



Configuring the Cisco IOS DHCP Server

Cisco devices running Cisco software include Dynamic Host Configuration Protocol (DHCP) server and the relay agent software. The Cisco IOS DHCP server is a full DHCP server implementation that assigns and manages IP addresses from specified address pools within the device to DHCP clients. The DHCP server can be configured to assign additional parameters such as the IP address of the Domain Name System (DNS) server and the default device.

This module describes the concepts and the tasks needed to configure the Cisco IOS DHCP server.

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the “[Feature Information for the IOS DHCP Server](#)” section on page 54-34.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

Prerequisites for Configuring the DHCP Server

- Before you configure a Cisco Dynamic Host Control Protocol (DHCP) server, you must understand the concepts documented in the “[Overview of the DHCP Server](#)” section.
- The Cisco DHCP server and the relay agent services are enabled by default. Use the **no service dhcp** command to disable the Cisco DHCP server and the relay agent and the **service dhcp** command to reenble the functionality.

- Port 67 (the DHCP server port) is closed in the Cisco DHCP/BOOTP default configuration. There are two logical parts to the **service dhcp** command: service-enabled and service running. The DHCP service is enabled by default, but port 67 does not open until the DHCP service is running. If the DHCP service is running, the **show ip sockets details** or the **show sockets detail** command displays port 67 as open.
- The Cisco DHCP relay agent is enabled on an interface only when you configure the **ip helper-address** command. This command enables a DHCP broadcast to be forwarded to the configured DHCP server.

Information About Cisco IOS DHCP Server

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Overview of the DHCP Server

The Cisco DHCP server accepts address assignment requests and renewals from the client and assigns the addresses from predefined groups of addresses within DHCP address pools. These address pools can also be configured to supply additional information to the requesting client such as the IP address of the Domain Name System (DNS) server, the default device, and other configuration parameters. The Cisco DHCP server can accept broadcasts from locally attached LAN segments or from DHCP requests that have been forwarded by other DHCP relay agents within the network.

DHCP Attribute Inheritance

The DHCP server database is organized as a tree. The root of the tree is the address pool for natural networks, branches are subnetwork address pools, and leaves are manual bindings to clients. Subnetworks inherit network parameters and clients inherit subnetwork parameters. Therefore, common parameters (for example, the domain name) should be configured at the highest (network or subnetwork) level of the tree.

Inherited parameters can be overridden. For example, if a parameter is defined in both the natural network and a subnetwork, the definition of the subnetwork is used.

Address leases are not inherited. If a lease is not specified for an IP address, by default, the DHCP server assigns a one-day lease for the address.

DHCP Server Address Allocation Using Option 82

The Cisco IOS DHCP server can allocate dynamic IP addresses based on the relay information option (option 82) sent by the relay agent.

DHCP provides a framework for passing configuration information to hosts on a TCP/IP network. Configuration parameters and other control information are carried in tagged data items that are stored in the options field of the DHCP message. The data items are also called options. Option 82 is organized as a single DHCP option that contains information known by the relay agent.

Automatic DHCP address allocation is based on an IP address. This IP address can either be the gateway address (giaddr field of the DHCP packet) or the IP address of an incoming interface. In some networks, it is necessary to use additional information to further determine which IP addresses to allocate. By using option 82, the Cisco IOS DHCP relay agent can include additional information about itself when forwarding client-originated DHCP packets to a DHCP server. The Cisco IOS DHCP server can also use option 82 to provide additional information to properly allocate IP addresses to DHCP clients. The information sent via option 82 is used to identify the port where the DHCP request arrives. Automatic DHCP address allocation does not parse out the individual suboptions contained in option 82. Rather, the address allocation is done by matching a configured pattern byte by byte.

This feature introduces a new DHCP class capability, which is a method to group DHCP clients based on some shared characteristics other than the subnet in which the clients reside.

For example, DHCP clients are connected to two ports of a single switch. Each port can be configured to be a part of two VLANs: VLAN1 and VLAN2. DHCP clients belong to either VLAN1 or VLAN2 and the switch can differentiate the VLAN that a particular DHCP Discover message belongs to (possibly through Layer 2 encapsulation). Each VLAN has its own subnet and all DHCP messages from the same VLAN (same switch) have the giaddr field set to the same value indicating the subnet of the VLAN.

Problems can occur while allocating IP addresses to DHCP clients that are connected to different ports of the same VLAN. These IP addresses must be part of the same subnet but the range of IP addresses must be different. In the preceding example, when a DHCP client that is connected to a port of VLAN1 must be allocated an IP address from a range of IP addresses within the VLAN's subnet, whereas a DHCP client connecting to port 2 of VLAN1 must be allocated an IP address from another range of IP addresses. The two range of IP addresses are part of the same subnet (and have the same subnet mask). Generally, during DHCP address allocation, the DHCP server refers only to the giaddr field and is unable to differentiate between the two ranges.

To solve this problem, a relay agent residing at the switch inserts the relay information option (option 82), which carries information specific to the port, and the DHCP server inspects both the giaddr field and the inserted option 82 during the address selection process.

When you enable option 82 on a device, the following sequence of events occurs:

1. The host (DHCP client) generates a DHCP request and broadcasts it on the network.
2. When the device receives the DHCP request, it adds the option 82 information in the packet. The option 82 information contains the device MAC address (the remote ID suboption) and the port identifier, vlan-mod-port, from which the packet is received (the circuit ID suboption).
3. The device adds the IP address of the relay agent to the DHCP packet.
4. The device forwards the DHCP request that includes the option 82 field to the DHCP server.
5. The DHCP server receives the packet. If the server is option 82 capable, it uses the remote ID, the circuit ID, or both to assign IP addresses and implement policies, such as restricting the number of IP addresses that can be assigned to a single remote ID or circuit ID. The DHCP server echoes the option 82 field in the DHCP reply.

6. The DHCP server unicasts the reply to the device if the request is relayed to the server by the device. The device verifies that it originally inserted the option 82 data by inspecting remote ID and possibly circuit ID fields. The device removes the option 82 field and forwards the packet to the interface that connects to the DHCP client that sent the DHCP request.

The Cisco software refers to a pool of IP addresses (giaddr or incoming interface IP address) and matches the request to a class or classes configured in the pool in the order the classes are specified in the DHCP pool configuration.

When a DHCP address pool is configured with one or more DHCP classes, the pool becomes a restricted access pool, which means that no addresses are allocated from the pool unless one or more classes in the pool matches. This design allows DHCP classes to be used either for access control (no default class is configured on the pool) or to provide further address range partitions within the subnet of the pool.

Multiple pools can be configured with the same class, eliminating the need to configure the same pattern in multiple pools.

The following capabilities are supported for DHCP class-based address allocation:

- Specifying the full relay agent information option value as a raw hexadecimal string by using the **relay-information hex** command in new relay agent information configuration mode.
- Support for bit-masking the raw relay information hexadecimal value.
- Support for a wildcard at the end of a hexadecimal string specified by the **relay-information hex** command.

If the relay agent inserts option 82 but does not set the giaddr field in the DHCP packet, the DHCP server interface must be configured as a trusted interface by using the **ip dhcp relay information trusted** command. This configuration prevents the server from dropping the DHCP message.

Disabling Conflict Logging

A DHCP database agent is any host (for example, an FTP, a TFTP, or a remote copy protocol [RCP] server) or storage media on a DHCP server (for example, disk0) that stores the DHCP bindings database. You can configure multiple DHCP database agents, and the interval between database updates and transfers for each agent.

Automatic bindings are IP addresses that are automatically mapped to the MAC addresses of hosts that are found in the DHCP database. Automatic binding information (such as lease expiration date and time, interface index, and VPN routing and forwarding [VRF] name) is stored in a database agent. The bindings are saved as text records for easy maintenance.

An address conflict occurs when two hosts use the same IP address. During address assignment, DHCP checks for conflicts by using ping and gratuitous Address Resolution Protocol (ARP). If a conflict is detected, the address is removed from the pool. The address is not assigned until the administrator resolves the conflict.



Note

We strongly recommend using database agents. However, the Cisco DHCP server can run without database agents. If you choose not to configure a DHCP database agent, disable the recording of DHCP address conflicts on the DHCP server by using the **no ip dhcp conflict logging** command in global configuration mode. If there is a conflict logging but no database agent is configured, bindings during a switchover are lost when a device reboots. Possible false conflicts can occur causing the address to be removed from the address pool.

