

Scaling IP Addresses

The Study Guide portion of this chapter uses a combination of matching, fill-in-the-blank, multiple-choice, and open-ended question exercises to test your knowledge of the theory of Network Address Translation (NAT), Port Address Translation (PAT), and Dynamic Host Configuration Protocol (DHCP).

The Lab Exercises portion of this chapter includes all the online curriculum labs and comprehensive labs and a challenge lab to ensure that you have mastered the practical, hands-on skills needed to configure NAT, Static NAT, PAT, and DHCP.

Study Guide

Scaling Networks with NAT and PAT

When connecting to the Internet, you must use a registered public IP address. When users connect to the Internet through a cable provider (such as Time Warner or Cablevision), the IP address assigned is registered and gives the user access to the Internet through the carrier's network. This arrangement actually makes the user's computer part of the cable provider's network. When you have more than one computer at home and each needs access to the Internet simultaneously, a router such as a Linksys usually does the trick. This device uses the single IP address assigned to you by your carrier and performs Port Address Translation (PAT), which allows multiple devices to access the Internet using a single unique address.

When it comes to a company, things are a little more complicated. Most companies require an entire network address for all their devices to access the Internet. Companies acquire these addresses from the American Registry of Internet Numbers (ARIN) or any Internet service provider (ISP) in their area. As the network grows, however, it might find that it no longer has enough addresses for all the devices. Instead of purchasing another network address (if even possible), another solution is to use Network Address Translation (NAT). Network administrators use private addresses put aside by RFC 1918 on the inside of their network. The router translates the device's inside private address into a registered global address each time the company needs to access the outside world. The use of NAT along with private addresses provides security by hiding a device's internal address from the outside world, thus making it difficult for "outsiders" to know exactly who is behind the device. Because not all devices inside a network need access to the Internet, NAT pools are created to determine who has access and who does not. Thus, NAT enables network administrators to allow multiple users to access the outside world dynamically; it also enables them to statically map an outside address to an internal device.

Concept Questions

1. Discuss the advantages of NAT.

2. RFC 1918 put aside three addresses and classified them as "private." Explain the difference between a public and private address.

3. When is it necessary to assign a static NAT address to a device inside your network? Give an example of a device, and explain the reason for doing so.

4. How many networks in total did RFC 1918 put aside?

5. Under what circumstances would you use NAT? PAT?

Research Assignment

This chapter discussed the difference between private and public addresses and their use within a network. Go to <http://www.arin.net> and research the following:

1. The American Registry for Internet Numbers (ARIN) allocates Internet number resources for the United States, Canada, and islands in the Caribbean and North Atlantic. What organization provides these same services in the following?

- a. Africa _____
- b. Asia _____
- c. Latin America _____
- d. Europe, the Middle East, and Central Asia _____

2. How do you obtain a registered network number through ARIN?

3. List at least five items found on the IPv4 Network Request template provided by ARIN.

4. What costs are associated with obtaining a 24-bit address from ARIN?

5. On the home page, click the “Who is” link. Enter a legitimate address in the Search box. This could be any address other than those put aside by RFC 1918. List five pieces of information you can retrieve about the owner of that address space.

6. Enter **Cisco** in the “Who is” Search box. Describe some of the information that appears.

Matching Terms

Match the definition on the left with the correct term on the right. Use each definition only one time.

Definitions

- a. Uses a single IP address to support numerous inside local addresses
- b. An IP address that is routable on the Internet
- c. Addresses never to be assigned to an organization as a registered network number
- d. An IP address assigned to a host in a private network
- e. Identifies an interface that is on the private side of a network
- f. Allows unregistered addresses to access the Internet using legitimate or public addresses
- g. The IP address of a host on the outside of the network as it is known to the hosts on the inside network
- h. A legitimate registered address that represents an inside local address to the outside world
- i. Identifies an interface that is on the public side of the network
- j. A one-to-one mapping of a public and private address

Terms

- _____ inside local address
- _____ NAT
- _____ **ip nat outside** command
- _____ outside local address
- _____ static NAT
- _____ inside global address
- _____ Port Address Translation
- _____ outside global address
- _____ **ip nat inside** command
- _____ RFC 1918

DHCP

Dynamic Host Configuration Protocol (DHCP) allows a device to dynamically receive network information upon boot. The basic information configured on a server includes network address, subnet mask, and default gateway. Domain Name System (DNS), NetBIOS, and Windows Internet Naming Service (WINS) server information are optional configurations if they exist on a network. As networks grow, DHCP deploys a plug-and-play design that allows new hosts to plug into the network without manual intervention. Designed by the Internet Engineering Task Force (IETF), it has become a standard component in network design and implementation.

Concept Questions

1. Explain the purpose of the DHCP **excluded-address** command.

2. Explain the advantages of DHCP over static allocation when a device such as a computer moves from one part of a network to another when multiple subnets exist.

3. Explain the difference between BOOTP and DHCP.

4. You are the network administrator of a company that uses DHCP on its network. Does DHCP provide a mechanism to prevent unauthorized users from plugging in and connecting to the network?

Matching Terms

Match the definition on the left with the correct term on the right. Use each definition only one time.

Definitions

- a. A proposed configuration, from a DHCP server, that may include IP addresses, DNS server addresses, and lease time
- b. A predecessor of DHCP (not dynamic)
- c. A broadcast sent by a client to locate a DHCP server
- d. Creates a pool with the specified name and puts the router in a specialized DHCP configuration mode
- e. Configures the router to prohibit an individual address or range of addresses from being used when assigning addresses to clients
- f. Verifies the operation of DHCP
- g. A security server
- h. Used to relay broadcast requests when the DHCP server resides on a different network than the host
- i. A protocol used for assigning IP addresses to devices on a network (client/server mode)
- j. DHCP assigning permanent IP addresses to the clients

Terms

- _____ DHCP
- _____ automatic allocation
- _____ **show ip dhcp binding**
- _____ TACACS server
- _____ BOOTP
- _____ **ip dhcp excluded-addresses**
- _____ DHCPOFFER
- _____ DHCPDISCOVER
- _____ **ip dhcp pool word**
- _____ **ip helper address**

Lab Exercises

Curriculum Lab 1-1: Configuring NAT (1.1.4a)

Figure 1-1 Topology for Lab 1-1

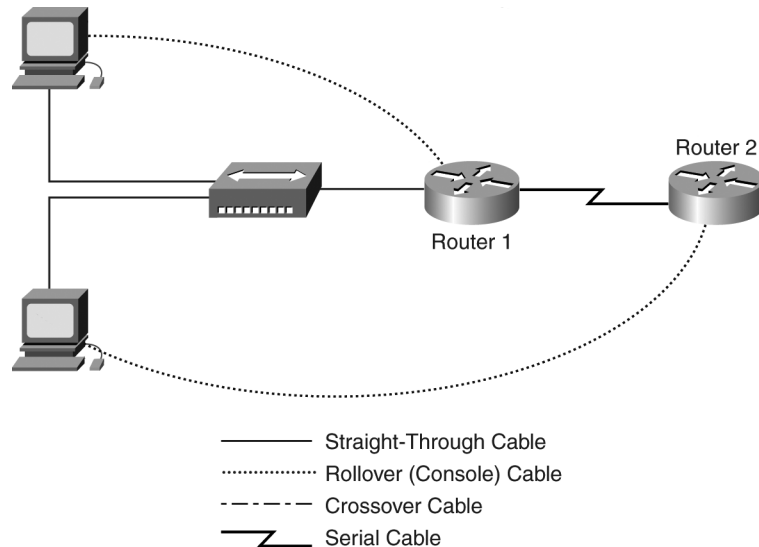


Table 1-1 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address/Subnet Mask	Loopback 0 Address/Subnet Mask
Router 1	Gateway	10.10.10.1/24	DCE	200.2.2.18/30	—
Router 2	ISP	—	DTE	200.2.2.17/30	172.16.1.1/32

The enable secret password for both routers is **class**.

The enable, VTY, and console password for both routers is **cisco**.

Objective

- Configure a router to use NAT to convert internal IP addresses, which are typically private addresses, into outside public addresses.

