13

Dynamic Host Configuration Protocol (DHCP)

Contents

Overview

Every computer or device that connects to the Internet or to an IP network needs an IP address. Most users do not have the expertise to configure an IP address, subnet mask, and gateway. In addition, whenever a computer changes its location in the network, it must receive a new address. Somehow, the address assigned to each device and the addresses that are still available must both be tracked. Most companies do not have the time, resources, or staff to devote to managing such configurations. In addition, networks operate with a finite number of IP addresses. It is most efficient for a host to reserve an address only when it is using it.

Dynamic Host Configuration Protocol (DHCP) enables hosts on an IP network, called DHCP clients, to lease a temporary IP address from a DHCP server. The server can also issue other configurations to the client that help it function on the network (such as the addresses of Domain Name System [DNS] and Windows Internet Naming Service [WINS] servers). This protocol helps reduce administrative overhead on an IP-based network.

The ProCurve Secure Router can act as a DHCP server for hosts on directly connected subnets. Router interfaces can also act as DHCP clients and receive a dynamic address from a directly connected DHCP server.

DHCP Request Process

Understanding the basics of DHCP will help you understand and remember how to configure a DHCP pool. If you can track the DHCP process, you will also find it much easier to troubleshoot the router's DHCP activity.

The DHCP request process breaks down into four steps (see Figure 13-1):

1. The client broadcasts a DHCPDISCOVER packet, requesting an IP address and other configurations.
2. The server responds with a DHCPOFFER, which includes an available network address.
3. The client sends a DHCPREQUEST, accepting the offer and requesting the complete configuration from the server.

4. The server responds with a DHCPACK, which includes:
   - the agreed-upon network address
   - a default gateway
   - a lease time
   - the address of one or more DNS servers (optional)
   - the address of one or more WINS servers (optional)

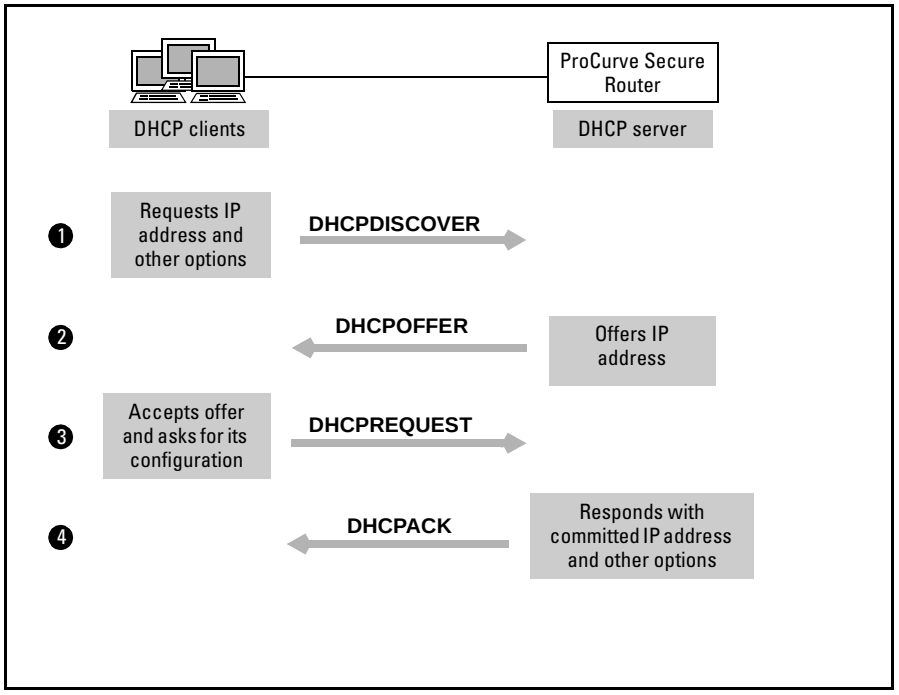

Figure 13-1. DHCP Request Process

Depending on how you configure the ProCurve Secure Router, the router can act as the DHCP server and/or one of its interfaces can act as a DHCP client. (However, an interface that acts as a DHCP client cannot also act as a server.)

The ProCurve Secure Router as a DHCP Server

A router that also functions as a DHCP server is particularly useful for a small-to-medium site at which all subnets connect to the WAN router. The ProCurve Secure Router can connect to up to two switches on its Ethernet ports.

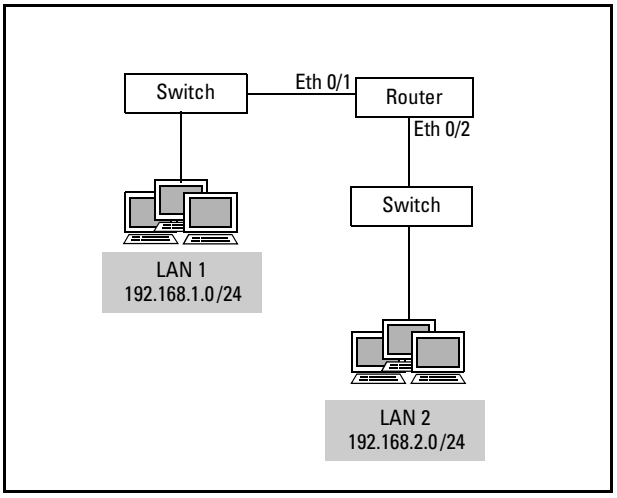

Figure 13-2. ProCurve Secure Router DHCP Server

You should configure one DHCP pool for each subnet. For the default gateway, you would specify the IP address of the Ethernet interface through which the router connects to the subnet. (See Figure 13-2.)

The switches may also connect to several VLANs. In this case, you would configure VLAN support on the Ethernet interfaces. (See *Chapter 3: Configuring Ethernet Interfaces*.) You would then create a DHCP pool for each VLAN.

A WAN interface can also act as a server for DHCP clients. However, usually the router at the remote site or a DHCP server would act as the remote network's server. On the other hand, when you bridge two remote sites, one router should act as a DHCP server for all clients in the network.

The ProCurve Secure Router as a DHCP Client

Some service providers require their subscribers to lease a dynamic address from them. In particular, Frame Relay service providers often require their costumers to use DHCP when connecting to their network. Each permanent virtual circuit (PVC) endpoint receives an IP address only when it needs it. This allows the service provider to conserve the limited number of IP addresses it owns. Internet service providers (ISPs) also often require subscribers to receive an IP address and other configurations from them.

You must configure the interface that connects to such a provider to act as a DHCP client.

Ethernet interfaces can also be DHCP clients on the connected subnet. Usually, however, it is a good idea to assign network nodes a static address.

Interfaces on the ProCurve Secure Router that can take a dynamic address are:

- Ethernet interfaces
- Frame Relay subinterfaces
- Asynchronous Transfer Mode (ATM) subinterfaces
- Point-to-Point Protocol (PPP) interfaces (only when bridging traffic)

DHCP Relay

Rather than acting as the server for connected DHCP clients, the router can run DHCP relay, which allows hosts on one subnet to receive configurations from a server on a different subnet. The router receives DHCP packets from clients and forwards them to a remote server on behalf of the clients. Similarly, it receives the committed IP addresses from the server and forwards them to the clients.

Configuring a DHCP Server

You configure the ProCurve Secure Router to act as a DHCP server by configuring a DHCP pool for each connecting subnet. The pool specifies the subnet's address and default gateway. It can also include other configurations such as a DNS server address.

