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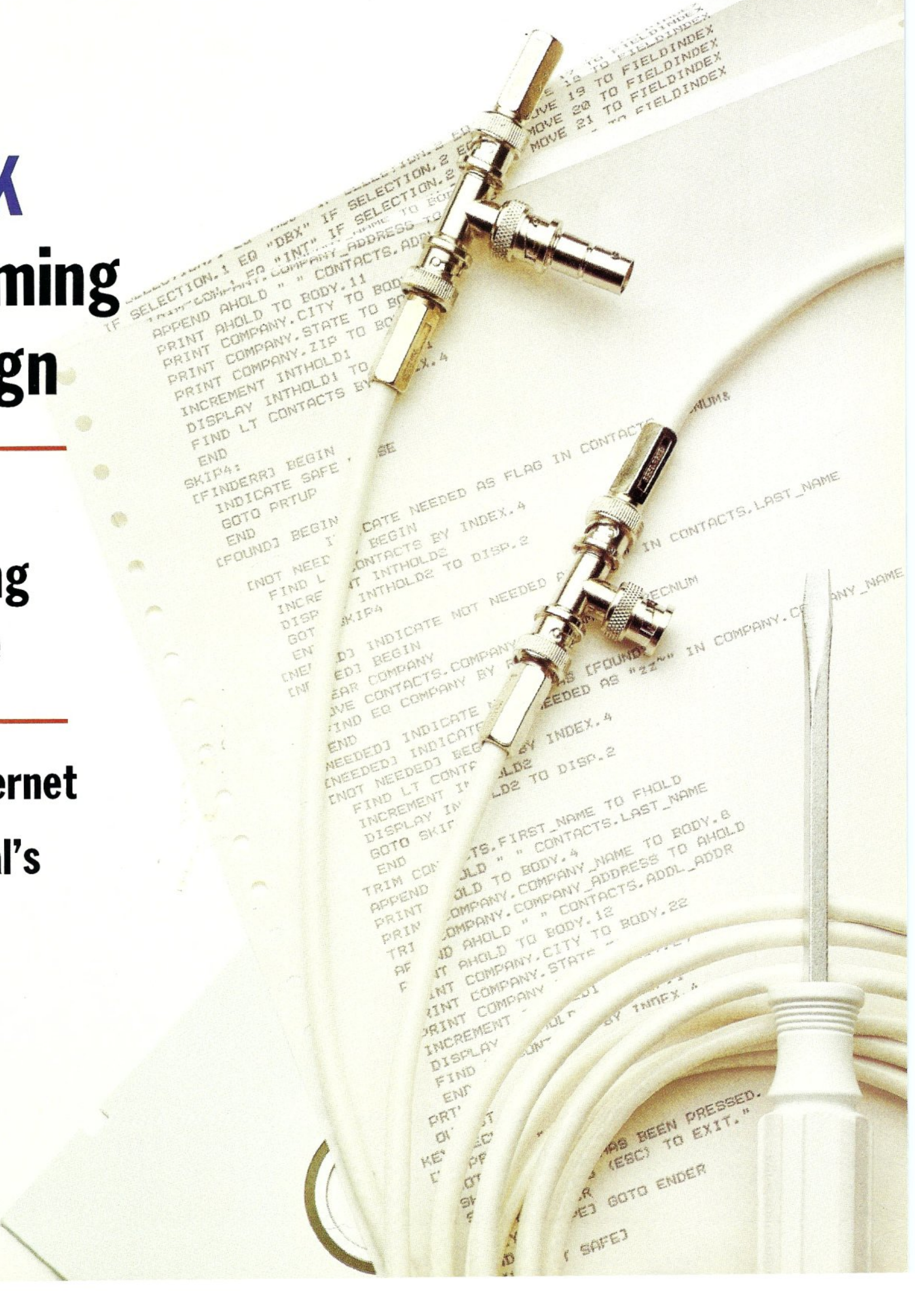
MicroSystems

JOURNAL for the PC Systems Integrator



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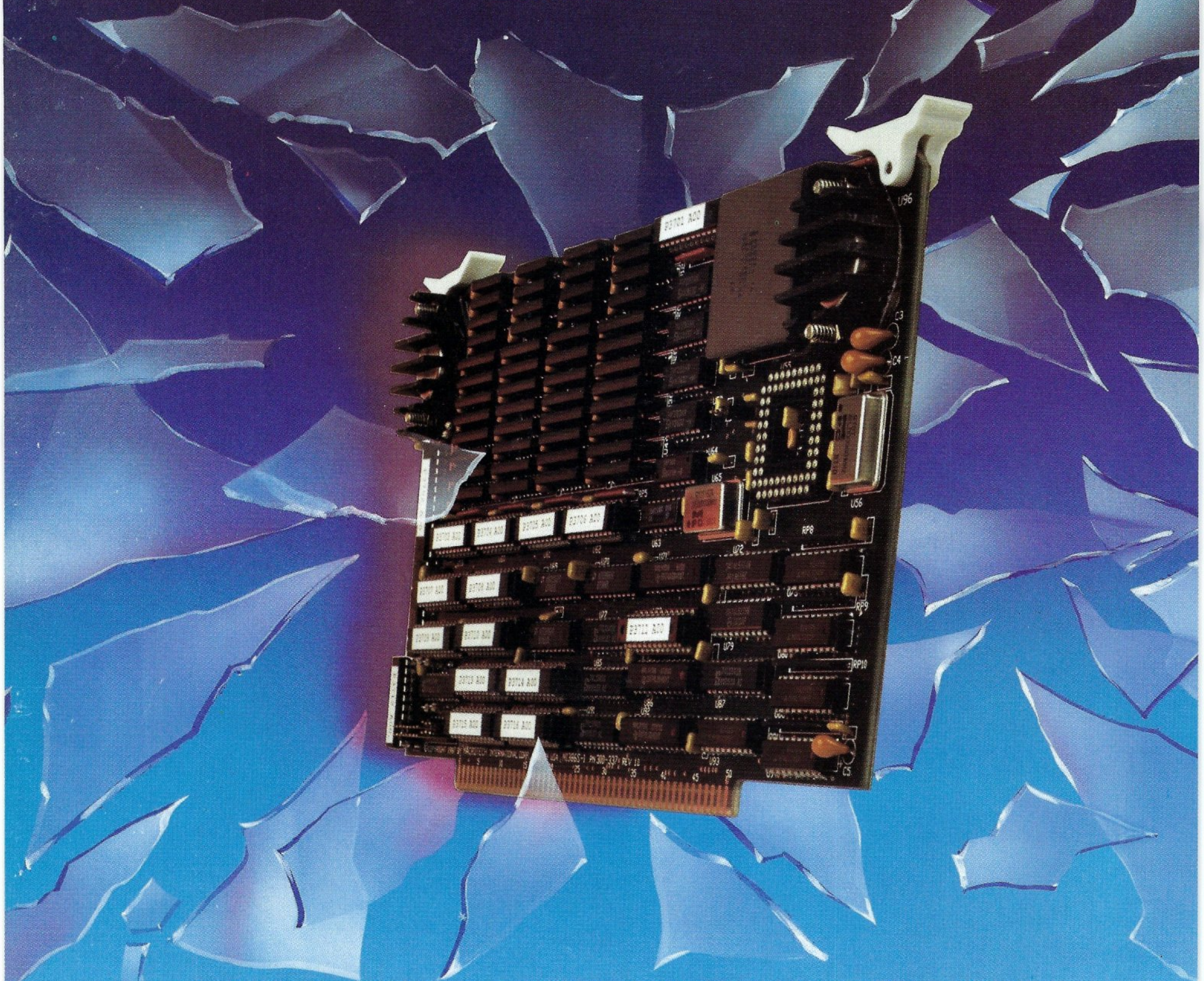

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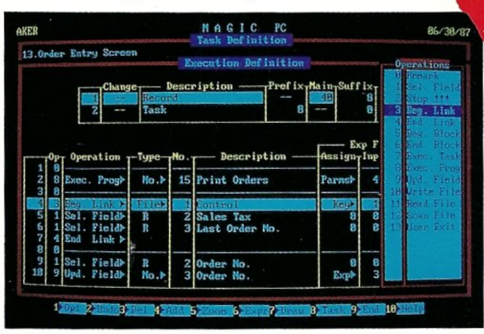

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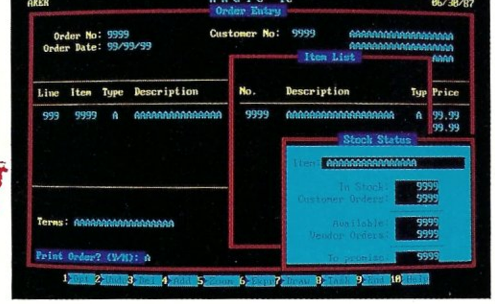

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Micro/Systems

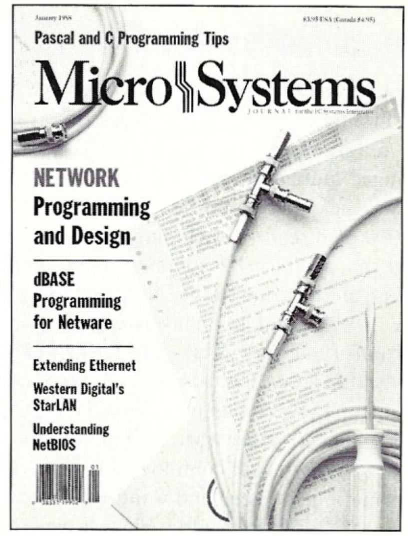
JOURNAL for the PC Systems Integrator

January 1988
Vol. 4 No. 1

FEATURE ARTICLES

PRODUCT REVIEWS

COLUMNS



About the cover: Local Area Networking is increasingly being used in multiuser environments to enable users to share resources, gain access to common databases, and speed communications. LANs also present new problems for system integrators. Solutions for some common LAN problems and reviews of two LAN systems are presented in this issue. In succeeding issues we will continue to give more space to this important area.

DEPARTMENTS

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From the Editor's Desk

Sol Libes

Good News for Our Subscribers

We have great news! Beginning with this issue, *Micro/Systems* goes monthly. During our first three years of publication, many of our readers have pleaded with us to publish the magazine every month. In the past three years, the computer marketplace has changed quite a bit, perhaps most significantly in its increased size. And as the market grows, the elite group who reads *Micro/Systems* grows as well. *Micro/Systems* now has 25,000 paid readers, including an even broader newsstand distribution than ever before. And that increased readership makes it possible for us to increase our frequency and bring you the same technical information 12 times each year.

You will also notice that *Micro/Systems* is now calling itself the *Journal for the PC Systems Integrator.* This is the best handle we have found for you, our readers. A recent readership study indicates that the vast majority of our readers, more than 86 percent, are computer systems professionals responsible for either integrating systems for their companies' in-house use, or building, buying, and supporting PC systems for clients. *Micro/Systems* will continue to concentrate its editorial efforts to provide the kind of information you need and want; articles that offer the latest in-depth technical information and offer insight into various aspects of PC systems integration.

To give you some idea of the kind of editorial commitment we are making to systems integration, these are the topics we will be discussing in coming months:

February	Inside the PS/2 Micro Channel
March	Interfacing to OS/2
April	C Software Development Tools
May	PC Multiuser Operating Systems
June	80386 Software Development Tools
July	Graphics On the PC
August	UNIX on the PC

If you are interested in writing about any of these topics for *Micro/Systems* please contact me as soon as possible. Write to me at: *Micro/Systems*, Box 1192, Mountainside, NJ 07092, or call: (201) 522-9347.

And as the magazine continues to grow, the *Micro/Systems* staff grows as well with the addition of a managing editor and another technical editor. Our new managing editor, Tom Woolf, is based at our parent company, M & T Publishing, in Redwood City, Calif., and our west coast readers may find it easier to contact him regarding editorial matters. Another member of the *Micro/Systems* family, Randy Davis, has been named technical editor. Regular readers will recognize Randy's name as the byline on our "Turbo Pascal Corner" column, and as the author of reviews of assemblers and other products. We welcome his increased editorial input.

You will also notice that this issue ushers in a new cover look. This is only the first phase of our graphic metamorphosis. Over the next few issues, you will see new graphic elements added to every page. We are striving to create a magazine look that takes the technology off the page and places it at your fingertips, where you can apply it. As the microcomputer industry continues to grow, *Micro/Systems* will continue to provide the kind of detailed, technical information you require.

Sol Libes

continued on page 6

Micro/Systems
JOURNAL for the PC Systems Integrator

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continued from page 4

News and Views

This past September, Storeboard Inc., a market research firm, reported that for the first time sales of 286 systems exceeded sales of 8088/8086 systems. Is this an indication users are preparing for the introduction of OS/2?

IBM has disclosed that it will make another attempt to crack the scientific workstation market with several new systems expected to be released early next year. One will be a new version of the PS/2 Model 80 with AIX, IBM's version of UNIX. The system will also support OS/2. The other system will be RISC-based with a Micro Channel bus and UNIX operating system. Both will be produced and marketed by the Entry Systems Division, the same group that brings us the PS/2 line.

IBM is also expected to introduce a PS/2 Micro Channel coprocessor board with 370 architecture very soon. This board will be capable of running IBM's popular mainframe VM operating system.

Intel is rumored to be readying samples of a new version of the 80386 with 16-bit I/O. Expect it to be used in high-end portables and lower-cost desktop systems based on the AT bus. When combined with support chips from outfits such as Chips & Technologies and Faraday, and 1-Mbit RAM chips, it is expected to cut the selling prices of 386 systems down to that of current 286-based systems.

Intel will also begin sampling a 24-MHz version of the 386 and has hinted at 30- and 35-MHz versions. Intel has also disclosed that it expects to begin sampling the 80486 chip by year end. The 486 will be fully compatible with the 386, offering an improved cache memory and clock speeds of 32 to 40 MHz.

Motorola is rumored to have shipped early samples of its 68040 64-bit microprocessor to Apple. Apple is also said to already have a demo system in a Mac II box up and running Mac and DOS programs concurrently.

dBASE-IV from Ashton-Tate is in beta test and due for release shortly. A-T is trying to play catch up with competitors such as R:base System V, Paradox, and Knowledgeman.

LAN Technology Improving

3Com has announced what many consider a major LAN technology breakthrough—hardware to carry 10-Mbits/sec. of Ethernet data over conventional twisted-pair telephone wiring. Previous systems using telephone wiring were limited to 4-Mbits/sec., since this wiring is typically close to power distribution wiring which causes interference. Further, conventional telephone wiring "closets" often house a "rat's nest" of intertwined cables with frequent cross-coupling problems.

3Com Ethernet users will be able to mix and match coaxial, thin coax, and twisted-pair wiring using 3Com's PairTamer, a passive line-impedance matcher/conditioner, and MultiConnect, a card-cage multimedia Ethernet switchboard. 3Com also will offer the LanScanner, a computerized cable and system tester.

The question now is when will IBM and AT&T announce twisted-pair high-speed versions of Token-ring and StarLAN? I am sure it will be soon. There are even rumors that 16-Mbits/sec. hardware will be announced in the near future.

PS/2 vs Enhanced AT Bus Battle

To stimulate the market for the PS/2, IBM has begun licensing the PS/2 functional technology. Chips & Technologies, Faraday, and one or more of the Far East chip makers will soon begin sampling chip sets that implement the features of IBM's PS/2 Micro Channel architecture. PS/2 Model 30 and Model 50 clones, with additional features and superior performance, should begin appearing at the Comdex show this spring.

Some clone makers are enhancing their AT compatibles to run the 286 at 20 MHz using the new high-performance AMD 286 chip. Although AMD rates its new 286 for 16-MHz operation, cloners are using selected chips at a higher clock rate the way manufacturers are pushing the current Intel 286, rated for 12.5-MHz operation, to 16-MHz operation. These new AT-compatibles can outperform an IBM PS/2 model 50 or 60 by a factor of 50 percent or better.

In the 386 marketplace, Compaq has become the leader. Once merely a cloner of IBM PC/XT/AT systems, Compaq has now become a technology leader and IBM is now a follower. Compaq introduced the first 386 system fully 10 months before IBM. Compaq introduced a dual-bus architecture. It retained the standard 16-bit AT I/O bus for peripheral interfacing and introduced a new 32-bit memory bus. This approach allowed compatibility with the large number of AT plug-in cards and at the same time improved processing speed via a high-speed memory bus.

IBM's PS/2 Model 80 386-based machine, only equaled the performance of the Compaq machine. Shortly after IBM's introduction, Compaq introduced a faster version of its system with improved memory caching and interfaces for either the high-speed Weitek or Intel 387 math coprocessors. The result was performance substantially faster than the IBM's 386 machine. Other clone makers are doing likewise. AST has gone even further by developing a multi-master extension to the AT bus architecture. Further, AST has published the extension's specifications in the hope that it may become a standard in the same way its previous extended memory system was adopted as a standard with EMS 4.0. Compaq and AST are both demonstrating that a dual-bus system consisting of the old AT 16-bit I/O bus and a well-designed 32-bit wide memory bus, and extensions to the AT bus may provide an effective alternative to IBM's proprietary Micro Channel.

OS/2, Windows/386 News

Compaq and AST are doing battle with IBM on the operating system front as well. Both companies now include DOS versions with their 386 systems that break the 32-Mbit disk barrier. They also include a copy of Microsoft Windows/386. Both Compaq and AST also plan to offer OS/2 implementation for their systems. Windows/386 gives users an alternative to OS/2, providing many of the multitasking features offered by OS/2 without requiring new application program versions to be written. However, Windows/386 does not offer the protection mechanisms inherent in OS/2.

IBM began shipping advance copies of OS/2 Version 1.0 last month, fully three months ahead of originally scheduled; indeed a rare occurrence in the software business. This month users should find it in stock at their local IBM dealer. Microsoft also is shipping copies to OEMs, who will have to add the necessary drivers and additional documentation. Therefore, don't expect to see versions for the AT-compatibles on the shelf until this spring.

Further, IBM and Microsoft are promising to ship advance copies of Version 1.1 containing the Presentation Manager in the third quarter, also earlier than originally promised. It was originally promised for late fourth quarter.

And IBM is now promising to release the Extended Edition of OS/2 by year-end instead of next year, as originally promised. Meanwhile, Microsoft has disclosed that it is actively working on OS/3, an operating system designed specifically for 386-based systems. No word on when it will be released. —*Sol Libes*

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Modifying the IBM PC

Dear *M/SJ*:

I couldn't agree with Edward White more about the documentation issue ("there is mail" column, July/August 1987). One of the things I like best about my IBM PC was the complete documentation including schematics and BIOS listings. As both a hardware and software "hacker," this allowed me to dream up any modification I wished. The only additional thing I wanted was a source listing for the COMMAND.COM and the other system files. I have since found them on various bulletin board systems.

I didn't like the automatic RAM test on power up, so I simply reprogrammed a Motorola 68761 EPROM with a modified version of the BIOS and skipped the power-up tests along with waiting for it to read "drive A:." This saves considerable time when continuously rebooting the machine during software development. I have also added other enhancements to my BIOS ROM, with the help of the available source code.

I have also modified the hardware of the PC in several ways. One was to upgrade a 64K machine to 256K by simply cutting a few traces and adding a couple of wires. I could have done this without a schematic, but it sure would have been more difficult.

Let's not turn the computer business into a world of appliance operators, where nobody but the manufacturers have detailed information about the machines. That's the best thing about personal computers: you can do anything to them that you want, without having to ask for your supervisor's approval. The open architecture attitude encourages experimentation and learning that was impossible on mainframe and minicomputer systems. Let's not allow the industry to make a 180-degree turn away from documentation availability.

John Battle
Norcross, Ga.

Editor's Response

I second John Battle's remarks on documentation. When we bought our first IBM PC in early 1982, it did indeed include a technical manual with complete schematics and BIOS listing. However, when we purchased subsequent IBM machines, we found that IBM no longer supplied the technical manual with the system. It now had to be ordered separately at a cost of a few hundred dollars. We were also put out by the fact that the BIOS listing printed in the manual did not agree with the code in our machine. We have also purchased several PC-compatibles. None came with BIOS listings and a few omitted schematic diagrams.

There is no doubt that IBM set a new standard in the industry for quality and completeness of documentation.

FORTRAN versus C

Dear *MS/J*:

Congratulations on your continuing improvement in quality, as evidenced by the September/October issue. I am pleased to see new material of interest to those of us involved in numerical computation.

My first reaction to Don Libes' column was that he was selling C short, even though I still consider FORTRAN more suitable for the majority of my work. Most of the issues raised are not really faults with the C language, but valid issues which ought to be addressed when writing code in any language. In defense of C, one might note that, although the ANSI standard for FORTRAN requires the ability to use floating point numbers to control DC loops, compiler developers generally don't test their ability to generate correct code. In effect, the standard dictates that an integer counter should be set up to assure that the loop is executed a fixed number of times, but in the process of doing this, some compilers lose track of the floating point increment. This reinforces the principle that one should not press his luck by testing the ability of a compiler to interpret code that wouldn't have worked on the compilers of 20 years ago.

The automatic promotion of expressions and arguments to double fits the architecture of several of the early C machines, as well as newer processors such as the 8087 and 68881 families. Relatively few obsolescent machines, including the beloved Z80 and VAX families, show a large performance penalty. Don shed some light on a subject that has caused me some trouble when he discussed the explicit permission given by K&R to ignore parentheses. However, he did not note that the expression

```
... = z + temp=x+y
```

would probably have the same value as

```
... = +(x+y) + z
```

which ought to be able to be written in FORTRAN as

```
... = (x+y) + z
```

With the modern viewpoint in some compiler generation shops that consider PASCAL and FORTRAN are just front ends on a C compiler, we have observed FORTRAN compilers that violate parentheses. This issue is not as important on machines such as the 68881, which keep guard bits during the evaluation of expressions. On the other hand, I know of no language that requires the expression

```
... = z + temp=x+y
```

not to be evaluated in extended precision. The writers of the Paranoia code assumed (erroneously) that the = sign should imply rounding of the precision implied by the declaration of *temp*, which perhaps it did on some compilers available to them.

Tim Prince
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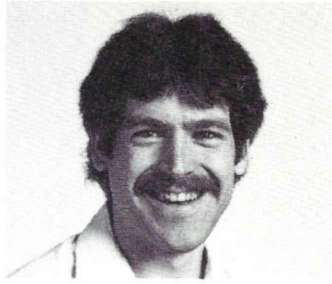
by Don Libes



Win a gold medal in the longjmp

This column features tips and techniques for using the C programming language productively. It discusses typical problems using C and their solutions. Readers suggestions, comments, and questions are encouraged and can be addressed to: C Forum, Micro/Systems Journal, *Box 1192, Mountainside, NJ 07092.*

setjmp( ) and *longjmp( )* are functions for "unwinding the stack." I will explain what this is shortly, but first I will introduce it by an example.

Assume we have written an interactive program such as a shell or editor. Its basic structure is that of a command loop as

```
while (1) {
    prompt_for_command();
    read_command();
    execute_command();
}
```

A typical problem arises when the user types in a command that begins running but takes a while to run. Changing her mind, the user attempts to cancel the command, perhaps by pressing a key predefined to generate an interrupt.

Whenever an interrupt occurs, control is given to an interrupt handler. The interrupt handler can call the main program to re-enter the loop, but because the interrupt handler hasn't actually returned, the stack is never cleaned up. Enough interrupts of this type will eventually cause a stack overflow. Simply returning from the interrupt handler isn't a viable solution either since control will return to the same routine from which the user wanted to escape in the first place.

The only solution is to pop off the stack frames until we get to the one from the main loop, and then jump directly from the interrupt handler to the top of the loop. (A "stack frame" or "activation frame" is everything on the stack pertinent to one procedure call.) Popping stack frames like this is called "unwinding the stack."

setjmp( ) and *longjmp( )*

The C library provides a function called *longjmp( )* which unwinds the stack. As its first argument, *longjmp( )* takes a location to jump to. The location is stored in a "jmp_buf" (defined in <setjmp.h>) and is set with *setjmp( )*. Just call *setjmp( )* at locations you may need to jump to, and call *longjmp( )* when you want to actually jump. This is very similar to *goto*s, in which labels indicate where you can jump to, and executing the *goto* actually causes the jump to occur. Unlike *goto*, however, *longjmp( )* can jump out of procedure calls and unwind the stack as necessary.

When the jump occurs, the program behaves like *setjmp( )* is returning again, but this time with the value of the second argument of *longjmp( )*. The following is our original loop using an interrupt routine that unwinds the stack. We ignore any value that *setjmp( )* returns.

```
#include <setjmp.h>
jmp_buf restart;

while (1) {
        setjmp(restart);
        prompt_for_command();
        read_command();
        execute_command();
}

interrupt_handler()
{
        longjmp(restart,0);
}
```

setjmp( ) returns 0 the first time it is called. When *longjmp( )* is called, *setjmp( )* returns again but with the value of the second argument passed to *longjmp( )*. This allows the program to figure out if *setjmp( )* is returning from *longjmp( )* or not.

