



Configuring DHCP Features

This chapter describes how to configure Dynamic Host Configuration Protocol (DHCP) snooping and the option-82 data insertion features on the Catalyst 3750 switch. Unless otherwise noted, the term *switch* refers to a standalone switch and to a switch stack.



Note

For complete syntax and usage information for the commands used in this chapter, see the command reference for this release, and refer to the “DHCP Commands” section in the *Cisco IOS IP Command Reference, Volume 1 of 3: Addressing and Services, Release 12.2*.

This chapter consists of these sections:

- [Understanding DHCP Features, page 19-1](#)
- [Configuring DHCP Features, page 19-4](#)
- [Displaying DHCP Information, page 19-9](#)

Understanding DHCP Features

DHCP is widely used in LAN environments to dynamically assign host IP addresses from a centralized server, which significantly reduces the overhead of administration of IP addresses. DHCP also helps conserve the limited IP address space because IP addresses no longer need to be permanently assigned to hosts; only those hosts that are connected to the network consume IP addresses.

The switch supports these DHCP features:

- [DHCP Server, page 19-2](#)
- [DHCP Relay Agent, page 19-2](#)
- [DHCP Snooping, page 19-2](#)
- [Option-82 Data Insertion, page 19-2](#)
- [DHCP Snooping and Switch Stacks, page 19-4](#)

For information about the DHCP client, refer to the “*Configuring DHCP*” section of the “*IP Addressing and Services*” section of the *Cisco IOS IP Configuration Guide, Release 12.2*.

DHCP Server

The DHCP server assigns IP addresses from specified address pools on a switch or router to DHCP clients and manages them. If the DHCP server cannot give the DHCP client the requested configuration parameters from its database, it can forward the request to one or more secondary DHCP servers defined by the network administrator.

DHCP Relay Agent

A DHCP relay agent is a Layer 3 device that forwards DHCP packets between clients and servers. Relay agents forward requests and replies between clients and servers when they are not on the same physical subnet. Relay agent forwarding is different from the normal Layer 2 forwarding, in which IP datagrams are switched transparently between networks. Relay agents receive DHCP messages and generate new DHCP messages to send on egress interfaces.

DHCP Snooping

DHCP snooping is a DHCP security feature that provides network security by filtering untrusted DHCP messages and by building and maintaining a DHCP snooping binding table. An untrusted message is a message that is received from outside the network or firewall that can cause traffic attacks within your network. When you use DHCP snooping in a service-provider environment, an untrusted message is sent from a device that is not in the service-provider network, such as a customer's switch. Messages from unknown devices are untrusted because they can be sources of traffic attacks.

The DHCP snooping binding table contains the MAC address, the IP address, the lease time, the binding type, the VLAN number, and the interface information that corresponds to the local untrusted interfaces of a switch; it does not contain information regarding hosts interconnected with a trusted interface.

In a service-provider network, a trusted interface is connected to a port on a device in the same network. An untrusted interface is connected to an untrusted interface in the network or to an interface on a device that is not in the network.

DHCP snooping acts like a firewall between untrusted hosts and DHCP servers. It also gives you a way to differentiate between untrusted interfaces connected to the end user and trusted interfaces connected to the DHCP server or another switch. For DHCP snooping to function properly, all DHCP servers must be connected to the switch through trusted interfaces.

When a switch receives a packet on an untrusted interface and the interface belongs to a VLAN in which DHCP snooping is enabled, it verifies that the source MAC address and the DHCP client hardware address match (the default). If the addresses match, the switch forwards the packet. If the addresses do not match, the switch drops the packet.