DHCP Address Pools

You can configure a DHCP address pool with a name that is a string (such as “engineering”) or an integer (such as 0). Configuring a DHCP address pool also puts the device into DHCP pool configuration mode—identified by the `(dhcp-config)#` prompt—from which you can configure pool parameters (for example, the IP subnet number and default device list).

DHCP defines a process by which the DHCP server knows the IP subnet in which the DHCP client resides, and it can assign an IP address from a pool of valid IP addresses in that subnet. The process by which the DHCP server identifies the DHCP address pool to use for a client request is described in the Configuring Manual Bindings section.

The DHCP server identifies and uses DHCP address pools for a client request, in the following manner:

- If the client is not directly connected to the DHCP server (the `giaddr` field of the DHCPDISCOVER broadcast message is nonzero), the server matches the DHCPDISCOVER with the DHCP pool that has the subnet that contains the IP address in the `giaddr` field.
- If the client is directly connected to the DHCP server (the `giaddr` field is zero), the DHCP server matches the DHCPDISCOVER with DHCP pools that contain the subnets configured on the receiving interface. If the interface has secondary IP addresses, subnets associated with the secondary IP addresses are examined for possible allocation only after the subnet associated with the primary IP address (on the interface) is exhausted.

Cisco DHCP server software supports advanced capabilities for IP address allocation. See the Configuring DHCP Address Allocation Using Option 82 section for more information.

DHCP Address Pool with Secondary Subnets

Each subnet is a range of IP addresses that the device uses to allocate an IP address to a DHCP client. The DHCP server multiple subnet functionality enables a Cisco DHCP server address pool to manage additional IP addresses by adding the addresses to a secondary subnet of an existing DHCP address pool (instead of using a separate address pool).

Configuring a secondary DHCP subnetwork places the device in DHCP pool secondary subnet configuration mode—identified by the `(config-dhcp-subnet-secondary)#` prompt—where you can configure a default address list that is specific to the secondary subnet. You can also specify the utilization rate of the secondary subnet, which allows pools of IP addresses to dynamically increase or reduce in size depending on the address utilization level. This setting overrides the global utilization rate.

- If the DHCP server selects an address pool that contains multiple subnets, the DHCP server allocates an IP address from the subnets as follows:
- When the DHCP server receives an address assignment request, it looks for an available IP address in the primary subnet.
- When the primary subnet is exhausted, the DHCP server automatically looks for an available IP address in any of the secondary subnets maintained by the DHCP server (even though the `giaddr` does not necessarily match the secondary subnet). The server inspects the subnets for address availability in the order of subnets that were added to the pool.

**Note**

If the giaddr matches a secondary subnet in the pool, the DHCP server allocates an IP address from that particular secondary subnet (even if IP addresses are available in the primary subnet and irrespective of the order of secondary subnets that were added).

The secondary subnet in the pool is supported only for directly connected clients. To avoid multiple IP address allocation from multiple subnets, you should configure secondary IP address on the interface connected to clients. Note that the secondary subnets should not be used in pools that are used for servicing requests from DHCP relay.

Manual Bindings

An address binding is a mapping between the IP address and MAC address of a client. The IP address of a client can be assigned manually by an administrator or assigned automatically from a pool by a DHCP server.

Manual bindings are IP addresses that are manually mapped to MAC addresses of hosts that are found in the DHCP database. Manual bindings are stored in the NVRAM of the DHCP server. Manual bindings are just special address pools. There is no limit to the number of manual bindings, but you can configure only one manual binding per host pool.

Automatic bindings are IP addresses that have been automatically mapped to MAC addresses of hosts that are found in the DHCP database. Because the bindings are stored in the volatile memory of the DHCP server, binding information is lost in the event of power failures or on device reloads. To prevent the loss of automatic binding information, a copy of the automatic binding information is stored on a remote host called the DHCP database agent. The bindings are periodically written to the database agent. When the device reloads, the bindings are read from the database agent to the DHCP database in the DHCP server.

**Note**

We strongly recommend that you use database agents. However, Cisco DHCP server can function even without database agents.

Some DHCP clients send a client identifier (DHCP option 61) in the DHCP packet. To configure manual bindings for such clients, you must enter the client-identifier command with the hexadecimal values that identify the DHCP client. To configure manual bindings for clients that do not send a client identifier option, you must enter the hardware-address DHCP pool configuration command with the hexadecimal hardware address of the client.

Depending on your release, the DHCP server sends infinite lease time to the clients for which manual bindings are configured.

Depending on your release, the DHCP server sends lease time that is configured using the lease command to clients for which manual bindings are configured.

**Note**

You cannot configure manual bindings within the same pool that is configured with the network command in DHCP pool configuration mode. See the Configuring DHCP Address Pools section for information about DHCP address pools and the network command.

DHCP Static Mapping

The DHCP Static Mapping feature enables the assignment of static IP addresses (without creating numerous host pools with manual bindings) by using a customer-created text file that the DHCP server reads. The benefit of this feature is that it eliminates the need for a long configuration file and reduces the space required in NVRAM to maintain address pools.

A DHCP database contains the mappings between a client IP address and the hardware address, which is referred to as a binding. There are two types of bindings: manual bindings that map a single hardware address to a single IP address, and automatic bindings that dynamically map a hardware address to an IP address from a pool of IP addresses. Manual (also known as static) bindings can be configured individually directly on the device or by using the DHCP Static Mapping feature. These static bindings can be read from a separate static mapping text file. The static mapping text files are read when a device reloads or the DHCP service restarts. These files are read-only.

The read static bindings are treated just like the manual bindings, in that they are:

- Retained across DHCPRELEASEs from the clients.
- Not timed out.
- Deleted only upon deletion of the pool.
- Provided appropriate exclusions for the contained addresses, which are created at the time of the read.

Just like automatic bindings, manual (or static) bindings from the static mapping text file are also displayed by using the **show ip dhcp binding** command.

To create a static mapping text file, input your addresses in the text file that is stored in the DHCP database for the DHCP server to read. There is no limit to the number of addresses that can be stored in the file. The file format has the following elements:

- Database version number
- End-of-file designator
- Hardware type
- Hardware address
- IP address
- Lease expiration
- Time the file was created

The following is a sample static mapping text file:

```
*time* Jan 21 2005 03:52 PM
*version* 2
!IP address      Type      Hardware address      Lease expiration
10.0.0.4 /24     1         0090.bff6.081e        Infinite
10.0.0.5 /28     id        00b7.0813.88f1.66     Infinite
10.0.0.2 /21     1         0090.bff6.081d        Infinite
*end*
```

Table 54-1 Static Mapping Text File Field Descriptions

Field	Description
time	Specifies the time the file was created. This field allows DHCP to differentiate between the new and old database versions when multiple agents are configured. The valid format of the time is mm dd yyyy hh:mm AM/PM.
version 2	Specifies the database version number.
IP address	Specifies the static IP address. If the subnet mask is not specified, a mask is automatically assigned depending on the IP address. The IP address and the mask is separated by a space.
Type	Specifies the hardware type. For example, type "1" indicates Ethernet. The type "id" indicates that the field is a DHCP client identifier. Legal values can be found online at http://www.iana.org/assignments/arp-parameters in the "Number Hardware Type" list.
Hardware address	<p>Specifies the hardware address.</p> <p>When the type is numeric, the type refers to the hardware media. Legal values can be found online at http://www.iana.org/assignments/arp-parameters in the "Number Hardware Type" list.</p> <p>When the type is "id," the type refers to a match on the client identifier.</p> <p>For more information about the client identifier, see RFC 2132, DHCP Options and BOOTP Vendor Extensions, section 9.14, located at http://www.ietf.org/rfc/rfc2132.txt, or the client-identifier command.</p> <p>If you are unsure about the client identifier to match with the hardware type, use the debug dhcp detail command to display the client identifier being sent to the DHCP server from the client.</p>

DHCP Server Operation

By default, the DHCP server pings a pool address twice before assigning a particular address to a requesting client. If the ping is unanswered, the DHCP server assumes (with a high probability) that the address is not in use and assigns the address to the requesting client.

