain a second machine license or update from the publisher directly. Please ask about quantity/dealer pricing. We also have Osb manuals/parts. Circle items ordered.

**Class A**
-  **$17.00**
  - Dbase 11 tutorial set.
  - Spellguard--checks grammar/syntax.
  - Footnote--for text files/books. Math--adds calculator to W.S.

**Class B**
-  **$28.00**
  - StartPac--tape tutorial intro to CP/M WS, Scal, Basic. Fortth v2.0--complete language for programming. MicroLink.

**Class C**
-  **$39.00**
  - Personal Datebook. Wordpac: writer's packages for use with Wordstar. Orig. $295.00 including Grammatick

**Class D**
-  **$95.00 ea.**
  - Osborne 1 5 Pac including Microsoft BASIC. SuperCalc, and Wordstar v2.4 with Manual--Complete text editor. Class A Documate plus--indexes and builds table of contents. Deadline--solve murder game. ZORK-1--Adventure game.

**Class E**
-  **$175.00 ea.**
  - DBase 11 w/Zip--the original relational database manager.
  - Exec. 4PAC Books $50.00.
  - Exec. tech parts A&B $75.00 (Excl. Bios). Class C BSTAM--super modem, great for multi-file transfers. SuperSort--easy data manager, very capable.

We recently acquired 80% of Osborne Computer Corp.'s Software stock, in a liquidation auction and can offer regular commercial grade software at prices far under usual wholesale. Most programs are copyable, and are in Osborne SD format, which we maintain a complete library of CP/Mug and SIG/M Public Domain CP/M Software. Presently about 90 meg/20,000 programs. Catalog $4.00. 1 volume on 2 DD SS 0-1 Disks $10.00. Post/Handling $3.00 order. We also have Osborne manuals/parts. Circle items ordered.

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Volume 281 is from Phil Ridler in Zimbabwe (Rhodesia to you colonials). Also on the disk is a Snoopy calendar that was donated at TCF. When you run it, don't panic. It grinds away for about 10 minutes writing a PRN file with no indication of what is going on. However, it does produce a multi picture calendar and can be updated.

We have been getting a lot of mail from M/SJ readers as well as requests for copies of the Commodore 128 sample disks. We have tried to answer all of them. One I would like to answer here is from David Dankello of Blacksburg, Virginia. Dave comments on two of his favorite programs in the library: SWEEP by Dave Rand and Z80E by Rick Surwilo. Z80E is quite a handy debugger on Volume 239. SWEEP, on 152 (NEWSWEEP is on 209) is a file management utility that is a favorite of a lot of people. (I preferVFILER because of its screen display.) The point Dave raises is that perhaps we should go further in publicly acknowledging fine contributions like these so as to encourage people to perfect or expand their software donations.

Dave Rand and Rick Surwilo and a lot of other people have made fine contributions to the public domain and we appreciate them all. We unfortunately can't send a personal thank you to every contributor. We do send contributors who request it two SIG/M volumes. We in SIG/M are volunteers just as the software contributors are volunteers. Both groups are doing their best to promote computing. We wish we could personally thank all of our contributors.

SIG/M Volumes are available on 8" SSDS Disks ($6 each, $9 foreign) directly from SIG/M, Box 97, Iselin, NJ 08830. They are also available in many 5" formats ($7 per volume; formats that require more than one disk add $2 per volume). Printed catalogs are $3.00 each ($4.00 foreign). A disk catalog (Vol-0) is available at the standard disk volume price. The catalog volume is usually more current and more readily available than the printed catalog.

Many bulletin boards have the software for downloading and most new releases are available on the CompuServe CP/M SIG. Several commercial companies also sell, or rent, SIG/M software. For Apple CP/M users, the Philadelphia Area Computer Society, Box 477, Kulpsville, PA 19442, has most of the SIG/M volumes in Apple II format.

