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Enhancing

NetWare

Connectivity

with

NLSP

Routing

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IPX™ Upgrade for NetWare Servers 1.0 NLSP™ Migration Guide

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NETWORK COMPUTING PRODUCTS

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100-002432-001
October 13, 1994

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About This Guide

This guide provides the information you need to implement NetWare® Link Services Protocol™ (NLSP™) software in a Novell® Internetwork Packet Exchange™ (IPX™) internetwork. Implementing NLSP in a RIP-based IPX network, a process known as *migration*, involves adding NLSP link state routing functionality to NetWare servers and dedicated routers. In most cases, NLSP can eventually replace Routing Information Protocol (RIP), the routing protocol that NetWare has traditionally used to carry out network-level operations.

This guide is written for network managers, administrators, and consultants responsible for planning, installing, and managing an IPX internetwork.

Chapter Summaries

This section briefly summarizes each chapter in this guide. Use these summaries to help you locate specific topics, or to help you decide which portions of this guide contain new information.

Chapter 1, "NetWare Link Services Protocol," presents a brief technical overview of NLSP.

Chapter 2, "Why You Should Migrate Your IPX Network from RIP to NLSP," is a benefits-oriented chapter that focuses on what NLSP can do for your network. It also answers some commonly asked questions about NLSP.

Chapter 3, "Trying Out NLSP on Your IPX Network," is for the busy—or skeptical—network professional who wants to "test drive" NLSP before implementing it throughout an entire network.

Chapter 4, “Developing a Migration Strategy,” helps you develop a strategy for migrating your network that is both comprehensive and easy to implement. *If you are already familiar with NLSP and want to start migrating your network, see this chapter first.*

Chapter 5, “Partitioning an Internetwork into Routing Areas,” provides guidelines for creating administrative domains called *routing areas*. Read this chapter only if you are migrating a very large IPX internetwork or if you want to filter routes and services between NetWare LANs.

Chapter 6, “Migrating a Network with Different NetWare Versions,” explains how to migrate or interoperate with servers running NetWare 2 software, NetWare 3™ software, or NetWare 4™ software.

Chapter 7, “Migrating a Network with Products That Require RIP and SAP,” explains how to configure a NetWare server or dedicated router running NLSP so that it can interoperate with Novell products that still rely on RIP and SAP.

Conventions Used in This Guide

The *IPX Upgrade for NetWare Servers NLSP Migration Guide* uses the documentation conventions described in this section. The following sections describe the conventions used:

- “Parameter Paths” on page xi
- “Terminology” on page xi
- “New Terms and Important Information” on page xi
- “System Messages” on page xi
- “User Input” on page xii
- “Special Characters” on page xii
- “Graphic Symbols” on page xiii

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Parameter Paths

This guide uses a special format to show the path to a parameter.

For example, rather than specifying "Load INETCFG; from the *Internetworking Configuration* menu, select *Protocols*; from the *Protocol Configuration* menu, select *IPX*; from the *IPX Protocol Configuration* menu, select *Static Routes for On-Demand Calls* (the *Static Routes for On-Demand Calls* menu appears); then press <Insert> (the *Static Route Configuration* menu appears)," the following format is used:

Utility: Load INETCFG (*Internetworking Configuration* menu appears)

Parameter Path: Select *Protocols* > Select *IPX* > Select *Static Routes for On-Demand Calls* (*Static Routes for On-Demand Calls* menu appears) > Press <Insert> (*Static Route Configuration* menu appears)

Note: The name of the menu that appears after each selection is specified only if it is not obvious.

Terminology

The following terms summarize frequently performed actions:

- "Select" means to use the cursor keys to highlight an item *and* press <Enter>.
- "Enter" means to type the indicated text *and* press <Enter> (as one complete operation). It is shown in one of two ways; for example:

  Enter **LOAD INETCFG** or **LOAD INETCFG** <Enter>

New Terms and Important Information

Highlighting emphasizes new terms and important information.

System Messages

Regular (nonboldface, nonitalic) monospaced character strings represent system prompts or responses; for example:

```
message example
```

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User Input

This guide uses the following conventions to denote user input:

- **`Highlighted`** monospaced character strings represent user input, which must be entered exactly as shown; for example:

  `LOAD INETCFG` <Enter> `or` **`Load inetcfg`** <Enter>

- *`Highlighted`* and lowercase character strings show descriptive names for items that you must replace with appropriate values. For example, in the following NetWare console command, you replace *`driver`* with the specific name of a driver:

  `UNBIND IPX FROM` *`driver`* <Enter>

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Special Characters

This guide uses special characters to denote the following:

- Asterisks * in text denote third-party trademarks.
- Angle brackets < >, brackets `[ ]`, braces `{ }`, vertical bar `|`, parenthesis `( )`, and quotation marks " are used as metacharacters and, as such, you must not type these as part of user input.
- Angle brackets < > enclose a descriptive name for any value that is provided as output by a computer; for example:

```
IPXRTR:3.00:32:Failed to unbind duplicate LAN
board <name>
```

  Characters enclosed in angle brackets can also represent keys; for example:

  - "Press <Ins>" means you press the <Insert> key on your keyboard.
  - Keys joined by a plus sign are pressed in combination. "Press <Ctrl>+<Alt>+<Delete>" means you press those keys simultaneously.

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- Square brackets `[ ]` enclose an option item; for example:

  BIND IPX TO *board_name* **NET=***network_number*
  [**RIP=***RIP_state*] [**SAP=***SAP_state*] <Enter>

  If a command, such as the preceding one, is too long to fit on one line, it wraps to the next line; such a command must be entered after the console prompt (:) but before the end-of-line (EOL) character.

- Braces `{ }` enclose multiple items separated by the vertical bar | character. You must specify only one of the items; for example:

  LOAD IPXRTR [**ROUTING=**{**NLSP**|**RIPSAP**|**NONE**}]

- Vertical bars | separate items in a list of alternatives. If the list is enclosed in square brackets `[ ]`, you can use any one or none of the items. If the list is enclosed in braces `{ }`, you must use any one, but only one, of the items.

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Graphic Symbols

In printed documentation, the following symbols appear in the left margin to identify different categories of information:

Procedure

1. This symbol identifies the first step of a procedure. To accomplish a specific task, follow the steps in the procedure.

Note

This symbol indicates sidelights, discussions, and general points of interest related to the current subject.

Important

This symbol points out key concepts or facts about the product.

Warning

This symbol alerts you to situations that can produce critical or irreversible errors if you do not follow instructions carefully.

Suggestion

This symbol points out hints, tips, or helpful information that you should know.

Online documentation omits these symbols, but either maintains the font change or labels the information for easy identification.