To configure the router as a DHCP server, you must:

1. Exclude static addresses from DHCP.
2. Create a DHCP pool:
   a. Specify the network address and subnet mask.
   b. Define the default gateway.
   c. Specify DNS and WINS (NetBIOS) server addresses—You should specify at least one DNS server.

Optionally:

- For a DHCP pool, you can:
  - change the lease time
  - specify a domain name for clients on a subnet

- You can also:
  - configure a parent pool from which child pools import global settings
  - assign a fixed DHCP address to a single client
  - configure ping settings for the DHCP server

Excluding Static Addresses

Certain IP addresses in your network may be statically assigned to specific hosts: for example, the router itself, the Ethernet interface, DNS and Web servers, and switches. Often administrators reserve an entire block of addresses for such devices. You must exclude all statically defined addresses from the pool of addresses the router assigns clients.

To specify that a range of addresses cannot be assigned to DHCP clients, move to the global configuration mode context and enter the following command:

Syntax: ip dhcp-server excluded-address <*first A.B.C.D*> [<*last A.B.C.D*>]

For example, your organization uses the first ten addresses on a subnet for routers and switches and the second ten for servers. You enter:

```
ProCurve(config)# ip dhcp-server excluded-address 192.168.1.1 192.168.1.20
```

You can also exclude a single address:

```
ProCurve(config)# ip dhcp-server excluded-address 192.168.1.254
```

Use the **no** form of this command to remove an IP address from the restricted list.

Creating a DHCP Pool

You should create a DHCP pool for each subnet that connects directly to the ProCurve Secure Router and for which you want the router to act as a DHCP server.

Use the following command to create the pool:

Syntax: ip dhcp-server pool <*poolname*>

Assign the pool an alphanumeric name meaningful within your network. For example:

```
ProCurve(config)# ip dhcp-server pool LAN1
```

The command line interface (CLI) displays **Configuring New Pool "*<poolname>*"** and moves you into the DHCP server pool configuration mode context.

You can also edit a pool with the same command. The CLI displays **Configuring Existing Pool "*<poolname>*"**.

You can create multiple DHCP server address pools to provide configurations to different segments of the network. If the subnets are contiguous, you can create a parent pool with global settings for all subnets and separate child pools, each with settings particular to an individual subnet. (See "Configuring Parent and Child Pools" on page 13-13.)

From the DCHP server address pool configuration mode context, you configure:

- subnet address
- default gateway address
- lease time
- DNS server addresses
- WINS server addresses
- domain name

Every pool must include a subnet address, default gateway, and lease time. You can accept the default lease time (1 day), but you must configure the subnet address and default gateway. You should also configure at least one DNS server.

Specifying the Network Address and Subnet Mask

You assign a subnet to the DHCP server address pool by specifying the network address and subnet mask:

Syntax: network <*network A.B.C.D*> <*subnet mask* | /*prefix length*>

For example, to specify a private Class C subnet:

```
ProCurve(config-dhcp)# network 192.168.1.0 255.255.255.0
```

The DHCP server on the ProCurve Secure Router supports Classless Inter-Domain Routing (CIDR) addresses, so you can enter a bit length for the network address rather than a subnet mask. For example, your organization may have divided the Class B network 172.16.0.0 into sixteen subnets, including 172.16.32.0 /20 and 172.16.48.0 /20. For the first DHCP pool, you would enter:

```
ProCurve(config-dhcp)# network 172.16.32.0 /20
```

See the overview in *Chapter 11: IP Routing—Configuring Static Routes* for more information on network addresses, subnet masks, and prefix lengths.

Note

If you do not specify a subnet mask or prefix length, the server will use the class A, B, or C natural mask associated with the network address. If your LAN does use CIDR network addresses, take care to indicate the correct prefix length; otherwise hosts may end up with an address on the wrong subnet.

Specifying the Default Gateway

A client's default gateway is the address on its network to which it sends all traffic. The gateway knows how to route and service the traffic. The ProCurve Secure Router acts as the gateway device for the subnets connected through its interfaces.

A DHCP pool's default gateway, or default router, is the interface through which the clients for the pool connect. This interface is almost always an Ethernet interface. (Although nothing technically prohibits a WAN interface from being a default gateway, it usually has an address on a different network from hosts on a LAN. Even when it does not, it almost always makes more sense to have the Ethernet interface be the gateway for local hosts and a remote device the gateway for clients on the remote network.)

You specify a pool's default gateway by entering the connected interface's IP address in the DHCP pool configuration mode context:

Syntax: default-router <*A.B.C.D*> [<*secondary A.B.C.D*>]

Another device on the network, such as a second router interface, router, or a routing switch, may also be able to route traffic for the client. You may add an optional address for this secondary device. For example:

```
ProCurve(config-dhcp)# default-router 192.168.1.1 192.168.1.10
```

Note

Addresses for both the primary and secondary gateway must be on the subnet defined for the pool using the **network** command.

Changing a Pool's Lease Time

Whenever a DHCP server sends a DCHPACK message to a client with its committed IP address and other network configurations, the server includes a lease time. This time puts a limit on how long the client can reserve the address. Temporary leases allow networks to satisfy multiple users with a limited pool of IP addresses. They also allow users to change addresses painlessly as the users change location in the network. Typically, active clients periodically request to keep their addresses before the lease expires so that data transmission is not interrupted.

The default lease time for DHCP pools on the ProCurve Secure Router is one day. This setting suits many environments, allowing clients to keep configurations throughout the workday, but also making it easy for a client to receive a new address when it changes location in the network.

However, subnets for various kinds of users require different lease times. For example, a subnet that provides public access computers, which are randomly used by many different people, may need a shorter lease time. Try not to set the lease shorter than necessary because DHCP exchanges consume bandwidth and router processing resources.

You can configure an individual lease time for each DHCP pool established on the router, according to your organization's policies. For example, you can set a lease time of 1 hour. From the configuration mode context of the pool, enter:

Syntax: lease <*days*> <*hours*> <*minutes*>

The Secure Router OS always sets the first number entered as the number of days for the lease, the second as hours, and the third as minutes. You must enter a zero to indicate that you are skipping a number. For example, to set a lease time of 15 minutes, enter:

```
ProCurve(config-dhcp)# lease 0 0 15
```

You do not have to input zeroes after the last significant number. For example, a lease time of 30 days is specified as:

```
ProCurve(config-dhcp)# lease 30
```

See your ProCurve *SROS Command Line Interface Reference Guide* for valid ranges for lease time.

Specifying DNS, WINS, and Other Servers

DHCP clients often need other configurations besides an IP address. The DHCP server can also issue addresses to clients for the devices that provide various services for the subnet.

DNS Server. A DNS server tracks the IP addresses associated with specific hostnames. It translates a hostname into its IP address in response to requests from DNS clients. Clients need a DNS server so that users can enter hostnames to reach other hosts and browse the Internet. You should designate at least one DNS server for the DHCP client by entering the following command:

Syntax: dns-server <*A.B.C.D*> [<*second A.B.C.D*>]

You may specify an optional secondary DNS server by adding a second IP address. For example:

```
ProCurve(config-dhcp)# dns-server 192.168.1.25 15.3.1.20
```

WINS (NetBIOS) Server. A WINS server maps computers' NetBIOS names to IP addresses. It ensures that hosts on the same network do not have the same hostname, and it performs DNS-type services for hosts with dynamic addresses. When a computer changes location in the network, the WINS server automatically updates the entry for its hostname with its new DHCP address.

