Configuring the Cisco IOS XE DHCP Relay Agent

Last Updated: December 20, 2011

Cisco routers running Cisco IOS XE software include Dynamic Host Configuration Protocol (DHCP) server and relay agent software. A DHCP relay agent is any host that forwards DHCP packets between clients and servers. This module describes the concepts and tasks needed to configure the Cisco IOS XE DHCP relay agent.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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

Prerequisites for Configuring the DHCP Relay Agent

Before you configure the DHCP relay agent, you should understand the concepts documented in the "DHCP Overview" module.

The Cisco IOS XE DHCP server and relay agent are enabled by default. You can verify if they have been disabled by checking your configuration file. If they have been disabled, the **no service dhcp** command

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Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

will appear in the configuration file. Use the **service dhcp** command to reenable the functionality if necessary.

The Cisco IOS XE DHCP relay agent will be enabled on an interface only when the **ip helper-address** is configured. This command enables the DHCP broadcast to be forwarded to the configured DHCP server.

Information About the DHCP Relay Agent

DHCP Relay Agent Overview

A DHCP relay agent is any host that forwards DHCP packets between clients and servers. Relay agents are used to forward requests and replies between clients and servers when they are not on the same physical subnet. Relay agent forwarding is distinct from the normal forwarding of an IP router, where IP datagrams are switched between networks somewhat transparently. By contrast, relay agents receive DHCP messages and then generate a new DHCP message to send out on another interface. The relay agent sets the gateway IP address (giaddr field of the DHCP packet) and, if configured, adds the relay agent information option (option82) in the packet and forwards it to the DHCP server. The reply from the server is forwarded back to the client after removing option 82.

The Cisco IOS XE DHCP relay agent supports the use of unnumbered interfaces. An unnumbered interface can "borrow" the IP address of another interface already configured on the router, which conserves network and address space. For DHCP clients connected though the unnumbered interfaces, the DHCP relay agent automatically adds a static host route once the DHCP client obtains an address, specifying the unnumbered interface as the outbound interface. The route is automatically removed once the lease time expires or when the client releases the address.

Packet Forwarding Address

DHCP clients need to use User Datagram Protocol (UDP) broadcasts to send their initial DHCPDISCOVER messages because they don't have information about the network to which they are attached. If the client is on a network segment that does not include a server, UDP broadcasts normally are not forwarded because most routers are configured to not forward broadcast traffic.
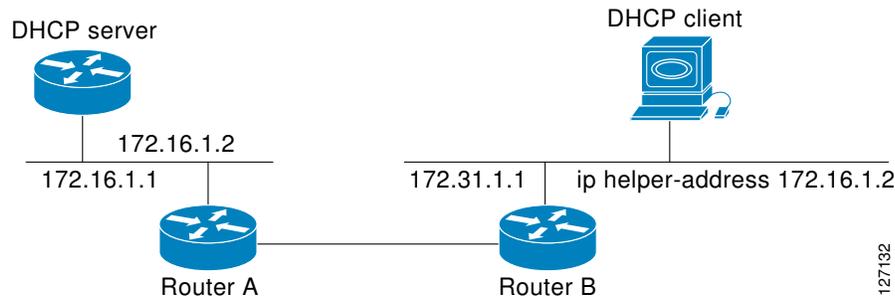
You can remedy this situation by configuring the interface of your router that is receiving the broadcasts to forward certain classes of broadcasts to a helper address. You can use more than one helper address per interface.

When a router forwards these address assignment/parameter requests, it is acting as a DHCP relay agent. The Cisco router implementation of the DHCP relay agent is provided via the **ip helper-address** interface configuration command.

In the figure below, the DHCP client broadcasts a request for an IP address and additional configuration parameters on its local LAN. Router B, acting as a DHCP relay agent, picks up the broadcast and generates a new DHCP message to send out on another interface. As part of this DHCP message, the relay agent inserts the IP address of the interface containing the **ip helper-address** command into the gateway IP address (giaddr) field of the DHCP packet. This IP address enables the DHCP server to determine which

subnet should receive the offer and identify the appropriate IP address range to offer. The DHCP relay agent sends the local broadcast, via IP unicast, to the DHCP server address 172.16.1.2 specified by the **ip helper-address** interface configuration command.