Related Novell Publications

See the following Novell publications for information about IPX, NLSP, RIP, SAP, and related topics:

- *IPX Upgrade for NetWare Servers 1.0 Installation and Configuration Guide* (Novell part number 100-002431-001)
- *NetWare Link Services Protocol In-Depth* (Novell part number 481-000085-001)
- *NetWare Link Services Protocol Specification* (Novell part number 100-001708-002)
- *The Novell Network Registry* (Novell part number 461-000248-001)

Additional Reading

The following publications provide general technical information about routing and related topics:

- *Interconnections: Bridges and Routers*, by Radia Perlman. Addison-Wesley Publishing Company, Inc.
- *Routing in Today's Internetworks*, by Mark Dickie. Van Nostrand Reinhold, an International Thomson Publishing company.
- *Novell's Guide to Multiprotocol Internetworking*, by Laura A. Chappell and Roger L. Spicer. Novell Press: Sybex.

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chapter 1

NetWare Link Services Protocol

This chapter introduces NetWare® Link Services Protocol™ (NLSP™) software, Novell's *link state* routing protocol for IPX™ internetworks.

Note: IPX Upgrade for NetWare Servers provides NLSP and RIP/SAP routing only for LAN-based NetWare servers. You must use other Novell or third-party products if you want to run NLSP or RIP/SAP over a WAN connection.

This chapter includes the following sections:

- "About NLSP," on this page

  This section gives a brief overview of what NLSP is and how it works.

- "NLSP Memory Requirements" on page 4

  This section gives some general memory requirements for NLSP to run on networks of different sizes.

- "Novell Products That Provide NLSP Functionality" on page 4

  This section lists the Novell products that provide NLSP functionality. You will install at least one of these products when you migrate your network.

Suggestion: If you are already familiar with NLSP and want to start implementing it in your network, turn to Chapter 4, "Developing a Migration Strategy."

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About NLSP

NetWare servers have traditionally used the Routing Information Protocol (RIP) to route IPX packets, and the Service Advertising Protocol (SAP) to exchange service information with other NetWare servers. In addition to providing this same functionality for network devices that rely on RIP and SAP (NetWare 2 servers, for example), NLSP provides link state routing for IPX internetworks.

NLSP is derived from IS-IS (Intermediate System-to-Intermediate System), the link state routing protocol developed by the International Standards Organization (ISO). Like IS-IS, NLSP exchanges routing information between routers and makes routing decisions based on that information. For workstation-to-router communication, NLSP routers continue to use RIP and SAP.

NLSP routers exchange information such as connectivity states, path costs, throughput, maximum packet size (MTU size), and networks learned through RIP (external network numbers). In networks with RIP/SAP devices, the routers keep track of services and external (RIP-based) routes. This information is carried in a *Link State Packet* (LSP). By exchanging this information with its peer routers, each NLSP router builds and maintains a logical map of the entire network.

Unlike RIP and SAP, which periodically broadcast routing and service information, NLSP transmits routing information only when a change occurs in a route or service, or every two hours—whichever occurs first.

Migrating an IPX network to NLSP involves only the NetWare servers and routers; you do not need to install any additional software on the NetWare workstations. NLSP is compatible with all NetWare workstations and RIP/SAP routers, and with other network devices—such as print servers—that use SAP to advertise their services.

Although NLSP is a routing protocol specifically for IPX, it is not limited to pure IPX LANs. NLSP operates seamlessly within multiprotocol LAN and WAN environments, such as TCP/IP, AppleTalk*, Frame Relay, and X.25, to name a few.

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The IPXRTR NLM

The IPXRTR NetWare Loadable Module™ (NLM™) file is the IPX protocol stack for the NetWare operating system. IPXRTR provides combined NLSP routing and full RIP/SAP functionality for network-level operations.

IPXRTR allows you to enable or disable RIP, SAP, and NLSP selectively on network interfaces within the same server or router. For example, you can use RIP and SAP exclusively on one interface and NLSP on another. Additionally, an interface can use NLSP as the active routing protocol but still accept and process RIP and SAP broadcasts from network devices that use RIP and SAP.

IPXRTR also allows you to bind IPX to two or more network interface boards connected to the same LAN. This enables NetWare workstations on that LAN to use either interface when accessing the server—a feature called *load balancing* or *load sharing*.

Current and Future NLSP Functionality

NLSP currently supports link state routing within a single *routing area*; this is called level 1 routing. A routing area is an administrative domain in which all users have Network-layer access to the same services.

Future releases of NLSP will link routing areas into *routing domains* (level 2 routing), and routing domains into a *global IPX internetwork* (level 3 routing). A routing domain can be a company, a university, an agency, or even a public carrier connecting two or more business or academic organizations. Within a routing domain, each local campus—or other suborganization—constitutes a routing area.

To read more about routing areas, see Chapter 5, “Partitioning an Internetwork into Routing Areas.”

NLSP Memory Requirements

IPXRTR and its internal stack processes occupy about 290 KB of system memory. The amount of memory required beyond this baseline depends on the size of the network—specifically, how many network numbers, RIP routes, and SAP-based services are supported throughout the network.

For example, on an IPX network using only NLSP as the routing protocol and having 400 network numbers, NLSP uses about 240 KB in addition to the 290 KB that IPXRTR requires. On an IPX network using both NLSP and RIP/SAP and having about 3000 network numbers and 1600 services, NLSP uses about 600 KB in addition to the 290 KB baseline requirement.

Novell Products That Provide NLSP Functionality

Which products you need to migrate your network depends on the specifics of the network topology—that is, how many NetWare LANs it comprises, whether it uses WAN connections or third-party routers, and so on.

IPX Upgrade for NetWare Servers 1.0 provides NLSP routing for IPX on NetWare 3™ servers, NetWare 4.01 servers, and NetWare 4.02 servers by upgrading only the IPX protocol stack. You retain all the functionality of the base NetWare operating system but gain the efficiency of NLSP routing.

This product is also available from the following sources:

- NetWire® electronic bulletin board. Type **`GO NOVLIB`**, then download the NOVLIB\08\IPXRTR.EXE file.
- ftp.novell.com, by anonymous FTP. Log in, then copy the pub/novlib/08/ipxrtr.exe file.
- Novell® Network Support Encyclopedia Professional Volume℠ (NSE Pro℠) CD-ROM. Type **`CD DOWNLOAD`**, then download the IPXRTR.EXE file.

chapter 2

Why You Should Migrate Your IPX Network from RIP to NLSP

This chapter explains how the NLSP™ routing protocol can benefit your IPX™ network.

This chapter includes the following sections:

- "How NLSP Can Benefit Your Network," on this page

  This section presents several reasons supporting the use of NLSP on an IPX network.

- "Answers to Commonly Asked Questions" on page 7

  This section answers questions that NetWare® administrators often ask about NLSP.

How NLSP Can Benefit Your Network

This section summarizes the principal benefits of running NLSP on your network.

Less Routing and Service Traffic on the Network

Each RIP router broadcasts its entire routing table and service database every 60 seconds, even if none of the information has changed since the previous broadcast. This generates a significant amount of traffic on the network.

By contrast, NLSP transmits information only when a change occurs in a route or service, or every two hours—whichever occurs first. Although this information is broadcast by default, it can be *multicast* if the network interface driver supports multicast transmission.