**NEW SIG/M RELEASES**

**Volumes 272-274**
- Improved Modem Program by Irvin M. Hoff

**Volume 275**
- CROWECOMP Z80 assembler
- RDMS/321 Reads MS-DOS in CP-M & +
- RO14 SYSP requests
- TIMEZONE Time around the world
- TINYTERM Minimal modem program
- UNICON Conversion utility

**Volume 276**
- LQ1500 WordStar patch
- ZCPR-WS ZCPR3 with ZCPR3CMD
- ZCPR3CMD ROM-resident commands
- ZDPR Enhanced directory

**Volume 277**
- BU12 Smart archive-backup
- PED11C Full screen text edit
- PHONE3 Phone list utility
- PROWR12 Set C-Itoh 8510
- SETATT Set/clear attributes

**Volume 278**
- FDUMP File dump/patch utility
- RPN RPN calculator
- ZDOSZI Disassembler

**Volume 279**
- COMP File compare utility
- FATCAT22 Disk catalog program
- LABEL Makes neat labels for disks
- TAIL Shows last few lines of a file
- XZII-2 Z80 & 8080 translator

**Volume 280**
- Turbo Pascal Programming from Jon Dart
- FRENCH French vocabulary quiz
- GERMAN German vocabulary quiz
- MACRO55 Macro processor
- MULTCOL Single to multi column

**Volume 281**
- Programs from Zimbabwe
- CMPCODE compare two object code files
- ZASMB Z80 assembler
- ZDPR directory display
- ZLOAD HEX code loader
- SNOOPY Snoopy calendar

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MICRO/SYSTEMS Journal SEPTEMBER/OCTOBER 1986 83
I recently installed a Compu/Time S-100 clock board in my system and was anxious to find new applications for it. The ad for DateStamper in M/SJ caught my eye and sold me on having all my files date stamped and so I ordered it. DateStamper is available in many formats and comes with a neatly printed 65 page loose leaf manual. There is an up-date file on the disk as well. I found it hard to believe what I had received, not only the DateStamper program in two versions (8088 & Z80 code), but also several utilities I would have gladly paid $50 for. You certainly get your money’s worth with this package.

Plu*Perfect has made installation painless. No modifications of the BIOS required. DateStamper and its buffers are approximately 1K long and can be installed under CCP at the top of the TPA, or if you can find a spare K above your BIOS, you can install it there. The latter is the better choice as it leaves the TPA at full size and avoids any conflicts with bad mannered programs that hog the top of the TPA. Besides, I need all of my TPA for working on long programs with MAC and ED.

DateStamper can be run in two versions. One runs on almost any hardware at all and does not use a clock board (the relative mode). Instead of datestamping the files, it assigns a four digit number to each file. This number is incremented each time the file is accessed. So, by looking at the number, you can tell which one of several files, with the same name (on different disks), you worked on last.

If you have a clock board, you can use the real time mode. The result is the program, SSD, a super directory program similar to its public domain predecessor SSD and ZCPR3’s XD and XDR. SSD, however, displays the TIME and DATE on which each file was CREATED, ACCESSED, or MODIFIED. It also shows file size and about a dozen other things as well as the CURRENT REAL TIME.

DateStamper and its utilities are very screen active. The only problem I had in getting it up was configuring my weird terminal to it. The terminal configure program presents a choice of 20+ terminals and, of course, mine was not there. Plu*Perfect offers to add yours if you send them the specifics. They also offer help by mail or phone, if you have trouble.

Plu*Perfect Systems’ DateStamper

by Gord Wiggins

A Powerful Date Stamper For CP/M

Luckily for me, the terminal installa-
tion program is excellent allowing one to make up their own or modify any of the 20 or so already there. After about 5 tries, I got it to work with my terminal. The features you must have are: cursor addressing; clear-screen; clear-to-end-of-line; clear-to-end-of-frame; cursor up, down, left, right; and some form of highlighting (dim or inverse video is nice, but not essential). My dumb terminal does not have erase-to-end-of-line or erase-to-end-of-screen, so I had to leave out erase-to-end-of-line with the result that some garbage is left in certain parts of the display. Also, I substituted home-cursor and erase-screen for erase-to-end-of-frame. At least it works, and yes, I am saving my bucks for a proper terminal with all the neat features.

