# news@ftp

The FTP Software® Newsletter

Volume III, Number 2 June 1990

**Inside…**


| Item | Page |
|---|---|
| New Product News | 2, 3 |
| Masthead | 2 |
| Technical Support | 4 |
| Corporate Notes | 11 |


## New Release of PC/TCP® for OS/2®

**by Bruce Campbell**

On April 4, 1990, four years to the day after the first release of PC/TCP, FTP Software released PC/TCP for OS/2. PC/TCP for OS/2 provides the link between OS/2-based PCs and everything from micros to supercomputers. It is a complete implementation of the TCP/IP protocol suite and provides the expected client utilities for file transfer, terminal emulation, electronic mail, remote command execution, remote backup, printing, and network information.

In addition, servers are included for the FTP, Telnet, Rexec, Rsh, and Tar protocols, as well as a simple route server. This means that you can transfer files directly from an OS/2 PC (also true with our PC/TCP for DOS™ product), execute OS/2 commands from a remote host, use an OS/2 PC as a tape backup server, and use the OS/2 PC as a low performance router.

Since the full multi-tasking capability of OS/2 is used, you can leave an FTP server up in one window, keep a tape backup operating in another window, and open multiple Telnet sessions in other windows. Presentation Manager™ is used to control these windows, and a mouse click or keyboard command moves you from one application to another.

With multi-tasking and servers, the PC becomes more like a minicomputer. Instead of the old client-server model for PC networking, a peer-to-peer model applies.

We also include several new utilities for your mailing pleasure. The **pcmail** utility simplifies mail reading by allowing your OS/2 PC to connect to a mail server and then process new messages as a batch process. Mail is read, saved, replied to, forwarded, and deleted off-line, saving your mail gateway's CPU cycles for more important tasks. POP2 and POP3 make sending mail easier by batching outgoing mail, thus permitting mail to be composed offline. We include unsupported public domain versions of the Berkeley UNIX® servers for these clients, so you can get a complete (though unsupported) mail system from FTP Software.

The PC/TCP Development Kit for OS/2 consists of a complete 4.3 BSD socket library. This socket library is identical to the PC/TCP for DOS socket library, in order to make porting applications easier. Libraries for FTP, Telnet, RPC, and the SUN extensions will be added in the near future. An interface that will allow applications to be ported from the DOS environment to the OS/2 environment will also be provided.

We are working on several extensions to the product. An NFS™ client and server are in the works, and NetBIOS is under development. Other applications are being reviewed for inclusion as well.

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FTP Software welcomes suggestions and contributions from readers. Submissions for the next issue of the newsletter must be received no later than August 30, 1990.

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# Release of PC/LPD for DOS

Printer ports for large, multi-user machines are expensive and computing cycles can be better used for other applications. Proprietary servers such as NetWare™ and LAN Manager work only with DOS machines running the proprietary client. If you have a multi-user host which runs an operating system other than Berkeley UNIX, such as System V UNIX, there are no standard ways to do print sharing. To help users solve these (and other) problems, FTP Software is now selling PC/LPD an inexpensive print server package for the IBM® PC and compatibles.

With PC/LPD, you no longer have to use an expensive multi-user host to get complete print services. Take an old PC, connect printers, and the entire network can share this resource. If printer needs vary, a dot matrix printer can be connected to one port, a daisy wheel to another, and a laser printer to a third, up to the capacity of the PC. PC/LPD can handle requests from any host with an Lpr client (or equivalent) which is Berkeley 4 BSD compliant. This lets networks with a variety of operating systems use a single print server.

## Operation

PC/LPD provides multiple printer service and runs continuously as a daemon taking over the PC. In other words, the computer can t be used for any other applications while PC/LPD is running. PC/LPD on a PC runs roughly as fast as similar programs run on a DEC® MicroVAX®, since the printer is the speed limiting factor.

Keyboard commands are available to operate PC/LPD. You can control individual printers, control each printer s queue, and control overall server operation. A variety of operating data can be displayed, including statistics on printer operation and network connections, printer queue lists, and debugging information.

PC/LPD is compliant with the line printer daemon as documented in the Berkeley UNIX 4 BSD programming documents. It accepts **lpr**, **lpq**, and **lprm** commands from other hosts. These programs are available in a wide range of software which implements the Berkeley utilities, including Berkeley UNIX, MultiNet for VMS and PC/TCP. However, you should note that some UNIX implementations (and other operating systems) do not have these utilities available. You should check to make sure your

software has an implementation of lpr or a compliant utility.