If your private network uses NetBIOS, you should give the DHCP client the address of the WINS server. Enter:

Syntax: netbios-name-server <*A.B.C.D*> [<*second A.B.C.D*>]

You may specify IP addresses for up to two WINS servers.

Other Servers. You can also assign clients a Trivial File Transfer Protocol (TFTP) server and a Network Time Protocol (NTP) server.

Clients download config and software files from TFTP servers.

NTP servers ensure that all clients' clocks are synchronized, which can be very important for some organizations. If the NTP server is in a different timezone than the DHCP clients, you must set a timezone offset. The range for the offset is **-12** to **12**. For example, to set an offset for a server 2 hours ahead of the local router, enter **timezone-offset -2**.

Enter these commands:

Syntax: tftp-server <*A.B.C.D*>
Syntax: ntp-server <*A.B.C.D*>
Syntax: timezone-offset <-12 to 12>

Specifying a Domain Name for the Subnet

If your organization wants users to have the organization's domain name, you should configure the DHCP server to issue this name with the IP address. Specify the domain name for the subnet from the configuration mode context of the corresponding DHCP server pool:

Syntax: domain-name <*domain name*>

Do not include the period before the name. For example:

```
ProCurve(config-dhcp)# domain-name procurve.com
```

Specifying a Bootfile

DHCP clients that do not store the correct boot software on an internal flash drive can receive a bootfile from a TFTP server. If your ProCurve Secure Router serves as the DHCP server for such clients, it should notify these clients:

- which bootfile to use
- the address for the TFTP server

Enter this command from the DHCP pool configuration mode context to specify the boot file:

Syntax: bootfile <*filename*>

Enter the name of a file exactly as it is stored on the TFTP server.

You must also specify the address of the TFTP server. From the DHCP pool configuration mode context, enter this command:

Syntax: tftp-server <*A.B.C.D*>

For example, enter:

```
ProCurve(config-dhcp)# bootfile ClientBoot.biz
ProCurve(config-dhcp)# tftp-server 192.168.1.15
```

Configuring Parent and Child Pools

If your ProCurve Secure Router supports contiguous subnets, you can configure a single parent pool for the range of subnets. In this pool, you would specify settings that apply to all of the subnets, such as domain name, DNS servers, WINS servers, and lease time.

You would then configure child pools, each of which would have its own subnet address and default gateway. The other settings would be automatically imported from the parent pool, saving you time and minimizing opportunities for miskeying a server address.

When you configure a parent pool, you specify the range of subnets by entering the network address bits the subnets have in common followed by the (now shorter) prefix length.

Figuring out the exact number of bits that two subnets have in common involves converting from decimal to binary and can be complicated. The simplest method is to use the address and bit length for the last common octet.

For example, you want to configure a parent pool for subnets 192.168.1.0 /24 and 192.168.2.0 /24. The parent pool network address could be 192.168.0.0 /16.

However, you should be careful using this method, especially when your network uses variable-length subnets.

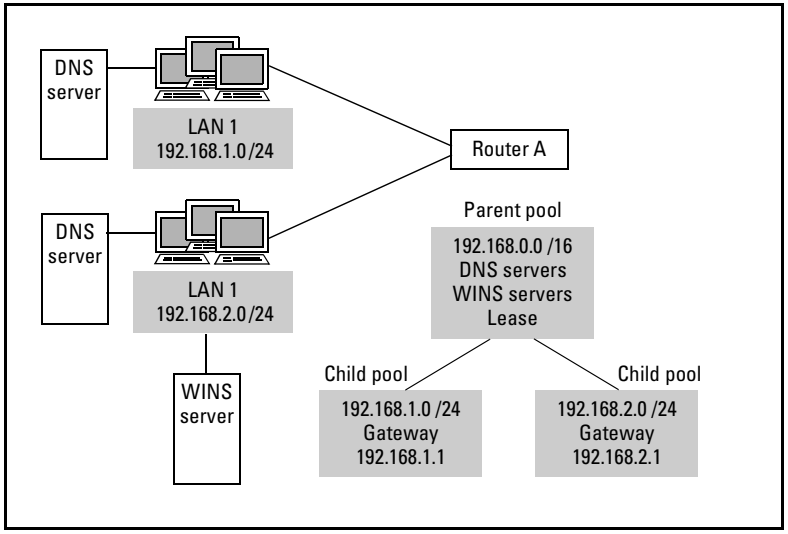

Figure 13-3. Example DHCP Pool Configuration

You do *not* specify a default router for a parent pool.

You configure the child pools just as you do any DHCP pool, but you only have to configure the subnet address and default router. If you alter a setting, such as the lease time, the configuration in the child pool overrides that in the parent pool.

Example DHCP Pool Configuration

In Figure 13-3, a router connects to two subnets. The figure also shows the network's DNS and WINS servers. This LAN reserves addresses 1 to 29 on each subnet for various network devices, such as routers, switches, and servers. To configure this router to act as a DHCP server for its local subnets, you would complete these steps:

1. Exclude static addresses:

   ```
   ProCurve(config)# ip dhcp-server excluded-address 192.168.1.1 192.168.1.29
   ProCurve(config)# ip dhcp-server excluded-address 192.168.2.1 192.168.2.29
   ```

2. Create the parent pool with global settings:

   ```
   ProCurve(config)# ip dhcp-server pool Parent
   ProCurve(config-dhcp)# network 192.168.0.0 /16
   ProCurve(config-dhcp)# dns-server 192.168.1.25 192.168.2.23
   ProCurve(config-dhcp)# netbios-name-server 192.168.2.26
   ProCurve(config-dhcp)# lease 0 12
   ```

3. Create the child pools, each with its own subnet and default gateway:

   ```
   ProCurve(config-dhcp)# ip dhcp-server pool LAN1
   ProCurve(config-dhcp)# network 192.168.1.0 /24
   ProCurve(config-dhcp)# default-router 192.168.1.1
   ProCurve(config-dhcp)# ip dhcp-server pool LAN2
   ProCurve(config-dhcp)# network 192.168.2.0 /24
   ProCurve(config-dhcp)# default-router 192.168.2.1
   ```

Assigning a Fixed Address to a Host through a DHCP Server

Certain devices should almost always be given static addresses so that routes remain accurate, the network design logical and consistent, and the traffic flow uninterrupted. However, sometimes such a device is also required to take a dynamic address from a DHCP server. You can configure the router to assign a fixed DHCP address to this device.

Also, when you want to assign a particular host a permanent address, sometimes it is better to configure this address through a server, rather than through whatever application is on the host. DHCP automatically tracks addresses so that two devices are not inadvertently given the same address.

