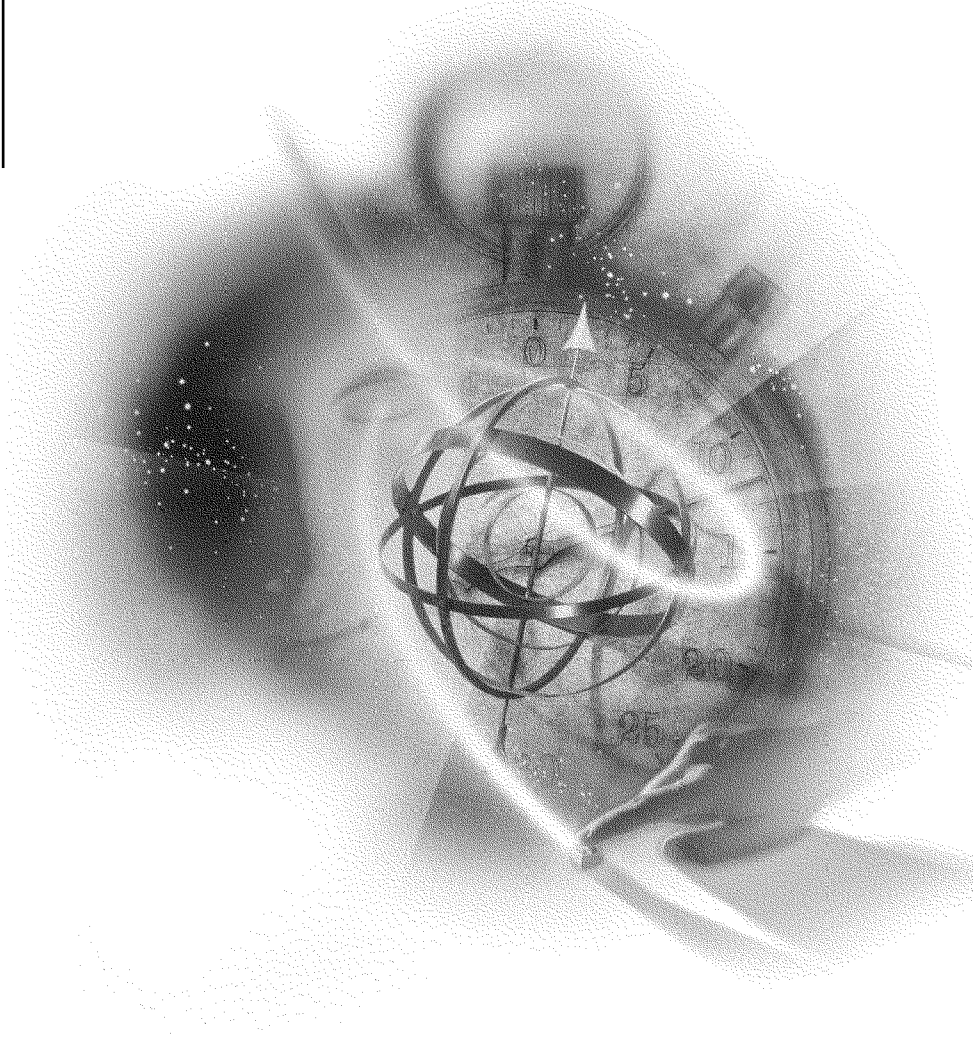


AppleTalk



Connectivity Services

**Novell**®

## Legal Notices

Novell, Inc. makes no representations or warranties with respect to the contents or use of this documentation, and specifically disclaims any express or implied warranties of merchantability or fitness for any particular purpose. Further, Novell, Inc. reserves the right to revise this publication and to make changes to its content, at any time, without obligation to notify any person or entity of such revisions or changes.

Further, Novell, Inc. makes no representations or warranties with respect to any software, and specifically disclaims any express or implied warranties of merchantability or fitness for any particular purpose. Further, Novell, Inc. reserves the right to make changes to any and all parts of Novell software, at any time, without any obligation to notify any person or entity of such changes.

This product may require export authorization from the U.S. Department of Commerce prior to exporting from the U.S. or Canada.

Copyright © 1993-2000 Novell, Inc. All rights reserved. No part of this publication may be reproduced, photocopied, stored on a retrieval system, or transmitted without the express written consent of the publisher.

U.S. Patent Nos. 4,555,775; 5,157,663; 5,349,642; 5,455,932; 5,553,139; 5,553,143; 5,594,863; 5,608,903; 5,633,931; 5,652,854; 5,671,414; 5,677,851; 5,692,129; 5,758,069; 5,758,344; 5,761,499; 5,781,724; 5,781,733; 5,784,560; 5,787,439; 5,818,936; 5,828,882; 5,832,275; 5,832,483; 5,832,487; 5,859,978; 5,870,739; 5,873,079; 5,878,415; 5,884,304; 5,893,118; 5,903,650; 5,905,860; 5,913,025; 5,915,253; 5,925,108; 5,933,503; 5,933,826; 5,946,467; 5,956,718; 5,974,474. U.S. and Foreign Patents Pending.

Novell, Inc.  
122 East 1700 South  
Provo, UT 84606  
U.S.A.

[www.novell.com](http://www.novell.com)

AppleTalk  
January 2000  
104-001246-001

**Online Documentation:** To access the online documentation for this and other Novell products, and to get updates, see [www.novell.com/documentation](http://www.novell.com/documentation).

## **Novell Trademarks**

For a list of Novell trademarks, see the final appendix of this book.

## **Third-Party Trademarks**

All third-party trademarks are the property of their respective owners.



# Contents

	<b>About This Guide</b>	<b>7</b>
<b>1</b>	<b>Understanding</b>	<b>9</b>
	Definition of Terms . . . . .	9
	Protocols . . . . .	11
	Addressing . . . . .	13
	Addressing for Extended Networks . . . . .	14
	Addressing for Nonextended Networks . . . . .	15
	Name Binding Protocol . . . . .	15
	Zones . . . . .	16
	Multiple Zones on a Network . . . . .	17
	How Zone Information Is Maintained on an Internetwork . . . . .	17
	Zones List Change on an Internetwork . . . . .	18
	Internal Network . . . . .	18
	Packet Frame Types . . . . .	19
	AppleTalk Routing Concepts . . . . .	20
	Routing Protocols . . . . .	21
	Routing Table Maintenance Protocol . . . . .	22
	AppleTalk Update-Based Routing Protocol . . . . .	22
	Benefits of AURP . . . . .	22
	AppleTalk for WAN Connections . . . . .	23
	WAN Network Support . . . . .	24
	Seeding State . . . . .	24
	Benefits of the Seeding State Option . . . . .	25
	How the Seeding Feature Works . . . . .	25
	Transition Mode Routing . . . . .	26
	What the Router Does in Transition Mode . . . . .	26
	How Transition Mode Affects Extended Networks . . . . .	27
	Rules for Setting Up a Transition Mode Configuration . . . . .	27
	Simple Network Management Protocol . . . . .	28
	Enabling SNMP Support on the AppleTalk Network . . . . .	29
	SNMP Operations on the AppleTalk Network . . . . .	29
<b>2</b>	<b>Planning</b>	<b>31</b>
	Configuration Decisions . . . . .	31

<b>3</b>	<b>Setting Up</b>	<b>35</b>
	Configuring Basic AppleTalk Parameters . . . . .	35
	Enabling AppleTalk . . . . .	36
	Enabling Packet Error Detection . . . . .	37
	Configuring an Internal Network . . . . .	38
	Enabling Static Routes for On-Demand Calls . . . . .	39
	Enabling Expert Configuration Options . . . . .	39
	Configuring Your PC Router as an AppleTalk End Node . . . . .	40
	How to Configure Your PC Router as an AppleTalk End Node . . . . .	41
	Configuring AppleTalk for LAN Connections . . . . .	42
	Configuring AppleTalk for WAN Connections . . . . .	43
	Configuring AppleTalk for a Permanent Connection . . . . .	46
	Configuring AppleTalk for an On-Demand Connection . . . . .	47
	Configuring the WAN Network Mode . . . . .	49
	Binding AppleTalk to a WAN Interface . . . . .	51
	Using Interface Groups . . . . .	56
<b>4</b>	<b>Managing</b>	<b>57</b>
	Using the ATCON Utility . . . . .	57
	Viewing AppleTalk Configuration Information . . . . .	57
	Determining Whether a Remote AppleTalk Router Is Reachable . . . . .	58
	Determining Which AppleTalk Services Are Reachable . . . . .	59
	Monitoring Error Counters . . . . .	60
	Monitoring AppleTalk Information . . . . .	60
	Checking the AppleTalk Routing Table . . . . .	61
	Monitoring AURP . . . . .	61
<b>5</b>	<b>Troubleshooting</b>	<b>63</b>
	Troubleshooting Tools . . . . .	63
	Configuration Tips . . . . .	63
	Troubleshooting Checkpoints . . . . .	65
	Common Problems . . . . .	67
	MACIPXGW.NLM . . . . .	67
	Zones and Zone Names . . . . .	68
	Console Messages . . . . .	69
	Connection Problems . . . . .	70
	Binding Problems . . . . .	72
	Routing Update Problems . . . . .	73
	Printing and Service Problems . . . . .	73
<b>6</b>	<b>AppleTalk</b>	

# About This Guide

This guide provides the information you need to configure and manage the Novell Internet Access Server 4.1 AppleTalk routing software. In addition to planning information, this guide provides troubleshooting tips, techniques, and tools, as well as the symptoms of and solutions to commonly occurring problems for the AppleTalk components of Novell Internet Access Server 4.1.





# 1

## Understanding

This section presents the basic concepts you need to understand AppleTalk and AppleTalk routing. It also describes the AppleTalk for NetWare<sup>®</sup> network management capabilities available through SNMP (Simple Network Management Protocol). This SNMP support provides access to configuration and status information, including zones lists, routing tables, and name services for network nodes.

### Definition of Terms

Before you begin configuring the Novell<sup>®</sup> Internet Access Server 4.1 routing software, you should know the following terms:

- ♦ *AppleTalk* is the Apple Computer suite of protocols that enables the hardware and software on an AppleTalk internetwork to interact and to exchange data.
- ♦ An *AppleTalk network* is a collection of connected, individually controlled computers, printers, and other devices, together with the hardware and AppleTalk software used to link them. All devices on the same network have addresses within the range assigned for the network.
- ♦ An *AppleTalk internetwork* is a group of AppleTalk networks connected by one or more AppleTalk routers. An internetwork allows all its network users to share information and network devices.
- ♦ An *AppleTalk node* is an addressable entity on a network. This term sometimes refers to a device itself. Some examples of nodes are Macintosh\* computers, printers, and file servers.
- ♦ An *AppleTalk packet* is a group of bits transmitted as a unit of information. These bits include data and control elements. The control

elements include the addresses of the packet's source and destination and, in some cases, error-detection information.

- ♦ The *AppleTalk stack* is the suite of AppleTalk protocols used to support AppleTalk applications such as file and print servers.
- ♦ An *AppleTalk router* connects AppleTalk networks into an internetwork so that all the nodes on each network can access services and nodes on any connected network. It receives and forwards AppleTalk packets on the networks to which it is directly connected.
- ♦ An *AppleTalk zone* is a logical grouping of services, such as print queues, file servers, and calendar systems. By associating a zone with certain devices, you enable Macintosh users to locate the services they need more easily. For example, a Macintosh user who needs to locate a printer used for administrative purposes might look in the Administration zone.
- ♦ *AppleTalk Phase 2* is the latest version of the AppleTalk protocols. Apple introduced AppleTalk Phase 2 in 1989 to provide support for AppleTalk networks with thousands of nodes, multiple AppleTalk zones on a network, and token ring networks. Its efficient routing techniques improve performance and use less bandwidth.
- ♦ An *extended AppleTalk network* is an AppleTalk network that supports Phase 2 extensions such as zones lists and network ranges. (An extended AppleTalk network is also referred to as simply an extended network.)
- ♦ A *nonexistent AppleTalk network* is an AppleTalk network that does not support Phase 2 extensions such as zones lists and network ranges. (A nonextended AppleTalk network is also referred to as simply a nonextended network.)
- ♦ A *network visible entity* (NVE) is any entity that is accessible on an AppleTalk network system through the Datagram Delivery Protocol (DDP).
- ♦ A *seed router* is a router on the network that has the network number range built into its port descriptor. Each network must have at least one seed router. There can be multiple seed routers on a network; however, they all must use the same network number range. All of the non-seed routers on a network learn the correct network number range from the seed routers.

# Protocols

The AppleTalk for NetWare protocols provide connectivity and routing to NetWare networks. These protocols work together with NetWare for Macintosh to provide AppleTalk print and file service features on a NetWare server, as well as the communication between network nodes.

Figure 1 represents the standard AppleTalk protocols and their ISO layers, as described in *Inside AppleTalk, Second Edition* .