Faster Network Convergence

When a router or a link comes up or goes down, or when a service becomes available or inaccessible, it takes time for that information to become known to all routers throughout the network. *Convergence* is the process by which a routing protocol learns of a topology or service change and makes that change known to each of the active routers on the network. A network is said to have converged when all routers once again share the same view of the network.

As a link state routing protocol, NLSP converges faster than RIP, the traditional distance vector routing protocol for IPX networks. Fast convergence is important for the following reasons:

- It helps keep sessions active across the network.

  While a network is converging, there is a brief period during which the routers are busy rebuilding their routing databases. In-transit packets are often lost during this process.

- It enables you to discover network problems more quickly.

- It reduces routing loops.

Larger IPX Networks Possible

With NLSP, you can build and operate larger IPX networks than are possible with RIP.

Whereas packets relayed by RIP routers can travel no more than 15 hops between their source and destination, packets relayed by NLSP can travel up to 127 hops.

Load Balancing

NLSP makes efficient use of network resources by automatically distributing forwarded traffic across network interfaces. That is, given two or more equal-cost routes between two network nodes, NLSP distributes the traffic evenly among them.

More Extensive Network Management

Any network management application that uses Simple Network Management Protocol (SNMP)—such as Novell's NetWare Management System™ (NMS™) software—can monitor an NLSP router or a RIP router implemented to the Management Information Base (MIB) specification. You can then use these applications to derive a topology map of your entire IPX internetwork from a single NLSP router.

Such far-reaching management capability enables you to detect problems such as duplicate network numbers, inactive routers or links, and even failed interface boards anywhere on your network.

Compatibility with IPX RIP and SAP

Because NLSP is fully compatible with IPX RIP and SAP, you can use NLSP and RIP routers together in the same network. NLSP routers also interoperate with devices and applications that use or depend on RIP and SAP. NLSP encapsulates and propagates the routing and service information it receives from RIP/SAP devices and networks.

You can also migrate NetWare LANs from RIP to NLSP as needed; you do not need to migrate your entire network at the same time.

Answers to Commonly Asked Questions

The following sections answer some commonly asked questions about NLSP.

Do Link State Protocols Use More CPU Than Distance Vector Protocols?

Each large network is different in its complexity and the network events it must process. Some events are processed more quickly by distance vector protocols; others are processed more quickly by link state protocols.

Link state protocols dispense with many of the time-consuming tasks associated with traditional distance vector protocols. Also, older implementations of distance vector protocols are often inefficient.

Novell has tested NLSP in very large networks, and has verified that the algorithms perform well and use a nominal amount of CPU.

Do Link State Protocols Use More Memory Than Distance Vector Protocols?

Typically they do, but not in every network. In addition to the 290 KB that IPXRTR requires, NLSP uses about 600 KB in a large internetwork of 3000 network numbers and 1600 services.

Can I Use NLSP to Migrate a NetWare 2 Network to NetWare 3?

Yes. NLSP automatically detects the presence of NetWare 2 software on the network. However, wherever you have a mix of NetWare 2 and NetWare 3™ servers, you run NLSP, RIP, and SAP.

How Many NLSP Routers Can I Have on a Single LAN Segment?

NLSP allows for up to 230 systems—routers and servers combined—on an Ethernet LAN segment. This number is higher for token ring and FDDI networks, depending on the maximum packet size you configure on each server on the LAN.

Can NLSP Run on the Same Network with OSPF and IS-IS?

Yes. NLSP can run on the same network—or even the same router—with Open Shortest Path First (OSPF) and IS-IS routing protocols. Because NLSP information is carried within IPX packets, it does not interfere with other routing protocols running on the same network.

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Can I Use Third-Party Network Management Software with NLSP?

Yes. NLSP, IPX RIP, and SAP use MIB variables in SNMP format that are fully compatible with the following network management products:

- Novell NMS software
- SunNet Manager*
- Hewlett-Packard* OpenView*
- IBM* NetView*

Some of these products have already integrated the NLSP, IPX RIP, and SAP MIB variables. IPX Upgrade for NetWare Servers 1.0 provides these MIB variables in ASN.1 format so that you can use your MIB compiler to convert them into a format that your network management software can use.

Where in My Network Should I Start Migrating to NLSP?

If you have a large network, first decide how you intend to partition it into routing areas, then migrate the routers at the area boundaries. You should also migrate one LAN at a time. Guidelines for partitioning your network are presented in “Defining Routing Areas in an Internetwork” on page 23.

Even if your network uses third-party routers that support RIP/SAP but not NLSP, you can still migrate your NetWare servers to NLSP. In this case, the servers and third-party routers can continue to exchange routing information using RIP/SAP. When you later migrate your dedicated routers and integrated server-routers to NLSP, your NetWare servers automatically use NLSP instead of RIP/SAP to exchange routing information with the NLSP routers.

As the percentage of NLSP routers on your network increases, the bandwidth use and convergence time improves throughout your network.

chapter **3**

Trying Out NLSP on Your IPX Network

This chapter provides a quick, easy-to-implement migration solution for those who want to see immediate benefits of NLSP™ software on their IPX™ internetwork. This approach enables you to "test drive" NLSP before migrating your entire IPX internetwork. Each solution also provides ways to measure server and network performance before and after migration.

This chapter includes the following sections:

- "Trying Out NLSP on a Single NetWare LAN" on page 12

  This section explains how to migrate the NetWare® servers on a small LAN in your internetwork.

- "Examining the Operation of Your NLSP Systems" on page 14

  This section shows how you can take a closer look at the NetWare systems you migrate.

- "Where to Go from Here" on page 14

  This section shows you where to look for more information about migrating other portions of your IPX internetwork.

Trying Out NLSP on a Single NetWare LAN

This section explains how to see the benefits of NLSP on a small NetWare LAN.

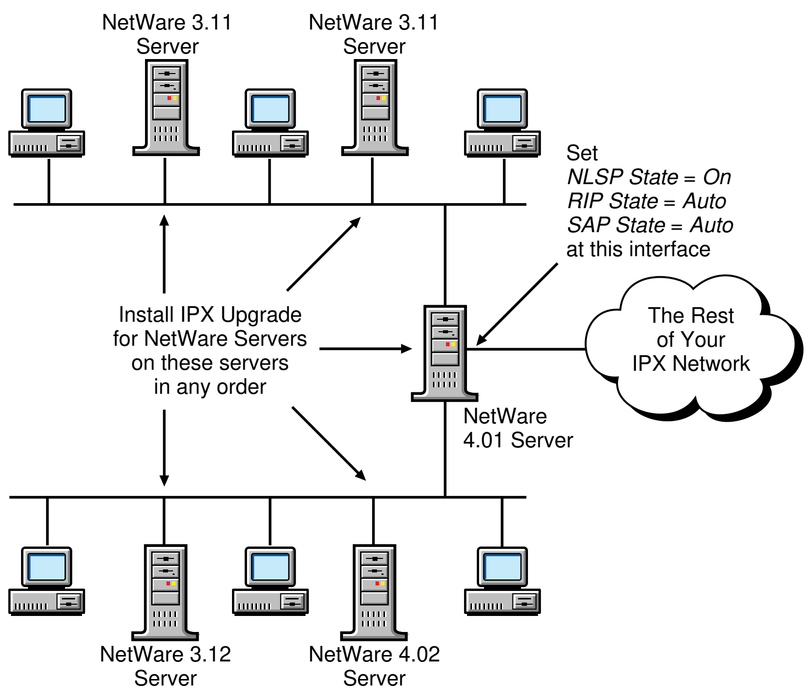
Choosing the LAN

Choose a LAN with the following characteristics:

- Supports no more than 10 servers running NetWare 3.11, NetWare 3.12, NetWare 4.01, or NetWare 4.02 software
- Has no third-party routers connecting the LAN to other networks

Figure 3-1 shows two LANs that satisfy these criteria.

