Routing in Windows NT

A Microsoft® Windows NT™ Server, along with Windows NT Server Multi-Protocol Routing, allows you to connect local area networks (LANs) together or local area networks to wide area networks (WANs) without needing to purchase a dedicated router.

After installing Windows NT Server Multi-Protocol Routing and enabling the Routing Information Protocol (RIP) routing options, your Windows NT Server computer should be able to route network packets between two or more network adapters using RIP on Internet Protocol (IP) or Internetwork Packet Exchange (IPX), or both, and be a BOOTP/DHCP Relay Agent (depending on your configuration) which allows a computer to relay BOOTP/DHCP messages across an IP LAN.

Note   Windows NT Server Multi-Protocol Routing is intended for use by system administrators already familiar with routing protocols and routing services. This document provides installation instructions and a brief overview on routing and assumes that the reader has a basic understanding of routing and dynamic routing protocols. For more information on routing in general and dynamic routing protocols please consult a TCP/IP or IPX protocol related book.

Overview

A *router* helps LANs and WANs achieve interoperability and connectivity, and can link LANs that have different network topologies, such as Ethernet and Token Ring. Each packet sent over a LAN has a packet header that contains source and destination address fields to indicate where the packet originated from and where it is going. Routers work by matching packet headers to a LAN segment and choosing the best path for that packet. In this way, they connect LANs/WANs together while optimizing network performance. For instance, for a packet to go from Computer x to Computer z in the following illustration, the best route uses only one hop. If Router 1 is the default router for x, the packet will be rerouted through Router 2 and Computer x will
be notified of the route to use to get to Computer z.
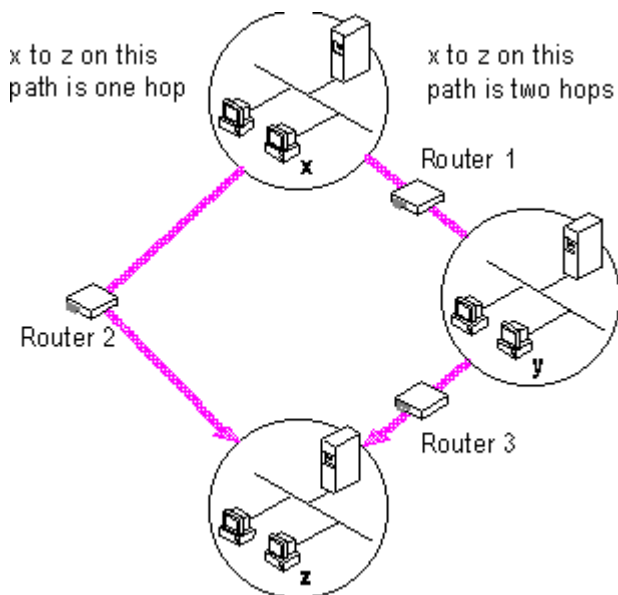
Routers choose the best path for packets to travel

The glossary section at the end of this document provides a brief overview of other types of common LAN connection devices: repeaters, bridges, brouters, and gateways.
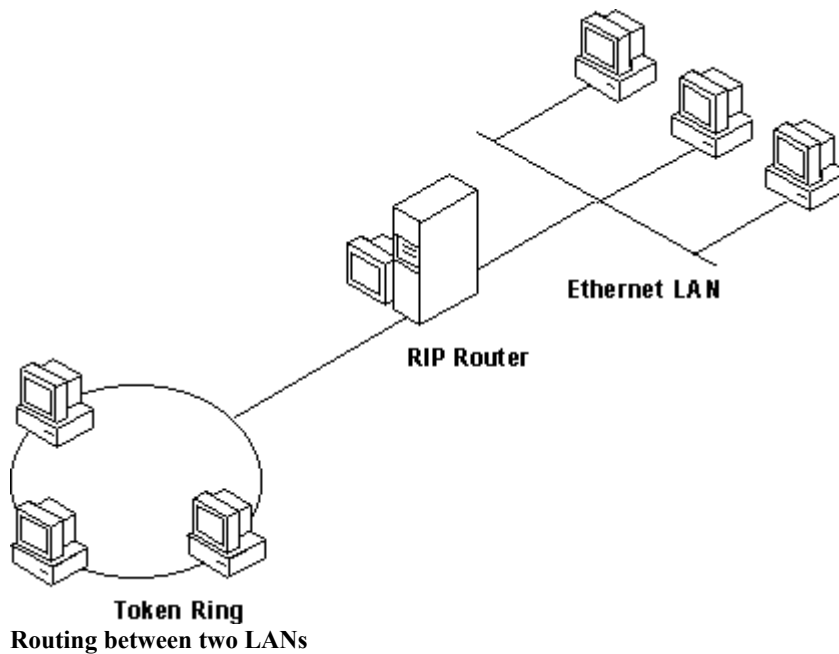
Windows NT Server Routing Capabilities

In Windows NT Server version 3.51, it is possible to use a RAS server to route between a remote client and a LAN, as shown in the following figure.
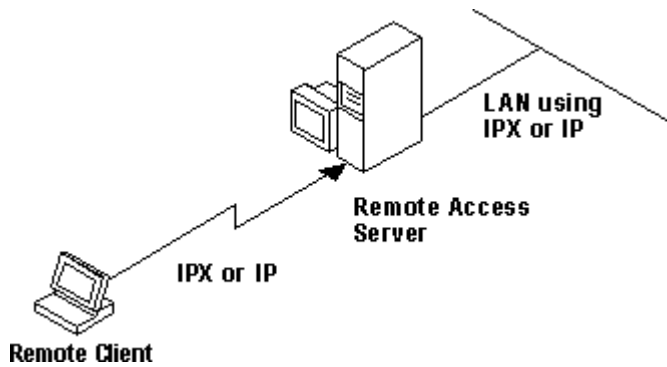
Routing between a remote client and a LAN

In Windows NT Server version 3.51, it is also possible to route between two LANs, as shown in the following figure.