### Hardware Independence

PC/LPD uses the FTP Software PC/TCP kernel as its transport and the kernel is included with PC/LPD. Because PC/LPD uses the PC/TCP kernel, it will operate on Ethernet™, Starlan, and Token Ring networks. Over 40 different network interface cards are supported, making it possible to use practically any interface card on the market. PC/LPD will run on IBM PCs, ATs, PS/2s, or compatibles, so a site can often install PC/LPD without buying any additional hardware.

## LANWatch® now Supports Ethernet Packet Drivers

**by James VanBokkelen**

A new version of LANWatch which uses the Packet Driver specification for monitoring Ethernet and Starlan networks is now in beta test. We expect quite a lot of sales from the new LW-110, because it has the potential to open up a large number of network interfaces which previously could not be used by LANWatch. There are a few hurdles that need to be dealt with first, however.

As of version 2.04, the Generic Ethernet PC/TCP uses only a minimal the basic level of the functions defined in the Packet Driver specification. The following functions (from the basic level) are required:

| | |
|---|---|
| *driver_info()* | Get Packet Driver characteristics |
| *get_address()* | Return MAC address of the interface |
| *access_type()* | Request demultiplexing of a packet type |
| *release_type()* | End demultiplexing of a packet type |
| *send_pkt()* | Transmit a packet, blocking until done |

In addition, the 2.04 kernel will make use of the following "high performance" level function, if available:

| | |
|---|---|
| *get_parameters()* | Read extended driver configuration info |

This is used primarily to determine if the Packet Driver issues an interrupt which the kernel can hook to do further processing after the driver has dismissed a hardware interrupt. If this is available, the kernel can provide better transport layer performance for our TCP/IP NetBIOS product.

The Packet Driver LANWatch uses the same functions that 2.04 does, except for *send_pkt()* and *get_parameters()*. It also breaks new ground, in two ways.

First, it uses two extended Packet Driver functions:

| | |
|---|---|
| *set_rcv_mode()* | Change interface s address matching |
| *get_statistics()* | Read interface hardware counters |

*set_rcv_mode()* allows the application to control what sort of hardware address matching the interface performs. Various levels are specified, but LANWatch requests mode 6, receive all packets . If the Packet Driver indicates that it doesn t support extended functions (in the functionality value returned by the *driver_info()* function), or if the call to *set_rcv_mode()* to mode 6 fails, LANWatch can t continue.

Second, the Packet Driver LANWatch calls *access_type()* only once, where PC/TCP calls it five times. For its one handle , LANWatch passes a *typelen* argument of 0, match all packet types , in order to see all the different protocols on the wire. If the Packet Driver doesn t support this, LANWatch exits with an error message, giving the error code returned by the driver.

The Ethernet drivers in the next release (Version 6) of the Clarkson freeware Packet Driver collection will most likely support LANWatch; the alpha versions we ve seen so far have run perfectly. We are also enhancing our own NDIS to Packet Driver converter module to support LANWatch (although it will only be useful where the NDIS drivers themselves support match all addresses ). We hope that other driver developers and maintainers will seriously consider adding extended functionality over the next year or so; LANWatch is one incentive, another will be our planned addition of IP Multicast support to the PC/TCP kernel, which will require either the *set/get_multicast_list()* functions, or support for mode 5 (all multicast packets) in *set_rcv_mode()*.

# INT 0x14 Telnet

**by Dave Burdelski**

PC/TCP s INT 0x14 BIOS emulator, **tnglass**, uses the definition of INT 0x14 that is published in the *IBM AT® Hardware Technical Reference*. This manual presents the BIOS listings and specifications. All four basic functions of INT 0x14 are implemented. These functions, which are invoked based on the value found in the AH register at the time of the INT 0x14 instruction, are listed below.

| Function | AH | AL |
|---|---|---|
| initialize port | 0 | initialization byte |
| send a character | 1 | character to be sent |
| receive a character | 2 | character read returned here |
| status | 3 | status value returned |

On return (IRET) from the INT 0x14 routine for function AH=3, a status word is returned in AX.

Our current current implementation does not implement the so-called extended BIOS functions (AH > 3) as published in the *PS/2® Technical Reference Manual* or the FOSSIL extensions.