Background/Preparation

The ISP has allocated the public classless interdomain routing (CIDR) IP address 199.99.9.32/27 to a company. This is equivalent to 30 public IP addresses. Because the company has an internal requirement for more than 30 addresses, the IT manager has decided to implement NAT. The company has decided to reserve the addresses 199.99.9.33 through 199.99.9.39 for static allocation and 199.99.9.40 through 199.99.9.62 for dynamic allocation. Routing between the ISP and the company's gateway router will be done using a static route from the ISP to the gateway and a default route from the gateway to the ISP. The ISP's connection to the Internet will be represented by a loopback address on the ISP router.

Cable a network that is similar to the one in Figure 1-1. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the

information in Appendix C, “Router Interface Summary Chart,” to correctly specify the required interface identifiers based on the equipment in your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See and implement the procedure documented in Appendix D, “Erasing and Reloading the Switch,” before you continue with this lab.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart.

Task 2: Save the Configuration

At the privileged EXEC mode prompt, on both routers, enter the command **copy running-config startup-config**.

Task 3: Configure the Hosts with the Proper IP Address, Subnet Mask, and Default Gateway

Each workstation should be able to ping the attached router. Troubleshoot as necessary. Hint: Remember to assign a specific IP address and default gateway to the workstation. If you are running Windows 98, check using **Start > Run > winipcfg**. If you are running Windows 2000 or later, check using **ipconfig** in a DOS window.

Task 4: Verify That the Network Is Functioning

Step 1. From the attached hosts, ping the Fast Ethernet interface of the default gateway router.

Did the ping from the first host succeed? _____

Did the ping from the second host succeed? _____

Step 2. If the answer is no for either question, troubleshoot the router and host configurations to find the error. Then, ping again until they succeed.

Task 5: Create a Static Route

Create a static route from the ISP to the gateway router. Addresses 199.99.9.32/27 have been allocated for Internet access outside the company. Use the **ip route** command to create the static route:

```
ISP(config)#ip route 199.99.9.32 255.255.255.224 200.2.2.18
```

Is the static route in the routing table? _____

What command checks the routing table contents?

If the route was not in the routing table, give one reason why this might be so.

Task 6: Create a Default Route

- Step 1.** Add a default route, using the **ip route** command, from the gateway router to the ISP router. This forwards any unknown destination address traffic to the ISP:

```
Gateway(config)#ip route 0.0.0.0 0.0.0.0 200.2.2.17
```

Is the static route in the routing table? _____

- Step 2.** Try to ping from one of the workstations to the ISP serial interface IP address.

Did the ping succeed? _____

Why?

Task 7: Define the Pool of Usable Public IP Addresses

To define the pool of public addresses, use the **ip nat pool** command:

```
Gateway(config)#ip nat pool public_access 199.99.9.40 199.99.9.62 netmask 255.255.255.224
```

Task 8: Define an Access List That Matches the Inside Private IP Addresses

To define the access list to match the inside private addresses, use the **access-list** command:

```
Gateway(config)#access-list 1 permit 10.10.10.0 0.0.0.255
```

Task 9: Define the NAT Translation from Inside the List to Outside the Pool

To define the NAT, use the **ip nat inside source** command:

```
Gateway(config)#ip nat inside source list 1 pool public_access
```

Task 10: Specify the Interfaces

You must specify whether the active interfaces on the router are inside or outside interfaces with respect to NAT. To do this, use the **ip nat inside** or **ip nat outside** command:

```
Gateway(config)#interface fastethernet 0
```

```
Gateway(config-if)#ip nat inside
```

```
Gateway(config-if)#interface serial 0
```

```
Gateway(config-if)#ip nat outside
```

Task 11: Test the Configuration

Configure a workstation on the internal LAN with the IP address 10.10.10.10/24 and a default gateway 10.10.10.1. From the PC, ping 172.16.1.1. If successful, look at the NAT translation on the gateway router by using the command **show ip nat translations**.

What is the translation of the inside local host address?

Table 1-2 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address/Subnet Mask	Loopback 0 Address/Subnet Mask
Router 1	Gateway	10.10.10.1/24	DCE	200.2.2.18/30	—
Router 2	ISP	—	DTE	200.2.2.17/30	172.16.1.1/32

The enable secret password for both routers is **class**.

The enable, VTY, and console password for both routers is **cisco**.

Objective

- Configure a router to use PAT to convert internal IP addresses, which are typically private addresses, into outside public addresses.

Background/Preparation

Aidan McDonald has just received a Digital Subscriber Line (DSL) Internet connection in his home to a local ISP. The ISP has allocated only one IP address for use on the serial port of his remote-access device. Routing between the ISP and the home router will be achieved by using a static route between the ISP and gateway routers and a default route between the gateway and ISP routers. The ISP connection to the Internet is represented by a loopback address on the ISP router.

Cable a network that is similar to the one in Figure 1-2. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the information in Appendix C to correctly specify the required interface identifiers based on the equipment in your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See and implement the procedure documented in Appendix E, “Erasing and Reloading the Router,” before you continue with this lab.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart. If you have trouble doing this, see Lab 1-1, “Configuring NAT.”

Task 2: Save the Configurations

At the privileged EXEC mode prompt on both routers, enter the command **copy running-config startup-config**.

Task 3: Configure the Hosts with the Proper IP Address, Subnet Mask, and Default Gateway

Each workstation should be able to ping the attached router. Troubleshoot as necessary. Hint: Remember to assign a specific IP address and default gateway to the workstation. If you are running Windows 98, check using **Start > Run > winipcfg**. If you are running Windows 2000 or later, check using **ipconfig** in a DOS window.

Task 4: Verify That the Network Is Functioning

- Step 1.** From the attached hosts, ping the Fast Ethernet interface of the default gateway router.
- Did the ping from the first host succeed? _____
- Did the ping from the second host succeed? _____
- Step 2.** If the answer is no for either question, troubleshoot the router and host configurations to find the error. Then, ping again until they succeed.

Task 5: Create a Default Route

- Step 1.** Add a default route from the gateway to the ISP router. This forwards any unknown destination address traffic to the ISP. Use the **ip route** command to create the default route:
- ```
Gateway(config)#ip route 0.0.0.0 0.0.0.0 200.2.2.17
```
- Is the route in the routing table? \_\_\_\_\_
- Step 2.** Try to ping from one of the workstations to the ISP serial interface IP address.
- Did the ping succeed? \_\_\_\_\_
- Why?
- \_\_\_\_\_
- What command checks the routing table contents?
- \_\_\_\_\_

## Task 6: Define an Access List That Matches the Inside Private IP Addresses

- To define the access list to match the inside private addresses, use the **access-list** command:
- ```
Gateway(config)#access-list 1 permit 10.10.10.0 0.0.0.255
```

Task 7: Define the PAT Translation from Inside the List to Outside the Address

- To define the PAT translation, use the **ip nat inside source** command. This command with the **overload** option creates PAT by using the serial 0 IP address as the base:
- ```
Gateway(config)#ip nat inside source list 1 interface serial 0 overload
```

## Task 8: Specify the Interfaces

- You must specify whether the active interfaces on the router are inside or outside interfaces with respect to PAT (NAT). To do this, use the **ip nat inside** or **ip nat outside** command:
- ```
Gateway(config)#interface fastethernet 0
Gateway(config-if)#ip nat inside
Gateway(config-if)#interface serial 0
Gateway(config-if)#ip nat outside
```

Task 9: Test the Configuration

Configure a PC on the internal LAN with the IP address 10.10.10.10/24 and a default gateway 10.10.10.1. From the PCs, ping the Internet address 172.16.1.1. If successful, telnet to the same IP address. Then, look at the PAT translation on the gateway router by using the command **show ip nat translations**:

What is the translation of the inside local host addresses?

What does the number after the colon represent?

Why do all the commands for PAT say NAT?

After you complete the previous tasks, log off (by entering **exit**) and turn the router off. Then, remove and store the cables and adapter.