Figure 3-1
Example NetWare LANs



Measuring LAN and Server Performance (Optional)

Before you migrate the servers, use any of the following NetWare software to examine server and network performance:

- **TRACK ON—**Use the `TRACK ON` command to display incoming and outgoing RIP and SAP traffic on the server. Note the frequency.
- **LANalyzer® network analyzer—**Use the LANalyzer product to examine the percentage of network utilization consumed by broadcast traffic. Record this number.
- **MONITOR—**If your IPX network has a large number of NetWare 3.11 servers, load MONITOR on one of the servers on which you intend to install NLSP software. Record the number displayed in the *Utilization* counter; this shows the percentage of time the CPU is busy.

  On a large network of NetWare 3.11 servers, CPU utilization typically exceeds 95 percent during RIP and SAP broadcasts. You should see a marked reduction in CPU utilization after migration.

Migrating the Servers

To migrate the servers on the LAN, complete the following steps:

Procedure

1. **Install and configure IPX Upgrade for NetWare Servers 1.0 on each server *in any order*.**

   For instructions, see the *IPX Upgrade for NetWare Servers 1.0 Installation and Configuration Guide*.

2. **Reexamine server and network performance with the same software you used in "Measuring LAN and Server Performance (Optional)" on page 13.**

3. **Compare these performance statistics with those you observed before migrating the servers.**

Examining the Operation of Your NLSP Systems

After you migrate a portion of your network to NLSP, you can gain management access to the NLSP systems with the IPX network management console (IPXCON). IPXCON allows you to monitor the operation of local and remote systems for troubleshooting, checking configuration parameters, and observing general performance and load statistics.

For information about how to use IPXCON, see the *IPX Upgrade for NetWare Servers 1.0 Installation and Configuration Guide*.

Where to Go from Here

If you want to migrate other portions of your IPX internetwork, continue to Chapter 4, "Developing a Migration Strategy." That chapter helps you develop an organized and comprehensive strategy that suits the size and topology of your network.

If you have migrated all the systems you want—or need—to migrate at this time, you are done.

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chapter 4

Developing a Migration Strategy

This chapter provides the information you need to develop a comprehensive migration strategy for your IPX™ internetwork.

Suggestion

Use this chapter as a point of reference when planning and implementing the migration.

This chapter includes the following sections:

- "Step 1: Determine the Size of Your Network," on this page

  This section explains how to determine how many internal and external network numbers are represented on the network.

- "Step 2: Characterize Your Network" on page 16

  This section outlines the steps you follow to develop the migration strategy that best suits your network.

- "Step 3: Migrate Your Network to NLSP" on page 17

  This section gives general guidelines for migrating your network.

Step 1: Determine the Size of Your Network

The migration strategy you adopt depends primarily on the number of networks and servers on your IPX internetwork. To determine this number, type the following NetWare® command at the server prompt:

DISPLAY NETWORKS <Enter>

The screen displays the internal network number of each server and the external network number of each IPX network that can be reached from the server. The total number of network numbers is displayed at the end of the list.

If Your Network Has Fewer Than 400 Network Numbers

A small network—one having fewer than 400 network numbers—is easy to migrate, especially if it comprises only NetWare servers and includes no third-party routers that do not support NLSP™ software. In this case, you can install NLSP on the servers in any order.

If Your Network Has 400 or More Network Numbers

A large network—one having 400 or more network numbers—should be partitioned into *routing areas*.

Suggestion

You should also consider reserving a contiguous block of IPX network addresses through the Novell® Network Registry℠ service.

For information about partitioning your network and participating in the Novell Network Registry, see Chapter 5, "Partitioning an Internetwork into Routing Areas."

Step 2: Characterize Your Network

How you migrate your network depends on the following network characteristics:

- Size
- NetWare versions
- Novell products other than NetWare on the network

This section provides a set of tasks that helps you determine what you need to do to migrate your network. Each step directs you to complete a task and refers you to a chapter for specific instructions. The number of chapters to which you must refer depends largely on the topological complexity of your network.

Procedure

1. **If your network comprises 400 or more network numbers, define the routing areas.**

   Routing areas provide a manageable hierarchy and preserve routing efficiency in large IPX networks. For further instructions, see Chapter 5, "Partitioning an Internetwork into Routing Areas."

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2. **Determine which versions of NetWare are running on the network.**

   In particular, NetWare 2 servers require special consideration because of their dependence on IPX RIP and SAP broadcasts. For further instructions, see Chapter 6, "Migrating a Network with Different NetWare Versions."

3. **Determine whether any of the following Novell products are running on the network:**

   - NetWare MultiProtocol Router™ 2.0, 2.1, or 2.11 software
   - UnixWare™ software
   - OS/2* Named Pipes
   - NetWare/IP™ software

   Like NetWare 2, these products depend on RIP, SAP, or both. For further instructions, see Chapter 7, "Migrating a Network with Products That Require RIP and SAP."

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Step 3: Migrate Your Network to NLSP

This section offers guidelines to help your network migration progress smoothly.

Important: To maintain connectivity between LANs during migration, do not disable RIP routing on any interface until you have installed NLSP software on every system.

If You Need to Define Routing Areas

Use the following guidelines if you need to partition your network into routing areas:

- **Define the routing areas first.** For information, see "Guidelines to Follow When Defining Routing Areas" on page 23.

- **Migrate the "core" routers first, then migrate one LAN at a time.** Core routers are typically those that form the network backbone or share a high-speed transit LAN. For information, see the examples in "Defining Routing Areas in an Internetwork" on page 23.

If You Do Not Need to Define Routing Areas

If you do not need to partition your network into routing areas, use Chapters 6 and 7, as necessary, to migrate your network.