We saw an example of how this could be useful in a previous "C Forum" column, "Garbage In" (*M/SJ*, September/October 1986). The problem was to read from a file and timeout if no bytes were available. Here I will show the simpler problem of just interrupting a *read( )*. The problem is that on some systems, *read( )*s that are interrupted are restarted automatically. On other systems, interrupted reads are not restarted. With *setjmp( )* it is possible to handle both cases with the same code, as with:

```
#include <setjmp.h>
jmp_buf env;

interruptable_read(fd,buffer,
          length)
int fd;
char *buffer;
int length;
{
      if (0 == setjmp(env))
            read(fd,buffer,
                 maxlength);
}

interrupt_handler()
{
      longjmp(env,1);
}
```

When we call *interruptable_read( )*, *setjmp( )* returns 0 and executes *read( )*. If *read( )* is interrupted, *interrupt_handler( )* is called and *longjmp( )* is executed, causing *setjmp( )* to return with the value 1. Since 0 != 1, *read( )* is not reexecuted and *interruptable_read( )* returns.

This is a paradigm for handling interrupts and other low-level errors in a variety of functions. You should get used to seeing this type of code, and immediately recognize what it is doing. It may be instructive to refer back to the earlier "C Forum" I mentioned, "Garbage In," to see another example of *setjmp( )* and *longjmp( )* being used to solve a similar problem. Notice that we could solve neither of these problems without *setjmp( )* and *longjmp( )*.

How do they work?

How do *setjmp( )* and *longjmp( )* work? Very simply. *setjmp( )* saves the pc, stack pointer, and most of the other registers in the *jmp_buf*. *longjmp( )* restores the registers. After calling *longjmp( )*, the effect

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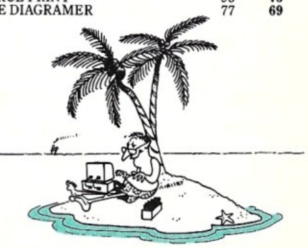

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is that we appear to return from *setjmp( )*, completely ignoring all the stack frames that were set up between the *setjmp( )* and the *longjmp( )*.

Of course, if we have returned from the function that executed the *setjmp( )*, the saved environment is useless since an old frame above the current one is meaningless. Be careful when setting up *jmp_bufs*, since it is unlikely that the system will catch this kind of error and you may find yourself jumping into oblivion.

Fast returns

longjmp( ) works equally well at popping one stack frame or popping ten stack frames. Therefore it can be used as a fast return which exits many functions at once. While this is not a technique that makes code easy to follow, there are valid uses.

For example, a recursive-descent parser may use many stack frames just parsing a single expression. It is quite typical that a low-level routine can determine that the entire expression must be aborted. Rather than return with a failure and have each caller do the same thing, the routine detecting the problem simply calls *longjmp( )* to restart or abort the parse. By aborting with a *longjmp( )* rather than a return, there is no need to put error checking code after each call. The code actually becomes more readable since most functions can now assume that every one they call always succeeds (if control is returned to them).

Multitasking

It is actually possible to do a limited form of multitasking with *setjmp( )* and *longjmp( )*. Restating the restriction I just mentioned, you can't *longjmp( )* to a routine if it is not in the calling chain of the current function. Then how can you pass control to multiple procedures that do not follow a strict hierarchical call sequence? Well, the restriction is simply there to avoid the possibility of jumping to a stack frame that is no longer valid because of its parent frames having been changed. But we can guarantee this doesn't happen by using separate stacks for each thread of control.

The idea is that you set up a number of tasks or top-level procedures. Each task initially allocates its own stack and starts using it immediately. Then, as each task wants to temporarily release the processor temporarily for other tasks to run, it puts itself on a queue of tasks to run, pulls off the next process to execute, saves the registers with *setjmp( )* and then calls *longjmp( )* with the environment of the next process. These functions can all be packaged into one function called *schedule_next_task( )*. Here is the basic idea of such a function:

```
schedule_next_task()
{
  insert(ready_queue,old_task);
  new_task = remove(ready_queue);
  if (0 == setjmp(old_task))
       longjmp(new_task,1);
  }
}
```

In the above code fragment, *old_task* and *new_task* represent places where one task is giving up control of the CPU, and another task is going to get control of the CPU (where it previously gave up control). *insert( )* puts the current task on a queue of tasks that are ready to execute. *remove( )* returns the highest priority task from those ready to execute. It also removes this task from the queue.

With *setjmp( )*, we now save the current task for later resumption, and resume the new task with *longjmp( )*. Where does the task resume? Of course, the new task resumes at the *setjmp( )*, so we must signify that we do not wish to execute the *longjmp( )* again by returning 1. Does this code look familiar? It should. It is exactly the same code that we used to write our *interruptable_read( )*!

What I have outlined here is a "non-preemptive multitasking" scheduler. Non-preemptive means that tasks must explicitly give up control of the CPU in this case, by calling *schedule_next_task( )*. A "preemptive" scheduler will take the CPU away from the tasks, whether or not they are done with it. It is not possible to do preemptive scheduling with *setjmp( )* and *longjmp( )*.

Writing a preemptive scheduler requires a little assembly coding (mainly to save and restore all the registers at task switch time). If you would like to read more about it, I highly recommend the book *Operating System Design: The XINU Approach* by Douglas Comer (Prentice-Hall, 1984). This unusually well-written text describes the complete implementation of an operating system written almost entirely in C. The book includes the necessary assembler for bringing the system up on a DEC LSI 11/2 (a microcomputer version of the PDP-11). It has been ported to several other microcomputers, however you may want to try doing it yourself.

Warnings

As I mentioned earlier, *setjmp( )* actually works by saving most of the registers—some registers are never saved at procedure calls but are used as temporaries. For example, if our compiler always reserves two registers for temporary results, *setjmp( )* does not have to waste time saving those two at procedure calls. Since *setjmp( )* itself is a procedure, the compiler guarantees that these two registers will not have useful values at the time *setjmp( )* is called or returned. For the same reason, the condition codes of the CPU are not saved either.

This explains why we cannot do preemptive multitasking with *setjmp( )* and *longjmp( )*. If tasks are interrupted (by a clock interrupt, for example) at any point in the code, we may well be using the temporary registers and condition codes. Since *setjmp( )* doesn't save any of this information, we will not be able to restart the task later in the same state that we found it.

Understanding how *setjmp( )* works is helpful in using it correctly. It should be clear to you now that when you call *longjmp( )*, your register variables will contain the same values that they had when *setjmp( )* was called. On the other hand, your memory variables will have whatever value they were last set with since they are not saved with *setjmp( )*. One further thing that you must be careful of; there is no guarantee that variables declared as "register" will have their variables saved by *setjmp( )*. The reason there is no guarantee is that the compiler will actually put your variable in a register, since the register storage class is only a hint to the compiler. This is especially a problem in attempting to write portable code.

Conclusion

We have seen how *setjmp( )* and *longjmp( )* are useful in dealing with low-level conditions such as interrupts and error-handling code. Used correctly, they are appropriate for certain problems that can be solved in no other way. However, like *goto*, they can be overused and abused. Indeed, they are worse than *goto*s in the sense that they make program control-flow non-hierarchical. Please use them carefully and only when you cannot otherwise avoid it. §

Don Libes is a computer scientist working in the Washington, D.C., area. He is working on artificial intelligence in robot control systems.

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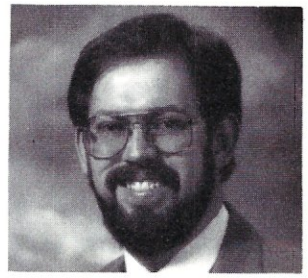
Turbo Pascal Corner

by Stephen R. Davis



Using INLINE to Debug

This column features tips and techniques for using Turbo Pascal productively on MS-DOS/PC-DOS, and CP/M microcomputer systems. It discusses typical problems and their solutions. Reader suggestions, comments, and questions are encouraged, and can be addressed to "Turbo Pascal Corner," Route 5, Box 107K, Greenville, TX 75401, or through MCI mail, 289-6124.

Despite its many good points, Turbo Pascal has some rather glaring deficiencies. First is the absence of a decent debug facility, which has been addressed in previous columns and will be examined again here. Just as serious, Turbo Pascal avoids a link step. While contributing to Turbo Pascal's compilation speed, the lack of a link step precludes the possibility of modular programming. (In linking, a program is divided into several modules that are compiled separately.)

This problem aggravates the fact that Turbo Pascal stops compiling at the first error it finds. After the user has fixed the error, compilation does not restart at the point of the infraction but from the beginning of the program. Being forced to compile entire programs repeatedly can become annoying to programmers using Turbo Pascal to develop large projects.

Borland has fixed these problems (and others) with its new release of Turbo Pascal Version 4.0. This version sports separate linking, as well as detection of multiple errors in one compilation pass. For those who do not want to upgrade, Tangent Designs also has introduced a new product, TMark, to address at least the latter of these problems.

The user executes TURBO.COM under TMark, installing save marks at strategic points in his program. Turbo Pascal runs exactly the same as without TMark until it is time to compile to memory. At this point, TMark offers a menu of compile options on the screen. From the menu, the user can start the compilation from the beginning or from any save points previously installed in the program. Thus, a programmer might install a TMark save point 5000 lines deep in his program. When an error pops up, halting compilation on line 5010, the programmer can fix the error and resume compilation from line 5000 instead of line 1.

TMark is available from Tangent Technologies, P.O. Box 896, Lake Forest, IL 60045. Call 312-295-0030 for further information or 800-356-2750 to place your order.

Today's Topic

The absence of a debug facility is a more serious problem. Several times in this column I have mentioned third-party source-code debuggers for Turbo Pascal. I consider these to be great productivity enhancement tools. Programmers who work with Turbo Pascal day in and day out will want to seriously consider one of these packages. That is not to say, however, that there is no help for the part-time hacker or the student whose budget just can't tolerate another burden.

One of the simplest debug techniques we all learned with our very first programs was that of WriteLn statements. The programmer starts by simply inserting WriteLns in his program at pivotal points to display the values of key variables. Output statements are inserted wherever there might be a question as to what the program is doing.

However, there are some serious problems with this technique. First, it is difficult for the programmer to anticipate all of the variables that he might want to see. If it turns out that there is an insufficient amount of information to solve the problem, the programmer must re-edit the program, insert more WriteLn statements, and recompile. The turnaround time between attempts slows the debug process.

The second problem involves programs that crash. With a program that simply goes away, it can be difficult to know where to insert WriteLn statements. Programs that expire ungracefully can also erase their tracks by either scrolling useful information off the top of the screen and replacing it with useless data generated from infinite loops, or by simply resetting the display in their dying gasps. Even when a program's death is not quite so traumatic, the necessity of rebooting the machine considerably adds to the turnaround time.

There is not much that we can do about the turnaround time using WriteLn statements. Given Turbo Pascal's extremely rapid compilations, the time required to edit and recompile a program is not nearly as much of a problem in this environment as it is with conventional languages. However, we can address the second problem, that of programs that crash, and offer some solutions.

The programmer need only add a call to either the KeyPressed or Read library functions immediately after the WriteLn statements to force the program to wait after each output for permission to continue executing. This gives the programmer time to copy down any data and contemplate its meaning before it gets erased by an impending reset. In fact, the programmer can usually immediately recognize when the program's logic has gone awry and stop the process using a Ctrl-Break before any real damage is done.

Although a big improvement, this still does not give the programmer the kind of control expected from a real debugger. Once the program stops, the programmer

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BYTE Magazine	November 1987	(80386 version)

- **Professional Pascal ™:**

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has no options other than to allow it to continue on or abort the program entirely and start over. What is really needed is some way to code breakpoints directly into the Pascal code (instead of simple Read statements).

Before we can hope to install a breakpoint, we must first understand what a breakpoint is. We tend to think of our programs as being executed from beginning to end without interruption. Even in single-user systems, however, this is not so. Other things are happening within the PC that demand the microprocessor's attention. There are clock ticks requiring servicing, floppy disks that need instructions, and communications ports waiting for data. These external events are handled through a mechanism commonly known as interrupts.

The 8086 microprocessor defines up to 256 different interrupts, each of which has an associated address. When an interrupt occurs, the program at the associated address is executed before the interrupted program is allowed to continue. For example, the PC's time-of-day clock uses interrupt 8. Every time the clock ticks, the 8086 jumps off and executes the code pointed at by interrupt 8. Once finished, it resumes its normal operation exactly at the point where it was interrupted. The interrupted program is unaware of the side trip.

Any of these interrupt routines can be executed from software via the INT assembly language instruction. Executing the INT 8 instruction has the same effect as an interrupt arriving from the time-of-day clock. The 8086 reserves several special interrupts for its own use. Two of these, interrupts 1 and 3, are the breakpoint interrupts. Debuggers, such as DOS's DEBUG, use these interrupts to regain control from an executing program. They store their own address into these interrupts so that these interrupts are like a jump to debugger instruction.

For example, suppose the programmer enters the command *G 200* from within DEBUG (that is, "go from the current location up to location 200"). DEBUG starts by saving the contents of location 200 and inserting a breakpoint interrupt instruction there. It then executes the user program from where it last left off. When the program gets to location 200, it executes the breakpoint interrupt and returns control back to DEBUG.

Setting breakpoints in a .COM file generated by Turbo Pascal is notoriously difficult (without one of the debug aides mentioned in previous columns), primarily because it is so difficult to find the user's code in the Turbo library without some kind of a load map. What if we simply code breakpoint instructions directly into our programs? The machine instruction INT 1 corresponds to the two hex values $CD and $01 which we can insert using the INLINE directive. Thus, an INLINE ($CD/$01) is a breakpoint instruction (this breakpoint is more convenient to the almost identical inter in Turbo Pascal).

There is only one small problem. For this to work something must be there to "catch" the interrupt 1. No problem, we simply execute TURBO.COM under the debugger. The instructions for DEBUG are as follows:

1. Enter DEBUG TURBO.COM to execute Turbo Pascal under DEBUG (you may use whatever debugger you prefer).

2. At the DEBUG prompt, enter T<CR> to trace one instruction. This insures that DEBUG properly defines interrupt 1.

3. Now enter G<CR>. Turbo Pascal should come up. Enter and edit your program normally. You may include WriteLn statements to display the value of key variables as desired. Include INLINE ($CD/$01) wherever you want to insert a breakpoint. Conditional breakpoints can be simulated by attaching an IF statement to the INLINE ($CD/$01). For example, the statement:

```
IF A ) 10 THEN INLINE ($CD/$01);
```

will only break if the variable A is greater than 10.

4. Now Run your program. Whenever the program encounters a breakpoint, it will stop and control will revert back to DEBUG. Once in DEBUG you can perform normal debugger commands. You can examine the Turbo Pascal generated machine instructions immediately around the breakpoint to determine where variables are located in memory. The WriteLn's themselves can help in this regard since they access these variables. If you are familiar with assembly language, you can develop a feel for Turbo Pascal-generated machine code.

5. Entering G<CR> will continue execution of your program. You are also free to enter new breakpoints from the debugger or single-step machine instructions, as desired, now that you know where you are. It is often the case that you will only need one INLINE ($CD/$01) breakpoint to get you in the ballpark of the problem. From that point you can press on using DEBUG alone by matching the assembly language to the Pascal statements yourself. This is especially true of INLINE sections of code where WriteLn statements are not of use. Begin such sections with a breakpoint and then single-step them using DEBUG's *T* command, carefully observing the effect of each instruction.

6. To abort execution of your program, you have two options. You can simply exit the debugger using the *Q* command and start over. It also is possible, however, to discover the address of Turbo Pascal's terminate routine and avoid the trouble. To do this, execute under the debugger a program consisting of nothing but:

```
BEGIN
  INLINE ($CD/$01)
END.
```

Disassemble from the point at which the program breaks. The first CALL you encounter in the disassembly will be to the terminate routine. It is $C89 for version 3.01A (both the 8087 and non-8087 versions), but it may be slightly different for other versions of Turbo Pascal. Write down and remember whatever it happens to be for your version. To abort directly back to Turbo's menu from a breakpoint in the future, simply change the instruction point to that address using the RIP command and then enter G. In my case it looks like the following:

```
-RIP
IP xxxx
:C89
-G
```

where xxxx is whatever happens to be in the IP. You will immediately find yourself looking at a ">" prompt which you might not recognize as Turbo's menu prompt (enter a Return by itself to restore the menu screen).

7. Upon exiting the Turbo menu you will return to DEBUG and not directly to DOS. To complete the exit process, simply enter a Q<CR> at the DEBUG prompt.

.COM files generated by Turbo Pascal can be debugged in the same fashion. Insert INLINE ($CD/$01)s just as above and then compile to a .COM file. Exit Turbo and execute the .COM file under DEBUG (or your own favorite debugger). Trace one instruction with the *T* command to properly initialize interrupt 1 and then enter G<CR>. When your program terminates, you will be returned to the DEBUG prompt. From this point you can either restart the program by changing the instruction pointer to 100 and entering *G* or exit back to DOS with the *Q* command.

This procedure is complicated, and programmers unfamiliar with 8086 assembly language and assembly language debuggers should probably not use it. Those who are will find it a wonderful method for converting trusty old DEBUG into a serviceable debugger for Turbo Pascal. Combined with judicious use of WriteLns, it may offer all the debugging horsepower you need. §

Randy Davis is a technical editor of M/SJ *and a systems programmer. He lives in Greenville, Texas, and is currently completing a Masters degree in Physics.*

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Using dBASE III+ and Clipper A86 with Advanced Netware 286

by Henry J. Franzoni III

dBASE and Clipper can be very useful in creating a library of problem-solving routines for a system integrator's programming toolkit.

Over the years, I have written many dBASE and Clipper applications to run under Novell Netware. Some time ago, this led to my developing a library of standard routines to solve certain problems. Once you understand how I came to develop these routines, you can build from the examples presented here to solve your own dBASE and Clipper network problems.

One common situation is the need to create temporary files during program execution to add records, sort records, edit records, and perform other operations, and yet make sure that different stations create different temporary files so that data is not overwritten by other stations. Another common problem in MS-DOS networks is that individual stations may have a variety of different video cards, disk drives, and printers. Programs need some way to identify the hardware that is available to each station. Programs also need a way to print on the available shared printers.

The Station Number

First, let's approach the subject of unique file names. Of the many methods I have heard being used, my favorite involves using the logical station number.

The station number is a number from 1 to 255 that is assigned to each terminal that logs on to the file server. This number is unique. There are two ways I obtain the value of the station number and bring it in to the program. In dBASE III+, I use the system *login* script and the environment area to pass the station number. In Clipper, I use an assembly language UDF (User Defined Function). Once I have the station number, I tack it on as a suffix to file name roots,

The first method using dBASE III works like this: start with the Novell Utility SYSCON and choose the system *login* script choice from the main menu. Add these lines as shown to the system *login* script:

```
SET STA="%STATION"
SET USER="%LOGIN_NAME"
```

This will create variables in the environment area named STA and USER that will then be set to the logical station number and *login* name, respectively, for each terminal and user that logs on to the network. dBASE III+ and Clipper A86 applications can get this information with the commands:

```
STA=GETE("STA")
USER=GETE("USER")
```

The function GETE( ) inlcuded with dBASE III+ is in file EXTENDC.OBJ, written by Tom Rettig and is included with the Clipper compiler.

Before I show you how to use STA and USER to create unique file names, here is an alternate method for Clipper users to get the station number.

Below is an assembly language UDF, *station( )*. This UDF uses one of the Novell Netware extended functions available through DOS Int 21h.

Copy the file named EXTENDA.ASM, also written by Tom Rettig and included with the Clipper compiler, and add the two segments shown in Listing 1 to the appropriate places in the copy.

Use an assembler that produces .OBJ file output and recompile EXTENDA.ASM to produce a new EXTENDA.OBJ that includes the *station( )* function. Link this in with your application. (I use A86 and PLINK86.)

To use *station( )* in an application, we have to make adjustments for the fact that *station( )* returns a four digit number,

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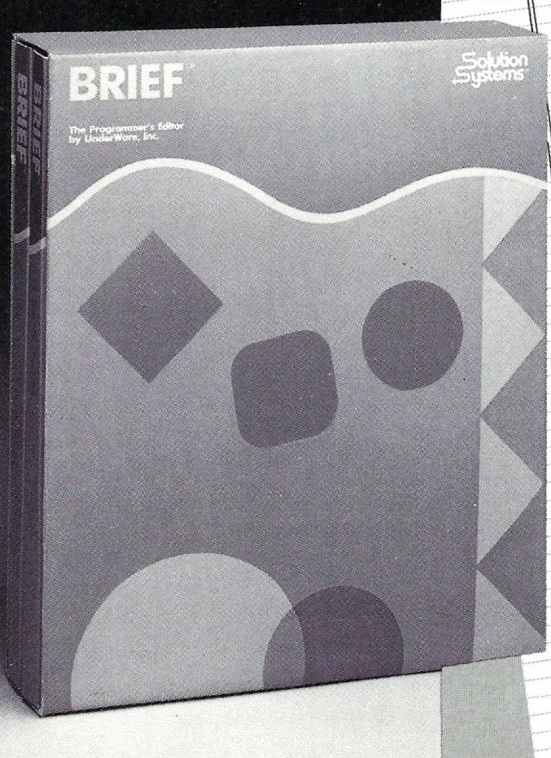

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ranging from 0001 to 0255. Below is a Clipper code example for *station( )*:

```
STA=LTRIM(STR(STATION(),4,0))
```

Creating Unique File Names

Both the system *login* script method and the Clipper UDF method produce a variable named STA that can now be used to create unique file names. The following dBASE/Clipper code segment illustrates this:

```
DTBSNAME="TEMPF"
SUFFIX=".DBF"
MDTBS="MASTER"
USE &MDTBS
SET DELETED ON
COPY TO &DTBSNAME.&STA
SET DELETED OFF
USE
ERASE &MDTBS.&SUFFIX
RENAME &DTBSNAME.&STA.&SUFFIX TO &MDTBS.&SUFFIX
USE &MDTBS
```

The period used above, the macro concatenation symbol, is invaluable for creating unique files names for networked applications.

Another use I find for environmental variables is to store unique hardware information about each terminal. For example, some stations may have a backup device, others may have an EGA monitor, etc. I use the SET command in the AUTOEXEC.BAT file of each terminal to do things like this:

```
SET BACKUP=NO
SET ADAPTER=EGA
SET LOCAL=YES
SET CLIPPER=V34;R64
```

When a user wants to perform do a backup, the application can see if the backup device is available. Likewise, the program can determine if the terminal has an EGA, a local printer, and an extra disk. I have used a small assembly language program to check the video card and return the errorlevel code that was used to set an environmental variable from the AUTOEXEC.BAT file for each station. There are a lot of possibilities with this technique.

If you run out of environment space, put the command

```
SHELL=COMMAND /p/e:nn
```

in your CONFIG.SYS file, and expand the environment in DOS 3.1 and 3.2. In DOS 3.3, the form is:

```
SHELL=COMMAND /p/e:nnnnn
```

In DOS 2.0 and 2.1 use the form:

```
SHELL=COMMAND /p/e:nnnn
```

The above does not work in DOS 3.0 and DOS 1.x.

Enough with the environment. Let's look at network printers.