Figure 1 AppleTalk Protocol Layers

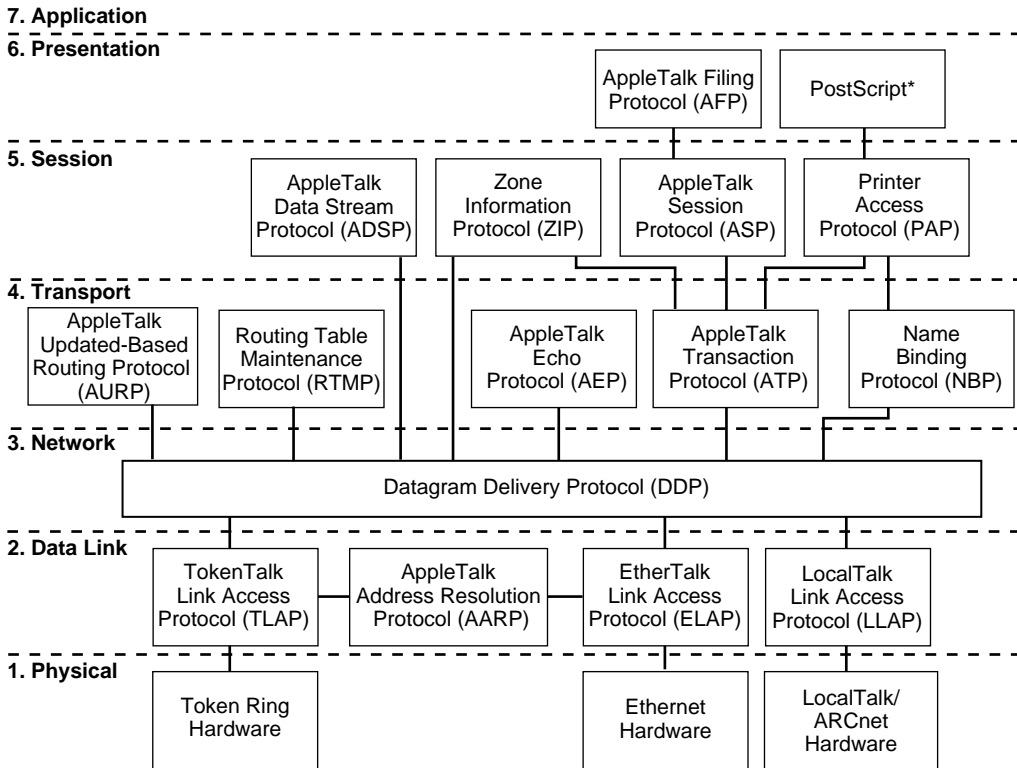


Table 1 lists the AppleTalk protocols used by the Novell Internet Access Server 4.1 routing software. The table also describes what each protocol does. For more detailed information about these protocols, refer to *Inside AppleTalk, Second Edition* .

**Table 1 AppleTalk Protocols**

<b>Protocol</b>	<b>Description</b>
AARP	AppleTalk Address Resolution Protocol. AARP maps AppleTalk addresses (network and node numbers) into LAN hardware addresses (for example, Ethernet or token ring addresses), and manages the process of each AppleTalk node acquiring its unique AppleTalk address on these media.
ADSP	AppleTalk Data Stream Protocol. ADSP enables two programs to communicate through a full-duplex data stream connection in which either program can read or write data bytes with reliable delivery.
AEP	AppleTalk Echo Protocol. AEP is a support protocol that provides a way for a node to bounce a packet off another node. Novell Internet Access Server 4.1 supports the AppleTalk Echo Protocol.
AFP	AppleTalk Filing Protocol. AFP is an Application-level support protocol that enables Macintosh users to share files. NetWare for Macintosh includes an AFP NetWare Loadable Module (NLM™) file that provides AFP support on a NetWare server.
ASP	AppleTalk Session Protocol. By enabling two processes to exchange a sequence of transactions reliably, ASP works with and adds session functionality to ATP (described below).
ATP	AppleTalk Transaction Protocol. ATP provides reliable request and response transaction services. By detecting errors and timeouts, ATP provides reliable packet exchange.
AURP	AppleTalk Update-based Routing Protocol. AURP provides two unique features: the exchange of routing information only when a change occurs on the internetwork (instead of exchanging the information on a set schedule), after the initial exchange of routing information, and IP tunneling. AURP uses the UDP transport protocol in the TCP/IP protocol suite. See “AppleTalk Update-Based Routing Protocol” on page 22 for more information.
DDP	Datagram Delivery Protocol. DDP defines sockets on AppleTalk nodes and defines datagram (packet) delivery between sockets. It provides a mechanism to address any node on an AppleTalk internetwork uniquely.
LAP	Link Access Protocol. LAP includes Data-Link level protocols for Ethernet (ELAP), LocalTalk* (LLAP), and token ring (TLAP). LAP hides media-specific information from the other layers of AppleTalk and sends packets onto a specific hardware link.

---

Protocol	Description
NBP	Name Binding Protocol. NBP provides lists of service names to a user and finds the network addresses of these names. When users request an AppleTalk service in the Macintosh Chooser application, NBP is responsible for broadcasting the request in the selected zone and displaying the names of responding services in the Chooser. See “Name Binding Protocol” on page 15 for more information about NBP.
PAP	Printer Access Protocol. PAP enables users to access printers or print queues on the AppleTalk network.
RTMP	Routing Table Maintenance Protocol. Routers use RTMP to exchange information they need to build and maintain their routing tables. This enables routers to discover each other and move packets from one point on an internetwork to another. AppleTalk routers on the internetwork that use RTMP continuously maintain their routing tables by exchanging RTMP packets. See “Routing Table Maintenance Protocol” on page 22 for more information.
ZIP	Zone Information Protocol. ZIP associates zone names with network numbers and uses queries to maintain this mapping when new zones are added to an internetwork. AppleTalk uses zones to subdivide the internetwork logically so that services are easier for users to find. Routers use ZIP to request and provide zone information when a router comes up with a new network configuration. ZIP also enables nodes to look up and deal with the zones on an internetwork. See “How Zone Information Is Maintained on an Internetwork” on page 17 for more information.

---

The following protocols are especially important in AppleTalk routing:

- ♦ NBP, discussed in “Name Binding Protocol” on page 15
- ♦ RTMP, discussed in “Routing Table Maintenance Protocol” on page 22
- ♦ AURP, discussed in “AppleTalk Update-Based Routing Protocol” on page 22

## Addressing

Addresses identify the exact locations of services. AppleTalk addresses consist of a network number and a node number (in the format of *network number.node ID*). An AppleTalk network number is a 2-byte (16-bit) value and an AppleTalk node number is a 1-byte (8-bit) value.

Each node acquires a unique node number dynamically when it connects to the network. It tries to use the same network and node numbers the next time it attempts to connect to the network; however, if its previous node number is

already in use, it keeps trying until it finds a unique node number that is not in use.

The network portion of an AppleTalk address is chosen from the network number, or range of network numbers, assigned to the AppleTalk network. Nonextended networks are assigned a single network number. Extended networks are assigned a range of network numbers, thus significantly increasing the number of devices that could exist on a network.

**NOTE:** The current version of AppleTalk (called Phase 2) supports both nonextended and extended addressing schemes.

For information about addressing, refer to:

- ◆ Addressing for Extended Networks
- ◆ Addressing for Nonextended Networks
- ◆ Name Binding Protocol

## Addressing for Extended Networks

On an extended network, such as EtherTalk 2.0, you can assign any contiguous range of unique 16-bit network numbers between 1 and 65,279 to a network segment. Each network number within the assigned range can support up to 253 nodes (node numbers 0, 254, and 255 are reserved). Each node on an extended network uses the combination of network and node number as its unique identifier. This scheme increases the theoretical limit of the number of nodes per network to greater than 16 million.

On extended networks, the first time a node is started up it requests a node address from the underlying data link. The node ID part of this address is chosen at random, and the network number part is chosen from the reserved startup range (65,280 through 65,534).

If the node address selected is in use, the node chooses different node numbers until it finds an unused one. Using this startup address, the node can communicate with the router and can acquire a valid network number from the configured range for the network.

If the node has been previously started on the extended network, it uses the same address when it attempts to reconnect to the network. If another node is using that address, the node again chooses different node numbers until it finds an unused one.

**NOTE:** A nonextended network can communicate with an extended network through an AppleTalk router. Refer to “Addressing for Nonextended Networks” on page 15 for more information.

Extended networks require a *network range* and a *zones list* .

A network range is a contiguous range of valid network numbers. The size of the network range you assign determines the maximum number of AppleTalk devices on that network; for example, an extended network with the range 1,001 to 1,010 could support up to 10 x 253, or 2,530, nodes. The only hard-coded limit to the size of a network range is 65,279; however, for optimal performance, you should specify the smallest range that suits your needs. A wider range unnecessarily consumes network numbers.

All AppleTalk routers connected to a network must use the same range for that network, and no other network within that internetwork can use that range or any number contained within it.

A zones list can contain up to 255 zone names. One zone is configured as the *default zone* . All AppleTalk routers on a network must agree about the zones list.

## Addressing for Nonextended Networks

Some AppleTalk networks do not support, and cannot use, extended network addressing. These networks include LocalTalk, ARCnet, and EtherTalk 1.0.

On nonextended networks, you can assign each network exactly one unique 16-bit network number (an integer between 1 and 65,279) and exactly one zone name. Each AppleTalk node is identified by an 8-bit node number. This limits the total number of nodes per network to 254 (the node numbers 0 and 255 are reserved by AppleTalk).

A node on a nonextended network can communicate with a node on an extended network, if the two networks are connected by a router.

## Name Binding Protocol

Nodes and applications use NBP to discover the addresses of nodes and services such as file servers and printers. NBP maps network entity names to AppleTalk addresses. Because people usually find it easier to remember names than numerical addresses, NBP enables users to specify descriptive or symbolic names for entities that applications label with numerical addresses.

One example of how AppleTalk uses NBP is the Chooser application. Users or applications form an NBP lookup by picking a zone and the type of device or service they are interested in. These two pieces of information form an NBP lookup equivalent to the following:

I want all devices of the chosen type (for example, a file server, a mail server, or a printer) in the chosen zone (service location) to respond to me (user location) with their network addresses.

The lookup is then sent to the appropriate zone. All devices or services of the chosen type in the chosen zone respond with an NBP reply. An NBP reply, depending on the content of the lookup, contains the name, type, and network address (AppleTalk address) of the service provided by a node. Then, applications base their communications with the device on its address. In comparison, the service is related through its name. The NBP reply contains information equivalent to the following:

The names and types of services available at this network address and zone (service location) are sent back to the requesting station (the user location).

If filters have been configured for the receiving router, the router then uses the filters to determine whether each NBP reply should be dropped or forwarded.

## Zones

An AppleTalk zone is a logical grouping of devices that enables users to locate and access network services in the Chooser or other application. A zone name is a logical name associated with some or all of the services on a network or set of networks.

When you configure AppleTalk zone names in the router, the zone names are a top-level organizer in the Chooser. A user selects the zone name that indicates where a service is located; for example, a zone named Building 1 or Accounting could indicate where a server resides. When you click a service icon (for example, a printer icon) and select a zone name, the following events occur:

1. The Macintosh sends out NBP Broadcast Request packets.
2. The router sends the NBP requests to the networks associated with the selected zone name and forwards them to other routers when appropriate.
3. The routers directly connected to the networks associated with the selected zone broadcast the NBP request to all nodes in the zone.



4. AppleTalk services in the selected zone send NBP reply packets back to the Macintosh that originated the request, which displays the services' names in the Chooser.

For more information about zones, refer to:

- ◆ Multiple Zones on a Network
- ◆ How Zone Information Is Maintained on an Internetwork
- ◆ Zones List Change on an Internetwork

## Multiple Zones on a Network

Only one zone name is assigned to a nonextended network; therefore, all nodes on that network belong to the same zone. On extended networks, each network range can be associated with up to 255 zones. When a network is associated with multiple zones, you configure the network with a zones list that contains the name of each zone. A node on an extended network can belong to only one zone in that list.

Each zones list has a default zone. When a node first starts up, it resides in the default zone. Each type of router can use its own method of defining which zone is the default zone. However, the routers on an internetwork must agree on which zone name is the default zone, and on the names in the zones list associated with that physical wire. Novell Internet Access Server 4.1 routing software uses the first zone in the list as the default zone. You can use NIASCFG to change the default.

Macintosh workstations belong to the default zone until the Macintosh user chooses another zone in the Network Control Panel. The zone in which a Macintosh workstation is registered is the zone in which its services, if any, are advertised. The Macintosh user can use the Chooser to view and access network services in any AppleTalk zone.

## How Zone Information Is Maintained on an Internetwork

When you bring up an AppleTalk router on the network, it is initialized with its own zones and network numbers. It then begins to exchange routing information packets with every adjacent router on the internetwork.

When other routers receive routing information packets informing them of a new network on the internetwork, those routers send a query to the router that represents the new network. The query asks for the zone name or zones list

associated with it. The new router responds to this query with its zone information. Eventually, all routers on the internetwork have an updated global list of all zones and networks on the entire internetwork. This global list enables all users on the internetwork to see services in all AppleTalk zones.

## Zones List Change on an Internetwork

The zones list associated with a network is changed by reconfiguring the routers connected to the network. To accomplish this, bring down all the routers connected to the network, except the seed routers. While you are waiting for the routers to go down, change the zones list in each of the seed routers, then bring down the seed routers. Bringing down all the routers on the network times out the zones list.

After all the routers have been brought down, wait at least 10 minutes for the old zones list to be removed from all the Zone Information tables on the internetwork. Bring up the seed routers first, then bring up all the non-seed routers on the network. They will learn the new zones list from the seed routers.

If the user has configured static routes to the network in question, the user must manually change the zones list for the static route. Bring the router down, wait 10 minutes for the network to age out, then bring the router up again to activate the change.