By default, the DHCP server waits for 2 seconds before timing out a ping packet.

You can configure the DHCP server to ignore and not reply to any BOOTP requests that the server receives. This functionality is beneficial when there is a mix of BOOTP and DHCP clients in a network segment and there is a BOOTP server and a Cisco DHCP server servicing the network segment. The BOOTP server is configured with static bindings for the BOOTP clients and the BOOTP clients must obtain their addresses from the BOOTP server. However, DHCP servers can also respond to BOOTP requests and the DHCP server may offer an address that causes the BOOTP clients to boot with the address from the DHCP server, instead of the address from the BOOTP server. Configuring the DHCP server to ignore BOOTP requests ensures that the BOOTP clients will receive address information from the BOOTP server and will not accept an address from a DHCP server.

Cisco software can forward these ignored BOOTP request packets to another DHCP server if the **ip helper-address** command is configured on the incoming interface.

Static Route with the Next-Hop Dynamically Obtained Through DHCP

Static routes are updated in the routing table when the default gateway is assigned by the DHCP server. These routes remain in the routing table until the DHCP lease expires and then the routes are removed.

When a DHCP client releases an address, the corresponding static route (the route configured using the **ip route** command) is automatically removed from the routing table. If the DHCP router option (option 3 of the DHCP packet) changes during the client renewal, the DHCP default gateway changes to the new IP address supplied after the renewal.

This feature is particularly useful for VPN deployments such as Dynamic Multipoint VPNs (DMVPNs). It is useful when a nonphysical interface, such as a multipoint generic routing encapsulation (mGRE) tunnel, is configured on a device and certain traffic must be excluded from entering the tunnel interface.



Note

- If the DHCP client is not able to obtain an IP address or the default device IP address, the static route is not installed in the routing table.
- If the lease has expired and the DHCP client cannot renew the address, the DHCP IP address assigned to the client is released and any associated static routes are removed from the routing table

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Configuring a DHCP Database Agent or Disabling Conflict Logging

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp database url [timeout seconds write-delay seconds] or Switch(config)# no ip dhcp conflict logging	Configures a DHCP server to save automatic bindings on a remote host called a database agent. Or Disables DHCP address conflict logging.
Step 4	Switch(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.

Excluding IP Addresses

The IP address configured on a device interface is automatically excluded from the DHCP address pool. The DHCP server assumes that all other IP addresses in a DHCP address pool subnet are available for assigning to DHCP clients.

You must exclude addresses from the pool if the DHCP server does not allocate those IP addresses to DHCP clients. Consider a scenario where two DHCP servers are set up for the same network segment (subnet) for redundancy. If DHCP servers do not coordinate their services with each other using a protocol such as DHCP failover, each DHCP server must be configured to allocate addresses from a nonoverlapping set of addresses in the shared subnet. See the Example: Configuring Manual Bindings section for a configuration example.

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp excluded-address <i>low-address</i> [<i>high-address</i>]	Specifies IP addresses that the DHCP server should not assign to DHCP clients.
Step 4	Switch(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.

Configuring DHCP Address Pools

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Configuring a DHCP Address Pool

On a per-address pool basis, specify DHCP options for the client as necessary.

Before you configure the DHCP address pool, you must:

- Identify DHCP options for devices where necessary, including the following:
 - Default boot image name
 - Default devices
 - Domain Name System (DNS) servers
 - Network Basic Input/Output System (NetBIOS) name server
 - Primary subnet
 - Secondary subnets and subnet-specific default device lists (see Configuring a DHCP Address Pool with Secondary Subnets section for information on secondary subnets).
- Decide on a NetBIOS node type (b, p, m, or h).
- Decide on a DNS domain name.



Note

You cannot configure manual bindings within the same pool that is configured with the network DHCP pool configuration command. To configure manual bindings, see the Configuring Manual Bindings section.

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp pool name	Assigns a name to a DHCP pool and enters DHCP configuration mode.
Step 4	Switch(dhcp-config)# utilization mark high percentage-number [log]	(Optional) Configures the high utilization mark of the current address pool size. <ul style="list-style-type: none"> • The log keyword enables the logging of a system message. A system message will be generated for a DHCP pool when the pool utilization exceeds the configured high utilization threshold.
Step 5	Switch(dhcp-config)# utilization mark low percentage-number [log]	(Optional) Configures the low utilization mark of the current address pool size. <ul style="list-style-type: none"> • The log keyword enables the logging of a system message. A system message will be generated for a DHCP pool when the pool utilization falls below the configured low utilization threshold.
Step 6	Switch(dhcp-config)# network network-number [mask /prefix-length] [secondary]	Specifies the subnet network number and mask of the DHCP address pool.
Step 7	Switch(dhcp-config)# domain-name domain	Specifies the domain name for the client.

Command or Action	Purpose
Step 8 Switch(dhcp-config)# dns-server <i>address</i> [<i>address2</i> ... <i>address8</i>]	Specifies the IP address of a DNS server that is available to a DHCP client. <ul style="list-style-type: none"> • One IP address is required; however, you can specify up to eight IP addresses in one command. • Servers should be listed in order of preference.
Step 9 Switch(dhcp-config)# bootfile <i>filename</i>	(Optional) Specifies the name of the default boot image for a DHCP client. <ul style="list-style-type: none"> • The boot file is used to store the boot image for the client. The boot image is generally the operating system that the client uses to load.
Step 10 Switch(dhcp-config)# next-server <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Configures the next server in the boot process of a DHCP client. <ul style="list-style-type: none"> • One address is required; however, you can specify up to eight addresses in one command line. • If multiple servers are specified, DHCP assigns them to clients in a round-robin order. The first client gets address 1, the next client gets address 2, and so on. • If this command is not configured, DHCP uses the server specified by the ip helper address command as the boot server.
Step 11 Switch(dhcp-config)# netbios-name-server <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Specifies the NetBIOS WINS server that is available to a Microsoft DHCP client. <ul style="list-style-type: none"> • One address is required; however, you can specify up to eight addresses in one command line. • Servers should be listed in order of preference.
Step 12 Switch(dhcp-config)# netbios-node-type <i>type</i>	(Optional) Specifies the NetBIOS node type for a Microsoft DHCP client.
Step 13 Switch(dhcp-config)# default-router <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Specifies the IP address of the default device for a DHCP client. <ul style="list-style-type: none"> • The IP address should be on the same subnet as the client. • One IP address is required; however, you can specify up to eight IP addresses in one command line. These default devices are listed in order of preference; that is, address is the most preferred device, address2 is the next most preferred device, and so on. • When a DHCP client requests an IP address, the device—acting as a DHCP server—accesses the default device list to select another device that the DHCP client will use as the first hop for forwarding messages. After a DHCP client has booted, the client begins sending packets to its default device.
Step 14 Switch(dhcp-config)# option <i>code</i> [<i>instance number</i>] { <i>ascii string</i> <i>hex string</i> <i>ip-address</i> }	(Optional) Configures DHCP server options.

	Command or Action	Purpose
Step 15	Switch(dhcp-config)# lease {days [hours [minutes]] infinite }	Optional) Specifies the duration of the lease. <ul style="list-style-type: none"> The default is a one-day lease. The infinite keyword specifies that the duration of the lease is unlimited.
Step 16	Switch(dhcp-config)# end	Exits DHCP configuration mode and returns to privileged EXEC mode.

Configuring a DHCP Address Pool with Secondary Subnets

For any DHCP pool, you can configure a primary subnet and any number of secondary subnets.

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp pool name	Assigns a name to a DHCP pool and enters DHCP configuration mode.
Step 4	Switch(dhcp-config)# utilization mark high percentage-number [log]	(Optional) Configures the high utilization mark of the current address pool size. <ul style="list-style-type: none"> The log keyword enables the logging of a system message. A system message will be generated for a DHCP pool when the pool utilization exceeds the configured high utilization threshold.
Step 5	Switch(dhcp-config)# utilization mark low percentage-number [log]	(Optional) Configures the low utilization mark of the current address pool size. <ul style="list-style-type: none"> The log keyword enables the logging of a system message. A system message will be generated for a DHCP pool when the pool utilization falls below the configured low utilization threshold.
Step 6	Switch(dhcp-config)# network network-number [mask /prefix-length] [secondary]	Specifies the subnet network number and mask of the DHCP address pool.
Step 7	Switch(dhcp-config)# domain-name domain	Specifies the domain name for the client.
Step 8	Switch(dhcp-config)# dns-server address [address2 ... address8]	Specifies the IP address of a DNS server that is available to a DHCP client. <ul style="list-style-type: none"> One IP address is required; however, you can specify up to eight IP addresses in one command. Servers should be listed in order of preference.
Step 9	Switch(dhcp-config)# bootfile filename	(Optional) Specifies the name of the default boot image for a DHCP client. <ul style="list-style-type: none"> The boot file is used to store the boot image for the client. The boot image is generally the operating system that the client uses to load.

