

IntranetWare

Over

TCP/IP

Now that most companies are connecting their network to the Internet, they are trying to standardize on a single transport protocol. Since the Internet uses TCP/IP, these companies are evaluating TCP/IP solutions for IntranetWare, which, of course, is currently IPX/SPX based. In the past, Novell has provided several TCP/IP solutions for IntranetWare and NetWare, but a future release of IntranetWare will provide a significant enhancement: IntranetWare will send NetWare Core Protocol (NCP) calls directly over TCP/IP.

This article briefly explains the TCP/IP solutions Novell has offered for IntranetWare and then takes a first look at a pre-alpha version of IntranetWare that has native support for TCP/IP. In fact, the version of IntranetWare I tested ran only on TCP/IP, although the final release of the product will support both TCP/IP and IPX/SPX.

WHAT TCP/IP OPTIONS HAS NOVELL PROVIDED IN THE PAST?

To provide TCP/IP connectivity for IntranetWare and NetWare, Novell has offered several solutions, including IP tunneling, IP relay, the LAN WorkPlace product family (client TCP/IP stack), the IPX-IP gateway, and NetWare/IP.

IP Tunneling

Novell introduced IP tunneling in NetWare 3.11, and every subsequent version of IntranetWare and NetWare has supported IP tunneling. IP tunneling technology is popular on IPX/SPX networks that are linked by a TCP/IP-only backbone. With this solution, an IPX/SPX-based workstation sends its packets to the IP tunnel partner, such as a local router. This partner encapsulates the IPX/SPX packet within a TCP/IP header, addresses this packet directly to its IP tunnel partner (such as a remote router), and sends the packet across the TCP/IP network. The receiving IP tunnel partner strips off the TCP/IP header and transmits the IPX/SPX packet to the remote network. (See Figure 1 on p. 32.)

To set up IP tunneling, you simply configure the IP tunnel partners to communicate with each other; you do not have to use specialized client software. You install the standard IntranetWare or NetWare client software, and the workstations are unaware that their communications are temporarily encapsulated in another protocol en route. As a result, IPX/SPX applications work in the IP tunneling world.

However, IP tunneling does not provide TCP/IP communications all the way to the desktop; the networks are still supporting IPX/SPX communications. If you are trying to restrict your network traffic to a single protocol to reduce protocol troubleshooting and management software, IP tunneling is not a viable solution. NetWare/IP, which is explained later in this article, provides TCP/IP communications all the way to the desktop.

IP Relay

IP relay is based on IP tunneling: IP relay temporarily encapsulates IPX/SPX communications within TCP/IP packets between IP tunnel partners. However, IP tunneling was designed as a single point-to-point connection. IP relay, on the other hand, was designed to tunnel IPX/SPX packets to a collection of point-to-point permanent virtual circuits (PVCs). A PVC is a continuously available communications path, such as a leased line, between two fixed points. For example, if a company supported six branch offices that were connected to the corporate backbone through leased lines, the company would have six point-to-point PVCs. If your network is designed in a star topology with a central hub office connected to several remote offices, IP relay provides IP tunneling technology for multiple point-to-point links.

IP relay offers the same advantages as IP tunneling by enabling workstations to maintain IPX/SPX at the desktop while encapsulating their communications within a TCP/IP header to cross a TCP/IP link. The workstations still communicate with the IP tunnel partner via IPX/SPX. If you want to restrict multi-

What's New on CNE Net's World-Wide Web Site

If you haven't visited CNE Net's World-Wide Web (WWW) site lately, you might want to stop by to check out the resources Novell has recently added to this site (<http://cnenet.novell.com>). For example, you can enter the CNE Net Refresher Contest, take advantage of the IntranetWare for Small Business Promotion, view the tech tip of the week from Novell Technical Support, and read all about the person who won a red Porsche Boxster in Novell's Rock the Net Sweepstakes at NetWorld+Interop.

Because CNE Net is Novell's benefits program for CNEs, you must be a CNE to access this site. If you are a CNE, you can access the site by entering your Novell Education testing ID or social security number as the username and your Novell Education personal identification number (PIN) as the password. If you have misplaced your PIN, you must call the Novell Education office nearest you. (To view a list of offices, go to <http://education.novell.com/general/eduphone.htm>.)

CNE NET REFRESHER CONTEST

CNE Net is now offering the CNE Net Refresher Contest, which you can enter on CNE Net's WWW site. Beginning on June 2, Novell will post five CNE test questions per week for four weeks, and you must submit the correct answers to these questions each week. If you receive a cumulative score of 90 percent or higher for all 20 questions, your name will be entered in a drawing to win prizes such as IntranetWare, GroupWise, or ManageWise.

and FTP Server Installation and Configuration (course 658). If you take advantage of this offer, you will automatically earn your IntranetWare CNE certification without having to pass test 50-627, which corresponds to course 540.

SEVERAL WAYS TO WIN

As if all of these discounts and incentives weren't enough, Novell Education is also giving away four Compaq DeskPro 6000 multimedia computers with a Pentium Pro 200 MHz MMX processor. To win one of these computers, you must enter the Increase Your Net Worth Sweepstakes by July 31, 1997. Novell Education will automatically enter you in the sweepstakes if you do one or more of the following:

- Take any Novell Education authorized certification test
- Earn your Novell Certified Internet Professional, Certified Novell Salesperson (CNS), Certified Novell Administrator (CNA), CNE, Master CNE, or Certified Novell Instructor (CNI) certification
- Update your contact information in the Novell Education database

If you have taken or registered for a certification test, you have been assigned a personal identification number (PIN) that allows you to access the Novell Education database. (If you have misplaced your PIN, you must call the Novell Education office nearest you. You can find a list of offices at <http://education.novell.com/general/eduphone.htm>.)

To access the Novell Education database, go to <http://certification.novell.com/pinlogin.htm>, and click the Login Now button. Then enter your Novell Education testing ID or your social security number as the username, and enter your PIN as the password. After accessing the database, you can update your contact information, and you can also change your PIN and check the status of any certification you have already earned or are currently working on.