Option-82 Data Insertion

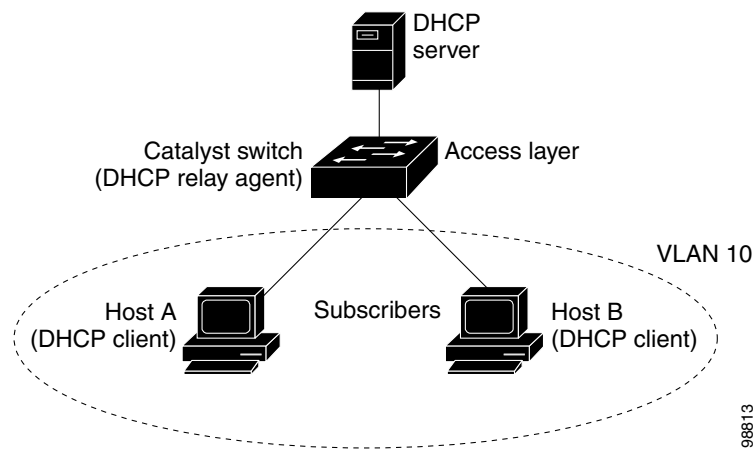
In residential, metropolitan Ethernet-access environments, DHCP can centrally manage the IP address assignments for a large number of subscribers. When the DHCP option-82 feature is enabled on the switch, a subscriber device is identified by the switch port through which it connects to the network (in addition to its MAC address). Multiple hosts on the subscriber LAN can be connected to the same port on the access switch and are uniquely identified.

**Note**

The DHCP option-82 feature is supported only when DHCP snooping is enabled globally and on the VLANs to which subscriber devices using this feature are assigned.

Figure 19-1 is an example of a metropolitan Ethernet network in which a centralized DHCP server assigns IP addresses to subscribers connected to the switch at the access layer. Because the DHCP clients and their associated DHCP server do not reside on the same IP network or subnet, a DHCP relay agent (the Catalyst switch) is configured with a helper address to enable broadcast forwarding and to transfer DHCP messages between the clients and the server.

Figure 19-1 DHCP Relay Agent in a Metropolitan Ethernet Network



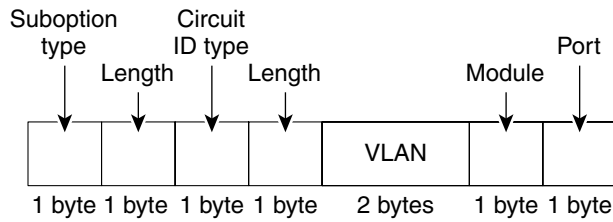
When you enable the DHCP snooping information option 82 on the switch, this sequence of events occurs:

- The host (DHCP client) generates a DHCP request and broadcasts it on the network.
- When the switch receives the DHCP request, it adds the option-82 information in the packet. The option-82 information contains the switch MAC address (the remote ID suboption) and the port identifier, **vlan-mod-port**, from which the packet is received (the circuit ID suboption).
- If the IP address of the relay agent is configured, the switch adds this IP address in the DHCP packet.
- The switch forwards the DHCP request that includes the option-82 field to the DHCP server.
- The DHCP server receives the packet. If the server is option-82-capable, it can use 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. Then the DHCP server echoes the option-82 field in the DHCP reply.
- The DHCP server unicasts the reply to the switch if the request was relayed to the server by the switch. The switch verifies that it originally inserted the option-82 data by inspecting the remote ID and possibly the circuit ID fields. The switch removes the option-82 field and forwards the packet to the switch port that connects to the DHCP client that sent the DHCP request.

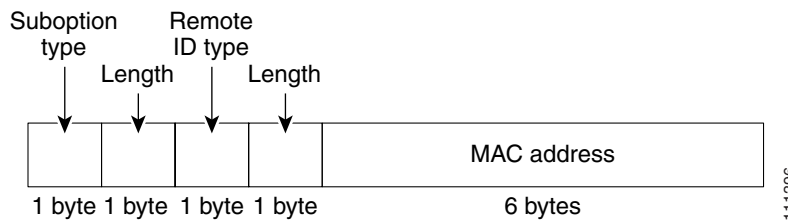
Figure 19-2 shows the packet formats for the remote ID suboption and the circuit ID suboption. For the circuit ID suboption, the module number corresponds to the switch number in the stack. The switch uses the packet formats when DHCP snooping is globally enabled and when the **ip dhcp snooping information option** global configuration command is entered.