Shared Network Printers

To control the shared printers, Novell supplies us with some command line utilities found in the SYS:PUBLIC directory. Hope-

Using dBASE III+ and Clipper A86
Listing 1

```
**************************************************************
******Printctl procedure file, By Henry J. Franzoni III*******
******Controls Output Selection on Novell 286 Network. *******
******     Released into public domain 9/28/87   *******
**************************************************************
DO PRINTCTL
DO TESTLOOP
PROCEDURE PRINTCTL && Initialize, variables then run OUTPUT
SET SCOREBOARD OFF
SET CONFIRM OFF
SET SAFETY OFF
SET TALK OFF
SET UNIQ OFF
SET EXCL OFF
SET STATUS OFF
SET MENU OFF
SET BELL OFF
*
***************** Declarations for memory variables**********
*
PUBL CLIPPER,MSCOLO,OUTPUT,DUMMY1,DUMMY2,DUMMY3
PUBL USER,STA,ENLGON,ENLGOFF,SPLVAR,PRINTVAR,PAUSE
PUBL L1QON,L1QOFF,G1RAPHON,G1RAPHOFF,E1LITEON,E1LITEOFF
PUBL C1OMPRON,C1OMPROFF, LQON,LQOFF,GRAPHON,GRAPHOFF,ELITEON,
PUBL ELITEOFF,COMPRON,COMPROFF,FRAME
*
*******************Get Station number, user name*************
*
USER=GETE('USER')    && Used for Q command user delete option
STA=GETE('STA')      && Used for unique file name creation.
*STA=LTRIM(STR(STATION(),4,0)) && You could use this method
*         && instead for STA with Clipper
*            && and an assembler
*
********************Determine monitor attributes************
*
IF CLIPPER        && Clipper uses more video parameters
 MSCOLO=IIF (ISCOLOR(), 'GR+/B,W+/R,N+,,R/W','N/W,W/N,N,,I')
 ELSE
 MSCOLO=IIF (ISCOLOR(), 'GR+/B,W+/R,N+','N/W,W/N,N')
 ENDI
SET COLO TO &MSCOLO
CLEA
DO OUTPUT WITH DUMMY1,DUMMY2,DUMMY3
RETURN              && End of Printctl procedure
*
**************************************************************
PROC TESTLOOP
AGAIN=' '             && Test loop for Clipper version
DO WHIL AGAIN # 'E'
 DO ASK2 WITH 23,0,'(P)rintctl, (O)utput, o(N), of(F),
 form fee(D), (E)xit ','PONFDE',AGAIN
 DO CASE
  CASE AGAIN='P'        && This enables Clipper users to
   DO PRINTCTL         && try each procedure.
  CASE AGAIN='O'
   DO OUTPUT WITH 1,2,3   && Dummy parameters
  CASE AGAIN='N'
   DO PRINTON
  CASE AGAIN='F'
   DO PRINTOFF
  CASE AGAIN='D'
   DO FORMFEED
 ENDC
ENDD                 && End of test loop
RETU
**************************************************************
PROCEDURE OUTPUT
PARA W,X,Y && dummy parameters enable hot-key access, if de-
*  sired. DO OUTPUT WITH DUMMY1,DUMMY2,DUMMY3 in dBASE or
*  Clipper SET KEY 301 TO OUTPUT For Clipper Alt-X hot-key
*  only. Determines where output is going: Disk, Printer,
*  Screen, or Novell LAN printers connected to current
*  file server. Assumes a public character variable called
*  OUTPUT for other related procedures such as PrintOn,
*  PrintOff, and Printset
DO ASK2 WITH 22,0,'(P)rinter, (S)creen, (N)etwork, (D)isk',
'PNDS',OUTPUT
OUTPUT=UPPE(OUTPUT)
@ 23,0 CLEA
IF CLIPPER              && Clipper code first
 DO CASE
  CASE OUTPUT='P'        && Printer chosen
  SET PRINTER TO LPT1
 CASE OUTPUT='S'        && Screen chosen
  Pause=.F.
  @ 23,0 SAY 'Pause for each page (Y/N)? ' GET Pause
  READ
 CASE OUTPUT='D'        && Disk file chosen
  OUTPUT='D'
  File=space(20)
```

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1029 Solano Avenue, Berkeley, CA 94706 (415) 527-1157 Telex: 176609 fully you have Netware up and running at this point and have a directory named SYS:PUBLIC. The directory SYS:PUBLIC is "mapped" to a search drive with the Novell *Map* command, another Novell command line utility. (*Map* is the Novell equivalent of *Path* in DOS). For example, MAP S1=SYS:PUBLIC makes SYS:PUBLIC a search directory, which are the same as *Path* to directories in DOS. Usually, the first search drive is drive letter Z:. The DOS *Path* command will reflect changes made by the Novell *Map* command.

Typing *Map* alone will show you all the current drive mappings. *Map* as few directories as possible, especially search drives, since each additional mapped directory slows down your application.

Shared Printer Commands

Novell Advanced Netware 286 Version 2.0a, today's model Netware, offers *Nprint*, *Spool*, *Endspool*, and *Q* for programmers to control the shared network printers from the command line. Each of these has many options and flags that can be set. Examining the dBASE/Clipper program listing will reveal how we use the options. But just to make sure you get the idea, lets briefly outline these utilities.

The *Nprint* command will print disk files on any one of the five shared printers. This is Novell's complement to the DOS Print program. A typical example of its use would be:

```
NPRINT FILENAME.TXT /P0 NB C=2 FF
```

/P0 refers to printer 0, and *C=2* means print two copies. *FF* means add a form feed before and after the print job. *NB* means print No Banner. (If you leave *NB* out after any of the shared print commands, a huge banner is printed.) *FF* is the flag to add a form feed after the job.

The *Spool* command works a little differently than *Nprint*. This command reroutes data bound for one of the local printer ports to a temporary file. When the temporary file is completed, it is sent to the appropriate shared printer. It is either printed immediately or put in the print queue of pending print jobs for that printer. Up to one hundred jobs can be "put behind" each of the five shared printers. For example:

```
SPOOL LPT1: /P0 NB C=2 FF
```

is very similar to the *Nprint* example above. The difference is that *Nprint* wants a file name or names and *Spool* wants a printer port.

Endspool works hand in hand with *Spool*. It resets the printer port to its original routing, and it completes the temporary spool file and sends it on to be printed. *Endspool* C cancels the pending temporary file without printing it.

Q deals with the print queue. The queue is a list of pending print jobs "behind" each printer. *Q* can be used to delete pending jobs as well as to show the status of pending jobs.

The Program Listings

The procedure library, ARTICLE.PRG (Listing 2) runs under dBASE III+ and compiles under Clipper A86. The basic idea is that each routine builds strings for the *Spool*, *Endspool*, and *Q* commands to execute. The technique used has many applications. Macros are evaluated before sending a command line to the DOS interpreter. This is a useful fact because, as shown in the listing, it allows each command to have an associated string. There are

(Continued on page 54)

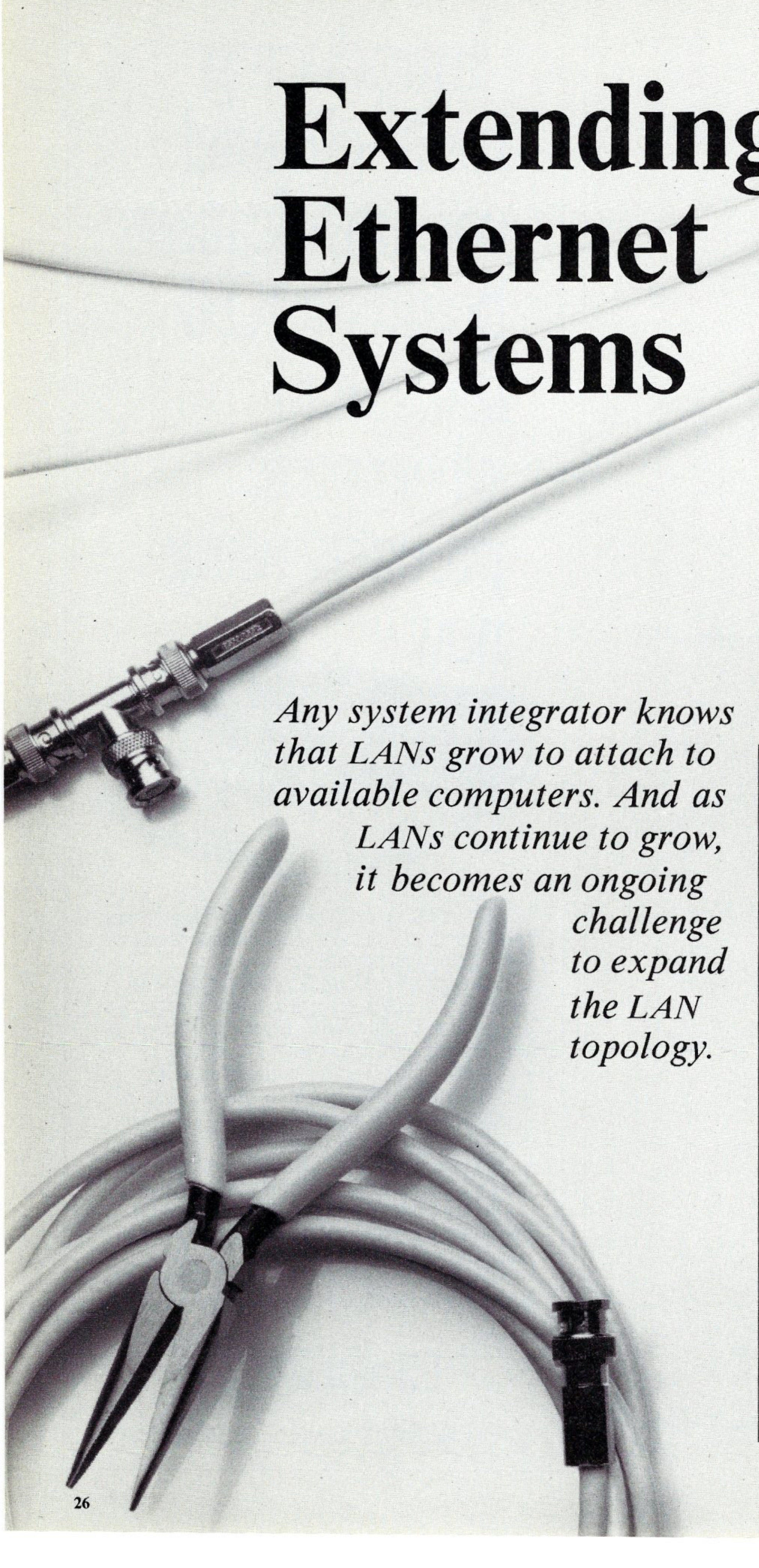
Using dBASE III+ and Clipper A86 Listing 1

```
   @ 23,0 SAY 'Enter drive/directory/file name: ' GET
   FILE PICT '@!'
   READ
    IF ! EMPTY(File)
     SET PRINTER TO &File
    ELSE
     OUTPUT='S'       && Default screen if no disk file
    ENDIF
  CASE OUTPUT='N'          && Network printers chosen
   SET PRINTER TO LPT1
   DO PRINTSET WITH 20,0
  ENDC
ELSE                      && dBASE III+ code next
  DO CASE
   CASE OUTPUT='P'         && Printer
   SET PRINTER TO
  CASE OUTPUT='S'          && Screen
   Pause=.F.
   @ 23,0 SAY 'Pause for each page (Y/N)? ' GET Pause
   READ
  CASE OUTPUT='D'          && Disk
   OUTPUT='D'
   File=space(20)
@ 23,0 SAY 'Enter drive/directory/file name: ' GET FILE
     PICT '@!'
   READ
    IF File # ' '
     SET ALTERNATE TO &File
    ELSE
     OUTPUT='S'
    ENDIF
  CASE OUTPUT='N'          && Network printers
   SET PRINTER TO
   DO PRINTSET WITH 20,0
  ENDC
ENDI
RETU
*****************************************************************
PROCEDURE PRINTON          && Turns output on
* Syntax:  DO PRINTON
*   Do this procedure after doing OUTPUT, instead of using
*   SET PRINT ON or SET DEVICE TO PRINT in your application.
*
IF TYPE('OUTPUT') = 'U'  && If Output undefined
 PUBLIC OUTPUT
 OUTPUT='S'
ENDIF
IF TYPE('OUTPUT') # 'C'  && If Output isn't a character string
 OUTPUT='S'
ENDIF
SET PRINT OFF
SET CONSOLE OFF
SET ALTERNATE OFF
 DO CASE
  CASE OUTPUT$'PN'   && If Output is a Printer or network
   IF CLIPPER       && If using clipper?
    IF ISPRINTER()  && Printer ready?
     SET PRINT ON
     SET DEVICE TO PRINT
    ELSE
     ?? chr(7)
     @ 0,0 SAY 'Hit any key when printer is ready/
  [Esc] for Screen output'
     key=inkey(0)
      DO WHILE Key#27 .AND. .NOT. ISPRINTER()
       KEY=INKEY(0)
      ENDDO
     IF Key=27
      SET CONS ON
      OUTPUT='S'
      Pause=.T.
      @ 23,0 SAY 'Pause for each page (Y/N)? ' GET Pause
      READ
      @ 23,0
     ENDIF
      @ 0,0
    ENDIF
   ELSE              && If using dBASE III+
    SET PRINT ON        && No check like Isprinter()
    SET DEVICE TO PRINT
   ENDI
  CASE OUTPUT='D'        && If Output is a disk file
    IF .NOT. CLIPPER     && If using dBASE III+
     SET ALTERNATE ON
    ELSE              && If using Clipper
     SET PRINT ON
     SET DEVICE TO PRINT
    ENDI
  OTHE
   SET CONSOLE ON
  ENDCASE
```

```
RETURN
*
PROCEDURE PRINTOFF          && Turns output off
* Do this procedure after doing procedures OUTPUT and PRINTON
* Use this instead of SET PRINT OFF and SET DEVICE TO SCREEN
* in your applications.
*
IF TYPE('OUTPUT') # 'C'
 OUTPUT='S'
ENDIF
IF OUTPUT='S'           && If output was to the screen
 WAIT
 @ 0,0 CLEA
ELSE                    && If output was anything else
 SET DEVICE TO SCREEN
 SET ALTERNATE OFF
 SET ALTERNATE TO
 SET PRINT OFF
 SET PRINTER TO
 SET CONS ON
ENDIF
IF OUTPUT='N'           && If output was the network
 @ 22,0 CLEA
 !ENDSPOOL
ENDI
OUTPUT='S'              && Output defaults to the screen
RETURN
*
PROCEDURE FORMFEED        && Issues appropriate form feed
DO CASE
CASE OUTPUT='S'          && Output is screen
 IF PAUSE
  DO CNTR WITH 'Hit a key'
  inkey(0)
 ENDIF
 CLEA
CASE OUTPUT = 'D'        && Output is disk file
 ?? chr(12)
CASE OUTPUT $ 'NP'       && Output is printer or network
 IF CLIPPER
  IF ISPRINTER()
   EJEC
  ENDI
 ELSE
  EJEC
 ENDI
ENDC
RETU
*
PROC PRINTSET           && network printer control program
PARA RR,CC           && control program
DO BLOCKCLR WITH RR,CC
STOR SPAC(10) TO PRINTVAR
STOR ' ' TO SPLVAR
DO PRNTCODE
 DO WHIL .T.
  DO ASK2 WITH RR,CC,'Printer: (0), (1), (2), (3), (4),
 (C)ancel, (S)pool, (Q)ueue, (E)xit ','CSQE01234',SPLVAR
    DO CASE
     CASE SPLVAR='S'       && Do Spooler setup
      DO SPOOL WITH RR,CC
     CASE SPLVAR='0'       && Spool printer 0
      @ 20,0 CLEA
      !SPOOL /P0 NB C=1
      EXIT
     CASE SPLVAR='1'       && Spool printer 1
      @ 20,0 CLEA
      !SPOOL /P1 NB C=1
      EXIT
     CASE SPLVAR='2'       && Spool printer 2
      @ 20,0 CLEA
      !SPOOL /P2 NB C=1
      EXIT
     CASE SPLVAR='3'       && Spool printer 3
      @ 20,0 CLEA
      !SPOOL /P3 NB C=1
      EXIT
     CASE SPLVAR='4'       && Spool printer 4
      @ 20,0 CLEA
      !SPOOL /P4 NB C=1
      EXIT
     CASE SPLVAR='Q'     && Setup Q options
      DO QUEUE WITH RR,CC
     CASE SPLVAR='C'     && Cancel jobs with Endspool
    && C or Q /D
      PRIV C1,C2,C3
      STOR ' ' TO C1
      DO ASK2 WITH RR+1,CC,'Delete (A)vailable jobs or
   (P)ending spooler job','AP',C1
       IF C1='P'
        @ RR,CC SAY ' '
```

source code continued on page 54

Extending Ethernet Systems



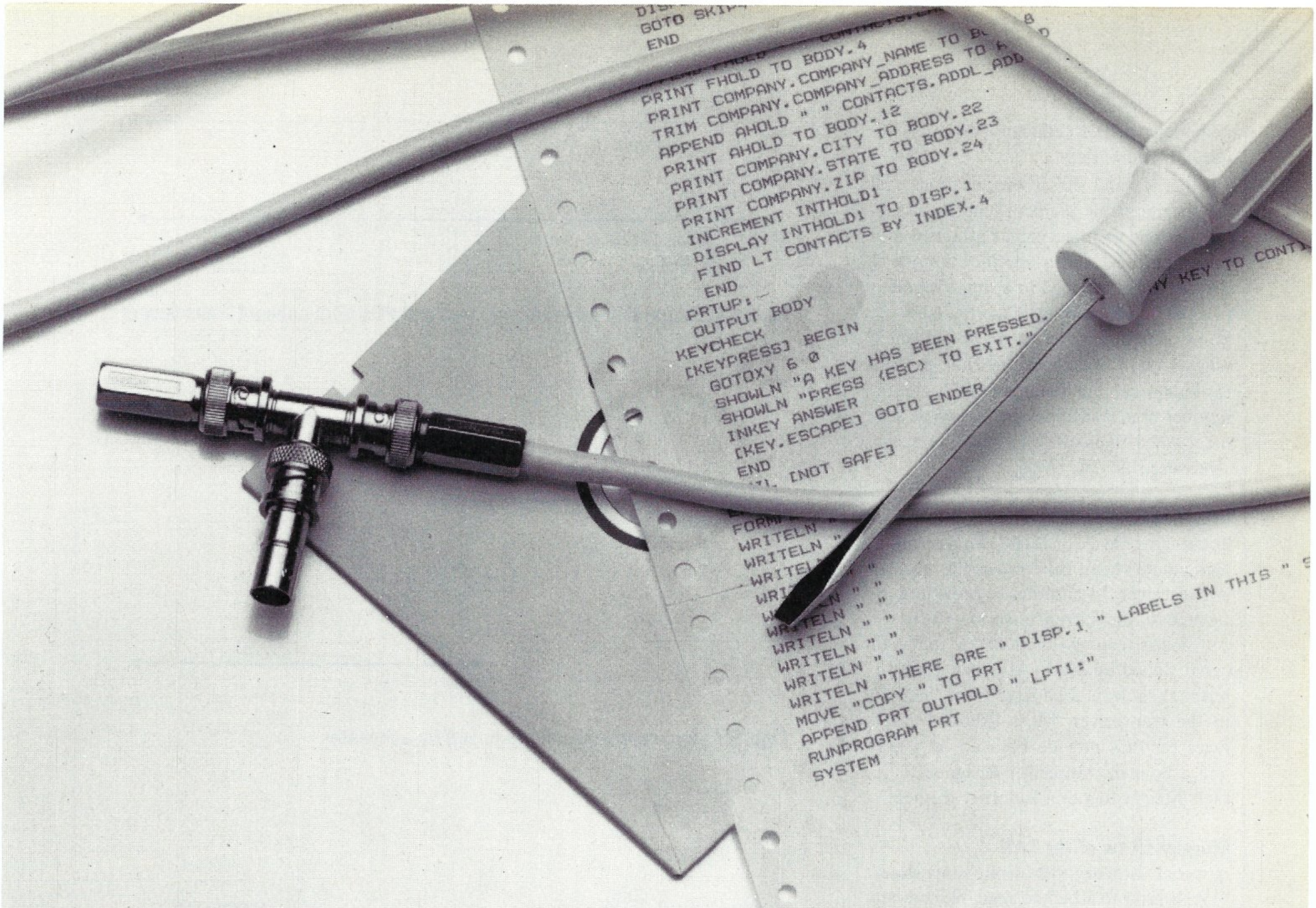
Any system integrator knows that LANs grow to attach to available computers. And as LANs continue to grow, it becomes an ongoing challenge to expand the LAN topology.

by Patrick H. Corrigan

Three years ago, a small-sized software company installed a PC Local Area Network for its product development division. As with many small PC LANs, this system was installed by the users—the product development group. This was an Ethernet system, using a single RG-58 "thin Ethernet" linear bus (Figure 1).

As the company became medium-sized, the product development group grew, along with its LAN. Eventually this medium-sized software company was acquired by a large software company. The LAN was moved and further expanded. Because the maximum distance of a single bus had been exceeded (the manufacturer of the LAN hardware, 3Com Corporation, specifies 300 meters as the maximum thin Ethernet segment length when 3Com components are exclusively used), a repeater was installed to extend the system. The system eventually grew to 80 users and approximately 600 meters, with each Ethernet segment approximately 300 meters long.

The linear bus had already grown sufficiently large to create additional problems. Fault diagnosis became increasingly difficult, and the strictly linear topology was becoming unwieldy. Because the ca-



pacity of the system was already being strained, and since another move was planned, the company decided to investigate cabling alternatives.

What is Ethernet?

Most people in the microcomputer world think of Ethernet as a network that must be cabled in a linear fashion (Figure 1). Although this is the simplest way to cable Ethernet, it is not the only way. Before we look at other approaches, however, let's cover the basics of Ethernet.

Ethernet is a widely supported local area network (LAN) system originally developed by Xerox Corporation. It is supported by many computer manufacturers, and interfaces are available for a wide range of minicomputers, microcomputers, mainframes, and peripherals. In addition, most popular LAN protocols and operating systems are supported on Ethernet.

Ethernet uses a contention scheme called Carrier Sense Multiple Access (CSMA) to allow multiple devices to access a transmission medium, usually cable. CSMA functions somewhat like a telephone party line—if the cable is free, a station can send a data packet; if the cable is busy, the station waits until the cable is free. It is possible, however, for more than one station to send data packets at the same time, creating a "data collision." Ethernet provides a means for sending stations to discern these collisions (called Collision Detection or CD, as in CSMA/CD) and resend data packets after a preset delay. Ethernet employs an algorithm that ensures that each station does not attempt to resend at the same interval thereby preventing a data collision.

Ethernet is a "bus" network. A bus network is a one-cable network in which all transmissions are broadcast across the entire LAN. Each device on a LAN must have a unique address, and each station or device selects only those transmissions that are specifically addressed to it and ignores all others.

There are actually several Ethernet standards. The first published specification, DEC/Intel/Xerox Ethernet Version 1.0, was released in 1980, followed by a revised Version 2.0 in 1982. In 1985, the IEEE issued the 802.3 specification for CSMA bus networks. Because of the differences between the specifications, a product adhering to one specification will usually operate on the same physical network as a product adhering to another, but they will not necessarily be able to communicate with each other.

Cable Types

Three types of cable are primarily used with Ethernet: (1) standard, thick Ethernet, a heavy coaxial cable roughly equivalent to RG-8; (2) thin Ethernet, sometimes called "Cheapernet" because of its lower cost, equivalent to RG-58; and (3) fiber optics.

Thick Ethernet is most commonly used in large networks of terminals and other devices, attaching them to minicomputers or mainframes. Thin Ethernet cable is primarily used in smaller LANs. Due to its ability to electrically isolate segments of a LAN, and its ability to serve more efficiently over greater distances than coax, fiber optic links are often used when networking between buildings. Also, because fiber optic cables do not radiate EMI emissions, they can be used in high-security environments. However, the cost of fiber and associated attachment devices is relatively high compared to coax.

In PC Ethernets, thin cable is used almost exclusively for two reasons: First, the cost of "Cheapernet" is more in line with microcomputer system costs. Second, most Ethernet interfaces for PCs have built-in transceivers (a transceiver is required to attach a device to an Ethernet cable) that attach directly to thin Ethernet. Vendors of Ethernet products for PCs have done little to educate customers regarding alternatives.

Ethernet and 802.3 specifications call for specific cable segment lengths (a segment is one or more cables attached in a linear fashion) and a specific number of devices to be attached to a single segment (see the box describing "Ethernet Rules"). Some vendors, however, have published non-standard specifications that provide for longer cabling distances and a greater number of attached devices per cable segment when their own products are exclusively used.

Ethernet Connections

To attach a device or DTE (Data Terminal Equipment) to an Ethernet cable, we need a transceiver. In addition to providing attachment points, transceivers perform the collision-detection functions. A four-pair cable, called an AUI (Attached Unit Interface) cable, is used to connect the DTE to the transceiver. Most Ethernet interfaces for PCs provide both an AUI port and a built-in transceiver designed to attach directly to a thin Ethernet segment.

Murphy's Law of the LAN

A recent corollary to Murphy's law states, "LANs grow to attach to available computers." An even more recent corollary states, "Computers appear on empty desks, thus promoting LAN growth even further." Therefore, in large companies, small LANs can become big LANs very quickly.

Linear Tyranny

A linear bus topology is very efficient and effective for small LAN systems. A single cable connecting a small number of microcomputers in a small office is cost-effective, easy to install, and easy to maintain. However, as LAN systems grow, the limitations of linear bus systems quickly become apparent. Distance considerations aside, as systems grow, it becomes difficult to snake a single cable through multiple offices and multiple floors of a building.

Because all signals are broadcast across an entire Ethernet network, a problem at one location can be manifested at another. With a linear system, problem resolution is similar to dealing with old-fashioned serial Christmas tree lights—check every device until you find the bad one. With 10 stations on a LAN this can be frustrating; with a hundred it can be disastrous.