You can submit additional entries to the Increase Your Net Worth Sweepstakes by purchasing an instructor-led, self-study, or computer-based training course from your local Novell authorized education center (NAEC) by July 31, 1997. Novell Education will announce the winners of the sweepstakes in a live chat forum on August 15, 1997. If you

And if you don't win the first time, you may have another chance: After the first contest is completed, CNE Net will repeat the contest using a different set of CNE test questions.

WATCH FOR SUCCESS PROMOTION

CNE Net is also offering the IntranetWare for Small Business promotion, and you can take advantage of this promotion by submitting an IntranetWare or IntranetWare for Small Business success story on CNE Net's WWW site. If Novell decides to use your success story in its marketing campaign, you will win a Swiss Army watch and an IntranetWare for Small Business T-shirt.

TECH TIP OF THE WEEK

Every Monday, CNE Net's WWW site features a tech tip of the week from Novell Technical Support. In addition to viewing the latest tech tip of the week, you can view past tech tips of the week in categories such as Server/OS, GroupWise, ManageWise, and UNIX Connectivity.

ROCK THE NET SWEEPSTAKES WINNER

CNE Net sponsored Novell's Rock the Net Sweepstakes, which was held May 5-8 at NetWorld+Interop '97 in Las Vegas, Nevada. Joanne C. Egner, a product marketing analyst at Tally Systems Corp. in Hanover, New Hampshire, won the grand prize in this sweepstakes: a red Porsche Boxster. On CNE Net's WWW site, you can find out more about Joanne, including how she's enjoying her fabulous prize. Congratulations, Joanne! ●

have entered your current e-mail address in Novell Education's database, you will receive an e-mail message telling you exactly when and where you can participate in the live chat forum.

CONCLUSION

Novell Education may have extended its Increase Your Net Worth promotion, but this promotion will not last forever. If you have been planning to take course 540 or 555 or if you have been thinking about earning your CNE or Master CNE certification, now's the time to take the plunge. And if you are a CNE who wants to check out IntranetWare, GroupWise, or ManageWise, you should enter the CNE Net Refresher Contest, which is now being held on CNE Net's World-Wide Web (WWW) site (<http://cnenet.novell.com>). You could win a free copy of one of these valuable Novell products. (See "What's New on CNE Net's World-Wide Web Site.")

For more information about Novell Education's Increase Your Net Worth promotion, call 1-800-233-EDUC or 1-801-222-7800. You can also visit Novell Education's WWW site (<http://education.novell.com/networth>). ●

point links to TCP/IP-only communications, IP relay is a viable solution.

Like IP tunneling, IP relay enables IPX/SPX workstations to communicate across a TCP/IP network but does not bring TCP/IP all the way to the desktop. You must still manage two protocols on your IntranetWare or NetWare network.

LAN WorkPlace

Novell's LAN WorkPlace products enable DOS, Windows 3.x, Windows 95, and Windows NT 3.51 and 4.0 workstations to run TCP/IP and IPX/SPX applications simultaneously. For example, with LAN WorkPlace Pro for Windows 95 and NT, a Windows NT workstation could use TCP/IP to access a UNIX host and IPX/SPX to view IntranetWare drives. However, Novell's LAN WorkPlace products do not convert an IPX/SPX network to a TCP/IP network. These products simply add TCP/IP connectivity, allowing users to run TCP/IP applications.

Unlike IP tunneling and IP relay, Novell's LAN WorkPlace products do not encapsulate IPX/SPX communications within a TCP/IP header. Instead, TCP/IP applications use the TCP/IP stack, and IPX/SPX communications use the IPX/SPX stack. However, you must run LAN WorkPlace on each workstation that needs TCP/IP connectivity, and you must manage two protocols on your IntranetWare or NetWare network.

IPX-IP Gateway

IntranetWare includes an IPX-IP gateway, which converts IPX/SPX communications to TCP/IP communications. This gateway allows you to run TCP/IP applications (such as Netscape Navigator) over an IPX/SPX network.

With Novell's IPX-IP gateway, you do not have to load a TCP/IP stack on your IPX/SPX-based workstations. However, you must install the IPX-IP gateway client software on these workstations. This client software intercepts TCP/IP communications, appends an IPX header to the TCP/IP packets, and directs these packets to the IPX-IP gateway. The gateway, in turn, converts the transport protocol to TCP/IP and forwards the packets to their intended destination.

If you are managing a large IPX/SPX network that requires TCP/IP communications, Novell's IPX-IP gateway can be a blessing: You can provide workstations with TCP/IP connectivity without

enduring the IP addressing headache. Unfortunately, however, these workstations must communicate with an IP host through a gateway, which affects the performance of your network communications. (See Figure 2 on p. 32.) (For more information about IPX-IP gateways, see "IPX-IP Gateways: Find Internet Solutions at a NetWare Conference and Exhibits," *NetWare Connection*, July 1996,

pp. 60-64. You can also download this article from <http://www.novell.com/nwc/jul.96/nuinws76/nuinwi76.html>.)

NetWare/IP

NetWare/IP allows you to maintain a TCP/IP-only IntranetWare or NetWare network. As the predecessor to IntranetWare over TCP/IP, NetWare/IP offers an excellent stepping stone to native TCP/IP.

Inetix[®]

IP to IPX/SPX Gateway

- Provides easy access to the Internet without loading TCP/IP.
- Gateway and Client available on multiple platforms with full 32-bit client support for Windows 95 and Windows NT.
- Includes easy-to-use file transfer program (FTP) and Calypso Lite e-mail.
- Natural built-in firewall, since clients do not have TCP/IP installed.
- Enhanced logging including user, group, workstation, time, host IP and domain name, bytes transmitted and received, client access denied and remote site denied.
- Advanced filtering based on the user and groups defined within the operating system. New features include time and day filtering, application filtering and domain name filtering.