To assign a fixed address to a single host:

1. Create a new DHCP server pool with a name indicative of the host.
2. Identify the fixed-address host by its MAC address:

   Syntax: hardware-address <*MAC address*>

   For example:

   ProCurve(config-dhcp)# hardware-address d2:17:04:91:11:50

3. Specify the IP address for the host. The router automatically assigns the address with its natural mask. If your organization uses variable-length subnetting, make sure to include the subnet mask or prefix length for the host's subnet:

   Syntax: host <*A.B.C.D*> <*subnet mask* | /*prefix length*>

4. Specify the default gateway:

   Syntax: default-router <*A.B.C.D*>

5. Configure other settings such as DNS and WINS servers and a domain name. (See "Specifying DNS, WINS, and Other Servers" on page 13-11). You can also assign the client a name:

   Syntax: client-name <*name*>

   For example:

   ProCurve(config-dhcp)# client-name LAN2Switch

Configuring DHCP Scopes

The ProCurve Secure Router supports VLAN tagging so that it can receive traffic from more than one VLAN on the same Ethernet interface. Therefore, the ProCurve Secure Router might receive DHCP requests from clients on different subnets on the same physical interface.

You can configure a separate DHCP scope to accommodate each VLAN. Simply configure the DHCP pool with the VLAN's network address just as you would configure a typical DHCP pool.

After you enable 802.1Q encapsulation (for VLAN tagging) on the Ethernet interface, you can configure Ethernet subinterfaces. You assign the subinterfaces a VLAN ID and an IP address. To configure the DHCP scope, you simply specify that IP address as the default router of the DHCP pool configured for the VLAN.

These are the only configurations that you must make on the ProCurve Secure Router. You can add options for the server addresses and lease time in the same way that you would for any pool. (You would also configure the connecting switch to pass DHCP packets from hosts on a specific VLAN to the address of the corresponding Ethernet subinterface on the router. This configuration ensures that clients receive an address on the correct subnet.)

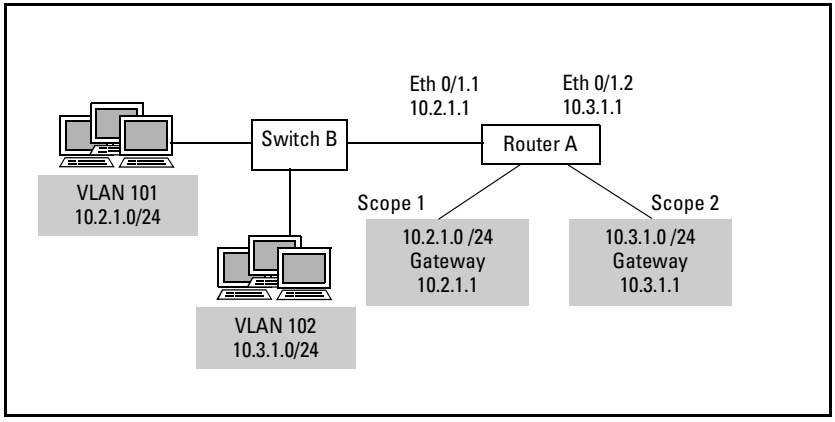

Figure 13-4. DHCP Scopes with VLANs

In Figure 13-4, Router A connects to Switch B on its Ethernet 0/1 interface. Switch B connects to hosts in VLANs 101 and 102. You enable VLAN tagging on the router so that traffic to both VLANs can be carried over the same cable. You configure IP address 192.168.1.1 /24 on Ethernet subinterface 0/1.1 and IP address 192.168.2.1 /24 on Ethernet subinterface 0/1.2.

You would configure the DHCP scopes as follows:

1. Enable VLAN tagging:

```
ProCurve(config)# interface eth 0/1
ProCurve(config-eth 0/1)# encapsulation 802.1q
ProCurve(config-eth 0/1)# no shutdown
```

2. Configure the VLAN interfaces:

```
ProCurve(config-eth 0/1)# interface eth 0/1.1
ProCurve(config-eth 0/1.1)# description Scope 1 interface
ProCurve(config-eth 0/1.1)# vlan-id 101
ProCurve(config-eth 0/1.1)# ip address 10.2.1.1 255.255.255.0
ProCurve(config-eth 0/1.1)# no shutdown
ProCurve(config-eth 0/1.1)# interface eth 0/1.2
ProCurve(config-eth 0/1.2)# description Scope 2 interface
ProCurve(config-eth 0/1.2)# vlan-id 102
ProCurve(config-eth 0/1.2)# ip address 10.3.1.1 255.255.255.0
ProCurve(config-eth 0/1.2)# no shutdown
```

3. Reserve addresses for the VLAN interfaces and other servers by excluding them from DHCP:

```
ProCurve(config)# ip dhcp excluded-address 10.2.1.1 10.2.1.20
ProCurve(config)# ip dhcp excluded-address 10.3.1.1 10.3.1.20
```

4. Configure a DCHP pool for each VLAN, and set the IP address of the default router to that of the corresponding VLAN interface:

```
ProCurve(config)# ip dhcp-server pool Scope1
ProCurve(config-dhcp-pool)# network 10.2.1.0 255.255.255.0
ProCurve(config-dhcp-pool)# default-router 10.2.1.1
ProCurve(config-dhcp-pool)# ip dhcp-server pool Scope2
ProCurve(config-dhcp-pool)# network 10.3.1.0 255.255.255.0
ProCurve(config-dhcp-pool)# default-router 10.3.1.1
```

Configuring the DHCP Server's Ping Settings

The DHCP server sends ping packets to verify that an address is available before assigning it to a DHCP client. You can configure two settings for DHCP server pings:

- Timeout—This determines how long the DHCP server waits for a reply to a ping.
- Ping packet count—The DHCP server pings an address without result this many times before assigning the address to a requesting client.

By default, the router times out a ping after 500 ms and pings an address twice before assuming it is available.

Ping settings apply to DHCP on the router as a whole, not to individual DHCP pools. You configure them from the global configuration mode context.

To change the timeout setting, enter:

Syntax: ip dhcp-server ping timeout <*milliseconds*>

The valid range is from 10 to 1000 ms.

To change the ping packet count, enter:

Syntax: ip dhcp-server ping packets <*count*>

The count can be from 0 to 100.

For example, enter:

```
ProCurve(config-dhcp)# ip dhcp-server ping timeout 700
ProCurve(config-dhcp)# ip dhcp-server ping packets 5
```

If you do not want the router to use ping packets to check that an address is available, enter 0 for the ping packet count.

Note

You should *not* rely on the DHCP server's ping functions to exclude IP addresses that are permanently assigned to devices. If these devices go down, the DHCP server will assume the IP addresses assigned to these devices are available and assign them to clients, which can lead to many problems. A client that takes a server's address, for example, can congest a network as devices send it requests it cannot fulfill. A client that takes a router address will not be able to route traffic. Always use the **ip dhcp-server excluded-address** command to exclude statically assigned addresses.

Managing and Troubleshooting the DHCP Server

As you troubleshoot DHCP functions, you will enter **show** and **debug** commands. You can enter these commands either from the enable mode context or from configuration mode contexts. If you enter one of these commands from a configuration mode context, you must add **do** to the command. For example:

```
ProCurve(config-dhcp)# do show ip dhcp-server binding
```

Viewing DHCP Client Bindings

The ProCurve Secure Router stores a table of DHCP bindings. In this table, you can view the IP addresses for all active DHCP clients served by the router. This can be helpful for troubleshooting. For example, you can ping a workstation to see if it can respond. Or you can zero-in on a host that is flooding a network with messages.