## Internal Network

The internal network enables you to advertise services in different zones on the server. Without the internal network, you must advertise all of a server's print queues and other services in a single zone. With the internal network, you can advertise services on any internal network zone.

The internal network also enables you to access any of its services from any working network that AppleTalk is bound to. You can bind and unbind interfaces—assign AppleTalk to specific interfaces—as often as necessary. As long as an interface is bound, the internal network and its services are accessible.

The internal network always supports two nodes, the AppleTalk stack (node 1 on the internal network) and the AppleTalk router (node 2 on the internal network). Nodes on the internal network are connection points between the AppleTalk software and the internal network. They do not represent physical

devices. The internal network is a virtual network with no physical components. It is entirely contained within the AppleTalk module. The internal network appears to the router as if it were just one of a number of networks to which the router is connected. You configure the internal network following the same configuration rules as when you configure an external, physical network.

*The internal network is an extended network.* The rules for extended networks apply when you configure an internal network, with these conditions:

- ◆ A range of one is required. (User input is limited to a single number, which is then automatically translated into a range. For example, if you enter 12, it is translated automatically into a range of 12 to 12.)
- ◆ Novell Internet Access Server 4.1 routing software enables a device to advertise in any zone on the internal network. This capability lets you advertise print queues in different zones.
- ◆ You cannot specify multiple zones for the internal network of a server that uses transition routing. (See “Transition Mode Routing” on page 26 for an explanation of transition routing.) The same is true of any extended network when transaction routing is configured.
- ◆ AFP file services are always advertised in the default zone you enter when you configure the internal network zones. If you do not specify a default zone, the first zone is used as the default zone. You can use NIASCFG to change this default zone.

When the router receives AppleTalk packets with a destination address for the server itself, the router forwards the packets internally to the AppleTalk protocol stack. For example, when a Macintosh user attempts to log in to the server, the router forwards the appropriate packets to the stack.

## Packet Frame Types

The information governed by protocols is grouped into a series of bits that includes data and control elements. That group is called a *packet*. The packet information is transmitted as a group within a *packet frame*. A *LAN driver* renders the different types of packet frames used by each network type into a form that AppleTalk can process. For more information about packet frame types, refer to *Inside AppleTalk, Second Edition*.

The following AppleTalk LAN packet frame types are supported by the Novell Internet Access Server 4.1 routing software:

- ◆ ARCnet (actual frame type is NOVELL\_RX\_NET)
- ◆ Ethernet\_SNAP
- ◆ Ethernet\_II (for AppleTalk Phase 1 and EtherTalk 1.0 only)
- ◆ FDDI\_SNAP
- ◆ LocalTalk
- ◆ Token-Ring\_SNAP

The routing software supports the following AppleTalk WAN packet frame types:

- ◆ ATM
- ◆ Frame relay
- ◆ ISDN
- ◆ PPP
- ◆ SNA LINKS
- ◆ X.25

## AppleTalk Routing Concepts

By connecting AppleTalk networks to other AppleTalk networks, the AppleTalk router creates an internetwork. You can use an AppleTalk router to do the following:

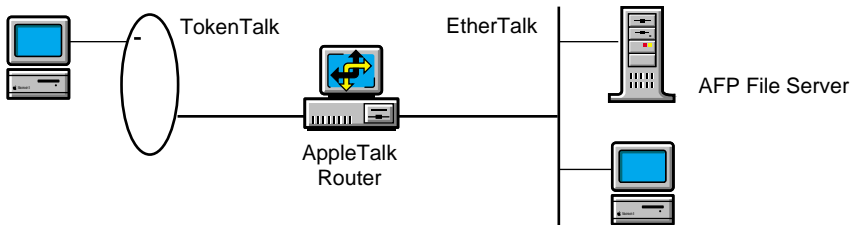
- ◆ Connect different types of AppleTalk networks, such as LocalTalk, EtherTalk, TokenTalk, and ARCnet
- ◆ Isolate traffic on different parts of the internetwork
- ◆ Expand an internetwork

When the AppleTalk router is connected to two or more network segments, it receives packets from a node on one network segment and forwards them to the destination node on another network segment.

Each network on an internetwork is assigned a unique identifier, specifically an address made up of a number or range of numbers. Every AppleTalk packet sent out on the internetwork includes the network number of its destination. The router is a forwarding device. It receives packets on one of its networks, consults the destination network number, and forwards the packet to the proper network.

An AppleTalk router forwards AppleTalk packets between the Macintosh computers and servers on the two networks, as shown in Figure 2.

**Figure 2** Routing on an AppleTalk Network



## Routing Protocols

Novell Internet Access Server 4.1 routing software supports the Routing Table Maintenance Protocol (RTMP) and the AppleTalk Update-Based Routing Protocol (AURP).

Routers use routing protocols to create and dynamically maintain a database of routing information called the *Routing Information Table*. This table contains information about all the networks on the AppleTalk internetwork. The router uses this information to forward packets to their destinations by the best possible route.

AppleTalk routing tables contain an entry for every network in the internetwork. AppleTalk learns the network ranges and/or network numbers of its directly connected interfaces through configuration of the seed router. If the router is configured as a non-seed router, the router listens to seed routers on the network and learns addressing information about its directly connected interfaces. An AppleTalk router learns about networks not directly connected to it through the exchange of routing information with each of its neighbors.

A router's neighbor is a router that has at least one interface on the same network. By learning its neighbor's routing information, the router learns about the entire internetwork.

For more information about routing protocols, refer to:

- ◆ Routing Table Maintenance Protocol
- ◆ AppleTalk Update-Based Routing Protocol

# Routing Table Maintenance Protocol

AppleTalk generally uses RTMP to transmit routing information to neighboring routers. It broadcasts its routing information every 10 seconds to all directly connected networks.

To save network bandwidth, RTMP provides distance vector, *split-horizon routing*. In split-horizon routing, a router does not advertise routes it learns from an interface through the same interface, because neighboring routers reachable through that interface know the information already.

RTMP has a maximum hop count of 15. (Hop count is the number of routers, or hops, that must be traversed to reach the destination network.) If nodes on an AppleTalk internetwork are separated by more than 15 routers, they cannot communicate.

## AppleTalk Update-Based Routing Protocol

AURP is a tunneling and a routing protocol. It is an enhancement of RTMP. AURP provides the feature of AppleTalk tunneling in TCP/IP. This feature enables two isolated AppleTalk networks to be connected by way of a TCP/IP network. AURP provides update-based routing and reliable delivery of routing information. To reduce the amount of bandwidth, update-based routing sends updates to peer routers only when network routing information changes, rather than sending periodic broadcasts of the routing table.

Like RTMP, AURP also provides distance vector, *split-horizon* routing. It has a maximum hop count of 15. A tunnel counts as one hop.

**NOTE:** The Novell Internet Access Server 4.1 routing software supports the minimal set of AURP features defined in RFC 1504.

## Benefits of AURP

AURP is useful in the following scenarios:

- ◆ You want to connect isolated AppleTalk networks by way of an existing TCP/IP internetwork. This is referred to as *tunneling*.
- ◆ You prefer to use only IP through your backbone network, but you have isolated AppleTalk networks that you want to connect.
- ◆ You have AppleTalk networks connected over a slow WAN link. To minimize bandwidth, AURP sends routing information to peer routers

only when there is a change in routing information; yet AURP keeps the routing tables up-to-date.

On a stable network, AppleTalk routers using RTMP broadcast the same information to each other continuously. Because most networks are stable after initial setup, these frequent broadcasts unnecessarily consume bandwidth that could be used to transport more user data. This is particularly noticeable on slow WAN links. Unlike RTMP, AppleTalk routers using the AURP protocol exchange routing information only when a change occurs in the internetwork.

Routing information exchanged with AURP must be communicated reliably. Because only changes are communicated among AURP routers and because this information is not sent periodically (that is, on a set schedule) to peer routers, the possibility of lost information is increased. Therefore, AURP is a transport protocol that provides reliable delivery. It requires the receiving router to acknowledge the receipt of the updates.

**NOTE:** The AURP transport ensures reliable delivery of routing packets only. AppleTalk protocols, such as ATP, ASP, PAP, and ADSP, ensure reliable delivery of AppleTalk data packets.

For more information about using AURP for tunneling AppleTalk through IP, including configuration information, refer to “Setting Up” in the routing documentation for AppleTalk.

## AppleTalk for WAN Connections

AppleTalk supports the following WAN connections:

- ◆ Permanent and on-demand unnumbered point-to-point links
- ◆ Permanent numbered point-to-point links, extended and nonextended network
- ◆ Permanent multiaccess links, extended and nonextended network

Unnumbered point-to-point links are supported for both on-demand and permanent WAN links to a remote peer. We recommend selecting this type of WAN connection. On-demand unnumbered point-to-point links are supported over ATM, PPP, PPP/ISDN, and X.25 links.

Numbered point-to-point links are supported for permanent WAN links running over NetWare Link/PPP™ software and PPP/ISDN software. PPP/ISDN software allows a numbered point-to-point link to support only one connection to a remote peer.

Multiaccess links are supported for permanent WAN links running over ATM, frame relay, and NetWare Link/X.25™ software. Multiaccess links support multiple connections to remote peers and are modeled as a LAN.

Numbered point-to-point and multiaccess links are offered only to allow interoperability with vendors that do not offer unnumbered point-to-point mode.

## WAN Network Support

AppleTalk permits WAN connections over the following protocols:

- ◆ ATM
- ◆ Frame relay
- ◆ PPP
- ◆ PPP/ISDN
- ◆ X.25

### Connecting to Other WAN Vendors

AppleTalk enables you to configure all the previously listed WAN media types to connect with other vendors, such as the following:

- ◆ 3Com\* Corporation
- ◆ Cisco Systems\*
- ◆ Wellfleet

In addition, the software allows a WAN connection with a vendor not compatible with any of the network types listed previously. You can specify to the media the protocol identifier of a WAN vendor along with a network type that it supports.

## Seeding State

*Seeding* refers to an AppleTalk router's ability to teach other routers on a connected network about the network configuration. A *non-seed router* (often called a *learning router*) learns its configuration information from a *seed router* (often called a *configured router*). The Network Range and Zone option (found in the AppleTalk Bindings configuration screen in NIASCFG) enables you to configure either a seed or a non-seed interface.



At least one router on a network must be a seed router. If the network is an extended network, a seed router is configured with a network number range and a zones list for the network. If the network is a nonextended network, a seed router is configured with a single network number and a single zone name for the network. Non-seed routers on the network learn this network number range and zone information dynamically from the seed router.

The seeding state option applies individually to each router interface. One interface can be specified as *learning*, whereas another can be specified as *configured*. If you configure an AppleTalk router interface as a learning interface and there is no seed router on that cable, the AppleTalk router remains inactive on that interface until it receives configuration information from a seed router on the network.

## Benefits of the Seeding State Option

The seeding state option provides these benefits:

- ◆ When you specify the non-seed option for an interface, the router obtains a network configuration consistent with other routers connected to that network.
- ◆ If you use one seed router and have learning interfaces in all other AppleTalk routers connected to the network, you can later change the network or zone configuration much more easily. Instead of reconfiguring all routers on a network, you can bring down all routers and reconfigure only the seed router. After the old network and zones lists are aged out from the internetwork, restart the reconfigure routers. The seed router updates the other routers with the new information.

## How the Seeding Feature Works

AppleTalk routers use RTMP to distribute network configuration information. Every 10 seconds, each AppleTalk router broadcasts RTMP packets containing information about networks, including the directly connected ones. Other AppleTalk routers receive the RTMP packets and use the information to build and maintain a complete view of the AppleTalk internetwork.

When you configure the AppleTalk router with one or more learning interfaces, it uses information received in the RTMP packets to acquire the network number on a learning interface. Then it sends a request for that network's zone information.

If you configure the network and zone information in the Novell Internet Access Server 4.1 routing software, the AppleTalk router tries to validate the configured information against advertised information from any other routers on the network. If there is a conflict, the router does not bind to the LAN card and an error message appears, indicating whether the conflict is in the network number, the default zone, or the zones list. This error message also displays the address of the router from which it received conflicting information. If such a conflict occurs, determine what the correct network and zone information should be, then use NIASCFG to reconfigure the router.

## Transition Mode Routing

Transition mode is a way of configuring Phase 2 routers so that they can operate with Phase 1 routers on an internetwork. This section describes how to configure AppleTalk for NetWare on an internetwork that includes one or more AppleTalk Phase 1 routers.

For more information about transition mode routing, refer to:

- ◆ What the Router Does in Transition Mode
- ◆ How Transition Mode Affects Extended Networks
- ◆ Rules for Setting Up a Transition Mode Configuration

## What the Router Does in Transition Mode

When you configure a router in transition mode, that router is prepared to send out Phase 1-compatible RTMP and NBP packets.

RTMP packets contain information about networks known to the router. By passing this information among themselves every 10 seconds, AppleTalk routers update and maintain their view of the internetwork. NBP packets are used to look up devices on the internetwork.

When the Phase 2 router is not in transition mode, it always sends out Phase 2 RTMP and NBP packets. Phase 2 RTMP packets can contain information about extended networks. A Phase 1 router cannot read the Phase 2 packets and cannot incorporate the Phase 2 information into its routing tables.