Figure 1　　　　　　*Forwarding UDP Broadcasts to a DHCP Server Using a Helper Address*

Relay Agent Information Option

Automatic DHCP address allocation is typically based on an IP address, whether it be the gateway IP address (giaddr field of the DHCP packet) or the incoming interface IP address. In some networks, it is necessary to use additional information to further determine which IP addresses to allocate. By using the relay agent information option (option 82), the Cisco IOS XE relay agent can include additional information about itself when forwarding client-originated DHCP packets to a DHCP server.

Cisco IOS XE supports this functionality by using the **ip dhcp relay information option** command. The relay agent will automatically add the circuit identifier suboption and the remote ID suboption to the relay agent information option and forward them to the DHCP server.
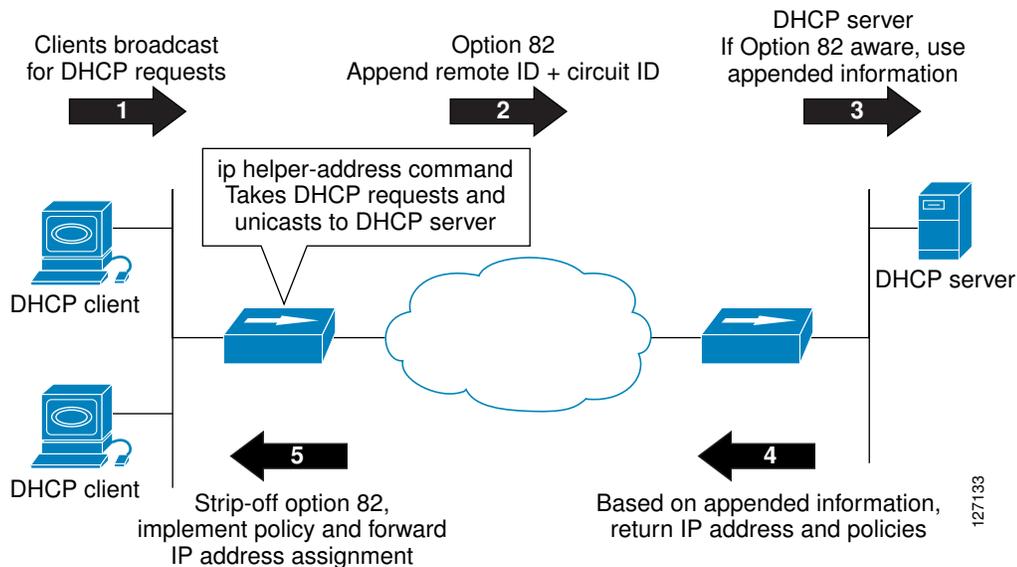
The DHCP server can use this information to assign IP addresses, perform access control, and set quality of service (QoS) and security policies (or other parameter-assignment policies) for each subscriber of a service provider network.

The figure below shows how the relay agent information option is inserted into the DHCP packet as follows:

1　The DHCP client generates a DHCP request and broadcasts it on the network.

2　The DHCP relay agent intercepts the broadcast DHCP request packet and inserts the relay agent information option (option 82) in the packet. The relay agent information option contains the related suboptions.

3　The DHCP relay agent unicasts the DHCP packet to the DHCP server.

4　The DHCP server receives the packet and uses the suboptions to assign IP addresses and other configuration parameters and forwards them back to the client.

5 The relay agent strips off the suboption fields of the packet while forwarding to the client.

Figure 2 **Relay Agent Information Option Operation**

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Relay Agent Information Reforwarding Policy

A DHCP relay agent may receive a message from another DHCP relay agent that already contains relay information. By default, the relay information from the previous relay agent is replaced. If this behavior is not suitable for your network, you can use the **ip dhcp relay information policy** {**drop** | **keep** | **replace**} global configuration command to change it.

To ensure the correct operation of the reforwarding policy, make sure to disable the relay agent information check by using the **no ip dhcp relay information check** global configuration command.

DHCP Relay Agent Support for MPLS VPNs

DHCP relay support for Multiprotocol Label Switching (MPLS) Virtual Private Networks (VPNs) enables a network administrator to conserve address space by allowing overlapping addresses. The relay agent can support multiple clients on different VPNs, and many of these clients from different VPNs can share the same IP address.

