Configuring DHCP Snooping

This chapter describes how to configure Dynamic Host Configuration Protocol (DHCP) snooping in Cisco IOS Release 12.2SX.

The following sections describe the DHCP snooping feature:

- Overview of DHCP Snooping, page 54-2
- Trusted and Untrusted Sources, page 54-2
- DHCP Snooping Binding Database, page 54-3
- Packet Validation, page 54-3
- DHCP Snooping Option-82 Data Insertion, page 54-3
- Overview of the DHCP Snooping Database Agent, page 54-5
Overview of DHCP Snooping

DHCP snooping is a security feature that acts like a firewall between untrusted hosts and trusted DHCP servers. The DHCP snooping feature performs the following activities:

- Validates DHCP messages received from untrusted sources and filters out invalid messages.
- Rate-limits DHCP traffic from trusted and untrusted sources.
- Builds and maintains the DHCP snooping binding database, which contains information about untrusted hosts with leased IP addresses.
- Utilizes the DHCP snooping binding database to validate subsequent requests from untrusted hosts.

Other security features, such as dynamic ARP inspection (DAI), also use information stored in the DHCP snooping binding database.

DHCP snooping is enabled on a per-VLAN basis. By default, the feature is inactive on all VLANs. You can enable the feature on a single VLAN or a range of VLANs.

The DHCP snooping feature is implemented in software on the route processor (RP). Therefore, all DHCP messages for enabled VLANs are intercepted in the PFC and directed to the RP for processing.

Trusted and Untrusted Sources

The DHCP snooping feature determines whether traffic sources are trusted or untrusted. An untrusted source may initiate traffic attacks or other hostile actions. To prevent such attacks, the DHCP snooping feature filters messages and rate-limits traffic from untrusted sources.

In an enterprise network, devices under your administrative control are trusted sources. These devices include the switches, routers, and servers in your network. Any device beyond the firewall or outside your network is an untrusted source. Host ports and unknown DHCP servers are generally treated as untrusted sources.

A DHCP server that is on your network without your knowledge on an untrusted port is called a spurious DHCP server. A spurious DHCP server is any piece of equipment that is loaded with DHCP server enabled. Some examples are desktop systems and laptop systems that are loaded with DHCP server enabled, or wireless access points honoring DHCP requests on the wired side of your network. If spurious DHCP servers remain undetected, you will have difficulties troubleshooting a network outage. You can detect spurious DHCP servers by sending dummy DHCPDISCOVER packets out to all of the DHCP servers so that a response is sent back to the switch.

In a service provider environment, any device that is not in the service provider network is an untrusted source (such as a customer switch). Host ports are untrusted sources.

In the switch, you indicate that a source is trusted by configuring the trust state of its connecting interface.

The default trust state of all interfaces is untrusted. You must configure DHCP server interfaces as trusted. You can also configure other interfaces as trusted if they connect to devices (such as switches or routers) inside your network. You usually do not configure host port interfaces as trusted.

Note

For DHCP snooping to function properly, all DHCP servers must be connected to the switch through trusted interfaces, as untrusted DHCP messages will be forwarded only to trusted interfaces.
DHCP Snooping Binding Database

The DHCP snooping binding database is also referred to as the DHCP snooping binding table.

The DHCP snooping feature dynamically builds and maintains the database using information extracted from intercepted DHCP messages. The database contains an entry for each untrusted host with a leased IP address if the host is associated with a VLAN that has DHCP snooping enabled. The database does not contain entries for hosts connected through trusted interfaces.

The DHCP snooping feature updates the database when the switch receives specific DHCP messages. For example, the feature adds an entry to the database when the switch receives a DHCPACK message from the server. The feature removes the entry in the database when the IP address lease expires or the switch receives a DHCPRELEASE message from the host.

Each entry in the DHCP snooping binding database includes the MAC address of the host, the leased IP address, the lease time, the binding type, and the VLAN number and interface information associated with the host.

Packet Validation

The switch validates DHCP packets received on the untrusted interfaces of VLANs with DHCP snooping enabled. The switch forwards the DHCP packet unless any of the following conditions occur (in which case the packet is dropped):

- The switch receives a packet (such as a DHCPOFFER, DHCPACK, DHCPNAK, or DHCPLEASEQUERY packet) from a DHCP server outside the network or firewall.
- The switch receives a packet on an untrusted interface, and the source MAC address and the DHCP client hardware address do not match. This check is performed only if the DHCP snooping MAC address verification option is turned on.
- The switch receives a DHCPRELEASE or DHCPDECLINE message from an untrusted host with an entry in the DHCP snooping binding table, and the interface information in the binding table does not match the interface on which the message was received.
- The switch receives a DHCP packet that includes a relay agent IP address that is not 0.0.0.0.