Other Cabling Options

Actually, Ethernet provides an extremely wide selection of cabling options. With the

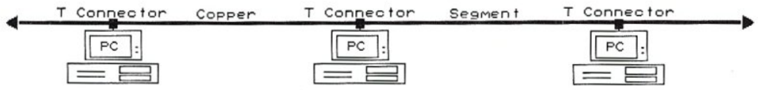


Figure 1. Single thin ethernet segment and PCs with onboard transceivers

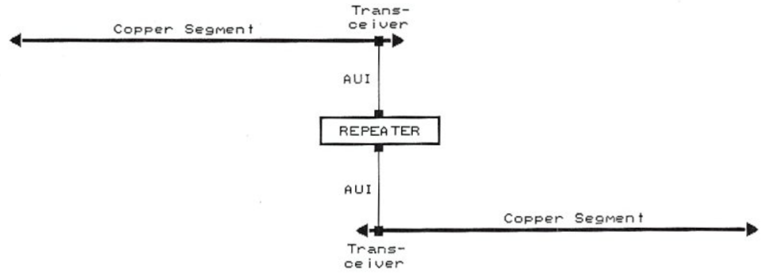


Figure 2. Two copper segments linked by a repeater

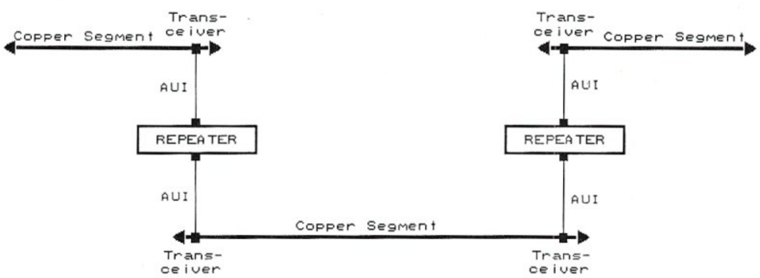


Figure 3. Three copper segments linked by repeaters

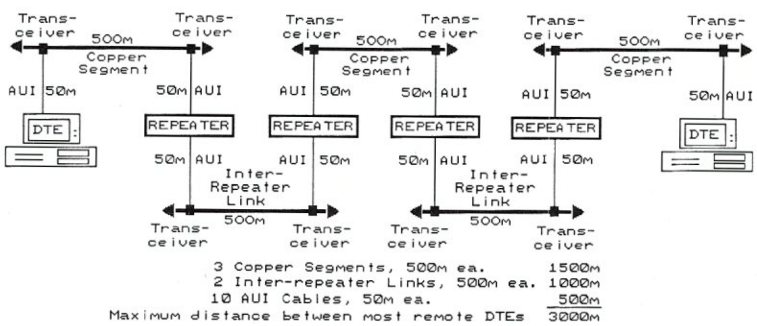


Figure 4. Three copper segments with repeaters and inter-repeater links maximum linear ethernet topology (standard thick ethernet)

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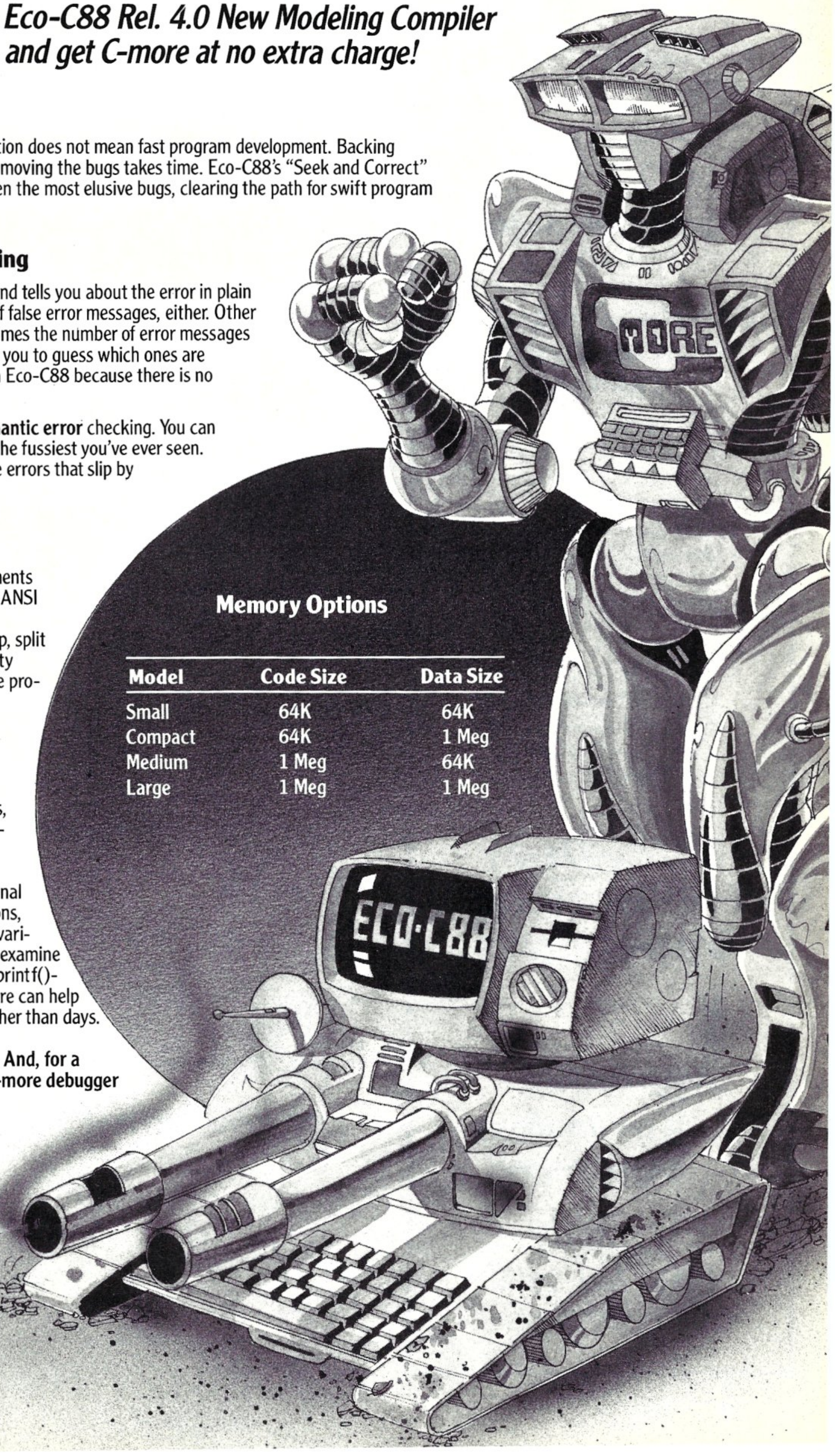

Memory Options

Model	Code Size	Data Size
Small	64K	64K
Compact	64K	1 Meg
Medium	1 Meg	64K
Large	1 Meg	1 Meg

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Ethernet Rules

1. No segment should be longer than 500 meters (185 meters for thin Ethernet, 1 kilometer for fiber).
2. There should be no more than 100 connections (transceivers) per segment (30 for thin Ethernet).
3. There should be no more than three copper segments in series.
4. The maximum length of any single series path must not exceed three active copper segments and two inter-repeater links.

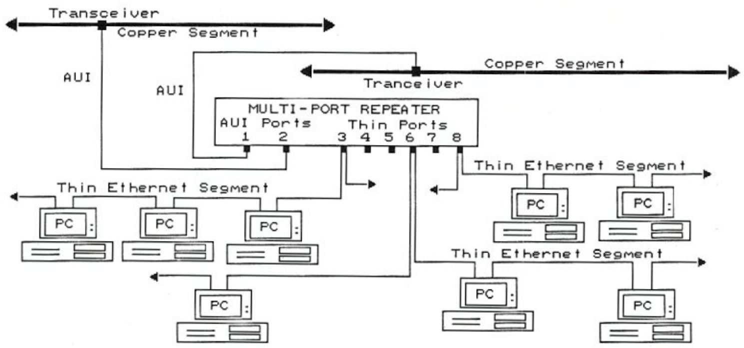

Figure 5. Multi-port repeater

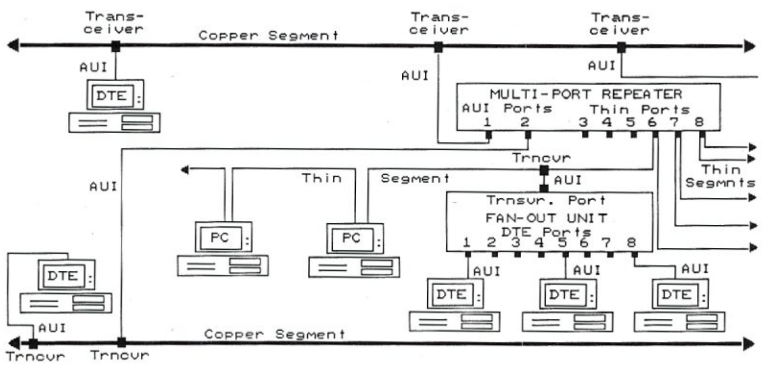

Figure 6. Two copper segments with multi-port repeater and fan-out unit

5. Both ends of a copper segment must be terminated with a 50-ohm terminator.
6. Transceivers must be placed at a minimum interval of 2.5 meters along a copper segment (0.5 meters for thin Ethernet).
7. Every copper segment must be grounded at only one point.
8. It is allowable to mix thin Ethernet segments with standard Ethernet and fiber optic segments using repeaters.

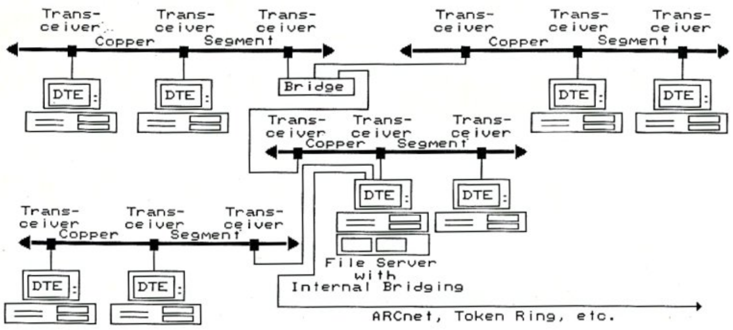

Figure 7. Multiple networks with bridges

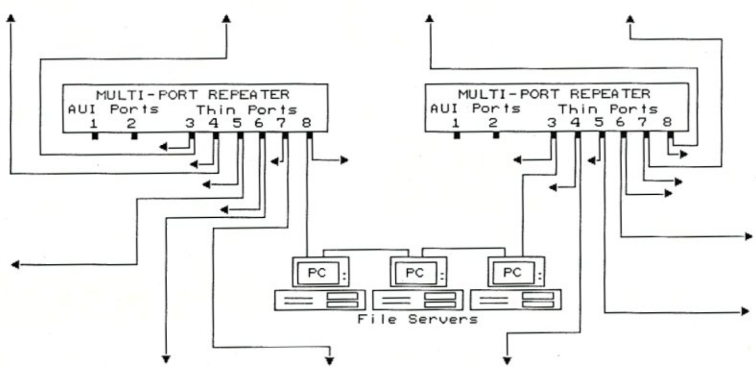

Figure 8. Two multi-port repeaters with thin ethernet

use of repeaters, multi-port repeaters, and fan-out units, the size and capacity of an Ethernet can be dramatically increased. In addition, multiple LANs may often be connected together using LAN bridges.

Repeaters

The first way that we can extend Ethernet is with repeaters (Figure 2). Repeaters amplify signals from one cable segment, passing those signals to another segment without changing the data. By using repeaters we can greatly increase our overall cable length. Up to three Ethernet segments can be daisy-chained using repeaters. In addition, we can add to the overall length of the Ethernet by using up to two passive inter-repeater links (Figure 3).

Multiple Paths

At first glance, it would appear that our Ethernet cabling scheme is limited to a linear topology that can be extended by using repeaters and cable segments in a strictly linear fashion. However, our Ethernet rule #4 (see box) refers to the maximum length of any single series path. The real trick to extending Ethernet is creating multiple series paths. With Ethernet, we can create parallel paths to extend our Ethernet cabling. As long any single path does not exceed the maximum cable length, we stay within the specifications.

There are several ways to create multiple paths. One way is to attach multiple repeaters to a "backbone" Ethernet cable. Any number of repeaters can be attached to a cable segment, up to the maximum number of allowable transceivers (Figure 4). Repeaters usually provide for automatic partitioning of faulty segments, thus simplifying troubleshooting and problem resolution.

Multi-port Repeaters

Another way is to use a multi-port repeater. This is a repeater that allows the attachment of more than two cable segments. A multi-port repeater supplied by BICC Data Networks, for example, has two AUI ports to attach to transceivers, and six ports to attach directly to thin Ethernet. Like standard repeaters, multi-port repeaters may be used in parallel, and also provide automatic partitioning (Figure 5).

Fan-Out Units

Ethernet rules limit the number of attachments to a cable segment. Each transceiver, including built-in transceivers on PC interfaces, is considered to be an attachment. We can still expand the number of attached devices, however, by using fan-out units (Figure 6).

A fan-out unit attaches to a single transceiver using an AUI cable and acts as a transceiver multiplexer, allowing up to eight devices (DTEs) to be attached. It can provide for more economical use of an Ethernet cable, and remove the necessity to "snake" cable into an area where a large number of units are to be connected. Fan-out units can be cascaded two-deep, allowing up to 64 attachments to a single transceiver. Fan-out units effectively allow Ethernet to be cabled as a star or multiple star clusters, and can be used as stand-alone units, without being connected to an Ethernet cable.

Bridges

Another way to extend LANs is with the use of LAN bridges. Unlike repeaters which amplify and broadcast all LAN traffic, bridges only transmit those packets that need to cross the bridge. This means that traffic and collisions on a single LAN section can be effectively reduced. Some bridges even allow two or more dissimilar LANs to be connected (Figure 7).

Bridges can be either specialized devices or software running on micro- or minicomputers. Some PC network operating systems, such as Novell's Netware and Banyan's VINES, provide bridging functions within the file server software. In addition, remote bridges are available to link systems together via phone lines, microwave links, and satellite.

Unlike repeaters, bridges are usually protocol specific. This means that only certain protocols or LAN operating systems are supported by a particular bridge. Ethernet users should be particularly careful of the Ethernet version supported by a particular bridge. In addition, bridges will generally induce some delay in the process of moving packets from one LAN to another.

Deciding on the Right LAN Configuration

Because the development team at our client company did not want to be limited to a particular protocol or LAN operating system, bridges were ruled out. In addition, the decision was made to adhere to the standard Ethernet cabling rules. This meant that the maximum length of any thin Ethernet segment would be 185 meters instead of 300. By doing this, Ethernet components from multiple vendors could be effectively employed in the system.

The new system includes two thin

Ethernet multi-port repeaters manufactured by BICC Data Networks. Each multi-port repeater has six thin Ethernet ports, complete with built-in transceivers, and two AUI ports. This allows the system to be cabled as two interconnected star clusters. Because the multi-port repeaters automatically partition faulty segments system, fault diagnosis has been simplified. By strategically attaching the file servers (i.e., PCs used for data storage and network control) to the link between the repeaters, fault tolerance has been increased and system down-time has been reduced (Figure 8).

By working within the Ethernet standards, maximum flexibility for future enhancement and expansion has been assured. §

Patrick H. Corrigan is a partner in The Corrigan Group—Information Services located in Larkspur California, an independent consulting firm specializing in the fields of local area networking, data communications, and office automation.

Glossary

- **AUI Cable**—Attached Unit Interface cable, a four-twisted-pair cable that connects a network device to a transceiver.
- **"Cheapernet"**—A slang term referring to thin Ethernet cable, or RG-58A/U coaxial cable. It is called Cheapernet because of its low cost in comparison with standard Ethernet cable. Thin Ethernet cable is widely used in PC LANs.
- **Copper Segment**—an Ethernet coaxial bus.
- **DTE**—Stands for Data Terminal Equipment. Refers to a terminal, PC, or other device attached to the LAN.
- **Fan-Out Unit**—A device that attaches to an Ethernet transceiver to allow multiple devices (DTEs) to attach to the transceiver in a star-cluster fashion.
- **IRL**—Inter-Repeater Link. This is a passive copper (or fiber) segment with no active devices (DTEs) are attached.
- **Multi-port Repeater**—A repeater that attaches multiple Ethernet segments.
- **Repeater**—Amplifies and regenerates signals, thus allowing multiple Ethernet segments to be attached together.
- **Transceiver**—Device to attach to Ethernet cable (usually built in on PC Ethernet boards).

Product Information

Banyan Systems Inc.
115 Flanders Rd.
Westboro, MA 01581
(617) 898-1000

BICC Data Networks Inc.
47061 Warm Springs Blvd.
Fremont, CA 94539
(415) 490-8000

Novell Inc.
122 East 1700 South
Provo, UT 84601
(801) 379-5900

3Com
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Santa Clara, CA 95052
(408) 562-6400

The StarLAN Local Area Network

by Michael K. Guttman

StarLAN is a local area networking system originally developed by AT&T as a simple, low-cost alternative to more traditional networking products such as Ethernet. Although AT&T has not had much success marketing StarLAN directly, it has begun to license its StarLAN technology to other vendors, including some in the PC market.

One such third party is Western Digital (WD), the well-known manufacturer of PC disk controllers, which has recently begun to diversify into a number of other PC product lines. WD is the first third-party vendor to introduce a StarLAN-compatible line of products for the PC. (Quadram has since announced a similar product line, but hasn't shipped any product as of this writing.) This review covers all of WD's currently available StarLAN products.

How Does StarLAN Work?

With StarLAN, devices are hooked together with ordinary twisted-pair telephone wire into a star configuration around a passive hub, which in turn can be tied to other hubs to make a higher-level star (see Figure 1).

The use of such a simple architecture and media means that StarLAN is limited in performance. In fact, StarLAN operates at data transfer rates of only 1 megabit per second compared, for example, to 10 Mbits for Ethernet or 4 Mbits for IBM's Token-Ring. However, in situations where speed is not a major issue, StarLAN can save a bundle in both hardware and installation costs.

Unlike other low-cost networking alternatives that are strictly proprietary, StarLAN boasts not only an AT&T pedigree but acceptance as an IEEE standard (802.3) as well. This means that prospective buyers can assume that StarLAN support from a variety of vendors is likely to be around for some time. In fact, WD itself sells versions of its PC interface and StarLAN controller chips to other hardware vendors and system integrators, allowing them to create their own StarLAN-compatible products.

Western Digital's StarLAN

Western Digital provided us with a review package consisting of five PC interface boards and a 10-station passive hub. WD also provided three software options, including a NetBIOS emulator for each workstation, an eight-user Novell Advanced Netware package, and five copies of its own ViaNet networking software.

The WD StarLAN PC interface boards, or StarCards, actually come in three varieties: the generic StarCard, the StarCard Plus, and the StarLink. All versions of this board will fit into any half- or full-sized PC expansion bus slot.

StarCard Plus is a high-performance version of StarCard that uses on-board buffering and a dual-porting scheme to effectively increase data throughput between the PC and the network. StarCard Plus is primarily intended for use at network bottlenecks, such as server stations, but could be used to improve performance at any network station.

StarLink is a board combining a StarCard workstation interface and a miniature two-station passive hub; in effect, one of the two hubs is used by the host workstation, and the other is available to be linked to another workstation. Unfortunately, a StarLink Plus board is not yet available, so StarLink stations must now make do with ordinary StarCard performance.

The regular 10-station passive hub is known as a StarHub. The StarHub is a little over a foot long and about half as wide and comes with its own power adapter. It also includes a set of installation brackets designed to attach the hub to a wall, desk, or other support.

WD's StarLAN is configured by connecting workstations (PCs with StarCards) to one or more StarHubs or StarLinks. The StarHubs and StarLinks themselves may be connected to other hubs or links, giving either a star-of-stars or a daisy-chain configuration at any level.

There appear to be only two limitations to the ability to connect hubs: (1) A direct connection between any two components may not exceed 800 feet; and (2) No more than 10 levels of hubs can be daisy-chained in a single run. Based on these limitations, it would theoretically be possible to construct a network extending over as much as 16,000 feet (8,000 feet in each direction from the very top node or header hub) and encompassing hundreds or even thousands of workstations.

This 10-level feature also applies to StarLink cards. For example, as many as 21 workstations could be networked by

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Supports all commercial grade C compilers. Requires 128K memory. Version 4.1F.

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List $1500 Reg $1184 **Sale $998**

Use the Lattice dBC III Plus library of functions to write fast C language programs to create, access and update files that are compatible with Ashton-Tate's dBASE III PLUS database management system. dBC III Plus is network ready with functions that solve complicated network database problems. These functions let you lock files or records automatically or manually, prevent you from accidentally locking files or records that are already locked, and allow you to test whether files or records are locked or free. You can share your ISAM files with as many stations as are possible on your network.

Specify compiler (current version): Borland Turbo C, Lattice C, or Microsoft C. Requires 128K memory. Version 1.0.

SoftCraft

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Btrieve is a keyed, indexed file management system for use with most programming languages. Btrieve allows a file structure with: record length up to 4K bytes (64K in some environments); up to 24 different keys per file; maximum key size of 255 bytes; a maximum file size of over 4 billion bytes; and file size limited only by physical storage capacity and operating system limitations. Duplicate, modifiable, null and segmented keys are allowed and there is no limit to the number of files open at one time. Written in 8088 assembly language for maximum efficiency, Btrieve uses extensive cache buffering to optimize performance and pre-imaging to automatically recover damaged files. Transaction bracketing and automatic record locking allow you to guarantee the integrity of your data files despite the concurrency problems that arise in a network. The optional Xtrieve is a menu-driven query system that enables Btrieve users to access Btrieve files without writing a program. The Report Option for Xtrieve allows you to easily generate reports.

Specify single-user or multi-user/network version. For multi- user/network version, specify environment: 3Com3plus; IBM TopView; Microsoft Windows; Multilink Advanced; MPOS; Novell Advanced NetWare; XENIX System V/AT; or satellite or server-based IBM PC Network. Btrieve supports most language compilers and interpreters. Requires hard disk and 128K memory (Btrieve routines use 32K). Version 4.10.

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daisy-chaining StarLinks from PC to PC. A more typical set-up would utilize ordinary StarHubs and StarCards for closely clustered workstations while supporting workstations on the physical periphery with StarLink extensions (see Figure 2).

Hardware Installation

Compared with these heady possibilities, our test network was rather modest. Our five-station main testing configuration included three users hooked to a StarHub, with one of the connections daisy-chained via StarLinks to two other users. Therefore, of the five users, two had StarLinks and three had StarCards, one of which was a StarCard Plus.

Each of the StarLAN components came complete with 25 feet of eight-wire telephone cable, an installation manual, and, except for the StarHub, a NetBIOS emulator package. Installation consisted of inserting each interface board into its PC, connecting the StarHub to an ordinary 110-volt power outlet, and running the supplied cable between the workstations and the hub. The cable connects to each component with telephone-style (RJ-45) modular clips and jacks.

We did encounter some minor problems in installation. First, we soon discovered that 25 feet of cable can actually be quite short if it has to be wrapped around walls and doors and under furniture in order to make a connection in another room. Another 10 to 15 feet would have made a lot of difference. In one case we were barely able to connect two adjacent rooms, and in another case we had to run cable across a busy room, which would hardly be acceptable for a permanent installation. What was even more frustrating was that WD does not sell extension cables or connectors separately, and they could not recommend a supplier for such items.

Furthermore, when we called several electronics supply houses to see if they had more cabling available, we had no luck at all. Most suppliers didn't even recognize the components by the specifications cited in the manual. Finally, one of the WD technicians gave us the name of the company's own supplier, but even they didn't have any premade cabling in stock.

Eventually we just gave up and decided to make do with our existing cable. This incident left us wondering, however, how other users are likely to respond when they discover that their network configuration plans may have to be scrapped for want of a few feet of cable. Presumably, WD dealers will just have to line up their own suppliers for cabling.

Another minor problem we encountered concerned the use of the StarCard or StarLink boards with PCs and XTs. The StarCard comes preconfigured for an AT, using DMA channel 3 for transmission. The manual insists that this must be changed to DMA channel 2 for PCs and XTs, a change that requires removing a jumper from the board. The StarCard Plus requires no modification for either ATs or PCs. The explanation for the change is buried in the installation manual, but it is clearly illustrated once you find it. Fortunately, we found the reference and changed jumpers because, shortly after getting our reviewer's package, we received an urgent technical bulletin from WD reiterating the problem and claiming that dire consequences might befall our disk drive if we didn't use the proper setting. Apparently WD will soon be shipping a version of StarCard that, like StarCard Plus, will operate on any kind of PC without modification.

Once installed, we experienced absolutely no problems with the network hardware, even after changing the configuration several times. We found that all combinations worked equally well and appeared to have no effect on the network's performance.

For those with special configuration or compatibility problems, WD provides a number of other jumper options, including the ability to change the Software Interrupt Request Channel, the Direct Memory Access Channels, the I/O Base Address Selection, the Board Interrupt Request Channel Selection, and the BIOS ROM Address Selection. Our documentation included a list of compatibility specifications for about 60 different PCs, most of which were completely compatible with StarCard and StarLink. Nearly all the exceptions lacked two available DMA channels for transmit and receive.