Curriculum Lab 1-3: Configuring Static NAT Addresses (1.1.4c)

Figure 1-3 Topology for Lab 1-3

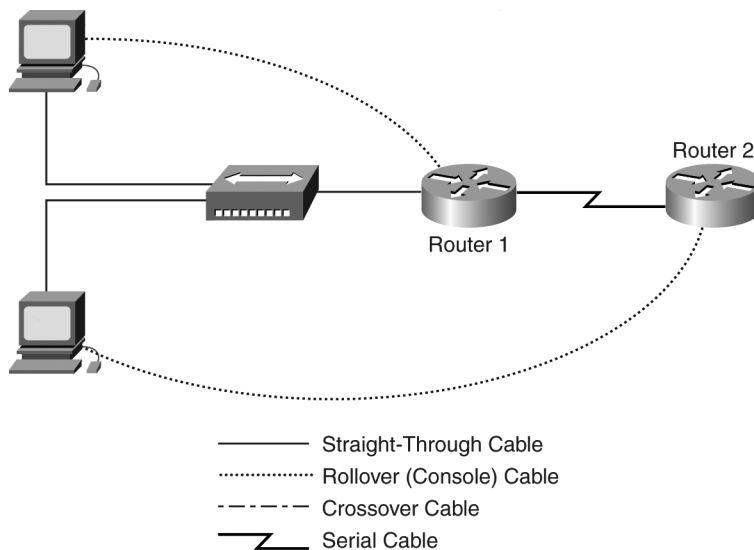


Table 1-3 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address/Subnet Mask	Loopback 0 Address/Subnet Mask
Router 1	Gateway	10.10.10.1/24	DCE	200.2.2.18/30	—
Router 2	ISP	—	DTE	200.2.2.17/30	172.16.1.1/32

The enable secret password for both routers is **class**.

The enable, VTY, and console password for both routers is **cisco**.

Objectives

- Configure a router to use NAT to convert internal IP addresses, which are typically private addresses, into outside public addresses.
- Configure static IP mapping to allow outside access to an internal PC.

Background/Preparation

The ISP has allocated the public CIDR IP address 199.99.9.32/27 to a company. This is equivalent to 30 public IP addresses. Because the company has an internal requirement for more than 30 addresses, the IT manager has decided to use NAT. The company has decided to reserve the addresses 199.99.9.33 through 199.99.9.39 for static allocation and 199.99.9.40 through 199.99.9.62 for dynamic allocation. Routing between the ISP and the gateway router will be done using a static route between the ISP and the gateway and a default route between the gateway and the ISP. The ISP connection to the Internet is represented by a loopback address on the ISP router.

Cable a network that is similar to the one in Figure 1-3. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the information in Appendix C to correctly specify the required interface identifiers based on the equipment in your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See and implement the procedure documented in Appendix E before you continue with this lab.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart.

Task 2: Save the Configurations

At the privileged EXEC mode prompt on both routers, enter the command **copy running-config startup-config**.

Task 3: Configure the Hosts with the Proper IP Address, Subnet Mask, and Default Gateway

Each workstation should be able to ping the attached router. Troubleshoot as necessary. Hint: Remember to assign a specific IP address and default gateway to the workstation. If you are running Windows 98, check using **Start > Run > winipcfg**. If you are running Windows 2000 or later, check using **ipconfig** in a DOS window.

Task 4: Verify That the Network Is Functioning

Step 1. From the attached hosts, ping the Fast Ethernet interface of the default gateway router.

Did the ping from the first host succeed? _____

Did the ping from the second host succeed? _____

Step 2. If the answer is no for either question, troubleshoot the router and host configurations to find the error. Then, ping again until they succeed.

Task 5: Create a Static Route

Create a static route from the ISP to the gateway router. Addresses 199.99.9.32/27 have been allocated for Internet access outside the company. Use the **ip route** command to create the static route:

```
ISP(config)#ip route 199.99.9.32 255.255.255.224 200.2.2.18
```

Is the static route in the routing table? _____

What command checks the routing table contents? _____

If the route was not in the routing table, give one reason why this might be so. _____

Task 6: Create a Default Route

Step 1. Add a default route, using the **ip route** command, from the gateway router to the ISP router. This forwards any unknown destination address traffic to the ISP:

```
Gateway(config)#ip route 0.0.0.0 0.0.0.0 200.2.2.17
```

Is the route in the routing table? _____

Step 2. Try to ping from one of the workstations to the ISP serial interface IP address.

Did the **ping** succeed? _____

Why?

Task 7: Define the Pool of Usable Public IP Addresses

To define the pool of public addresses, use the **ip nat pool** command:

```
Gateway(config)#ip nat pool public_access 199.99.9.40 199.99.9.62 netmask 255.255.255.224
```

Task 8: Define an Access List That Matches the Inside Private IP Addresses

To define the access list to match the inside private addresses, use the **access-list** command:

```
Gateway(config)#access-list 1 permit 10.10.10.0 0.0.0.255
```

Task 9: Define the NAT Translation from Inside the List to Outside the Pool

To define the NAT translation, use the **ip nat inside source** command:

```
Gateway(config)#ip nat inside source list 1 pool public_access
```

Task 10: Specify the Interfaces

You must specify whether the active interfaces on the router are inside or outside interfaces with respect to NAT. To do this, use either the **ip nat inside** or **ip nat outside** command.

Task 11: Configure Static Mapping

Step 1. You should use workstation 1, 10.10.10.10/24, as the public WWW server. This server needs a permanent public IP address. Define this mapping by using a static NAT mapping.

Step 2. Configure one of the PCs on the LAN with the IP address 10.10.10.1 and a default gateway 10.10.10.1. To configure a static IP NAT mapping, use the **ip nat inside source static** command at the privileged EXEC mode prompt:

```
Gateway(config)#ip nat inside source static 10.10.10.10 199.99.9.33
```

This permanently maps 199.99.9.33 to the inside address 10.10.10.10.

Step 3. Look at the translation table:

```
Gateway#show ip nat translations
```

Does the mapping show up in the output of the **show** command? _____

Task 12: Test the Configuration

Step 1. From the 10.10.10.10 workstation, ping 172.16.1.1.

Did the ping succeed? _____

Why? _____

Step 2. From the ISP router, ping the host with the static NAT translation by entering **ping 10.10.10.10**.

What were the results of the ping? Did it succeed? _____

Why? _____

Step 3. From the ISP router, ping 199.99.9.33. If successful, look at the NAT translation on the gateway router by using the command **show ip nat translations**.

What is the translation of the inside local host address?

After you complete the previous tasks, log off (by entering **exit**) and turn the router off. Then, remove and store the cables and adapter.

Curriculum Lab 1-4: Verifying NAT and PAT Configuration (1.1.5)

Figure 1-4 Topology for Lab 1-4

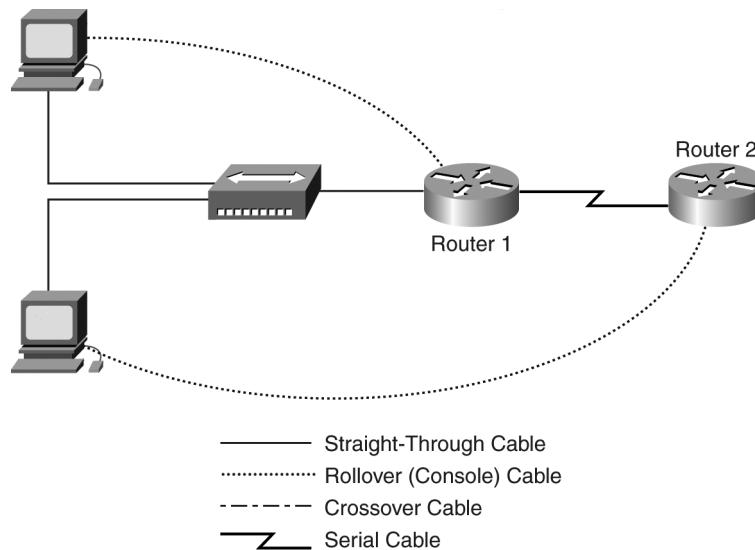


Table 1-4 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address/Subnet Mask	Loopback 0 Address/Subnet Mask
Router 1	Gateway	10.10.10.1/24	DCE	200.2.2.18/30	—
Router 2	ISP	—	DTE	200.2.2.17/30	172.16.1.1/32

The enable secret password for both routers is **class**.

The enable, vty, and console password for both routers is **cisco**.

Objectives

- Configure a router for NAT and PAT.
- Test the configuration and verify NAT/PAT statistics.

