

# 40

## Dynamic Host Configuration Protocol (DHCP) Snooping

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**Note**

- For complete syntax and usage information for the commands used in this chapter, see these publications:  
[http://www.cisco.com/en/US/products/ps11846/prod\\_command\\_reference\\_list.html](http://www.cisco.com/en/US/products/ps11846/prod_command_reference_list.html)
  - Cisco IOS Release 15.4SY supports only Ethernet interfaces. Cisco IOS Release 15.4SY does not support any WAN features or commands.
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**Tip**

For additional information about Cisco Catalyst 6500 Series Switches (including configuration examples and troubleshooting information), see the documents listed on this page:

[http://www.cisco.com/en/US/products/hw/switches/ps708/tsd\\_products\\_support\\_series\\_home.html](http://www.cisco.com/en/US/products/hw/switches/ps708/tsd_products_support_series_home.html)

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### Prerequisites for DHCP Snooping

None.

### Restrictions for DHCP Snooping

- [DHCP Snooping Configuration Restrictions, page 40-2](#)
- [DHCP Snooping Configuration Guidelines, page 40-2](#)
- [Minimum DHCP Snooping Configuration, page 40-2](#)

## DHCP Snooping Configuration Restrictions

- The DHCP snooping database stores at least 12,000 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

- 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 this publication:  
[http://www.cisco.com/en/US/docs/ios-xml/ios/ipaddr\\_dhcp/configuration/15-sy/dhcp-15-sy-book.html](http://www.cisco.com/en/US/docs/ios-xml/ios/ipaddr_dhcp/configuration/15-sy/dhcp-15-sy-book.html)
- 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.

## Minimum DHCP Snooping Configuration

1. Define and configure the DHCP server. See this publication:

[http://www.cisco.com/en/US/docs/ios-xml/ios/ipaddr\\_dhcp/configuration/15-sy/dhcp-15-sy-book.html](http://www.cisco.com/en/US/docs/ios-xml/ios/ipaddr_dhcp/configuration/15-sy/dhcp-15-sy-book.html)

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 40-12
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 40-13
4. Configure the DHCP snooping database agent.  
This step ensures that database entries are restored after a restart or switchover. See the “[The DHCP Snooping Database Agent](#)” section on page 40-15
5. Enable DHCP snooping globally.  
The feature is not active until you complete this step. See the “[Enabling DHCP Snooping Globally](#)” section on page 40-9

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 40-11

## Information About DHCP Snooping

- [Overview of DHCP Snooping, page 40-4](#)
- [Trusted and Untrusted Sources, page 40-4](#)
- [DHCP Snooping Binding Database, page 40-5](#)
- [Packet Validation, page 40-5](#)
- [DHCP Snooping Option-82 Data Insertion, page 40-5](#)
- [Overview of the DHCP Snooping Database Agent, page 40-7](#)
- [VRF-Aware DHCP Option 82, page 40-8](#)

## 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 DHCP OFFER, 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**

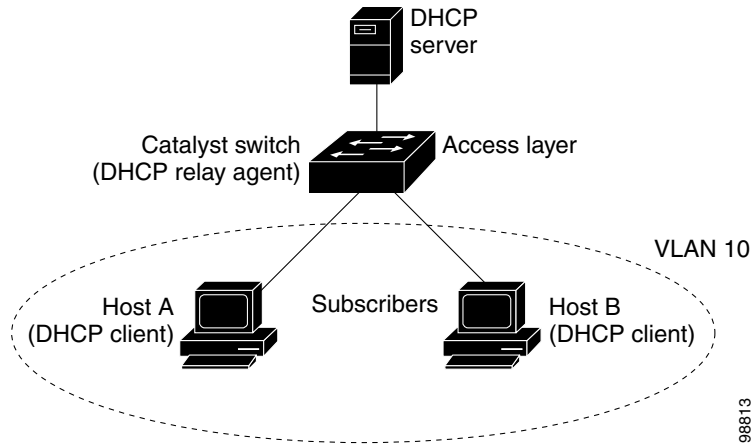
With the DHCP option-82 on untrusted port feature enabled, use dynamic ARP inspection on the aggregation switch to protect untrusted input interfaces.

## 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.

Figure 40-1 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.