Configuring VPNs involves an adjustment to the usual DHCP host IP address designation. VPNs use private address spaces that might not be unique across the Internet.

In some environments, a relay agent resides in a network element that also has access to one or more MPLS VPNs. A DHCP server that provides service to DHCP clients on those different VPNs must locate the VPN in which each client resides. The network element that contains the relay agent typically captures the VPN association of the DHCP client and includes this information in the relay agent information option of the DHCP packet.

DHCP relay support for MPLS VPNs allows the relay agent to forward this necessary VPN-related information to the DHCP server using the following three suboptions of the DHCP relay agent information option:

- VPN identifier
- Subnet selection
- Server identifier override

The VPN identifier suboption is used by the relay agent to tell the DHCP server the VPN for every DHCP request it passes on to the DHCP server, and it is also used to properly forward any DHCP reply that the DHCP server sends back to the relay agent. The VPN identifier suboption contains the VPN ID configured on the incoming interface to which the client is connected. If you configure the VRF name but not the VPN ID, the VRF name is used as the VPN identifier suboption. If the interface is in global routing space, the VPN suboptions are not added.
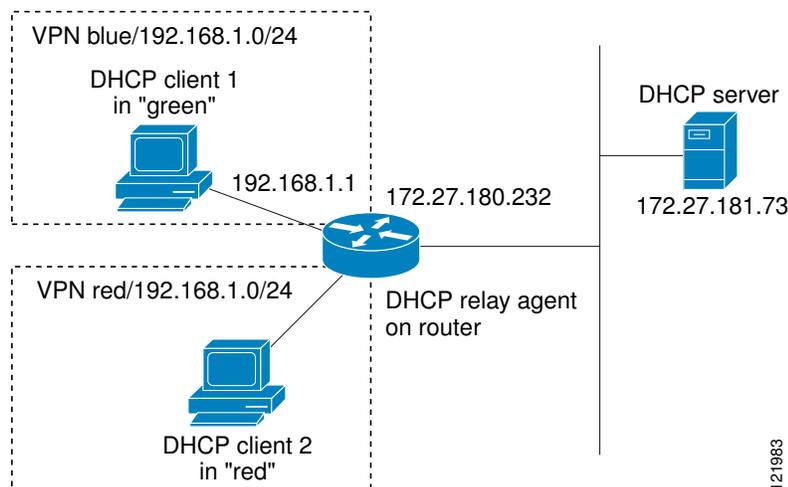
The subnet selection suboption allows the separation of the subnet where the client resides from the IP address used to communicate with the relay agent. In typical DHCP processing, the gateway address specifies both the subnet on which a DHCP client resides and the IP address that the server can use to communicate with the relay agent. Situations exist where the relay agent needs to specify the subnet on which a DHCP client resides that is different from the IP address the server can use to communicate with the relay agent. The subnet selection suboption is included in the relay agent information option and passed on to the DHCP server. The gateway address is changed to the outgoing interface of the relay agent toward the DHCP server. The DHCP server uses this gateway address to send reply packets back to the relay agent.

The server identifier override suboption value is copied in the reply packet from the DHCP server instead of the normal server ID address. The server identifier override suboption contains the incoming interface IP address, which is the IP address on the relay agent that is accessible from the client. Using this information, the DHCP client sends all renew and release packets to the relay agent. The relay agent adds all of the VPN suboptions and then forwards the renew and release packets to the original DHCP server.

After adding these suboptions to the DHCP relay agent information option, the gateway address is changed to the outgoing interface of the relay agent toward the DHCP server. When the packets are returned from the DHCP server, the relay agent removes the relay agent information options and forwards the packets to the DHCP client on the correct VPN.

The figure below shows a VPN scenario where the DHCP relay agent and DHCP server can recognize the VPN that each client resides within. DHCP client 1 is part of VPN green and DHCP client 2 is part of VPN red and both have the same private IP address 192.168.1.0/24. Because the clients have the same IP address, the DHCP relay agent and DHCP server use the VPN identifier, subnet selection, and server identifier override suboptions of the relay agent information option to distinguish the correct VPN of the client.