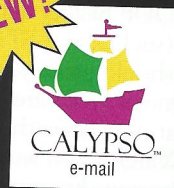
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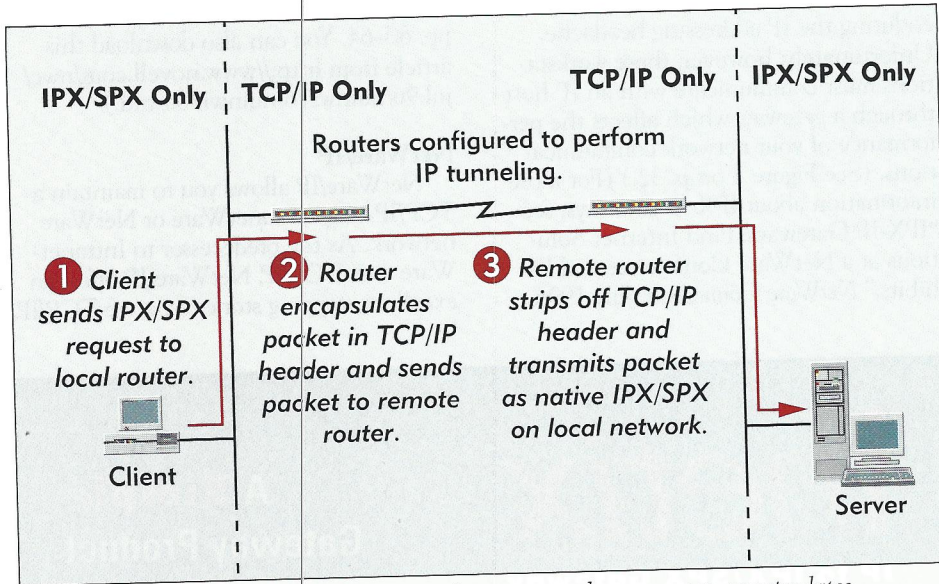


Figure 1. With IP tunneling, an IP tunnel partner, such as a router, encapsulates IPX/SPX communications within a TCP/IP header.

With NetWare/IP, all IPX/SPX communications are encapsulated within IP. If you analyze NetWare/IP communications, you can see the IPX header inside a User Datagram Protocol (UDP)/IP header. (See Figure 3 on p. 37.) UDP is a connectionless protocol similar to IPX. The UDP header defines the specific port (such as the FTP or Telnet port) that should process the packet.

One of NetWare/IP's main advantages is that it works with TCP/IP applications. NetWare/IP also works with IPX/SPX applications because the IPX/SPX stack is still available on each workstation and applications can communicate directly

with that stack. In fact, IPX/SPX applications are unaware that the workstation is using TCP/IP as the transport protocol.

In addition to enabling IntranetWare and NetWare workstations to communicate over TCP/IP, NetWare/IP uses domain SAP servers, which reduce the Routing Information Protocol (RIP) and Service Advertising Protocol (SAP) traffic sent across the network. Unlike IntranetWare and NetWare servers that support SAP and RIP, domain SAP servers do not broadcast SAP and RIP information across the network every 60 seconds. Domain SAP servers reduce SAP and RIP traffic by maintaining SAP and RIP information for

NetWare/IP servers and distributing this information when servers request it. You can load the domain SAP server NetWare Loadable Modules (NLMs) on any IntranetWare or NetWare 4 server.

Although NetWare/IP is a viable solution, it still encapsulates IPX/SPX communications, and workstations must continue to run the IPX/SPX stack.

THE FUTURE: INTRANETWARE OVER TCP/IP

IntranetWare with native support for TCP/IP does not encapsulate or tunnel IPX/SPX communications. With this future version of IntranetWare, NCP calls run directly over the TCP/IP stack and can be routed by any IP router. (See Figure 4 on p. 37.) Novell severed the IntranetWare kernel's IPX/SPX dependency and rewrote the applications and utilities that made IPX-specific calls. As a result, IntranetWare servers and workstations can use TCP/IP, IPX/SPX, or both.

IntranetWare over TCP/IP uses the standard installation program. During the installation process, you select the protocols that your server will support. If you enable IPX/SPX, you must select an internal IPX address for the server, as you normally would. If you enable TCP/IP, you must select an IP address for the server. (Since I tested a pre-alpha version of IntranetWare with native TCP/IP support, I am not sure how you will select protocols in the shipping version of the product.)

NCP takes advantage of both TCP and UDP as transport protocols. Like IPX, UDP provides *connectionless datagram services*, which do not require a "handshake" to set up communications.

TCP, on the other hand, is similar to SPX, which provides *connection-oriented services*. *Connection-oriented services* require communication partners to perform a "handshake" before exchanging data and enable these partners to acknowledge the receipt of transmitted data. Although both SPX and TCP provide connection-oriented services, TCP's windowing and streaming capabilities provide greater throughput than SPX provides.

Some NCP calls use UDP, and some NCP calls use TCP: For example, "control" NCP calls, such as a request for file server information, use UDP. On the other hand, large transactions, such as NCP file reads and writes and Novell Di-