**Figure 40-1 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 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 [“802.1X Authentication with DHCP Snooping”](#) section on page 45-15.
- 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 40-2 do not change:

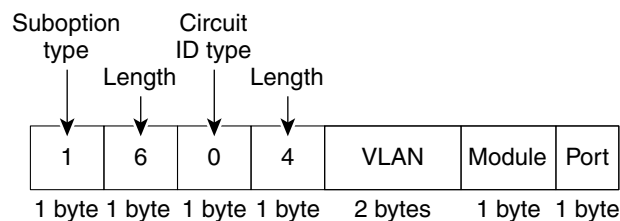
- Circuit ID suboption fields
  - Suboption type
  - Length of the suboption type

- 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

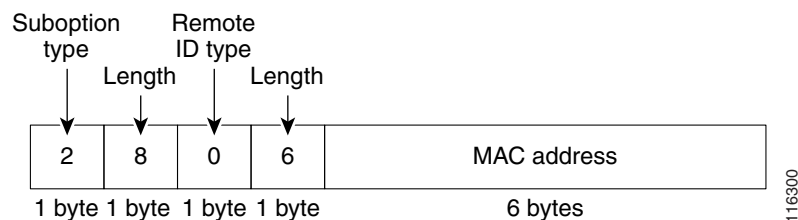
Figure 40-2 shows the packet formats for the remote ID suboption and the circuit ID suboption. The switch uses the packet formats when DHCP snooping is globally enabled and when the **ip dhcp snooping information option** global configuration command is entered. For the circuit ID suboption, the module field is the slot number of the module.

**Figure 40-2 Suboption Packet Formats**

#### Circuit ID Suboption Frame Format



#### Remote ID Suboption Frame Format



## 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>
```

```

<entry-2> <checksum-1-2>
...
...
<entry-n> <checksum-1-2-..-n>
END

```

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.

## VRF-Aware DHCP Option 82

VRF-aware DHCP option 82 provides additional security when DHCP is used to allocate network addresses. It enables the device to act as a DHCP relay agent to prevent DHCP client requests from untrusted sources.

You must configure two VRFs on the Cisco Catalyst 6500 Series switch that functions as the DHCP relay agent. The first VRF receives the DHCP discover message from the DHCP client. The second VRF forwards the DHCP request to the DHCP server. The DHCP relay agent adds option 82 information to DHCP requests from clients, before forwarding the DHCP requests to the DHCP server. The DHCP server verifies this information and offers an IP address from the VRF IP address pool to the DHCP request. The DHCP relay agent forwards the offer to the DHCP client and establishes a connection between the DHCP client and DHCP server.

Starting with Cisco IOS Release 15.5(1)SY5, support for VRF-aware DHCP option 82 with IANA settings as sub-options was introduced.



See [Enabling VRF-Aware DHCP Option 82 with IANA Settings, page 40-14](#) section for more information on how to enable VRF-Aware DHCP Option 82 with IANA Settings.

## Default Configuration for DHCP Snooping

Option	Default Value/State
DHCP snooping	Disabled
DHCP snooping information option	Enabled
DHCP option-82 on untrusted port feature	Disabled
DHCP snooping limit rate	None
DHCP snooping trust	Untrusted
DHCP snooping vlan	Disabled
DHCP snooping spurious server detection	Disabled
DHCP snooping detect spurious interval	30 minutes

## How to Configure DHCP Snooping

- [Enabling DHCP Snooping Globally, page 40-9](#)
- [Enabling DHCP Option-82 Data Insertion, page 40-10](#)
- [Enabling the DHCP Option-82 on Untrusted Port Feature, page 40-11](#)
- [Enabling DHCP Snooping MAC Address Verification, page 40-11](#)
- [Enabling DHCP Snooping on VLANs, page 40-12](#)
- [Configuring the DHCP Trust State on Layer 2 LAN Interfaces, page 40-13](#)
- [Configuring Spurious DHCP Server Detection, page 40-13](#)
- [Configuring DHCP Snooping Rate Limiting on Layer 2 LAN Interfaces, page 40-14](#)
- [Enabling VRF-Aware DHCP Option 82 with IANA Settings, page 40-14](#)
- [The DHCP Snooping Database Agent, page 40-15](#)
- [Configuration Examples for the Database Agent, page 40-16](#)
- [Displaying the DHCP Snooping Binding Table, page 40-19](#)

## 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:

	Command	Purpose
Step 1	Router(config)# <b>ip dhcp snooping</b>	Enables DHCP snooping globally.
Step 2	Router(config)# <b>do show ip dhcp snooping   include Switch</b>	Verifies the configuration.

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
Router(config)#
```



**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:

	Command	Purpose
Step 1	Router(config)# <b>ip dhcp snooping information option</b>	Enables DHCP option-82 data insertion.
Step 2	Router(config)# <b>do show ip dhcp snooping   include 82</b>	Verifies the configuration.