Command or Action	Purpose
Step 10 Switch(dhcp-config)# next-server <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Configures the next server in the boot process of a DHCP client. <ul style="list-style-type: none"> • One address is required; however, you can specify up to eight addresses in one command line. • If multiple servers are specified, DHCP assigns them to clients in a round-robin order. The first client gets address 1, the next client gets address 2, and so on. • If this command is not configured, DHCP uses the server specified by the ip helper address command as the boot server.
Step 11 Switch(dhcp-config)# netbios-name-server <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Specifies the NetBIOS WINS server that is available to a Microsoft DHCP client. <ul style="list-style-type: none"> • One address is required; however, you can specify up to eight addresses in one command line. • Servers should be listed in order of preference.
Step 12 Switch(dhcp-config)# netbios-node-type <i>type</i>	(Optional) Specifies the NetBIOS node type for a Microsoft DHCP client.
Step 13 Switch(dhcp-config)# default-router <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Specifies the IP address of the default device for a DHCP client. <ul style="list-style-type: none"> • The IP address should be on the same subnet as the client. • One IP address is required; however, you can specify up to eight IP addresses in one command line. These default devices are listed in order of preference; that is, address is the most preferred device, address2 is the next most preferred device, and so on. • When a DHCP client requests an IP address, the device—acting as a DHCP server—accesses the default device list to select another device that the DHCP client will use as the first hop for forwarding messages. After a DHCP client has booted, the client begins sending packets to its default device.
Step 14 Switch(dhcp-config)# option <i>code</i> [<i>instance number</i>] { <i>ascii string</i> hex <i>string</i> <i>ip-address</i> }	(Optional) Configures DHCP server options.
Step 15 Switch(dhcp-config)# lease { <i>days</i> [<i>hours</i> [<i>minutes</i>]] infinite }	(Optional) Specifies the duration of the lease. <ul style="list-style-type: none"> • The default is a one-day lease. • The infinite keyword specifies that the duration of the lease is unlimited.

	Command or Action	Purpose
Step 16	Switch(dhcp-config)# network <i>network-number</i> [<i>mask</i> <i>/prefix-length</i>] [secondary]	(Optional) Specifies the network number and mask of a secondary DHCP server address pool. <ul style="list-style-type: none"> Any number of secondary subnets can be added to a DHCP server address pool. During execution of this command, the configuration mode changes to DHCP pool secondary subnet configuration mode, which is identified by (config-dhcp-subnet-secondary)# prompt. In this mode, the administrator can configure a default device list that is specific to the subnet. See Troubleshooting Tips section if you are using secondary IP addresses under a loopback interface with DHCP secondary subnets.
Step 17	Switch(config-dhcp-subnet-secondary)# override default-router <i>address</i> [<i>address2</i> ... <i>address8</i>]	(Optional) Specifies the default device list that is used when an IP address is assigned to a DHCP client from a particular secondary subnet. <ul style="list-style-type: none"> If the subnet-specific override value is configured, this override value is used when assigning an IP address from the subnet; the network-wide default device list is used only to set the gateway device for the primary subnet. If this subnet-specific override value is not configured, the network-wide default device list is used when assigning an IP address from the subnet.
Step 18	Switch(config-dhcp-subnet-secondary)# override utilization high <i>percentage-number</i>	(Optional) Sets the high utilization mark of the subnet size. <ul style="list-style-type: none"> This command overrides the global default setting specified by the utilization mark high command.
Step 19	Switch(config-dhcp-subnet-secondary)# override utilization low <i>percentage-number</i>	(Optional) Sets the low utilization mark of the subnet size. <ul style="list-style-type: none"> This command overrides the global default setting specified by the utilization mark low command.
Step 20	Switch(config-dhcp-subnet-secondary)# end	Exits DHCP secondary subnet configuration mode and returns to privileged EXEC mode.

Troubleshooting Tips

If you are using secondary IP addresses under a single loopback interface and using secondary subnets under a DHCP pool, use one DHCP pool to configure networks for all the secondary subnets instead of using one pool per secondary subnet. The **network** *network-number* [*mask* | */prefix-length*] [**secondary**] command must be configured under a single DHCP address pool rather than multiple DHCP address pools.

The following is the correct configuration:

```
ip dhcp pool dhcp_1
 network 172.16.1.0 255.255.255.0
 network 172.16.2.0 255.255.255.0 secondary
 network 172.16.3.0 255.255.255.0 secondary
 network 172.16.4.0 255.255.255.0 secondary
!
interface Loopback111
 ip address 172.16.1.1 255.255.255.255 secondary
```

```
ip address 172.16.2.1 255.255.255.255 secondary
ip address 172.16.3.1 255.255.255.255 secondary
ip address 172.16.4.1 255.255.255.255 secondary
```



The following is the incorrect configuration:

```
ip dhcp pool dhcp_1
network 172.16.1.0 255.255.255.0
lease 1 20 30
accounting default
!
ip dhcp pool dhcp_2
network 172.16.2.0 255.255.255.0
lease 1 20 30
accounting default
!
ip dhcp pool dhcp_3
network 172.16.3.0 255.255.255.0
lease 1 20 30
accounting default
!
ip dhcp pool dhcp_4
network 172.16.4.0 255.255.255.0
lease 1 20 30
accounting default
!
interface Loopback111
ip address 172.16.1.1 255.255.255.255 secondary
ip address 172.16.2.1 255.255.255.255 secondary
ip address 172.16.3.1 255.255.255.255 secondary
ip address 172.16.4.1 255.255.255.255 secondary
```

Verifying the DHCP Address Pool Configuration

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Switch# show ip dhcp pool [<i>name</i>]	(Optional) Displays information about DHCP address pools.
Step 3	Switch(config)# show ip dhcp binding [<i>address</i>]	(Optional) Displays a list of all bindings created on a specific DHCP server. <ul style="list-style-type: none"> Use the show ip dhcp binding command to display the IP addresses that have already been assigned. Verify that the address pool is not exhausted. If necessary, recreate the pool to create a larger pool of addresses. Use the show ip dhcp binding command to display the lease expiration date and time of the IP address of the host.
Step 4	Switch(dhcp-config)# show ip dhcp conflict [<i>address</i>]	(Optional) Displays a list of all IP address conflicts.
Step 5	Switch(config)# show ip dhcp database [<i>url</i>]	(Optional) Displays recent activity on the DHCP database.
Step 6	Switch(config)# show ip dhcp server statistics [<i>type-number</i>]	(Optional) Displays count information about server statistics and messages sent and received.