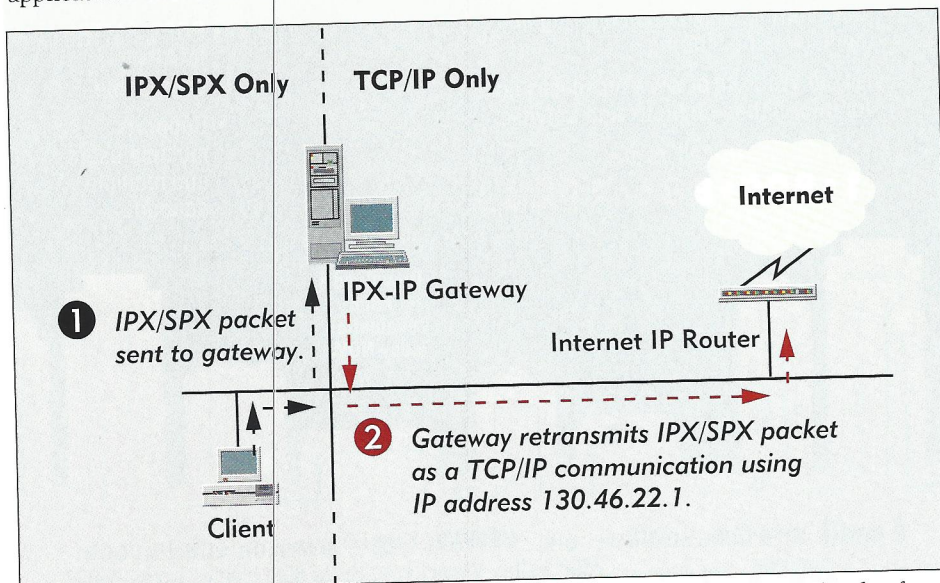


Figure 2. Novell's IPX-IP gateway provides TCP/IP connectivity without the hassle of managing multiple IP addresses.

Standard IntranetWare Communications: NCP Over IPX/SPX

IntranetWare and NetWare use IPX/SPX to send NetWare Core Protocol (NCP) calls over the network. The following sections explain this communications process:

WORKSTATION CONNECTIONS

Using Service Advertising Protocol (SAP), a workstation transmits a Get Nearest Server request to locate either a file server for bindery-based connections or a directory server for Novell Directory Services (NDS) connections. IntranetWare and NetWare servers respond with their internal IPX address. Then to communicate with a server using NCP, the workstation uses the Routing Information Protocol (RIP) to find out how to locate the server's internal IPX address on the network.

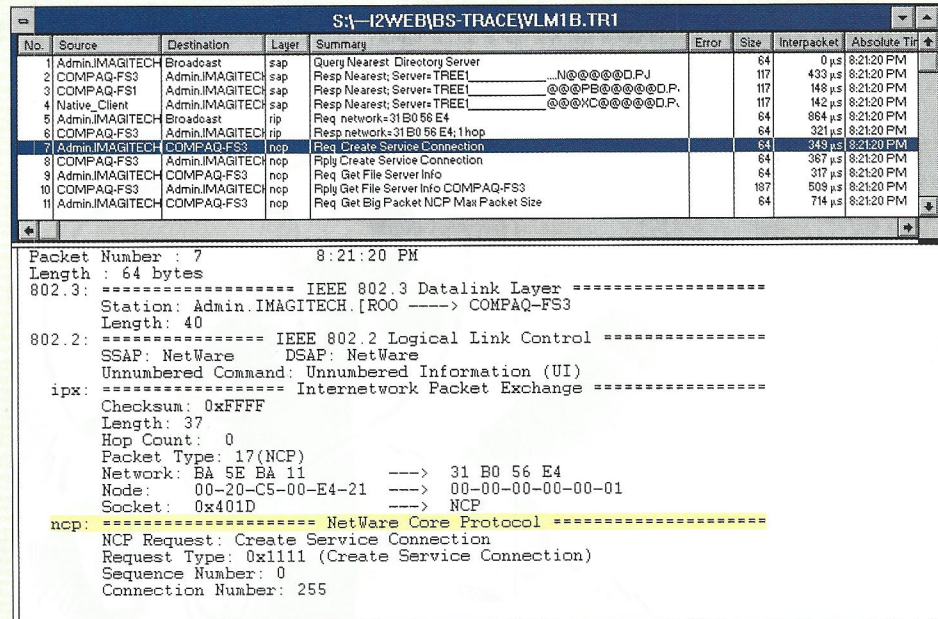
After receiving a RIP reply from a device that can forward the workstation's packets to the requested internal IPX address, this workstation begins to communicate with the server using NCP over IPX. (See Sidebar Figure 1.)

IPX ADDRESSING SCHEME

An IPX addressing scheme is different from an IP addressing scheme. As you know, you do not assign an IPX address to IPX workstations—they dynamically learn their IPX address when they boot up. When first booted, an IPX-based workstation does not know its network address, so it uses network address 0x00-00-00-00 as its source address in its first SAP and RIP packets.

When servers and routers reply to the workstation's request, they include the workstation's network address in the IPX header. The workstation learns its network address when it receives the SAP and RIP reply packets. This workstation then uses its own network interface board address, or node address, as a unique host ID address.

Servers are assigned a network address either manually or automatically (in the case of IntranetWare and NetWare 4 servers) during the installation process. When a server is rebooted, it uses



Sidebar Figure 1. Standard IntranetWare and NetWare communications use NCP over IPX.

this assigned network address and the host ID address 0x00-00-00-00-00-01 for its communications.

Servers also use SAP to share server information tables. By default, servers use SAP to broadcast their server information tables every 60 seconds for every frame type to which IPX/SPX is bound.

IPX/SPX COMMUNICATIONS

Connection-oriented communications use SPX as the transport protocol. (A connection-oriented protocol such as SPX requires communication partners to perform a "handshake" before exchanging data. A connectionless protocol such as IPX, on the other hand, does not require a handshake to set up communications.) SPX relies on IPX for network addressing information. Because SPX is dependent on IPX, applications that are written to use SPX as the transport protocol must be rewritten to use IP.

If you want to see a protocol analysis of IPX/SPX communications, visit the BrainShare section of ImagiTech's World-Wide Web (WWW) site (<http://www.imagitech.com/Bstrace.htm>). This site offers a variety of workstation connection sequences that use IPX-only communications. You can also see a protocol analysis of IntranetWare with native TCP/IP support for comparison. ●

rectory Services (NDS) synchronization, use TCP. Large transactions use TCP because TCP's streaming capability is similar to IPX's burst-mode technology. This capability provides quicker and more efficient file transfers.