Software

Western Digital effectively offers three network software choices. It sells its own software, ViaNet; it sells Novell Netware; and it supplies a NetBIOS emulator designed to allow a variety of other third-party software to operate on the network. Although we received all three options

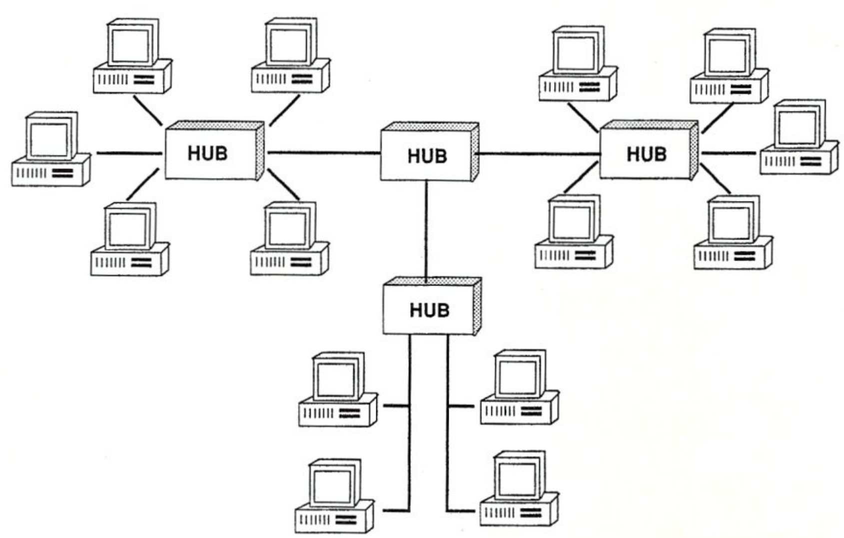

Figure 1. Classic StarLAN Configuration

with our review package, we only had time (and space) to evaluate one. Because it is a proprietary product and unlikely to be reviewed elsewhere, we concentrated our attention on ViaNet.

ViaNet's appeal is that it has a relatively low entry cost ($140 per workstation) and allows a great deal of configuration flexibility. Under ViaNet, all users essentially operate as peers and, potentially, have the capability to access any of each other's resources. This creates some interesting possibilities not available with other networking software systems, such as Novell's, which creates distinctions between servers and ordinary workstations.

For example, we were easily able to configure ViaNet so that every workstation could access all other stations' local drives, including the floppy drives. In one case, we used this capability as a convenient way to create DSDD floppies from our ATs by directly accessing the floppy drive on a PC. This eliminated the need to find a machine with both types of drives.

We were also able to shuffle around available hard disk space at will by giving a group of users direct access to each other's machines. This proved very useful when one member of the group ran out of disk space during a project; he was able to continue by creating new subdirectories for himself on another machine with more space.

ViaNet achieves this flexibility through the use of a virtual DOS drive Z:, which has mappings to all users. When a user (let's call her Sarah) boots the ViaNet software, her user name is entered into a system table. From then on, every other user has access to a virtual directory Z:\SARAH\, of which Z:\SARAH\C\ is Sarah's drive C, Z:\SARAH\B\ is Sarah's drive B, and so on.

ViaNet takes this scheme to its logical conclusion—any one user can even access another user's virtual disk drive, e.g. Z:\SARAH\D\. In fact, a user's own drives are accessible to him through this redirection scheme as well; for example, Z:\SARAH\C\ is the same as C:\ to Sarah herself, a feature that can prove useful in setting up batch files and path names.

While this totally egalitarian system can sometimes be very convenient, it would not be very practical in many situations. Fortunately, ViaNet also offers a variety of options that create group names, user names, and passwords to prevent inappropriate access to restricted files and devices. While ViaNet's security is not as sophisticated as, for example, Novell's system, it would be sufficient on many small networks.

ViaNet also includes a spooler system called ViaSpool. Once ViaSpool is initiated for any particular workstation, that workstation's printer can be accessed by any other authorized user. A disadvantage to ViaSpool is that, like ViaNet itself, it is a memory-resident program that consumes memory. Also, ViaNet does not allow the use of the ordinary DOS PRINT utility; you must install ViaSpool and use the VIAPRINT command to achieve equivalent functionality to PRINT.

With the exception of the VIAPRINT command, which provides a menu-driven configuration program, all user interface to ViaNet is through commands and parameters entered directly at the DOS prompt. This type of interface has the advantage of allowing all ViaNet operations to be invoked from batch files, but also means that users have to learn a new set of commands in a cumbersome DOS-like syntax. It would be a big improvement if ViaNet would also provide a universal, menu-driven, control program that could be invoked with a single command or hot key.

We did not attempt to benchmark ViaNet, but it appeared to perform ably. Accessing someone else's hard disk was obviously not achieved as quickly as accessing one's own disk, but it was a lot faster than the floppy-like speeds we have observed on some networks. We soon became quite comfortable with working off each other's drives. Also, ViaNet appears to do a certain amount of caching. For example, we observed that our second access to a remote directory operated much more quickly than our first access to the same directory.

ViaNet showed no problem in interleaving disk device requests. It appears to place all device requests at about the same priority, so a workstation being accessed remotely occasionally suspends local operation to service the requester. Since ViaNet performed data transfers quickly, however, such interruptions never seemed onerous.

We liked ViaNet because it doesn't demand dedicating or depending on a server

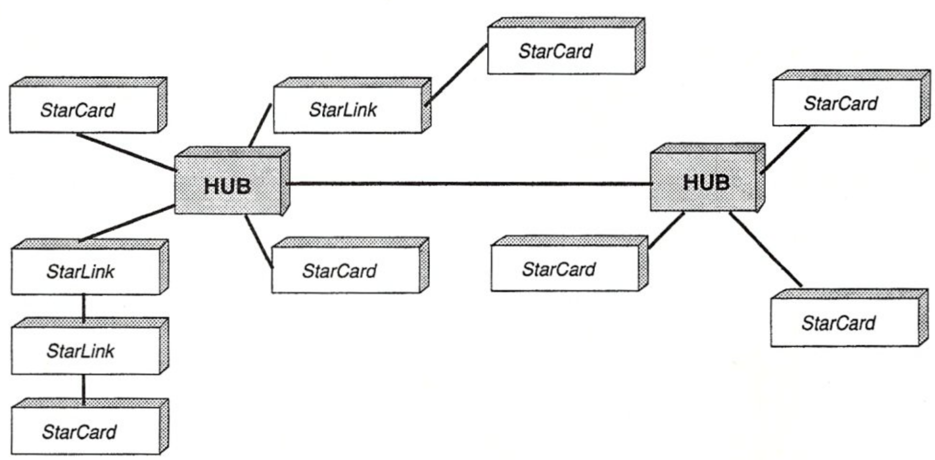

Figure 2. Typical Western Digital StarLAN Office Configuration

and because its resource-sharing system is so forthright and flexible. However, as currently released, the product still has some rough edges.

For example, the main ViaNet software module apparently hard-codes the names of the configuration files and subdirectories it needs, and the installation procedure offers no way to change this. It also hard-codes the virtual drive letter Z:. We found this very annoying when we used Microsoft Windows, which dutifully generated icons for drives A-Z in the MS-DOS Executive window.

Furthermore, the lack of a convenient command utility is compounded by poor organization and some glaring omissions in the user's manual. For example, we were unable to figure out how to set up a spooler. When we called WD's technical support staff (who were quite helpful), they admitted that it was virtually impossible to figure this out from the manual. Fortunately, they were able to talk us through the process. They also promised that a major manual update was underway.

Finally, we were also very disappointed to find that the configuration procedure involves editing ordinary text files with a word processor. Although this procedure doesn't pose any problem for experienced programmers (in fact, it's almost a convenience), it is far too easy for new users to corrupt their configuration files, and far too much to expect them to figure out the cryptic configuration syntax required.

ViaNet achieves its flexibility through the use of a virtual DOS drive Z:, which has mappings to all users.

Pricing and Value

Western Digital's StarCard has a suggested retail price of $249; the StarCard Plus lists for $299; the 10-port StarHub is $495; and the minihub StarLink is $349. On the software side, Western Digital provides IBM PC NetBIOS emulation software free with each StarCard or StarLink. WD also sells two versions of Novell's Advanced Netware for its network—$1,595 for Netware/86 ($795 for up to eight workstations) and $2,195 for Netware/286. ViaNet is $140 per workstation.

Considering that distributor pricing is typically about half of list price, WD's hardware products should be quite attractive to both dealers and users alike. The products appear to operate reliably, and they are easy and cheap to install (except that additional cabling is often needed).

In price, ViaNet is reasonable, although after five or six nodes, it actually becomes cheaper to buy an eight-user network license for Novell Netware, a far more capable and mature networking system. However, distributors and dealers will be able to get much better price breaks from WD for ViaNet than from Novell for Netware, so ViaNet may remain an attractive alternative even for larger systems. §

Michael Guttman is a senior member of Morrisey Associates, a Chicago-area software development and consulting group.

The Alloy PC-Plus Network

by A. L. Bender, M.D.

A High-Performance LAN System

The Alloy PC-Plus local area network (LAN) system combines hardware and software in a wheel-like configuration. The hub is an IBM PC/XT or PC/AT server-host with a high-capacity, fast-access, hard disk drive.

The spokes of the wheel are Alloy Computer Products PC-Slave/16 cards (called "slaves"), which function as a complete PC when plugged into a PC bus with the proper software loaded into the host PC. Up to 31 slave cards can be installed. Each slave board draws a hefty 2.5 amps, so be sure each PC can support the power requirements. The host PC may also be used as a workstation.

The Alloy QICSTOR-Plus or QICSTOR functions with the host. Either unit contains a hard disk and streaming tape controller card as well as a large (40 to 390 megabyte) hard disk and a 60-Mbyte streaming tape backup unit. The QICSTOR-Plus also contains an expansion bus that will accommodate five slave cards and an XI interface card to connect the expansion bus to a HI interface card in the host PC bus. A short, thick cable connects the two interface cards by means of a 62-pin connector. The QICSTOR plugs into an empty slot on the PC bus. The Alloy expansion bus differs from the PC bus in that it does not provide a −5-volt line.

For networks which require more than five or six slave cards, Alloy offers a 12-slot expansion bus called an XBUS. These hardware devices are contained in cases similar in height and width to the IBM PC but of greater depth. Each expansion bus can be connected to the PC or to another expansion bus by means of HI and XI cards. The QICSTOR-Plus, XBUS, and QICSTOR each contain a heavy-duty switching power supply as well as two cooling fans. The noise level is high, with most of the noise coming from the hard disk drive, but it is not objectionable.

PC-Slave/16 Cards

Each slave card contains an NEC V-20 processor chip, a display UART, a serial port UART, and one megabyte of dynamic RAM (usually, 512K is assigned to the processor). The remaining 512K can be configured as disk cache or, using a new software release, as RAM disk. The memory assignment is selectable via jumpers or switches on each slave card. Memory in the current slave board is not parity checked, but a new revision of slave boards is expected to have parity-checked memory. Some older slave boards have less than one megabyte of memory, but these boards are no longer being made.

Memory chip timing is critical. Motorola 41256 chips will work on the current boards while OKI chips of the same type may not. Older boards use the Intel 8088 while the new boards use the NEC V-20. The V-20 calculates addresses faster and uses less power than the older 8088 chip. It also looks like an 80188 to your software and can run 8080 programs as well.

Every slave board has a serial I/O port configured as COM2. The interrupt line for the port is IRQ3. An optional piggyback 8087 chip and carrier board can be connected to the slave. Interrupts are handled by an on-board 8259 interrupt controller chip.

A nine-pin connector on each slave card connects the board's display UART to a serial display terminal and keyboard. Although a wide variety of terminals is supported, only the Kimtron KT-7/PC, Link 125, and Alloy PCST/C terminals support all the display modes of the IBM PC monochrome display adapter.

I found that the terminal functioned well in RS-232 mode up to 300 feet from the slave card. However, Alloy suggests a maximum distance of 50 feet. For distances up to 1,000 feet, the serial RS-232 output can be used to drive a current loop adapter. Longer runs can be made by inserting an optoisolator repeater circuit into the current loop. Communication be-

tween the terminal and the slave occurs serially at 19,200 baud. The display terminal and keyboard can be omitted if the slave will be performing some task that does not require a keyboard/display. Data can be written without adverse effects to a display screen even if it doesn't exist.

The Kimtron, Link, and Alloy terminals all send IBM PC keyboard scan codes to the display port, and special escape sequences make it possible for these terminals to run software that ordinarily depend on IBM PC display hardware. A good rule to keep in mind when writing software for the PC+ Network is, "If it will run on an IBM PC with a monochrome adapter, it will run on the PC+."

System Software

The network software for the PC+ system is called NTNX. Earlier versions of NTNX, including RTNX, the earliest version; ATNX, a more advanced RTNX; and MTNX, a multiple-terminal, single-user system useful for program development, are still available.

NTNX allows the user to make Novell Netware calls within the Alloy system. To use the Novell Netware calls on earlier versions of the Alloy slave boards, you must change some PAL chips. Revision E4 and later boards all contain the new PAL chips. The older disk/tape controller cards in the QICSTOR and QICSTOR-Plus may also need to have a PROM changed to allow NTNX to run properly. The newer PROM does streaming tape operations with DMA while the older PROM did disk operations on the DMA channel. According to Alloy, the newer PROM corrects some undisclosed, secret problems and should be used even at the expense of slower disk operations.

Installation

When you first receive your hardware you must do a hardware format of your disk. The program that does this, APF, formats and partitions the disk. If you are going to use your system with the Novell Netware calls, you will need to use a different hardware format procedure than the one you would use if you were going to use the MS-DOS Network. The Novell formatting procedure is very slow. Once the disk has been formatted, you must decide how to partition it; how many volumes will be shared by all users (each user is a slave card; the host can be another user); how big these volumes will be; and what sort of record or file locking will be used.

Next you configure your network by running the configuration program, NXCNFG. This program customizes the network to meet your system's needs. It decides on parameters for each user, chooses between the cache and RAM disk, decides how many slaves the system will have, and, in general, factors not dependent on hard disk formatting and partitioning. The system is then installed by rebooting to link the network drivers to the device driver chain.

Now comes the moment of truth. If your system boots and you can read and write every disk volume, you did everything correctly. You will not have to run APF again unless you want to make a low-level change in the disk partitioning.

Up to 31 users and the host can share files on two disk volumes . . . Free space on shared volumes is partitioned equally among the users when the network executive is loaded.

Once the system is up, you execute NTNX on the host, and the slave cards undergo a memory and facilities check. When the test is completed, each slave receives its own copy of the network executive interface, a display driver consistent with the display connected to it (information from NXCNFG), a copy of a specially modified COMMAND.COM called COMMAND.SLV, and a modified copy of MS-DOS. Each slave may have its own CONFIG and AUTOEXEC files. The file extension for these files is *Unn* where *nn* is 01 to 31. To illusrate, when slave 1 is brought up by the network executive, CONFIG.U01 is examined, and when slave 3 is started, AUTOEXEC.U03 is executed.

Operation

Up to 31 users and the host can share files on two disk volumes. Users may have other disk volumes that they alone can use, while still other volumes may be attached and released by any user who needs them. Free space on shared volumes is partitioned equally among the users when the network executive is loaded. A system program can dynamically alter this allocation scheme. When an unshared facility is put into use, it is locked so other users cannot attach that facility and use it. A shared facility that remains locked but unused for prolonged periods does not "time-out." In other words, it does not become available just because it was not used for a prolonged period. Facilities such as printers or floppy disks are usually not shared, and the system printer is normally used by a print spooling program.

Disk volumes can be hidden so other users will not know of their existence. Passwords also may be attached to files so that the contents are encrypted and scrambled beyond recognition. The Orchid PCnet-compatible record locking is supported if you do not elect to use the Novell Netware. Both records and files can be locked, and any application attempting to read a locked file is terminated.

Slaves do not perform disk I/O directly. Rather such requests are passed to the host to be carried out. When a file is printed during the usual course of program operation, nothing actually prints. The output is captured and may later be spooled to the printer. Any file can be spooled to the printer as well. If the system crashes during spooling, the print files can be recovered and reprinted or deleted—a not unimportant feature. The spool program can use parallel or serial printers on a variety of different ports. Files may also be printed on a serial device connected to a slave COM2 port, or they may be passed through the display terminal to that terminal's local serial port.

Each slave board has a unique user number that is set by switches on the board. Other switches or jumpers set the memory size, the base address of the slave board, and, if the board should use hardware interrupts in communication with the host PC, it sets those as well. Each slave is polled about 293 times per second to see if there is a request for the host PC to provide access to system resources. The host processor also may be used as a workstation. Hence, interrupts may be disabled by the software that is currently executing. What's more, NTNX uses polling in addition to interrupt requests to service the user slaves. Each slave board has a common "broadcast" address that allows all slaves to "listen" to a broadcast from the host. In addition, the unique address of each board is a combination of the base port address and the user number.

Many networks not only require that data be transferred between files and various distributed users, but also require a facility to transfer information from one terminal to another. Frequently, such information is quite low-level: Messages such as Artie asking Rachel (via their terminals) to lunch. The Alloy software supports not only this form of communication but also datagramming.

A datagram is a packet of information that can be transferred at the program level from one user to another, from one user to all users, from host to users, or from users to host. Datagramming, program interface to the spooler, and many other useful features are available in the optional Advanced Programming Kit or APK. This is a software product that exploits the network executive.

Performance

While the host PC can be used as a workstation, I do not recommend it. If there are more than seven slaves and extensive disk activity, you will degrade system performance. I have used five slaves and the host in a program that makes heavy use of the disk without finding any significant change in system performance. However, in another system with 21 users, using the host as a workstation interfered with performance during periods when there were greater demands on disk access.

On systems that use the slaves as a processor for a bulletin board, where most of the slave processing is servicing the COM2 port and reading or writing a few blocks of data to and from the disk, it is possible to use the host as a workstation. However, I would not use the host's async port to service a modem due to the interaction with disk transfers. Ring interrupts from a modem cause the slave board to reboot. An AUTOEXEC file can be used to start up the bulletin board program for the current caller.

General Comments

I have been using an Alloy system for about nine months. In general, the hardware is reliable. Most of Alloy's problems have been solved and I feel that the system offers a low-cost, high-performance, star-type LAN. When the hardware is installed, be certain that a competent electrician prepares the site wiring. There should be no "floating" grounds and you should use an uninterruptible power source (UPS) to ensure data integrity. If you have problems with your system after installation, start by checking the electrical outlets first.

Alloy's quality control consists of a few hours of burn-in and a hardware confidence test. In my view, this kind of quality control rates as only fair. I have received boards that do not work right out of the box. I recommend purchasing equipment from a reputable dealer who is thoroughly familiar with Alloy. You need someone who can get action for you when you have problems. For this same reason, never buy any Alloy products by mail or from discounters. Generally, discount and mail-order outlets do not have people who will "go to bat" for you with the manufacturer.

Once your hardware has been up and running for more than 40 hours, you can be assured it will probably remain reliable for a long time.

Alloy's software is very good, and NTNX is generally reliable. However, telephone calls to Alloy about NTNX's bizarre behavior with redirected files have sometimes resulted in the response, "That's a known bug." Also, usually, fixes cure problems without causing others. QTIP, the tape backup program, is fast, menu-driven, and easy-to-use. However, one bug in QTIP does cause the program to fail, making it hard to use under certain circumstances. TIPTOK can be used to make backups automatically on a regular basis, but I have not used this program so I cannot report any first hand experiences. I can recommend the Alloy hardware and software to anyone wishing to install a star LAN for high performance at low cost. Documentation of the Alloy hardware and software is quite good, and a bulletin-board hotline is available for communicating with other Alloy users. Nationwide hardware service for all Alloy products also is available from Bunker-Ramo Corporation at (800) 556-0065. §

A. L. Bender is a physician specializing in neurology. He also has more than 26 years of computer experience and does hardware and software computer consulting.

Product Information

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Framingham, MA 01701-9990
(617) 875-6100

A Hardware Breakout Switch for PC-DOS's DEBUG

by Alex Cameron

Breaking out of PC-DOS' DEBUG is not hard to do. In the September 1986 issue of *Byte*, Edward Batutis went some way to supply a break-out feature to DEBUG by using the keyboard to initiate a trap. However, as he stated in his article, the keyboard is often not the best way of breaking out of DEBUG since the keyboard interrupt can be disabled so easily. Notwithstanding this, it is inevitable that some other resident program will use the same keystrokes to perform some other function. It is far better to generate a non-maskable interrupt (NMI), which is what most advanced debuggers do. This normally means that it is unlikely that the debugger can now be locked out, unless the NMI is disabled through hardware.

There are two features that have been incorporated into BREAKNMI to assist the programmer, and to make BREAKNMI more useful. The first displays the current Code Segment and Instruction Pointer (CS:IP) values at the top right of the screen. The second prompts the user as to whether or not the NMI interrupt was taken while within either DOS or ROM. (DOS is defined as the region below the CS value associated with BREAKNMI while ROM is any CS value above 0A000H.) An essential ingredient in any good debugger is the requirement to not crash when encountering a break point within non re-entrant code (see *M/SJ*, September/October 1986). Without major modification to DEBUG's internals, this is not a simple task, so BREAKNMI settles for a simple DOS or ROM prompt and inhibits any breakout when a breakpoint within either DOS or ROM is detected. A READY prompt informs the user that the NMI is enabled and that any previous DOS or ROM lock has been removed.

How NMI Works

A NMI may be generated at any time by the system hardware. Within the PC it is used to signal a catastrophic event such as a power failure or a memory parity check. The PC/XT BIOS will, as a rule, process the NMI and attempt to determine what type of event caused it. The most common cause of this type of interrupt is a memory parity error, when BIOS generates the familar PARITY CHECK (????) message and then HALTs the PC.

The schematics in the IBM PC/XT Technical Reference manual indicate that a NMI may also be generated by the signal I/O CHCK. This signal pin is part of the PC's expansion bus (pin A1), and primarily is designed to allow peripheral cards to activate a NMI. The I/O CHCK signal forms one of the inputs to a R/S flip flop, the other being ENABLE/IOCK. Provided the NMI hardware is not disabled (by writing a 00H to Port 0A0H) and the ENABLE/IOCK is active low, then pulling I/O CHCK low will bring the NMI line active high.

BREAKNMI's Internals

BREAKNMI works in a similar fashion to BREAKPT in so far as it is made resident by using the DOS Interrupt 27H function, and uses bit 8 of the 8088's trap flag within the status register. It is installed in similar fashion to BREAKPT by typing BREAKNMI at the DOS prompt and then using DEBUG to execute the program to be debugged. Pressing the breakout switch will invoke BREAKNMI which then outputs the standard register dump along with the disassembled code of the location at which the breakpoint was activated.

When BREAKNMI is entered, a comparison is made of the current value of the Code Segment (CS) register against the value of the CS register which is on the stack. If the values are identical, it is assumed the BREAKNMI has been recursively re-entered due to the inability of the hardware to adequately debounce the I/O CHCK line. If this check were not made it is conceivable the stack would overflow, and corrupt the program being debugged.

The label NM0 is the entry point for first-time processing, where a reasonably high priority is given to disabling the NMI and IO/ENABLE lines so that the NMI signal is driven low. Checks are now made on CS to catch any breakpoints emanating from either the DOS or ROM environment. If either of these tests are true, the STATUS_FLAG is set to the appropriate value to both allow the routine STATUS_LINE to display the message on the status line and to bypass the setting of the 8088's trap flag (bit 8).

Following this, a check is made on the value of the keyboard interrupt vector. If it has a different value to that required to enter BREAKNMI, then it is patched with the correct segment and offset values. Hopefully this ensures that any program which fiddles with INT 9 cannot prevent a return to BREAKNMI. Fi-

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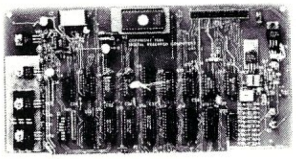

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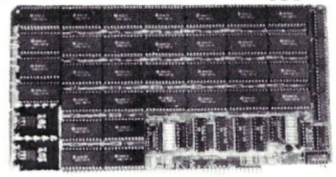

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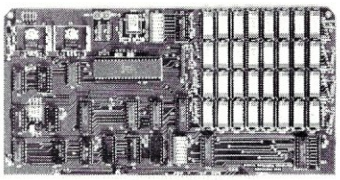

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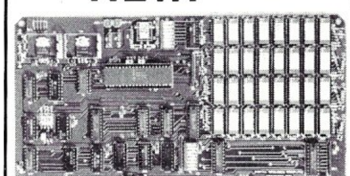

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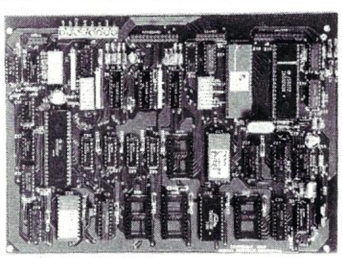

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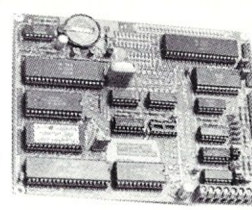

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WE ARE NOT ASSOCIATED WITH DIGITAL RESEARCH INC. (CALIF.) THE SUPPLIERS OF CPM SOFTWARE nally, the trap flag is set by ORubg 0100H against the 8088's status flag, which is on the stack. (The I/O address map and PPI 8255 I/O bit map are presented in Section 1 of the IBM PC/XT Technical Reference manual.)