Configuring Manual Bindings

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(dhcp-config)# ip dhcp pool <i>pool-name</i>	Assigns a name to a DHCP pool and enters DHCP configuration mode.
Step 4	Switch(dhcp-config)# host <i>address</i> [<i>mask</i> <i>/prefix-length</i>]	Specifies the IP address and subnet mask of the client. <ul style="list-style-type: none"> There is no limit to the number of manual bindings you can configure. However, you can configure only one manual binding per host pool.
Step 5	Switch(dhcp-config)# client-identifier <i>unique-identifier</i>	Specifies the unique identifier for DHCP clients. <ul style="list-style-type: none"> This command is used for DHCP requests. DHCP clients require client identifiers. You can specify the unique identifier for the client in either of the following ways: <ul style="list-style-type: none"> A 7-byte dotted hexadecimal notation. For example, 01b7.0813.8811.66, where 01 represents the Ethernet media type and the remaining bytes represent the MAC address of the DHCP client. A 27-byte dotted hexadecimal notation. For example, 7665.6e64.6f72.2d30.3032.342e.3937.6230.2e33.3734.312d.4661.302f.31. The equivalent ASCII string for this hexadecimal value is vendor-0024.97b0.3741-fa0/1, where vendor represents the vendor, 0024.97b0.3741 represents the MAC address of the source interface, and fa0/1 represents the source interface of the DHCP client. See the Troubleshooting section for information about how to determine the client identifier of the DHCP client. <p> Note The identifier specified here is considered for a DHCP client that sends a client identifier in the packet.</p>
Step 6	Switch(dhcp-config)# hardware-address <i>hardware-address</i> [<i>protocol-type</i> <i>hard-</i> <i>ware-number</i>]	Specifies a hardware address for the client. <ul style="list-style-type: none"> This command is used for BOOTP requests. <p> Note The hardware address specified here is considered for a DHCP client that does not send a client identifier in the packet.</p>

	Command or Action	Purpose
Step 7	Switch(dhcp-config)# client-name name	(Optional) Specifies the name of the client using any standard ASCII character. <ul style="list-style-type: none"> The client name should not include the domain name. For example, the name client1 should not be specified as client1.cisco.com.
Step 8	Switch(dhcp-config)# end	Exits DHCP configuration mode and returns to privileged EXEC mode.

Troubleshooting Tips

You can determine the client identifier by using the **debug ip dhcp server packet** command. In the following sample output, the client is identified by the value 0b07.1134.a029:

```
Switch# debug ip dhcp server packet
```

```
DHCPD:DHCPDISCOVER received from client 0b07.1134.a029 through relay 10.1.0.253.
DHCPD:assigned IP address 10.1.0.3 to client 0b07.1134.a029.
.
.
.
```


Configuring the DHCP Server to Read a Static Mapping Text File

Before You Begin

The administrator must create the static mapping text file in the correct format and configure the address pools before performing this task.

Before editing the file, you must disable the DHCP server using the **no service dhcp** command.

The static bindings must not be deleted when a DHCPRELEASE is received or must not be timed out by the DHCP timer. The static bindings should be created by using the **ip dhcp pool** command.

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp pool pool-name	Assigns a name to a DHCP pool and enters DHCP configuration mode. <div style="text-align: center;">  <p>Note</p> </div> <p>If you have already configured the IP DHCP pool name using the ip dhcp pool command and the static file URL using the origin file command, you must perform a fresh read using the no service dhcp command and the service dhcp command.</p>
Step 4	Switch(dhcp-config)# origin file url	Specifies the URL that the DHCP server can access to locate the text file.

	Command or Action	Purpose
Step 5	Switch(dhcp-config)# end	Exits DHCP configuration mode and returns to privileged EXEC mode.
Step 6	Switch# show ip dhcp binding [address]	(Optional) Displays a list of all bindings created on a specific DHCP server.

Customizing DHCP Server Operation

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp ping packets <i>number</i>	(Optional) Specifies the number of ping packets the DHCP server sends to a pool address before assigning the address to a requesting client. <ul style="list-style-type: none"> The default is two packets. Setting the <i>number</i> argument to a value of 0 disables the DHCP server ping operation.
Step 4	Switch(config)# ip dhcp ping timeout <i>milliseconds</i>	(Optional) Specifies the duration the DHCP server waits for a ping reply from an address pool.
Step 5	Switch(config)# ip dhcp bootp ignore	(Optional) Allows the DHCP server to selectively ignore and not reply to received BOOTP requests. <ul style="list-style-type: none"> The ip dhcp bootp ignore command applies to all DHCP pools configured on the device. BOOTP requests cannot be selectively ignored on a per-DHCP pool basis.
Step 6	Switch(config)# end	Exits global configuration mode and returns to privileged EXEC mode.

Configuring a Remote Device to Import DHCP Server Options from a Central DHCP Server

The Cisco DHCP server can dynamically configure options such as the Domain Name System (DNS) and Windows Internet Name Service (WINS) addresses to respond to DHCP requests from local clients behind the customer premises equipment (CPE). Earlier, network administrators configured the Cisco DHCP server on each device manually. Now, the Cisco DHCP server is enhanced to allow configuration information to be updated automatically. Network administrators can configure one or more centralized DHCP servers to update specific DHCP options within the DHCP pools. The remote servers can request or “import” these option parameters from centralized servers.

This section contains the following tasks:

- [Configuring the Central DHCP Server to Update DHCP Options, page 54-20](#)
- [Configuring a Remote Device to Import DHCP Server Options from a Central DHCP Server, page 54-19](#)

Configuring the Central DHCP Server to Update DHCP Options

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp pool name	Assigns a name to a DHCP pool and enters DHCP configuration mode.
Step 4	Switch(dhcp-config)# network network-number [mask /prefix-length]	Specifies the subnet number and mask of the DHCP address pool.
Step 5	Switch(dhcp-config)# dns-server address [address2 ... address8]	(Optional) Specifies the IP address of a DNS server that is available to a DHCP client. <ul style="list-style-type: none"> • One IP address is required; however, you can specify up to eight IP addresses in one command line. • Servers should be listed in the order of preference.
Step 6	Switch(dhcp-config)# end	Exits DHCP configuration mode and returns to privileged EXEC mode.

Configuring the Remote Device to Import DHCP Options

Perform the following task to configure the remote device to import DHCP options:



Note

When two servers provide DHCP addresses to a single device configured with `ip address dhcp` on two different interfaces, the imported information is merged and, for those options that take a single value, the last known option value will be used.

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp pool name	Assigns a name to a DHCP pool and enters DHCP configuration mode.
Step 4	Switch(dhcp-config)# network network-number [mask /prefix-length]	Specifies the subnet number and mask of the DHCP address pool.
Step 5	Switch(dhcp-config)# import all	(Optional) Specifies the IP address of a DNS server that is available to a DHCP client. <ul style="list-style-type: none"> • One IP address is required; however, you can specify up to eight IP addresses in one command line. • Servers should be listed in the order of preference.
Step 6	Switch(dhcp-config)# exit	Exits DHCP configuration mode and returns to privileged EXEC mode.
Step 7	Switch(config)# interface type number	Configures an interface and enters interface configuration mode.
Step 8	Switch(config-if)# ip address dhcp	Specifies that the interface acquires an IP address through DHCP.

	Command or Action	Purpose
Step 9	Switch(config-if)# end	Exits interface configuration mode and returns to privileged EXEC mode.
Step 10	Switch# show ip dhcp import	Displays the options that are imported from the central DHCP server.

Configuring DHCP Address Allocation Using Option 82

- [Enabling Option 82 for DHCP Address Allocation, page 54-21](#)
- [Defining the DHCP Class and Relay Agent Information Patterns, page 54-21](#)

Enabling Option 82 for DHCP Address Allocation

By default, the Cisco DHCP server uses information provided by option 82 to allocate IP addresses. If the DHCP address allocation is disabled, perform the task described in this section to reenable this capability.

	Command or Action	Purpose
Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp use class	Controls DHCP classes that are used for address allocation. <ul style="list-style-type: none"> • This functionality is enabled by default. • Use the no form of this command to disable this functionality without deleting the DHCP class configuration.
Step 4	Switch(config)# end	Exits global configuration mode and returns to privileged EXEC mode.

Troubleshooting Tips

If DHCP classes are configured in the pool, but the DHCP server does not use the classes, verify if the **no ip dhcp use class** command was configured.

Defining the DHCP Class and Relay Agent Information Patterns

Before You Begin

You must know the hexadecimal value of each byte location in option 82 to configure the relay-information hex command. The option 82 format may vary from product to product. Contact the relay agent vendor for this information.

Perform this task to define the DHCP class and relay agent information patterns.

Step 1	Switch> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp class name	Defines a DHCP class and enters DHCP class configuration mode.
Step 4	Switch(dhcp-class)# relay agent information	Enters relay agent information option configuration mode. • If you omit this step, the DHCP class matches any relay agent information option, whether the relay agent information option value is available or not.
Step 5	Switch(dhcp-class-relayinfo)# relay-information hex pattern [*] [bitmask mask]	(Optional) Specifies a hexadecimal value for full relay information option. • The pattern argument creates a pattern that is used to match the DHCP class. • If you omit this step, no pattern is configured and it is considered a match to any relay agent information option value, but the relay information option must be available in the DHCP packet. • You can configure multiple relay-information hex commands in a DHCP class.
Step 6	Repeat Steps 3 through 5 for each DHCP class you need to configure.	—
Step 7	Switch(dhcp-class-relayinfo)# end	Exits relay agent information option mode and returns to privileged EXEC mode.