To support trusted edge switches that are connected to untrusted aggregation-switch ports, you can enable the DHCP option-82 on untrusted port feature, which enables untrusted aggregation-switch ports to accept DHCP packets that include option-82 information. Configure the port on the edge switch that connects to the aggregation switch as a trusted port.

Note

With the DHCP option-82 on untrusted port feature enabled, use dynamic ARP inspection on the aggregation switch to protect untrusted input interfaces.

DHCP Snooping 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 snooping 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.
Chapter 54  Configuring DHCP Snooping

Understanding DHCP Snooping

Figure 54-1 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 is configured with a helper address to enable broadcast forwarding and to transfer DHCP messages between the clients and the server.

![DHCP Relay Agent in a Metropolitan Ethernet Network](image)

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 IEEE 802.1X port-based authentication is enabled, the switch will also add the host’s 802.1X authenticated user identity information (the RADIUS attributes suboption) to the packet. See the “Understanding 802.1X Authentication with DHCP Snooping” section on page 60-11.
- If the IP address of the relay agent is configured, the switch adds the 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, or 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 then 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. When the client and server are on the same subnet, the server broadcasts the reply. 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.

When the previously described sequence of events occurs, the values in these fields in Figure 54-2 do not change:

- Circuit ID suboption fields
  - Suboption type
  - Length of the suboption type
- Circuit ID type
- Length of the circuit ID type

- Remote ID suboption fields
  - Suboption type
  - Length of the suboption type
  - Remote ID type
  - Length of the circuit ID type

Figure 54-2 shows the packet formats for the remote ID suboption and the circuit ID suboption. 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. For the circuit ID suboption, the module field is the slot number of the module.

**Figure 54-2 Suboption Packet Formats**

**Circuit ID Suboption Frame Format**

- Suboption type
- Circuit ID type
- Length
- Length

<table>
<thead>
<tr>
<th>1</th>
<th>6</th>
<th>0</th>
<th>4</th>
<th>VLAN</th>
<th>Module</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 byte</td>
<td>1 byte</td>
<td>1 byte</td>
<td>1 byte</td>
<td>2 bytes</td>
<td>1 byte</td>
<td>1 byte</td>
</tr>
</tbody>
</table>

**Remote ID Suboption Frame Format**

- Suboption type
- Remote ID type
- Length
- Length

<table>
<thead>
<tr>
<th>2</th>
<th>8</th>
<th>0</th>
<th>6</th>
<th>MAC address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 byte</td>
<td>1 byte</td>
<td>1 byte</td>
<td>1 byte</td>
<td>6 bytes</td>
</tr>
</tbody>
</table>

**Overview of the DHCP Snooping Database Agent**

To retain the bindings across reloads, you must use the DHCP snooping database agent. Without this agent, the bindings established by DHCP snooping are lost upon reload, and connectivity is lost as well.

The database agent stores the bindings in a file at a configured location. Upon reload, the switch reads the file to build the database for the bindings. The switch keeps the file current by writing to the file as the database changes.

The format of the file that contains the bindings is as follows:

```
<initial-checksum>
TYPE DHCP-SNOOPING
VERSION 1
BEGIN
<entry-1> <checksum-1>
```
Each entry in the file is tagged with a checksum that is used to validate the entries whenever the file is read. The <initial-checksum> entry on the first line helps distinguish entries associated with the latest write from entries that are associated with a previous write.

This is a sample bindings file:

```
3ebe1518
TYPE DHCP-SNOOPING
VERSION 1
BEGIN
  1.1.1.1 512 0001.0001.0005 3EBE2881 Gi1/1  e5e1e733
  1.1.1.1 512 0001.0001.0002 3EBE2881 Gi1/1  4b3486ec
  1.1.1.1 1536 0001.0001.0004 3EBE2881 Gi1/1  f0e02872
  1.1.1.1 1024 0001.0001.0003 3EBE2881 Gi1/1  ac41adf9
  1.1.1.1 1 0001.0001.0001 3EBE2881 Gi1/1  34b3273e
END
```

Each entry holds an IP address, VLAN, MAC address, lease time (in hex), and the interface associated with a binding. At the end of each entry is a checksum that is based on all the bytes from the start of the file through all the bytes associated with the entry. Each entry consists of 72 bytes of data, followed by a space, followed by a checksum.

Upon bootup, when the calculated checksum equals the stored checksum, the switch reads entries from the file and adds the bindings to the DHCP snooping database. If the calculated checksum does not equal the stored checksum, the entry read from the file is ignored and so are all the entries following the failed entry. The switch also ignores all those entries from the file whose lease time has expired. (This is possible because the lease time might indicate an expired time.) An entry from the file is also ignored if the interface referred to in the entry no longer exists on the system, or if it is a router port or a DHCP snooping-trusted interface.