Routing between two LANs

It is not possible to route between WANs over switched circuits or dial-up lines. The only exception to this rule is a WAN card (for example, T1 or Frame Relay) that appears to the router as a LAN.

Installing LAN to LAN Routing

You can enhance the use of your Windows NT Server computer by installing LAN to LAN routing support and the BOOTP/DHCP Relay Agent. You must have at least two network adapters on your Windows NT Server computer to install LAN to LAN routing. For more information on enabling LAN to LAN routing, see the following sections, "RIP Routing for IPX" and "RIP Routing for IP."

Depending on your network, you can install LAN to LAN routing support for IP or IPX. Before you install LAN to LAN routing, ensure that the selected protocol (IP or IPX) is already installed on the Windows NT Server computer. You can install the IP or IPX protocol using the Network icon in Control Panel.

Installing the BOOTP/DHCP Relay Agent allows a computer to relay BOOTP/DHCP messages across an IP LAN. For example, the Relay Agent is advantageous in a network with two LANs and a router between them, but only one Dynamic Host Configuration Protocol (DHCP) server on LAN a. To get configuration information to the clients, you would have to install another DHCP server on LAN b, which would result in higher maintenance and cost. Instead, you can install a BOOTP/DHCP Relay Agent on any computer in LAN b and it will relay messages through the router to the DHCP server on LAN a.

For more information about the BOOTP/DHCP Relay Agent, see the public specification RFC1542. The specification can be located through anonymous ftp to ds.internic.net in the rfc subdirectory.

To install LAN to LAN routing on a Windows NT Server computer

1. Install Windows NT Server Multi-Protocol Routing by running the UPDATE.EXE program from the disk or CD-ROM.

   The update program copies files over your Windows NT installation.

2. Using the Network icon in Control Panel, choose the Add Software button, and then select RIP for Internet Protocol, RIP for NWLink IPX, or BOOTP/DHCP Relay Agent, in the Network Software box. When prompted for the source file location, enter the drive letter where the installation files are located (for example, A:\I386).

   When installing RIP for NWLink IPX, Setup displays a message that NetBIOS Broadcast Propagation (broadcast of type 20 packets) is currently disabled. If you are using NetBIOS over IPX, choose the Yes button to enable broadcasts of type 20 packets.

   When installing the BOOTP/DHCP Relay Agent, choose the default configuration, and then choose the OK button in the configuration dialog box.

3. After installing RIP routing for IPX, you must enable it by configuring the IPX protocol. For instructions on how to do so, see "Enabling IPX Routing," later in this chapter.

   RIP for IP and the BOOTP/DHCP Relay Agent are installed as services and are enabled automatically.

4. If you want to change the default values for the BOOTP/DHCP Relay Agent (Maximum Hops, Seconds Threshold, or list of DHCP Server addresses) choose the Config Relay Agent button in the Advanced TCP/IP Configuration dialog box.

5. In the Network Settings dialog box, choose the OK button, and then restart the system when prompted.

Note   You can remove the RIP service by choosing the RIP for IP or IPX option in the Network Settings dialog box, and then choosing the Remove button. This deletes the files from your computer, so you must reinstall before you can use the RIP service again.

RIP Routing for IPX

The implementation of IPX by Windows NT Server version 3.51 conforms to the Novell® IPX Router Specification.

IPX Routing Protocol

Routers interconnect different network segments and by definition are network layer devices. In other words, routers receive their instructions for forwarding a packet from one segment to another from a network layer protocol. IPX, with the help of the Routing Information Protocol (RIP) and the Service Advertising Protocol (SAP), performs these network layer tasks. These tasks include addressing, routing, and switching information packets to move single packets from one location to another on an internetwork. The following figure shows how these protocols are related.
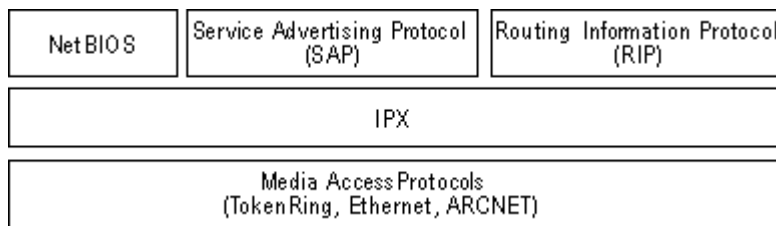
IPX Protocol Model

Features and Limitations

This version of IPX internal routing for Windows NT supports LAN to LAN routing (sending data packets from one network segment to another based on routing information), forwarding type 20 packet broadcasts, and NetBIOS packets propagation.

IPX provides the addressing mechanism that allows packets to be delivered to a desired destination. RIP and SAP enable routers to gather internetwork information and share that information with other routers. The RIP and SAP agents combine to make an IPX router, although SAP is not necessary in all cases. You only need to install the SAP agent if you have services running on your network that use SAP, such as NetWare-compatible file servers or SQL servers.

This version of IPX internal routing does not have any filtering capability. Therefore, all of the entries in the RIP and SAP tables are propagated. On large networks, the bandwidth required for forwarding RIP and SAP tables can be considerable. Internal routing is not supported over dial-up lines.