Next, I proceeded to get my clock board working with DateStamper. This turned out to be easy. The setup program presented a list of about 50 clocks; I had no idea there were so many. DateStamper is for all CP/M computers, not just S-100’s. The list of clocks can be dumped to the printer and I was surprised to see more info come out on the printer than was on the screen. The screen display and the printer output of the clock lists were different. The 50 clocks were listed on the screen in two columns of 25, but lengthwise on the printer with additional info, both at the same time. Neat!

After selecting my clock board, the program asked for only two things, the CPU speed, and the clock board base address. After a warning not to test the clock unless you were sure of the addresses (might write to the disk controller instead) the clock was tested and there was the time and date with the seconds being updated in real time. The clock routine, now having been automatically written by the installa-
tion program, was then written to the disk under a name of your choice to be used later by the DateStamper installation program.

This was so easy I could hardly believe it. I had envisioned having to write assembly language clock driver routines. The manual does guide you on this, if need be.

Next, the installation program walked me through the modification of the DateStamper file for hardware specifics. It also allows one to put DateStamper above BIOS, if desired. Since my system is set up for ZCPR3 and I was not yet using the Resident I/O package, I had 1.5K where this was to go. So, I put DateStamper there. I also used ZCPR3’s ability to run a multiple command line at cold boot time to install DateStamper at cold boot into RAM up above the BIOS.

DateStamper, when first installed at cold boot, or whenever, has the ability to run a file. You don’t need SUBMIT on the disk as it is in DateStamper. Just tell DateStamper what command line to run after it is finished loading. However, your CCP must have the ability to run SUBMIT files. I had to put this back into ZCPR3 as I had taken it out to make more room and was running ALIAS instead (which is the same as SUBMIT, but is a disk-based ZCPR3 utility). I decided to have DateStamper give the command line LOG after loading.

LOG is a utility supplied with DateStamper. It keeps track of the time you spend on your computer doing one or more of nine activities which you select. Another program called TOTAL LOG gives a formatted print-out of your time in hours and tens, month-by-month, for the entire year on each of the nine activities. I called mine Cbios mods, System mods, Word-
processing, Data Base, Financial, Games, Basic, Forth, and Other. This is handy at income tax time to show how much you used the computer, and for what. This is an example of the great stuff Plu*Perfect supplies with DateStamper, at no extra cost.

You can LOG anytime to change activi-
ties. Before you shut down, you Log Off and your time is calculated and written to a file called DAILY.LOG which is used by TOTAL LOG to make the report. Simple and informative.

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"DateStamper... is a real winner."
Bruce Morgen, Users Guide, July-Aug. 1985

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ENHANCING CP/M continued from page 33

; A>initist
; for z80 with simple bank select
; include listing.4a ;global equates for history
; asegb org tpa
; move real program to memory above bank select ram
ld hl, mstart
ld de, nonbnnk
ld bc, pend-psart
ldir
jp psart

mstart: .phase nonbnnk
; clear a page of ram to zeroes
psart: id hl, empty
ld bc, empty + 1
ld (hl), 0
idr
ld a, bank2 ;select the second bank
out (bank), a
; set up loop counters for multi page clear
ld de, hbuff
ld b, high (hbuff)
cr1ip: push bc
; copy the clear page into the history buffer
ld hl, empty
ld bc, empty
ldir
pop bc
cr1ip
; set the current command pointer to point to
; the beginning of the (empty) history buffer
ld hl, cbuff
ld (buff), hl
ld a, bank1 ;select the first bank
out (bank), a
ret ;to CP/M's CP without a warm boot

pend:
empty: ds 1
.dephase
end

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\[ \sum_{i=1}^{\infty} \left( \frac{a_{11}}{2} \cdots \frac{a_{1n}}{2} \frac{a_{21}}{2} \cdots \frac{a_{2n}}{2} \cdots \frac{a_{m1}}{2} \cdots \frac{a_{mn}}{2} \right) \int_{-\infty}^{\infty} e^{-x^2} dx \]

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Plu*Perfect has modified a few public domain programs to work with DateStamper including MCAT and XCAT. They also sell these for the cost of the media plus shipping ($12). You can't go wrong buying DateStamper from Plu*Perfect Systems. The main program is excellent, does all they say it does and the utilities supplied with it are the icing on the cake. It is a treat to see fine software like this being produced for CP/M users instead of aiming at the mass MS-DOS IBM market. Congratulations Plu*Perfect, you have done us CP/M users proud.