When the switch learns of new bindings or when it loses some bindings, the switch writes the modified set of entries from the snooping database to the file. The writes are performed with a configurable delay to batch as many changes as possible before the actual write happens. Associated with each transfer is a timeout after which a transfer is aborted if it is not completed. These timers are referred to as the write delay and abort timeout.

**DHCP Snooping Host Tracking**

Release 12.2(33)SXJ2 and later releases support DHCP snooping host tracking. The DHCP snooping host tracking feature implements a cache to learn VLAN and MAC addresses to port the mapping of clients from snooped DHCP request packets and uses this information to forward snooped DHCP reply packets.

This feature improves DHCP snooping packet processing performance for DHCP reply packets by not needing to lookup the hardware VLAN and MAC address table in order to determine the port on which to send the DHCP reply packets. This feature is useful in deployments where it is not possible to use the DHCP snooping information option along with DHCP (for example, when the server does not support DHCP information option). If DHCP is configured it takes higher precedence than the DHCP snooping host tracking feature in determining the port on which to forward reply packets.

The DHCP snooping host tracking feature is off by default (see the “Enabling DHCP Snooping Host Tracking” section on page 54-11).
Default Configuration for DHCP Snooping

Table 54-1 shows all the default configuration values for each DHCP snooping option.

Table 54-1  Default Configuration Values for DHCP Snooping

<table>
<thead>
<tr>
<th>Option</th>
<th>Default Value/State</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHCP snooping</td>
<td>Disabled</td>
</tr>
<tr>
<td>DHCP snooping host tracking feature</td>
<td>Disabled</td>
</tr>
<tr>
<td>DHCP snooping information option</td>
<td>Enabled</td>
</tr>
<tr>
<td>DHCP option-82 on untrusted port feature</td>
<td>Disabled</td>
</tr>
<tr>
<td>DHCP snooping limit rate</td>
<td>None</td>
</tr>
<tr>
<td>DHCP snooping trust</td>
<td>Untrusted</td>
</tr>
<tr>
<td>DHCP snooping vlan</td>
<td>Disabled</td>
</tr>
<tr>
<td>DHCP snooping spurious server detection</td>
<td>Disabled</td>
</tr>
<tr>
<td>DHCP snooping detect spurious interval</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>

DHCP Snooping Configuration Restrictions and Guidelines

These sections provide DHCP snooping configuration restrictions and guidelines:

- DHCP Snooping Configuration Restrictions, page 54-7
- DHCP Snooping Configuration Guidelines, page 54-8
- Minimum DHCP Snooping Configuration, page 54-8

DHCP Snooping Configuration Restrictions

When configuring DHCP snooping, note these restrictions:

- The DHCP snooping database stores at least 8,000 bindings.
- When DHCP snooping is enabled, these Cisco IOS DHCP commands are not available on the switch:
  - `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 option` global configuration command
  - `ip dhcp relay information trusted` interface configuration command

If you enter these commands, the switch returns an error message, and the configuration is not applied.
DHCP Snooping Configuration Guidelines

When configuring DHCP snooping, follow these guidelines:

- DHCP snooping is not active until you enable the feature on at least one VLAN, and enable DHCP globally on the switch.
- 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.
- For DHCP server configuration information, see “Configuring DHCP” in the Cisco IOS IP and IP Routing Configuration Guide at:
- If a Layer 2 LAN port is connected to a DHCP server, configure the port as trusted by entering the ip dhcp snooping trust interface configuration command.
- If a Layer 2 LAN port is connected to a DHCP client, configure the port as untrusted by entering the no ip dhcp snooping trust interface configuration command.
- You can enable DHCP snooping on private VLANs:
  - If DHCP snooping is enabled, any primary VLAN configuration is propagated to its associated secondary VLANs.
  - If DHCP snooping is configured on the primary VLAN and you configure DHCP snooping with different settings on an associated secondary VLAN, the configuration on the secondary VLAN does not take effect.
  - If DHCP snooping is not configured on the primary VLAN and you configure DHCP snooping on a secondary VLAN, the configuration takes affect only on the secondary VLAN.
  - When you manually configure DHCP snooping on a secondary VLAN, this message appears:
    DHCP Snooping configuration may not take effect on secondary vlan XXX
  - The show ip dhcp snooping command displays all VLANs (both primary and secondary) that have DHCP snooping enabled.
- If DHCP snooping information option is configured, it takes higher precedence than the DHCP snooping host tracking feature in determining the port on which to forward reply packets.