If you have a fixed synchronous line (for example, T1) with network drivers that emulate the LAN, then RIP and SAP tables will be forwarded over those lines. Note that in this case, bandwidth usage for large networks can be exorbitant. You may be best advised to use another advanced third-party router for this situation.

Enabling IPX Routing

To enable IPX routing, you must install the IPX protocol and RIP for IPX. The SAP agent is installed automatically when RIP is installed. Use the Networks option in Control Panel to install this software on the

computer you want to use as a router. You will need to restart the computer before your changes take effect. For more information on installing RIP for IPX, see the previous section, "Installing LAN to LAN Routing."

To enable IPX routing

1. Choose the Network icon in Control Panel.
2. From the Installed Network Software list in the Network Settings dialog box, select NWLink IPX/SPX Compatible Transport, and then choose the Configure button.
3. In the NWLink IPX/SPX Protocol Configuration dialog box, select the Enable RIP Routing check box, and then choose the OK button.
   This step enables LAN to LAN routing.

Note   This release does not provide LAN to WAN to LAN routing.
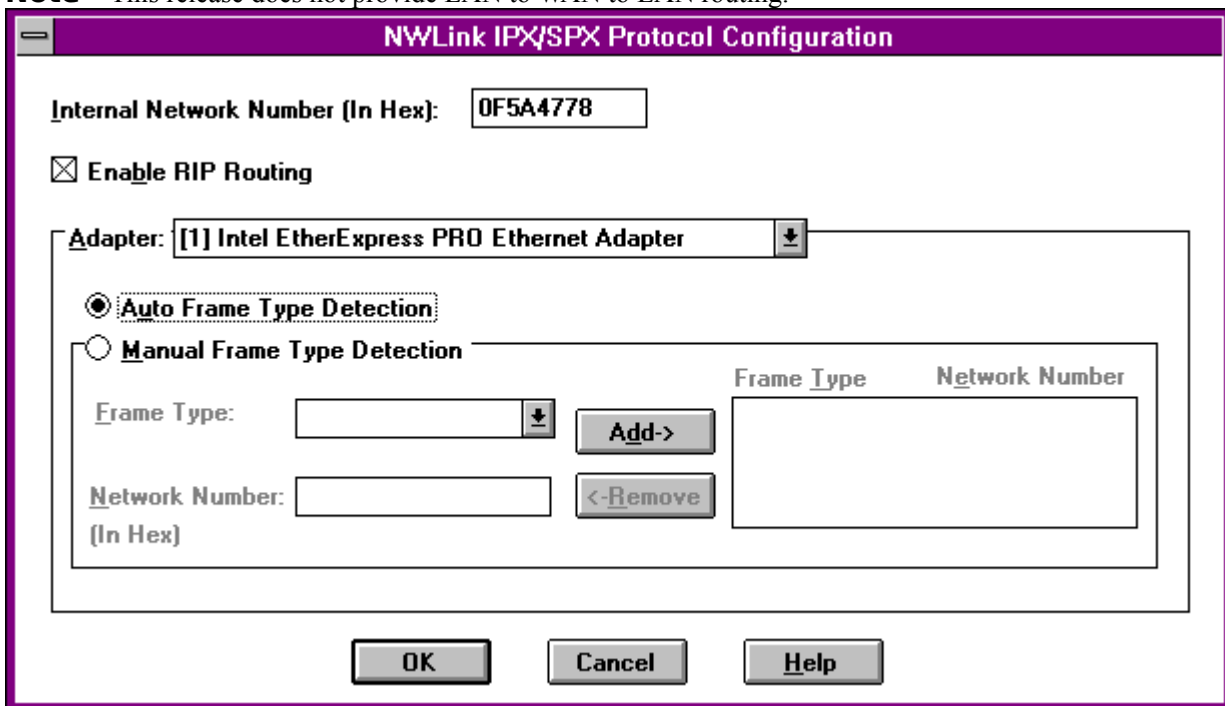
For more information on the other options in the NWLink IPX/SPX Protocol Configuration dialog box, choose the Help button.

Managing an IPX Router

In addition to the current source routing information, the **ipxroute** utility now provides information on RIP, SAP, and statistics. Use the **ipxroute** utility to display and modify information about the source routing tables used by IPX.

Note   All parameters should be separated by spaces. The **ipxroute** console utility can be used remotely via the **remote** utility in the Windows NT Resource Kit version 3.5.

*   At the command prompt, type **ipxroute** with the appropriate options.

ipxroute board=*n* [**clear**] [**def**] [**gbr**] [**mbr**] [**remove**=*xxxxx*]
ipxroute config

ipxroute table
ipxroute servers [**/type**=*xxx*]
ipxroute stats [**/show**] [**/clear**]

The following options can be used:

board=*n*
    Specifies the network adapter card for which to query or set parameters.
clear
    Clears the source routing table.
def
    Sends packets to the ALL ROUTES broadcast. If a packet is transmitted to a unique *media access control (MAC)* address that is not in the source routing table, the default is to send the packet to the SINGLE ROUTES broadcast.
gbr
    Sends packets to the ALL ROUTES broadcast. If a packet is transmitted to the broadcast address (FFFF FFFF FFFF), the default is to send the packet to the SINGLE ROUTES broadcast.
mbr
    Sends packets to the ALL ROUTES broadcast. If a packet is transmitted to a multicast address (C000 xxxx xxxx), the default is to send the packet to the SINGLE ROUTES broadcast.
remove=*xxxxx*
    Removes the given node address from the source routing table.
config
    Displays information on all the bindings for which IPX is configured.
table
    Displays the IPX routing table.
servers
    Displays the SAP table.
/type=*xxx*
    xxx refers to server type. The default is all server types.
stats
    Displays or clears IPX internal routing statistics.
/show
    Displays the internal routing table. This is the default option.
/clear
    Clears the internal routing table.