Figure 19-2 Suboption Packet Formats

Circuit ID Suboption Frame Format



Remote ID Suboption Frame Format



DHCP Snooping and Switch Stacks

DHCP snooping is managed on the stack master. When a new switch joins the stack, the switch receives the DHCP snooping configuration from the stack master. When a member leaves the stack, all DHCP snooping address bindings associated with the switch age out.

When a stack merge occurs, all DHCP snooping bindings in the stack master are lost if it is no longer the stack master. With a stack partition, the existing stack master is unchanged, and the bindings belonging to the partitioned switches age out. The new master of the partitioned stack begins processing the new incoming DHCP packets. For more information about switch stacks, see [Chapter 5, “Managing Switch Stacks.”](#)

Configuring DHCP Features

These sections describe how to configure the DHCP server, the DHCP relay agent, DHCP snooping, and option 82 on your switch:

- [Default DHCP Configuration, page 19-5](#)
- [DHCP Snooping Configuration Guidelines, page 19-5](#)
- [Configuring the DHCP Server, page 19-6](#)
- [DHCP Server and Switch Stacks, page 19-6](#)
- [Configuring the DHCP Relay Agent, page 19-6](#)
- [Specifying the Packet Forwarding Address, page 19-7](#)
- [Enabling DHCP Snooping and Option 82, page 19-8](#)

Default DHCP Configuration

Table 19-1 shows the default DHCP configuration.

Table 19-1 Default DHCP Configuration

Feature	Default Setting
DHCP server	Enabled ¹
DHCP relay agent	Enabled ²
DHCP packet forwarding address	None configured
Checking the relay agent information	Enabled (invalid messages are dropped) ²
DHCP relay agent forwarding policy	Replace the existing relay agent information ²
DHCP snooping enabled globally	Disabled
DHCP snooping information option	Enabled
DHCP snooping limit rate	None configured
DHCP snooping trust	Untrusted
DHCP snooping VLAN	Disabled
DHCP snooping MAC address verification	Enabled

1. The switch responds to DHCP requests only if it is configured as a DHCP server.
2. The switch relays DHCP packets only if the IP address of the DHCP server is configured on the SVI of the DHCP client.

DHCP Snooping Configuration Guidelines

These are the configuration guidelines for DHCP snooping.

- You must globally enable DHCP snooping on the switch.
- DHCP snooping is not active until DHCP snooping is enabled on a VLAN.
- Before globally enabling DHCP snooping on the switch, make sure that the devices acting as the DHCP server and the DHCP relay agent are configured and enabled.
- When you globally enable DHCP snooping on the switch, these Cisco IOS commands are not available until snooping is disabled. If you enter these commands, the switch returns an error message, and the configuration is not applied.
 - **ip dhcp relay information check** global configuration command
 - **ip dhcp relay information policy** global configuration command
 - **ip dhcp relay information trust-all** global configuration command
 - **ip dhcp relay information trusted** interface configuration command
- Before configuring the DHCP snooping information option on your switch, be sure to configure the device that is acting as the DHCP server. For example, you must specify the IP addresses that the DHCP server can assign or exclude, or you must configure DHCP options for these devices.
- Before configuring the DHCP relay agent on your switch, make sure to configure the device that is acting as the DHCP server. For example, you must specify the IP addresses that the DHCP server can assign or exclude, configure DHCP options for devices, or set up the DHCP database agent.

- If the DHCP relay agent is enabled but DHCP snooping is disabled, the DHCP option-82 data insertion feature is not supported.
- If a switch port is connected to a DHCP server, configure a port as trusted by entering the **ip dhcp snooping trust** interface configuration command.
- If a switch port is connected to a DHCP client, configure a port as untrusted by entering the **no ip dhcp snooping trust** interface configuration command.