An ambiguity that seems to be plaguing emulator writers is that before you can expect to send, or (especially) receive, 8-bit data on the connection, you must specify that the word length is 8 bits. This initialization is done through the AH == 0 function of INT 0x14. According to the BIOS listing in the *IBM AT Hardware Technical Reference Manual*, the two low order bits of AL determine the word length:

if (bit 1) == 1 and (bit 0) == 0, then the word length is 7 bits

if (bit 1) == 1 and (bit 0) == 1, then the word length is 8 bits

The snippet of code below (from the **tnglass** program) shows what our software does when asked for various word lengths.

```
int14_bin(c)
register byte c;                /* c is character from INT 0x14 service routine. */
{
     if ((c&3)==0x03) {         /* i.e. if bits 0 and 1 are set: */
          tn_rqst_bin(tn);      /* then request TELNET binary mode! */
     } else {
          if ((c&0x02)==2) {    /* i.e. if bit 1 is set and bit 0 is not: */
               tn_bin_off(tn);  /* tell host WONT BINARY (i.e. 7 bit mode) */
          }
     }
}
```

This functionality has been tested extensively in the 2.04 patch level 1 implementation of the **tnglass** program. One way to verify that the code really works is to write a simple test program through the PC s **debug** program. Let s assume that you have connected to a host called *random* using the **tnglass** emulator with *command.com* (the DOS command interpreter), as follows:

```
c:> tnglass.exe host -e \command.com
```

Now, enter **debug** by typing debug at the prompt. Then, assemble the following program through **debug**, using the a command at the **debug** prompt. Line by line, this program does the following:

```
mov ah,0   ; sets up for the initializa-
           ; tion of the RS232 port.
           ; (Subfunction initialize)
mov al,3   ; Sets bits 0 and 1 indicating
           ; an 8-bit word length
int 14     ; Call the BIOS INT 0x14
           ; (Serviced by PC/TCP).
nop        ; hang out here!
```

Execute this down to the nop instruction, by using the **debug** g command. Watch your LAN analyzer to get a packet trace of the transaction between you and the remote host, and you should see several packets traded. The PC should send TCP Telnet data ff fd (Telnet IAC followed by Telnet DO BINARY ) and the remote host, if it understands

Telnet binary mode, should reply with ff fb (Telnet IAC followed by Telnet WILL BINARY ). Next, you should see the PC send ff fb (Telnet WILL BINARY ) and the remote host should respond ff fd (Telnet DO BINARY ). If these packets are traded as specified here, the connection is now binary, and 8-bit data will flow correctly.

This is an empirical test to determine that the code works as stated. Until a standard has been established, we hope that this will serve as a guide to INT 0x14 emulator implementors who wish to interoperate with the PC/TCP BIOS emulator.

### Editor s Note

A number of terminal emulation software packages have been written to use INT 0x14 and the PC/TCP kernel to communicate with a remote host over a network. Some are listed below. Additional products will probably work with PC/TCP, if they normally communicate through the COM ports and can be reconfigured to use INT 0x14.

DCS makes emulators for the Tektronix® 4014 and 4105 terminals, as well as the VT®100 and VT220 terminals from DEC. For more information, contact:

Diversified Computer Systems
3775 Iris Avenue, Suite 1B
Boulder, CO 80301
(303) 447-9251

Grafpoint™ makes emulators for the Tektronix 4010, 4014, 4105, 4107, 4109, and 4115 terminals, as well as the VT52 and VT100 terminals from DEC. For more information, contact:

Grafpoint
4340 Stevens Creek Boulevard
San Jose, CA 95129
(408) 249-7951

TEEMTALK™ from Pericom emulates the Tektronix 4105, 4111, and 4207 terminals, as well as the VT52, VT100, VT220, and VT241 ReGIS terminals from DEC. For more information, contact:

Pericom
2291 205th Street, Suite 103
Torrence, CA 90501
(213) 618-9190

SmarTerm® 240 from Persoft® emulates the VT52, VT100, VT220, VT240, VT241 with ReGIS graphics, and VT340 with 16-color ReGIS graphics terminals, as well as the 2392 terminal from Hewlett-Packard. For more information, contact:

Persoft, Inc.
465 Science Drive
Madison, WI 53711
(519) 886-5320

The Reflection® series of products from Walker, Richer & Quinn emulates the 700/92, 2392A, 2623A, 2624B, and 2627A color graphics terminals; Tektronix 4014 terminal; and the VT52, VT102, VT220, and VT241 with 16-color ReGIS graphics terminals from DEC. For more information, contact:

Walker, Richer, & Quinn
2825 Eastlake Avenue East
Seattle, WA 98102
(800) 872-2829

## The INTEROP 89 Network: From one of its builders

**by Stev Knowles**

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### Introduction

There are infinite reasons to go to the INTEROP trade show. Daniel Dern went through several in his ConneXions article in the November 1989 issue. In the past, when I have gone to INTEROP, I have done a wide variety of things, going to class sessions to learn about new protocols my company had an interest in, attended BOF sessions concerning issues from the extremely boring to the excitingly fascinating. I had hoped that INTEROP 89, the biggest INTEROP held so far, would be a place to renew friendships with the people I rarely see, and to talk (all right, argue) about current hot topics. Unfortunately, I didn t get much of a chance to do any of these things. Fortunately, what I did get to do was infinitely more interesting than arguing about routing with people who already have their minds made up.

*continued*

Before I get lost in detail, allow me to clarify some points. I am sure that there will be people whom I will not mention here, who deserve some credit for their assistance in INTEROP 89. The number of companies and individuals who provided hardware and assistance is monumental. Rarely have I seen so many companies help each other out, with loans of equipment and technical expertise to bring everyone s networks up with a minimum amount of hassle and stress. Several companies provided equipment from their booths for the INTEROP show to use for emergency shortages and changes in topology, some just hours before the doors opened Wednesday at noon. The network ran smoothly, once the show opened. The only complaint that made its way back to us was one conference attendee who felt that everything was running too smoothly. There was no one running around, typing hurriedly at a terminal, while 5 people stood around him with concerned expressions on their faces. Whoever you were: sorry about that!

## The Real Heroes

There are two people who deserve most of the credit for the success of the INTEROP show network, Peter de Vries, and Lisa Robertson, both from Interop. These are the people who spent months planning out the physical topology, adding up the lengths of cable runs, locating fan-out boxes and concentrators, coordinating with the vendors who loaned all the hardware that makes a network run, making sure that everyone was listed in all the appropriate lists for their network drops, and making sure that the 25 or 30 cases of assorted soda that the technical people consumed were always cold. This is an important point: if they remembered to keep the soda cold, you can assume that they had thought of everything else too. They had.

You may wonder why I am writing this, if all the credit for this goes to Peter and Lisa. Well, to be honest, so do I. I was invited to join about 10 other people to put together, play with, and take apart an arbitrarily complex network. A lot of people take this very seriously, and ignore that this is in reality a challenging goal. During the brief time it is up, it is a pretty amazing toy. The fact it was kept running in a near flawless condition was due to our pride in its magnificence. Our grand toy should appear nothing less than awe-inspiring to other people. As for our motivation for putting forth all this effort, if you have to ask, you wouldn t understand the answer.

This article is not intended to give one a coherent story about what went on in creating the shownet for the INTEROP 89 show, but rather to provide highlights of the difficulties we ran into, and explanations of the options as we saw them, and our decisions and reasoning behind the decisions. It is possible (actually, probable) that any given decision could have been made better, but one must realize that the people who produced the shownet did so in 4 days, working 18 hour days.

## An early start

Friday morning started early; 5:30 am wake up call, 6:00 am meeting. Valerie Collins (Interop) had reserved a room for us every morning at 6:00 am for breakfast until Wednesday. The first breakfast included about 20 people, including reps from some of the vendors who were loaning us hardware and some of the more esoteric other toys we needed (fiber optic cable, breakout boxes, line testing equipment).

Within 3 hours it became clear that there were about 10 serious people here. They were, in no particular order, Peter, Lisa, Steve Larbig (Interop), Dave Bridgham (Epilogue Technology), Karl Auerbach (Epilogue), John Romkey (Epilogue), Eric Brunner (Tule Network Services), Alan Brunner (consultant), Shelly de Vries (Interop), and myself (FTP Software). These are the people who understood why we were there, and are the people who put in 18 hour days from Friday until Wednesday afternoon. Some of the other people who should be mentioned are Geoff Baehr (Sun), Jeff Burgan (NASA Ames), Ronnie Hueter, Phil Almquist (Stanford University) and Chris Lynch (Interop).