The IntranetWare NCP Port

In the IPX/SPX world, developers use sockets to define the sending or receiving process in communications. In the TCP/IP world, however, the Internet

Registration Group assigns port numbers to vendors, thereby differentiating between the various processes on the network. For example, IntranetWare's port number is 524.

The Workstation Connection Sequence

A workstation on an IPX/SPX network sends a SAP Get Nearest Server request to locate an IntranetWare or NetWare server. (For more information about IPX/SPX communications, see "Standard

IntranetWare Communications: NCP Over IPX/SPX.") A workstation on a TCP/IP network, on the other hand, uses the Dynamic Host Configuration Protocol (DHCP) to locate an IntranetWare or NetWare server. After the workstation locates a server using DHCP, this workstation transmits an Address Resolution Protocol (ARP) request to find the server's hardware address. (See Figure 5 on p. 38.) (Because DHCP and BOOTP use the same socket number, LANalyzer for

Configuring LANalyzer for Windows 2.2 to Decode Native TCP/IP Communications

LANalyzer for Windows 2.2 and below cannot decode native TCP/IP communications. However, you can use a text editor to configure LANalyzer for Windows 2.2 to decode NetWare Core Protocol (NCP) over TCP/IP. Complete the following steps to edit the LZFW.INI file (which is usually located in the C:\WINDOWS subdirectory on the workstation that is running LANalyzer for Windows 2.2):

1. Using a text editor, open the LZFW.INI file, and locate the section that starts with "; NetWare." (In LANalyzer for Windows 2.2, you will find "; NetWare" on line 245.)

2. Next, locate the line that begins with "ncp=NetWare," and after this line, add the line below. (This format is case-sensitive.)

```
ncp(ncp/udp)=NetWare,udp,TCP/IP,300,0,0,0,0
```

3. In the [protocols] section, add the following text to the end of the existing DLLFiles1= line. (Make sure you include the comma as shown below.)

```
,l_tdtncp
```

This line should now read:

```
DLLFiles1=l_tdnk,l_tdatk,l_tdnw,l_tdsnmp,l_tdtcp,l_tdnfs,l_tdsna,  
l_tdnwip,l_tdtncp
```

4. In the same section, add the following lines before the "; TCP/IP" line:

```
;  
; NCP over TCP/IP  
tncp=NCPTCPSuite,tcp,TCP/IP,524  
ncp(tcp)=NetWare,tncp,NCPTCPSuite,0  
;
```

Windows 2.2 refers to both protocols as BOOTP communications. For more information about LANalyzer for Windows 2.2, see "Configuring LANalyzer for Windows 2.2 to Decode Native TCP/IP Communications.") At this point, the workstation uses NCP calls to retrieve the file server information, authenticate to NDS, and log in to the server.

SLP Versus SAP

On an IPX/SPX network, workstations use SAP to locate servers, and servers use SAP to share service information with each other. However, servers cannot use SAP to exchange service information on

a TCP/IP network. Instead, IntranetWare servers with native TCP/IP support use the Service Location Protocol (SLP) to exchange service information. SLP is an emerging technology defined for the TCP/IP community.

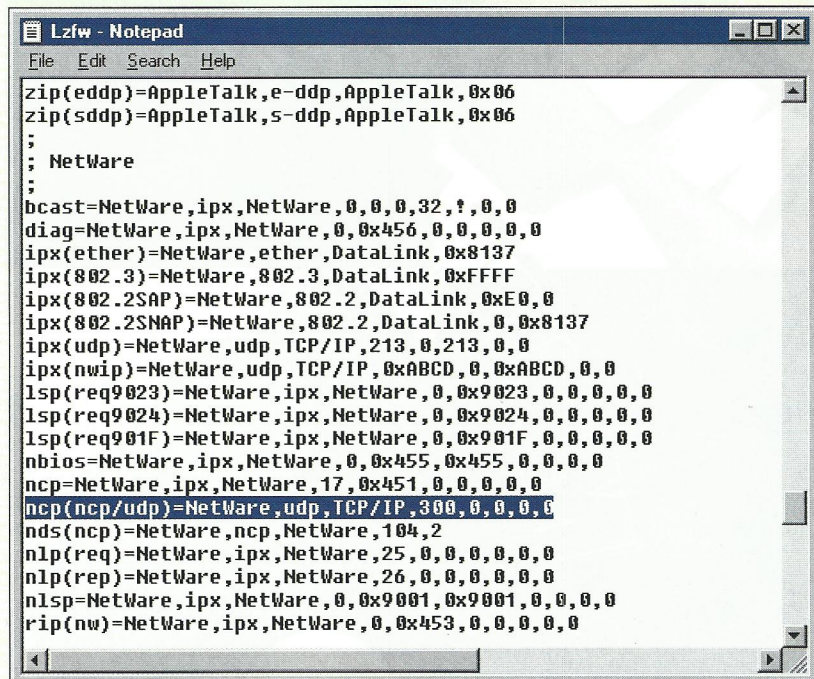
IP Address Assignments

With IntranetWare, you can configure a workstation to automatically obtain an IP address from a DHCP host. Using a DHCP host can dramatically reduce the amount of time required to configure and maintain IP addressing on your network.

IntranetWare offers DHCP support through a DHCP configuration NLM

(DHCPCFG.NLM). You use this NLM to configure DHCP addressing, and it performs the DHCP functions for your IntranetWare network.

On the other hand, you can manually assign an IP address to your workstation. For example, if you wanted to manually assign an IP address to a Windows 95 workstation, you would define the IP address and subnet mask in the TCP/IP Properties window. To access the IP Address Configuration window, select Run, and then select Settings. Next, select Control Panel, select Network, and finally, select the TCP/IP entry listed. (For DOS and Windows 3.x workstations,



Sidebar Figure 2. Editing the LZFW.INI file to decode native TCP/IP communications

5. Save the LZFW.INI file.

6. Locate the L_TDTNCP.DLL file on the CD-ROM that contains the alpha version of IntranetWare over TCP/IP. Copy this file to the LANalyzer subdirectory on your workstation. (If you do not have the alpha version of IntranetWare over TCP/IP, you can download the L_TDTNCP.DLL file from <http://www.imagitech.com/Bstrace.htm>.)