The important thing to notice here is that the initial NMI processing does not attempt to clear the NMI line by resetting the I/O CHCK flip flop. This is due primarily to the fact that there is no elegant way to achieve a fast response time and, at the same time, try to determine when the I/O CHCK line has ceased to bounce up and down. Premature resetting could result in false traces as well as losing the capability to initiate any other breakpoints. The method chosen here to overcome this problem is to wait until DEBUG has finished its trace dump to the screen. At this point, DEBUG prompts the user for keyboard input and sufficient time has elapsed to allow the I/O CHCK line to stabilize. As the keyboard interrupt (INT 9) has been redirected to point into BREAKNMI, striking any key allows BREAKNMI to reinitialize the NMI control signals.

To allow the current values of the CS:IP registers to be monitored, BREAKNMI gains access to the system program by diverting the TIME_OF_DAY interrupt (INT 8) to point to the routine NEW_INT8. Reprogramming the 8253 timer 0 interrupt interval allows us to monitor CS:IP at a faster rate than the normal BIOS default value would allow. However, to maintain the original TIME_OF_DAY interval and function, the routine OLD_INT8 is called every time the value of NO_OF_TICKS is reached. Displaying the CS:IP pair is straightforward and simply involves pulling the CS and IP values off the stack, converting them to a HEX value, and placing them on the status line by calling the routine STATUS_LINE.

Installing a Breakout Switch

A simple method of pulling the I/O CHCK (pin A1) signal line low is to solder a push-button switch to one end of a short length of coaxial cable, with the center conductor of the other end connected to pin A1 of the expansion bus, while the ground side of the coax is connected to a ground point on the PC. The center connector may be held in place by wedging it between the fingers of the peripheral edge connector and the socket. The location of pin A1 of the expansion bus is shown in Listing 1.

If the breakout switch is to be used extensively, then a better solution would be to purchase a short prototyping board which, with the breakout cable fitted, could be placed out of the way in slot 8. This card could contain isolation and debouncing circuitry.

Conclusion

This PC modification is not for the faint-hearted, and when installing the breakout switch great care should be exercised so the wrong pin is not grounded. However, once BREAKNMI and the breakout switch are installed, you will discover DEBUG can be a powerful debugging tool. §

Alex Cameron is a Lieutenant Commander in the Royal Australian Navy (RAN) and is currently stationed at the Defense Research Centre, in South Australia. He has a Master's degree in Engineering Science and is currently working on Australia's OTHR program.

Hardware Breakout Switch for PC-DOS's DEBUG
Listing 1

```
; BREAKNMI: A PROGRAM TO PROVIDE A HARDWARE BREAKOUT FOR DEBUG.
; By Alex Cameron 1987.
;
; Reference E.Batutis, BYTE September 1986.
;
; Overview:
;   BREAKNMI allows DEBUG to work with NMI hardware assisted
; interrupt. In addition, BREAKNMI assists user by displaying
; status line at top right of screen showing current CS:IP values
; along with indication of internal state of BREAKNMI. BREAKNMI
; state refers to whether NMI interrupt is enabled , shown as
; 'READY', whether a breakout was attempted while in DOS and
; lastly whether breakout was attempted while in ROM. Last two
; conditions, if not detected would crash DEBUG. In DOS, ROM
; state may be cleared by pressing any key on keyboard.
;
; To build:
;         masm breaknmi;
;         link breaknmi;
;         exe2bin breaknmi breaknmi.com
; To run:
;create batch file with
; breaknmi
; debug
;
;------------------------------------------------------------
-
;
CSEG   SEGMENT   PARA  PUBLIC 'CODE'
    ASSUME   CS:CSEG, DS:CSEG, ES:CSEG
    ORG      0100H; FOR COM FILE
;
BREAKNMI    PROC
;
JMPINSTALL
;
; EQUATES AREA
;
PPI_61  EQU061H; PPI 8255 PORT PB0
NMI_PORT EQU0A0H; NMI CONTROL PORT
NO_OF_TICKSEQU1
INT9_OFFSEQU   9*4; INT9 LOCATION IN LOW MEMORY
INT9_SEG     EQU   INT9_OFFS+2
DOSEQU18; DOS MESSAGE OFFSET
ROMEQU36; ROM MESSAGE OFFSET
;
; SEGMENT AND OFFSET SAVE AREA
;
OLD_INT9_VECTORLABEL  DWORD
OLD_INT9_OFFS  DW    ?
OLD_INT9_SEG   DW    ?
OLD_INT8_VECTORLABEL  DWORD
OLD_INT8_OFFS  DW    ?
OLD_INT8_SEG   DW ?
;
; SYSTEM VARIABLES
;
TICK_COUNTERDB0
COLCTRDB0; ROW AND COLUMN COUNTER
ROWCTRDB0
ROWCURDB0; SAVED CURSOR POSITION STORAGE
COLCURDB0
COUNTDB0; CHARACTER OUTPUT COUNT
DPAGEDB0
HEXTABDB'0123456789'; HEX CONVERSION TABLE
DB'ABCDEF'
STATUS_FLAGDB0; BREAKNMI STATUS FLAG
;
; STATUS LINE DATA
;
CSIPLABELWORD
DB0,0,0,0,':',0,0,0,0,' READY '
DB0,0,0,0,':',0,0,0,0,' IN DOS '
DB0,0,0,0,':',0,0,0,0,' IN ROM '
;
;-------------------------------------------------------
; PROCESSS NMI INTERRUPT HERE
;-------------------------------------------------------
NEW_INT2:
PUSH  AX              ; SAVE REGISTERS
    PUSH  BX
PUSHCX
PUSHDX
PUSHSI
PUSHDI
PUSHDS
PUSHES
MOV AX,CS; PROVIDE ACCESS TO DS SEGMENT
MOV DS,AX
     MOV   BX,SP            ; GET STACK POINTER
     MOV   AX,SS:[BX+18]       ; AND RECOVER CS REGISTER
```

continued

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Hardware Breakout Switch for PC-DOS's DEBUG
Listing 1—Continued

```
      MOV   BX,CS
CMPAX,BX; HAS NMI BEEN RE-ENTERED
      JNZ   NMO              ; WITHIN THIS INTERRUPT ROUTINE?
MOV   BX,SP             ; IF YES RETURN TO TO NMI
      AND   SS:[BX+20],0FEFFH    ; MAKE SURE TRAP BIT IS OFF
JMPT2
NM0:  MOVSTATUS_FLAG,0; INITIALISE TRACE FLAG
JBENM1; CHECK FOR CS WITHIN DOS
CMP AX,0A000H; AND FOR CS IN ROM AREAS
JBE  DO_NMI; IF NEITHER ENTER OKAY TO BREAK
MOVSTATUS_FLAG,ROM; CAUGHT IN ROM - SET UP MESSAGE
JMPDO_NMI
NM1:MOVSTATUS_FLAG,DOS; SET UP IN DOS MESSAGE
DO_NMI: MOV   AL,0
      OUT   NMI_PORT,AL        ; DISABLE NMI LINE TO 8088
;
; GRAB KEYBOARD INTERRUPT (INT 9) AND REDIRECT KEYBOARD ENTRY INTO
; BREAKNMI IN CASE ANY OTHER RESIDENT PROGRAMME HAS ALTERED ITS VALUE.
      XOR   AX,AX
      MOV   ES,AX              ; SEGMENT 0
      MOV   BX,WORD PTR ES:INT9_OFFS ; FETCH KEYBOARD VECTOR VALUES
      MOV   AX,WORD PTR ES:INT9_SEG
      CMP   BX,OFFSET NEW_INT9     ; ARE WE ALREADY INSTALLED
      JE    TRAP               ; YES, THEN JUST CONTINUE

      MOV   WORD PTR OLD_INT9_OFFS,BX ; SAVE KEYBOARD INTERRUPT
      MOV   WORD PTR OLD_INT9_SEG,AX  ; ADDRESS
;
; SET PC's KEYBOARD INTERRUPT TO POINT TO NEW_INT9
      MOV   WORD PTR ES:INT9_OFFS,OFFSET NEW_INT9
      MOV   WORD PTR ES:INT9_SEG,CS
;
; NOW TURN ON TRAP FLAG BY SETTING TRAP BIT IN
; FLAGS REGISTER WHICH IS ON STACK.
TRAP:
MOVBX,SP
CMPSTATUS_FLAG,0; BREAK IF IN USER AREA ONLY
JNZT2
      OR    SS:[BX+20],0100H     ; TURN TRAP BIT ON
T2:POPES; SAVE REGISTERS AND RETURN
POPDS
POPDI
POPSI
POPDX
POPCX
POP   BX
      POP   AX
IRET
;
;-----------------------------------------------------
; KEYBOARD INTERRUPT (INT 9) USED TO FORCE DEBUG TO RETURN TO
; BREAKNMI' TO ALLOW NMI SYSTEM HARDWARE TO BE RE-ENABLED.
; ATTEMPTING TO ENABLE NMI ON FLY WILL CAUSE PROBLEMS DUE TO
; DIFFICULTY IN DETERMINING WHEN ' I/
O CH CK' LINE HAS STABILIZED.
; THIS ROUTINE ALSO CLEARS REGION PROMPT ON STATUS LINE.
;-----------------------------------------------------
NEW_INT9:
    PUSHF                   ; SIMULATE AN INTERRUPT
    CALL   CS:OLD_INT9_VECTOR    ; TO THE OLD KEYBOARD ROUTINE
;
; ENABLE NMI AND PARITY CHECK HARDWARE
PUSH  AX
MOV   AL,0
      OUT   NMI_PORT,AL        ; DISABLE NMI LINE TO 8088
      IN    AL,PPI_61         ; GET PB0 SETTINGS
      OR    AL,00110000B        ; AND TURN OFF I/O CHCK BIT
      OUT   PPI_61,AL
IN    AL,PPI_61          ; GET CURRENT PB0 STATUS
      AND   AL,11001111B        ; CLEAR RELEVANT BITS
      OUT   PPI_61,AL         ; SEND BYTE TO PPI
      MOV   AL,80H            ; MSB ENABLES NMI LINE
      OUT   NMI_PORT,AL         ; DO IT
      POP   AX
MOVCS:STATUS_FLAG,0; SHOW WE'RE READY
      IRET                  ; BACK TO DEBUG
;
;-----------------------------------------------------
; OLD TIME OF DAY INTERRUPT HAS BEEN RE-VECTORED TO ENTER THIS
; ROUTINE.  STATUS LINE WILL ONLY BE UPDATED ONCE TICK_COUNTER
; EQUALS NO_OF_TICKS.  EVERY OTHER TIME OLD INTERRUPT IS CALLED.
;-----------------------------------------------------
NEW_INT8PROCNEAR
;
CMPCS:TICK_COUNTER,NO_OF_TICKS
JNZINT8_01
MOVCS:TICK_COUNTER,0
PUSHF
CALLCS:OLD_INT8_VECTOR; PERFORM ORIGINAL INT 8
INT8_01:
INCCS:TICK_COUNTER
```

```
PUSHAX
     PUSH  BX
PUSHCX
PUSHDX
PUSHSI
PUSHDI
PUSHDS
PUSHES
MOV AX,CS; PROVIDE ACCESS TO DS AND
MOV DS,AX; ES
MOVES,AX
     MOV   BX,SP              ; GET STACK POINTER
MOV ES,AX
     MOV  DX,SS:[BX+18]        ; AND RECOVER CS REGISTER
LEA   AX,CSIP
ADDAL,[STATUS_FLAG]; POINT TO STATUS DATA
MOV DI,AX; FOR AXTOHEX ROUTINE
MOVSI,AX; FOR STATUS_LINE ROUTINE
MOV AX,DX; DATA TO BE CONVERTED
     CALLAX2HEX; CONVERT CS
MOVBX,SP
MOVDX,SS:[BX+16]; RECOVER IP
     LEA   AX,CSIP
ADDAL,[STATUS_FLAG]
ADDAL,5; JUMP OVER ':'
MOV DI,AX
MOV AX,DX
CALL AX2HEX; CONVERT IP
MOVCL,18; NO OF CHARACTER ON STATUS LINE
CALLSTATUS_LINE; OUTPUT CURRENT CS:IP
MOV AL,20H; SEND EOI TO 8259
OUT 20H,AL
POPES
POPDS
POPDI
POPSI
POPDX
POPCX
POPBX
POP AX
IRET
NEW_INT8 ENDP
;
; ROUTINE TO CONVERT REGISTER AX TO HEX
AX2HEXPROC    NEAR
     CLD; SET DIRECTION
     MOV    BX,OFFSET HEXTAB; HEX TRANSLAT TABLE
     MOV    CX,4; LOOP COUNT
HEX_1:ROL    AX,1
     ROL    AX,1
     ROL    AX,1
     ROL    AX,1
     MOV    DX,AX
     AND    AL,0FH; ISOLATE NIBBLE
     XLAT
     STOSB
     MOV    AX,DX
     LOOP    HEX_1
RET
AX2HEX ENDP
;
;--------------------------------------------------------
; PRINT CS:IP STATUS LINE AT TOP RIGHT OF SCREEN
;--------------------------------------------------------
STATUS_LINE PROC NEAR
;
MOVCOUNT,CL
CALLSCRN_ATTR; SAVE CURRETN SCREEN ATTRIBUTES
MOVCOLCTR,62; STATUS LINE COLUMN POSITION
MOVROWCTR,0; STATUS LINE ROW POSITION
MESS2:
CALLMOVE_CURSOR; POSITION CURSOR
MOVAL,[SI]; GET CHARACTER
CALLPUT_CHAR; AND PLACE AT CURSOR
INCSI
INCCOLCTR
DECCOUNT
JNZMESS2
CALLRESTORE_CURSOR
RET
STATUS_LINEENDP
;
; RESTORE OLD CURSOR POSTION AFTER STATUS LINE DISPLAY
RESTORE_CURSOR PROC NEAR
MOVAH,02H
MOVBH,DPAGE
MOVDH,ROWCUR
MOVDL,COLCUR
INT10H
RET
RESTORE_CURSOR ENDP
```

continued

Hardware Breakout Switch for PC-DOS's DEBUG
Listing 1 — continued

```
;
; GET CURRENT PAGE AND VIDEO AND CURSOR ATTRIBUTES
SCRN_ATTR PROCNEAR
MOVAH,0FH
INT10H
MOVDPAGE,BH
MOVAH,03H
MOVBH,DPAGE
INT10H
MOVCOLCUR,DL
MOVROWCUR,DH
RET
SCRN_ATTR ENDP
;
; PUT CHARACTER AT CURRENT CURSER POSITION
PUT_CHAR PROCNEAR
MOVAH,09H
MOVBH,DPAGE
MOVBL,4EH; YELLOW ON RED BACKGROUND
MOVCX,1
INT10H
RET
PUT_CHAR ENDP
;
; PROCEDURE TO POSITION CURSER
MOVE_CURSOR PROCNEAR
MOVAH,02
MOVBH,DPAGE
MOVDH,ROWCTR
MOVDL,COLCTR
INT10H
RET
MOVE_CURSOR ENDP
END_OF_RESIDENT_CODE   LABEL  BYTE
;
;-------------------------------------------------------
; INSTALL NEW INTERRUPT VECTORS FOR INT2,INT8 AND INT9
; AND MAKE BREAKNMI RESIDENT.
;-------------------------------------------------------
INSTALL:
     MOV   AH,35H        ; GET INTERRUPT VECTOR
     MOV   AL,2
     INT   21H
;
     CMP   BX,OFFSET NEW_INT2    ; ARE WE ALREADY INSTALLED
     JE    NO_INSTALL         ; YES, THEN JUST EXIT
     MOV   DX,OFFSET BANNER     ; PRINT BANNER
     MOV   AH,9              ; PRINT STRING FUNCTION
     INT   21H
;
; SET NMI INTERRUPT TO POINT TO NEW_INT2
     MOV   AH,25H            ; SET INTERRUPT FUNCTION
     MOV   AL,2
     MOV   DX,OFFSET NEW_INT2    ; POINT TO NEW ROUTINE
     INT   21H
;
;  REPROGRAM TIMER, REPLACE TIME_OF_DAY
;  INTERRUPT AND SAVE OLD INTERRUPT 8
CLI
MOVAL,36H; SET TIMER PARAMETERS
OUT43H,AL; TIMER 0, MODE 3
MOVBX,0FFFFH; TIMER COUNT
MOVAL,BL
OUT40H,AL
MOVAL,BH
OUT40H,AL
MOV   AH,35H; GET INTERRUPT VECTOR FUNCTION
     MOV   AL,08H
     INT   21H
MOVOLD_INT8_OFFS,BX; SAVE OLD INT_8 SEGMENT+OFFSET
MOVOLD_INT8_SEG,ES
MOVAH,25H; INSTALL OUR INT_8
MOVAL,08H;
MOVDX,OFFSET NEW_INT8
INT21H
STI
;
; SAVE OLD KEYBOARD INTERRUPT VECTORS AND
; REPLACE WITH NEW VALUES
MOVAH,35H; DOS FUNCTION TO GET OLD VECTOR
MOV AL,09H
INT21H
MOVOLD_INT9_OFFS,BX; SAVE OLD SEGMENT AND OFFSET
MOVOLD_INT9_SEG,ES
MOVAH,25H; SET NEW KEYBOARD VECTOR
MOVAL,09H;
MOVDX,OFFSET NEW_INT9;
INT21H
;
; TERMINATE, BUT STAY PARTIALLY RESIDENT , SO POINT
; TO LAST BYTE OF RESIDENT ROUTINES+1
```

(Continued from page 24)
differences in the ways that dBASE III+ and Clipper print to a file, and this should be clear from the program listing.

The procedures assume that two environmental variables exist: STA and USER. Slight changes to the code will substitute the *station( )* function for the STA environmental variable. This is documented in the listing.

Running The Programs

With dBASE III+, first SET PROCEDURE TO ARTICLE-.PRG, then DO PRINTCTL. The PRINTCTL program has one extra line of code to make it DO OUTPUT. Later, you may wish to remove this line and maintain PRINTCTL and OUTPUT as separate procedures. They are linked here for demonstration purposes only.

Next, the procedures PRINTON and PRINTOFF are replacements for the commands SET PRINT ON, SET DEVICE TO SCREEN, SET PRINTER TO, SET ALTERNATE ON, etc. Once the OUTPUT program has run, DO PRINTON and DO PRINTOFF will turn the selected output device on and off, including the network printers. These routines are designed to be called just before printing, and just after printing. DO FORMFEED will put a formfeed in any output.

Clipper users can just compile ARTICLE.PRG and run Article from the DOS prompt. You then can run PRINTCTL, OUTPUT, PRINTON, PRINTOFF, and FORMFEED from the handy test menu. Remember to link EXTENDA.OBJ and EXTENDC.OBJ at link time. For example, the commands:

```
CLIPPER ARTICLE
PLINK86 FI ARTICLE,EXTENDA,EXTENDC LIB CLIPPER
```

ought to take care of it. Compile it and try it. After you try the examples offered here, you can build your own library of routines to solve a host of networking problems. §

Henry James Franzoni III is a freelance programmer/analyst living in Portland, Oregon, who specializes in network database applications.

All the source code for articles in this issue is available on a single, MS-DOS disk. To order, send $14.95 to: Micro/Systems Journal, *501 Galveston Drive, Redwood City, CA 94063, or call (415) 366-3600, ext. 216. Please specify the issue number.*

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Using dBASE III+ and Clipper A86
Listing 1—Continued from page 25

```
        !ENDSPOOL C    && Cancel current print job
        WAIT
       ELSE
        STOR ' ' TO C2
        DO ASK2 WITH RR+2,CC,'Select printer queue
to delete (0,1,2,3,4)?','01234',C2
         IF CLIPPER
          SAVE SCREEN
         ENDI
          @ 0,0 CLEA
        STOR '*.*' TO C3  && Build command string
        STOR C3+' /P'+C2+' ' TO C3
        STOR C3+'U='+USER+' ' TO C3
        STOR C3+' D' TO C3
        !Q &C3   && Issue built up Q command to DOS
        WAIT
         IF CLIPPER
          RESTORE SCREEN
         ENDI
       ENDI
     CASE SPLVAR='E'
      EXIT
     ENDC
   ENDD
     @ 0,0 clea
RETU
*
PROC SPOOL                && Spool command control
PARA RR,CC
PRIV SP1,SP2,SP3,SP4,SP5,SP6,SP7,SP8,SP9,SP10
STOR ' ' TO SP7
STOR '0' TO SP1,SP2
STOR .F. TO SP3,SP6,SP5,SP9,SP10
STOR SPAC(14) TO SP4
STOR '0  ' TO SP8
 DO WHIL .T.
   DO BLOCKCLR WITH RR,CC
   DO ASK2 WITH RR,CC,'Select network printer (0,1,2,3,4)
 or (E)xit?','01234E',SP1
    IF SP1='E'
     DO BLOCKCLR WITH RR,CC
     RETU
    ENDI
   @ RR,CC SAY 'Printer '+SP1+' selected.'
   STOR ' P'+SP1 TO SP7
   DO ASKL WITH RR+1,CC,'Show spooler settings only?',SP3
    IF SP3
      IF CLIPPER
       SAVE SCREEN
      ENDI
     @ 0,0 CLEA
     STOR SP7+' SH' TO SP7
     !SPOOL &SP7      && Issue spool show command to DOS
     WAIT
     STOR ' ' TO SP7
     @ 0,0 CLEA
      IF CLIPPER
       RESTORE SCREEN
      ENDI
     RETU
    ENDI
   DO ASK2 WITH RR+1,CC,'Select number of copies 0-9, 0 for
 disk file only ','0123456789',SP2
    DO CASE
     CASE SP2='1'
      @ RR+1,CC SAY SP2+' copy selected.'
     CASE SP2='0'
      @ RR+1,CC SAY 'Disk file only'
     OTHE
      @ RR+1,CC SAY SP2+' copies selected.'
    ENDC
   DO ASKL WITH RR+2,CC,'Create disk file? (Y/N)',SP3
    IF SP3
     @ RR+2,CC SAY 'Enter filename (With drive identifier)
 for disk file' GET SP4 PICT 'A:AXXXXXXXXXXX'
     READ
     @ RR+2,CC SAY SPAC(80)
     @ RR+2,CC SAY 'File name '+SP4+' selected.'
    ENDI
   DO ASKL WITH RR+3,CC,'Alter default form type in
    printer? (Y/N)',SP10
    IF SP10
     @ RR+3,CC SAY 'Enter form type 0-255 or <cr> for 0,
  default form ' GET SP8 PICT '999'
     READ
    ENDI
   DO ASKL WITH RR+4,CC,'Add form feed after printing job
(Y/N)?',SP9
   DO ASKL WITH RR+4,CC,'Execute this spooler command
(Y/N)?',SP5
    IF SP5
```

```
      EXIT
     ENDI
   ENDD
 STOR SP7+' NB' TO SP7           && Build spool command
 STOR SP7+' C='+TRIM(SP2) TO SP7  && number of copies
 STOR SP7+' F='+TRIM(SP8) TO SP7
   IF SP3                 && create a file?
    STOR SP7+' CR='+TRIM(SP4) TO SP7
   ENDI
   IF SP9                 && add form feed?
    STOR SP7+' FF' TO SP7       && Yes add form feed
   ELSE
    STOR SP7+' NFF' TO SP7      && No form feed
   ENDI
 DO BLOCKCLR WITH RR,CC
 @ RR,CC SAY ' '
 !SPOOL &SP7              && Issue spool command to DOS
 DO BLOCKCLR WITH RR,CC
 DO ASKL WITH RR,CC,'Add extra printer control codes
     (Y/N)?',SP6
   IF SP6
    DO CTLCODES WITH RR,CC     && Send printer control codes
   ENDI
 RETU
 *
 PROC QUEUE               && Q command control
 PARA RR,CC
 PRIV Q1,Q2,Q3,Q4,Q5,Q6,Q7
 STOR SPAC(12) TO Q1
 STOR USER TO Q5
 STOR STA TO Q4
 STOR '0' TO Q2
 STOR ' ' TO Q3
 STOR .F. TO Q6,Q7,Q8
   DO WHIL .T.
    DO BLOCKCLR WITH RR,CC
    DO ASK2 WITH RR,CC,'Select printer queue number
0,1,2,3,4 or (E)xit?','01234E',Q2
      IF Q2='E'          && Exit
       DO BLOCKCLR WITH RR,CC
       RETU
      ENDI
    @ RR,CC SAY 'Printer queue '+Q2+' selected.
    @ RR+1,CC SAY 'Select files: enter <filespec> , print
   job #, or <cr> for all?' GET Q1 PICT 'XXXXXXXXXXXX'
    READ
    DO ASK2 WITH RR+2,CC,'Select files: (A)ll, (S)tation
     '+STA+' only, or (U)ser '+USER+' only?','SUA',Q3
      DO CASE
       CASE Q3='S'
         STOR 'ST='+Q4 TO Q3
         @ RR+2,CC SAY 'Files from station number '+Q4+'
   selected.'
       CASE Q3='U'
         STOR 'U='+TRIM(Q5) TO Q3
         @ RR+2,CC SAY 'Files from user '+TRIM(Q5)+'
   selected.'
       CASE Q3='A'
         @ RR+2,CC SAY 'All available files selected.'
         Q3=' '
      ENDC
    DO ASKL WITH RR+4,CC,'Delete these files from queue
   (Y/N)?',Q6
    DO ASKL WITH RR+4,CC,'Do you want a detailed file list
   (Y/N)?',Q7
    DO ASKL WITH RR+4,CC,'Do it all now (Y/N)?',Q8
      IF Q8              && Execute Q command
       EXIT
      ENDI
   ENDD
   IF Q1 # ' '            && Build Q command
    Q1=' '+TRIM(Q1)+' '
   ELSE
    Q1=' '
   ENDI
    Q1=Q1+'/P='+Q2          && Printer number
   IF Q3 # ' '
    Q1=Q1+' '+Q3
   ENDI
   IF Q6
    Q1=Q1+' D'              && Delete flag?
   ENDI
   IF .NOT. Q7
    Q1=Q1+' NL'             && No detailed list?
   ENDI
   IF CLIPPER
    SAVE SCREEN
   ENDI
 @ 0,0 CLEA
 !Q &Q1                   && issue Q command to DOS
 WAIT
```