If your network has fewer than 400 network numbers and uses no WAN connections or routers that do not support NLSP, install NLSP software on the NetWare servers or dedicated routers *in any order.*

chapter 5

Partitioning an Internetwork into Routing Areas

This chapter explains how to partition a large IPX™ internetwork into routing areas. Because these internetworks are typically linked by one or more WAN connections, the guidelines and examples provided in this chapter are oriented primarily toward WAN connections, which require other Novell® or third-party products in addition to IPX Upgrade for NetWare® Servers. However, the information in this chapter can still help you partition a purely LAN-based internetwork.

You should read this chapter if

- Your IPX internetwork has 400 or more network numbers

  If you do not know how many network numbers your internetwork has, see "Step 1: Determine the Size of Your Network" on page 15.

- You want to use route or service filtering as a means of establishing security or limiting broadcast traffic on your internetwork

Note: IPX Upgrade for NetWare Servers 1.0 does not provide filtering capability. Filtering utilities are available with other Novell products.

This chapter includes the following sections:

- "Routing Areas" on page 20

  This section explains what routing areas are.

- "Using the Novell Network Registry" on page 22

  This section introduces the Novell Network Registry℠ service and explains how to use the services it provides.

- "Defining Routing Areas in an Internetwork" on page 23

  This section presents guidelines to help you determine how you should partition your network.

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Routing Areas

Routing areas establish hierarchy within an IPX internetwork. For growing networks, routing areas allow for better scaling—more LANs, servers, and routers than otherwise possible. Routing areas also separate an internetwork into manageable components, which is desirable for administrative simplicity.

Area Addresses and Masks

Two 32-bit numbers—a network number and a *mask*—identify a routing area. Together, these numbers constitute the *area address*. Here is an example:

`08068500` (network number)

`FFFFFF00` (mask)

The default values for the network number and mask are as follows:

- Address=00000000
- Mask=00000000

The address and mask are both set to zero to ensure compatibility with future versions of NLSP™ software. Zero values mean that all NLSP routers operate in a single routing area.

Using RIP to Partition Routing Areas

Although the current version of NLSP does not support interarea (level 2) routing, you *can* create routing areas by running RIP on the network interfaces that link the areas. Figure 5-1 shows two routing areas partitioned by RIP.

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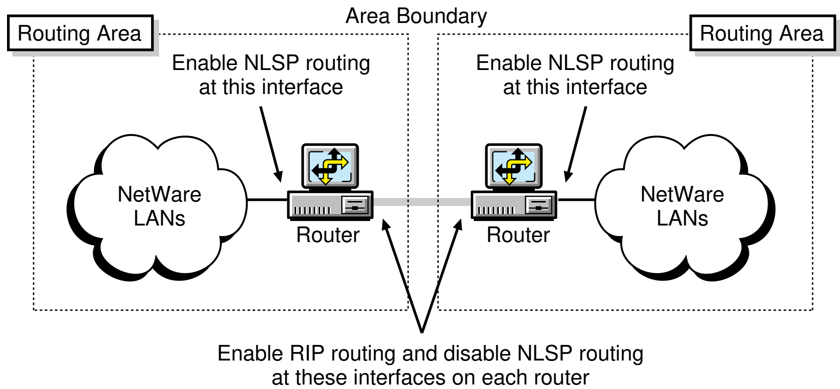
Figure 5-1
Creating Routing Areas Partitioned by RIP



The following steps summarize how to configure the interfaces:

Procedure

1. **Enable NLSP routing on each router.**

   Load IPXRTR as follows:

   ```
   LOAD IPXRTR ROUTING=NLSP
   ```

2. **On the network interface that *links* the areas, turn off NLSP and turn on RIP and SAP.**

   Bind IPX to the interface as follows:

   ```
   BIND IPX boardname NET=network_number RIP=YES
     SAP=YES NLSP=NO
   ```

Although NLSP is disabled on the interface at the area boundary, each router still imports the routes and services from the connected network into its own routing area.

Filtering Routes and Services Between Routing Areas

You can use routing areas to prevent RIP and SAP traffic on one network from flowing to another. For example, suppose you want to prevent some users from gaining access to the accounting services on a particular network. You can use service filters to restrict access to those services.

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Important You cannot filter routes or services *within* a routing area, but you can filter routes and services *between* areas at the area boundaries. If you want to restrict Network-layer access within a routing area, you can filter IPX packets.

If you use route and service filters, you must configure the same inbound and outbound filters on *all* NLSP routers connected to the same LAN within the same area. With NLSP, all routers in the same area share the same link state information; however, a single system called the *Designated Router* imports routes and services for the entire network. Therefore, if you configure an inbound route or service filter on one—but not all—NLSP routers, and that router is not the Designated Router, the filter might have no effect.

Note IPX Upgrade for NetWare Servers 1.0 does not provide filtering capability. Filtering utilities are available with other Novell products.

Using the Novell Network Registry

Business organizations, each with its own enterprise network, sometimes merge or agree to share information. Or, these same organizations might want to connect their networks to a larger public internetwork to use the services it provides. This means that all network numbers throughout the connected organizations must be unique.

For this purpose, Novell offers the *Novell Network Registry*. The Novell Network Registry service assigns and tracks IPX network addresses and organization names. The Novell Network Registry enables participating organizations to share data between interconnected NetWare networks without name and address conflicts.

The Novell Network Registry assigns a contiguous "block" of IPX network addresses that are unique to your organization. The size of your address block depends on the number of NetWare LANs and servers in your IPX internetwork, including any additional LANs or servers you anticipate installing over the next two years.

To learn more about the Novell Network Registry, or to reserve a block of IPX network addresses, call 1-408-577-7506 or send Internet E-mail to *registry@novell.com*. You can also send E-mail by way of the MHS NHUB system to *registry@novell*. Ask for the publication *The Novell Network Registry*.

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Defining Routing Areas in an Internetwork

This section uses examples to show how to define routing areas in an IPX internetwork.

Note: There are many ways to partition an internetwork into areas. This section provides only a few examples of how this can be done.

Guidelines to Follow When Defining Routing Areas

Apply the following guidelines when defining routing areas in your internetwork:

- **Make a sketch of the internetwork.** A graphic representation can help you identify area boundaries and key routers more easily.

- **Identify the routers that make up the "core" network infrastructure.** These routers typically form the corporate *backbone network*.

  A core area that uses backbone routers is shown in "Partitioning an Internetwork That Uses a WAN Backbone" on page 25.

- **Identify the routers that "feed" one or more LANs.** These *feeder routers* service LANs that typically represent functional groups, such as remote sales offices, an engineering department, and so on.

  An example of feeder routers is shown in "Partitioning an Internetwork That Uses a Transit LAN" on page 26.

- **Do not enable NLSP on the interfaces at area boundaries.** Two routers running NLSP at an area boundary automatically become *neighbors* and join their respective areas into a single area. Run only RIP at an area boundary, as shown in Figure 5-1 on page 21.

  However, a router in one area can run NLSP on a *transit LAN* while routers to other areas run RIP. An example of this is shown in "Partitioning an Internetwork That Uses a Transit LAN" on page 26.