Troubleshooting Tips

Use the `debug ip dhcp server class` command to display the class matching results.

Defining the DHCP Address Pool

Step 1	Switch> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip dhcp pool name	Assigns a name to a DHCP pool and enters DHCP configuration mode. • Multiple pools can be configured with the same class, eliminating the need to configure the same pattern in multiple pools.
Step 4	Switch(dhcp-config)# network network-number [mask /prefix-length]	Configures the subnet and mask for a DHCP address pool on a Cisco IOS DHCP server.

Step 5	Switch(dhcp-config)# class <i>class-name</i>	Associates a class with a pool and enters DHCP pool class configuration mode. <ul style="list-style-type: none"> This command also creates a DHCP class if the DHCP class is not yet defined.
Step 6	Switch(dhcp-pool-class)# address range <i>start-ip end-ip</i>	(Optional) Sets an address range for the DHCP class in a DHCP server address pool. <ul style="list-style-type: none"> If this command is not configured for a class, the default value is the entire subnet of the pool. Each class in the DHCP pool is examined for a match in the order configured.
Step 7	Repeat Steps 5 and 6 for each DHCP class you need to associate with the DHCP pool.	—
Step 8	Switch(dhcp-pool-class)# end	Exits DHCP pool class option mode and returns to privileged EXEC mode.

Configuring Static Route with the Next-Hop Dynamically Obtained Through DHCP

This task enables static routes to be assigned using a DHCP default gateway as the next-hop device. Without this feature the gateway IP address is not known until after the DHCP address assignment. You cannot configure a static route with the CLI without knowing that DHCP-supplied address.

Before You Begin

Verify all DHCP client and server configuration steps. Ensure that the DHCP client and server are properly defined to supply a DHCP device option 3 of the DHCP packet.

Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Switch# configure terminal	Enters global configuration mode.
Step 3	Switch(config)# ip route <i>prefix mask</i> { <i>ip-address</i> <i>interface-type interface-number</i> [<i>ip-address</i>]} dhcp [<i>distance</i>]	Assigns a static route for the default next-hop device when the DHCP server is accessed for an IP address. <ul style="list-style-type: none"> If more than one interface is configured to obtain an IP address from a DHCP server, use the ip route prefix mask interface-type interface-number dhcp command for each interface. If the interface is not specified, the route is added to the routing table as soon as any of the interfaces obtain an IP address and a default device.
Step 4	Switch(config)# end	Exits global configuration mode and returns to privileged EXEC mode.
Step 5	Switch# show ip route	(Optional) Displays the current state of the routing table.

Clearing DHCP Server Variables

Step 1	Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	Switch# clear ip dhcp binding {address *}	Deletes an automatic address binding from the DHCP database. <ul style="list-style-type: none"> • Specifying the address argument clears the automatic binding for a specific (client) IP address, whereas specifying an asterisk (*) clears all automatic bindings.
Step 3	Switch# clear ip dhcp conflict {address *}	Clears an address conflict from the DHCP database. <ul style="list-style-type: none"> • Specifying the address argument clears the conflict for a specific IP address, whereas specifying an asterisk (*) clears conflicts for all addresses.
Step 4	Switch# clear ip dhcp server statistics	Resets all DHCP server counters to 0.

Configuration Examples for the Cisco IOS DHCP Server

- [Example: Configuring a DHCP Database Agent or Disabling Conflict Logging, page 54-24](#)
- [Example: Excluding IP Addresses, page 54-24](#)
- [Example: Configuring a DHCP Address Pool, page 54-25](#)
- [Example: Configuring Manual Bindings, page 54-27](#)
- [Example: Configuring Static Mapping, page 54-28](#)
- [Example: Customizing DHCP Server Operation, page 54-29](#)
- [Example: Configuring a Remote Device to Import DHCP Server Options from a Central DHCP Server, page 54-30](#)
- [Example: Configuring DHCP Address Allocation Using Option 82, page 54-31](#)
- [Example: Configuring a Static Route with the Next-Hop Dynamically Obtained Through DHCP, page 54-32](#)

Example: Configuring a DHCP Database Agent or Disabling Conflict Logging

The following example shows how to store bindings on host 172.16.4.253. The file transfer protocol is FTP. The server waits for 2 minutes (120 seconds) before performing database changes.

```
Switch> enable
Switch# configure terminal
Switch(config)# ip dhcp database ftp://user:password@172.16.4.253/router-dhcp write-delay
120
Switch(config)# exit
```

Example: Excluding IP Addresses

In the following example, server A and server B service the subnet 10.0.20.0/24. If the subnet is split equally between the two servers, server A is configured to allocate IP addresses 10.0.20.1 to 10.0.20.125 and server B is configured to allocate IP addresses 10.0.20.126 to 10.0.20.254.

Server A

```
Switch# configure terminal
switch(config)# ip dhcp excluded-address 10.0.20.126 10.0.20.255
Switch(config)# ip dhcp pool A
Switch(dhcp-config)# network 10.0.20.0 255.255.255.0
```

Server B

```
Switch# configure terminal
switch(config)# ip dhcp excluded-address 10.0.20.0 10.0.20.125
Switch(config)# ip dhcp pool B
Switch(dhcp-config)# network 10.0.20.0 255.255.255.0
```

Example: Configuring a DHCP Address Pool

In the following example, three DHCP address pools are created: one in network 172.16.0.0, one in subnetwork 172.16.1.0, and one in subnetwork 172.16.2.0. Attributes from network 172.16.0.0—such as the domain name, Domain Name System (DNS) server, (Network Basic Input/Output System) NetBIOS name server, and NetBIOS node type—are inherited in subnetworks 172.16.1.0 and 172.16.2.0. In each pool, clients are granted 30-day leases and all addresses in each subnetwork, except the excluded addresses, are available to the DHCP server for assigning to clients. The table below lists the IP addresses for the devices in three DHCP address pools.

Table 54-2 DHCP Address Pool Configuration

	Pool 0 (Network 172.16.0.0)	Pool 1 (Subnetwork 172.16.1.0)	Pool 2 (Subnetwork 172.16.2.0)
Device Type	IP Address	IP Address	IP Address
Default Devices		172.16.1.100 172.16.1.101	172.16.2.100 172.16.2.101
DNS Server	172.16.1.102 172.16.2.102		
NetBIOS Name Server	172.16.1.103 172.16.2.103		
NetBIOS Node Type	h-node		

```
Switch(config)# ip dhcp database ftp://user:password@172.16.4.253/router-dhcp write-delay 120
Switch(config)# ip dhcp excluded-address 172.16.1.100 172.16.1.103
Switch(config)# ip dhcp excluded-address 172.16.2.100 172.16.2.103
!
Switch(config)# ip dhcp pool 0
Switch(dhcp-config)# network 172.16.0.0 /16
Switch(dhcp-config)# domain-name cisco.com
Switch(dhcp-config)# dns-server 172.16.1.102 172.16.2.102
Switch(dhcp-config)# netbios-name-server 172.16.1.103 172.16.2.103
Switch(dhcp-config)# netbios-node-type h-node
!
Switch(config)# ip dhcp pool 1
Switch(dhcp-config)# network 172.16.1.0 /24
Switch(dhcp-config)# default-router 172.16.1.100 172.16.1.101
Switch(dhcp-config)# lease 30
```

```

!
Switch(config)# ip dhcp pool 2
Switch(dhcp-config)# network 172.16.2.0 /24
Switch(dhcp-config)# default-router 172.16.2.100 172.16.2.101
Switch(dhcp-config)# lease 30

```

Example: Configuring a DHCP Address Pool with Multiple Disjoint Subnets

Multiple disjoint subnets in a DHCP pool can be used in any of the following network topologies:

- IP address pooling—The DHCP client and server reside on the same subnet.
- DHCP relay—The DHCP client and DHCP server communicate through a DHCP relay agent where the relay interface is configured with secondary IP addresses.
- Hierarchical DHCP—The DHCP server is configured as the DHCP subnet allocation server. The DHCP client and DHCP subnet allocation server communicate through an on-demand address pool (ODAP) router.