Under Phase 2, to find an entity on the internetwork, a node sends an NBP Broadcast Request packet to the closest router. If the requested entity resides on the network directly connected to that router, the NBP Broadcast Request packet is converted into a Lookup packet.

If the requested entity resides on a remote network, the router converts the NBP Broadcast Request packet into a Forward Request packet for each network containing nodes in the zone specified in the NBP Broadcast Request packet. Then the NBP Forward Request packet is transmitted to a router directly connected to the network on which the entity resides. When this router receives the NBP Forward Request packet, it converts it to a Lookup packet and broadcasts it to all nodes in the proper zone on the local network.

When the Phase 2 router is in transition mode, it sends out Phase 1-compatible RTMP packets. A Phase 2 router in transition mode also does not convert Broadcast Request packets into Forward Request packets. Rather, it sends Broadcast Request packets to a router directly connected to the network on which the requested entity resides, whether that network is local or remote.

In transition mode, to avoid extended ranges and zones lists incomprehensible to a Phase 1 router, all Phase 2 routers must observe these addressing constraints:

- ◆ On extended networks, the first number in the network range must be equal to the last number in the range, as in 10 to 10.
- ◆ On extended networks, the zones list must have only one zone.

## How Transition Mode Affects Extended Networks

The addressing constraints in transition mode limit extended networks to 253 devices. If you must support more devices, you cannot use transition mode. Your alternative is to upgrade the Phase 1 routers to AppleTalk Phase 2 so that you do not need to use the transition mode.

## Rules for Setting Up a Transition Mode Configuration

When you configure Novell Internet Access Server 4.1 routing software in transition mode for extended networks, the following conditions must be in effect:

- ◆ Phase 1 routers typically predate the introduction of AppleTalk Phase 2 and have not been upgraded to support Phase 2. You can connect Phase 1 routers only to nonextended networks (EtherTalk 1.0, ARCnet, and LocalTalk) because Phase 1 does not support extended networks (EtherTalk 2.0, TokenTalk, and FDDITalk). However, having nonextended networks on an internetwork does not necessarily mean that a Phase 1 router is present.

- ◆ If the internetwork has Phase 1 routers and you want to keep them installed and configured as Phase 1 routers (rather than upgrade them to Phase 2), you configure all Phase 2 routers on the internetwork in transition mode. When you do that, the Phase 2 router modifies its behavior to operate with a Phase 1 router.
- ◆ The Type of Packet Forwarding option must be set to Transition (Phase 1 and 2) from the AppleTalk Configuration screen.
- ◆ On extended networks, the first number in the network range must be equal to the last number in the range, as in 10 to 10.
- ◆ On extended networks, the zones list must have only one zone.

Nonextended networks should be configured as usual.

As usual, the network number or range you assign to an interface must be unique on the internetwork and consistent for all routers on that network segment. The zone name you assign to an interface must also be consistent for all routers on that network segment.

## Simple Network Management Protocol

A Simple Network Management Protocol (SNMP) Agent is software that acts as an intermediary to receive SNMP requests and distribute them to the protocol stack. An SNMP Agent also relays replies from the protocol stack to a console utility. To provide information about the AppleTalk network, Novell's SNMP Agent, SNMP.NLM, communicates with the AppleTalk stack and router, contained in APPLETLK.NLM.

For remote access to network management information, SNMP.NLM uses either the Datagram Delivery Protocol (DDP), the Internetwork Packet Exchange™ (IPX™) protocol, or the TCP/IP protocol stack as a transport protocol. DDP is native to AppleTalk and is supported by APPLETLK.NLM. IPX is the primary protocol used by the NetWare IPX Router™ software and is supported by NetWare. TCP/IP support is provided with TCPIP.NLM and is included with NetWare.

You need an SNMP management console application to retrieve AppleTalk data. Most third-party applications use TCP/IP to retrieve network management data from routers and servers on the network. However, APPLETLK.NLM enables an SNMP console to use DDP as the basic transport for communication with SNMP.NLM. Novell Internet Access Server

4.1 routing software can also support SNMP over TCP/IP, but this scenario requires that TCPIP.NLM also be loaded on the NetWare server.

## Enabling SNMP Support on the AppleTalk Network

You do not need to enable SNMP. It is loaded and enabled along with the AppleTalk software. To access SNMP information about the local Novell router, load ATCON.

For more information about SNMP support and ATCON, refer to “Setting Up” in the routing documentation for AppleTalk.

## SNMP Operations on the AppleTalk Network

SNMP support in Novell Internet Access Server 4.1 is compliant with the AppleTalk MIB specification (described in RFC 1243). A Management Information Base (MIB) is a collection of *objects* an application can access through SNMP. The AppleTalk MIB specification describes the following groups of objects:

- ◆ LocalTalk Link Access Protocol (LLAP)—This group provides information about all LocalTalk interfaces on the server. Only the objects llapInPkts and llapOutPkts are supported.
- ◆ AppleTalk Address Resolution Protocol (AARP)—This group maps AppleTalk node addresses and the addresses of the underlying Data-Link layer for data links other than LocalTalk. This group provides a view of the AARP Address Mapping table.
- ◆ AppleTalk Port (ATPort)—An AppleTalk port is a logical connection to a network over which AppleTalk packets can be transmitted. This group of objects provides information about the configuration of each AppleTalk port.
- ◆ Datagram Delivery Protocol (DDP)—This group provides statistical counters on the operation of DDP.
- ◆ Routing Table Maintenance Protocol (RTMP)—This group shows the table that the AppleTalk router uses to forward datagrams on the AppleTalk internetwork.
- ◆ Kinetics Internet Protocol (KIP)—This version of APPLETLK.NLM does not support this group. In other implementations of AppleTalk, this group provides status and routing information in a tunneling environment.

- ♦ Zone Information Protocol (ZIP)—This group shows the mapping of networks and zone names of which the AppleTalk router is aware.
- ♦ Name Binding Protocol (NBP)—This group provides information about the NBP table containing services registered with NBP and statistics about NBP operations in the server.
- ♦ AppleTalk Echo Protocol (AEP)—AEP is a Transport-level protocol that can verify the status of nodes on the internetwork. This group provides statistics about the operation of AEP.

APPLETLK.NLM supports the Get and GetNext SNMP operations. It does not support the Set SNMP operation or SNMP Traps.

# 2 Planning

This section describes the decisions that you must make before you configure AppleTalk for the Novell® Internet Access Server 4.1 routing software.

For information about general AppleTalk concepts, refer to “Understanding.”

## Configuration Decisions

This section provides you with the information you need to decide whether a feature is useful in your environment and how to configure a feature to fit your needs. How you configure AppleTalk beyond the most basic configuration depends on the following decisions:

- ◆ **Whether to use the computer as a router or as an end node**

The Packet Forwarding parameter controls AppleTalk routing. Enable this parameter if you want your computer to operate as an AppleTalk router. Disable it if you want your computer to operate as an end node.

Select an end node configuration only if you are using AppleTalk for NetWare to support applications and you already have another AppleTalk router that provides connectivity to other networks.

For more information, refer to “Enabling Expert Configuration Options.”

- ◆ **Whether your network supports Phase 1 or Phase 2 routing**

The Type of Packet Forwarding option you select depends on the type of AppleTalk routing your network supports. The default is Phase 2. Select Transition (Phase 1 and Phase 2) if you need to connect to Phase 1 routers.

The type of AppleTalk routing your network supports depends on the type of media used. An extended network, such as EtherTalk 2.0, supports both

Phase 1 and Phase 2 routing. Nonextended networks, such as LocalTalk, ARCnet, and EtherTalk 1.0, support only Phase 1 routing.

For more information, refer to “Configuring Basic AppleTalk Parameters.”

◆ **Whether to use an internal network**

The Internal Network , Network Number , and Network Zone(s) List parameters let you configure an internal network to enable application support on the internal network.

For more information, refer to “Configuring an Internal Network” on page 38 and “Internal Network.”

◆ **If you are configuring a WAN connection, whether to use a permanent or an on-demand link .**

Determine whether the interface to which you are binding AppleTalk should bring up a permanent or an on-demand link to the remote peer. For permanent connections, specify WAN call destinations for the interface during binding configuration. For on-demand calls, specify an on-demand WAN call destination for the interface during binding configuration, then specify the static route configuration for that call destination.

Advantages of using on-demand connections include the following:

- ◆ On-demand WAN connections usually cost less than permanent WAN connections.
- ◆ After an on-demand connection terminates, you can use the same interface to establish another on-demand connection to a different location. Unlike permanent WAN connections, no service provider involvement is necessary to connect to a different destination.

Disadvantages of using on-demand connections include the following:

- ◆ On-demand connections are configuration-intensive; therefore, they are more prone to operator errors. You must list all the networks (through static routes) that users might need to get to the other end of the connection.
- ◆ To prevent periodic routing traffic from keeping the on-demand connection active continuously, static route configuration is required. Because static routes do not get updated dynamically, packets are sent to a destination even if the actual network is disconnected or down temporarily.



- ◆ If, while using the Macintosh Chooser, a user accidentally browses a zone located at the other end of an on-demand connection, the connection will be brought up to retrieve the service information. As a result, unexpected cost is incurred.
- ◆ If a user connects to a file server over an on-demand connection but sends no data, the connection will not time out and disconnect. The file server constantly sends tickle packets, keeping the connection active.

To configure AppleTalk to run over an on-demand connection, you must enable the *Static Routes for On Demand Calls* in the AppleTalk protocol configuration, and enter static routes for your on-demand call in *Static Routes Configuration* when configuring the WAN call destination during the binding configuration.

For more information, refer to “Configuring AppleTalk for LAN Connections.”

- ◆ **If you are configuring a permanent WAN connection, whether to use an unnumbered point-to-point link, a numbered point-to-point link, or a multiaccess link**

Unnumbered point-to-point links do not require a network number or a zone name. Numbered point-to-point links and multiaccess links require a network number (or network range), zone(s) list, and peer address configuration. AppleTalk for NetWare supports on-demand links only in the unnumbered point-to-point mode.

Use unnumbered point-to-point when connecting two Novell Internet Access Server 4.1 peers together. Select numbered point-to-point to connect to third-party routers that do not support unnumbered schemes. Select multiaccess to connect with a third-party router that requires multiaccess configuration using ATM, frame relay, or X.25 links.

Numbered and multiaccess link configurations are created only to allow interoperability with other AppleTalk router vendors that do not implement unnumbered point-to-point links.

For more information, refer to “Configuring Basic AppleTalk Parameters.”

- ◆ **Whether your router will be a seed router**

A seed router propagates network and zone configuration information to other routers in the network. A non-seed router learns its configuration

information from the seed router. The seeding state is configured individually for each interface.

At least one router on an AppleTalk network must be a seed router. If you have more than one seed router on a network, the network number/range and zone(s) list configuration must be the same for all seed routers.

Non-seed routers learn the network number and zone name from a seed router on the network. Therefore, if you need to reconfigure the network addressing, you need to change the configuration only on the seed router and restart all the directly connected non-seed routers, rather than reconfiguring all the routers.

However, before restarting the routers with new configuration information, you must wait 10 minutes to make sure the changed network and zone names are aged out from the internetwork.

# 3

## Setting Up

The AppleTalk for NetWare<sup>®</sup> protocol offers a set of configurable parameters you can use to modify the default characteristics of the protocol, to configure it to run over a WAN connection, or to configure it to run over an IP tunnel.

To configure AppleTalk for the Novell<sup>®</sup> Internet Access Server 4.1 routing software, you must enable the protocol, set its various options, and bind the protocol to a network interface. To configure or change any AppleTalk options, run the Novell Internet Access Server Configuration utility (NIASCFG).

This section helps you configure basic and advanced options for AppleTalk for Novell Internet Access Server 4.1. During basic configuration, default protocol parameters were set and the network protocols were bound to network interface boards.

For information about general AppleTalk concepts, refer to “Understanding.”

### Configuring Basic AppleTalk Parameters

AppleTalk can be routed over a LAN or WAN by use of Novell Internet Access Server 4.1. You can configure AppleTalk to run over permanent or on-demand WAN connections, and provide application support through the internal network or on a bound LAN interface. The basic AppleTalk configuration parameters modify the default behavior of the protocol and how it is used for LAN or WAN connections.

This topic contains the following sections:

- ◆ Enabling AppleTalk
- ◆ Enabling Packet Error Detection

- ◆ Configuring an Internal Network
- ◆ Enabling Static Routes for On-Demand Calls
- ◆ Enabling Expert Configuration Options

## Enabling AppleTalk

AppleTalk addressing consists of a network number and a node number. Each node dynamically acquires a unique 8-bit node number when it connects to the network. The node tries to use the same address when it connects to the network again. If that address is not available, it tries other numbers until it finds a unique address.

The network portion of the address, as well as the zone assignments, can be of two forms, depending on whether the network is an *extended* or a *nonextended* network.

When a nonextended network is used, you assign a single network number and a single zone name to each network. This limits the total number of nodes per network to 254 (nodes 0 and 255 are reserved).

When an extended network is used, you assign a network number range and a zone(s) list to each network. You can assign any contiguous range of network numbers between 1 and 65279 to a network segment. Each network number within the assigned range can support up to 253 nodes, which increases the theoretical limit of the number of nodes per network to greater than 16 million (nodes 0, 254, and 255 are reserved).

An AppleTalk *zone* is a logical grouping of devices that enables users to locate and access network services, such as printing. A zone name is a logical name associated with some or all of the services on a network or set of networks.