Figure 3   Virtual Private Network DHCP Configuration

DHCP Relay Support for Option 82 Encapsulation

When two relay agents are relaying messages between the DHCP client and DHCP server, the second relay agent (closer to the server), by default, replaces the first option 82 information with its own option 82. The remote ID and circuit ID information from the first relay agent is lost. In some deployment scenarios, it is necessary to maintain the initial option 82 from the first relay agent, in addition to the option 82 from the second relay agent. For example, an Intelligent Service Gateway (ISG) acting as a second relay agent is connected to a Layer 2 device. The Layer 2 device connects to the household and identifies the household with its own option 82.
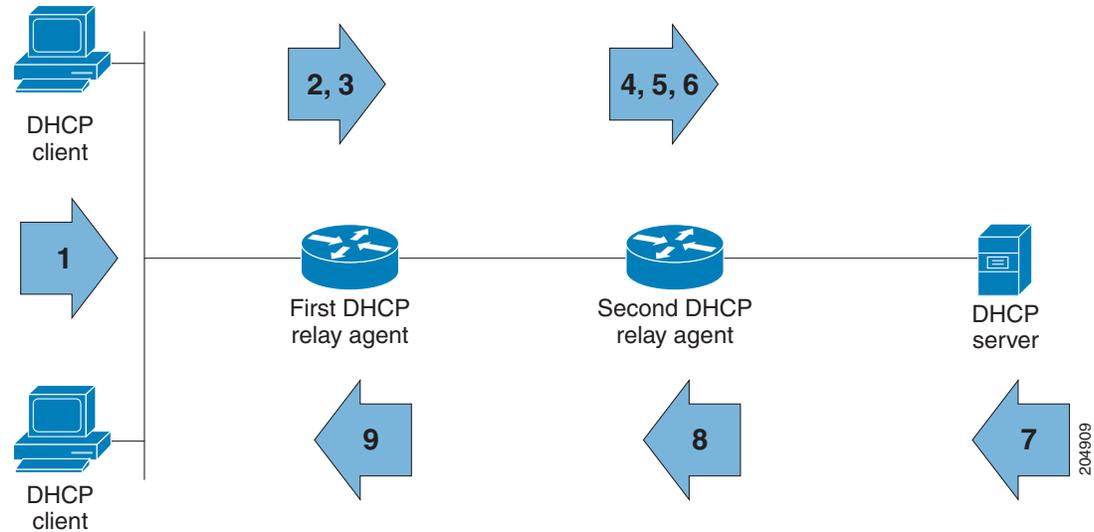
The DHCP Relay Option 82 Encapsulation feature allows the second relay agent to encapsulate option 82 information in a received message from the first relay agent if it is also configured to add its own option 82 information. This configuration allows the DHCP server to use option 82 information from both relay agents. The DHCP server can use the VPN information from the second relay agent along with the option 82 information from the first relay agent to send correct address assignments and other configuration parameters for the client devices based on the VRF, option 60, and encapsulated option 82. The reply message from the DHCP server to the DHCP client traverses the same path as the request messages through the two relay agents to the DHCP client.

Figure 4 shows the processing that occurs on the two relay agents and the DHCP server when this feature is configured:

1. The DHCP client generates a DHCP message (including option 60) and broadcasts it on the network.
2. The first DHCP relay agent intercepts the broadcast DHCP request packet and inserts its own option 82 in the packet.
3. The relay agent automatically adds the circuit ID suboption and the remote ID suboption to option 82 and forwards them to the second relay agent.
4. The second relay agent encapsulates the first relay agent's option 82 and inserts its own option 82.
5. The gateway IP address (giaddr) is set to the incoming interface on the second relay agent and the original giaddr from the first relay agent is encapsulated.
6. The second DHCP relay agent unicasts the DHCP packet to the DHCP server.
7. The DHCP server receives the packet and uses the VPN suboption information from the second relay, along with the option 82 information from the first relay agent, to assign IP addresses and other configuration parameters and forwards the packet back to the second relay agent.
8. When the second relay agent receives the reply message from the server, it restores the encapsulated option 82 and prior giaddr from the first relay agent. The reply message is then sent to the prior giaddr.