RIP Routing for IP

Windows NT Server version 3.51 supports Routing Information Protocol (RIP) for dynamic management of Internet Protocol (IP) routing tables. RIP eliminates the need to establish static IP routing tables. This version of RIP routing does not support RIP over dial-up (switched WAN) links.
RIP for IP is installed as a Windows NT Server service through Control Panel, and is therefore configured through the Services icon in Control Panel. By default, the RIP service starts automatically when the computer starts.

Understanding the Routing Information Protocol

The Routing Information Protocol (RIP) facilitates the exchange of routing information. A RIP router is a computer or other piece of hardware that broadcasts routing information, such as network addresses, and directs data packets on IP networks.

RIP allows a router to exchange routing information with neighboring routers. As a router becomes aware of any change in the internetwork layout (for instance, a router down), this information is broadcast to any neighboring routers. Routers also send periodic RIP broadcast packets containing all routing information known to the router. These broadcasts keep all routers on the internetwork synchronized.

Using RIP for IP requires the Microsoft TCP/IP protocol family. The TCP/IP family consists of three main protocols: Internet Protocol (IP), Transmission Control Protocol (TCP), and User Datagram Protocol (UDP). The following figure illustrates the relationship between RIP and these three main protocols.
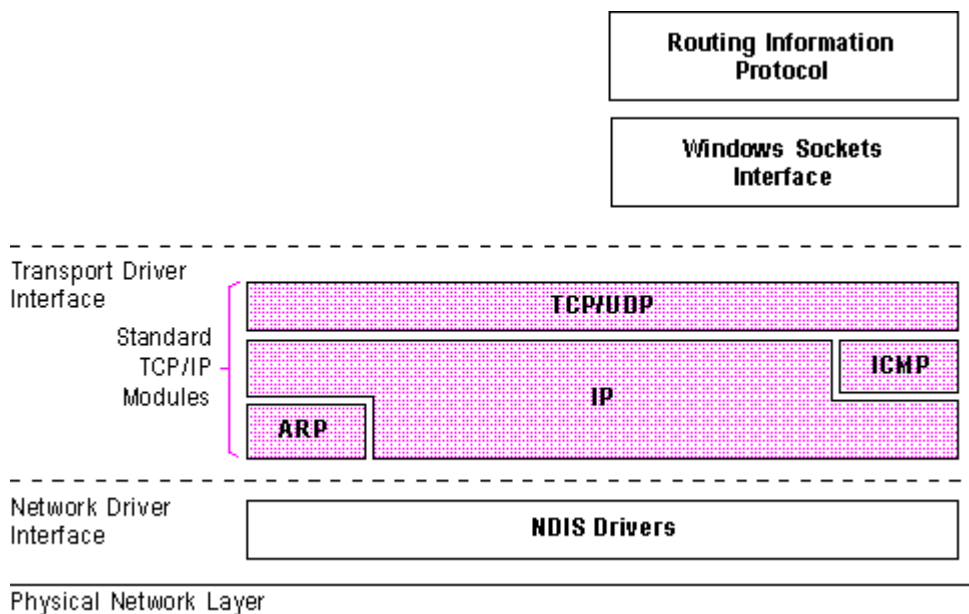
TCP/IP and RIP architectural model

Internet Protocol

Internet Protocol (IP) is a protocol that provides packet delivery for all other protocols within the TCP/IP family. IP provides a best-effort, connectionless delivery system for computer data. That is, IP packets are not guaranteed to arrive at their destination, nor are they guaranteed to be received in the sequence in which they were sent. Internet Protocol's checksum feature confirms only the IP header's integrity. Thus, responsibility for the data contained within the IP packet (and the sequencing) is assured only by using higher-level protocols.

User Datagram Protocol

User Datagram Protocol (UDP), a TCP complement, offers a connectionless datagram service that guarantees neither delivery nor correct sequencing of delivered packets (much like IP). UDP data checksums are optional, providing a way to exchange data over highly reliable networks without unnecessarily consuming network resources or processing time. Because RIP repeatedly broadcasts information, RIP uses UDP/IP instead of TCP/IP.

Transmission Control Protocol

Although Transmission Control Protocol (TCP) guarantees the delivery of packets, proper sequencing of the data, and a checksum feature that validates both the packet header and its data for accuracy, TCP is not required for RIP. Instead, this reliability makes TCP the protocol of choice for session-based data transmission, client-server applications, and critical services, such as electronic mail.

IP Routing

IP data packets, the basic IP information units, are sent to a local LAN connection by the originating host if the destination host is on the same network. If the destination host is on a different network, the data packet is sent to a router on the local LAN, which routes it toward its destination.

If the destination host is not directly connected to the LAN that the router connects to, the router looks up the IP address of the next router that lies along the path to the ultimate destination system. The router then passes the datagram on to the next router. This continues until the ultimate destination router is reached and the data packet is sent by IP over the LAN card to the destination host.

In this implementation of RIP routing over IP, routing over dial-up (switched WAN) links is not supported. For more information on static IP routing over dial-up lines, see the topic "Installing a Simple Dial-up Router," later in this section.