To view the bindings for all DHCP clients supported by the router, enter:

```
ProCurve# show ip dhcp-server binding
```

The table displays:

- IP Address—the committed IP address
- Client ID—usually a MAC address
- Lease Expiration—date and time the lease for the address expires
- Client Name—the user-selected name on the computer or device

Figure 13-5 shows an example of the information that displays when you enter the **show ip dhcp-server binding** command.

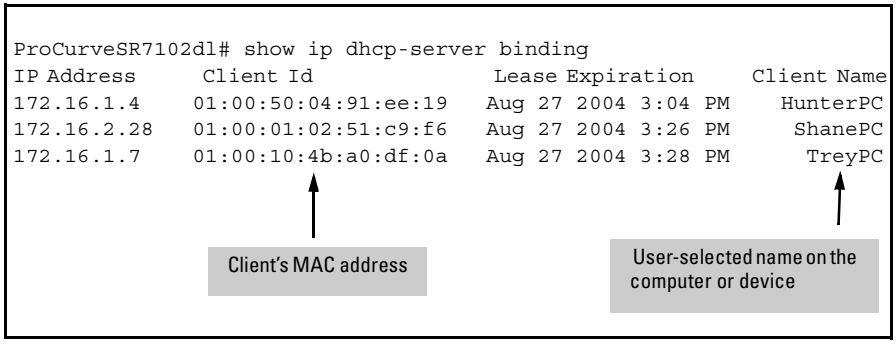

Figure 13-5. Viewing DHCP Clients Supported by the Router

Monitoring the DHCP Process

When troubleshooting a router's DHCP functions, it is often helpful to track the DHCP process. (To review this process, refer to "DHCP Request Process" on page 13-3.)

You can view DHCP messages as they arrive on the interface by entering:

```
ProCurve# debug ip dhcp-server
```

Caution

Debug messages can tie up the router's processor. Therefore, you should be very cautious about using them in a live network. You should begin by troubleshooting the host experiencing the problem and rule out a connectivity problem.

In a large network, you should not use DHCP debug messages to fix a problem for a single host. The router may be flooded with DHCP messages from other hosts, and displaying them all could potentially compromise network performance.

DHCP messages generally break down into the steps of the DHCP request process. You can look for a message that repeats several times to determine where the process begins to break down.

View Table 13-1 for a quick guide to what steps you should take when you see a debug message repeat again and again.

Table 13-1. DHCP Debug Messages

Repeated Message	Possible Problem	Best Next Step
Processing Discover message	• There are no addresses available. • The default gateway is on the wrong subnet.	• Check the DHCP client bindings. • Check settings for the pool.
Server sent an Offer to the Client	The client will not accept the address and configurations.	Troubleshoot the host.

Clients Unable to Receive a DHCP Address

If the router continually receives the "Processing Discover Message" event, it is having difficulty preparing an offer for the client. One of the most common reasons for this difficulty is that the server cannot find an available IP address. It is possible that all available addresses are being used (view the DHCP client bindings by entering **show ip dhcp-server binding**). However, it could be that the default router for the pool is not on the same subnet as the network address, which prevents the router from finding a valid IP address.

View the running-config (**show run**) and look for the DHCP pool for the clients unable to get an address. This is the pool whose default router is the interface to which the client connects. The address for the network should match the network bits in the default router address.

A router interface must have its primary address on the subnet specified in the pool in order to respond to requests. You should also check that the DHCP network matches the address for the connecting router interface.

Client Receiving the Wrong Fixed DHCP Address

If a host is unable to get the fixed address you configured for it in a single host DHCP pool, or if it receives an address from a different pool, check the running-config. Make sure that you have not excluded the fixed address.

Configuring a Router Interface as a DHCP Client

Your service provider may require the router to receive an address from one of its DHCP servers. For example, some Frame Relay providers conserve IP addresses by only assigning them to a PVC endpoint when the PVC is open and active. In this case, you must configure the WAN interface that connects to the provider as a DHCP client.

Ethernet interfaces can also be DHCP clients. For example, the interface could take an address from a server on the local network. When possible, it is a good idea to assign network devices static addresses. However, DHCP does automatically track IP addresses assigned to devices as well as which addresses are still available, relieving IT staff of this task. You can configure the DHCP server to assign the Ethernet interface a fixed DHCP address.

Interfaces that receive a DHCP address can receive other configurations, too. This is particularly useful for interfaces that connect to the Internet. For example, an ATM subinterface can receive the address for a DNS server.

To learn about assigning various types of IP addresses to interfaces, see *Chapter 3: Configuring Ethernet Interfaces*, *Chapter 6: Configuring the Data Link Layer Protocol for E1, T1, and Serial Interfaces*, *Chapter 7: ADSL WAN Connections*, and *Chapter 8: Configuring Demand Routing for Primary ISDN Modules*.

To configure an interface as a DHCP client, you must:

- configure the interface with a dynamic address

You can also:

- set the interface's client ID
- set the interface's hostname
- prevent the interface from taking configurations other than the IP address
- attach a network monitoring track to the DHCP interface
- set the interface's administrative distance

Configuring a Dynamic Address

You enable the DHCP client on an individual interface. Interfaces that can act as DHCP clients are:

- Frame Relay subinterfaces
- ATM subinterfaces
- Ethernet interfaces
- PPP interfaces (only when bridging traffic)

Move to the appropriate interface configuration mode context and enter one of these commands:

Syntax: ip address dhcp {client-id [ethernet 0/<*port*> | HH:HH:HH:HH:HH:HH:HH] | hostname <*hostname*>} [track <*name*>] [<*administrative distance*>]

Syntax: ip address dhcp [hostname <*hostname*> | no-default-route | no-domain-name | no-nameservers] [track <*name*>] [<*administrative distance*>]

You can enter this command without any options to initiate the client with the default client ID and host name:

```
ProCurve(config-fr 1.101)# ip address dhcp
```

You will learn more about adding the other options to the command in the following sections:

- "Setting an Interface's Client ID" on page 13-24
- "Setting the Interface's Hostname" on page 13-25
- "Preventing the Interface from Taking Other Configurations" on page 13-25
- "Attaching a Network Monitoring Track to the DHCP Default Route" on page 13-26
- "Setting the Interface's Administrative Distance" on page 13-27

Note

As soon as you enable the DHCP client with this command, the interface sends a Discover message to the server and attempts to take a dynamic address. If you want to configure any of the options discussed below, you must add these options to the command before entering it. Otherwise, the interface will have already received its configurations; you will have to release the address, disable the DHCP client (by entering **no ip address dhcp**), and re-enter the command with the optional settings.

Setting an Interface's Client ID

DHCP servers use client identifiers to index their database of address bindings. This database maps clients to their temporary IP addresses and other configurations. A client sends its identifier in its Discover messages. Each client on a subnet must use a unique client identifier. Because MAC addresses are by definition unique, they are most commonly used.

The Secure Router OS automatically populates the client identifier for an interface with the interface's media type and MAC address. Typically, you should assume that the server accepts this type of ID and not alter it.

You can, however, have a WAN interface use an Ethernet interface's MAC address. For example, you might want to identify the router using a single MAC address. If your organization later purchases a different module to connect to the provider, you can receive the same IP address. When you configure the interface to take a dynamic address, enter this command:

Syntax: ip address dhcp client-id ethernet <*slot*>/<*port*>

You can alternatively manually enter a hexadecimal string for the client identifier.