## Network drops

Friday morning was spent marking the approximate locations of the network drops in the booths (some kind souls had already marked the booth locations for us). We just did a rough estimate of the locations; since they would be hanging from the ceiling some 30 feet above us, we could afford a bit of leeway in the exact locations that the wires had to be dropped to. Peter had spent some serious time involved in network planning; when we arrived there were maps of everything we could possibly want. There were maps for all the major media types, UTP (Unshielded Twisted Pair), Thin Ethernet, Thick Ethernet, 802.5, and FDDI fiber. These maps were further sub-divided into work sheets. Work sheets were parts of the master maps

in smaller, workgroup sized allotments. The long, backbone thick Ethernet runs were on one map, the thin Ethernets fanning out from each fan-out location were on others.

Media like UTP and thick Ethernet which had a large number of drops were put on maps based on sections of the show floor (east, middle, and west). Copies of these maps were used by crews of people who went off to do their assigned tasks. When they were done, and when time permitted, someone else would go over the work they had done to make sure everything was in place. As it turned out, we still ended up missing about 3 network drops. Considering there were several hundred, this, I suppose, should not reflect badly on us.

Our greatest resource was having some people on tap who have been doing this for a long time, and along with being up on all the latest technology, are pretty flexible people, willing to scrap the well laid foundation Peter gave us and strike out on our own when it appeared that our previous plans were not going to work. Fortunately, Peter was as agile as we were, and changes were quickly hashed out and implemented.

## Running wires out from the exhibit hall

We found, as we were running wires, that we had been given incomplete information about the building we were working in. We had been told that one could get into the ceiling and thereby cross from the exhibit hall to the main concourse running along the front of the building. This we anticipated using to provide cable runs to the mail centers (one each on the east and west ends of the convention center), the microwave relay (for the mail center in the Fairmont Hotel, across the street), and a set of information terminals being provided by Prime for the concourse area. We found that the exhibit hall s cinder block wall went to the roof, and was sealed to the roof with mortar to provide fire walls. We sent off people to detail the building, and to provide recommendations for how to get the cable out of the exhibit hall and into the concourse area in light of this obstacle. We were brought back several suggestions:

1) We could just run the wires out one of the doors, and then run them back to the ceiling in the hall. The benefit to this approach was that it would be quick to implement. The problems were many, as we saw it. Since we were running cable through a door, it would have to be left open all day and night, requiring another security guard to sit by it. We decided that while we could put a connector in the cable at this point, and disconnect it at night, that would be cutting off e-mail service after show hours. We also decided we could not use one of the main doors, since people would tend to pull on the wires and such. We also decided it was not aesthetically pleasing.

2) We could punch a small hole through the cinder block wall. This was eventually decided to be antisocial (!)

3) The convention center includes floor access plates for power and phone all over the show floor. These open into the garage under the convention center. The people we sent back out were to determine how to get the cables from the garage to the drop locations along the concourse in the front of the building. Unfortunately, there was no access between the garage and the concourse that didn t involve propping open a door. We decided it would be worse to leave these wires hanging out so far from us, and we didn t want to leave a guard down with them.

4) The final suggestion, and the eventual solution, involved careful study of how a large building is put together, and playing on the weaknesses that show up. The convention center is not really one building, it is actually 4 buildings built 5 inches apart. The space between them is covered by aluminum panels. This allows the building to expand and contract as it heats and cools. As it turns out, you can also get from the exhibit hall to the concourse through these passages. The problem here is that these expansion joints tend to travel under walls.

## Expansion joints

The convention center breaks the large hall up into 4 pieces, each slightly larger than the preceding one. This is why the concourse in front of the building is much larger on the east side than the west side, since the walls of the exhibit hall move farther towards the front of the building as you go the the west (see Figure 1 on the following page). The building joints tend to appear at the locations where the walls jut out to make the next hall bigger.

We eventually managed to pass cables through the expansion joints, under the walls, and into the concourse area. This involved an incredible amount of contortion, but seemed the best solution to the problem. We could then continue the run under the floor (in the expansion joint), to the front of the

*continued*

Figure 1: The San Jose Convention Center

building, where we planned to have the mail center runs, and the microwave and Prime terminals were set up. We ended up spending a lot of time trying to figure this one out, and it involved some careful, real-time planning to allow us to remove expansion joint covers when the convention center was not being used by INTEROP or other tenants (this usually happened after midnight or 1 am.).