After you complete these steps, LANalyzer for Windows 2.2 can decode NCP over User Datagram Protocol (UDP) communications. (See Sidebar Figure 2.) To ensure that you have edited the LZFW.INI file correctly, download the Moab traces from Imagi-Tech's World-Wide Web (WWW) site (<http://www.imagitech.com/Bstrace.htm>). If you have edited this file correctly, the NCP information is decoded in plain English. (See Figure 7 on p. 39.)

you can define individual IP addresses in the NET.CFG file.)

The next sections explain how to configure the IntranetWare client for TCP/IP and the IntranetWare server to send NCP calls over TCP/IP.

CONFIGURING THE INTRANETWARE CLIENT FOR TCP/IP

To run NCP calls over TCP/IP, you must install the IntranetWare client for TCP/IP and then load and configure a TCP/IP stack. You can use any standard TCP/IP stack, such as the TCP/IP stack that ships with Windows 95.

When I selected Network on my Windows 95 workstation, the following options were listed:

- Novell NetWare Client 32
- LAN Driver (NDIS or ODI) (if you use ODI drivers, you must also load ODINSUP for TCP/IP support)
- IPX 32-bit Protocol for Novell NetWare Client 32
- TCP/IP

The NetWare Client 32 entry was set up when I installed the client software, but I manually added the TCP/IP entry: To add this entry, I selected Add and then Protocol. Next, I selected Microsoft and then TCP/IP.

With IntranetWare, you can configure the IntranetWare workstation to use both IPX/SPX and TCP/IP. This dual-stack configuration enables the workstation to communicate with both IPX/SPX- and TCP/IP-based servers. If you configure all of your servers to run TCP/IP, however, you may want to eliminate the IPX/SPX protocol stack to conserve resources on the workstation. Figure 6 shows the transport options for an IntranetWare network that supports NCP calls over both TCP/IP and IPX/SPX. (See p. 39.)

If you decide to change your IPX/SPX network to a TCP/IP network, you may want to support NCP over both transport protocols during the migration phase. In this way, you can gradually move your workstations to the TCP/IP network. You can also ensure that your NCP applications work properly when they run directly over the TCP/IP stack.

CONFIGURING THE SERVER TO RUN NCP CALLS OVER TCP/IP

As mentioned earlier, you use the standard IntranetWare installation program to

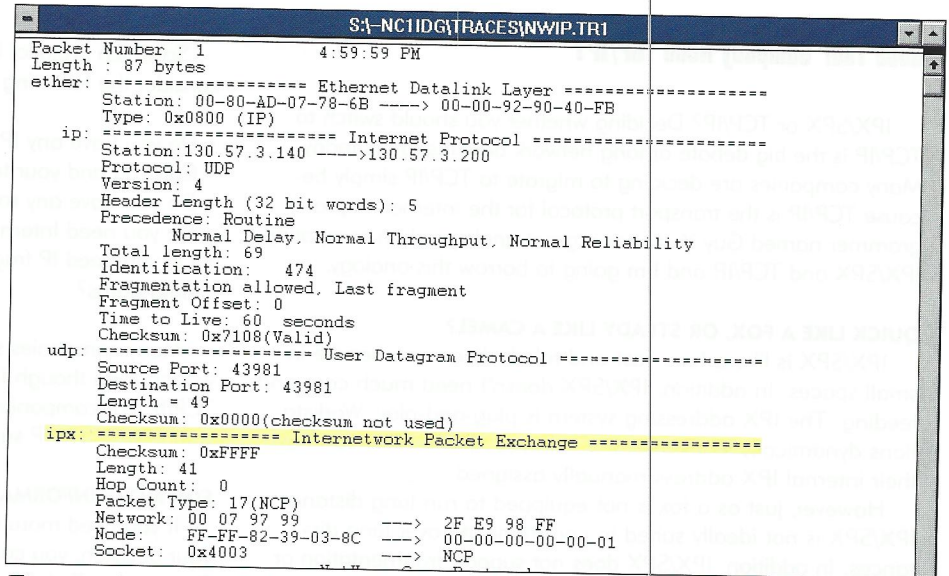


Figure 3. NetWare/IP actually encapsulates IPX/SPX communications within a TCP/IP header.

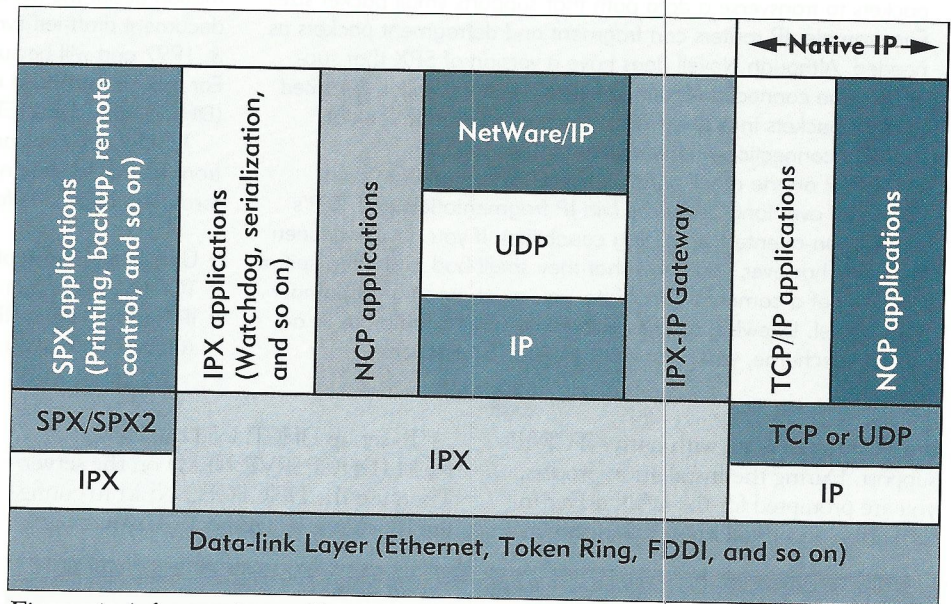


Figure 4. A future release of IntranetWare will send NCP calls directly over TCP/IP.