Background/Preparation

The ISP has allocated the public CIDR IP address 199.99.9.32/30 to a company. This is equivalent to four public IP addresses. Because the company has an internal requirement for more than 30 addresses, the IT manager has decided to use NAT with PAT. Routing between the ISP and the gateway will be done using a static route between the ISP and the gateway and a default route between the gateway and the ISP. The ISP connection to the Internet is represented by a loopback address on the ISP router.

Cable a network that is similar to the one in Figure 1-4. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the information in Appendix C to correctly specify the required interface identifiers based on the equipment in

your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See and implement the procedure documented in Appendix E before you continue with this lab.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart. If you have trouble doing this, see Lab 1-1, “Configuring NAT.”

Task 2: Save the Configurations

At the privileged EXEC mode prompt on both routers, enter the command **copy running-config startup-config**.

Task 3: Configure the Hosts with the Proper IP Address, Subnet Mask, and Default Gateway

Each workstation should be able to ping the attached router. Troubleshoot as necessary. Hint: Remember to assign a specific IP address and default gateway to the workstation. If you are running Windows 98, check using **Start > Run > winipcfg**. If you are running Windows 2000 or later, check using **ipconfig** in a DOS window.

Task 4: Verify That the Network Is Functioning

Step 1. From the attached hosts, ping the Fast Ethernet interface of the default gateway router.

Did the ping from the first host succeed? _____

Did the ping from the second host succeed? _____

Step 2. If the answer is no for either question, troubleshoot the router and host configurations to find the error. Then, ping again until they succeed.

Task 5: Create a Static Route

Create a static route from the ISP to the gateway router. Addresses 199.99.9.32/27 have been allocated for Internet access outside the company. Use the **ip route** command to create the static route:

```
ISP(config)#ip route 199.99.9.32 255.255.255.252 200.2.2.18
```

Is the static route in the routing table? _____

What command checks the routing table contents? _____

If the route was not in the routing table, give one reason why this might be so. _____

Task 6: Create a Default Route

Step 1. Add a default route, using the **ip route** command, from the gateway router to the ISP router. This forwards any unknown destination address traffic to the ISP:

```
Gateway(config)#ip route 0.0.0.0 0.0.0.0 200.2.2.17
```

Is the route in the routing table? _____

Step 2. Try to ping from one of the workstations to the ISP serial interface IP address.

Did the ping succeed? _____

Why?

Task 7: Define the Pool of Usable Public IP Addresses

To define the pool of public addresses, use the **ip nat pool** command:

```
Gateway(config)#ip nat pool public_access 199.99.9.32 199.99.9.35 netmask 255.255.255.252
```

Task 8: Define an Access List That Matches the Inside Private IP Addresses

To define the access list to match the inside private addresses, use the **access-list** command:

```
Gateway(config)#access-list 1 permit 10.10.10.0 0.0.0.255
```

Task 9: Define the NAT Translation from Inside the List to Outside the Pool

To define the NAT translation, use the **ip nat inside source** command:

```
Gateway(config)#ip nat inside source list 1 pool public_access overload
```

Task 10: Specify the Interfaces

You must specify whether the active interfaces on the router are inside or outside interfaces with respect to NAT. To do this, use the **ip nat inside** or **ip nat outside** command:

```
Gateway(config)#interface fastethernet 0
```

```
Gateway(config-if)#ip nat inside
```

```
Gateway(config-if)#interface serial 0
```

```
Gateway(config-if)#ip nat outside
```

Task 11: Test the Configuration

From the workstations, ping 172.16.1.1. Open multiple DOS windows on each workstation and telnet to the 172.16.1.1 address. Next, view the NAT translations on the gateway router with the command **show ip nat trans**.

What is the translation of the inside local host addresses?

Task 12: Verify NAT/PAT Statistics

To view the NAT and PAT statistics, enter the **show ip nat statistics** command at the privileged EXEC mode prompt.

How many active translations have taken place? ____

How many addresses are in the pool? ____

How many addresses have been allocated so far? ____

After you complete the previous tasks, log off (by entering **exit**) and turn the router off. Then, remove and store the cables and adapter.

Curriculum Lab 1-5: Troubleshooting NAT and PAT (1.1.6)

Figure 1-5 Topology for Lab 1-5

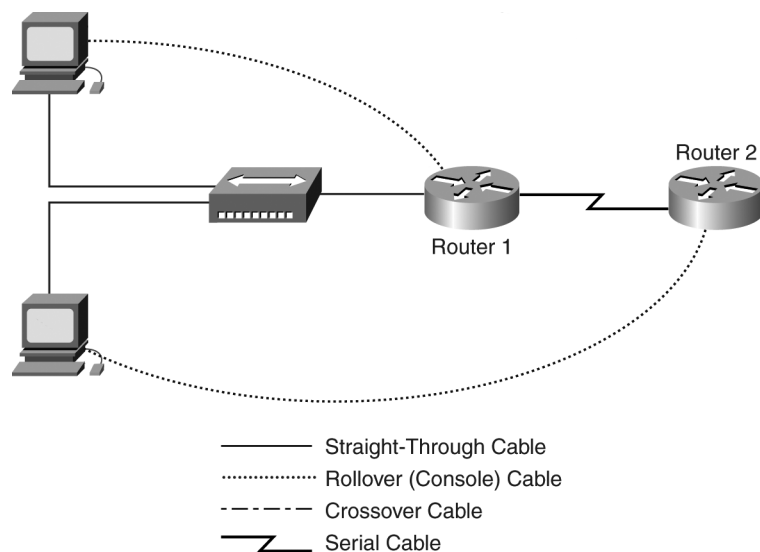


Table 1-5 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address/Subnet Mask	Loopback 0 Address/Subnet Mask
Router 1	Gateway	10.10.10.1/24	DCE	200.2.2.18/30	—
Router 2	ISP	—	DTE	200.2.2.17/30	172.16.1.1/32

The enable secret password for both routers is **class**.

The enable, VTY, and console password for both routers is **cisco**.

Objectives

- Configure a router for NAT and PAT.
- Troubleshoot NAT and PAT by using **debug**.

Background/Preparation

The ISP has allocated the public CIDR IP address 199.99.9.32/30 to a company. This is equivalent to four public IP addresses. Because the company has an internal requirement for more than 30 addresses, the IT manager has decided to use NAT and PAT. Routing between the ISP and the gateway router will be done using a static route between the ISP and the gateway and a default route between the gateway and the ISP. The ISP's connection to the Internet is represented by a loopback address on the ISP router.

Cable a network that is similar to the one in Figure 1-5. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the information in Appendix C to correctly specify the required interface identifiers based on the equipment in your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See the erase and reload instructions in Appendix E. Perform those tasks on all routers in this lab assignment before you continue.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart. If you have trouble doing this, see Lab 1-1, "Configuring NAT."

Task 2: Save the Configurations

At the privileged EXEC mode prompt on both routers, enter the command **copy running-config startup-config**.

Task 3: Configure the Hosts with the Proper IP Address, Subnet Mask, and Default Gateway

Each workstation should be able to ping the attached router. Troubleshoot as necessary. Hint: Remember to assign a specific IP address and default gateway to the workstation. If you are running Windows 98, check using **Start > Run > winipcfg**. If you are running Windows 2000 or later, check using **ipconfig** in a DOS window.

Task 4: Verify That the Network Is Functioning

- Step 1.** From the attached hosts, ping the Fast Ethernet interface of the default gateway router.
- Did the ping from the first host succeed? _____
- Did the ping from the second host succeed? _____
- Step 2.** If the answer is no for either question, troubleshoot the router and host configurations to find the error. Then, ping again until they succeed.

Task 5: Create a Static Route

Create a static route from the ISP to the gateway router. Addresses 199.99.9.32/27 have been allocated for Internet access outside the company. Use the **ip route** command to create the static route:

```
ISP(config)#ip route 199.99.9.32 255.255.255.252 200.2.2.18
```

Is the static route in the routing table? _____

What command checks the routing table contents? _____

If the route was not in the routing table, give one reason why this might be so. _____

Task 6: Create a Default Route

- Step 1.** Add a default route, using the **ip route** command, from the gateway router to the ISP router. This forwards any unknown destination address traffic to the ISP:

```
Gateway(config)#ip route 0.0.0.0 0.0.0.0 200.2.2.17
```

Is the route in the routing table? _____

- Step 2.** Try to ping from one of the workstations to the ISP serial interface IP address.