Enabling IP Routing

RIP routing is enabled automatically when you install RIP for IP as described in the earlier section "Installing LAN to LAN Routing."

There are two kinds of routing you can do with IP, static and dynamic. Static routing limits you to fixed routing tables. If you have a slower WAN line (for example, ISDN) you might prefer static routing in order to reduce network traffic. With dynamic routing the routing tables are automatically updated, reducing administrative overhead, but increasing traffic over the network.

Installing RIP for IP provides dynamic routing. When you install RIP for IP, the RIP routing service is automatically enabled and the Enable IP Routing option in the Advanced TCP/IP Configuration dialog box is automatically checked. If you want static routing only, see the following section "Enabling Static Routing."

Enabling Static Routing

1. Choose the Network icon in Control Panel.
   2. In the Network Settings dialog box, remove the RIP routing service by choosing RIP for IP from the Installed Network Software list and then choosing the Remove button.

3. From the Installed Network Software list, select TCP/IP Protocol, and then choose the Configure button.
4. In the TCP/IP Configuraton dialog box, choose the Advanced button.
5. In the Advanced Microsoft TCP/IP Configuration dialog box, select the Enable IP Routing check box, and then choose the OK button.
   You should check this option if you have two or more network cards and you want to route between them. This option is not available if your computer has only one network adapter and one IP address.

You may need to make additional static routing entries. For information about creating static routing tables, see the topic "Managing an IP Router," later in this section.
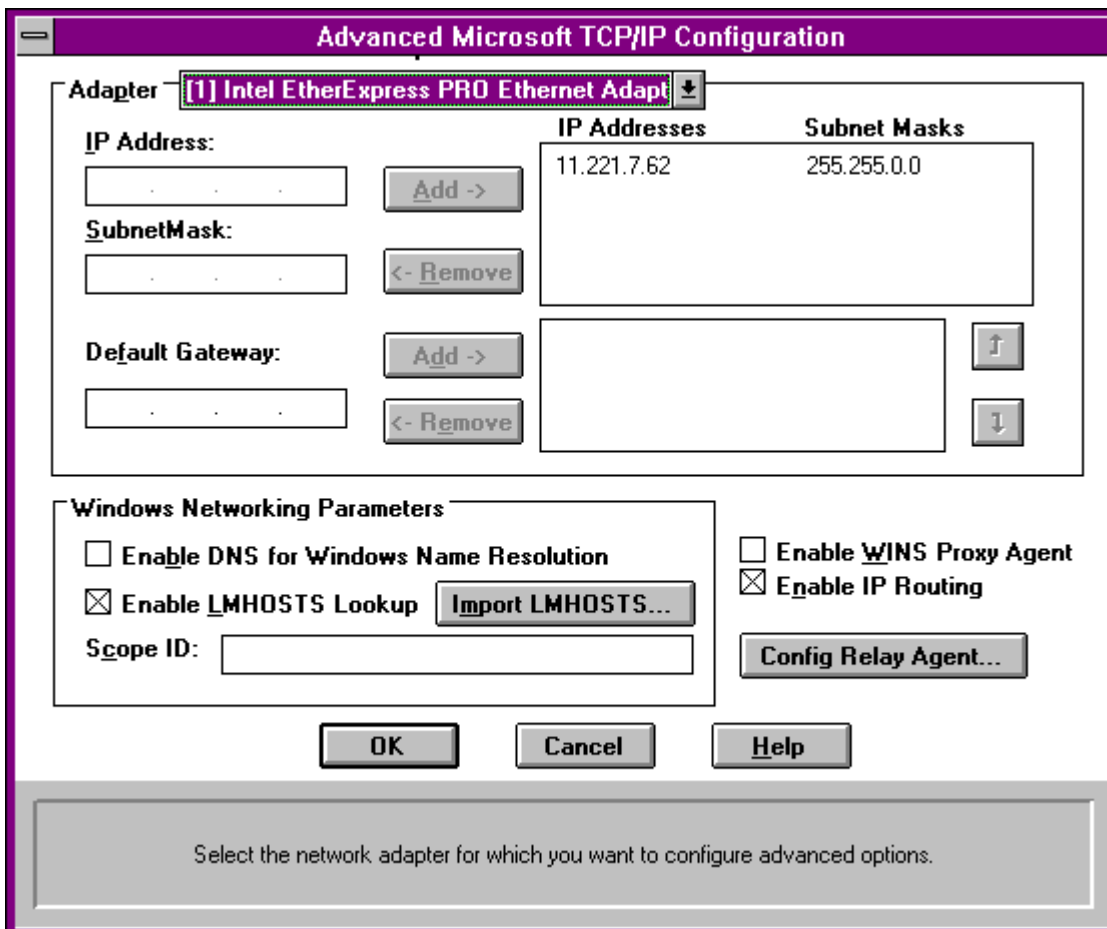
For more information on the other options in the Advanced Microsoft TCP/IP Configuration dialog box, choose the Help button.

Managing an IP Router

You can use the **route** utility to configure static routing tables.