The client identifier does not have to be based on a MAC address, although it almost always is. In the past, some administrators opted for customized identifiers so that a user could receive the same address even after changing network hardware. You can use a unique identifier instead of a MAC address for this same purpose: you can change how you connect to a service provider without having to negotiate a new address.

Your service provider should inform you what type of identifier it uses. You can then agree upon a unique identifier for your interface, if necessary.

You enter a customized ID as a hexadecimal number or a text string (which the router converts to a hexadecimal value):

Syntax: ip address dhcp client-id [<*HH:HH:HH:HH:HH:HH:HH*> | <*text string*>]

If you enter a hexadecimal number, you must enter seven numbers separated by colon delimiters. For example:

ProCurve(config-atm 1.102)# ip address dhcp client-id 0f:ff:ff:ff:ff:ff:ff

Setting the Interface's Hostname

If necessary, you can change the hostname for the single interface only. For example, you could register for a hostname with a dynamic DNS service. (See *Chapter 12: Domain Name System (DNS) Services*.) You could then ask your ISP to advertise this hostname, which you specify with the following command:

Syntax: ip address dhcp hostname <"*name*">

You should put quotation marks around the hostname. For example, you might enter:

```
ProCurve(config-fr 1.101)# ip address dhcp hostname "procurve"
```

Note

Remember that you must override client identifiers and hostnames at the same time that you enable the DHCP client. For example:

```
ProCurve(config-fr 1.101)# ip address dhcp client-id eth 0/1 hostname "procurve"
```

Preventing the Interface from Taking Other Configurations

One of the advantages for an interface that receives a DHCP address is that it can receive other configurations as well. This can be particularly useful for connections to the Internet. The interface can receive an IP address and DNS server address at the same time.

Interfaces running the DHCP client can receive these configurations:

- a default route
- a domain name
- a DNS server

However, the seeming advantage also poses risks. For example, when a router has more than one WAN connection, the default route should not always be to the server providing the temporary address. Some organizations prefer to control their own settings for routing, domain names, and DNS, rather than relying on a remote or foreign device.

If you want to prevent the interface from taking configurations other than an IP address, you must do so before you activate the DHCP client.

Move to the interface configuration mode context. Then enter the **ip address dhcp** command with the keyword for the configuration that you do not want the router to accept:

Syntax: ip address dhcp [no-default-route | no-domain-name | no-name-servers]

To disable more than one configuration, string the keywords together in the same command. For example, enter:

```
ProCurve(config-fr 1.1)# ip address dhcp no-default-route no-domain-name
```

Note

You must trust the DHCP server and be absolutely clear on what configurations it will send the interface. An incorrect domain name and default route could disrupt the entire network.

If the interface has already received configurations that it should not have, you must release the address. Enter **no ip address dhcp**, and then re-enter the **ip address dhcp** command with the keywords to reject the configurations.

Attaching a Network Monitoring Track to the DHCP Default Route

As a part of network monitoring, you can attach a network monitoring track to the DHCP client to monitor the default route sent as part of the configuration. A track uses probes to test connections to remote endpoints with the goal of either removing failed routes or logging poor network performance.

To add the DHCP default route as a monitored route, use the **track** option with the **ip address dhcp** command. You can combine the **track** option with any of the other options for the **ip address dhcp** command (except **no-default-route**—the router cannot monitor a route that the interface does not accept).

For example, enter this command when you enable DHCP on a Frame Relay subinterface:

```
ProCurve(config-fr 1.101)# ip address dhcp track DHCPDefault
```

Before entering the command, you should create the track named DHCPDefault. Also, you should create a probe to test the route. For example, the probe could test connectivity to the default gateway listed in the DHCP default route. If the probe fails to reach the gateway, the track determines that the default route has failed and removes it. For more information about network monitoring and configuring tracks and probes, see the *Advanced Management and Configuration Guide*, *Chapter 9: Network Monitoring*.

Setting the Interface's Administrative Distance

In any of the variations of the **ip address dhcp** command, you can specify the administrative distance to use when adding the DHCP gateway into the route table. The ProCurve Secure Router uses the administrative distance to determine the best route when multiple routes to the same destination exist. The router assumes that the smaller the administrative distance, the more reliable the route is. The range is 1 to 255; the default value is 1. For example, to set an administrative distance of 5, enter:

```
ProCurve(config-fr 1.101)# ip address dhcp 5
```

Configuring a Static Hostname for an Interface with a Dynamic Address

Your organization may have a device behind the ProCurve Secure Router that remote users should be able to reach. For example, customers may need to access your Web server.

Often, a Web server's address is linked to the public IP address on a router interface using Network Address Translation (NAT). If the router's interface changes IP address, the entry for the Web server in the DNS servers' host tables will no longer be correct. Users will no longer be able to reach the device.

When an interface receives a dynamic IP address from an ISP, its IP address may change relatively frequently or without warning. In this situation, you should run dynamic DNS on the router interface to ensure that customers can always reach a device when they enter its hostname.

The ProCurve Secure Router supports a client that works with Dynamic Networking Services, Inc. (DynDNS). After you register a hostname with DynDNS, the dynamic DNS client automatically informs DynDNS whenever the associated interface's IP address changes. DynDNS propagates the change throughout its DNS servers so that you do not lose connectivity with your customers.

See *Chapter 12: Domain Name System (DNS) Services* to learn how to configure dynamic DNS.

Managing and Troubleshooting the DHCP Client

You should carefully monitor interfaces with dynamic addresses to ensure that they have an address and are using the proper configurations.

Viewing the Interface's Lease

To view the active DHCP client leases on the router, enter:

```
ProCurve# show ip dhcp-client lease
```

The CLI displays all interfaces with dynamic addresses. For each interface, it lists:

- Temp IP address—the dynamic address
- DHCP lease server
- Lease—total time for the lease
- Temp default gateway address
- Client ID—typically, based on the MAC address
- Primary DNS server

Figure 13-6 shows an example of a DHCP lease for an Ethernet 0/1 interface.

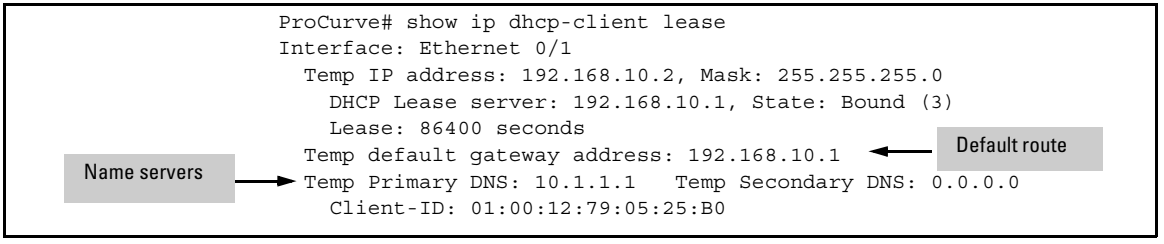

Figure 13-6. Viewing Dynamic Configurations for Router Interfaces

If you see that the interface has received a configuration that it should not have, such as a default route, you will have to restart the DHCP client. Follow these steps:

1. Move to the configuration mode context for the DHCP client interface:

   ```
   ProCurve(config)# interface frame-relay 1.101
   ```

2. To turn off the DHCP client, enter:

   ```
   ProCurve(config-eth 0/1)# no ip address dhcp
   ```

   This command disables the DHCP client on the interface, which then immediately sends a message to release its DHCP-assigned address.