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see page 90
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Micro/Systems Journal September/October 1986
The UNIX File

by Ian F. Darwin

This column discusses the UNIX operating system. If you have comments or questions about UNIX or this column, please write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have access to the uucp network, mail "ihnp4!darwin!ian". I can’t always answer immediately, but I will get back to you; electronic mail gets answered first!

Every UNIX system comes with some electronic mail capability. Even if it’s only mail, a program whose function has changed little since the early 1970’s, the function is there to send mail to other people on the same UNIX system and, if the machine is on a network, to other people on the net. Several more ambitious mail programs have been written for UNIX over the years. Berkeley systems come with a mail system called Mail (called "cap-mail" since the initial "m" is capitalized, or Berkeley Mail for its origin). Berkeley Mail has been incorporated into System V Release 2 under its original name. Berkeley Mail has been incorporated into System V Release 2 under the more reasonable name mailx. Rushing in where those with more wisdom had known not to tread, I once wrote my own mail program, only to abandon it when I discovered MH.

What’s an MH? Unlike most mailers, it’s not a large, all-in-one package. MH is a series of UNIX commands, invoked directly from UNIX shell that perform the common electronic mail functions. Some of the most common commands are inc to incorporate incoming mail into your MH directory, show to show (read) one or more messages, comp to compose a new message, rmm to remove a message, repl to reply, and scan to list the messages in an MH directory. A session with MH might appear as shown in the box.

Here I receive several messages with inc, look at one with show, reply to it with repl and refile it, look at another and delete it with rmm. inc lists the messages as it incorporates them, assigning each a number, and showing the date, sender, subject, header, and as much of the first few lines of the message as will fit. MH provides convenient names such as first, last, cur to refer to particular messages instead of using the message numbers, and sensible defaults. The listing provided by inc can be recalled later with scan. Show can be configured to run its output through a paginator such as pg or more. A really friendly feature is that repl and comp will invoke any editor you like to compose the text of the message; "prompter" is a simple editor-like program for entering short messages directly from the terminal. Since MH, like many UNIX subsystems, is controlled by a "profile" file, you can specify your choice of default editor, and many other defaults, separately for each program. Also, in any command that lets you edit a message, the mail headers (including the recipient lists) are just text, and can be updated with your favorite editor. By contrast, Berkeley Mail makes you learn and use a series of special escapes to access header text.

And since you are always working with the UNIX shell, you can use the full power of shell syntax, such as

```
scan ! lp
grep Fred
```

to get a listing of all the mail in one directory sent to the line printer.

This is a (less-than-optimal) way of grepping all the mail in one directory for references to Fred. Since each message is a separate file in the UNIX file system, you can write shell files to manipulate your mail, such as an edm program to edit one or more messages.

---

**The MH Mail Handler**

Through a pager such as pg or more. A really friendly feature is that repl and comp will invoke any editor you like to compose the text of the message; "prompter" is a simple editor-like program for entering short messages directly from the terminal. Since MH, like many UNIX subsystems, is controlled by a "profile" file, you can specify your choice of default editor, and many other defaults, separately for each program. Also, in any command that lets you edit a message, the mail headers (including the recipient lists) are just text, and can be updated with your favorite editor. By contrast, Berkeley Mail makes you learn and use a series of special escapes to access header text.