* At the command prompt, type **route** with the appropriate options.

route [**-f**] [**-p**] [*command* [*destination*] [**MASK** *netmask*] [*gateway*] [**METRIC** *metric*]]

The following options can be used:
-f
  Clears the routing tables of all gateway entries. If this parameter is used in conjunction with a command, the tables are cleared prior to running the command.
-p
  Enables persistent routes This means routing table changes are carried over automatically after restarting your computer.
command
  Specifies one of the following commands.
Command
  Purpose

print
  Prints a route.
add
  Adds a route.
delete
  Deletes a route.
change
  Modifies an existing route.

destination
  Specifies the host or network to which you want to route.
MASK
  Specifies that the next parameter be interpreted as the *netmask* parameter.
netmask
  Specifies the subnet mask value to be associated with this route entry. If not present, this parameter defaults to 255.255.255.255.
gateway
  Specifies the gateway to the destination.
METRIC
  Specifies that the next parmeter be interpreted as the *metric* parameter.
metric
  Associates a cost/hop count for the destination specified by the route entry. Generally, this specifies the distance in number of hops from the destination. If not specified, the metric is set to 1 by default.

The **route** utility does not accept a subnet mask value of 255.255.255.255 on the command line. To specify a subnet mask with this value, you must accept the default.

On a multihomed computer on which a network is available from more than one adapter card, all remote network traffic is passed over the first gateway defined. If you add a second gateway to the same network, the entry is added to the route table, and is used if it is a default gateway and dead gateway detection is activated.

The **route** utility uses the NETWORKS file to convert destination names to addresses. For the **route** utility to work correctly, the network numbers in the NETWORKS file must specify all four octets in dotted decimal notation. For example, a network number of 284.122.107 must be specified in the NETWORKS file as 284.122.107.0, with trailing zeroes appended.

The gateway must be on the network that your computer is on. Otherwise, the route will not be added.

Registry Parameters for IP RIP

This section presents configuration parameters that affect the behavior of RIP routing for IP and that can be modified only through Registry Editor.

To make changes using Registry Editor
1. Start the Registry Editor by running the REGEDT32.EXE file from File Manager or Program Manager.
    – Or –
    At the command prompt, type the **start regedt32** command, and then press ENTER.
    When the Registry Editor window appears, you can press F1 to get Help on how to make changes in Registry Editor.
2. In Registry Editor, click the window titled HKEY_LOCAL_MACHINE On Local Machine, and then click the icons for the SYSTEM subtree until you reach the appropriate subkey, as described later in this section.

The Registry parameters for IP RIP are specified under the following key:

..SYSTEM\CurrentControlSet\Services\IpRip\Parameters

AcceptDefaultRoutes
    Data type = REG_DWORD
    Range = 0 or 1
    Default = 0
    If set to 1, default routes in received RIP announcements are accepted. By default, they are ignored.
AcceptHostRoutes
    Data type = REG_DWORD
    Range = 0 or 1
    Default = 0
    If set to 1, host routes in received RIP announcements are accepted. By default, they are ignored.
AnnounceDefaultRoutes
    Data type = REG_DWORD
    Range = 0 or 1
    Default = 0
    If set to 1, default routes are included in RIP announcements.
AnnounceHostRoutes
    Data type = REG_DWORD
    Range = 0 or 1
    Default = 0
    If set to 1, host routes are included in RIP announcements.
EnablePoisonedReverse
    Data type = REG_DWORD
    Range = 0 or 1
    Default = 1
    By default, if a RIP announcement contains a route that was previously advertised by that route, then that route is announced on the network with a metric of 16.
EnableSplitHorizon
    Data type = REG_DWORD
    Range = 0 or 1

Default = 1
By default, routes learned on a network are suppressed in updates sent on that network. If the parameter is set to 0, routes learned on a network are announced on the same network, as well.

EnableTriggeredUpdates
Data type = REG_DWORD
Range = 0 or 1
Default = 1
By default, new routes and metric changes trigger an immediate update which includes only the changes. The time between updates depends on the value of MaxTriggeredUpdateFrequency.

GarbageTimeout
Data type = REG_DWORD
Range = 15 seconds - 259200 seconds (72 hours)
Default = 120 seconds
The number of seconds to wait before removing a route marked for garbage collection.

LoggingLevel
Data type = REG_DWORD
Range = 0 - 3
Default = 1
The minimum level of information for entries being made to the system log; 0 = no logging, 1 = errors, 2 = warnings, 3 = information.

MaxTriggeredUpdateFrequency
Data type = REG_DWORD
Range = 1 second - 884400 seconds (24 hours)
Default = 5 seconds
The minimum number of seconds that must elapse between triggered updates.

RouteTimeout
Data type = REG_DWORD
Range = 15 seconds - 259200 seconds (72 hours)
Default = 180 seconds
The number of seconds to wait before marking a route for garbage collection.

SilentRip
Data type = REG_DWORD
Range = 0 or 1
Default = 0
If set to 1, suppresses periodic RIP announcements.

UpdateFrequency
Data type = REG_DWORD
Range = 15 seconds - 884400 seconds (24 hours)
Default = 30 seconds
The number of seconds between periodic updates which contain the entire routing table.

Installing a Simple Dial-up Router

Windows NT RAS version 3.5 or later was not designed to route packets from a large LAN over a dial-up link. However, by correctly configuring both the RAS computer acting as a router and the other
computers on your small LAN with a static network configuration, you can use the computer running Windows

NT RAS as a simple router to the Internet or to an enterprise TCP/IP network.
The following requirements are necessary for using Windows NT RAS as a dial-up router between your LAN and the Internet.

* A Windows NT computer with a high-speed modem and a network adapter card
* A *Point-to-Point Protocol (PPP)* connection to the Internet or enterprise TCP/IP network
* A valid network or a subnet, different from the subnet of the Internet service provider
* The proper Registry and Default Gateway configurations on the computer acting as a router and the LAN clients. The configurations are described later in this section.
* Your LAN is small and does not require the automatic routing configuration provided by RIP. (You probably do not need RIP functionality if you have a small LAN that is not expected to grow or change.)