3. Re-enter the **ip address dhcp** command with the keywords for preventing the interface from taking optional configurations. For example, you might enter:

   ```
   ProCurve(config-eth 0/1)# ip add dhcp no-default-route no-domain-name no-name-servers
   ```

Releasing and Renewing Dynamic Addresses

You can force an interface to give up the address it has received from a server. Move to the interface configuration mode context and enter:

```
ProCurve(config-eth 0/1)# ip dhcp release
```

Note

Take care when releasing an address; you could inadvertently lock yourself out of the router. If you are managing the ProCurve Secure Router with a Telnet or Web connection through that interface, your session will be immediately terminated. You will not be able to reconnect until a DHCP server issues another IP address to the interface.

You should then force the interface to request a new address:

```
ProCurve(config-eth 0/1)# ip dhcp renew
```

Alternatively, you can configure a static address on the interface.

You should only have to manually force the interface to renew its lease after releasing an address. The DHCP client will periodically request to keep its address so that data flow is not disrupted.

Monitoring DHCP Client Activity

If the interface will not take a dynamic address, you should track the DHCP request process to determine what is going wrong. (For more information on this process, refer to "DHCP Request Process" on page 13-3.)

To view real-time DHCP client messages, enter:

```
ProCurve# debug ip dhcp-client
```

Caution

Debug messages can tie up the router's processor and compromise the network's functions. Therefore, you should take care when using them with active networks.

Before you run debug messages, you should verify that the interface is up and double-check your client ID.

Scan the debug messages. The interface should produce debug messages such as those shown in Figure 13-7:

```
ProCurve# debug ip dhcp-client
2005.07.08 19:15:23 DHCP.CLIENT Loading timer 1 with 1 seconds
2005.07.08 19:15:23 DHCP.CLIENT Loading timer 2 with 3
2005.07.08 19:15:24 DHCP.CLIENT Timer 1 Expired
2005.07.08 19:15:24 DHCP.CLIENT Sending Discover Message: Xid =
34681764
2005.07.08 19:15:24 DHCP.CLIENT Loading timer 1 with 3 seconds
2005.07.08 19:15:24 DHCP.CLIENT Current State = Selecting
2005.07.08 19:15:25 DHCP.CLIENT Processing Offer Message: Xid =
34681764
2005.07.08 19:15:25 DHCP.CLIENT Sending Request Message: Xid = 34681764
2005.07.08 19:15:25 DHCP.CLIENT Loading timer 1 with 2 seconds
2005.07.08 19:15:25 DHCP.CLIENT Current State = Requesting
2005.07.08 19:15:25 DHCP.CLIENT Processing Ack Message: Xid = 34681764
2005.07.08 19:15:25 DHCP.CLIENT Loading timer 1 with 43200 seconds
2005.07.08 19:15:25 DHCP.CLIENT Loading timer 2 with 64800 seconds
2005.07.08 19:15:25 DHCP.CLIENT Current State = Bound
```

Figure 13-7. An Interface Successfully Receiving a Dynamic Address

When the DHCP client's state is "Bound," the interface has received the address. The client sets two timers, which expire before the lease does. When these timers expire, the client requests to keep its address.

Usually, problems with the DHCP client occur after sending a Discover message. The server does not return an Offer message, and so the interface continues sending out Discover message after Discover message. The state toggles between "Selecting" and "Init."

Causes for this condition include:

- the interface is down
- the interface's client identifier does not match that expected by the DHCP server
- the server has no available addresses

An individual interface does not have to be up with an active network link for the router to run the DHCP client. Before looking for problems with the DHCP client configuration, make sure that the interface is up with the **show interfaces** command.

If the status is "administratively down," move to the configuration mode context for the interface and enter **no shutdown**. If the status is down, troubleshoot the interface. (See *Chapter 3: Configuring Ethernet Interfaces*, *Chapter 4: Configuring E1 and T1 Interfaces*, *Chapter 5: Configuring Serial Interfaces for E1- and T1-Carrier Lines*, *Chapter 6: Configuring the Data Link Layer Protocol for E1*, *T1*, *and Serial Interfaces*, *Chapter 7: ADSL WAN Connections*, and *Chapter 8: Configuring Demand Routing for Primary ISDN Modules*.)

You can also try pinging the DHCP server to test connectivity.

Once you have determined that the interface can actually reach the DHCP server, you should troubleshoot the client configuration.

You can view the client ID in the configuration for the client interface (by entering, for example, **show run int fr 1.100**). If you are using a customized identifier, you can try returning to the default MAC address. For example, enter:

```
ProCurve(config-eth 0/1)# no ip add dhcp
ProCurve(config-eth 0/1)# ip add dhcp
```

If the default ID does not work, you should check with the service provider or other entity administering the DHCP server to find out what identifier it expects from the router.

If the problem is at the service provider's end, then you will have to wait for your ISP to resolve the problem.

Configuring DHCP Relay

DHCP relies on clients being able to reach a server by broadcasting a request. The DHCP request is limited by being broadcast to the application port for DHCP (the BOOTPS port, 67). Limited broadcasts propagate only throughout the local subnet. If the client is not on the same subnet as the server, the broadcast will not reach the server.

However, your network does *not* need a separate DHCP server on each subnet (or VLAN). You can configure network devices to forward DHCP requests from directly connected hosts to a server on a different network. This function is sometimes called DHCP relay.

Often a switch will perform DHCP relay for the local hosts. However, if your router may receive DHCP requests from hosts, you should configure it to forward these requests to the appropriate DHCP server. For example, the router may need to forward DHCP requests to a remote server so that hosts at a site that does not have a DHCP server can receive IP addresses and other necessary configurations.

To enable DHCP relay, you configure the router to forward packets received on the DHCP application port to a helper address.

Note

You cannot configure the router to forward DHCP requests if the router itself is acting as a DHCP server.

To configure the router to forward DHCP packets, move to the global configuration mode context and enter this command:

Syntax: ip forward-protocol udp bootps

Next, set the address of the helper address. The helper address is the address of the DHCP server or a device on the same subnet as the server. Set this address from the configuration mode context of the interface that connects to the clients:

Syntax: ip helper-address <*A.B.C.D*>

You can set different helper addresses for different interfaces. For example, if your LAN uses different servers for different subnets, you could configure the router to forward DHCP requests received on one Ethernet (or VLAN) interface to one address and requests received on another interface to a different address.

For example:

```
ProCurve(config)# interface eth 0/1
ProCurve(config-eth 0/1)# ip helper-address 10.1.1.1
ProCurve(config-eth 0/1)# interface eth 0/2
ProCurve(config-eth 0/2)# ip helper-address 10.2.1.1
```

The router does not simply forward the DHCP packets. It also examines them, checks their validity, and adds any appropriate changes, such as the IP address of the interface that received the packets. The remote server uses this address to determine from which pool it should select the IP address that it offers to the client.

For example, an Ethernet interface with the IP address 192.168.1.1 /24 receives a DHCP packet and forwards it to a remote server. The server searches its database for a DHCP pool for the 192.168.1.0 /24 network and returns an offer for IP address 192.168.1.36 to the local router at 192.168.1.1. The local router then forwards this offer to the client.