Configuring the DHCP Server

The switch can act as a DHCP server. By default, the Cisco IOS DHCP server and relay agent features are enabled on your switch but are not configured. These features are not operational.

For procedures to configure the switch as a DHCP server, refer to the “Configuring DHCP” section of the “IP addressing and Services” section of the *Cisco IOS IP Configuration Guide, Release 12.2*.

DHCP Server and Switch Stacks

The DHCP binding database is managed on the stack master. When a new stack master is assigned, the new master downloads the saved binding database from the TFTP server. If the stack master fails, all unsaved bindings are lost. The IP addresses associated with the lost bindings are released. You should configure an automatic backup by using the **ip dhcp database url [timeout seconds | write-delay seconds]** global configuration command.

When a stack merge occurs, the stack master that becomes a stack member loses all of the DHCP lease bindings. With a stack partition, the new master in the partition acts as a new DHCP server without any of the existing DHCP lease bindings.

For more information about the switch stack, see [Chapter 5, “Managing Switch Stacks.”](#)

Configuring the DHCP Relay Agent

Beginning in privileged EXEC mode, follow these steps to enable the DHCP relay agent on the switch:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	service dhcp	Enable the DHCP server and relay agent on your switch. By default, this feature is enabled.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable the DHCP server and relay agent, use the **no service dhcp** global configuration command.

Refer to the “Configuring DHCP” section of the “IP Addressing and Services” section of the *Cisco IOS IP Configuration Guide, Release 12.2* for these procedures:

- Checking (validating) the relay agent information
- Configuring the relay agent forwarding policy

Specifying the Packet Forwarding Address

If the DHCP server and the DHCP clients are on different networks or subnets, you must configure the switch with the **ip helper-address** *address* interface configuration command. The general rule is to configure the command on the Layer 3 interface closest to the client. The address used in the **ip helper-address** command can be a specific DHCP server IP address, or it can be the network address if other DHCP servers are on the destination network segment. Using the network address enables any DHCP server to respond to requests.

Beginning in privileged EXEC mode, follow these steps to specify the packet forwarding address:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	interface vlan <i>vlan-id</i>	Enter interface configuration mode, and create a switch virtual interface.
Step 3	ip address <i>ip-address subnet-mask</i>	Configure the interface with an IP address and an IP subnet.
Step 4	ip helper-address <i>address</i>	Specify the DHCP packet forwarding address. The helper address can be a specific DHCP server address, or it can be the network address if other DHCP servers are on the destination network segment. Using the network address enables other servers to respond to DHCP requests. If you have multiple servers, you can configure one helper address for each server.
Step 5	exit	Return to global configuration mode.
Step 6	interface range <i>port-range</i> or interface <i>interface-id</i>	Configure multiple physical ports that are connected to the DHCP clients, and enter interface range configuration mode. or Configure a single physical port that is connected to the DHCP client, and enter interface configuration mode.
Step 7	switchport mode access	Define the VLAN membership mode for the port.
Step 8	switchport access vlan <i>vlan-id</i>	Assign the ports to the same VLAN as configured in Step 2.
Step 9	end	Return to privileged EXEC mode.
Step 10	show running-config	Verify your entries.
Step 11	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To remove the DHCP packet forwarding address, use the **no ip helper-address** *address* interface configuration command.

Enabling DHCP Snooping and Option 82

Beginning in privileged EXEC mode, follow these steps to enable DHCP snooping on the switch.