You've got a fancy cellular phone...

Circle 817 on the reader service card.

Does Your Company Need TCP/IP?

IPX/SPX or TCP/IP? Deciding whether you should switch to TCP/IP is the big debate among network administrators today. Many companies are deciding to migrate to TCP/IP simply because TCP/IP is the transport protocol for the Internet. A programmer named Guy Yost uses a great analogy when comparing IPX/SPX and TCP/IP, and I'm going to borrow this analogy.

QUICK LIKE A FOX, OR STEADY LIKE A CAMEL?

IPX/SPX is like a fox—fast and relatively easy to handle in small spaces. In addition, IPX/SPX doesn't need much care and feeding: The IPX addressing system is plug-and-play. Workstations dynamically learn their IPX address, and servers can have their internal IPX address manually assigned.

However, just as a fox is not equipped to run long distances, IPX/SPX is not ideally suited to communicate over long distances. In addition, IPX/SPX does not support fragmentation or connection-oriented streaming of large chunks of data. *Fragmentation* is the ability to break a single, large packet into smaller packets to transverse a data path that supports small packet sizes. For example, IP routers can fragment and defragment packets as needed. Although Novell does have a version of SPX that supports some connection-oriented streaming, this version is limited to eight packets in a single burst—a good reason to look at TCP/IP's connection-oriented streaming capability.

TCP/IP, on the other hand, is like a camel—built to communicate over long distances (via IP fragmentation and TCP's connection-oriented streaming capability). If you have ever seen a camel, however, you know that they smell bad and often spit at you. To get a camel to cooperate, you must groom and pamper that camel. Likewise, to ensure that you have a foolproof IP addressing scheme, you must carefully plan that scheme.

So which protocol is right for your company? You should consider the following questions when making this decision:

- Do you have any IPX/SPX-dependent applications?
- Can you and your team support more than one protocol stack?
- Do you have any routers that support only one protocol?
- Do you need Internet connectivity?
- Do you need IP fragmentation to send packets over diverse data paths?

Many companies seem to be jumping on the TCP/IP bandwagon even though IPX/SPX is working well and they don't need TCP/IP. For companies that do need TCP/IP, however, IntranetWare with native TCP/IP support is exactly what they are looking for!

FOR MORE INFORMATION ABOUT TCP/IP

If you need more information about TCP/IP before you make your decision, you can read several documents from the Internet Engineering Task Force (IETF). To access these documents, go to <ftp://ietf.org/Internet-drafts>. For example, you can get more information about the Service Location Protocol (SLP) in the IETF document [draft-ietf-svrlc-protocol-17.txt](#). (This draft expires Oct. 3, 1997 and will be superseded by [draft-ietf-svrlc-protocol-18.txt](#).) For more information about Dynamic Host Configuration Protocol (DHCP), download IETF document [draft-ietf-dhc-dhcp-09.txt](#).

In addition, you can download Requests for Comments (RFCs) from <ftp://ds.internic.net/rfc>. For example, you can get more information about the following protocols:

- User Datagram Protocol (UDP) is explained in RFC 768.
- TCP is explained in RFC 793.
- IP is explained in RFC 791.
- Address Resolution Protocol (ARP) is explained in RFC 826. ●

install IntranetWare with native TCP/IP support. During the installation process, you are prompted for the LAN driver information and IP address of your server.

To set up DHCP, load the DHCP NLM (DHCP\$SRVR.NLM) on the server. Then use the DHCP\$CFG NLM to configure IP address assignments. It's that easy!

Packet Structures for NCP Over TCP/IP

If you examine the packets sent by IntranetWare with native TCP/IP support, you can see immediately that these communications do not contain embedded IPX/SPX packets. For example, if you look at the packet shown in Figure 7, you will notice that this packet includes an IP header that defines the next protocol as UDP. The UDP header, in turn, defines the next protocol as NCP by specifying the destination port number as 524—the port assigned to IntranetWare. The NCP header and data (if any) sit directly behind the UDP header. Since these packets are IP based, they can be forwarded by any IP router.

SHOULD YOU INSTALL NETWARE/IP OR WAIT FOR NATIVE TCP/IP SUPPORT?

When I attended BrainShare Salt Lake City '97 in March, many CNEs asked me if they should install NetWare/IP now or

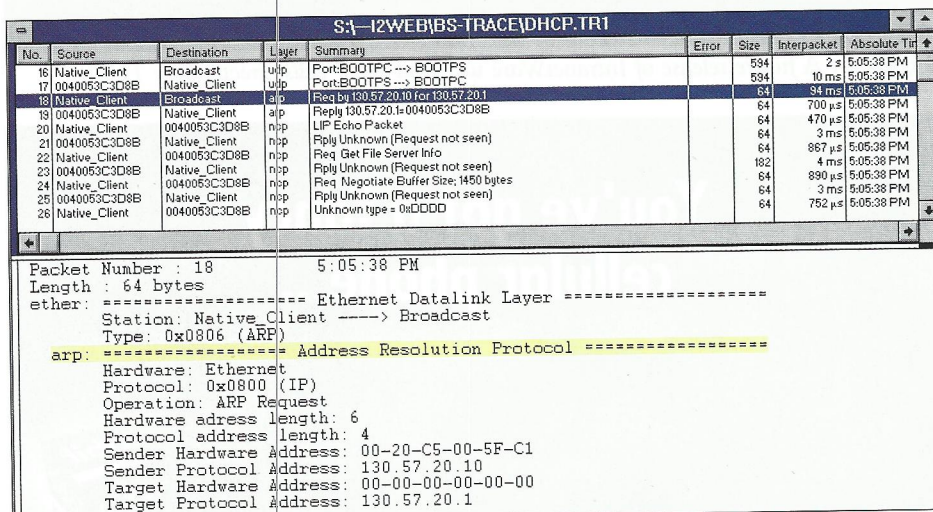


Figure 5. A workstation uses standard ARP broadcasts to locate an IntranetWare or NetWare server's hardware address.