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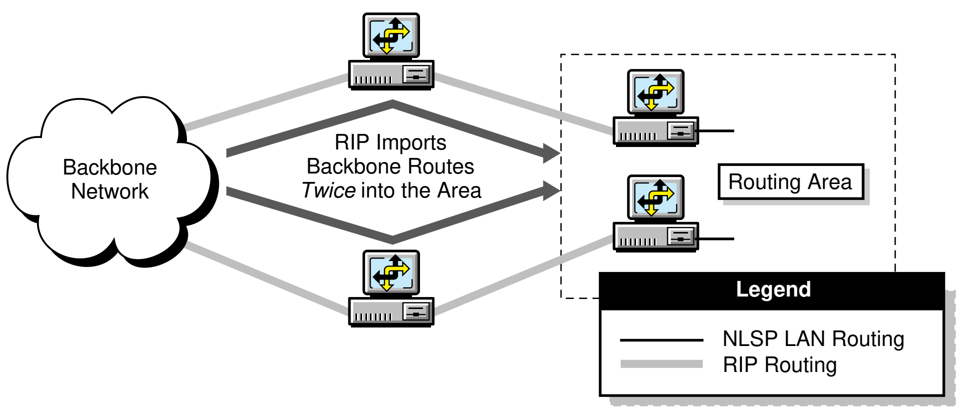
- **Avoid partitioning routing areas across WAN connections.** Doing so forces RIP to run over the WAN connection, which, along with SAP, consumes network bandwidth. Wherever it is possible, run only NLSP over the WAN connections in your internetwork.

  Figure 5-3 on page 25 and Figure 5-4 on page 27 show how an internetwork can be partitioned to keep WAN connections within a single area.

- **Avoid having more than one RIP connection between a backbone router and a single routing area.** Otherwise, the routers import the same routing and service information through *each* connection from the backbone into the routing area. This can double the routing traffic flowing into the area.

  Figure 5-2 shows the type of area configuration you should avoid.

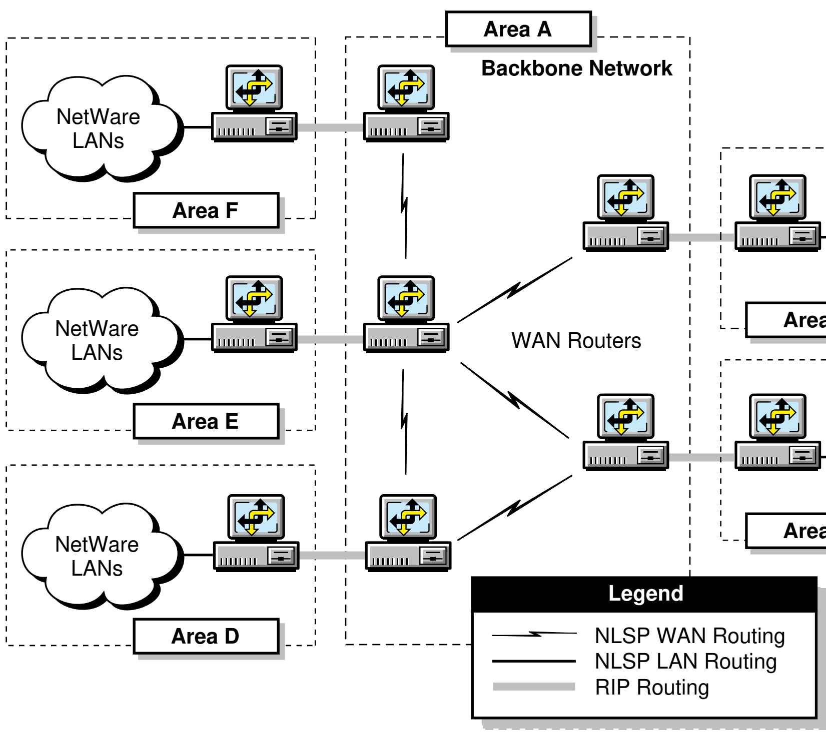
Figure 5-2
Why You Should Have Only One RIP Connection Between a Backbone Network and a Routing Area



Partitioning an Internetwork That Uses a WAN Backbone

This section explains how to define areas on an internetwork that uses a central backbone of WAN routers. Figure 5-3 shows a large IPX internetwork linked by five WAN routers that form the network backbone. Each WAN router is connected to a LAN router that services a small group of NetWare LANs. Without the benefit of NLSP or routing areas, RIP and SAP traffic from all the NetWare LANs traverses the backbone and consumes a large percentage of the available network bandwidth.

Figure 5-3
Routing Areas in an Internetwork Connected by a WAN Backbone



This internetwork is partitioned as follows:

- **Area A.** The backbone network of WAN routers forms one area.
  - NLSP routing is enabled on the WAN interface between each WAN router.
  - RIP routing is enabled on the interface between each WAN router and the corresponding LAN router that services its respective group of NetWare LANs.
- **Areas B through F.** Each group of NetWare LANs forms its own area.

  NLSP routing is enabled on the interface between each LAN router and its respective group of NetWare LANs.

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Partitioning an Internetwork That Uses a Transit LAN

This section explains how to define areas on an internetwork that uses a *transit LAN*. A transit LAN is typically a high-speed LAN—such as a high-speed token ring or Fiber Distributed Data Interface (FDDI) ring—that serves as a "crossroads" for all traffic on the internetwork. A transit LAN can link several routing areas.

The internetwork in Figure 5-4 has six routers connected to an FDDI transit LAN:

- A *backbone router* links the transit LAN to a corporate backbone network like the one shown in Figure 5-3.
- Two LAN routers each connect a large group of NetWare LANs to the transit LAN.
- Three feeder routers are each linked through a WAN connection to several *branch office routers*. Each branch office router services a group of LANs at a branch office.