source code continued on page 57

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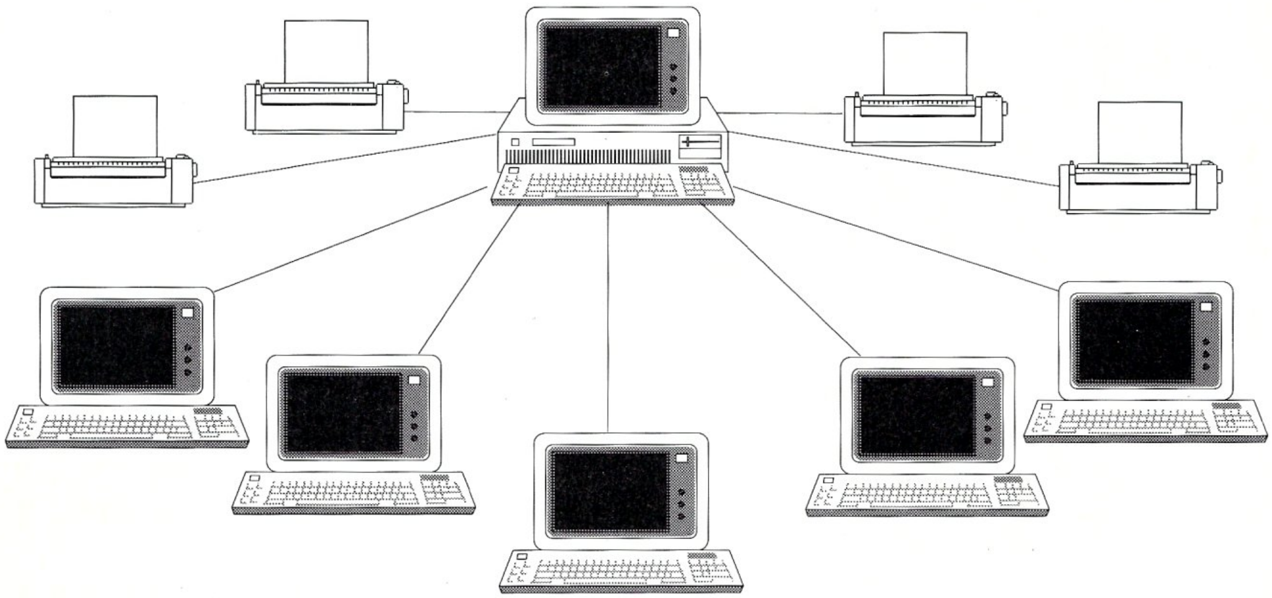

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Using dBASE III+ and Clipper A86
Listing 1—Continued from page 55

Continued from page 55

```
 IF CLIPPER
  RESTORE SCREEN
 ENDI
DO BLOCKCLR WITH RR,CC
RETU
*
PROC CTLCODES     && ISSUES CONTROL CODES TO PRINTERS
PARA RR,CC        && ONLY TWO PRINTERS, ADD MORE YOURSELF...
DO BLOCKCLR WITH RR,CC  && EXTEND THE DO CASE STRUCTURE
VALU='E'          && Exit
 DO CASE
  CASE SP1='1'           && Menu for printer 1
  @ RR,CC SAY '(1) Letter quality on (2) Letter quality off'
  @ RR+1,CC SAY '(3) Graphic char on  (4) Graphic char off'
  @ RR+2,CC SAY '(5) 20 chars/in on  (6) 20 chars/in off'
   DO WHIL .T.
    @ RR+3,CC SAY '(7) 17 chars per inch on  (8) 17 chars. off
 {(E)xit } -> ' GET VALU PICT '@! X'
    READ              && Get menu choice
     DO CASE
      CASE VALU='1'
       PRINTVAR=L1QON
      CASE VALU='2'
       PRINTVAR=L1QOFF
      CASE VALU='3'
       PRINTVAR=G1RAPHON
      CASE VALU='4'
       PRINTVAR=G1RAPHOFF
      CASE VALU='5'
       PRINTVAR=E1LITEON
      CASE VALU='6'
       PRINTVAR=E1LITEOFF
      CASE VALU='7'
        PRINTVAR=C1OMPRON
      CASE VALU='8'
        PRINTVAR=C1OMPROFF
      CASE VALU='E'
        EXIT
      OTHE
        LOOP
     ENDC
     IF CLIPPER
      IF ISPRINTER()
       SET CONS OFF
       SET PRIN ON
       ?&PRINTVAR        && Send printer control code
       SET PRIN OFF
       SET CONS ON
      ENDI
     ELSE
      SET CONS OFF
      SET PRIN ON
      ?&PRINTVAR         && Send printer control code
      SET PRIN OFF
      SET CONS ON
     ENDI
   ENDD
 CASE SP1='0'           && Menu for printer 0
 @ RR,CC SAY '(1) Letter quality on  (2) Letter quality off'
 @ RR+1,CC SAY '(3) 5 chars/in on   (4) 5 chars/in off'
 @ RR+2,CC SAY '(5) 12 chars/in on  (6) 12 chars/in off'
    DO WHIL .T.
     @ RR+3,CC SAY '(7) 17 chars. per inch on  (8) 17 chars. off
{(E)xit } -> ' GET VALU PICT '@! X'
     READ            && get choice for printer 0
      DO CASE
       CASE VALU='1'
        PRINTVAR=LQON
       CASE VALU='2'
        PRINTVAR=LQOFF
       CASE VALU='3'
        PRINTVAR=ENLGON
       CASE VALU='4'
        PRINTVAR=ENLGOFF
       CASE VALU='5'
        PRINTVAR=ELITEON
       CASE VALU='6'
        PRINTVAR=ELITEOFF
       CASE VALU='7'
        PRINTVAR=COMPRON
       CASE VALU='8'
        PRINTVAR=COMPROFF
      CASE VALU='E'
        EXIT
      OTHE
        LOOP
     ENDC
     IF CLIPPER
      IF ISPRINTER()
       SET CONS OFF
       SET PRIN ON
       ?&PRINTVAR        && Send printer control code
       SET PRIN OFF
       SET CONS ON
      ENDI
     ELSE
      SET CONS OFF
      SET PRIN ON
      ?&PRINTVAR         && Send printer control code
      SET PRIN OFF
      SET CONS ON
     ENDI
    ENDD
   OTHE
  ENDC
VALU=SPAC(20)
DO BLOCKCLR WITH RR,CC
RETU
*
PROC ASKL             && Ask a logical question
PARA MLINE,MCOLUMN,MQUESTION,MANSWER
@ MLINE,MCOLUMN SAY SPAC(LEN(MQUESTION)+4)
STOR .F. TO MANSWER
@ MLINE,MCOLUMN SAY MQUESTION GET MANSWER PICT '@L '
READ
@ MLINE,MCOLUMN SAY SPAC(LEN(MQUESTION)+4)
RETU
*
PROC ASK2             && Ask a multiple choice question
PARA MLINE,MCOLUMN,MQUESTION,MCHOICES,MANSWER
@ MLINE,MCOLUMN SAY SPAC(LEN(MQUESTION)+4)
STOR ' ' TO MANSWER
 DO WHIL .NOT. MANSWER $ MCHOICES
  @ MLINE,MCOLUMN SAY MQUESTION GET MANSWER PICT '@! '
  READ
 ENDD
@ MLINE,MCOLUMN SAY SPAC(LEN(MQUESTION)+4)
RETU
*
PROC BLOCKCLR          && Clears a four line block
PARA RR,CC             && on the screen.
@ RR,CC SAY SPAC(80)
@ RR+1,CC SAY SPAC(80)
@ RR+2,CC SAY SPAC(80)
@ RR+3,CC SAY SPAC(80)
@ RR+4,CC SAY SPAC(80)
RETU
*
PROC PRNTCODE          && CONTAINS PRINTER CONTROL CODES
LQON='CHR(27)+'I'+'2''      && CODES OF IBM PROPRINTER
LQOFF='CHR(27)+'I'+'0''     && FOR NETWORK PRINTER 0
ELITEON='CHR(27)+':''
ELITEOFF='CHR(27)+'I'+'0''
COMPRON='CHR(15)'
COMPROFF='CHR(18)'
ENLGON='CHR(14)'
ENLGOFF='CHR(20)'
L1QON='CHR(27)+'x'+CHR(1)'
L1QOFF='CHR(27)+'x'+CHR(0)'
G1RAPHON='CHR(27)+CHR(109)+CHR(4)'  && CODES OF EPSON LX80
G1RAPHOFF='CHR(27)+CHR(109)+CHR(0)'  && FOR NETWORK PRINTER 1
E1LITEON='CHR(27)+'M'+CHR(15)'
E1LITEOFF='CHR(27)+'P'+CHR(18)'
C1OMPRON='CHR(27)+CHR(15)'
C1OMPROFF='CHR(27)+CHR(18)'
E1NLGON='CHR(27)'
E1NLGOFF='CHR(27)'
*************************************************************
* Add more printer control codes here for printers 2,3,    *
* and 4 if you like.                                       *
*************************************************************
RETU
*
PROCEDURE CNTR           && Centers <Text> on <Line>
* Syntax:  DO CNTR WITH <Text>, [<Line>]
PARA Text,Line
IF CLIPPER
 IF Pcount()<2
  Line=0
 ENDIF
ENDI
@ Line,40-len(text)/2 SAY text
RETU
```

The LANScape

by B.J. Hall and Michael Cherry

Part IV NetBIOS

As promised, this month we are moving away from the basics, such as media and topology, and focusing on a particular area: NetBIOS.

The What and Why of NetBIOS

Most PC users are familiar with the BIOS, the Basic Input/Output System. The Network Basic Input/Output System (NetBIOS) is an extension of this system that provides a communication interface to network hardware. NetBIOS establishes a virtual link between peers on a network and passes data over that virtual link. That is, it provides for peer-to-peer communications between nodes on a network. NetBIOS is the basis for local area network (LAN) software such as the IBM PC LAN program, and it is a requirement of specialized network services such as the Eicon SDLC gateway.

How is NetBIOS used by LAN software? We use the IBM PC LAN program as an example. The PC LAN program requires PC-DOS (3.2) and NetBIOS. Figure 1 shows schematically the architecture of a workstation using the PC LAN program. An application communicates with other nodes on this network via DOS and a redirector (the Microsoft MS-NET redirector).

The application's calls are interpreted by DOS. If the call is local, it is executed locally by DOS and BIOS. If the call is to the network, DOS hands the call to the redirector, which transmits it to the network via NetBIOS. For example, to access a file stored on another node on the network the application would issue an open call via interrupt 21 (all interrupts are Hex).

DOS takes the call and, understanding that it is intended for the network, hands it to the redirector. The redirector puts the request in a Server Message Block (SMB) packet. This packet is sent to the network via NetBIOS.

The node that has the file receives the pack and will use DOS to execute the call and open the file. The requested data is then put into an SMB packet, sent back to the redirector via NetBIOS, and, finally, is delivered to the application.

With specialized products such as the Eicon gateway, NetBIOS redirects requests from the workstation to the node on the network that is housing the gateway. Figure 2 illustrates a small Novell token-ring network with a workstation, file server, and gateway PC (which does not have to be dedicated to the gateway function). In addition to loading the Novell shell, the workstation and gateway PCs also load NetBIOS.

The gateway is running software that

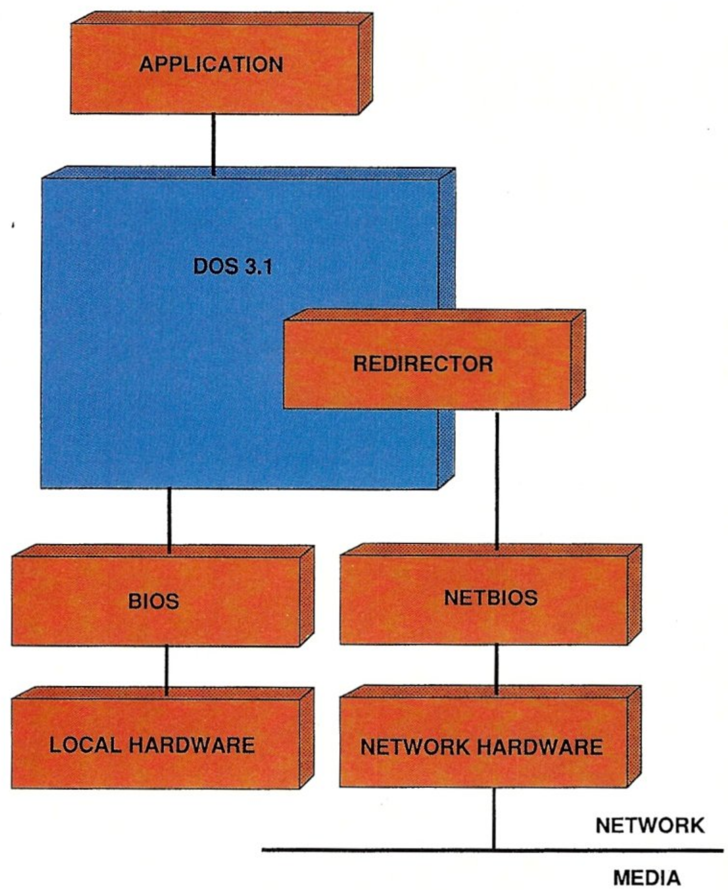

Figure 1. Architecture of a workstation using a PC-LAN program

makes it emulate a 3274 cluster control unit. The workstation is running software that makes it emulate a 3278 terminal.

There are two ways of looking at NetBIOS. The first is as a communication link between workstation and host. When a workstation has data to send to the host, it uses NetBIOS to direct the data to the gateway PC. The gateway PC (functioning as a communication server) then sends the data to the host. When the host has data to send to the workstation, it sends it first, via NetBIOS, to the gateway. The gateway then directs the data to the appropriate workstation. All of this interaction is irrespective of the file server node.

Another way to look at NetBIOS is to compare its services to the ISO model, which uses layers to define communication functions. These layers include:

- **Application**—Gives user access to all lower functions; deals only with semantic exchanges between applications
- **Presentation**—Concerned with representation of user data; provides common syntax used in exchanges between applications on different systems
- **Session**—Provides mechanisms for organizing and structuring interaction among application processes
- **Transport**—Provides transparent and reliable end-to-end data transfer, relying on lower layer functions for handling peculiarities of actual transfer media
- **Network**—Definitions in this layer provide means to establish connections between networks; standards also include procedures for operational control of inter-network communications and routing of information through multiple networks
- **Data Link**—Provides functional and procedural means to transfer data between network entities and to detect and possibly correct errors that may occur in physical layer
- **Physical**—Provides mechanical, electrical, functional, and procedural standards to access physical medium

NetBIOS provides the session, transport, and network functions, as illustrated in Figure 3.

NetBIOS is implemented by LAN manufacturers in any one of a variety of ways. The original NetBIOS was written by SYTEK for IBM to use with its PC network. This version of NetBIOS was implemented in the firmware of the network adapter card.

For the IBM PC LAN program on its

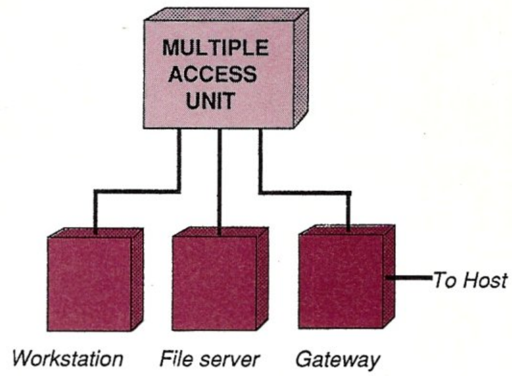

Figure 2. Architecture of a small Token-ring network

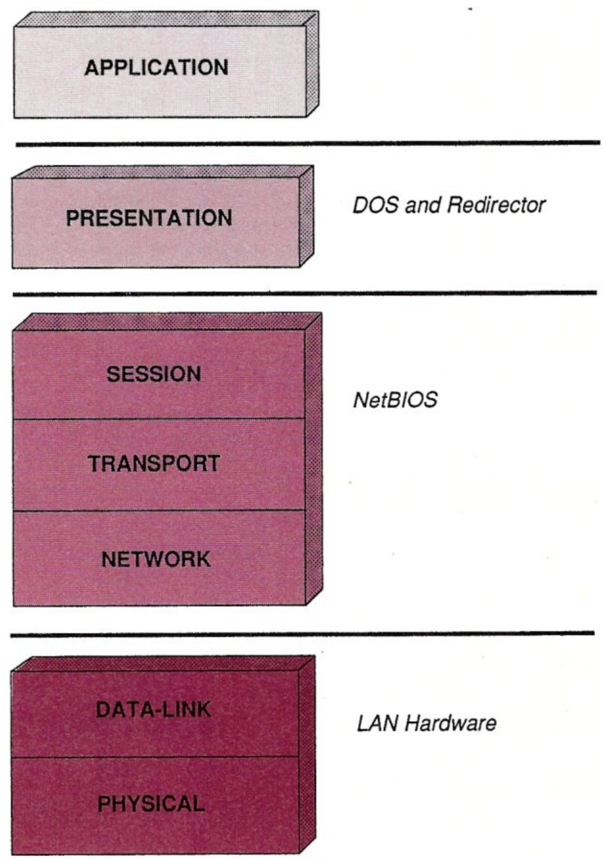

Figure 3. NetBIOS session, transport, and network functions

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Automatic file save	Yes	Yes	No	No
Online help	Extensive	Limited	Limited	Limited
Online tutorial	Yes	No	No	Yes
Choice of keystroke commands or menu system	Yes	No	No	Yes
Function Key assignments labeled on screen	Yes	No	No	No
WP Functions	Extensive	Limited	Limited	Extra Cost
Complete DOS shell	Yes	No	No	No
Pop-up Programmer's Calculator and ASCII table	Yes	No	No	No ASCII
Unlimited 'Off the Cuff' keystroke macros	Yes	No	No	Yes
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Intelligent indenting, template editing and brace/parenthesis/block matching and checking for all major languages	Yes	C Only	No	Limited
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token-ring hardware, IBM uses a NetBIOS emulator called NETBEUI. To use the token-ring hardware, the user first loads COMMAND.COM (DOS), TOKREUI (the interface to the token-ring hardware), and NETBEUI. Then the user can load the IBM PC LAN program.

For Advanced NetWare, Novell provides a NetBIOS emulation. To use Advanced NetWare with token-ring hardware, the user first loads COMMAND.COM, TOKREUI, and the Novell NetBIOS emulator. Then the user can load the Novell NetWare shell ANET3.

Note that in the case of Advanced NetWare, NetBIOS is loaded only to support specialized services, such as linking an Eicon gateway to an IBM mainframe. Also note that the Novell NetBIOS emulation can be used with non-token-ring hardware such as on an Ethernet network.

The Redirector

The concept of a redirector is often tied to a discussion of NetBIOS. A redirector is software that redirects network calls from the workstation to another node on the network that is functioning as the server.

A redirector uses interrupts 2A and 2F to communicate to NetBIOS. Figure 4 shows the internal functions of the Microsoft redirector.

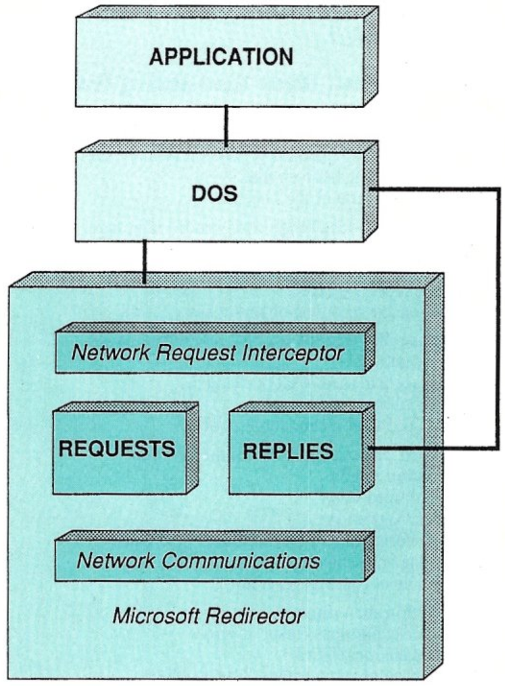


Figure 4. Internal Functions of the Microsoft Redirector

The Network Control Block

Application software communicates with NetBIOS by means of a Network Control Block (NCB) and interrupt 5C. Commands to NetBIOS can be divided into the following four groups:

1. **General**—These services allow a program to request status information, to stop operations for a given Name, or reset complete NetBIOS interface.
2. **Name Support**—A Name is a NetBIOS identifier for a logical entity in which all session-level communication activity is centered. A Name can request that a session be established with another Name. Data can then be exchanged over that session between the two names. These services allow a program to manage user-assigned Names.
3. **Session Support**—A session is a logical connection between two Names that supports peer-to-peer communications.
4. **Datagram Support**—This feature of a NetBIOS interface allows for nonreliable data transmission. That is, when Datagrams are sent, they are not acknowledged by the receiver's adapter.

DATAGRAM COMMANDS

Command	*NCB Command*	*Function*
SEND DATAGRAM	20 WAIT A0 RETURN	Send a datagram to a name or group name.
SEND BROADCAST DATAGRAM	22 WAIT A2 RETURN	Send message to everyone who has RECEIVE BROADCAST DATAGRAM outstanding.
RECEIVE DATAGRAM	21 WAIT A1 RETURN	Receive datagram from any name or anyone on network directed to this station.
RECEIVE BROADCAST DATAGRAM	23 WAIT A3 RETURN	Receive a datagram from anyone who issues SEND BROADCAST DATAGRAM.

Table 1. NetBIOS Commands

Table 1—continued

NAME SUPPORT COMMANDS

Command	NCB_ Command	Function
ADD NAME	30 WAIT B0 RETURN	Add unique name to name table.
ADD GROUP NAME	36 WAIT B6 RETURN	Add group name to name table.
DELETE NAME	31 WAIT B1 RETURN	Delete name from name table.

SESSION SUPPORT COMMANDS

Command	NCB_ Command	Function
CALL	10 WAIT 90 RETURN	Open session with another name. Called name must have issued a LISTEN command.
LISTEN	11 WAIT 91 RETURN	Enable session to be established.
HANG UP	12 WAIT 92 RETURN	Close session with another name.
SEND	14 WAIT 94 RETURN	Send data from indicated buffer.
CHAIN	17 WAIT 97 RETURN	Like SEND except data taken from buffers for indicated number of bytes. Two buffers can be chained together.
RECEIVE	15 WAIT 95 RETURN	Receive data from specified session.
SESSION	34 WAIT B4 RETURN	Get status of all active sessions for your name.
RECEIVE ANY	16 WAIT 96 RETURN	Receive data from any station with a session.

GENERAL COMMANDS

Command	NCB_ Command*	Function
RESET	32	Reset local adapter status and clear name and session tables.
CANCEL	35	Request cancellation of pending command.
STATUS	33 WAIT B3 RETURN	Give status information for local or remote adapter.
UNLINK	70	Used with remote program load (RPL) to unlink session.

**Hex Values*

NetBIOS Commands

Specific NetBIOS commands are summarized in Table 1.

The NetBIOS interface uses a Message Control Block (MCB) for interprogram communications. To issue a command, the user must allocate 70 bytes of memory for a control block, fill in the required fields, set ES:BX to the control block, and issue an interrupt 5C.

The control block should not be altered until command processing is complete. This alteration prevention can be handled in one of two ways: through a Wait option or a No Wait option. With the Wait option, the user program is put into a wait state until the command has completed. With the No Wait option, the application receives a return code immediately after issuing the interrupt 5C. The purpose of this code is to inform the issuing program that the command has started. When all command processing is completed a second return code is received.