## Meanwhile, at the Fairmont hotel

At this point, we had a problem with the microwave connection to the hotel. The problem was getting from the room the receiving dish was in to the room the mail center was in. The hotel had told us they would be able to provide a connection between these rooms. We assumed they meant they would be able to connect us through the phone drops in the two rooms by jumpering them together in a phone closet. They thought all we needed to do was run modems between the two rooms, and they had refitted the rooms to have modular connectors in them. We decided that we had benefited from investing the time in sending someone to detail the convention center, so we sent someone over to look at the hotel. Their suggestion we went along with. It involved running a UTP line from the microwave room, to the stairwell, down to the floor the terminal room was on, and over. Fortunately, both rooms were on the same side of the hotel. This involved us using additional UTP transceivers, which we had over-ordered, but required an additional UTP fan-out unit, since you cannot connect UTP transceivers back to back. Discussions with the SynOptics engineers resulted in them removing a unit from one of their demo racks and handing it over to us to use elsewhere.

The final problem with the mail centers, that resulted in us opening them late, after the INTEROP tutorials had started, was a shipping delay in the fiber we expected to run along the front of the buildings. We decided to wait for the fiber to show up because our shipping contacts told us it was in transit, and because we already had the appropriate hardware on hand to allow us to use it. After Monday, we decided that we were going to assume the fiber was never going to show up, and huddled together for another solution. The final decision was based solely on what we had left over. We ended up running thin Ethernet from the drop to both ends of the building for the mail centers. This introduced yet another problem. We had no equipment on hand to bridge from the thick Ethernet to the two thin Ethernets we were running. A quick talk to the engineers at the Wellfleet booth produced

a box we could use as a bridge for the duration of the show. This was taken from the demo machines they had brought for use in their own booth.

## Connectors

One serious problem we had was with the UTP connectors. These were standard eight conductor telco modular phone type connectors. Initially, the shipment of connectors we got could not be located. We sent out a runner to get more. One thing that people putting on something like this forget is the value of someone to go out and get the things you forget. The more you can keep your crews doing the stuff they do best, the more progress you make. Having someone who is willing to spend the day running around and getting parts, and lunch, for the crews is very important, and may be one of the most generally useful people you will have around. The runner returned with crimp-on connectors. Since I have seen these connectors before, I gave the crew starting on it a quick class in crimping the connectors with a pair of channel-lock pliers. They went off to be productive.

## Two types

Later they returned proclaiming a startling lack of success. As more people got involved, we discovered that there are two types of crimp-on connectors; one for stranded wire, one for solid. We, of course, had stranded connectors, and solid wire. The runner reported that the store he had bought the connectors at only had that one type. One of the people who had extensive experience showed us a connector he had in his pocket. It was much easier to use, since it required no special tools. It had a flared back, where one could lay the wire strands in channels, and screwing the cap on caused teeth to bite into the wires.

This proved to be much quicker than the crimp-on connectors (even after we had gotten some crimping tools), and much more reliable, but had the disadvantage that the part that stuck out of the wall was so wide that the fan-out boxes we used could not have connections in every jack; we had to leave empty jacks between them. While Peter had planned extra jacks, he had not planned on twice as many jacks. Fortunately, Synoptics was able to provide us with additional fan-out boxes for the duration of the show.

Here we got bitten by several problems. The connectors did not arrive on time, and the replacements that were bought were the incorrect type (even the packaging did not imply that there were two types). Fortunately, someone was able to put us in touch with a vendor who would extend us immediate credit for the connectors we needed and let us go and pick them up from them with no notice. Some of the crimping tools we had did not work correctly, and there were not enough of them if they had. The module we were using to test the lines was defective, since the adapter we plugged the cable into had a broken wire. Some of these things we could have taken care of before hand, like more crimping tools, and testing the tester out on a known good wire. Some of it, like the two types of crimp-on connectors, we should have known about, but most of us had never run into these problems before.

## UTP or All I got was a phone connection!

One of the big problems was caused by people not paying enough attention. We ran a lot of UTP. UTP was used for several reasons:

- ¥ It was cheap, and easily available.
- ¥ It was easy to work with, and (we thought!) easy to connectorize.
- ¥ It didn t weigh much, so we could connect more runs to one anchor point on the ceiling.
- ¥ Using off-the-shelf technology, we could provide either thick or thin Ethernet access from it.