Did the ping succeed? _____

Why?

Task 7: Define the Pool of Usable Public IP Addresses

To define the pool of public addresses, use the **ip nat pool** command:

```
Gateway(config)#ip nat pool public_access 199.99.9.32 199.99.9.35 netmask 255.255.255.252
```

Task 8: Define an Access List That Matches the Inside Private IP Addresses

To define the access list to match the inside private addresses, use the **access-list** command:

```
Gateway(config)#access-list 1 permit 10.10.10.0 0.0.0.255
```

Task 9: Define the NAT Translation from Inside the List to Outside the Pool

To define the NAT translation, use the **ip nat inside source** command:

```
Gateway(config)#ip nat inside source list 1 pool public_access overload
```

Task 10: Specify the Interfaces

You must specify whether the active interfaces on the router are inside or outside interfaces with respect to NAT. To do this, use the **ip nat inside** command:

```
Gateway(config)#interface fastethernet 0
Gateway(config-if)#ip nat inside
```

Task 11: Test the Configuration

Step 1. Turn on debugging for the NAT process by entering **debug ip nat** at the privileged EXEC mode prompt.

Does the **debug** command show output? _____

Step 2. If translation were taking place, there would be output from the **debug** command. In reviewing the running configuration of the gateway router, you see that the **ip nat outside** statement has not been entered on the serial 0 interface. To configure this, enter the following:

```
Gateway(config)#interface serial 0
Gateway(config-if)#ip nat outside
```

Step 3. From the workstations, ping 172.16.1.1.

If you entered the **ip nat outside** statement correctly, there should be output from the **debug ip nat** command.

What does NAT*: S=10.10.10.? -> 199.99.9 mean?

Step 4. Stop the **debug** output by entering **undebug all** at the privileged EXEC mode prompt.

After you complete the previous tasks, log off (by entering **exit**) and turn the router off. Then, remove and store the cables and adapter.

Curriculum Lab 1-6: Configuring DHCP (1.2.6)

Figure 1-6 Topology for Lab 1-6

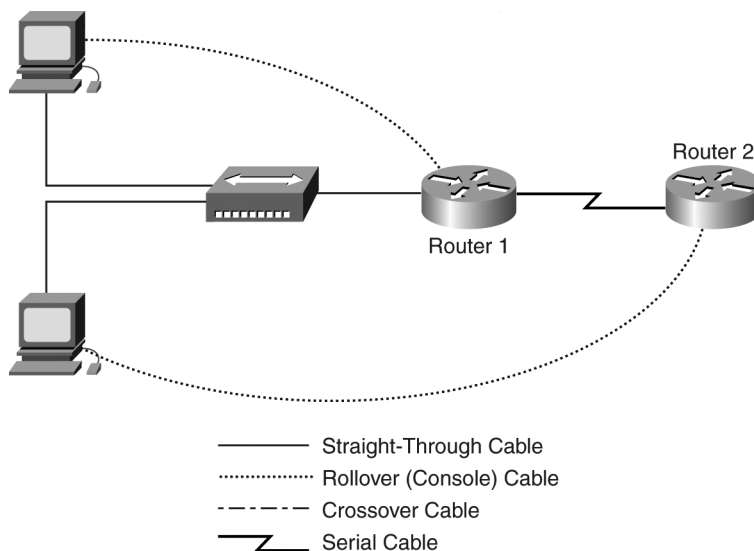


Table 11-6 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address/Subnet Mask	Loopback 0 Address/Subnet Mask
Router 1	campus	172.16.12.1/24	DCE	172.16.1.6/30	—
Router 2	ISP	—	DTE	172.16.1.5/30	172.16.13.1/32

The enable secret password for both routers is **class**.

The enable, VTY, and console password for both routers is **cisco**.

Objective

- Configure a router for DHCP to dynamically assign addresses to attached hosts.

Background/Preparation

Routing between the ISP and the campus router is by way of a static route between the ISP and the gateway and a default route between the gateway and the ISP. The ISP connection to the Internet is identified by a loopback address on the ISP router.

Cable a network that is similar to the one in Figure 1-6. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the information in Appendix C to correctly specify the required interface identifiers based on the equipment in your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See and implement the procedure documented in Appendix E before you continue with this lab.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart. If you have trouble doing this, see Lab 1-1, “Configuring NAT.”

Task 2: Save the Configurations

At the privileged EXEC mode prompt on both routers, enter the command **copy running-config startup-config**.

Task 3: Create a Static Route

Addresses 172.16.12.0/24 have been allocated for Internet access outside the company. Use the **ip route** command to create the static route:

```
ISP(config)#ip route 172.16.12.0 255.255.255.0 172.16.1.6
```

Is the static route in the routing table? _____

Task 4: Create a Default Route

Use the **ip route** command to add a default route from the campus router to the ISP router. This provides the mechanism to forward unknown destination address traffic to the ISP:

```
campus(config)#ip route 0.0.0.0 0.0.0.0 172.16.1.5
```

Is the route in the routing table? _____

Task 5: Create the DHCP Address Pool

To configure the campus LAN pool, use the following commands:

```
campus(config)#ip dhcp pool campus
campus(dhcp-config)#network 172.16.12.0 255.255.255.0
campus(dhcp-config)#default-router 172.16.12.1
campus(dhcp-config)#dns-server 172.16.1.2
campus(dhcp-config)#domain-name foo.com
campus(dhcp-config)#netbios-name-server 172.16.1.10
```

Task 6: Exclude Addresses from the Pool

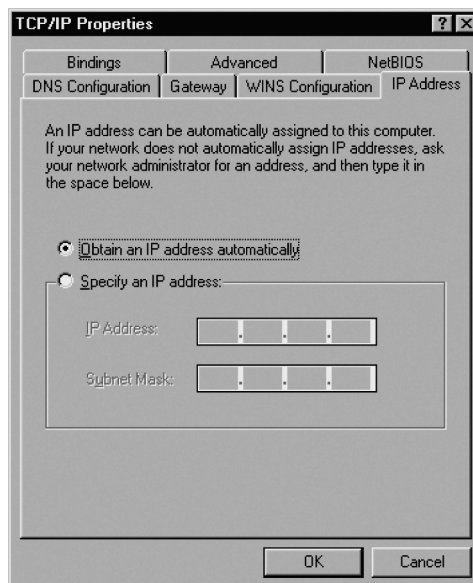
To exclude addresses from the pool, use the following command:

```
campus(dhcp-config)#ip dhcp excluded-address 172.16.12.1 172.16.12.10
```

Task 7: Verify DHCP Operation

- Step 1.** At each workstation on the directly connected subnet, configure the TCP/IP properties so that the workstation obtains an IP address and DNS server address from the DHCP server (see Figure 1-7). After you change and save the configuration, reboot the workstation.

Figure 1-7 TCP/IP Properties Dialog Box



- Step 2.** To confirm the TCP/IP configuration information on each host, use **Start > Run > winipcfg**. If you are running Windows 2000, check using **ipconfig** in a DOS window.

What IP address was assigned to the workstation?

What other information was assigned automatically?

When was the lease obtained?

When will the lease expire?

Task 8: View DHCP Bindings

From the campus router, you can see the bindings for the hosts. To see the bindings, use the command **show ip dhcp binding** at the privileged EXEC mode prompt.

What IP addresses were assigned?

What three other fields does the output list?

After you complete the previous tasks, log off (by entering **exit**) and turn the router off. Then, remove and store the cables and adapter.