9 The option 82 is stripped off of the packet by the first relay agent before forwarding to the client.

Figure 4　　　*DHCP Relay Agent Information Option Encapsulation Support Processing*

How to Configure the DHCP Relay Agent

Specifying the Packet Forwarding Address

Perform this task to configure the DHCP relay agent to forward packets to a DHCP server.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip helper-address** *address*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface GigabitEthernet0/0/0	Configures an interface and enters interface configuration mode.
Step 4	**ip helper-address** *address* **Example:** Router(config-if)# ip helper-address 172.16.1.2	Forwards UPD broadcasts, including BOOTP and DHCP. • The *address*argument 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.

Configuring Relay Agent Information Option Support

Perform this task to enable support for the DHCP relay agent information option.

Note

- If an **ip dhcp relay information** command is configured in global configuration mode but not configured in interface configuration mode, the global configuration is applied to all interfaces.
- If an **ip dhcp relay information** command is configured in both global configuration mode and interface configuration mode, the interface configuration command takes precedence over the global configuration command. However, the global configuration is applied to interfaces without the interface configuration.
- If an **ip dhcp relay information** command is not configured in global configuration mode but is configured in interface configuration mode, only the interface with the configuration option applied is affected. All other interfaces are not impacted by the configuration.

See the "Configuring Relay Agent Information Option Support per Interface" section for more information on per-interface support for the relay agent information option.

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SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp relay information option**
4. **ip dhcp relay information check**
5. **ip dhcp relay information policy** {**drop** | **keep** | **replace**}
6. **ip dhcp relay information trust-all**
7. **end**
8. **show ip dhcp relay information trusted-sources**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. - Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.

Command or Action	Purpose
Step 3 **ip dhcp relay information option** **Example:** Router(config)# ip dhcp relay information option	Enables the system to insert the DHCP relay agent information option (option-82 field) in forwarded BOOTREQUEST messages to a DHCP server. • This function is disabled by default.
Step 4 **ip dhcp relay information check** **Example:** Router(config)# ip dhcp relay information check	(Optional) Configures DHCP to check that the relay agent information option in forwarded BOOTREPLY messages is valid. • By default, DHCP checks that the option-82 field in DHCP reply packets it receives from the DHCP server is valid. If an invalid message is received, the relay agent drops it. If a valid message is received, the relay agent removes the option-82 field and forwards the packet. Use the **ip dhcp relay information check** command to reenable this functionality if it has been disabled.
Step 5 **ip dhcp relay information policy** {**drop** | **keep** | **replace**} **Example:** Router(config)# ip dhcp relay information policy replace	(Optional) Configures the reforwarding policy for a DHCP relay agent (what a relay agent should do if a message already contains relay information). • See the "Relay Agent Information Reforwarding Policy" section for more information.
Step 6 **ip dhcp relay information trust-all** **Example:** Router(config)# ip dhcp relay information trust-all	(Optional) Configures all interfaces on a router as trusted sources of the DHCP relay information option. • By default, if the gateway address is set to all zeros in the DHCP packet and the relay agent information option is already present in the packet, the DHCP relay agent will discard the packet. Use the **ip dhcp relay information trust-all** command to override this behavior and accept the packets. • This command is useful if there is a switch in between the client and the relay agent that may insert option 82. Use this command to ensure that these packets do not get dropped. • You can configure an individual interface as a trusted source of the DHCP relay information option by using the **ip dhcp relay information trusted** interface configuration mode command.
Step 7 **end** **Example:** Router(config)# end	Returns to privileged EXEC mode.

Command or Action	Purpose

Step 8   **show ip dhcp relay information trusted-sources**
 	
Example:
 	
`Router# show ip dhcp relay`
`information trusted-sources`
	(Optional) Displays all interfaces configured to be a trusted source for the DHCP relay information option.

Configuring Relay Agent Information Option Support per Interface

Perform this task to enable support for the DHCP relay agent information option (option 82) on a per interface basis.

The interface configuration allows the subscribers with different DHCP option 82 requirements on different interfaces to be reached from one Cisco router.

Read the "Restrictions" and "Relay Agent Information Reforwarding Policy" sections to understand how DHCP processes the relay agent information option for global configurations.