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
Router(config)#
```

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
Router(config)#
```

## Enabling the DHCP Option-82 on Untrusted Port Feature



### Note

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 allow-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:

	Command	Purpose
Step 1	Router(config)# <b>ip dhcp snooping information option allow-untrusted</b>	(Optional) Enables untrusted ports to accept incoming DHCP packets with option-82 information. The default setting is disabled.
Step 2	Router(config)# <b>do show ip dhcp snooping</b>	Verifies the configuration.

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

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

## 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:

	Command	Purpose
Step 1	Router(config)# <b>ip dhcp snooping verify mac-address</b>	Enables DHCP snooping MAC address verification.
Step 2	Router(config)# <b>do show ip dhcp snooping   include hwaddr</b>	Verifies the configuration.

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

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

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

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

## 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 PFC or DFC 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:

	Command	Purpose
Step 1	Router(config)# <b>ip dhcp snooping vlan</b> {{vlan_ID [vlan_ID]}   {vlan_range}}	Enables DHCP snooping on a VLAN or VLAN range.
Step 2	Router(config)# <b>do show ip dhcp snooping</b>	Verifies the configuration.

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:

Insertion of option 82 is enabled
Verification of hwaddr field is enabled
Interface                Trusted      Rate limit (pps)
-----                -
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:

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

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

```
Router# configure terminal
Router(config)# interface gigabitethernet 5/12
Router(config-if)# ip dhcp snooping trust
Router(config-if)# do show ip dhcp snooping | begin pps
Interface                Trusted      Rate limit (pps)
-----
GigabitEthernet5/12      yes         unlimited
Router#
```

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

```
Router# configure terminal
Router(config)# interface gigabitethernet 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)
-----
GigabitEthernet5/12      no         unlimited
Router#
```

## Configuring Spurious DHCP Server Detection

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

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

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
Router(config)# ip dhcp snooping detect spurious interval 50
Router# do show ip dhcp snooping detect spurious
```

```
Spurious DHCP server detection is enabled.
```

```
Detection VLAN list : 20-25
Detection interval : 50 minutes
Router#
```

## 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:

	Command	Purpose
Step 1	Router(config)# <b>interface</b> { <i>type slot/port</i>   <b>port-channel number</b> }	Selects the interface to configure.  <b>Note</b> Select only LAN ports configured with the <b>switchport</b> command or Layer 2 port-channel interfaces.
Step 2	Router(config-if)# <b>ip dhcp snooping limit rate rate</b>	Configures DHCP packet rate limiting.
Step 3	Router(config-if)# <b>do show ip dhcp snooping</b>   <b>begin pps</b>	Verifies the configuration.

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 Gigabit Ethernet port 5/12:

```
Router# configure terminal
Router(config)# interface gigabitethernet 5/12
Router(config-if)# ip dhcp snooping limit rate 100
Router(config-if)# do show ip dhcp snooping | begin pps
Interface                Trusted      Rate limit (pps)
-----
GigabitEthernet5/12      no          100
Router#
```

## Enabling VRF-Aware DHCP Option 82 with IANA Settings

To enable VRF-aware DHCP option 82 on a DHCP relay agent with IANA settings, perform this task:

	Command	Purpose
Step 1	Router# <b>enable</b>	Enters privileged EXEC mode.  Enter your password, if prompted.
Step 2	Router# <b>configure terminal</b>	Enters global configuration mode.
Step 3	Router(config)# <b>interface vlan vlan-id</b>	Enters interface configuration mode for the specified VLAN.

	Command	Purpose
Step 4	Router(config-if)# <b>ip dhcp relay information option vpn-id</b>	Enables VRF-aware DHCP option 82.
Step 5	Router(config-if)# <b>exit</b>	Returns to global configuration mode.
Step 6	Router(config)# <b>ip dhcp compatibility suboption link-selection standard</b>	<p>Enables standard IANA link selection as a sub-option for DHCP option 82.</p> <p>When standard IANA link selection is not manually enabled, Cisco standard link selection is enabled as the default sub-option for DHCP option 82.</p> <p><b>Note</b> To override the standard IANA link selection and enable Cisco standard link selection as the sub-option for DHCP option 82, run the <b>ip dhcp compatibility suboption link-selection cisco</b> command in global configuration mode.</p>
Step 7	Router(config)# <b>ip dhcp compatibility suboption server-override standard</b>	<p>Enables standard IANA server override as a sub-option for DHCP option 82.</p> <p>When standard IANA server override is not manually enabled, Cisco standard server override is enabled as the default sub-option for DHCP option 82.</p> <p><b>Note</b> To override the standard IANA server override and enable Cisco standard server override as the sub-option for DHCP option 82, run the <b>ip dhcp compatibility suboption server-override cisco</b> command in global configuration mode.</p>
Step 8	Router(config)# <b>end</b>	Returns to privileged EXEC mode.

## The DHCP Snooping Database Agent

- [Prerequisites for the DHCP Snooping Database Agent, page 40-15](#)
- [Restrictions for the DHCP Snooping Database Agent, page 40-16](#)
- [Default Settings for the DHCP Snooping Database Agent, page 40-16](#)
- [How to Configure the DHCP Snooping Database Agent, page 40-16](#)
- [Configuration Examples for the Database Agent, page 40-16](#)

### Prerequisites for the DHCP Snooping Database Agent

None.

## Restrictions for the DHCP Snooping Database Agent

- 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.

## Default Settings for the DHCP Snooping Database Agent

None.

## How to Configure the DHCP Snooping Database Agent

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

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

## Configuration Examples for the Database Agent

- [Example 1: Enabling the Database Agent, page 40-16](#)
- [Example 2: Reading Binding Entries from a TFTP File, page 40-18](#)
- [Example 3: Adding Information to the DHCP Snooping Database, page 40-19](#)

### 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

Last Succeeded Time : None
Last Failed Time : 17:14:25 UTC Sat Jul 7 2001
Last Failed Reason : Unable to access URL.

Total Attempts      :      21   Startup Failures :      0
Successful Transfers :      0   Failed Transfers :     21
Successful Reads    :      0   Failed Reads    :      0
Successful Writes   :      0   Failed Writes   :     21
Media Failures     :      0

First successful access: Read

Last ignored bindings counters :
Binding Collisions   :      0   Expired leases   :      0
Invalid interfaces  :      0   Unsupported vlans :      0
Parse failures      :      0
Last Ignored Time : None

Total ignored bindings counters:
Binding Collisions   :      0   Expired leases   :      0
Invalid interfaces  :      0   Unsupported vlans :      0
Parse failures      :      0

Router#

```

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.



#### Note

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:

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

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
------------	-----------	------------	------	------	-----------

```

-----
00:01:00:01:00:05  1.1.1.1      49810      dhcp-snooping  512  GigabitEthernet1/1
00:01:00:01:00:02  1.1.1.1      49810      dhcp-snooping  512  GigabitEthernet1/1
00:01:00:01:00:04  1.1.1.1      49810      dhcp-snooping  1536 GigabitEthernet1/1
00:01:00:01:00:03  1.1.1.1      49810      dhcp-snooping  1024 GigabitEthernet1/1
00:01:00:01:00:01  1.1.1.1      49810      dhcp-snooping   1    GigabitEthernet1/1
Router# clear ip dhcp snoop bind
Router# show ip dhcp snoop bind
MacAddress      IPAddress      Lease(sec)  Type           VLAN  Interface
-----
Router#

```

### Example 3: Adding Information to the DHCP Snooping Database

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

	Command	Purpose
Step 1	Router# <b>show ip dhcp snooping binding</b>	Views the DHCP snooping database.
Step 2	Router# <b>ip dhcp snooping binding</b> <i>binding_id</i> <b>vlan</b> <i>vlan_id</i> <b>interface</b> <i>interface</i> <b>expiry</b> <i>lease_time</i>	Adds the binding using the <b>ip dhcp snooping</b> exec command.
Step 3	Router# <b>show ip dhcp snooping binding</b>	Checks the DHCP snooping database.

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#
Router# ip dhcp snooping binding 1.1.1.1 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 the DHCP Snooping 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   GigabitEthernet6/10

```

[Table 40-1](#) describes the fields in the **show ip dhcp snooping binding** command output.

**Table 40-1** *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)	IP address lease time
Type	Binding type: dynamic binding learned by DHCP snooping or statically-configured binding
VLAN	VLAN number of the client interface
Interface	Interface that connects to the DHCP client host

**Tip**

For additional information about Cisco Catalyst 6500 Series Switches (including configuration examples and troubleshooting information), see the documents listed on this page:

[http://www.cisco.com/en/US/products/hw/switches/ps708/tsd\\_products\\_support\\_series\\_home.html](http://www.cisco.com/en/US/products/hw/switches/ps708/tsd_products_support_series_home.html)

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