The topology was simple, and involved the use of several fan-out boxes. Fan-out boxes can be cascaded to a certain degree (cascading is hanging one fan-out box under another, instead of attaching them all at the same level). The destination end can either provide the user with a thick connection (really, a place to plug in a transceiver cable), or a thin connection (a place to attach a T-connector). Unfortunately, fewer people than we would have thought had heard of this technology. This would not be a problem, but people were being told that we had finished running wire around the show floor (they were concerned since their roady cases were being moved in, filling the aisles, making it impossible for us to move cherry-pickers around the booths. People were constantly coming up to us telling us that they had a phone drop, but not the thick Ethernet drop they expected.

*continued*

Very quickly we started putting up signs at the entrance doors telling people that the UTP drops above their booths were indeed network drops, and not to worry about it. We surrounded the INTEROP booth with these signs also. This did not seem to stem the tide very much. When people would come to ask a question, we would just point to the closest sign, and usually they would go away. Sometimes they would ask anyway. We made the mistake of telling them they would have thick Ethernet or thin Ethernet on the forms they filled out.

What we should have done was ask if they wanted a drop for a transceiver cable or a T-connector. Since we were vague about this, some people did not bring enough of their own equipment. Fortunately, a lot of companies brought more than they thought they could possibly use, and were very helpful in loaning connectors and cables to each other. Seeing competitors helping each other fix problems is unusual in today s competitive market. It is a shame that the customers that came to see the shownet never got to see this wonderful cooperation.

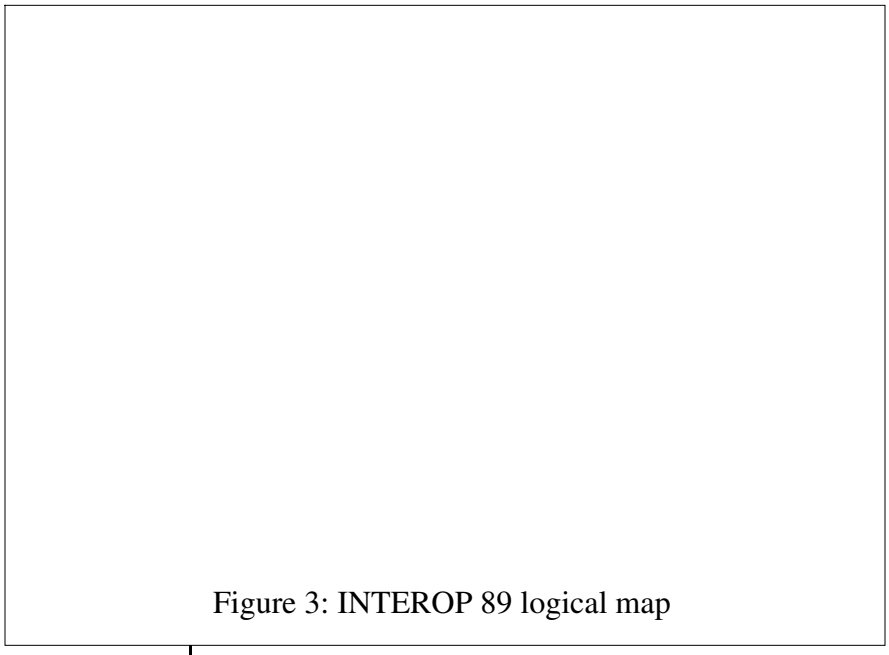

Figure 3: INTEROP 89 logical map

## Routing

Actually, there were few machines on the INTEROP show floor that misbehaved on the community wires. Some booths had routers between their networks and the shownet internetwork. When possible, we got the network addresses they were using internally, and allowed them to be RIPed around the shownet floor. Since the shownet was connected to the outside world by several routes (including NASA Ames and the NSFNET NOC in Ann Arbor), we were very sensitive to routing issues. We allowed only one of the shownet routers to peer with routers outside of our internetwork, and we only allowed it to advertise a route to the shownet class B network. We were not interested in the dynamic routing on the NSFNET backbone finding out that there was a low cost route from the NSFNET NOC to NASA Ames across the shownet.

While this in itself would have been an impressive advertisement for the adaptability of TCP/IP to expand and contract its routes based on availability, we decided that it would be a hard thing to convey to the people visiting INTEROP 89, and it would also add to the load of what we thought would be an over-crowded backbone.