In the following example, one DHCP address pool named pool3 is created; the primary subnet is 172.16.0.0/16, one secondary subnet is 172.16.1.0/24, and the other secondary subnet is 172.16.2.0/24.

- When IP addresses in the primary subnet are exhausted, the DHCP server inspects the secondary subnets in the order in which the subnets were added to the pool.
- When the DHCP server allocates an IP address from the secondary subnet 172.16.1.0/24, the server uses the subnet-specific default device list that consists of IP addresses 172.16.1.100 and 172.16.1.101. However, when the DHCP server allocates an IP address from the subnet 172.16.2.0/24, the server uses the pool-wide list that consists of the four IP addresses from 172.16.0.100 to 172.16.0.103.
- Other attributes from the primary subnet 172.16.0.0/16—such as the domain name, DNS server, NetBIOS name server, and NetBIOS node type—are inherited in both the secondary subnets.
- DHCP clients are granted 30-day leases on IP addresses in the pool. All addresses in each subnet, except the excluded addresses, are available to the DHCP server for assigning to clients.

The table below lists the IP addresses for the devices in the DHCP address pool that consists of three disjoint subnets.

Table 54-3 DHCP Address Pool Configuration

	Primary Subnet (172.16.0.0/16)	First Secondary Subnet (172.16.1.0/24)	Second Secondary Subnet (172.16.2.0/24)
Device Type	IP Address	IP Address	IP Address
Default Devices	172.16.0.100	172.16.1.100	172.16.0.100
	172.16.0.101	172.16.1.101	172.16.0.101
	172.16.0.102		172.16.0.102
	172.16.0.103		172.16.0.103
DNS Server	172.16.1.102		
	172.16.2.102		

	Primary Subnet (172.16.0.0/16)	First Secondary Subnet (172.16.1.0/24)	Second Secondary Subnet (172.16.2.0/24)
NetBIOS Name Server	172.16.1.103 172.16.2.103		
NetBIOS Node Type	h-node		

```
Switch(config)# ip dhcp database ftp://user:password@172.16.4.253/router-dhcp write-delay
120
Switch(config)# ip dhcp excluded-address 172.16.0.100 172.16.1.103
Switch(config)# ip dhcp excluded-address 172.16.1.100 172.16.1.101
!
Switch(config)# ip dhcp pool pool3
Switch(dhcp-config)# network 172.16.0.0 /16
Switch(dhcp-config)# default-router 172.16.0.100 172.16.2.101 172.16.0.102 172.16.0.103
Switch(dhcp-config)# domain-name cisco.com
Switch(dhcp-config)# dns-server 172.16.1.102 172.16.2.102
Switch(dhcp-config)# netbios-name-server 172.16.1.103 172.16.2.103
Switch(dhcp-config)# netbios-node-type h-node
Switch(dhcp-config)# lease 30
!
Switch(dhcp-config)# network 172.16.1.0 /24 secondary
Switch(dhcp-config)# override default-router 172.16.1.100 172.16.1.101
!
Switch(dhcp-config)# network 172.16.2.0 /24 secondary
```

Example: Configuring Manual Bindings

The following example shows how to create a manual binding for a client named example1.abc.com that sends a client identifier in the DHCP packet. The MAC address of the client is 02c7.f800.0422 and the IP address of the client is 172.16.2.254.

```
Switch(config)# ip dhcp pool pool1
Switch(dhcp-config)# host 172.16.2.254
Switch(dhcp-config)# client-identifier 01b7.0813.8811.66
Switch(dhcp-config)# client-name example1
```

The following example shows how to create a manual binding for a client named example2.abc.com that does not send a client identifier in the DHCP packet. The MAC address of the client is 02c7.f800.0422 and the IP address of the client is 172.16.2.253.

```
Switch(config)# ip dhcp pool pool2
Switch(dhcp-config)# host 172.16.2.253
Switch(dhcp-config)# hardware-address 02c7.f800.0422 ethernet
Switch(dhcp-config)# client-name example1
```

Because attributes are inherited, the two preceding configurations are equivalent to the following:

```
Switch(config)# ip dhcp pool pool1
Switch(dhcp-config)# host 172.16.2.254 255.255.255.0
Switch(dhcp-config)# hardware-address 02c7.f800.0422 ieee802
Switch(dhcp-config)# client-name client1
Switch(dhcp-config)# default-router 172.16.2.100 172.16.2.101
Switch(dhcp-config)# domain-name abc.com
Switch(dhcp-config)# dns-server 172.16.1.102 172.16.2.102
Switch(dhcp-config)# netbios-name-server 172.16.1.103 172.16.2.103
Switch(dhcp-config)# netbios-node-type h-node
```

Example: Configuring Static Mapping

The following example shows how to restart the DHCP server, configure the pool, and specify the URL where the static mapping text file is stored:

```
Switch# configure terminal
Switch(config)# no service dhcp
Switch(config)# service dhcp
Switch(config)# ip dhcp pool pool1
Switch(dhcp-config)# origin file tftp://10.1.0.1/static-bindings
Switch(dhcp-config)# end
```



Note

The static mapping text file can be copied to flash memory on the device and served by the TFTP process of the device. In this case, the IP address in the original file line must be an address owned by the device and one additional line of configuration is required on the device: `tftp-server flash static-filename`.

The following sample output from the `show ip dhcp binding` command displays address bindings that are configured:

```
Device# show ip dhcp binding
```

```
00:05:14:%SYS-5-CONFIG_I: Configured from console by console
Bindings from all pools not associated with VRF:
IP address  Client-ID/          Ls expir   Type    Hw address          User name
10.9.9.4/8  0063.7363.2d30.3036.  Infinite   Static   302e.3762.2e39.3634.  632d.4574.8892.
10.9.9.1/24 0063.6973.636f.2d30.  Infinite   Static   3036.302e.3437.3165.  2e64.6462.342d.
```

The following sample output displays each entry in the static mapping text file

```
*time* Jan 21 2005 22:52 PM
!IP address      Type      Hardware address          Lease expiration
10.19.9.1 /24    id        0063.6973.636f.2d30.3036.302e.3437
10.9.9.4         id        0063.7363.2d30.3036.302e.3762.2e39.3634.632d  Infinite
*end*
```

The following sample debug output shows the reading of the static mapping text file from the TFTP server:

```
Switch# debug ip dhcp server
```

```
Loading abc/static_pool from 10.19.192.33 (via Ethernet0):
[OK - 333 bytes]
*May 26 23:14:21.259: DHCPD: contacting agent tftp://10.19.192.33/abc/static_pool (attempt 0)
*May 26 23:14:21.467: DHCPD: agent tftp://10.19.192.33/abc/static_pool is responding.
*May 26 23:14:21.467: DHCPD: IFS is ready.
*May 26 23:14:21.467: DHCPD: reading bindings from tftp://10.19.192.33/abc/static_pool.
*May 26 23:14:21.707: DHCPD: read 333 / 1024 bytes.
*May 26 23:14:21.707: DHCPD: parsing text line
*time* Apr 22 2002 11:31 AM
*May 26 23:14:21.707: DHCPD: parsing text line ""
*May 26 23:14:21.707: DHCPD: parsing text line
!IP address Type Hardware address Lease expiration
*May 26 23:14:21.707: DHCPD: parsing text line
"10.9.9.1 /24 id 0063.6973.636f.2d30.3036.302e.3437"
*May 26 23:14:21.707: DHCPD: creating binding for 10.9.9.1
*May 26 23:14:21.707: DHCPD: Adding binding to radix tree (10.9.9.1)
*May 26 23:14:21.707: DHCPD: Adding binding to hash tree
*May 26 23:14:21.707: DHCPD: parsing text line
"10.9.9.4 id 0063.7363.2d30.3036.302e.3762.2e39.3634.632d"
*May 26 23:14:21.711: DHCPD: creating binding for 10.9.9.4
```

```
*May 26 23:14:21.711: DHCPD: Adding binding to radix tree (10.9.9.4)
*May 26 23:14:21.711: DHCPD: Adding binding to hash tree
*May 26 23:14:21.711: DHCPD: parsing text line "Infinite"
*May 26 23:14:21.711: DHCPD: parsing text line ""
*May 26 23:14:21.711: DHCPD: parsing text line
!IP address Interface-index Lease expiration VRF
*May 26 23:14:21.711: DHCPD: parsing text line "*end*"
*May 26 23:14:21.711: DHCPD: read static bindings from
tftp://10.19.192.33/abcemp/static_pool.
```