Minimum DHCP Snooping Configuration

The minimum configuration steps for the DHCP snooping feature are as follows:

1. Define and configure the DHCP server.
   For DHCP server configuration information, see “Configuring DHCP” in the Cisco IOS IP and IP Routing Configuration Guide at:
2. Enable DHCP snooping on at least one VLAN.
   By default, DHCP snooping is inactive on all VLANs. See the “Enabling DHCP Snooping on VLANs” section on page 54-13
3. Ensure that DHCP server is connected through a trusted interface.
   By default, the trust state of all interfaces is untrusted. See the “Configuring the DHCP Trust State on Layer 2 LAN Interfaces” section on page 54-14
4. Configure the DHCP snooping database agent.
   This step ensures that database entries are restored after a restart or switchover. See the “Configuring the DHCP Snooping Database Agent” section on page 54-16

5. Enable DHCP snooping globally.
   The feature is not active until you complete this step. See the “Enabling DHCP Snooping Globally” section on page 54-9

If you are configuring the switch for DHCP relay, the following additional steps are required:

1. Define and configure the DHCP relay agent IP address.
   If the DHCP server is in a different subnet from the DHCP clients, configure the server IP address in the helper address field of the client side VLAN.

2. Configure DHCP option-82 on untrusted port.
   See the “Enabling the DHCP Option-82 on Untrusted Port Feature” section on page 54-11

### Configuring DHCP Snooping

These sections describe how to configure DHCP snooping:

- Enabling DHCP Snooping Globally, page 54-9
- Enabling DHCP Option-82 Data Insertion, page 54-10
- Enabling the DHCP Option-82 on Untrusted Port Feature, page 54-11
- Enabling DHCP Snooping Host Tracking, page 54-11
- Enabling DHCP Snooping MAC Address Verification, page 54-12
- Enabling DHCP Snooping on VLANs, page 54-13
- Configuring the DHCP Trust State on Layer 2 LAN Interfaces, page 54-14
- Configuring Spurious DHCP Server Detection, page 54-14
- Configuring DHCP Snooping Rate Limiting on Layer 2 LAN Interfaces, page 54-15
- Configuring the DHCP Snooping Database Agent, page 54-16
- Configuration Examples for the Database Agent, page 54-16
- Displaying a Binding Table, page 54-19

### Enabling DHCP Snooping Globally

**Note**

Configure this command as the last configuration step (or enable the DHCP feature during a scheduled maintenance period) because after you enable DHCP snooping globally, the switch drops DHCP requests until you configure the ports.
To enable DHCP snooping globally, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# ip dhcp snooping</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config)# do show ip dhcp snooping</td>
</tr>
</tbody>
</table>

This example shows how to enable DHCP snooping globally:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# ip dhcp snooping
Router(config)# do show ip dhcp snooping | include Switch
Switch DHCP snooping is enabled
```

**Note** When DHCP snooping is disabled and DAI is enabled, the switch shuts down all the hosts because all ARP entries in the ARP table will be checked against a nonexistent DHCP database. When DHCP snooping is disabled or in non-DHCP environments, use ARP ACLs to permit or to deny ARP packets.

### Enabling DHCP Option-82 Data Insertion

To enable DHCP option-82 data insertion, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# ip dhcp snooping information option</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config)# ip dhcp snooping information option replace</td>
</tr>
<tr>
<td></td>
<td>Or: Router(config-if)# ip dhcp snooping information option replace</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router(config)# do show ip dhcp snooping</td>
</tr>
</tbody>
</table>

This example shows how to disable DHCP option-82 data insertion:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# no ip dhcp snooping information option
Router(config)# do show ip dhcp snooping | include 82
Insertion of option 82 is disabled
```

This example shows how to enable DHCP option-82 data insertion:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# ip dhcp snooping information option
Router(config)# do show ip dhcp snooping | include 82
Insertion of option 82 is enabled
```
Enabling the DHCP Option-82 on Untrusted Port Feature

With the DHCP option-82 on untrusted port feature enabled, the switch does not drop DHCP packets that include option-82 information that are received on untrusted ports. Do not enter the `ip dhcp snooping information option allowed-untrusted` command on an aggregation switch to which any untrusted devices are connected.

To enable untrusted ports to accept DHCP packets that include option-82 information, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables untrusted ports to accept incoming DHCP packets with option-82 information. Available in interface configuration mode in releases where CSCto29645 is resolved. The default setting is disabled.</td>
</tr>
<tr>
<td>Router(config)# ip dhcp snooping information option allow-untrusted</td>
<td>Enables untrusted ports to accept incoming DHCP packets with option-82 information. Available in interface configuration mode in releases where CSCto29645 is resolved. The default setting is disabled.</td>
</tr>
<tr>
<td>Or:</td>
<td></td>
</tr>
<tr>
<td>Router(config-if)# ip dhcp snooping information option allow-untrusted</td>
<td>Enables untrusted ports to accept incoming DHCP packets with option-82 information. Available in interface configuration mode in releases where CSCto29645 is resolved. The default setting is disabled.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Verifies the configuration.</td>
</tr>
<tr>
<td>Router(config)# do show ip dhcp snooping</td>
<td>Verifies the configuration.</td>
</tr>
</tbody>
</table>

This example shows how to enable the DHCP option-82 on untrusted port feature:

```bash
Router# configure terminal
Enter configuration commands, one line. End with CNTL/Z.
Router(config)# ip dhcp snooping information option allow-untrusted
Router(config)#
```

Enabling DHCP Snooping Host Tracking

To configure the DHCP snooping host tracking feature, perform one or more of the following tasks:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# ip dhcp snooping track host</td>
<td>Enables the DHCP snooping host tracking feature.</td>
</tr>
<tr>
<td>Router# show ip dhcp snooping track host</td>
<td>Displays the contents of the DHCP snooping host tracking cache.</td>
</tr>
<tr>
<td>Router# show ip dhcp snooping track host statistics</td>
<td>Displays the DHCP snooping host track statistics.</td>
</tr>
<tr>
<td>Router# clear ip dhcp snooping track host</td>
<td>Clears the DHCP snooping host track cache.</td>
</tr>
<tr>
<td>Router# clear ip dhcp snooping track hosts statistics</td>
<td>Clears the DHCP snooping host track statistics.</td>
</tr>
</tbody>
</table>

This example shows how to enable the DHCP snooping host tracking feature:

```bash
Router# configure terminal
Enter configuration commands, one line. End with CNTL/Z.
Router(config)# no ip dhcp snooping information option
Router(config)# ip dhcp snooping track host
Router(config)# exit
```
This example shows how to display the contents of the DHCP snooping host tracking cache:

```plaintext
Router# show ip dhcp snooping track host

VLAN   interface     mac           time left
----------------------------------------------
203     Gi3/47      000a.cb00.126d     expired
204     Gi11/47     000a.cc00.1262     expired
202     Gi2/47      000a.ca00.125d     expired
204     Gi11/47     000a.cc00.1263     expired
203     Gi3/47      000a.cb00.1276     expired
201     Gi1/47      000a.c900.1273     expired
```

This example shows how to display the statistics associated with DHCP snooping host tracking feature:

```plaintext
Router# show ip dhcp snooping track host statistics

DHCP host track entries            = 168
DHCP host track hits               = 34028
DHCP host track misses             = 0
DHCP host track limit exceeded     = 0
```

### Enabling DHCP Snooping MAC Address Verification

With DHCP snooping MAC address verification enabled, DHCP snooping verifies that the source MAC address and the client hardware address match in DHCP packets that are received on untrusted ports. The source MAC address is a Layer 2 field associated with the packet, and the client hardware address is a Layer 3 field in the DHCP packet.

To enable DHCP snooping MAC address verification, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# ip dhcp snooping verify mac-address</code></td>
<td>Enables DHCP snooping MAC address verification.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>`Router(config)# do show ip dhcp snooping</td>
<td>include hwaddr`</td>
</tr>
</tbody>
</table>

This example shows how to disable DHCP snooping MAC address verification:

```plaintext
Router(config)# no ip dhcp snooping verify mac-address
Router(config)# do show ip dhcp snooping | include hwaddr
Verication of hwaddr field is disabled
```

This example shows how to enable DHCP snooping MAC address verification:

```plaintext
Router(config)# ip dhcp snooping verify mac-address
Router(config)# do show ip dhcp snooping | include hwaddr
Verification of hwaddr field is enabled
```

### Command Purpose

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><code>ip dhcp snooping verify mac-address</code></td>
<td>Enables DHCP snooping MAC address verification.</td>
</tr>
<tr>
<td>2</td>
<td>`do show ip dhcp snooping</td>
<td>include hwaddr`</td>
</tr>
</tbody>
</table>
Enabling DHCP Snooping on VLANs

By default, the DHCP snooping feature is inactive on all VLANs. You may enable the feature on a single VLAN or a range of VLANs.

When enabled on a VLAN, the DHCP snooping feature creates four entries in the VACL table in the MFC3. These entries cause the PFC3 to intercept all DHCP messages on this VLAN and send them to the RP. The DHCP snooping feature is implemented in software on the RP.

To enable DHCP snooping on VLANs, perform this task:

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>`Router(config)# ip dhcp snooping vlan {vlan_ID}</td>
<td>{vlan_range}</td>
</tr>
<tr>
<td>2</td>
<td>`Router(config)# do show ip dhcp snooping</td>
<td>Verifies the configuration.</td>
</tr>
</tbody>
</table>

You can configure DHCP snooping for a single VLAN or a range of VLANs:

- To configure a single VLAN, enter a single VLAN number.
- To configure a range of VLANs, enter a beginning and an ending VLAN number or a dash-separated pair of VLAN numbers.
- You can enter a comma-separated list of VLAN numbers and dash-separated pairs of VLAN numbers.

This example shows how to enable DHCP snooping on VLANs 10 through 12:

`Router# configure terminal`
`Router(config)# ip dhcp snooping vlan 10 12`
`Router(config)#`

This example shows another way to enable DHCP snooping on VLANs 10 through 12:

`Router# configure terminal`
`Router(config)# ip dhcp snooping vlan 10-12`

This example shows another way to enable DHCP snooping on VLANs 10 through 12:

`Router# configure terminal`
`Router(config)# ip dhcp snooping vlan 10,11,12`

This example shows how to enable DHCP snooping on VLANs 10 through 12 and VLAN 15:

`Router# configure terminal`
`Router(config)# ip dhcp snooping vlan 10-12,15`

This example shows how to verify the configuration:

`Router(config)# do show ip dhcp snooping`
`Switch DHCP snooping is enabled`
`DHCP snooping is configured on following VLANs: 10-12,15`
`DHCP snooping is operational on following VLANs: none`
`DHCP snooping is configured on the following Interfaces: none`
`Insertion of option 82 is enabled`
`Verification of hwaddr field is enabled`

<table>
<thead>
<tr>
<th>Interface</th>
<th>Trusted</th>
<th>Rate limit (pps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>------------</td>
<td>---------</td>
<td>------------------</td>
</tr>
</tbody>
</table>

`Router#`
Configuring the DHCP Trust State on Layer 2 LAN Interfaces

To configure DHCP trust state on a Layer 2 LAN interface, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# interface {type\ slot/port</td>
</tr>
<tr>
<td></td>
<td>Selects the interface to configure.</td>
</tr>
<tr>
<td></td>
<td>Note Select only LAN ports configured with the switchport command or Layer 2 port-channel interfaces.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config-if)# ip dhcp snooping trust</td>
</tr>
<tr>
<td></td>
<td>Configures the interface as trusted.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router(config-if)# do show ip dhcp snooping</td>
</tr>
<tr>
<td></td>
<td>Verifies the configuration.</td>
</tr>
</tbody>
</table>

This example shows how to configure Fast Ethernet port 5/12 as trusted:

```
Router# configure terminal
Router(config)# interface FastEthernet 5/12
Router(config-if)# ip dhcp snooping trust
Router(config-if)# do show ip dhcp snooping | begin pps
Interface                 Trusted     Rate limit (pps)
------------------------     -------     ----------------
FastEthernet5/12             yes         unlimited
Router#
```

This example shows how to configure Fast Ethernet port 5/12 as untrusted:

```
Router# configure terminal
Router(config)# interface FastEthernet 5/12
Router(config-if)# no ip dhcp snooping trust
Router(config-if)# do show ip dhcp snooping | begin pps
Interface                 Trusted     Rate limit (pps)
------------------------     -------     ----------------
FastEthernet5/12             no          unlimited
Router#
```

Configuring Spurious DHCP Server Detection

To detect and locate spurious DHCP servers, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# ip dhcp snooping detect spurious vlan range</td>
</tr>
<tr>
<td></td>
<td>Enables detection of spurious DHCP servers on a specified VLAN range.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config)# ip dhcp snooping detect spurious interval time</td>
</tr>
<tr>
<td></td>
<td>Sets the interval time, the default is 30 minutes.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router# show ip dhcp snooping detect spurious</td>
</tr>
<tr>
<td></td>
<td>Verifies spurious DHCP server detection.</td>
</tr>
</tbody>
</table>

This example shows how to configure DHCP spurious server detection on VLANs 20 to 25 and set the interval to 50 minutes:

```
Router# configure terminal
Router(config)# ip dhcp snooping detect spurious vlan 20-25
```
Configuring DHCP Snooping Rate Limiting on Layer 2 LAN Interfaces

To configure DHCP snooping rate limiting on a Layer 2 LAN interface, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# interface {type slot/port</td>
</tr>
<tr>
<td></td>
<td>Note: Select only LAN ports configured with the switchport command or Layer 2 port-channel interfaces.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config-if)# ip dhcp snooping limit rate rate</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router(config-if)# do show ip dhcp snooping</td>
</tr>
<tr>
<td></td>
<td>begin pps</td>
</tr>
</tbody>
</table>

1. *type* = fastethernet, gigabitethernet, or tengigabitethernet

When configuring DHCP snooping rate limiting on a Layer 2 LAN interface, note the following information:

- We recommend an untrusted rate limit of not more than 100 packets per second (pps).
- If you configure rate limiting for trusted interfaces, you might need to increase the rate limit on trunk ports carrying more than one VLAN on which DHCP snooping is enabled.
- DHCP snooping puts ports where the rate limit is exceeded into the error-disabled state.

This example shows how to configure DHCP packet rate limiting to 100 pps on Fast Ethernet port 5/12:

Router# configure terminal
Router(config)# interface FastEthernet 5/12
Router(config-if)# ip dhcp snooping limit rate 100
Router(config-if)# do show ip dhcp snooping | begin pps
<table>
<thead>
<tr>
<th>Interface</th>
<th>Trusted</th>
<th>Rate limit (pps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FastEthernet5/12</td>
<td>no</td>
<td>100</td>
</tr>
</tbody>
</table>
Router#
Configuring the DHCP Snooping Database Agent

To configure the DHCP snooping database agent, perform one or more of the following tasks:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# ip dhcp snooping database { _url</td>
<td>write-delay seconds</td>
</tr>
<tr>
<td>Router# show ip dhcp snooping database [detail]</td>
<td>Displays the current operating state of the database agent and statistics associated with the transfers.</td>
</tr>
<tr>
<td>Router# clear ip dhcp snooping database statistics</td>
<td>Clears the statistics associated with the database agent.</td>
</tr>
<tr>
<td>Router# renew ip dhcp snooping database [validation none] [url]</td>
<td>Requests the read entries from a file at the given URL.</td>
</tr>
<tr>
<td>Router# ip dhcp snooping binding mac_address vlan vlan_ID ip_address interface ifname expiry lease_in_seconds</td>
<td>Adds bindings to the snooping database.</td>
</tr>
</tbody>
</table>

When configuring the DHCP snooping database agent, note the following information:

- The DHCP snooping database stores at least 8,000 bindings.
- Store the file on a TFTP server to avoid consuming storage space on the switch storage devices.
- When a switchover occurs, if the file is stored in a remote location accessible through TFTP, the newly active supervisor engine can use the binding list.
- Network-based URLs (such as TFTP and FTP) require that you create an empty file at the configured URL before the switch can write the set of bindings for the first time.

Configuration Examples for the Database Agent

These sections provide examples for the database agent:

- **Example 1: Enabling the Database Agent**, page 54-16
- **Example 2: Reading Binding Entries from a TFTP File**, page 54-18
- **Example 3: Adding Information to the DHCP Snooping Database**, page 54-19

Example 1: Enabling the Database Agent

The following example shows how to configure the DHCP snooping database agent to store the bindings at a given location and to view the configuration and operating state:

```
Router# configure terminal
Router(config)# ip dhcp snooping database tftp://10.1.1.1/directory/file
Router(config)# end
Router# show ip dhcp snooping database detail
Agent URL : tftp://10.1.1.1/directory/file
Write delay Timer : 300 seconds
Abort Timer : 300 seconds
Agent Running : No
Delay Timer Expiry : 7 (00:00:07)
Abort Timer Expiry : Not Running
```
The first three lines of output show the configured URL and related timer-configuration values. The next three lines show the operating state and the amount of time left for expiry of write delay and abort timers. Among the statistics shown in the output, startup failures indicate the number of attempts to read or create the file that failed on bootup.

Create a temporary file on the TFTP server with the `touch` command in the TFTP server daemon directory. With some UNIX implementations, the file should have full read and write access permissions (777).

DHCP snooping bindings are keyed on the MAC address and VLAN combination. If an entry in the remote file has an entry for a given MAC address and VLAN set for which the switch already has a binding, the entry from the remote file is ignored when the file is read. This condition is referred to as the binding collision.

An entry in a file may no longer be valid because the lease indicated by the entry may have expired by the time it is read. The expired leases counter indicates the number of bindings that are ignored because of this condition. The Invalid interfaces counter refers to the number of bindings that have been ignored when the interface referred by the entry either does not exist on the system or is a router or DHCP snooping trusted interface (if it exists) when the read happened. Unsupported VLANs refers to the number of entries that have been ignored because the indicated VLAN is not supported on the system. The Parse failures counter provides the number of entries that have been ignored when the switch is unable to interpret the meaning of the entries from the file.

The switch maintains two sets of counters for these ignored bindings. One provides the counters for a read that has at least one binding ignored by at least one of these conditions. These counters are shown as the “Last ignored bindings counters.” The total ignored bindings counters provides a sum of the number of bindings that have been ignored because of all the reads since the switch bootup. These two sets of counters are cleared by the `clear` command. The total counter set may indicate the number of bindings that have been ignored since the last clear.
Example 2: Reading Binding Entries from a TFTP File

To manually read the entries from a TFTP file, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router# show ip dhcp snooping database</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router# renew ip dhcp snoop data url</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router# show ip dhcp snoop data</td>
</tr>
<tr>
<td>Step 4</td>
<td>Router# show ip dhcp snoop bind</td>
</tr>
</tbody>
</table>

This is an example of how to manually read entries from the tftp://10.1.1.1/directory/file:

Router# show ip dhcp snooping database
Agent URL :
Write delay Timer : 300 seconds
Abort Timer : 300 seconds

Agent Running : No
Delay Timer Expiry : Not Running
Abort Timer Expiry : Not Running

Last Succeeded Time : None
Last Failed Time : None
Last Failed Reason : No failure recorded.

Total Attempts : 0 Startup Failures : 0
Successful Transfers : 0 Failed Transfers : 0
Successful Reads : 0 Failed Reads : 0
Successful Writes : 0 Failed Writes : 0
Media Failures : 0

Router# renew ip dhcp snoop data tftp://10.1.1.1/directory/file
Loading directory/file from 10.1.1.1 (via GigabitEthernet1/1): !
[OK - 457 bytes]
Database downloaded successfully.

Router#
00:01:29: %DHCP_SNOOPING-6-AGENT_OPERATION_SUCCEEDED: DHCP snooping database Read succeeded.
Router# show ip dhcp snoop data
Agent URL :
Write delay Timer : 300 seconds
Abort Timer : 300 seconds

Agent Running : No
Delay Timer Expiry : Not Running
Abort Timer Expiry : Not Running

Last Succeeded Time : 15:24:34 UTC Sun Jul 8 2001
Last Failed Time : None
Last Failed Reason : No failure recorded.

Total Attempts : 1 Startup Failures : 0
Successful Transfers : 1 Failed Transfers : 0
Successful Reads : 1 Failed Reads : 0
Successful Writes : 0 Failed Writes : 0
Media Failures : 0

Router#
Router# show ip dhcp snoop bind
MacAddress          IpAddress        Lease(sec)  Type       VLAN  Interface

Command Purpose
Step 1 Router# show ip dhcp snooping database Displays the DHCP snooping database agent statistics.
Step 2 Router# renew ip dhcp snoop data url Directs the switch to read the file from the URL.
Step 3 Router# show ip dhcp snoop data Displays the read status.
Step 4 Router# show ip dhcp snoop bind Verifies whether the bindings were read successfully.
Configuring DHCP Snooping

Example 3: Adding Information to the DHCP Snooping Database

To manually add a binding to the DHCP snooping database, perform this task:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router# show ip dhcp snooping binding</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router# ip dhcp snooping binding binding_id vlan vlan_id interface interface expiry lease_time</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router# show ip dhcp snooping binding</td>
</tr>
</tbody>
</table>

This example shows how to manually add a binding to the DHCP snooping database:

Router# show ip dhcp snooping binding
MacAddress          IpAddress        Lease(sec)  Type           VLAN  Interface
------------------  ---------------  ----------  -------------  ----  --------------------
Router# ip dhcp snooping binding 1.1.1 vlan 1 1.1.1.1 interface gi1/1 expiry 1000
Router# show ip dhcp snooping binding
MacAddress          IpAddress        Lease(sec)  Type           VLAN  Interface
------------------  ---------------  ----------  -------------  ----  --------------------
          00:01:00:01:00:01   1.1.1.1          992         dhcp-snooping  1     GigabitEthernet1/1
Router#

Displaying a Binding Table

The DHCP snooping binding table for each switch contains binding entries that correspond to untrusted ports. The table does not contain information about hosts interconnected with a trusted port because each interconnected switch will have its own DHCP snooping binding table.

This example shows how to display the DHCP snooping binding information for a switch:

Router# show ip dhcp snooping binding
MacAddress          IpAddress        Lease(sec)  Type           VLAN  Interface
------------------  ---------------  ----------  -------------  ----  --------------------
          00:02:B3:3F:3B:99   55.5.5.2         6943        dhcp-snooping  10    FastEthernet6/10

Table 54-2 describes the fields in the show ip dhcp snooping binding command output.
For additional information about Cisco Catalyst 6500 Series Switches (including configuration examples and troubleshooting information), see the documents listed on this page:


Participate in the Technical Documentation Ideas forum

### Table 54-2  show ip dhcp snooping binding Command Output

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC Address</td>
<td>Client hardware MAC address</td>
</tr>
<tr>
<td>IP Address</td>
<td>Client IP address assigned from the DHCP server</td>
</tr>
<tr>
<td>Lease (seconds)</td>
<td>IP address lease time</td>
</tr>
<tr>
<td>Type</td>
<td>Binding type: dynamic binding learned by DHCP snooping or statically-configured binding</td>
</tr>
<tr>
<td>VLAN</td>
<td>VLAN number of the client interface</td>
</tr>
<tr>
<td>Interface</td>
<td>Interface that connects to the DHCP client host</td>
</tr>
</tbody>
</table>