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---

**Listing**

<table>
<thead>
<tr>
<th>You have mail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>% inc</td>
</tr>
<tr>
<td>36 4/24 <a href="mailto:geoff@utcs.uucp">geoff@utcs.uucp</a> &lt;---Happy Birthday.</td>
</tr>
<tr>
<td>37 4/24 ric@lan &lt;------- Forwarded</td>
</tr>
<tr>
<td>38 4/25 mailx1root &lt;--- Moving! Effective 5th May.</td>
</tr>
<tr>
<td>39 4/26 root /usr/adm/e search output &lt;aadm owns</td>
</tr>
<tr>
<td>40 4/26 ian (Ian P. Darw ---&gt; goodbye to uucp</td>
</tr>
<tr>
<td>41 4/26 ian (Ian P. Darw his handshake Failures;</td>
</tr>
<tr>
<td>42 4/26 heptoadignu (Soh Hoptoad is moving this</td>
</tr>
<tr>
<td>44 4/28 ihnp4!uucp Warning From uucp &lt;--- We have</td>
</tr>
<tr>
<td>% show</td>
</tr>
<tr>
<td>(Message inbox:36)</td>
</tr>
<tr>
<td>Return-Path: &lt;utcs!geoff&gt;</td>
</tr>
<tr>
<td>From: <a href="mailto:geoff@utcs.uucp">geoff@utcs.uucp</a> (Geoff Collyer)</td>
</tr>
<tr>
<td>To: darvin@lan</td>
</tr>
<tr>
<td>Date: 24 Apr 1986 0336-EST (Thursday)</td>
</tr>
<tr>
<td>Happy Birthday.</td>
</tr>
</tbody>
</table>

% repl -e prompter

To: geoff@utcs.uucp (Geoff Collyer) 
cc: darvin@lan 
In-reply-to: Your message of 24 Apr 1986 
-----------
Thanks!
----------

What now? send

% refile +/-geoff
% show last

(Message inbox:43) 
Return-Path: <ihnp4!uucp>
From: ihnp4!uucp 
Subject: Warning From uucp 
Apparently-To: darvin@lan 
Date: 26 Apr 1986 1419-EST (Saturday) 

We have been unable to contact machine ncrcsdmail ncrcsalsaauronxyzzy (Date 04/23) 
The job will be deleted in several days if the problem is not corrected.

Sincerely, 

ihnp4!uucp
And, as important, MH is public domain. It was written at the Rand Corporation, as an experiment in electronic mail. One of the authors of Ethics and Etiquette for Electronic Mail (reviewed a couple of UNIX files ago) was one of the original authors of MH. An early version, probably Version 4 of MH, was included with the 4.2 release of Berkeley UNIX. MH.6, the current version, is maintained at the University of California at Irvine, and a variant is scheduled to be included with 4.3BSD. Note that MH.6 is a large mail system, and includes support for several network types, mail-based "bulletin boards", and many other features. There's a lot of source code here, about 3 megabytes; it is not for the weak of heart, nor for the small of disk.

MH.6 is available free if you have access to the Internet (a collection of online networks including the older Arpanet). If not, you can often find a copy locally if you live in a major metropolis with lots of UNIX activity. If all else fails, you can get a copy by sending $50 (U.S.) payable to the Regents of the University of California for the tape (including source and manuals) and a printed manual set. The UNIX manuals are formatted with troff, and the rest of the documents (including an excellent introductory tutorial) are formatted with Knuth's TeX. Send your order to:

Support Group
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University of California
Irvine, California 92717
phone: 714-856-6852

Once you have electronic mail up and running, you can get listed in one or both of the "mailing lists" distributed by UCI; one for MH users and another for installers. Details come with the tape. If you're looking for the ultimate UNIX-based electronic mail package, get a copy of MH.

That's all for this month. I welcome electronic mail and letters on these and other topics, especially suggestions for future columns. Please write to me at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have UNIX mail access to the uucp network, mail "ihnp4!darwin!ian". I can't always answer immediately, but I will get back to you; electronic mail gets answered first! [8]

Ian Darwin is director of Research and Development for SoftQuad Inc., a company providing supported troff publishing software for UNIX. He and his wife live in a rural setting, north of Toronto.

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Ian Darwin
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Price: $140
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Price: $139
Publisher: Gimpel Software, 3207 Hogarth Lane, Collegeville PA 19426

Program Name: LATTICE TOPVIEW TOOLBASKET
Requirements: PC or compatible
Description: For software developers writing LATTICE Topview applications. Consists of a library of more than 70 C functions to control window, cursor, and pointer operations. Also includes printer control, cut and paste, and debugging functions, and sample source programs.
Price: $250; Source code add $250
Publisher: Lattice Inc., Box 3072, Glen Ellyn IL 60138; (312)858-7950; TXW 910-291-2190