As it turns out, the shownet backbone was very crowded. The network monitoring programs we had available were scrolling packets by faster than one could read. Fortunately, any of the routers we put on the shownet backbone could be configured to broadcast routing information only on certain subnets, and accept information only from certain hosts.

This way, we did not have to worry about someone s mis-configured BSD-derived system trying to peer with the shownet backbone routers. Since there were several fan-out boxes in use, short term network outages were restricted to small physical parts of the much larger logical network, when one thin drop from a fan-out box went unterminated, usually because someone was adding another segment and T-connector to it, the other drops in the fan-out box did not notice the outage, and continued to function as before.

## Lessons learned

What makes an endeavor like this possible? The cooperation among several key people. People who know what you are trying to do very well, and are not so rigid that they cannot accept suggestions from out of their scope of knowledge. Maximizing communications is important. Interop provided the wiring crew with 8 walkie-talkies. These went far in speeding up the decision making process. We spent considerably less time tracking people down

to collect their opinion about crises and planning changes than we would have had to otherwise. It allowed us to propagate changes to the crews faster, and to quickly reassign people to fight crises that were always springing up. Since we had several people around who, while not being knowledgeable about what we were trying to do, were willing to learn how to do the jobs we needed done, willing to follow orders, willing to go run out and pick up supplies, or call people to track down equipment, we freed other people to do more complex jobs.

Keeping people working on what they do best greatly increases the amount of work a crew can accomplish. Since the people assembled here all knew each other, we could quickly put together a good group to evaluate change proposals, or make suggestions about how to fix the problems we encountered. Often we found that even when incomplete groups met to make decisions, the groups would make a decision that the missing people would agree with. Some people find it hard to run a large project by consensus. We found it to be a process that speeded us up rather than slowed us down. Having several people with a complete world view, who could be counted on to give an authoritative answer on 95% of the questions asked, allowed people trying to get work done to move faster since they could get their approval from a closer source.

### Conclusion

All in all, this was a pleasurable experience. I got to work closely with some of the best people in our business, and I was able to learn a lot from the people around me. We ended up with something that the trade show attendees were excited about, and impressed with. I found the vendors in our industry to be made up of smart, helpful people willing to give their competitors a hand when they forgot equipment or cables needed to connect equipment to the shownet. While it was a very draining experience, I would be glad to do it again. We have already started thinking about INTEROP 90. From what I hear, since people thought it went so smoothly this time, we are going to have to make it more complex and flashy next year to impress the attendees. I can't wait to start playing with it!

STEV KNOWLES is a hacker at FTP Software. (This referring to the Old School of hackers, when being a hacker was a title bestowed upon you by others. It is not the only title bestowed on Mr. Knowles by others, but it is the only one we could get past the publisher.) Mr. Knowles had many diverse words (some of encouragement and some not) for the INTEROP 88 shownet engineering team, and therefore was drafted for the 89 team. He is currently involved in the IETF Benchmarking Methodology Working Group, and watches over several projects at FTP. He has no degrees, certificates, or warrants outstanding for his arrest. He can be reached by Internet e-mail as stev@ftp.com.

## The FTP Software Staff

Since FTP Software has been growing so fast over the past year, we would like to introduce you to the members of the board, the officers of the corporation, and the staff. An asterisk next to the name of a board member indicates a previous employee who continues to maintain close ties with the company.

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Robert Goodnow
John Romkey *
Mark Rosenstein *
James VanBokkelen

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Jennifer DeSouza
Margaret Forsythe
Peter Grasso

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Caroline Lange — Manager
Patricia Hanagan
Dave Shute

*continued*

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Michael Greenberg
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Karen Kohn
Bill Lampman
Benjamin Levy
Gary Malkin
Mark Mason
Rehmi Post
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Colin Mahan
Bill Shaw
Jim Worley
Nancy Zipf
Penny Zirkle

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Raghu Nath — Channels Marketing Manager
Cris Shuldiner — Product Manager

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Robert Casa
Kevin Gosson
Keith Nardone

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Larissa King
Sharon Smith
Riki Weiner
Dana Mercer

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Frances Selkirk — Technical Assistant
Tammy D Amore — Receptionist
Kelly Lewis — Receptionist
Marguerite Walsh — Administrative Assistant