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	ip dhcp snooping	Enable DHCP snooping globally.
Step 3	ip dhcp snooping vlan <i>vlan-range</i>	Enable DHCP snooping on a VLAN or range of VLANs. The range is 1 to 4094. You can enter a single VLAN ID identified by VLAN ID number, a series of VLAN IDs separated by commas, a range of VLAN IDs separated by hyphens, or a range of VLAN IDs separated by entering the starting and ending VLAN IDs separated by a space.
Step 4	ip dhcp snooping information option	Enable the switch to insert and remove DHCP relay information (option-82 field) in forwarded DHCP request messages to the DHCP server. The default is enabled.
Step 5	interface <i>interface-id</i>	Enter interface configuration mode, and specify the interface to be configured.
Step 6	ip dhcp snooping trust	(Optional) Configure the interface as trusted or untrusted. You can use the no keyword to configure an interface to receive messages from an untrusted client. The default is untrusted.
Step 7	ip dhcp snooping limit rate <i>rate</i>	(Optional) Configure the number of DHCP packets per second than an interface can receive. The range is 1 to 4294967294. The default is no rate limit configured. Note We recommend an untrusted rate limit of not more than 100 packets per second. If you configure rate limiting for trusted interfaces, you might need to increase the the rate limit if the port is a trunk port assigned to more than one VLAN on which DHCP snooping is enabled.
Step 8	ip dhcp snooping verify mac-address	(Optional) Configure the switch to verify that the source MAC address in a DHCP packet that is received on untrusted ports matches the client hardware address in the packet. The default is to verify that the source MAC address matches the client hardware address in the packet.
Step 9	end	Return to privileged EXEC mode.
Step 10	show running-config	Verify your entries.
Step 11	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable DHCP snooping, use the **no ip dhcp snooping** global configuration command. To disable DHCP snooping on a VLAN or range of VLANs, use the **no ip dhcp snooping vlan** *vlan-range* global configuration command. To disable the insertion and removal of the option-82 field, use the **no ip dhcp snooping information option** global configuration command.

This example shows how to enable DHCP snooping globally and on VLAN 10 and to configure a rate limit of 100 packets per second on a port:

```
Switch(config)# ip dhcp snooping
Switch(config)# ip dhcp snooping vlan 10
Switch(config)# ip dhcp snooping information option
Switch(config)# interface gigabitethernet2/0/1
Switch(config-if)# ip dhcp snooping limit rate 100
```

Displaying DHCP Information

You can display a DHCP snooping binding table and configuration information for all interfaces on a switch.

Displaying a Binding Table

The DHCP snooping binding table for each switch has binding entries that correspond to untrusted ports. The table does not have information about hosts interconnected with a trusted port.

This example shows how to display the DHCP snooping binding entries for a switch.

```
Switch# show ip dhcp snooping binding
-----
MacAddress          IpAddress          Lease(sec)  Type             VLAN  Interface
-----
01:02:03:04:05:06  10.1.2.150         9837        dhcp-snooping   20    GigabitEthernet2/0/1
00:D0:B7:1B:35:DE  10.1.2.151         237         dhcp-snooping   20    GigabitEthernet2/0/1
00:00:00:00:00:01  40.0.0.46          286         dhcp-snooping   20    GigabitEthernet2/0/2
00:00:00:00:00:03  42.0.0.33          286         dhcp-snooping   22    GigabitEthernet2/0/2
00:00:00:00:00:02  41.0.0.53          286         dhcp-snooping   21    GigabitEthernet2/0/2
```

Table 19-2 describes the fields in the `show ip dhcp snooping binding` command output.

Table 19-2 *show ip dhcp snooping binding Command Output*

Field	Description
MAC Address	Client hardware MAC address
IP Address	Client IP address assigned from the DHCP server
Lease (seconds)	Remaining lease time for the IP address
Type	Binding type
VLAN	VLAN number of the client interface
Interface	Interface that connects to the DHCP client host

Displaying the DHCP Snooping Configuration

This example shows how to display the DHCP snooping configuration for a switch.

```
Switch# show ip dhcp snooping
Switch DHCP snooping is enabled
DHCP snooping is configured on following VLANs:
40-42
Insertion of option 82 is enabled
Verification of hwaddr field is enabled
Interface                Trusted      Rate limit (pps)
-----                -
gigabitethernet1/0/1      yes         unlimited
gigabitethernet2/0/2      no          100
gigabitethernet2/0/3      yes         unlimited
gigabitethernet2/0/4      yes         unlimited
```