Summing Up

NetBIOS is an important interface on a network, especially for services such as gateways. But NetBIOS is not without limitations. NetBIOS, with its peer-to-peer node orientation, does not provide for easy inter-networking or for the ability to bridge across different networks.

More information on NetBIOS is available in IBM publications such as:

IBM Token-Ring Network NetBIOS Program User's Guide.
IBM Token-Ring Network PC Adapter Technical Reference.
IBM Personal Computer Seminar Proceedings:
IBM PC Network Overview.
IBM PC Network SMB Protocol.

In addition, the following two sources were invaluable in preparing this column:

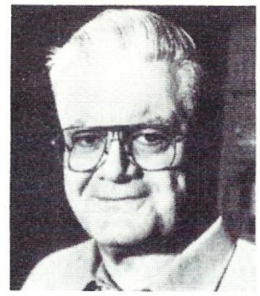
Inside the Token-Ring, (on IBM's Token-Ring) by J. Scott Haugdahl, Architecture Technology Corporation, P.O. Box 24344, Minneapolis, MN 55424.

LAN Operating System Report—1986, Novell, Inc., 748 North 1340 West, Orem, UT 84057. §

B.J. Hall and Michael Cherry operate HallComm Network Services (HNS), a company devoted exclusively to designing and implementing LAN systems. HNS is located at 8101 E. Prentiss Ave., Ste. 304., Englewood, CO 80111; (303) 770-6378.

The Scientific Computer User

by A. G. W. Cameron



Number-Crunching Coprocessor Boards

Definicon 780+/4

The day of the workstation in a PC has arrived, and soon you will have quite a variety of them from which to choose. This column deals with 68020-based boards and a close relative to them. A subsequent column will deal with 386-based boards.

At home, I have a Definicon 780+/4 coprocessor board in an XT clone. It runs 24 hours per day, grinding through three-dimensional simulations of planetary collisions. For this particular problem, the modified clone is 25 percent faster than a VAX 11/780, one-third as fast as my Sun 3/260 workstation with floating point accelerator, and about five percent as fast as a Cray X-MP (which is penalized for this problem because its vector processing power cannot be efficiently used). The board's list price is $3,595, to which you need to add nearly $1,000 in software. Add 50 percent to these prices to get a good 8-MHz XT clone to make a complete system, and you have one of the most cost-effective number-crunching machines around. I call it a "dedicated computing engine."

Definicon Systems (DSI) started putting out boards of this type in the middle of 1985. Its first board used National Semiconductor 32000 series chips running at 10 MHz. (These are still available but by modern standards are very slow.) In mid-1986 Definicon introduced its Motorola 68020 product line. These include the 68020 CPU and 68881 floating point coprocessor. The least expensive and slowest of these boards is the DSI-020, which has one Mbyte of RAM on board, runs at 10 MHz, and costs $1094.

Passing over a 16.67-MHz version of this board, we come to the DSI-750+ line of boards, also running at 16.67 MHz. These may have 1, 2, or 4 Mbyte of RAM on board. The amount of memory on the board is indicated by adding /1, /2, or /4 to the name. The "+" indicates that the board runs faster than a VAX 11/750. The memory begins to dominate the price—the prices of the /1, /2, and /4 are $1,995, $2,395, and $3,295, respectively.

The next step up is the DSI-780+ series. You guessed it; at 20 MHz, this is faster than a VAX 11/780. There are five memory configurations: /1, /2, /4, /8, and /16. The first three in the series use 256K, 120 nanosecond chips, and the last two use 1-Mbit chips. The five configurations are priced at $2,295, $2,695, $3,595, $6,630, and $11,235, respectively. This means that the /4, which I have in my XT clone, is the most cost-effective.

Finally, at 25 MHz there is the DSI-785 (no "+"), which is rated as approximately equivalent to a VAX 11/785, and comes in /4, /8, and /16 memory configurations. The cost of components running at 25 MHz is significantly increased, so the list prices are $6,610, $8,375, and $12,695, respectively. This leaves the DSI-780+/4 as still the most cost-effective.

The DSI-780+/4 is a full length board that can be used in either an XT 8-bit bus or an AT 16-bit bus. Interestingly, Definicon has found that disk I/O with the 8-bit bus is almost as fast as with the 16-bit bus. The board has a selection jumper for 8- and 16-bit modes, and is shipped with the 16-bit mode disabled. Trevor Marshall, the Definicon engineer who designed the PC interface, says that few customers who could use the 16-bit interface bother to reset the jumper.

The memory is surface-mounted so that the chips stand on end. Four megabytes in 256K chips only take up about three inches at the front end of the board. Therefore you should only use a short board in the slot on the chip side of the Definicon board, and in any case it is advisable that the Definicon board have cooler-running boards as neighbors.

The board has two clock crystals for operation at both 16.67 and 20 MHz. I found out about this the hard way. The board was supposed to operate at 20 MHz, but when I ran a speed diagnostic utility which came with the board, it indicated operation at 16.67 MHz. Rodger Morris of Definicon then talked me through the operation of switching a pair of jumpers, and I then gained the expected performance. He said that the slower clock speed was provided so if there was some component degradation, board operation could continue at the slower speed until a fix could be made.

The thing that really makes this board a joy to use is the simple DOS interface. There is a LOAD program that loads an operating system kernel for the Motorola chips into board memory and then hands off operation. Thereafter, the LOAD program handles requests for DOS services from the kernel. Thus, if I want to run program XYZ, all I need to do is to type LOAD XYZ and the program starts. Unlike some operating systems which are memory hogs, this one only takes up about 20K of Definicon memory, and the LOAD program only takes up a similar amount of regular DOS memory. Hence, most of the board memory is available for application programs.

One nice feature of the LOAD program is that it can be suspended. The Alt-- key combination suspends processing of requests for DOS services and brings up a second DOS interface that allows you to do other tasks. The EXIT command restarts LOAD and processing continues where it left off. The 68020 processor is only halted if it requests DOS services during this interval; otherwise it is not affected by the suspension.

Even better is the ability of LOAD to run properly with multitasking. I tried using DOUBLEDOS with LOAD in one of the two grounds, but found it to hang very quickly (apparently because of something other than LOAD in my machine: I did not pursue this). But DESQview works ex-

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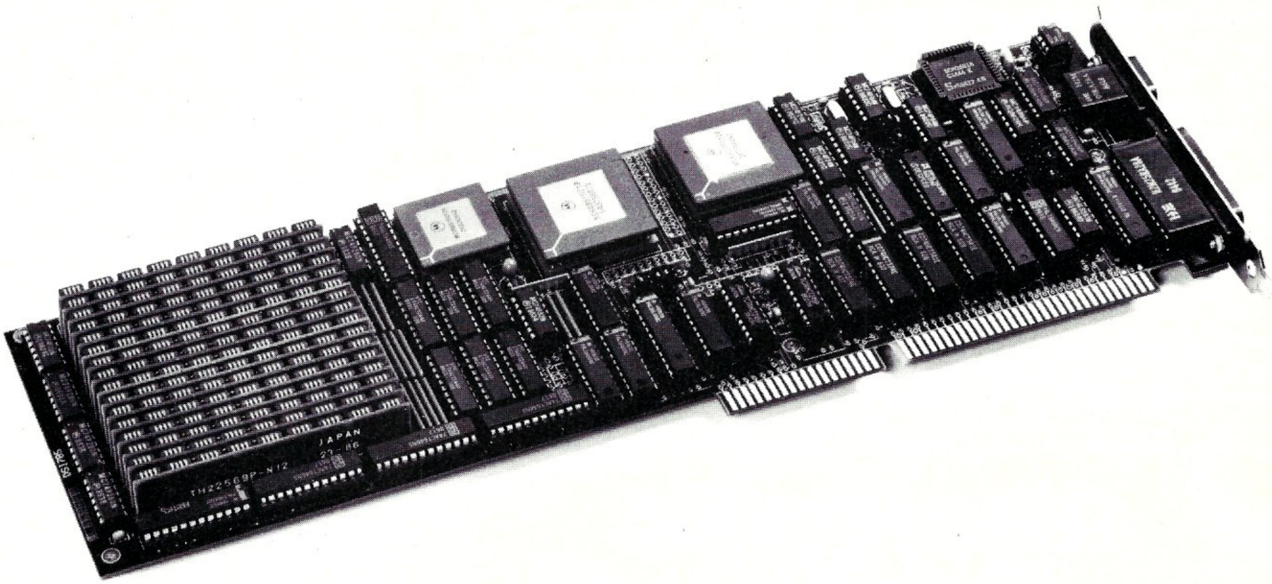

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DEFINICON

tremely well, particularly with an expanded memory board and most of the memory disconnected on the motherboard. LOAD runs normally in the foreground, but I use I/O requests occasionally and briefly, so that when LOAD runs in the background and is slowed down, there is a minimal impact on the operation of the Definicon board.

The C, Pascal, and Fortran languages are available for use with the Definicon board from Silicon Valley Software, and Topexpress Fortran. I used only the Fortrans, starting with the SVS Fortran and later using the beta version of the Topexpress Fortran.

Fortran compilers running under DOS are very slow. One equation of state routine that takes me well over an hour to compile with Ryan-McFarland Fortran took less than a minute with SVS Fortran. This immediately marks the Definicon board as one well suited to program development. The SVS Fortran optimizing compiler is a full implementation of ANSI standard Fortran-77, which was written for Motorola 68000 and 68020 and National Semiconductor 32000 computer systems. The SVS compiler generates intermediate output that is fed into an SVS compiler code generator, and is also very fast. In addition, there is an SVS linker that completes the generation of executable code. I have found the error messages produced by these various stages to be brief but helpful. Definicon supplies a source-level debugger for the SVS compilers which I have not had occasion to use.

I did encounter one subtle bug in the SVS Fortran compiler. In our three-dimensional hydrodynamics program the machine-dependent routines were all contained in one subroutine at the end with entry statements. As the program was run, the numbers obtained in calls to these service routines underwent some mysterious transformations under some but not all circumstances. I did not get rid of this problem until I abolished all entry statements and made separate subroutines out of these machine-dependent routines.

Table 1 shows the performance of various Definicon boards and emphasizes floating point performance. I have used the benchmark routines that were employed by Avram Tetewsky and Dan Feenberg (see *M/SJ*, September/October 1987) in their comparisons of different machines, and a few of their results are reproduced here. The bulk of the results for the Definicon boards were run for me at Definicon Systems. (I produced special versions of the benchmarks for the Definicon boards in which the programs only needed to be run and the results saved to disk.)

The Clock column shows the actual speeds on the boards as determined by a Definicon utility. The Definicon benchmark results agree with mine for the two speeds at which I could run my board. It is also very interesting that Definicon was able to make some tests with the new Motorola 68882 floating point coprocessor substituted for the 68881. There is a substantial improvement in speed resulting from this substitution. The maximum speed for the 68881 is supposed to be 20 MHz, but the 68882 can run at 25 MHz. Definicon expects to start supplying boards with 68882 chips early in 1988.

In Table 1, S-whet and D-whet stand for single-precision and double-precision whetstones in kilowhetstones per second and are standard benchmark programs. REMEZ is an IEEE digital signal-processing program that is floating-point intensive. SVD is a single value decomposition program that operates on 50 × 50 matrices. Roots finds complex roots of real polynomials. Also in Table 1, notice that the Definicon board did poorly compared to other computers on the Roots program. This is the fault of the SVS Fortran compiler, not the boards. The SVS compiler is notoriously poor with complex arithmetic. The Topexpress Fortran did significantly poorer than SVS Fortran on the first four programs, but it ran Roots nearly twice as fast. Ordinarily, I do not use complex variables in my programs, so I use the SVS compiler in the interest of speed.

SPARC Technology

Sun Microsystems has announced the next generation of its workstations, the 4/200 series. Based on a new chip architecture developed by Sun, the 4/200 doubles the performance of the 3/200 series. Sun's announced goal is to double the performance each year until 1990.

The new architecture is based on Reduced Instruction Set Computing (RISC) hardware that was developed internally. Sun executives call this the Scalable Processor ARChitecture (SPARC). The current chips run at 16.67 MHz, and this speed should increase in the future and become an important part of techniques that will be used to speed up the workstations. The CPU contains two 20K CMOS gate-array VLSI chips based on 1.5-micron technology, the SF9010IU Integer Unit and the SF9010FPC floating point control unit. In addition, the board contains the Weitek 1164/1165 floating point arithmetic units. The board achieves much of its performance through the use of a 128K virtual address, write-back data and instruction cache.

There are 89 SPARC instructions, and the CPU executes most of them in a single cycle. This is a design goal of most RISC architectures. Another design goal is to have a large number of registers. The SPARC architecture uses 120 registers in a windowed register file. The processor performs four-stage pipelined operations; the stages are fetch, decode, execute, and write. Thus, four operations typically are going forward simultaneously. With the large cache memory, most of the fetches occur in a single cycle.

Sun designed these new chips to use instructions that were compatible with the Motorola 68020 instructions whenever possible. This facilitates mixing the Sun 2, 3, and 4 families of workstations on the same server. However, this will not actually be possible until about February 1988, when the new Version 4 of the Sun implementation of UNIX becomes available. At that time I am planning to upgrade my Sun 3/260 workstation to a 4/260, which will involve a simple CPU board swap, and, of course, remaking my disks to handle the new operating system. I will also upgrade my memory board, trading in my 8-Mbyte board for a new 32-Mbyte board.

This new workstation will operate at about twice the speed as my present 3/260, the benchmark performance of which is given in Table 1. This is the result of mounting the Weitek chips on the CPU board directly, rather than having them on a separate FPA board. In this way, the chips benefit from smaller paths and the improved cache on the CPU board. The Weitek chips just do fast arithmetic; more complicated operations like exponentials, powers, and trigonometric functions (which are part of the IEEE standard), signal exceptions—these operations are handed off to the other floating point chip.

I have heard a rumor that Weitek is coming out with a new chip that will execute the full IEEE standard. This will certainly make it easier to incorporate Weitek's chip as a standard coprocessor in place of the Intel 8087 series chips.

It is particularly interesting that Sun is licensing the SPARC technology to other companies. Of special interest to me is that one of these companies is Definicon Systems. Definicon is planning to bring out a coprocessor board with the new Sun chips and the Weitek chips, together with fast memory, and perhaps the static column memory they are using in their present development work (Compaq uses such memory in its 386 machines). The coprocessor board will operate much like the present Definicon boards. There will be a simple DOS interface (a variant of the LOAD program). Because this simple interface replaces UNIX, which has a much larger overhead, the Definicon board may operate slightly faster than a Sun 4/260.

Definicon will port the Sun compilers (designed for the SPARC technology) to operate with its boards.

At the time of writing, Sun is planning to bring out a "hacker's special" SPARC board in late 1987; this will probably have about 1 Mbyte on the board, and it will allow development work to go on with the new board. The commercial version of the board will offer much more memory and is scheduled to come out this spring.

This new board should be a splendid dedicated computing engine. Much of the expense of a regular workstation arises from the fact that expensive graphics capabilities are usually built into it for use in CAD-CAM operations. If you do not need multitasking or fancy graphics, then something like this coprocessor board is very cost-effective. §

A. G. W. Cameron is Professor of Astronomy at the Harvard-Smithsonian Center for Astrophysics.

Product Information

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Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, CA 94043
(415) 960-1300

Table 1. Benchmark of Definicon boards plus some comparison computers.

SPEEDS					BENCHMARKS				
Board DSI-	Clock	CPU MHz	Co-P MHz	Type 6888+	S-whet kwhet/s	D-whet kwhet/s	REMEZ sec	SVD sec	Roots sec
020	12.72	12.5	12.5	1	722.9	659.2	3.79	24.28	7.14
750+	16.98	16.0	16.0	1	953.2	864.7	2.91	18.51	5.66
780+	20.41	20.0	20.0	1	1157.0	1051.0	2.41	15.22	4.45
780+	20.40	20.0	20.0	2	1364.0	1229.0	1.98	12.14	3.90
785	25.54	25.0	20.0	1	1281.0	1162.0	2.20	13.84	3.96
785	25.54	25.0	25.0	2	1698.0	1522.0	1.60	9.78	3.18
PC/XT		4.77	4.77		57.8	52.5	31.26	264.35	13.74
PC/AT		6.00	4.00		98.0	89.0	26.66	170.31	13.91
Number Smasher		9.54	9.54		148.8	137.8	13.13	109.20	6.64
Prodigy 4 Mac					528.0	485.0	3.00	failed	2.45
VAX 11/780 FPA					1191.0	734.0	3.00	N/A	N/A
VAX 11/785 FPA					1800.0	1157.0	1.30	7.90	0.399
Sun 3/260 FPA					3561.0	2373.0	0.65	2.21	0.68

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New Products

Manufacturers who would like to have their hardware products listed here should send their news releases to the Managing Editor, Micro/Systems Journal, *501 Galveston Dr., Redwood City, California 94063.*

New Software Products

Interpreter for Debugging Turbo C

Gimpel Software has released Turbo C-terp, a debugging C interpreter that is fully compatible with Turbo C. C-terp's debugging facilities include split screen with code in the upper portion and dialogue in the lower. Breakpoints can be temporary or sticky, specified via line number, function name, or cursor, and may be conditional. Any C expression may be executed, and the value of any expression may be displayed, and arrays, subarrays, and structures are dumped automatically. C-terp also features function traceback with arguments, watch expressions, and watch conditions. C-terp is a development environment that supports full K&R C plus ANSI enhancements, supports multiple modules, includes a built-in multifile editor, built-in automatic make, a virtual memory option, and shared symbols.

Turbo C-terp is available for $100 from Gimpel Software, 3207 Hogarth Lane, Collegeville, PA 19426; (215) 584-4261.

PC-Compatible Hardware

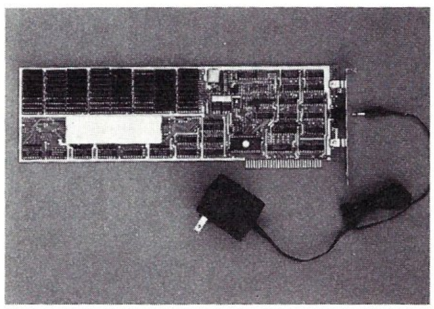
Multiuser PC Card

The Quicklink-IV is the newest four-user plug-in card developed by InterContinental Microsystems (ICM). This PC/AT latest version of the ICM Quicklink can plug into any PC/AT or compatible to add from four to 16 users per PC, thus eliminating the need for an expansion chassis in most applications. With the expansion chassis, up to 100 users can be added. Quicklink-IV runs Novell Netware 86 and 286, including thousands of Netware-compatible multiuser software packages. As with the Quicklink, each user is based on an 8086-compatible processor running at 8 MHz and has 640K of RAM.

Quicklink-IV lists for $2,295, or approximately $575 per user. For more information, contact InterContinental Microsystems, 4020 Leaverton Ct., Anaheim, CA 92807; (714) 630-0964.

Add-On Solid-State Memory Drive

Kapak Design has introduced the Novo Drive 2000 RAM-based disk drive for IBM PC/XT/AT and compatibles. This solid-state unit offers 2 megabyte capacity on a



single card. This product is designed to quickly access and transfer data using Direct Memory Access (DMA), which transfers information every memory cycle. Installing the Novo Drive 2000 is easy since it formats itself during first power up with the need for special drivers or programs. Boot firmware is part of the product. And because the Novo Drive is separate from the main memory, it is compatible with all types of add-on memories.

The Novo Drive 2000 is available for $570. For more information, contact Kapak Design, 12280 Saratoga-Sunnyvale Rd., Saratoga, CA 95070; (408) 253-5000.

Other Hardware Products

Test Unit Simulates Cable

Telebyte Technology Inc. has released the Model 451 Wire Line Simulator to simulate a pair of wires to be used for ISDN, T1, or other short-haul facilities. The Wire Line Simulator is the first of its kind to offer T1 capability, and can use 1.544 MHz T1 or the European 2.048 version. The unit allows for worst-case testing of cable lengths of up to 7500 feet (whereas AT&T provides repeaters every 6000 feet)

and can introduce up to 25,500 feet for testing other technologies.

The Model 451 Wire Line Simulator is available for $2,950. For more information, contact Telebyte Technology Inc., 270 E. Pulaski Rd., Greenlawn, NY 11740; (800) 835-3298, (516) 423-3232.

Multiplexer Facilitates Information Sharing

The newest addition to Astrocom Corporation's product line is Squeeziplexer, a 3199 controller multiplexer. This unit allows users to connect up to four IBM 3299-compatible coaxial links from an IBM 3X74 controller. Data from as many as 32 terminals can be transmitted over a single RG62A/U coaxial or fiber optic cable to a remote terminal Squeeziplexer, The remote unit then demultiplexes the signal and sends the data to the appropriate terminal device.

The Squeeziplexer is priced from $1,250 for a standalone model. For more information, contact Astrocom Corporation, 120 W. Plato Blvd., St. Paul, MN 55107; (612) 227-8651.

CORRECTION:

In the November/December 1987 issue of *Micro/Systems*, we profiled the VAST system, a new helical-scan recording device from Emerald Systems. The correct price for that unit is $6,995. §

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- Interfacing to the PS/2
- Interfacing to the OS/2
- C Software Development Tools
- PC Multiuser Operating Systems
- 386 Software Development Tools
- UNIX on the PC

We would welcome your contributions on any of these subjects. Please contact:

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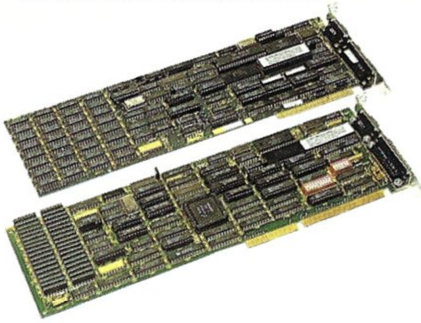
Shaun Hooper

PC-PLUS™ High Performance Network Solutions

Unlike traditional LANs, PC-PLUS' on-the-bus architecture puts the computing power where you need it — with the data — inside the server.

PC-PLUS: The LAN Engineered for Shared Data

Any local area network can connect PCs. PC-PLUS, however, is engineered to optimize multiuser access to shared databases. We put a PC — or AT — on a card that *plugs into the server.* Putting your computing power on the same bus as your data. Giving you high bandwidth *where you need it.* Without the transmission overhead that steals performance on most LANs.



PC-PLUS Gives You the Power You Need

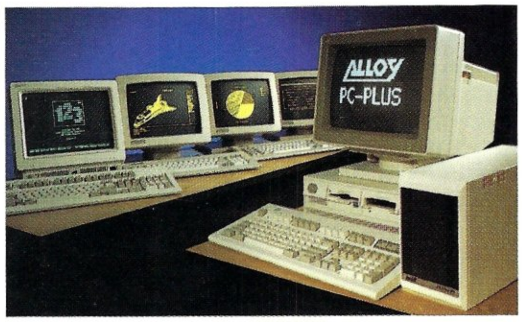
Our plug-in cards come as 8 MHz PCs or 8 MHz ATs — to match your computing needs exactly. And PC-PLUS networks can *deliver* that power — proven by benchmarks. Power to get your job done. Power to grow into new applications without sacrificing performance.

PC-PLUS is Easy to Install and Use

We put the computing engines all in one place — in the server. Not spread all over the building. And our LAN software is truly easy to install. Use PC-PLUS with your choice of AT compatible servers or with Personal System/2.™ Add a card and terminal to grow. Simple RS-232 twisted-pair data cables — no expensive rewiring with coax. You can often use existing telephone cable. Convenient packaged solutions, including Alloy's NTNX™ network software.

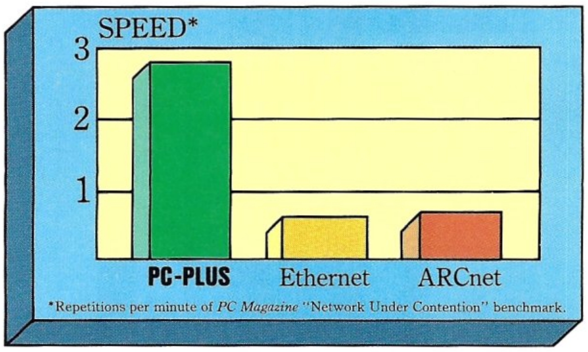
PC-PLUS Runs With Personal System/2

With Alloy's new HI/2™ Micro Channel™ interface, you can connect PC-PLUS to IBM's new Personal System/2 Model 50, 60 or 80 computers. Use Alloy's 4, 8, 12 or 16 slot expansion boxes to build PC-PLUS networks with PS/2 file servers. Or choose our PLUS4/PS for a simple, preconfigured 4 workstation network.



PC-PLUS: Find Out Before You Invest

A local area network is a long term investment. Today's applications are just the beginning. Make sure your choice is ready for tomorrow — with mainframe connections, remote access, graphics and the power for growing database applications. To find out more about PC-PLUS, call or write Alloy today at (617) 875-6100.



*Repetitions per minute of *PC Magazine* "Network Under Contention" benchmark.

PC-PLUS™ The No-Nonsense Network

ALLOY COMPUTER PRODUCTS

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