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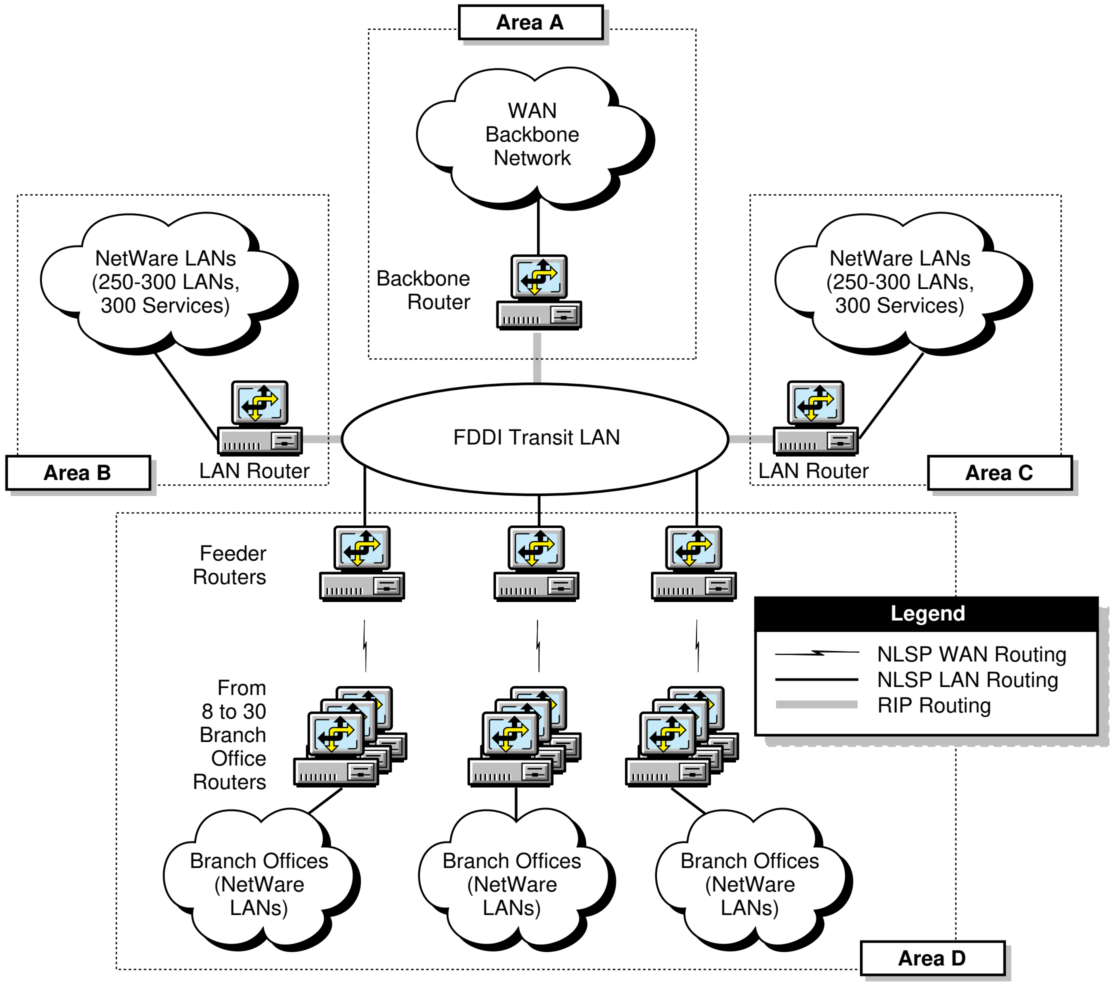
Figure 5-4
Routing Areas in an Internetwork Connected by an FDDI Transit LAN



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This internetwork is partitioned as follows:

- **Area A.** The backbone router and the backbone network form one area.
  - RIP routing is enabled on the network interface between the backbone router and the FDDI transit LAN.
  - NLSP routing is enabled on the network interface between the backbone router and the backbone network.

  Because the backbone router is running NLSP on the interface to the backbone network, it incorporates the route and service information it receives from the LAN routers into its Link State Packets (LSPs). The backbone router passes these LSPs to the backbone network.

- **Areas B and C.** Each LAN router and its group of NetWare LANs form a separate area.
  - RIP routing is enabled on the network interface between each LAN router and the FDDI transit LAN.
  - NLSP routing is enabled on the network interface between each LAN router and its corresponding group of NetWare LANs.

- **Area D.** The feeder routers, branch office routers, and branch office LANs form one area.
  - NLSP routing is enabled on the network interface between each feeder router and the FDDI transit LAN.
  - NLSP routing is enabled on the WAN interface between each feeder router and branch office router.
  - NLSP routing is enabled on the network interface between each branch office router and its corresponding group of NetWare LANs.

  To exchange routing information, the feeder routers use NLSP among themselves and RIP with the three other routers on the transit LAN.

When you configure the network interfaces, start with the routers on the transit LAN—the backbone router in area A, the LAN routers in areas B and C, and the feeder routers in area D—then work “out” toward the branch office LANs.

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You can use the IPX network management console (IPXCON) to make sure you have configured the routers correctly. Using the internetwork shown in Figure 5-4 as an example, you would load IPXCON on one of the routers and view the neighboring routers on the transit LAN. The three routers running NLSP on the transit LAN should show each other as neighbors. They should not, however, show the backbone router or the two LAN routers as neighbors. The backbone router and the LAN routers should have no neighbors on the transit LAN.

For more information about how to use IPXCON, see the *IPX Upgrade for NetWare Servers 1.0 Installation and Configuration Guide*.

chapter 6

Migrating a Network with Different NetWare Versions

This chapter presents upgrade options for servers running different versions of the NetWare® operating system.

This chapter includes the following sections:

- "If Your Network Has NetWare 2 Servers" on page 31

  This section outlines the options available for migrating a network with NetWare 2 servers.

- "If Your Network Has NetWare 3 or NetWare 4.0x Servers" on page 32

  This section outlines the options available for migrating a network that has NetWare 3™ servers, NetWare 4.01 servers, or NetWare 4.02 servers.

Because NLSP™ software can receive and broadcast IPX™ RIP and SAP packets, it can interoperate with any NetWare server. However, although the NetWare 3, NetWare 4.01, and NetWare 4.02 operating systems can run NLSP, the NetWare 2 system cannot and must either continue using RIP and SAP or be upgraded to a NetWare version that runs NLSP.

If Your Network Has NetWare 2 Servers

NetWare 2 servers depend on periodic RIP and SAP broadcasts. On an IPX network, NLSP detects NetWare 2 servers automatically and updates them with RIP and SAP broadcasts. However, unless you put the NetWare 2 servers on a single LAN, you must run both IPX routing protocols—RIP and NLSP—as well as SAP.

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The following options are available for migrating or interoperating with NetWare 2 servers on an IPX network:

- Upgrade the NetWare 2 servers to NetWare 3, NetWare 4.01, or NetWare 4.02.

  From this point, you install IPX Upgrade for NetWare Servers 1.0 on each server. To install this product, see the *IPX Upgrade for NetWare Servers 1.0 Installation and Configuration Guide*. This product is also available from the following sources:

  - NetWire® electronic bulletin board. Type **GO NOVLIB**, then download the NOVLIB\08\IPXRTR.EXE file.
  - ftp.novell.com, by anonymous FTP. Log in, then copy the pub/novlib/08/ipxrtr.exe file.
  - Novell® Network Support Encyclopedia Professional Volume℠ (NSE Pro℠) CD-ROM. Type **CD DOWNLOAD**, then download the IPXRTR.EXE file.

- Put all NetWare 2 servers on the same LAN.

  This conserves network bandwidth by limiting the RIP/SAP traffic generated by the NetWare 2 servers to a single LAN. Any NetWare server running NLSP on an interface connected to the NetWare 2 LAN can then "import" and forward the routes and services from that LAN.

If Your Network Has NetWare 3 or NetWare 4.0x Servers

To enable NetWare 3, NetWare 4.01, and NetWare 4.02 servers to run NLSP, you install IPX Upgrade for NetWare Servers 1.0 on each server.