Curriculum Lab 1-7: Configuring DHCP Relay (1.2.8)

Figure 1-8 Topology for Lab 1-7

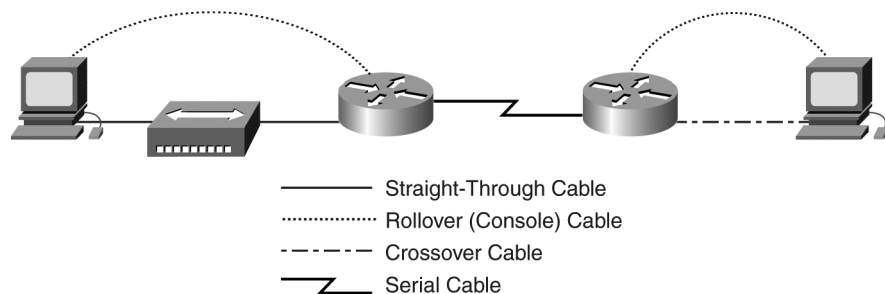


Table 1-7 Lab Equipment Configuration

Router Designation	Router Name	Fast Ethernet 0 Address/Subnet Mask	Interface Type	Serial 0 Address
Router 1	campus	172.16.12.1/24	DCE	172.16.1.6/30
Router 2	remote	172.16.13.1/24	DTE	172.16.1.5/30

The enable secret password for both routers is **class**.

The enable, VTY, and console password for both routers is **cisco**.

Objectives

- Configure a router for DHCP.
- Add the capability for workstations to remotely obtain DHCP addresses and dynamically assign addresses to the attached hosts.

Background/Preparation

A DHCP client uses IP broadcasts to find the DHCP server. However, routers do not forward these broadcasts, so in the case of the remote LAN, the workstations cannot locate the DHCP server. The router must be configured with the **ip helper-address** command to enable forwarding of these broadcasts, as unicast packets, to the specific server.

Routing between the remote and the campus router is done by using a static route between remote and gateway and a default route between gateway and remote.

Cable a network that is similar to the one in Figure 1-8. You can use any router that meets the interface requirements in the diagram (that is, 800, 1600, 1700, 2500, and 2600 routers, or a combination). See the information in Appendix C to correctly specify the required interface identifiers based on the equipment in your lab. The configuration output in this lab results from 1721 series routers. Another router might produce slightly different output. Execute the following tasks on each router unless you are specifically instructed otherwise.

Start a HyperTerminal session.

See and implement the procedure documented in Appendix E before you continue with this lab.

Task 1: Configure the Routers

Configure the hostname, console, virtual terminal and enable passwords, and interfaces according to the chart. If you have a problem completing this, see Lab 1-1, “Configuring NAT.”

Task 2: Configure Routing on the Remote Router

Using Open Shortest Path First (OSPF) as the routing protocol, set up network as area 0 and the process ID as 1:

```
remote(config)#router ospf 1
remote(config-router)#network 172.16.1.0 0.0.0.255 area 0
remote(config-router)#network 172.16.13.0 0.0.0.255 area 0
```

Task 3: Configure Routing on the Campus Router

Using OSPF as the routing protocol, set up the network as area 0 and the process ID as 1:

```
campus(config)#router ospf 1
campus(config-router)#network 172.16.1.0 0.0.0.255 area 0
campus(config-router)#network 172.16.12.0 0.0.0.255 area 0
```

Do OSPF routes exist in the routing table? _____

Task 4: Save the Configurations

At the privileged EXEC mode prompt on both routers, enter the command `copy running-config startup-config`.

Task 5: Create the Campus DHCP Address Pool on the Campus Router

To configure the campus LAN pool, use the following commands:

```
campus(config)#ip dhcp pool campus
campus(dhcp-config)#network 172.16.12.0 255.255.255.0
campus(dhcp-config)#default-router 172.16.12.1
campus(dhcp-config)#dns-server 172.16.12.2
campus(dhcp-config)#domain-name foo.com
campus(dhcp-config)#netbios-name-server 172.16.12.10
```

Task 6: Create the Remote DHCP Address Pool on the Campus Router

To configure the remote LAN pool, use the following commands:

```
campus(dhcp-config)#ip dhcp pool remote
campus(dhcp-config)#network 172.16.13.0 255.255.255.0
campus(dhcp-config)#default-router 172.16.13.1
campus(dhcp-config)#dns-server 172.16.12.2
campus(dhcp-config)#domain-name foo.com
campus(dhcp-config)#netbios-name-server 172.16.12.10
```

Task 7: Exclude Addresses from the Pool

To exclude addresses from the pool, use the following commands:

```
campus(dhcp-config)#ip dhcp excluded-address 172.16.12.1 172.16.12.10
campus(dhcp-config)#ip dhcp excluded-address 172.16.13.1 172.16.13.10
```

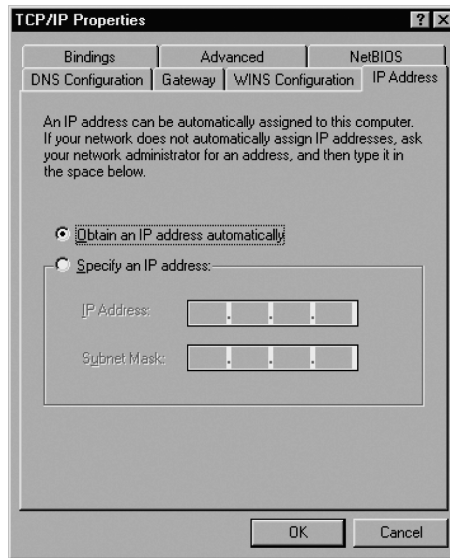
This defines the address range that the DHCP server excludes from dynamic issue.

Why would addresses be excluded?

Task 8. Verify DHCP Operation on the Campus Router

- Step 1.** From the workstation directly connected to the campus router, configure the TCP/IP properties for the workstation to obtain its IP properties automatically from DHCP. These properties include the IP and DNS server address (see Figure 1-9).

Figure 1-9 TCP/IP Properties Dialog Box



- Step 2.** After you change the configuration, reboot the workstation. View the TCP/IP configuration information. If you are running Windows 98, go to **Start > Run > winipcfg**. With Windows 2000 or higher, use **ipconfig** in a DOS window.

What IP address was assigned to the workstation? _____

Task 9: Verify DHCP Operation on the Remote Router

Repeat Task 8 using the workstation that is attached to the remote router.

Is a valid address assigned from the DHCP pool? _____

What IP address was assigned to the workstation?

What does this address (if any) represent?

Task 10: Configure DHCP Relay

Configure the remote router with the **ip helper-address** command to enable forwarding of broadcasts, as unicast packets, to the specific server. You must configure this command on the LAN interface of the remote router for DHCP to function:

```
remote(config)#interface fastethernet 0
remote(config-if)#ip helper-address 172.16.12.1
```

Task 11: Verify DHCP Operation on the Remote Router

Step 1. Reboot the workstation that is attached to the remote router.

Is a valid address assigned from the DHCP pool? _____

What IP address was assigned to the workstation? _____

Step 2. If there is no IP address, troubleshoot the workstation and router configurations and repeat Task 11.

Task 12: View DHCP Bindings

From the campus router, you can see the bindings for the hosts. To see the bindings, use the command **show ip dhcp binding** at the privileged EXEC mode prompt.

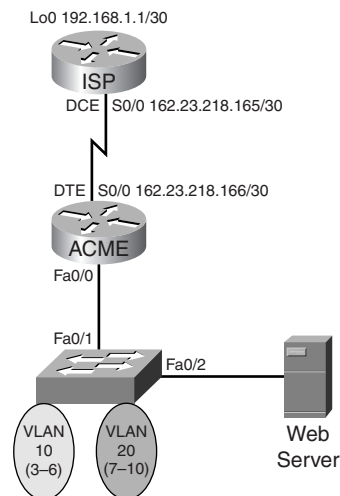
Which IP addresses are assigned to the hosts?

After you complete the previous tasks, log off (by entering **exit**) and turn the router off. Then, remove and store the cables and adapter.

Comprehensive Lab 1-8: Configuring NAT, PAT, and Static NAT

You are the network administrator of ACME, a start-up marketing company with a limited number of users. Your company purchased a small range of public addresses from your ISP for global communication. Your company's IP address is 200.127.54.0/26—which is the equivalent of 62 assignable addresses. Routing between ACME and the ISP is accomplished using a classless routing protocol. A loopback address represents the ISP's connection to the Internet. Figure 1-10 shows the network topology for this lab.

Figure 1-10 Network Topology for Lab 1-8



Objective

- Configure a router with multiple NAT pools to accommodate numerous VLANs within the network. To complete this lab, you can use 2620, 1721, and 1760 routers and 2950 switches.