To be identified using names rather than IP addresses, you also need a domain name. Your Internet service provider might help you obtain a domain name.
Once you have a PPP connection, IP addresses for your subnet (and correct subnet mask), and (optionally) a domain name, you can then configure the RAS and LAN computers for Internet gateway as described next.

To configure a small LAN for routing to the Internet over a dedicated PPP account
1. On the RAS computer that will route packets from the LAN to the Internet, add the value
   DisableOtherSrcPackets to the following Registry path, and then set the value to 0.
   By default, the header of each packet sent by the RAS computer over the PPP link uses the IP address of the RAS computer as the source. Since the packets that come from LAN clients are not originating from the RAS computer, you must set **DisableOtherSrcPacket** to 0 so that the packets will be forwarded over the PPP link.
   \HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services
   \RasArp\Parameters

   DisableOtherSrcPackets   **REG_DWORD**
        Range: 0-1
        Default: 1 (not in Registry)

2. If the subnet you have is on the same logical IP subnet as your service provider, (which is very likely in this scenario), you must also add the value **PriorityBasedOnSubNetwork** to the Registry of the RAS computer that routes packets from the LAN to the Internet, and then set this parameter to 1.
   A computer can connect to the LAN using a network card and a RAS connection. If the RAS connection and the LAN network adapter card are assigned addresses with the same network number and the Use Default Gateway On Remote Network check box is selected, then all packets are sent over the RAS connection, even though the two addresses are in different subnetworks within the same network.
   For example, if the network adapter card has IP address 17.1.1.1 (subnet mask 255.255.0.0) and the RAS connection is assigned the address 17.2.1.1, RAS sends all 17.x.x.x packets using the RAS connection. If the parameter is set, RAS sends 17.2.x.x packets using the RAS connection and 17.1.x.x packets using the network adapter card.

   \HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services
   \RasMan\PPP\IPCP

   PriorityBasedOnSubNetwork   **REG_DWORD**
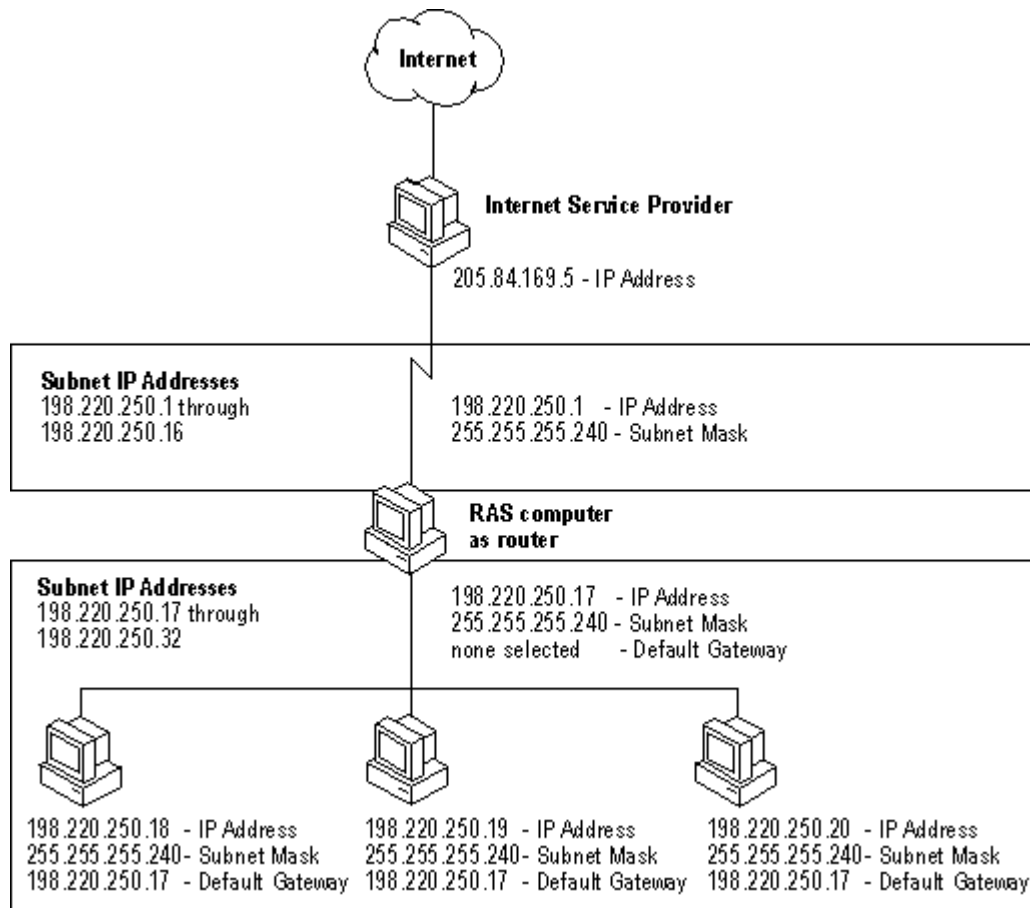   Range: 0-1
        Default: 0 (not in registry)

3. Configure the default gateway of all the computers on the LAN using the Network option in Control Panel. The default gateway is set when you configure the TCP/IP protocol.

Use the IP address of the network card adapter in the RAS computer acting as a router to the Internet as the default gateway for all computers on the LAN except this computer. The default gateway for the computer acting as the router to the Internet should be left blank. Refer to the following figure to determine the correct assignment pattern of IP addresses, subnet masks, and default gateways.