wait until Novell releases the version of IntranetWare that includes native TCP/IP support. Migrating to a TCP/IP-only network is obviously a hot topic. (If you are trying to decide whether you should migrate your network to TCP/IP, see "Does Your Company Need TCP/IP?") My recommendation is to install NetWare/IP now. This option has two advantages over waiting for IntranetWare with native TCP/IP support:

First, you can get all of the IP addressing hassles out of the way before you move to TCP/IP. If you have never set up a TCP/IP-only network, designing and implementing an IP addressing scheme can take a long time. By configuring your IP addressing scheme now, you can resolve any problems you encounter. Then if a communications problem occurs when you install IntranetWare with native TCP/IP support, you will know that the problem is not caused by your IP addresses.

Second, because some of your applications may not be protocol independent, they will not work without NetWare/IP. Although most applications have been engineered to use standard NCP calls and are 100-percent compatible with native TCP/IP, some applications have been written directly to IPX or SPX. Therefore, these applications must be rewritten to work over the TCP/IP stack. By installing NetWare/IP now, you will be prepared to support any applications that may not work with native TCP/IP when you roll it out.

CONCLUSION

If you are evaluating all of the advantages and disadvantages of configuring a TCP/IP-only network, IntranetWare with native TCP/IP support just may convince you to take the TCP/IP plunge. With this version of IntranetWare, you can easily run TCP/IP, IPX/SPX, or a combination of both protocols on your network. In my opinion, native TCP/IP support is one of the greatest enhancements that Novell has made to IntranetWare since NDS was implemented.

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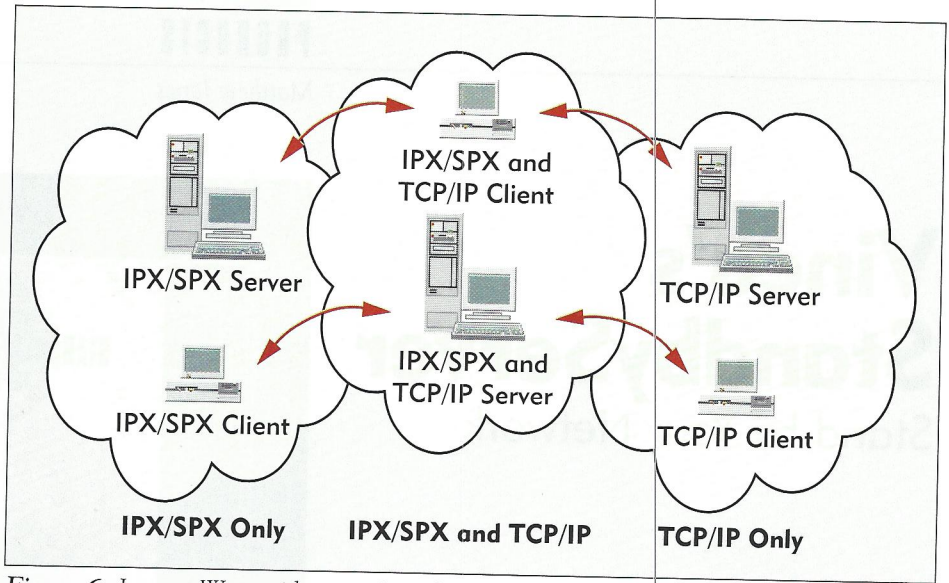


Figure 6. IntranetWare with native TCP/IP support allows you to set up a TCP/IP-only network, an IPX/SPX-only network, or a network that supports both protocols.

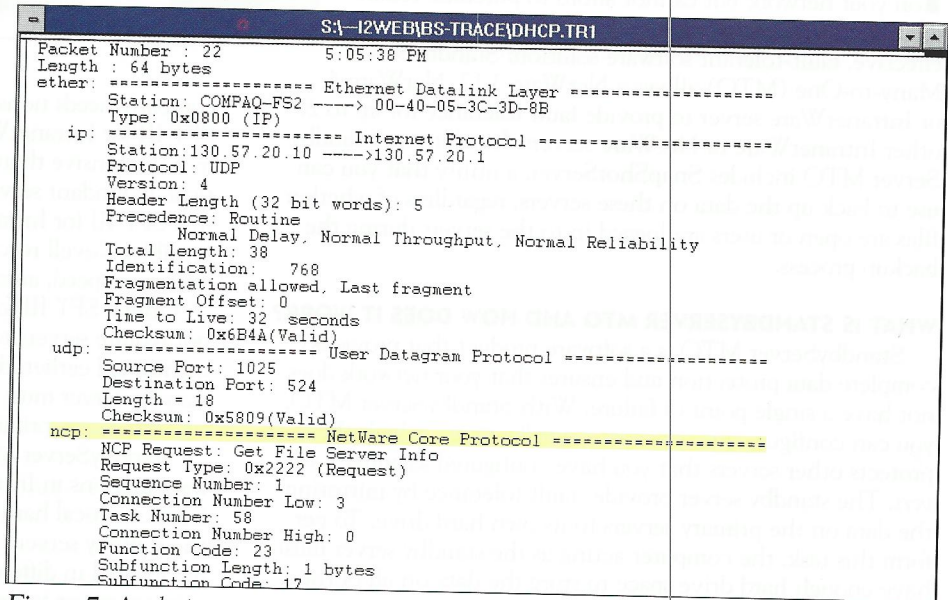


Figure 7. Analyzing communications proves that IntranetWare is running directly on TCP/IP.

and an even fancier
LAN setup...