Configuration Tasks

- Cable and configure the equipment according to the topology diagram in Figure 1-10.
- Control access to the console port on all devices using **cisco** as the password.
- Use an encrypted password when accessing the privileged mode of all devices using **class** as the password.
- Restrict remote access to all devices using **itsasecret** as the password.
- Configure interface descriptions.

Addressing Scheme

- As the network administrator of ACME, you decide to use the 192.168.100.0/24 address for devices inside your network.
- You must create an addressing scheme that will support three subnets:
 - Department of Information Services (DIS) Department: 12 users
 - Finance department: 13 users
 - Marketing department: 30 users

VLANs

- Create three VLANs and apply them to the following ports on the ALswitch:
 - VLAN 1: DIS.
 - VLAN 10: Marketing department ports 3–6.
 - VLAN 20: Finance department ports 7–10.
 - All unassigned ports should be assigned to VLAN 1. If they are unused, they should be disabled for security purposes.
- Configure trunk ports as indicated by the diagram. All trunk links should carry traffic for all VLANs.
- Configure the switch with an address from VLAN 1 with an appropriate default gateway.
- Configure inter-VLAN routing on the ACME router using IEEE 802.1q encapsulation.

Web Server

- Configure the web server with an address from VLAN 1.

NAT

Using the public addresses assigned to you by the ISP, configure three separate NAT pools for each of the following:

- You are to allow all 30 users in the Marketing department to access the Internet by pulling an IP address dynamically (NAT).
- Users in the Finance department will communicate with the outside world using the same IP address (PAT).
- The company's web server is inside the private network and must be statically assigned a public address.

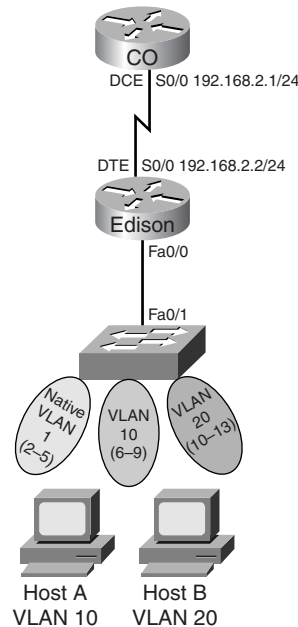
Routing

- Use a classless routing protocol to route traffic between the ISP and ACME routers. Because you are the network administrator, you decide which protocol to use.

Challenge Lab 1-9: NAT, PAT, DHCP

Estimated time: 90 minutes

Figure 1-11 Network Topology for Lab 1-9



Note

This lab tests your knowledge of NAT, PAT, DHCP, static, and default routes. It builds on VLAN concepts and configurations you have learned previously in CCNA 3 of the curriculum. You might find it useful to review notes and labs from CCNA 3 before proceeding.

General Configuration Tasks

- Cable and configure the equipment based on the topology shown in Figure 1-11.
- Control access to the console on all devices using **cisco** as the password.
- Use an encrypted password when accessing the privileged mode of all devices using **class** as the password.
- Restrict remote access to all devices using **itsasecret** as the password.
- Configure descriptions on all interfaces.

Addressing

- As the network administrator, you decide which private address to use on the inside of your network. Choose a Class B address with a 24-bit mask from RFC 1918.
- Use the address that you have chosen and create three subnets to accommodate users on the management, teacher, and student VLANs:
 - 90 users on the student VLAN
 - 20 users on the teacher VLAN
 - 12 users on the management VLAN

VLANs

- Create three VLANs and apply them to the following ports on the ALswitch:
 - VLAN 1: Management VLAN ports 2–5
 - VLAN 10: Student VLAN ports 6–9
 - VLAN 20: Teacher VLAN ports 10–13
- Configure trunk ports as indicated in the diagram. All trunk links should carry traffic for all VLANs.
- Configure the switch with an address from VLAN 1 with the appropriate default gateway.
- Configure inter-VLAN routing on the Edison router using IEEE 802.1q encapsulation.

Static Routes

- Create a default route on the Edison router so that the hosts can access all networks on the Central Office router.
- Create a static route on the Central Office router so that it can connect to all networks on the Edison LAN.

DHCP

- Instead of assigning a static IP address to each device on the network, use DHCP to assign IP addresses to all devices on the student VLAN.
- Configure the appropriate default gateway and exclude the first 10 addresses from this pool.
- Connect the PCs to the appropriate switch ports as indicated by the diagram. Verify that the PCs on the student VLAN have been assigned an address from the correct subnet pool.
- Devices on the teacher VLAN will be statically assigned. Remember to use only those addresses suitable for teacher client devices.

NAT/PAT

- Only traffic from the student and teacher VLANs will be NATed when leaving the Edison router. Traffic from the management VLAN will remain the same.
- The NAT/PAT pools should be created from the unused address space on the WAN subnet between the Central Office and Edison routers. Separate pools should be created for each VLAN.
- Create a large pool for students so that they are each assigned a unique address when crossing the WAN.
- All devices on the teacher VLAN will cross the WAN as the same address. In other words, the teacher pool will require overloading (PAT).

Testing and Verification

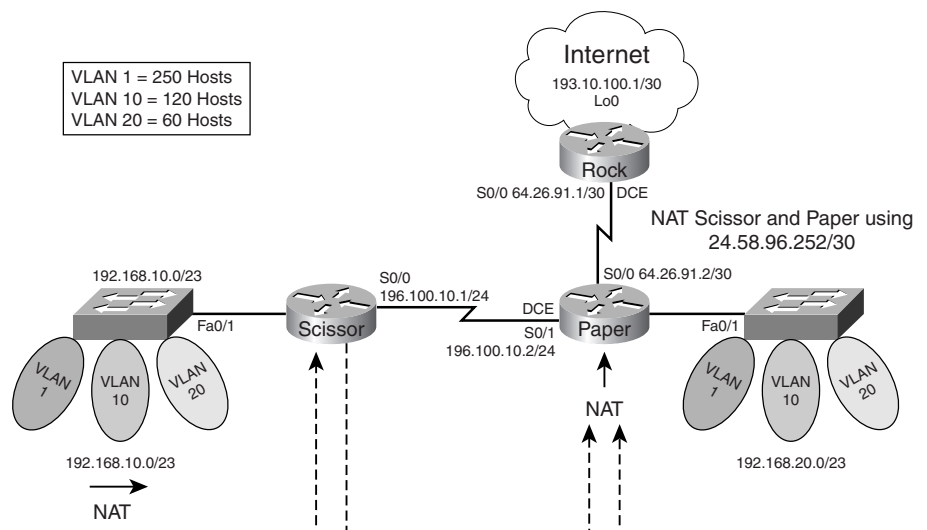
- Test connectivity between PCs, to the default gateway, and from the PC to the loopback interface on the Central Office router.
- Ensure that devices on the student VLAN have an address assigned from the DHCP pool.
- Ensure that each device on the student VLAN crosses the WAN link with an address from the NAT pool and that each device on the teacher VLAN crosses the WAN with the same address assigned in that pool.

Reflection

List five commands other than the **show running-config command** that you used to verify the correct configuration of the lab assignment. Explain how each command proved useful in completing this lab.

Challenge Lab 1-10: Double NAT Configuration

Figure 1-12 Topology for Challenge Lab 1-10



This lab requires you to perform NAT on two different routers. The Scissor LAN addresses are translated on the Scissor router using remaining address space from the WAN connection and are translated again on the Paper router using a different set of addresses.

Objectives

- Configure VLANs and inter-VLAN routing.
- Configure DHCP.
- Configure NAT and PAT.
- Configure RIPv2.

Task 1: Cabling and Configuration

Cable and configure equipment according to the diagram in Figure 1-12.

Task 2: IP Addressing

Assign IP addresses on your routers using the appropriate addressing scheme for each LAN based on the detailed VLAN information in Figure 1-12. This task tests your knowledge of Classless Interdomain Routing (CIDR) and Variable-Length subnet Masks (VLSMs).

Task 3: Inter-VLAN Communication

Configure inter-VLAN routing using IEEE 802.1q encapsulation.