Quick Start

This section provides the commands you must enter to quickly configure:

- the router to act as a DHCP server for a subnet
- the router to assign a fixed DHCP address to a single host
- a router interface to act as a DHCP client

Only a minimal explanation is provided. If you need additional information about any of these options, check "Contents" on page 13-1 to locate the section that contains the explanation you need.

Table 13-2. DHCP Server Settings

Configurations	Parameters	Your Setting
network's static IP addresses	first address in range	
	last address in range	
	other static address	
parent pool for a range of subnets (optional)	pool name	
	range of subnets and prefix length for range	
DHCP pool for a subnet	pool name	
	subnet address and mask (or prefix length)	
	default gateway	
servers	primary DNS server	
	secondary DNS server	
	primary WINS (NetBIOS) server	
	secondary WINS (NetBIOS) server	
	TFTP server	
	NTP server	

Configurations	Parameters	Your Setting
other configurations	lease in days, hours, and minutes	
	domain name	
	timezone offset	

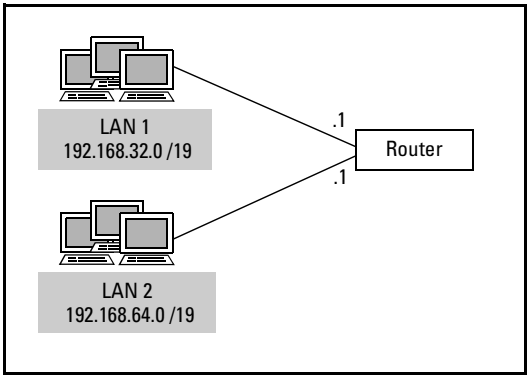

Figure 13-8. Example DHCP Network

Configuring a DHCP Server for a Network

If you so choose, you can print and fill out Table 13-2 and refer to it while configuring the DHCP server on your router.

Figure 13-8 illustrates a simplified example of a router acting as a DHCP server for two local networks.

1. Move to the global configuration mode context and exclude all static address on DHCP subnets.

   Syntax: ip dhcp-server excluded <*A.B.C.D*>

   You can also exclude a range of addresses.

   Syntax: ip dhcp-server excluded <*first A.B.C.D*> <*last A.B.C.D*>

2. If you are configuring DHCP for a range of subnets, create a parent DHCP server pool from the global configuration mode context. Otherwise, move to step 5.

   Syntax: ip dhcp-server pool <*parent poolname*>

3. Specify the range of subnets for the parent pool.

   Syntax: network <*network A.B.C.D*> <*subnet mask* | /*prefix length*>

   For example:

   ProCurve(config-dhcp)# network 192.168.0.0 /16

4. Specify optional global settings such as DNS servers, WINS servers, and lease time.

   Syntax: dns-server <*A.B.C.D*> <*secondary server A.B.C.D*>
   Syntax: netbios-name-server <*WINS server A.B.C.D*> <*secondary server A.B.C.D*>
   Syntax: lease <*days*> <*hours*> <*minutes*>
   Syntax: tftp-server <*A.B.C.D*>
   Syntax: ntp-server <*A.B.C.D*>
   Syntax: timezone-offset <-12 to 12>
   Syntax: domain-name <*domain*>

5. Create a DHCP server pool for an individual subnet.

   ProCurve(config)# ip dhcp-server pool <*poolname*>

6. Specify the subnet address and subnet mask for the pool.

   Syntax: network <*network A.B.C.D*> <*subnet mask* | /*prefix length*>

   Use a prefix length for variable length networks. For example:

   ProCurve(config-dhcp)# network 192.168.32.0 /19

7. Specify the default gateway.

   Syntax: default-router <*gateway A.B.C.D*>

   For example:

   ProCurve(config-dhcp)# default-router 192.168.32.1

8. If you did not do so in a parent pool, specify a primary DNS server.

   Syntax: dns-server <*A.B.C.D*>

9. You can also configure settings such as addresses for other servers and lease time. See step 4. (The settings in the pool with the most specific network address override settings in any parent pool.)

Assigning a Fixed DHCP Address to a Single Host

If you so choose, you can print and fill out Table 13-3 and refer to it while configuring the pool for the single host.

Table 13-3. Settings for Assigning a Host a Fixed Address

Configuration	Parameter	Your Setting
host DHCP Pool	pool name	
	host MAC address	
	fixed IP address	
	default gateway IP address	
servers	primary DNS server	
	secondary DNS server	
	primary WINS (NetBIOS) server	
	TFTP server	
	NTP server	
other configurations	lease in days, hours, and minutes	
	client name	
	domain name	
	timezone offset	

1. Move to the global configuration mode context and create a DHCP client pool for the host.

   Syntax: ip dhcp-server pool <*poolname*>

2. Identify the host by its MAC address.

   Syntax: hardware-address <*MAC address*>

   For example:

   ProCurve(config-dhcp)# hardware-address d2:17:04:91:11:50

3. Specify the IP address for the host, including its subnet mask. If your organization uses variable-length subnetting, be particularly careful to enter the correct subnet mask or prefix length.

   Syntax: host <*fixed A.B.C.D*> <*subnet mask* | /*prefix length*>

4. Specify the default gateway.

   Syntax: default-router <*gateway A.B.C.D*>

5. Configure other necessary settings such as servers and a domain name. You can also assign the client a name.

   Syntax: dns-server <*DNS server A.B.C.D*> <*secondary DNS server A.B.C.D*>
   Syntax: netbios-name-server <*WINS server A.B.C.D*> <*secondary WINS server A.B.C.D*>
   Syntax: lease <*days*> <*hours*> <*minutes*>
   Syntax: tftp-server <*TFTP server A.B.C.D*>
   Syntax: ntp-server <*NTP server A.B.C.D*>
   Syntax: timezone-offset <-12 to 12>
   Syntax: client-name <*name*>
   Syntax: domain-name <*name*>

Configuring a Router Interface as a DHCP Client

The following interfaces can take dynamic addresses:

- Ethernet interfaces
- Frame Relay subinterfaces
- ATM subinterfaces
- bridged PPP interfaces

You call fill in the settings for the interface on your router in Table 13-4.

Table 13-4. DHCP Client Settings

Configuration	Parameter	Your Setting
interface	• <slot>/<port> (for Ethernet) • subinterface number (for Frame Relay or ATM) • interface number (for bridged PPP)	
hostname		
client ID		

1. Move to the interface configuration mode context. For example:

   ProCurve(config) int fr 1.101

2. Configure the router to take a dynamic address from a server.

   Syntax: ip address dhcp

   a. For a default configuration, simply enter the command without any options. For example:

      ProCurve(config-fr 1.101)# ip address dhcp

   b. You may not want the interface to take its default gateway, domain name, or DNS servers from the DHCP server. In this case, enter the **ip address dhcp** command with one or more of the following options:

      Syntax: ip address dhcp [hostname <*name*> | no-default-route | no-domain-name | no-nameservers]

   c. You should usually accept the default ID generated from the interface's MAC address. However, you can configure a customized client ID. You can also configure a hostname for the interface that is different from the router's hostname. Enter the **ip address dhcp** command with one of these options:

      Syntax: ip address dhcp [client-id {<ethernet <*slot*>/<*port*> | HH:HH:HH:HH:HH:HH:HH} | hostname <*name*>]

      For example, enter:

      ProCurve(config-fr 1.101)# ip address dhcp client-id 0f:ff:ff:ff:ff:ff:ff