Internet

Internet Service Provider

205.84.169.5 - IP Address

Subnet IP Addresses
198.220.250.1 through
198.220.250.16

198.220.250.1   - IP Address
255.255.255.240 - Subnet Mask

RAS computer
as router

Subnet IP Addresses
198.220.250.17 through
198.220.250.32

198.220.250.17   - IP Address
255.255.255.240 - Subnet Mask
none selected   - Default Gateway

198.220.250.18 - IP Address
255.255.255.240- Subnet Mask
198.220.250.17 - Default Gateway

198.220.250.19 - IP Address
255.255.255.240- Subnet Mask
198.220.250.17 - Default Gateway

198.220.250.20 - IP Address
255.255.255.240- Subnet Mask
198.220.250.17 - Default Gateway

Sample configuration using RAS as a Simple Internet Router

Glossary

bandwidth
In communications, the difference between the highest and lowest frequencies in a given range - for example, a telephone line accommodates a bandwidth of 3000 Hz, the difference between the lowest (300 Hz) and highest (3300 Hz) frequencies it can carry. In computer networks, greater bandwidth indicates faster data-transfer capability.

BOOTP/DHCP Relay Agent
The component responsible for relaying DHCP and BOOTP broadcast messages between a BOOTP/DHCP server and a client across an IP router.

bridge
Connects two or more LAN segments, and also makes decisions about which signals to transmit. A bridge is more sophisticated than a repeater, but not as sophisticated as a router. The bridge looks at the destination and

source addresses of each packet, and then decides whether to pass on the packet to its other connected LAN segments. This way, the bridge filters out local traffic, preventing it from unnecessarily passing on packets to other segments.

Bridges are transparent to other devices on the network, so LAN segments connected by a bridge form a single logical network. Bridges generally connect two similar types of networks, such as two Ethernet networks or two Token Ring networks.

brouter

Combines elements of the bridge and the router. Usually, a brouter acts as a router for one transport protocol (such as TCP/IP), sending packets of that format along detailed routes to their destination. The brouter also acts as a bridge for all other types of packets (such as IPX), just passing them on, as long as they are not local to the LAN segment from which they originated.

BPS

An abbreviation for bits per second, a measure of the speed at which a device, such as a modem, can transfer data.

dial-up line

A standard dial-up connection such as telephone and ISDN lines.

Ethernet

A widely implemented network from which the IEEE 802.3 standard for contention networks was developed.

gateways

Used to connect two LANs that use different transport protocols or data formats, for example, connecting IPX to IP. The gateway translates between the two. Generally, the gateway is added to the network primarily for the translation ability. This translation ability is specific to the types of systems being connected, so different types of gateways are required to connect different types of networks.

The entity on one side of a gateway may be something other than a LAN of personal computers, such as a mainframe computer or a bulletin-board service.

Internet Protocol

One member of the IP protocol suite. IP provides a best-effort, connectionless delivery system that does not guarantee that packets arrive at their destination or that they are received in the sequence in which they were sent.

Internetwork Packet Exchange (IPX)

A transport protocol used by Novell NetWare. The Microsoft NWLink protocol provides IPX support for Windows NT networks.

IP

See Internet Protocol.

IPX

See Internetwork Packet Exchange.

LAN

See local area network.

local area network (LAN)

A group of computers and other devices dispersed over a relatively limited area and connected by a communications link that enables any device to interact with any other on the network.

MAC

See Media access control.

Media access control

A layer in the network architecture that deals with network access and collision detection.

multihomed computer

A system that has multiple network cards.

packet header

The part of a packet that contains an identification number, source and destination addresses, and sometimes, error-control data.

Point-to-Point Protocol

A set of industry standard framing and authentication protocols. PPP negotiates configuration parameters for multiple layers of the OSI model.

PPP

See Point-to-Point Protocol.

repeaters

The most basic LAN connection device. Repeaters operate only at the physical layer. A repeater simply takes the electrical signals that reach it, and then regenerates them to full strength before passing them on. Repeaters generally extend a single network, rather than link together two networks.

Repeaters are the least expensive of the LAN connection devices, but their use is fairly limited . For example, the IEEE specifications state that a Thinnet network can use repeaters to link only up to five thinnet segments. Repeaters are most often used to connect LAN cable segments within a single building or small group of buildings.

RIP

See Routing Information Protocol.

router

Looks at the network addresses in the packets it receives before deciding whether to pass them on. Routers make packet forwarding decisions on the basis of addresses in the network layer of the OSI reference model (e.g. IP addresses). A router makes more intelligent decisions than a bridge about data it passes on. A bridge can only
decide whether or not to pass on a packet, but a router can choose the best path along the network for the packet to reach its destination address.

Routing Information Protocol (RIP)

Enables a router to exchange routing information with a neighboring router.

SAP

See Service Advertising Protocol.

Service Advertising Protocol (SAP)

Used by servers to advertise thier services and addresses on a network.

switched circuit

See dial-up line.

TCP/IP

See Transmission Control Protocol/Internet Protocol.

Transmission Control Protocol/Internet Protocol

A set of networking protocols that provide communication across interconnected networks made up of computers with diverse hardware architectures and various operating systems.

UDP

See User Datagram Protocol.

User Datagram Protocol (UDP)

A TCP complement that offers a connectionless datagram service that guarantees neither delivery nor correct sequencing of delivered packets (much like IP).

WAN

See wide area network.

wide area network (WAN)

A communications network that connects geographically separated areas.