Task 4: Configure VLANs, VLAN Ports, and the HTTP Server

Step 1. Configure the Scissor switch and the Paper switch with the following VLANs:

- VLAN 1
- VLAN 10: Wholesale
- VLAN 20: Retail

Step 2. Assign the VLANs to the appropriate ports:

- VLAN 1: All unassigned ports
- VLAN 10: Ports 6–10
- VLAN 20: Ports 11–15

Step 3. Set up the Rock router as an HTTP server.

Task 5: Configure and Verify RIPv2 Operation

Step 1. Configure RIPv2 on each router and advertise all directly connected networks.

Step 2. Verify functionality with the **show ip route** command.

Task 6: Configure DHCP

Step 1. Configure DHCP on the Paper and Scissor routers.

Step 2. Exclude the first 10 addresses from each VLAN.

Task 7: Configure NAT and PAT

- Step 1.** Configure NAT and PAT on the Paper and Scissor routers.
- Step 2.** Translate the Scissor LAN with the unused address space from 196.100.10.0/24 in this way:
- VLAN 1 will access the outside world using one IP address.
 - Create a NAT pool for VLAN 10.
 - Create a NAT pool for VLAN 20.
- Step 3.** All addresses will be retranslated at the Paper router when communicating with the Rock router in the following way:
- All Scissor addresses will use the 24.58.96.253/30 address.
 - The Paper LAN will use the 24.58.96.254/30 address.

Task 8: Verify Configurations

Verify configurations using the appropriate commands.

Hosts on the Scissor LAN should ping the Paper LAN using an address from the 196.100.10.0/24 network.

Hosts on the Scissor LAN should ping the Rock router using the 24.58.96.253/30 address.

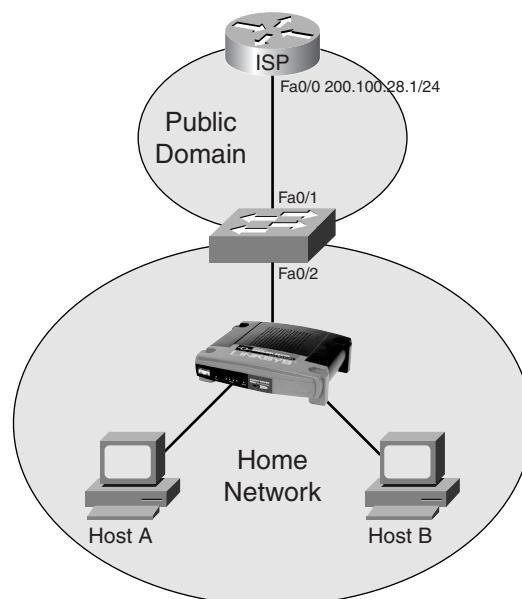
Hosts on the Paper LAN should ping the Scissor LAN using an address from the 192.168.20.0/23 network.

Hosts on the Paper LAN should ping the Rock router using the 24.58.96.254/30 address.

Optional Lab 1-11: Using a Linksys Router to Simulate a Home Network

In this lab, you use a Linksys router to simulate a real-world example of a home network.

Figure 1-13 Network Topology for Lab 1-11



Equipment

- You can complete this lab using any Linksys router other than voice-enabled models. You can use 1700, 2500, and 2600 series routers for this lab to simulate the ISP.

Objective

- Configure the ISP router with DHCP, which will allow the Linksys router to pull an address from the pool you create. The Linksys router will then perform PAT on attached devices without having to be configured. Before you begin, reset the Linksys router to factory defaults by pressing the small button on the back of the router for 1 minute using a small pointy object, such as a pencil or paper clip.

Step 1. Cable and configure the equipment based on the topology in Figure 1-13.

Step 2. Configure the router with DHCP. Omit the router's IP address from the pool.

Step 3. The switch does not to be configured but should be cleaned of any previous configurations, especially VLAN information. Use the following commands to clear configurations:

```
Switch#delete flash:vlan.dat
```

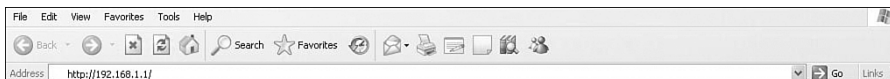
```
Switch#erase startup-config or write erase
```

```
Switch#reload
```

Step 4. Connect to the Linksys router.

- Open your web browser.
- Enter **192.168.1.1** in the address bar. This is the default IP address of the Linksys router (see Figure 1-14).

Figure 1-14 Default Linksys IP Address



- The router prompts you for a password (see Figure 1-15).

Figure 1-15 Linksys Password Prompt



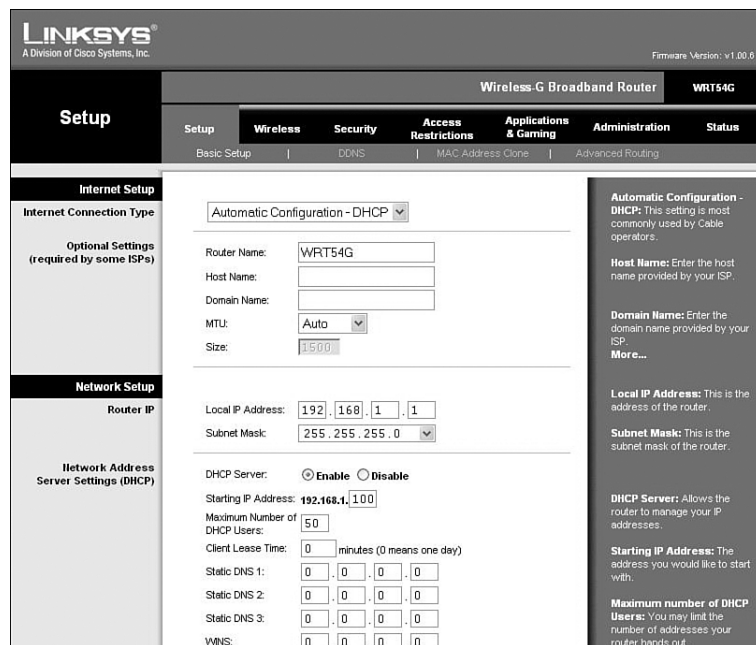
- Leave the username blank and enter the default password, admin (see Figure 1-16).

Figure 1-16 Linksys Administrator Login



- e. The information shown in Figure 1-17 appears on the Linksys setup page.

Figure 1-17 Linksys Setup Page



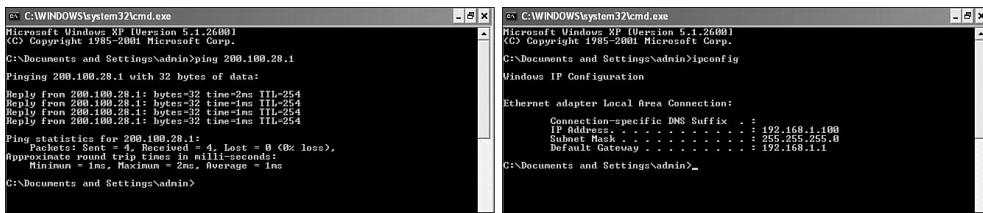
- f. Under Network Setup, the default address of the Linksys router appears. With this option, you can use any address you choose, including those not included in RFC 1918.

Why is the router's IP address 192.168.1.1 rather than an address from the pool that has been created?

What is the range of DHCP addresses used by the Linksys router?

- Step 5.** Open the command prompt dialog box and display the IP address of Host A and Host B (see Figure 1-18).

Figure 1-18 Displaying Host A and B IP Addresses



Step 6. On the ISP router, enter the following command:

```
ISP#debug ip icmp
```

Step 7. From Host A, ping the ISP router’s Fast Ethernet interface.

The following information was displayed on the ISP router:

```

Router#
*Apr 14 07:51:53.955: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
*Apr 14 07:51:54.953: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
Router#
*Apr 14 07:51:55.955: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
*Apr 14 07:51:56.956: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
Router#
*Apr 14 07:52:06.760: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
*Apr 14 07:52:07.750: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
Router#
*Apr 14 07:52:08.752: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
*Apr 14 07:52:09.753: ICMP: echo reply sent, src 200.100.28.1, dst
200.100.28.3
Router#
    
```

Why is the reply sent to the 200.100.28.3 address rather than the 192.168.100.2 address?

Step 8. Ping the 200.100.28.1 address from both hosts.

Why is only one address listed as the source instead of the IP address from each host?