To enable AppleTalk and configure the basic AppleTalk parameters, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:  
Select Configure NIAS > Protocols and Routing > Protocols > AppleTalk
- 2** Select AppleTalk Status .  
Select Enabled .

If you disable the AppleTalk Status parameter, the configuration of the protocol is saved, but AppleTalk is not active.

**3** Select Packet Forwarding .

Select Enabled (Router) .

When the Packet Forwarding parameter is disabled, the system behaves like an end node and does not forward AppleTalk packets from one network to another.

**NOTE:** Changing Packet Forwarding from Enabled to Disabled , or Disabled to Enabled , will cause all AppleTalk bindings to be deleted. As a precaution, you should write down the binding parameters for all AppleTalk bindings so that you can reconfigure them if necessary.

**4** Select Type of Packet Forwarding .

AppleTalk for NetWare is a Phase 2 router. Select Transition mode if you must support Phase 1 AppleTalk routers. Otherwise, leave the default, Phase 2 , selected.

Once you select Transition , each extended network number must have a range of one and can have only one associated zone name.

If you want to configure other parameters, do so now. When you are finished, complete Step 5 and Step 6 .

**5** If you want to save these changes, press Esc to exit AppleTalk, select Yes to save your changes, then press Esc again to return to the Internetworking Configuration menu.

**6** If you want these changes to take effect immediately, select Reinitialize System from the Internetworking Configuration menu. Select Yes when prompted.

## Enabling Packet Error Detection

Use this procedure to detect packet errors. We recommend that you leave DDP Checksum disabled under most circumstances.

To enable DDP Checksum , complete the following steps:

**1** Follow the steps in “Enabling AppleTalk.”

**2** Select DDP checksum .

Select Enabled .

If you want to configure other parameters, do so now. When you are finished, complete Step 3 and Step 4 .

- 3** If you want to save these changes, press **Esc** to exit AppleTalk, select **Yes** to save your changes, then press **Esc** again to return to the Internetworking Configuration menu.
- 4** If you want these changes to take effect immediately, select **Reinitialize System** from the Internetworking Configuration menu. Select **Yes** when prompted.

## Configuring an Internal Network

An *internal network* is a virtual network contained within the AppleTalk module. It has no physical components and it appears to the router as if it were one of a number of networks to which the router is connected. The internal network supports two nodes, the AppleTalk stack (node 1 on the internal network) and the AppleTalk router (node 2 on the internal network).

Packets must be routed from an external network interface to the internal network. Because the internal network requires an address, it takes up a network number. If you configure AppleTalk without configuring an internal network, to allow application support you must configure one of the bound LAN interfaces.

This procedure enables you to create an internal network; however, AppleTalk can operate without an internal network.

To configure an internal network, complete the following steps:

**1** Follow the steps in “Enabling AppleTalk.”

**2** Select **Internal Network** .

Select **Enabled** .

**3** Select **Network Number** .

Assign a unique network number between 1 and 65279 to your internal network.

**4** Select **Network Zones List** .

To add a zone to the list, press **Ins** and enter the name of desired network zones. You can enter up to 255 zone names. If your router uses transitional routing, it is allowed to use only one zone name. Each zone name can be up to 32 characters.

If you want to configure other parameters, do so now. When you are finished, complete Step 5 and Step 6 .

- 5** If you want to save these changes, press **Esc** to exit AppleTalk, select **Yes** to save your changes, then press **Esc** again to return to the Internetworking Configuration menu.
- 6** If you want these changes to take effect immediately, select **Reinitialize System** from the Internetworking Configuration menu. Select **Yes** when prompted.

## Enabling Static Routes for On-Demand Calls

This procedure lets you set up static route configurations that AppleTalk recognizes.

To enable static routes for on-demand calls, complete the following steps:

- 1** Follow the steps in “Enabling AppleTalk.”
- 2** Select **Static Routes for On Demand Calls** .  
Select **Enabled** .

If you want to configure other parameters, do so now. When you are finished, complete Step 3 and Step 4 .

- 3** If you want to save these changes, press **Esc** to exit AppleTalk, select **Yes** to save your changes, then press **Esc** again to return to the Internetworking Configuration menu.
- 4** If you want these changes to take effect immediately, select **Reinitialize System** from the Internetworking Configuration menu. Select **Yes** when prompted.

## Enabling Expert Configuration Options

The Expert Configuration options allow you to configure advanced AppleTalk features, such as identifying the Protocol ID (PID) for third-party WAN router vendors. Use this option if your configuration involves a WAN connection connecting AppleTalk for NetWare with another vendor's implementation of AppleTalk, such as the following:

- ◆ AppleTalk over frame relay
- ◆ AppleTalk over X.25
- ◆ AppleTalk over ATM

To enable the Expert Configuration options, complete the following steps:

- 1 Follow the steps in “Enabling AppleTalk.”
- 2 Select the Expert Configuration Options menu.

Select Vendor Providing AppleTalk over X.25 on the Other Peer when you want to make an X.25 connection with another vendor. Depending on the vendor to whom you will connect, select Cisco, Novell, or Other. When you select Other, you are prompted to enter the vendor's Protocol ID. Use the default (Novell) unless the vendor does not use the standard Protocol ID.

Select Vendor Providing AppleTalk over X.25 on the Other Peer when you want to make this type of connection. Depending on the vendor to whom you will connect, select 3Com/Cisco, Novell, or Other. When you select Other, you are prompted to enter the vendor's Protocol ID. Use the default (Novell) unless the vendor does not use the standard Protocol ID.

Select Configure other WAN Media Type PID when you want to make a connection other than X.25 or frame relay. The Other WAN media PIDs screen is displayed. Press Ins, then select a WAN media type.

**NOTE:** It is not possible to configure more than one Protocol ID for each WAN media type. That is, the same Novell Internet Access Server 4.1 router cannot connect to routers using different Protocol IDs for X.25 at the same time.

If you want to configure other parameters, do so now. When you are finished, complete Step 3 and Step 4.

- 3 If you want to save these changes, press Esc to exit AppleTalk, select Yes to save your changes, then press Esc again to return to the Internetworking Configuration menu.
- 4 If you want these changes to take effect immediately, select Reinitialize System from the Internetworking Configuration menu. Select Yes when prompted.

## Configuring Your PC Router as an AppleTalk End Node

The Novell Internet Access Server 4.1 routing software allows you to turn off, or disable, AppleTalk routing on a dedicated router or NetWare file server. A NetWare system with AppleTalk routing disabled operates as an AppleTalk end node. If you are using AppleTalk for NetWare only to support applications on a LAN, and you already have another AppleTalk router that provides



connectivity to other networks, an end node configuration has the following characteristics:

- ◆ An end node does not periodically broadcast routing table maintenance protocol packets. More network bandwidth can be used for data rather than for routing traffic.
- ◆ An end node does not require any network number or zone configuration. It assumes the network number and zone from the network to which the AppleTalk interface is connected.

For AppleTalk to support file and print services, NetWare for Macintosh should be installed before Novell Internet Access Server 4.1.

Features such as filtering, WAN support, AURP, and internal network support are available only if AppleTalk for NetWare is configured as a router.

## How to Configure Your PC Router as an AppleTalk End Node

To turn off AppleTalk routing and configure AppleTalk as an end node, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing

- 2** Configure the LAN board.

For information about configuring boards, refer to *Setting Up in the Boards* documentation.

- 3** Select the following parameter path:

Select Protocols > AppleTalk > Packet Forwarding > Disabled

When packet forwarding is disabled, the system does not route AppleTalk packets from one network to another.

**NOTE:** Because all previous AppleTalk bindings will be deleted after changing Packet Forwarding to Disabled, make sure AppleTalk is bound to a network interface. When you configure AppleTalk as an end node, you can bind AppleTalk to only one LAN interface. If you want the application services to be registered in a zone other than the default zone, in the binding menu enter the name of the zone in which you want the services to be registered.

# Configuring AppleTalk for LAN Connections

To configure AppleTalk for a LAN connection and bind it to a LAN interface, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing

- 2** Configure the LAN board.

For information about configuring boards, refer to Setting Up in the *Boards* documentation.

- 3** Configure the basic AppleTalk options, including Type of Packet Forwarding , Filtering Support , and Internal Network , if necessary.

For information about these AppleTalk options, refer to “Configuring Basic AppleTalk Parameters.”

- 4** Select the following parameter path:

Select Bindings > press Ins > a network interface

**NOTE:** You must enable and configure AppleTalk before you can bind AppleTalk to an interface.

- 5** Configure the following options:

- 5a** Select Network Range and Zone configuration to establish whether this is a seed or non-seed router.

**NOTE:** At least one router on the network must be a seed router. The seeding state is configured individually for each interface.

The network and zone configuration is propagated through *seed routers* . A seed router can teach other routers on a network about the network number or range and zone configuration. A *non-seed router* (or *learning router* ) learns its configuration information from the seed router.

For a nonextended network, the seed router is configured with the network number and zone name for the network. For an extended network, the seed router is configured with a network range and a zone(s) list for the network.

For more information about seeding, refer to “Understanding.”

- 5b** Select the type of AppleTalk network.

An *extended network* supports a network range and multiple zones. A *nonextended network* supports one network number and one zone.

On an extended network, such as EtherTalk 2.0, each network number within the assigned range can support up to 253 nodes. (Node numbers 0, 254, and 255 are reserved.)

On a nonextended network, such as LocalTalk, ARCnet, and EtherTalk 1.0, the total number of nodes is limited to 254. (Node numbers 0 and 255 are reserved.)

**NOTE:** AppleTalk supports nonextended networks only for ARCnet networks. The user must ensure that AppleTalk is bound to an ARCnet interface using only the nonextended network type.

- 5c** Select **Provide Applications on this Interface** and **Applications Zone Name** if you want application support through the interface when the internal network is disabled.

You can provide application support through the internal network or the LAN interface. You can configure application support through the interface only when the internal network is disabled. You can select only one LAN interface to provide AppleTalk application support.

For more information about internal networks, refer to “Understanding.”

If you want to configure other parameters, do so now. When you are finished, complete Step 6 and Step 7 .

- 6** If you want to save these changes, press **Esc** to exit AppleTalk, select **Yes** to save your changes, then press **Esc** again to return to the Internetworking Configuration menu.
- 7** If you want these changes to take effect immediately, select **Reinitialize System** from the Internetworking Configuration menu. Select **Yes** when prompted.

## Configuring AppleTalk for WAN Connections

AppleTalk supports the following WAN connections:

- ◆ Permanent and on-demand unnumbered point-to-point links
- ◆ Permanent numbered point-to-point links
- ◆ Permanent multiaccess links

We recommend selecting unnumbered point-to-point WAN connections. Multiaccess and numbered point-to-point links are offered mainly to allow interoperability with other router vendors that do not offer unnumbered point-to-point mode.

To configure AppleTalk to run over a WAN connection, you must complete the following tasks:

1. Configure the WAN interface you are using for your connection.

For information about setting up PPP, PPP/ISDN, or other WAN interfaces, refer to "Setting Up" in the documentation for the appropriate WAN protocol.

2. Configure the WAN call destination for your WAN connection.

For information about setting up permanent or on-demand WAN call destinations, refer to Setting Up in the *NetWare Link/PPP* documentation.

3. Configure the basic AppleTalk options, such as Type of Packet Forwarding , Filtering Support , and Internal Network , if necessary.

For information about these AppleTalk options, refer to "Configuring Basic AppleTalk Parameters."

4. Configure the following AppleTalk options, if necessary:

- a. Static Routes for On-Demand Calls , if you are setting up AppleTalk over an on-demand WAN connection.

- b. Expert Configuration Options , if your configuration involves a WAN connection (frame relay, X.25, ATM, or other WAN media) over which AppleTalk for NetWare interoperates with another vendor's AppleTalk implementation.

5. Bind AppleTalk to a WAN interface, including the following options:

- a. WAN Network Mode , to establish whether this is a numbered point-to-point, unnumbered point-to-point, or multiaccess interface. Numbered point-to-point and multiaccess modes are offered mainly to allow interoperability with other vendors that do not offer unnumbered point-to-point mode.

- b. AppleTalk Network Type , which is required for numbered point-to-point and multiaccess interfaces. Select NonExtended or Extended , depending on the other vendor's implementation of AppleTalk over that WAN media.

- c. Network Range/Number , to specify the network range for extended networks or a single network number for nonextended networks. This parameter is used for numbered point-to-point and multiaccess configuration.
- d. Local AppleTalk Address and Zone List , to identify this WAN interface. Each numbered point-to-point or multiaccess link must have a unique address. This parameter is active only if you selected numbered point-to-point or multiaccess as the WAN Network Mode .
- e. WAN Call Destinations , which can be any one of three types: permanent automatic, permanent manual, or on-demand. If the link is permanent automatic, the list includes WAN call destinations that should make the call automatically when the router comes up and/or the remote node address of the WAN call destination peer. For on-demand calls, the list includes WAN call destinations and static routes for the WAN call destinations for unnumbered point-to-point interfaces.
- f. Negotiation , to negotiate the RTMP updates interval for this interface. If set to Yes , this interface will negotiate all incoming calls using the Routing Update Timer value specified in the next field. Any manual calls that are not configured in this interface's peer list, but are executed through the Call Manager utility (CALLMGR), will use the setting of the Negotiation and Routing Update Timer fields as defined here.