Program Name: MPS
Requirements: MS-DOS or CP/M system. MS-DOS system must have Microsoft macro assembler and linker
Description: A user-extensible language via user defined PROC's. Eliminates need for redundant coding. File I/O includes full B-Tree ISAM, Random, and Sequential with unique features. Has simplified screen formatting and data editing, fast BCD arithmetic (up to 36 digits), program chaining with common data, access to operating system functions, powerful string manipulation. Allows in-line assembly code and generates object code.
Price: MS-DOS version, $149.95; CP/M version, $249.95 (includes macro assembler and linker). Manual, $39.95 credits toward purchase.
Publisher: System Facilities Inc., Box 7079, Charlottesville VA 22906, (804)977-5245, or Box 5664, Lacey WA 98503, (206)436-0628

Program Name: DSD86 & DSD87
Requirements: PC or compatible
Description: Full screen symbolic debugger. Features window with user-controlled screen layout (6 different display types including instructions, registers, stack, memory and source). Keyboard can be customized. Recursive macro facility allows extensions to commands.
Price: DSD86 - $69.95; DSD-87 - $99.95
Publisher: Soft Advances, Box 49475, Austin TX 78765, (512)478-4763

C CODE FOR THE PC

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<thead>
<tr>
<th>Source code, of course</th>
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<tr>
<td>Concurrent C</td>
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<td>$45</td>
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The Austin Code Works
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(512)258-0785
New Products

When contacting vendors please mention that you read about them in Micro/Systems Journal.

S-100 HARDWARE
ENCLOSURE FOR LARGE MULTI-USER SYSTEMS

The 5820-S is a heavy duty S-100 tower style systems enclosure. It includes a ferroresonant-based power supply rated at 50 amps (+8V), a highly efficient cooling design, 20 slot motherboard with active termination (adjustable) and independently fused connectors. The enclosure (38" high x 12.1" wide x 26.25" deep) has a 3 position key switch and LED bus and drive indicators. There are 32 DB-25 openings on the rear panel.

The enclosure can house and power a wide assortment of drives with power sequenced to be applied to the drives 3 seconds after power is applied to the bus. Price is $1,495. From Para Dynamics, 7895 E. Acoma Dr, Scottsdale AZ 85260, (602)991-1600.

PC COMPATIBLE HARDWARE

Z-80 COPROCESSOR SUPPORTING UP TO 16 USERS

The Turboslave-PC (tmk) is an 8Mhz Z80 coprocessor card for PC/XT/AT type systems. It contains 128K RAM (with parity), 2 serial ports, a port-mapped FIFO for Master-Slave communications, onboard diagnostics, monitor EPROM and the SLR Z-80 Assembler software.

The board can be supported by multi-user TurboDOS(tmk) or configured as a coprocessor under MS-DOS. Up to 16 Turboslave-PC cards can be supported under TurboDOS, each running as a dumb terminal, with full record locking and security. The Turboslave-PC can be used as a background processor.

The price is $495, from Earth Computers, Box 8067, Fountain Valley CA 92728, (714)964-5784.

DEBUGGING SYSTEMS

Periscope I, Version 2.00, is a debugging system for software developers who need full crash recovery capability, including protected debugger software. It includes a break-out switch and 16K write-protected RAM board. An installation program loads crucial debugger software into the board, then write-protects it so that runaway software programs cannot corrupt it. The break-out switch allows recovery of hung systems and locked keyboards or just to interrupt programs to see what is going on. It can be used with compilers that generate line number references in their object files (e.g. Computer Innovations, IBM, Lattice, and Microsoft C and IBM and Microsoft Pascal, to see symbols, line numbers and actual object code. Traceback enables user to view previously-executed instructions. An in-line symbolic assembler is included as well as support for EGA cards. Users can view text files, change windows while debugging, break I/O port access, and customize Periscope with their own programs via user exits.

Periscope-I includes the memory board, debugger software, break-out switch, 150-page manual and quick reference card. Comes with a 30-day money-back and costs $295, from Data Base Decisions, 14 Bonnie Lane, Atlanta GA 30328, (800)722-7006 or (404)256-3860. A demo disk ($5) is available.

For those not needing the memory protection feature there is Periscope-II for only $145. It includes the break-out switch and all the other feature of Periscope-I.