Example: Customizing DHCP Server Operation

```
Switch# configure terminal
Switch(config)# ip dhcp ping packets 5
Switch(config)# ip dhcp ping timeout 850
Switch(config)# ip dhcp bootp ignore
Switch(config)# end
```

Example: Configuring the Option to Ignore all BOOTP Requests

The following example shows two DHCP pools that are configured on the device and that the device's DHCP server is configured to ignore all received BOOTP requests. If a BOOTP request is received from subnet 10.0.18.0/24, the request will be dropped by the device (because the `ip helper-address` command is not configured). If there is a BOOTP request from subnet 192.168.1.0/24, the request will be forwarded to 172.16.1.1 via the `ip helper-address` command.

```
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
ip subnet-zero
!
ip dhcp bootp ignore
!
ip dhcp pool ABC
  network 192.168.1.0 255.255.255.0
  default-router 192.168.1.3
  lease 2
!
ip dhcp pool DEF
  network 10.0.18.0 255.255.255.0
!
ip cef
!
interface FastEthernet0/0
  no ip address
  shutdown
  duplex half
!
interface Ethernet1/0
  ip address 10.0.18.68 255.255.255.0
  duplex half
!
interface Ethernet1/1
  ip address 192.168.1.1 255.255.255.0
  ip helper-address 172.16.1.1
```

```

duplex half
!
interface Ethernet1/2
 shutdown
 duplex half
!
interface Ethernet1/3
 no ip address
 shutdown
 duplex half
!
interface FastEthernet2/0
 no ip address
 shutdown
 duplex half
!
ip route 172.16.1.1 255.255.255.255 e1/0
no ip http server
no ip pim bidir-enable
!
call rsvp-sync
!
mgcp profile default
!
dial-peer cor custom
!
gatekeeper
 shutdown
!
line con 0
line aux 0
line vty 0 4
!
end

```

Example: Configuring a Remote Device to Import DHCP Server Options from a Central DHCP Server

- [Example: Importing DHCP Options, page 54-30](#)
- [Example: Configuring the Remote Device to Import DHCP Options, page 54-31](#)

Example: Importing DHCP Options

The following example shows how to configure a remote and central server to support the importing of DHCP options. The central server is configured to automatically update DHCP options, such as DNS and WINS addresses, within the DHCP pools. In response to a DHCP request from a local client behind CPE equipment, the remote server can request or “import” these option parameters from the centralized server. See the figure below for a diagram of the network topology.

Central Device

```

!do not assign this range to DHCP clients
ip dhcp-excluded address 10.0.0.1 10.0.0.5
!
ip dhcp pool central
! Specifies network number and mask for DHCP clients
 network 10.0.0.0 255.255.255.0
! Specifies the domain name for the client

```

```

domain-name central
! Specifies DNS server that will respond to DHCP clients when they need to correlate host
! name to ip address
dns-server 10.0.0.2
!Specifies the NETBIOS WINS server
netbios-name-server 10.0.0.2
!
interface FastEthernet0/0
 ip address 10.0.0.1 255.255.255.0
 duplex auto
 speed auto

```

Remote Device

```

ip dhcp pool client
! Imports DHCP option parameters into DHCP server database
import all
network 172.16.2.254 255.255.255.0
!
interface FastEthernet0/0
 ip address dhcp
 duplex auto
 speed auto

```

Example: Configuring the Remote Device to Import DHCP Options

```

Switch# configure terminal
Switch(config)# ip dhcp pool 1
Switch(dhcp-config)# network 172.16.0.0 /16
Switch(dhcp-config)# import all
Switch(dhcp-config)# exit
Switch(config)# interface FastEthernet 0/0
Switch(config-if)# ip address dhcp
Switch(config-if)# end
Switch# show ip dhcp import

```

Example: Configuring DHCP Address Allocation Using Option 82

This example shows how to configure two DHCP classes. CLASS1 defines the group of DHCP clients whose address requests contain the relay agent information option with the specified hexadecimal values. CLASS2 defines the group of DHCP clients whose address requests contain the configured relay agent information suboptions. CLASS3 has no pattern configured and is treated as a “match to any” class. This type of class is useful for specifying a “default” class.

The subnet of pool ABC has been divided into three ranges without further subnetting the 10.0.20.0/24 subnet. If there is a DHCP Discover message from the 10.0.20.0/24 subnet with option 82 matching that of class CLASS1, an available address in the range from 10.0.20.1 to 10.0.20.100 will be allocated. If there is no free address in CLASS address range, the DHCP Discover message will be matched against CLASS2, and so on.

Therefore, each class in the DHCP pool will be examined for a match in the order configured by the user. In pool ABC, the order of matching is CLASS1, CLASS2, and finally CLASS3. In pool DEF, class CLASS2 does not have any address range configured. By default, the address range for a particular class is the pool’s entire subnets. Therefore, clients matching CLASS2 may be allocated addresses from 10.0.20.1 to 10.0.20.254.

Multiple pools can be configured with the same class, eliminating the need to configure the same patterns in multiple pools. For example, there may be a need to specify that one or more pools must be used only to service a particular class of devices (for example, cable modems and IP phones).

```
! Defines the DHCP classes and relay information patterns
ip dhcp class CLASS1
  relay agent information
  relay-information hex 01030a0b0c02050000000123
  relay-information hex 01030a0b0c02*
  relay-information hex 01030a0b0c02050000000000 bitmask 00000000000000000000FF
ip dhcp class CLASS2
  relay agent information
  relay-information hex 01040102030402020102
  relay-information hex 01040101030402020102
ip dhcp class CLASS3
  relay agent information
! Associates the DHCP pool with DHCP classes
ip dhcp pool ABC
  network 10.0.20.0 255.255.255.0
  class CLASS1
  address range 10.0.20.1 10.0.20.100
class CLASS2
  address range 10.0.20.101 10.0.20.200
class CLASS3
  address range 10.0.20.201 10.0.20.254
ip dhcp pool DEF
  network 172.64.2.2 255.255.255.0
  class CLASS1
  address range 172.64.2.3 172.64.2.10
class CLASS2
```

Example: Configuring a Static Route with the Next-Hop Dynamically Obtained Through DHCP

The following example shows how to configure two Ethernet interfaces to obtain the next-hop device IP address from the DHCP server:

```
Switch(config)# ip route 10.10.10.0 255.255.255.0 dhcp 200
Switch(config)# ip route 10.10.20.1 255.255.255.255 ethernet 1 dhcp
```


Additional References for the Cisco IOS DHCP Server

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Catalyst 4500 commands	Cisco IOS <<technology>> Command Reference

Standards & RFCs

Standard/RFC	Title
RFC 951	Bootstrap Protocol (BOOTP)
RFC 1542	Clarifications and Extensions for the Bootstrap Protocol
RFC 2131	Dynamic Host Configuration Protocol
RFC 2132	DHCP Options and BOOTP Vendor Extensions

MIBs

MIB	MIBs Link
•	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for the IOS DHCP Server

Table 4 lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.


Note

Table 4 lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 4 Feature Information for the IOS DHCP Server

Feature Name	Feature Information
DHCP Server Import All Enhancement	The DHCP Server Import All Enhancement feature is an enhancement to the import all command. Prior to this feature, the options imported through the import all command were overwritten by those imported by another subsystem. Through this feature, options imported by multiple subsystems can coexist in the DHCP address pool. When the session is terminated or the lease is released, the imported options are cleared.
DHCP Server Multiple Subnet	The DHCP Server Multiple Subnet feature enables multiple subnets to be configured under the same DHCP address pool. The following commands were introduced or modified: network(DHCP), override default-router.
DHCP Server Option to Ignore all BOOTP Requests	The DHCP Server Option to Ignore all BOOTP Requests feature allows the Cisco IOS DHCP server to selectively ignore and not reply to received Bootstrap Protocol (BOOTP) request packets. The following command was introduced or modified: ip dhcp bootp ignore.

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