If this is a link to a remote Novell Internet Access Server 4.1 peer, set the Negotiation value to Yes . In most cases, third-party vendors might not understand our negotiation packet; therefore, setting the Negotiation value to No and specifying a value for the Routing Update Timer will force this interface to transmit RTMP packets within the specified time without going through the negotiation process.
- g. Routing Update Timer , to specify the number of seconds between updates of the routing table. The called and calling routers should be configured to use the same value. If they have different values, the shorter time is used. Note that using a long time value results in a prolonged route convergence time.

This topic contains the following sections:

- ◆ Configuring AppleTalk for a Permanent Connection
- ◆ Configuring AppleTalk for an On-Demand Connection

- ◆ Configuring the WAN Network Mode
- ◆ Binding AppleTalk to a WAN Interface
- ◆ Using Interface Groups

## Configuring AppleTalk for a Permanent Connection

A *permanent call* is always active between the local router and the remote peer router associated with a WAN call destination. The call remains active until AppleTalk is unbound from the board, or until the call is disconnected using CALLMGR from the calling router. If the disconnect is initiated from the called router, the calling router will try to reestablish the call if the call's Retry Mode parameter is set to Retry All Failures . For a detailed discussion of the options for the Retry Mode parameter in the WAN Call Destination configuration menu, refer to the previous WAN Call Destination section. If the connection fails at the initial call attempt, the calling router immediately tries to establish the call again.

To configure AppleTalk for a permanent WAN connection, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing

- 2** Configure the basic AppleTalk options.

For information about the basic AppleTalk configuration options, refer to “Configuring Basic AppleTalk Parameters.”

- 3** Bind AppleTalk to a WAN interface or a group interface.

For information about binding AppleTalk for a permanent WAN connection, refer to “Binding AppleTalk to a WAN Interface.”

If you want to configure other parameters, do so now. When you are finished, complete Step 4 and Step 5 .

- 4** If you want to save these changes, press Esc to exit AppleTalk, select Yes to save your changes, then press Esc again to return to the Internetworking Configuration menu.
- 5** If you want these changes to take effect immediately, select Reinitialize System from the Internetworking Configuration menu. Select Yes when prompted.

## Configuring AppleTalk for an On-Demand Connection

An *on-demand* call is a WAN connection between two routers that becomes active only when one router must send data to the other. On-demand calls are well-suited for occasional use, to save money on connections that use expensive telecommunications carriers and for slow links over which it is undesirable to exchange routing traffic.

If you want to use an on-demand call instead of a permanent call, you must complete the following tasks:

- ◆ Enable Static Routes for On-Demand Calls in the AppleTalk Protocol Configuration menu.
- ◆ Select a WAN call destination of call type on-demand.
- ◆ Configure at least one static route for the on-demand WAN connection.

AppleTalk does not send routing traffic across an on-demand call. Instead, you must configure static routes to run an on-demand WAN connection. Static routes inform AppleTalk which networks are reachable and how to forward packets to those destinations.

When AppleTalk receives a packet for a destination specified as a static route, it initiates the on-demand call and forwards the packet. For on-demand calls to work successfully, both ends of the link for a configured call must configure a call to each other. Each call must be configured with enough static route information to send and receive AppleTalk packets between the routers at both ends.

On-demand connections are supported only on the unnumbered point-to-point WAN network mode. To select and configure the WAN network mode, refer to “Configuring the WAN Network Mode.”

**NOTE:** You cannot configure on-demand connections for frame relay.

To configure AppleTalk for an on-demand WAN connection, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing

- 2** Configure the basic AppleTalk options.

For information about the basic AppleTalk configuration options, refer to “Configuring Basic AppleTalk Parameters.”

- 3** Enable Static Routes for On Demand Calls .

This selection activates static routes for AppleTalk. It lets you configure static routes for each WAN call destination in the binding menu.

- 4** Press **Esc** to exit the AppleTalk Protocol menu. Save your changes when prompted.
- 5** Select WAN Call Directory .
- 6** Press **Ins** . Enter a Call Destination Name .
- 7** In the Call Type field in the WAN Call Destination configuration menu, select On-Demand .

**NOTE:** When configuring an on-demand call or a permanent call that can be initiated by either end of the connection, enable inbound authentication on the network interface as described in the section that explains how to configure the WAN protocol you are using. This allows AppleTalk to identify the remote system making the inbound call and to associate that call with the outbound WAN call destination.

Depending on the type of WAN connection, consult one of the following sections for more information about WAN call destination configuration:

- ◆ For more information about PPP or PPP/ISDN, refer to *Setting Up* in the *NetWare Link/PPP* documentation.
  - ◆ For more information about ATM, refer to *Setting Up* in the *NetWare Link/ATM* documentation.
  - ◆ For more information about X.25, refer to *Setting Up* in the *NetWare Link/X.25* documentation.
- 8** Bind AppleTalk to a WAN interface or an Interface Group.

For information about binding AppleTalk for an on-demand WAN connection and configuring static routes, refer to “Binding AppleTalk to a WAN Interface.”

If you want to configure other parameters, do so now. When you are finished, complete Step 9 and Step 10 .

- 9** If you want to save these changes, press **Esc** to exit the WAN Call Directory menu, select **Yes** to save your changes, then press **Esc** again to return to the Internetworking Configuration menu.
- 10** If you want these changes to take effect immediately, select **Reinitialize System** from the Internetworking Configuration menu. Select **Yes** when prompted.



## Configuring the WAN Network Mode

The WAN network mode governs how AppleTalk operates over a WAN connection. Depending on which WAN medium you use—ATM, frame relay, X.25, PPP, or PPP/ISDN—and how you want to use the connection, you can use any of the following network modes:

- ◆ Unnumbered point-to-point

We recommend this mode, unless you are connecting to a third-party router that does not support it. This mode does not require an AppleTalk network address for the interface. You can use unnumbered point-to-point mode with any WAN medium that supports single or multiple connections to remote peer routers.

- ◆ Numbered point-to-point

Numbered point-to-point is used with PPP and PPP/ISDN when you are connecting to other vendors that do not support unnumbered point-to-point. Numbered point-to-point supports a single permanent connection to a remote system, such as a link between a local branch office and the main office.

- ◆ Multiaccess

Multiaccess is used with ATM, frame relay, and X.25 when you are connecting to other vendors that do not support unnumbered point-to-point. Multiaccess supports multiple simultaneous connections to remote peer routers.

Table 2 indicates the supported mode for each network medium. Use this table as a guide when you are choosing a network mode for your WAN connections.

**Table 2 WAN Media, Call Types, and Compatible WAN Network Modes**

WAN Medium	WAN Call Type	WAN Network Mode		
		Unnumbered Point-to-Point	Numbered Point-to-Point	Multiaccess
ATM	Permanent	X		X
	On-Demand	X		
PPP	Permanent	X	X	
	On-Demand	X		

WAN Medium	WAN Call Type	WAN Network Mode		
		Unnumbered Point-to-Point	Numbered Point-to-Point	Multiaccess
PPP/ISDN	Permanent	X	X	
	On-Demand	X		
X.25	Permanent	X		X
	On-Demand	X		
Frame relay	Permanent	X		X

Table 3 lists the vendors and WAN media with which AppleTalk WAN connections can interoperate.

**Table 3 AppleTalk WAN Vendor Interoperability**

WAN Medium	WAN Network Mode	AppleTalk Network Type	Vendor Interoperability
PPP	Unnumbered point-to-point	Nonextended #	3Com, NetWare MultiProtocol Router 3.1, NetWare MultiProtocol Router 3.0
		Numbered point-to-point	Bay Networks, NetWare MultiProtocol Router 3.1, NetWare MultiProtocol Router 3.0
	Extended	Cisco, 3Com	
X.25	Unnumbered point-to-point	Nonextended #	3Com, NetWare MultiProtocol Router 3.1, NetWare MultiProtocol Router 3.0

WAN Medium	WAN Network Mode	AppleTalk Network Type	Vendor Interoperability
	Multiaccess	Nonextended	Cisco, NetWare MultiProtocol Router 3.1, NetWare MultiProtocol Router 3.0
		Extended	Cisco, 3Com
Frame relay	Unnumbered point-to-point	Nonextended #	3Com, NetWare MultiProtocol Router 3.1, NetWare MultiProtocol Router 3.0
	Multiaccess	Nonextended	Cisco
		Extended	Cisco, 3Com

# If Unnumbered Point-to-Point WAN Network mode is selected, the nonextended AppleTalk network type is automatically configured.

**NOTE:** The latest releases of router software from third-party router vendors might have better interoperability than is indicated in Table 3 .

## Binding AppleTalk to a WAN Interface

To configure the WAN network mode and bind AppleTalk to a WAN interface, complete the following steps:

- 1 Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing

**2** Configure the basic AppleTalk options.

For information about the basic AppleTalk configuration options, refer to “Configuring Basic AppleTalk Parameters.”

**3** Select Bindings from the Internetworking Configuration menu, then press Ins .

The Protocol-to-Interface/Group Bindings menu displays a list of the configured bindings that includes the following information:

- ◆ Protocol —Name of the protocol.
- ◆ Interface/Group —Name of the interface or the interface group to which the protocol is bound.
- ◆ Status —Current status of the binding. The status can be toggled between Enabled and Disabled by pressing Tab .
- ◆ Identifier —Network address, type of network, type of interface, or type of connection associated with the interface to which the protocol is bound.

If you are changing an existing binding, select that entry, press Enter , then continue with Step 7 .

If you are creating a new binding to a WAN interface, press Ins . A new screen displays a list of the configured protocols, which should include AppleTalk. Continue with Step 4 .

**4** Select AppleTalk from the list, then press Enter .

A screen is displayed that asks if you want to bind AppleTalk to a particular network interface or to each interface in a group.

**5** Select A Network Interface , then press Enter .

A new screen displays a list of the configured WAN interfaces.

**6** Select a WAN interface from the list, then press Enter .

A new menu displays parameters for binding AppleTalk to the selected WAN interface.

**7** Select WAN Network Mode. Then select the mode for this connection.

Select Unnumbered Point to Point, unless you must allow interoperability with a system that does not support this mode. You can select Multiaccess only if you are using ATM, frame relay, or X.25.

Refer to Table 2 on page 49 and Table 3 on page 50 for more information about when each WAN network mode can be used.

If you select **Numbered Point to Point** or **Multiaccess**, configure the **AppleTalk Network Type**, **Network Range/Number**, **Local AppleTalk Address**, and **Zone Name** parameters for the interface as follows:

- 7a** Select **AppleTalk Network Type** and press **Enter**. Select **NonExtended** or **Extended**, depending on the other vendor's implementation of AppleTalk over the WAN media used, then press **Enter**.
- 7b** Select **Network Range/Number** and press **Enter**. Enter your network number, then press **Enter**.  
  
The network range/number must be the same for all peers, and the node number must be unique among peers. Select **Yes** to save your changes.
- 7c** Select **Local AppleTalk Address** and press **Enter**. Enter the AppleTalk address and node number for this WAN interface, then press **Enter**.
- 7d** Select **Zone List** and press **Enter**. Press **Ins**, enter a zone name, then press **Enter**.

Repeat this step to enter additional zone names as required.

- 8** Skip **WAN Call Destinations** for now, select **Negotiation**, and press **Enter**. Select **No** and press **Enter** again.

Setting this value to **No**, and specifying a value for the **Routing Update Timer** parameter that follows, forces this interface to transmit RTMP packets within the specified time without going through the negotiation process. Any manual calls that are not configured in this interface's peer list, but executed through **CALLMGR** will use the setting of the **Negotiation** and **Routing Update Timer** fields as defined here.

- 9** Select **Routing Update Timer**, enter a value, and press **Enter**.

This value specifies the number of seconds between updates of the routing table. The called and calling routers should be configured to use the same value. If they have different values, the shorter time is used. Note that using a long time value results in a prolonged route convergence time. The range of values is 10 through 1,800 seconds. The default value is 10 seconds.

- 10 Select WAN Call Destinations , then press Enter to specify the WAN call destination that you want this interface to establish.

**NOTE:** You do not need to configure WAN call destinations for routers that receive only permanent calls. For on-demand call configuration, each router must have a call configured to the other router with static routes for the packets to go out and return.

**For permanent calls using numbered point-to-point, unnumbered point-to-point, or multiaccess interfaces, press Ins, then configure the following parameters for the WAN destination peer with which you want to establish a connection:**

- ♦ WAN Call Type —select Automatic or Manual . Automatic calls are placed automatically when the router is started. Manual calls are placed through CALLMGR.

**NOTE:** The Network Number and Node Number are required only for numbered point-to-point interfaces.

- ♦ Network Number —enter the network number of the remote peer for this WAN interface.

For an extended network, enter a network number within the Start of Network Range and the End of Network Range as specified in the Binding AppleTalk to a WAN Interface menu Step 7b on page 53 .

For a nonextended network, enter the same network number as specified in the Binding AppleTalk to a WAN Interface menu.

- ♦ Node Number —enter the node number of the peer.
- ♦ Configure the Negotiation and Routing Update Timer parameters for the WAN call destination, if necessary. We recommend that you leave these values at their default settings.

Set Negotiation to No when the peer on the other side of the connection is not an AppleTalk for NetWare router.

- ♦ Routing Update Timer —specify the number of seconds between updates of the routing table. The called and calling routers should be configured to use the same value. If they have different values, the shorter time is used. Note that using a long time value results in a prolonged route convergence time.