OTHER PRODUCTS

68020 DEVELOPMENT SYSTEM

Gimix Inc., 1337 W 37th Pl, Chicago IL 60609, (312) 927-5510, has announced the GMX-68020, a multi-user, multitasking, demand-paged, virtual memory system based on the Motorola 68020, 32-bit microprocessor. It includes 512K RAM, 3 serial ports (19.2K max), a 19M hard disk and 1Mb floppy. It uses the UniFLEX VM Operating System V. Written in assembler, it claims to be several times faster than standard Unix systems and C-source compatible. Motorola’s 68020-Bug is included. Languages available includes: Ada, C, Cobol, Fortran, Basic, Assembler, Franz Lisp, and Prolog.

IN-CIRCUIT EMULATOR

A full speed in-circuit emulator called “I.C.E. BOX” for Z-80, 8085 and NSC800 systems. Consists of a palm-size unit, cable and plug assembly that plugs into the system’s processor socket; then plug a terminal or other computer into the RS-232 port on the I.C.E.Box. A single command tests system RAM, ROM and exercises all I/O ports, memory addressing and analyzes code for runtime bottlenecks. Up to 65,535 hardware breakpoints may be set. Can trace program execution, skipping subroutines if needed, and can assemble and disassemble code. Optional software is available to automate test and repair operations. Price is $500 plus shipping ($5 U.S., $25 overseas). From Softaid Inc., Box 2412, Columbia MD 21045, (301)792-8096.
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• If you are already somewhat experienced in Pascal programming, this tutorial will lead you into using those aspects of Pascal that you have been ignoring. A clear definition of records, pointers, dynamic allocation, and even linked files are given along with examples of each.

• There are 71 Pascal source files on a disk that you compile and run after examining them using the explanations given in the printed instruction manual.

• This tutorial is especially written for TURBO Pascal 2.0 or 3.0 but could be used with any Pascal compiler since the majority of the programs are written in standard Pascal as defined by Niklaus Wirth.

• The last chapter includes several example programs to illustrate program development methods. These programs are all on the disk and can be compiled and run as further examples of programming in Pascal.

• Requires MS-DOS or PC-DOS 1.0 or later and can be run on any IBM-PC or compatible computer. Equipment requirements are only as needed for your compiler.

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Turbo Pascal Programmer's Library by K. Jamsa & S Nameoff. A collection of more than 250 routines and complete programs as well as advanced programming techniques. $19.95

C Language
C: A Reference Manual by S. Harbison & G. Steele. Without doubt the best reference manual for C. Don Libes (C Forum author) uses this as his reference. $20.95
C Programmer's Handbook by AT&T. A concise reference. $15.95
The C Library by Kris Jamsa. 125 routines from macros to UNIX utilities. $15.95
C Programming Language by Kernighan & Ritchie. $23.50

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Using Turbo Pascal by Steve Wood. For new Turbo Pascal (V3.0) programmers. Contains lots of code examples. $20.95
Programming With Turbo Pascal by David Carroll. By the author of the Turbo Pascal Corner in this magazine. Includes disk with limited version of Turbo Pascal and lots of sample programs, 310 pgs, $34.95

IBM-PC/XT & COMPATIBLES
Inside IBM PC: Access to Advanced Features & Programming by Peter Norton. Detailed analysis of MS-DOS, PC-system architecture, ROM-BIOS service routines and much more. $20.95; Companion disk $65.95
Assembly Language For IBM PC DOS by Joe Dorner. Book $20.95; Disk $40.95
PC/BLUE Software Directory Catalog listing contents of public domain software disks in PC/BLUE library. Includes cross-reference index by application and other useful information for PC/MS-DOS public domain software users. $5

CP/M
Following books, by Dave Cortesi, are recommended for learning more about CP/M.
Inside CP/M $27.50
Inside CP/M-86 $18.95
The Osborne/McGraw-Hill CP/M User's Guide Includes Concurrent-DOS, Concurrent CP/M-86, DR/Net, DR-EDIX, and DR/Talk. How to use these packages more effectively and trouble shoot hardware and software problems. $19.95
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Discover Forth by T. Hogan $15.95
Operating Systems Design: The XINU Approach by Comer. How to write a Unix-like operating system with much of source code included. $34.95 (hard cover)

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