To install this product, see the *IPX Upgrade for NetWare Servers 1.0 Installation and Configuration Guide*. This product is also available from the following sources:

- NetWire electronic bulletin board. Type **GO NOVLIB**, then download the NOVLIB\08\IPXRTR.EXE file.

- ftp.novell.com, by anonymous FTP. Log in, then copy the pub/novlib/08/ipxrtr.exe file.

- Novell Network Support Encyclopedia Professional Volume (NSE Pro) CD-ROM. Type **`CD DOWNLOAD`**, then download the IPXRTR.EXE file.

chapter **7**

Migrating a Network with Products That Require RIP and SAP

This chapter explains how to migrate or interoperate with systems running Novell® products other than the standard NetWare® operating system. Like NetWare 2 software, the products named in this chapter rely on RIP and SAP to advertise their services. These products can be running anywhere on the IPX™ internetwork, from a local server to systems on connected NetWare LANs.

Important: This chapter identifies products known to require special configurations to interoperate with NetWare servers or dedicated routers running NLSP™ software. Other Novell products, as well as third-party network interface boards and routing software, might also require special configurations.

Note also that some network printers use SAP to advertise their print services on the network.

This chapter includes the following sections:

- "Interoperating with NetWare MultiProtocol Router 2.x" on page 36

  This section explains how to migrate or interoperate with NetWare servers or dedicated routers running NetWare MultiProtocol Router™ 2.0, 2.1, or 2.11 software, NetWare WAN Links™ 2.0 software, or NetWare MultiProtocol Router Plus™ 2.1 or 2.11 software.

- "Interoperating with UnixWare" on page 36

  This section explains how to configure an NLSP router to interoperate with systems running UnixWare™ software.

- "Interoperating with OS/2 Named Pipes" on page 37

  This section explains how to configure an NLSP router to interoperate with systems running OS/2 Named Pipes. Read this section only if you are using OS/2 Named Pipes from version 2.01 or earlier of NetWare Client™ for OS/2 software.

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- "Interoperating with NetWare/IP" on page 38

  This section explains how to configure a NetWare server running both NLSP and NetWare/IP™ software.

Interoperating with NetWare MultiProtocol Router 2.x

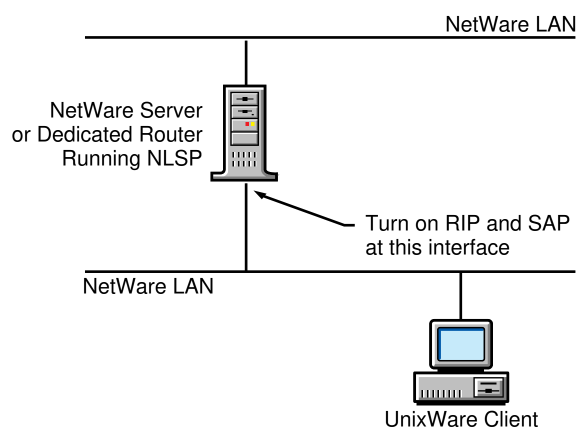
The 2.*x* versions of NetWare MultiProtocol Router—2.0, 2.1, and 2.11—as well as NetWare WAN Links 2.0 and NetWare MultiProtocol Router Plus 2.1*x*, support RIP-based IPX routing. In this case, the servers or dedicated routers running these products continue to run RIP and SAP. NLSP interoperates with these systems.

Interoperating with UnixWare

If one or more UnixWare servers or clients are on a LAN connected to one of the network interfaces and the users are running the internal UNIX® NetWare client instead of the DOS NetWare client, you must enable RIP and SAP explicitly on the interface connected to the LAN.

Figure 7-1 shows how you configure this interface.

Figure 7-1
Configuring an Interface for UnixWare



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If the connected system is running IPX Upgrade for NetWare Servers 1.0, add the following **BIND** command to the server AUTOEXEC.NCF file:

BIND IPX *boardname* **NET=***network_number* **RIP=YES SAP=YES**

Interoperating with OS/2 Named Pipes

If you are using OS/2 Named Pipes from version 2.01 or earlier of NetWare Client for OS/2 software on a LAN connected to one of the server's network interfaces and you load IPXRTR with the *ROUTING=NLSP* option, add the following **BIND** command to the server AUTOEXEC.NCF file:

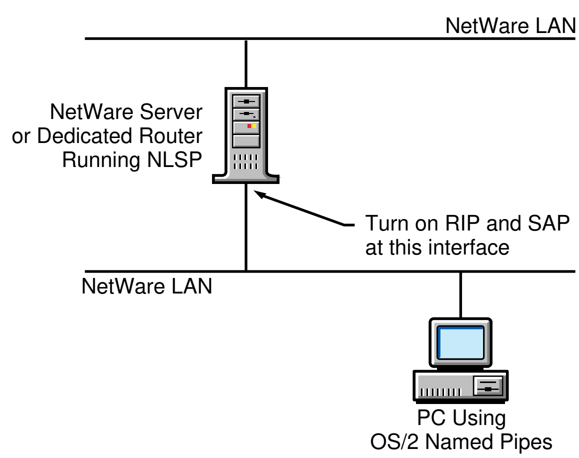
BIND IPX *boardname* **NET=***network_number* **RIP=YES SAP=YES**

The OS/2 Named Pipes that is part of version 2.10—the current version—of NetWare Client for OS/2 does not require RIP and SAP to be active; in this case, just add the **BIND** command as follows:

BIND IPX *boardname* **NET=***network_number*

Figure 7-2 shows how you configure this interface.

Figure 7-2
Configuring an Interface for OS/2 Named Pipes



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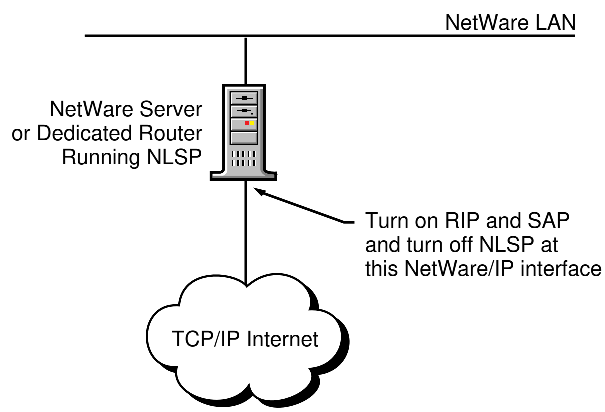
Interoperating with NetWare/IP

If you install NLSP software on a server that is running NetWare/IP, you must enable RIP and SAP and disable NLSP on the interface to which IPX is bound.

Figure 7-3 shows how you configure this interface.

Figure 7-3
Configuring an Interface for NetWare/IP



If the connected system is running IPX Upgrade for NetWare Servers 1.0, add the following **BIND** command to the server AUTOEXEC.NCF file:

BIND IPX *boardname* **NET=***network_number* **RIP=YES SAP=YES NLSP=NO**

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