**For on-demand calls using an unnumbered point-to-point interface, configure the following parameters for the WAN call destination that you want this interface to establish:**

You must first pick an on-demand call destination from the list of configured WAN call destinations. On-demand calls are supported only on unnumbered point-to-point WAN links to a remote peer. For on-demand connections, you must enable static route configuration and configure the appropriate static routes.

- ◆ Press **Ins** in the Unnumbered Point-to-Point WAN Call Destination screen to select a WAN call destination of call type on-demand, then press **Enter** .

The WAN Call Type is automatically set to on-demand when you select an on-demand WAN call destination.

- ◆ Select **Static Routes** , then press **Enter** .

Press **Ins** to enter a static route. The Static Routes for On-Demand Calls screen is displayed. Configure the following static route parameters:

AppleTalk Network Type —Press **Enter** , select **Extended** or **NonExtended** depending on the network type of the destination network that you are configuring, then press **Enter** again.

Network Range/Number —Press **Enter** , specify the network range for extended networks or a single network number for nonextended networks, then press **Enter** again.

Hops to Network —Press **Enter** , specify the number of hops between this router and the destination network, then press **Enter** again.

Each router the packet goes through is one hop.

Network Zone(s) List —Press **Enter** , then press **Ins** , add a zone, then press **Enter** again. Repeat this procedure until you have entered all the zones on the destination network.

To add more static routes, press **Ins** in the Static Routes for On-Demand Calls screen and repeat the above procedure. When you are finished, complete Step 11 and Step 12 .

- 11** If you want to save these changes, press **Esc** , select **Yes** to save your changes, then press **Enter** .

You must do this four times to return to the Internetworking Configuration menu.

- 12** If you want these changes to take effect immediately, select **Reinitialize System** from the Internetworking Configuration menu. Select **Yes** when prompted.

## Using Interface Groups

An interface group is a grouping of several PPP, PPP/ISDN, or X.25 interfaces with similar characteristics. Interfaces that belong to a group can be used interchangeably by a WAN call. Interface groups are defined during configuration of PPP or X.25 interfaces that belong to the group. To configure WAN interfaces, load NIASCFG and select Configure NIAS > Protocols and Routing > Network Interfaces .

Defining an interface group lets you make a permanent or an on-demand call on any of several network interfaces without creating an individual WAN call destination for each interface. When an interface group name is specified in place of the interface name in the WAN call destination, an available interface is selected automatically from the group when a call is made.

Interface groups are used for permanent or on-demand connections for X.25, PPP, and PPP/ISDN. You can bind AppleTalk to interfaces that belong to an interface group only for the unnumbered point-to-point network mode.

Backup calls can be configured with interface groups. However, all backup calls that are part of an interface group must be configured as *permanent* calls using PPP. The primary call associated with each backup call must also be permanent but can use any WAN medium supported by Novell Internet Access Server 4.1. For information about configuring backup calls, refer to Setting Up in the *NetWare Link/PPP* documentation.

**IMPORTANT:** All AppleTalk bindings to interfaces in the same group must have the same configuration. When you bind AppleTalk to an interface in a group, you must make sure that the settings for that binding are the same as the settings for every other binding to interfaces that belong to that group. The WAN network mode must be set to Unnumbered Point-to-Point .



# 4 Managing

This section describes how to monitor AppleTalk LAN and WAN connections using the available router management consoles and utilities.

## Using the ATCON Utility

ATCON is a console utility used for diagnosing AppleTalk network conditions and verifying connectivity. ATCON provides information about the router's AppleTalk stack and any attached AppleTalk networks.

To launch ATCON, enter **LOAD ATCON** at the system console prompt or load NIASCFG and follow this path:

Select View Status for NIAS > Protocols and Routing > AppleTalk Protocol Stack

You can select Routing Table to display information about connected AppleTalk networks. You can also use the Lookup Network Entities option to verify the connectivity of AppleTalk devices.

## Viewing AppleTalk Configuration Information

To see how AppleTalk is configured, load ATCON and select the following options:

- ◆ Interfaces views the interfaces in the router to which AppleTalk is bound.
- ◆ Protocol Configuration views the current configuration for AppleTalk.

# Determining Whether a Remote AppleTalk Router Is Reachable

To determine whether a remote router is reachable, you can run an Echo test. To run an Echo test, load ATCON and perform the following steps:

**1** From the Available Actions window, select Lookup Network Entities.

**2** In the Name field, type the name of the router you want to reach.

To find all services, leave the default value (=).

**3** In the Type field, select NetWare Router.

Press Enter to get a list of Name Binding Protocol (NBP) types from which you can select. If NetWare Router is not in the list, press Insert to add it to the list.

**4** In the Zone field, select the name of the zone in which the remote router resides.

Press Enter to get a list of zones from which you can select.

**5** Select Perform Lookup and press Enter .

The Network Entities Found window appears.

Wait at least 30 seconds for the link to be established and routes to be exchanged, then perform the lookup again. Do not wait for routers to be exchanged for destinations connected by an on-demand link. Also, be aware that performing the lookup for destinations connected by an on-demand link will generate packets to the destination and will bring up the link.

**6** Select the router you want to reach.

The Edit Echo Parameters and Execute Test window appears.

**7** Edit the Echo parameters.

You can edit the following parameters:

- ◆ Mode—Choose Send Specified Number of Packets to send only the number of packets specified in the Number of Packets to Send field. Choose Send Continuously to send packets until you press Esc to stop the Echo test.
- ◆ Number of Packets to Send—Determines the number of echo requests to be sent to the remote router.

- ♦ Timeout—Determines the amount of time to wait for an echo reply from the remote router. If the reply is returned before the timeout is over, the next echo request is sent. If the reply does not come back, an echo request is sent after the timeout is over.
- ♦ Number of Data Bytes—Specifies the size of the echo request packet.

**8** Select Perform Echo and press Enter .

The Sending Echo Packets window appears. The window shows the progress of the Echo test.

## Determining Which AppleTalk Services Are Reachable

If you want to know whether a specific AppleTalk service is available, you need to find out which AppleTalk services are reachable. To determine the services available to a router, load ATCON and perform a lookup for network entities.

To perform a lookup, follow these steps:

- 1** From the Available Actions window, select Lookup Network Entities.
- 2** In the Name field, type the name of the service for which you are looking.

To find all services, leave the default value (=). To use a wildcard character, enter the following sequence of keys at the numeric keypad while pressing Alt: 2 , 4 , and 7 .

- 3** In the Type field, select the NBP type of the service you want to reach.

Press Enter to get a list of NBP types from which you can select. If the NBP type of the service you want to reach is not in the list, press Insert to insert a new NBP type.

- 4** In the Zone field, select the name of the zone in which the remote router resides.

Press Enter to get a list of zones from which you can select.

- 5** Select Perform Lookup and press Enter .

The Network Entities Found window appears.

Wait at least 30 seconds for the link to be established and routes to be exchanged, then perform the lookup again. Do not wait for routers to be exchanged for destinations connected by an on-demand link. Also, be

aware that performing the lookup for destinations connected by an on-demand link will generate packets to the destination and will bring up the link.

## Monitoring Error Counters

Error counters are monitored to make sure they are not increasing rapidly, because a rapid increase indicates a problem. For information about troubleshooting these problems, refer to “Troubleshooting.” You can monitor error counters in one of the following ways:

- ◆ By using MONITOR to view counters such as Checksum Errors, Send and Receive Packet Errors, and interface-specific errors. To view these counters, load MONITOR and follow this path:

Select LAN/WAN Information > interface you want to view

- ◆ By using ATCON to view the following AppleTalk counters:
  - ◆ Bad DDP Length
  - ◆ Bad DDP Checksum
  - ◆ No Route Found
  - ◆ Too Many Hops

To view these counters, load ATCON and select Packet Statistics.

- ◆ By using PPPCON to view the following PPP counters:
  - ◆ Bad Address Fields
  - ◆ Bad Control Fields
  - ◆ Bad FCS Values
  - ◆ Packets Too Long

To view these counters, load PPPCON and follow this path:

Select PPP Interfaces > interface you want to view > PPP Error Statistics

## Monitoring AppleTalk Information

Monitoring AppleTalk information can give you a clear view of the status of your AppleTalk network and whether the router is configured properly to run efficiently in the network. This information can also be helpful in

troubleshooting and optimizing the network. This topic contains the following sections:

- ◆ Checking the AppleTalk Routing Table
- ◆ Monitoring AURP

## Checking the AppleTalk Routing Table

To check the AppleTalk routing table to obtain information associated with each route, load ATCON and follow this path:

Select Routing Table > Network or Zone Name (to sort the list of routes)

The Routing Table window displays all known AppleTalk networks. The list shows the following information about each item:

- ◆ Network number or range
- ◆ Zone or zones associated with the network
- ◆ Status of the route
- ◆ Number of hops to the network
- ◆ DDP address of the next hop or IP address of the next hop when AURP is used
- ◆ Port number of the interface used to reach the next hop

## Monitoring AURP

If you have AURP configured, you can monitor the status of AURP connections by loading ATCON and selecting AURP Information.

The list shows the following information about each AURP connection:

- ◆ IP address of the peer to which the router is connected
- ◆ IP address of the AURP tunnel
- ◆ State of the receiver peer
- ◆ State of the sender peer
- ◆ Time between Tickle (keep-alive) packets sent between two peers



# 5

## Troubleshooting

This section contains AppleTalk troubleshooting information that is divided into four categories:

- ◆ Troubleshooting tools
- ◆ Configuration tips
- ◆ Troubleshooting checkpoints
- ◆ Common problems

If a problem that is general in nature occurs, the procedure described in “Troubleshooting Checkpoints” on page 65 will help you isolate and resolve the problem. If a problem with a specific symptom occurs, refer to “Common Problems.”

### Troubleshooting Tools

ATCON is an NLM console utility used for diagnosing AppleTalk network conditions and verifying connectivity. ATCON provides information about the router's AppleTalk stack and any attached AppleTalk networks. Enter **LOAD ATCON** at the system console prompt. You can select Routing Table to display information about connected AppleTalk networks. You can also use the Lookup Network Entities option to verify the connectivity of AppleTalk devices.

### Configuration Tips

We recommend the following guidelines for configuring AppleTalk:

- ◆ To configure AppleTalk to work on a WAN, you must configure only one side of the WAN connection to initiate outgoing calls, with the exception

of X.25 permanent virtual circuits. Therefore, a WAN call destination is required. The other side of the WAN connection should be configured to receive incoming calls. If you have both ends initiate calls to each other on the same port and the WAN data link used is PPP, you might see the following message:

```
Retrying call for target name call_name . Call attempt
  failed because the selected port is currently in use.
```

Check whether a connection to the remote server already exists, and reconfigure the connection as needed.

- ◆ If you are running AppleTalk on X.25 at 19.2 Kbps or faster, change the Default Inbound Packet Size option and the Default Outbound Packet Size option in NIASCFG from the default of 128 bytes to 1,024 bytes (parameter path: Select Configure NIAS > Protocols and Routing > Network Interfaces > a specific interface > Profile). Press F3 to edit the profile and select Packet Level Parameters. This change increases performance.
- ◆ AppleTalk functions over PPP at 1,200 baud or faster. AppleTalk can function only over X.25 at 2,400 baud or faster.
- ◆ If you are running an AppleTalk numbered WAN link (PPP numbered, PPP-ISDN numbered, ATM multiaccess, frame relay multiaccess, or X.25 multiaccess) between two routers, both ends of the link must be configured with the same network number (or range of numbers) and zone name. Otherwise, the routers do not exchange routing information. This results in error messages indicating network number conflicts and increases in the Bad DDP Length or results in No Route Found statistics in ATCON indicating dropped packets (parameter path: Select Packet Statistics). Similar results appear when you configure a numbered or multiaccess WAN link to connect to an unnumbered link on another router.
- ◆ Increase the Routing Update Timer period for outgoing calls in NIASCFG from the default of 10 seconds to anywhere between 60 and 300 seconds when you are using links below 19.2 Kbps (parameter path: Select Configure NIAS > Protocols and Routing > Bindings > a specific binding > WAN Call Destinations). This increase maximizes data throughput by minimizing the number of routing information packets sent through the link.

**WARNING:** By increasing the Router Update Timer period, you adversely affect the amount of time it takes a network to converge after a change of topology.



- ◆ If an internal network is configured on a NetWare for AppleTalk router, the router's Name Binding Protocol (NBP) name resides on the default zone of the internal network. If the internal network is not configured, the NetWare for AppleTalk router name resides on the default zone of the LAN interface configured to provide application support. If the AppleTalk applications are configured to home on a nondefault zone of an external LAN interface, the router's NetWare AppleTalk stack and applications such as AFP Server will home to the specified nondefault zone. However, the NetWare router and SNMP Agent will always reside in the default zone.
- ◆ When configuring the AppleTalk seed state in NIASCFG (parameter path: Select Configure NIAS > Protocols and Routing > Bindings > a specific binding > Network Range and Zone configuration), you must verify that at least one seed router is on each AppleTalk network. If other seed routers are directly connected to the same network, all the network numbers and zone names must be configured the same.

## Troubleshooting Checkpoints

To isolate and resolve AppleTalk problems, complete the following steps:

- 1** Use an Echo test to determine whether the router can communicate with a particular node on one of its networks.

When you execute an Echo test, the router sends a specified number of packets across the network to a specified node; the node then returns the same number of packets.

If the Number of Packets Received field does not increment, the specified node might be switched off or a cable connection might have become loose.

If an Echo test executes successfully, the number of packets received is equal or nearly equal to the number of packets sent. If the communication is successful, AppleTalk is working on that interface and the specified node is up and running.

To execute an Echo test:

- 1a** Select Lookup Network Entities from the Available Actions window of ATCON.
- 1b** Enter a zone name in the Name field.
- 1c** Select Perform Lookup for the Proceed option.

**1d** Select an entity from the displayed list.

**1e** Edit the following test parameters as required: Mode, Number of Packets to Send, Timeout, and Number of Data Bytes.

- 2** Use an Echo test to determine whether the router can communicate with a node on a remote AppleTalk network.

Use the same procedure described in Step 1 .

If the test is successful, the router can reach another AppleTalk network, and all intermediate AppleTalk routers are routing correctly.

If the test is not successful, execute an Echo test to the closest router on the path to the remote node. Continue Echo testing each router along the path until you find the closest point at which the test fails, then perform corrective action on the router that failed. Check the interfaces in ATCON and enter **CONFIG** at the system console prompt to determine whether the interface has a hardware problem. Verify that AppleTalk is bound to the network interface with the correct address.

- 3** Check the routing table in ATCON.

The Routing Table option contains entries for all networks and zones to which the router can send packets. If entries are missing, verify that each router on the internetwork is active and advertising routes. Check for any filters that would interfere with the propagation of routes.

- 4** Check the zones list in ATCON.

The Zones List option displays a global list of all AppleTalk zones in the internetwork. This list should be identical to the zones list that appears in the Macintosh Chooser. If entries are missing, verify that each router on the internetwork is active. Check for any filters that would interfere with the propagation of zones.

- 5** Verify that AppleTalk is bound to the interface.

- 6** Use ATCON to check the system log file for error messages.

The No Route Found statistic indicates that entries are missing from the routing table. The Too Many Hops statistic indicates that the path between some nodes in your internetwork is too long.

- 7** Verify that the AppleTalk configuration options in NIASCFG are set to the proper values.

- 8** Check the AppleTalk Packet Statistics option in ATCON.

If you find Bad DDP Length errors, you probably have a malfunctioning interface board or an incorrect version of the board driver software.

If you find Bad DDP Checksum errors, use the LANalyzer<sup>®</sup> software to find the device that is sending packets with bad checksums.

If you find No Route Found errors, there is probably a malfunctioning router or a malfunctioning cable between your router and the destination. To find the portion of the network with the problem, follow the route and send NBP lookups or echo packets to each router along the way until you find a router that knows the route to the final destination. The problem is located between the router that knows the route and the previous router in the path.

If you find Too Many Hops errors, verify that no clients are more than 15 hops away from the servers they access.

## Common Problems

This section discusses various symptoms of common problems and their potential solutions. The symptoms are listed in the following categories:

- ◆ MACIPXGW.NLM
- ◆ Zones and Zone Names
- ◆ Console Messages
- ◆ Connection Problems
- ◆ Binding Problems
- ◆ Routing Update Problems
- ◆ Printing and Service Problems

### MACIPXGW.NLM

- ◆ MACIPXGW fails to load and the following error message appears:

```
Failed to find zone for gateway.
```

- ◆ Try to load MACIPXGW manually from the console. If it loads, MACIPXGW was loaded before the AppleTalk stack could resolve the default zone. Delay loading MACIPXGW in your AUTOEXEC.NCF file as long as possible. You should load and bind AppleTalk first, followed by other protocols, and finally MACIPXGW.

- ◆ If MACIPXGW still fails to load when you load it manually, the AppleTalk stack might be homing on an external non-seed interface and there is no router on the network to which the interface is attached. Reconfigure AppleTalk to be a seed router on that interface, or enable the AppleTalk internal network.
- ◆ MACIPXGW fails to load because of an incorrect AppleTalk Application Program Interface (API) version.

You have incompatible APPLETLK.NLM and MACIPXGW.LAN files on your system. Update both to the latest version.

- ◆ The following message appears:

```
Gateway name truncated to 32 characters.
```

The gateway name that you configured is more than 32 bytes long. This is not a fatal error, but to avoid the warning message in the future, you should change the gateway name to less than 32 bytes.

- ◆ There are too many IPX broadcast packets encapsulated in unicast AppleTalk packets on the wire and you want to reduce the traffic.

Change the Unicast Threshold parameter for MACIPXGW to a smaller number. This forces the broadcast IPX packets to be encapsulated in AppleTalk broadcast packets.

## Zones and Zone Names

- ◆ Reconfigured zones are still visible in the client's Chooser or in the router's zone tables.

This problem results from the way in which AppleTalk maintains routing tables and zone information on the internetwork. Routers are not informed automatically about changes in zone configuration.

- ◆ If this problem is occurring at your site and the reconfigured router is the only router directly connected to the network supporting new zones, bring down the router and keep it off the network for at least 10 minutes (or until the changed routes are aged out from the internetwork). When you bring up the router again, the new zones will be in effect.
- ◆ If more than one router is connected to the network supporting new zones, all routers must be reconfigured to support the same zones. Bring down all the routers, reconfigure the zones, and leave the

routers down for at least 10 minutes (or until the changed routes are aged out from the internetwork).

- ◆ If the zones are supporting more than one network and you want to change the zones for all or some of those networks, you must bring down the routers connected to each of the networks on which you want to change the zones. Reconfigure the zones and leave the routers down for at least 10 minutes (or until the changed routes are aged out from the internetwork).
- ◆ Zone names do not match configured zone names.
  - ◆ Although zone names are not case-sensitive, it is always better to use the same case when the same zone name is entered in different configuration files. Maintaining the same lowercase and uppercase conventions for zone names helps to avoid confusion on the internetwork, because zone names can be easily identified when viewed in the Chooser or ATCON on a router attached to an AppleTalk network.
  - ◆ It is recommended that you do not use blanks at the end of zone names.
- ◆ A network number or network range has a different zones list on different routers after the zones list of the network was changed on the seed router.

The seed router was brought up before the network was aged out from all the routers. Bring down the seed router and the directly connected routers, and wait for the network to age out all the routers. At least 10 minutes is recommended.

## Console Messages

- ◆ The following message is displayed when the Lookup Network Entities option is executed for the first time over on-demand zones:

```
No entities were found.
```

The on-demand link is not connected yet. Wait at least 30 seconds before retrying so that the on-demand link can complete the connection.

- ◆ The console displays messages about mismatched network numbers or mismatched zones.

### General Solutions

- ◆ Verify that the network number or range is unique on the internetwork.

- ◆ Verify that all routers on the cable agree about the network number or range.
- ◆ Verify that the network's zones list has the same names and that all routers agree about that name.

### **Solutions for Extended Networks**

- ◆ Verify that the extended network range of the router in Transition Mode has a network range of one (such as 21-21).
- ◆ Verify that the extended network range is unique on the internetwork.
- ◆ Verify that all routers on the cable agree about the network range.
- ◆ Verify that all routers on the cable agree about the zone names.

## **Connection Problems**

- ◆ An AppleTalk numbered WAN link (PPP numbered, frame relay multiaccess, and X.25 multiaccess) does not connect to a third-party router. Make sure the correct name of the manufacturer of the third-party router is configured in NIASCFG (parameter path: Select Configure NIAS > Protocols and Routing > Protocols > AppleTalk > Expert Configuration).

AppleTalk for NetWare supports both extended and nonextended networks over numbered WAN links. Verify that the third-party router is configured for the appropriate AppleTalk extended or nonextended network. Make sure the network number (or range of numbers) and zone name are the same on the routing software and the third-party router.

- ◆ An AppleTalk frame relay or X.25 link does not connect to a third-party router.

Verify that the correct name of the manufacturer of the third-party router is configured in NIASCFG (parameter path: Select Configure NIAS > Protocols and Routing > Protocols > AppleTalk > Expert Configuration).

- ◆ An on-demand link never times out.
  - ◆ Do not use an on-demand TCP connection for an AppleTalk Update-based Routing Protocol (AURP) connection. Because AURP sends Tickle (keep-alive) packets routinely, the on-demand link never times out. If you want the link to time out, filter AURP packets for that interface.

- ◆ If the AppleTalk on-demand link is up all the time, make sure that no Macintosh on the network is leaving the Chooser on with the AppleShare\* or printer icons selected for an on-demand zone. Make sure that no Macintosh is accessing an application (such as AFP Server) on an on-demand zone and is sitting idle.

- ◆ The console displays the following message:

```
Misconfiguration - routing update is received from the  
remote system for an on-demand link.
```

The link will stay up until deleted explicitly.

- ◆ For X.25 connections, either a static route on-demand call is not configured on the called router or there is a misconfiguration of the Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination).
- ◆ For PPP connections, either a static route on-demand call is not configured on the called router or there is a misconfiguration of the Remote System ID or the Local System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination) or the Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > Network Interfaces > a specific PPP interface > Authentication Options > Inbound Authentication).
- ◆ A second call to the same router using the same WAN protocol does not connect or does not pass data.

AppleTalk does not use a second call between the same two routers and often cannot establish the second connection.

- ◆ A permanent or on-demand call does not connect to the same destination. If a permanent call is established, an on-demand call cannot be connected to the same destination. Likewise, if an on-demand call is established, a permanent call cannot be connected to the same destination.
- ◆ Data is not reaching an on-demand static route even though ATCON displays the connection as GOOD.

Static routes for on-demand links are always displayed as GOOD in ATCON, even when the on-demand link is not connected. Use CALLMGR to verify the status of the on-demand connection.

- ◆ There is more than one AppleTalk WAN connection between two NetWare routers.

- ◆ There are two X.25 connections.

The two routers are configured to call each other. The duplicate calls might be caused by the incorrect configuration of the Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination).

- ◆ There are two PPP connections.

This can happen only if both routers have two PPP interfaces that are configured to call each other and there is a misconfiguration of the Remote System ID or the Local System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination) or the Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > Network Interfaces > a specific PPP interface > Authentication Options > Inbound Authentication).

- ◆ There is one X.25 call and one PPP call.

There is a misconfiguration of the Remote System ID or the Local System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination), the PPP Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > Network Interfaces > a specific PPP interface > Inbound Authentication), or the X.25 Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > Network Interfaces > a specific X.25 interface > Authentication Options > Inbound Authentication).

## Binding Problems

- ◆ AppleTalk does not successfully bind to a seed interface.

Because the routing software does soft seeding, AppleTalk verifies the configured seeding information with the current network configuration from the other routers on that network. If the seeding information is inconsistent with the current configuration of the network, there is a misconfiguration and AppleTalk does not allow the interface to come up. Check the interface's configuration to verify that the network number (or range) and zone names are configured in exactly the same way as all other seed routers connected to the same network.

- ◆ AppleTalk fails to bind to an interface and the following message is displayed:



Error binding APPLETLK to board *board\_name* .

This occurs because the driver was not initialized fully when AppleTalk was bound to it the first time. This can happen when the *LOAD driver* command immediately precedes the command for binding AppleTalk to the driver in a batch file such as AUTOEXEC.NCF. To correct this problem, use NIASCFG to configure the board and AppleTalk, or manually move the *LOAD driver* line to above the *LOAD APPLETLK* line to allow more time for the board to complete initialization.

## Routing Update Problems

- ◆ Routing update packets are exchanged on X.25 on-demand links.

A static route on-demand call is not configured on the called router, or there is a misconfiguration of the Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination).

- ◆ Routing update is exchanged on PPP on-demand links.

A static route on-demand call is not configured on the called router or there is a misconfiguration of the Remote System ID or the Local System ID (parameter path: Select Configure NIAS > Protocols and Routing > WAN Call Directory > a specific WAN call destination) or the Remote System ID (parameter path: Select Configure NIAS > Protocols and Routing > Network Interfaces > a specific PPP interface > Authentication Options > Inbound Authentication).

## Printing and Service Problems

- ◆ AppleTalk clients cannot access the services provided on the NetWare server from the Chooser, and the server does not respond to AURP requests.

The LAN driver does not support multicast correctly. Use a different LAN driver.

- ◆ AppleTalk clients cannot see the services provided on the NetWare server from the Chooser.

Load ATCON from the NetWare server console, then select Protocol Configuration. If the status of the stack is Disabled and the AppleTalk router has no internal network configured, you might have forgotten to select a LAN interface to provide application support when you bound AppleTalk to the LAN interface.

- ◆ Macintosh print jobs over on-demand links are suspended.

If a Macintosh was linked to the printer over an on-demand link some time ago and did not print anything, the on-demand link might time out and disconnect. If the Macintosh starts to print, its print job is suspended and the Macintosh system displays a message to check the Print Monitor. At the same time, the on-demand link starts to make the connection. As you select Try Again and close the Print Monitor, the on-demand link finishes establishing the connection. The print job would then be printed. Subsequent print jobs are printed without any interruption from the Print Monitor, as long as the on-demand link is connected.

- ◆ There are differences in the routing tables between routers.

Routing tables between AppleTalk routers can vary from each other. Check that routing filters among the routers are not preventing the propagation of required routes. If AURP is being used, verify that all AURP routers have been configured with the correct peer list. Verify that the required static routes for the on-demand calls have been configured in NIASCFG (parameter path: Select Configure NIAS > Protocols and Routing > Bindings > a specific binding > WAN Call Destination > Static Routes).