Note

- If an **ip dhcp relay information** command is configured in global configuration mode but not configured in interface configuration mode, the global configuration is applied to all interfaces.
- If an **ip dhcp relay information** command is configured in both global configuration mode and interface configuration mode, the interface configuration command takes precedence over the global configuration command. However, the global configuration is applied to interfaces without the interface configuration.
- If an **ip dhcp relay information** command is not configured in global configuration mode but is configured in interface configuration mode, only the interface with the configuration option applied is affected. All other interfaces are not impacted by the configuration.

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SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip dhcp relay information option-insert** [**none**]
5. **ip dhcp relay information check-reply** [**none**]
6. **ip dhcp relay information policy-action** {**drop**| **keep**| **replace**}
7. **exit**
8. Repeat Steps 3 through 7 to configure relay agent information settings on different interfaces.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface GigabitEthernet0/0/0	Configures an interface and enters interface configuration mode.
Step 4	**ip dhcp relay information option-insert** [**none**] **Example:** Router(config-if)# ip dhcp relay information option-insert	Enables the system to insert the DHCP relay agent information option (option-82 field) in forwarded BOOTREQUEST messages to a DHCP server. • This function is disabled by default. However, if support for the relay agent information option is configured in global configuration mode, but not in interface configuration mode, the interface inherits the global configuration. • The **ip dhcp relay information option-insert none** interface configuration command is saved in the running configuration. This command takes precedence over any global relay agent information configuration.
Step 5	**ip dhcp relay information check-reply** [**none**] **Example:** Router(config-if)# ip dhcp relay information check-reply	Configures a DHCP server to validate the relay information option in forwarded BOOTREPLY messages. • By default, DHCP checks that the option-82 field in DHCP reply packets it receives from the DHCP server is valid. If an invalid message is received, the relay agent drops it. If a valid message is received, the relay agent removes the option-82 field and forwards the packet. Use the **ip dhcp relay information check-reply** command to reenable this functionality if it has been disabled. • The **ip dhcp relay information check-reply none** interface configuration command option is saved in the running configuration. This command takes precedence over any global relay agent information configuration.

	Command or Action	Purpose

Step 6	**ip dhcp relay information policy-action** {**drop**| **keep**| **replace**}
	
	Example:
	
	`Router(config-if)# ip dhcp relay`
	`information policy-action replace`
		Configures the information reforwarding policy for a DHCP relay agent (what a relay agent should do if a message already contains relay information).

Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 8	Repeat Steps 3 through 7 to configure relay agent information settings on different interfaces.	(Optional)

Configuring the Subscriber Identifier Suboption of the Relay Agent Information Option

Perform this task to enable an Internet service provider (ISP) to add a unique identifier to the subscriber-identifier suboption of the relay agent information option.

The unique identifier enables an ISP to identify a subscriber, to assign specific actions to that subscriber (for example, assignment of host IP address, subnet mask, and domain name system DNS), and to trigger accounting.

Before the introduction of this feature, if a subscriber moved, each ISP had to be informed of the change and all ISPs had to reconfigure the DHCP settings for the affected customers at the same time. Even if the service was not changed, every move involved administrative changes in the ISP environment. With the introduction of this feature, if a subscriber moves from one Network Access Server to another, there is no need for a change in the configuration on the part of the DHCP server or ISP.

You should configure the unique identifier for each subscriber.

The new configurable subscriber-identifier option should be configured on the interface connected to the client. When a subscriber moves from one interface to the other, the interface configuration should also be changed.

The server should be able to recognize the new suboption.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp relay information option**
4. **interface** *type number*
5. **ip dhcp relay information option subscriber-id** *string*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**ip dhcp relay information option** **Example:** Router(config)# ip dhcp relay information option	Enables the system to insert the DHCP relay agent information option (option-82 field) in forwarded BOOTREQUEST messages to a DHCP server. • This function is disabled by default.
Step 4	**interface** *type number* **Example:** Router(config)# interface atm4/0/0	Configures an interface and enters interface configuration mode.
Step 5	**ip dhcp relay information option subscriber-id** *string* **Example:** Router(config-if)# ip dhcp relay information option subscriber-id newsubscriber123	Specifies that a DHCP relay agent add a subscriber identifier suboption to the relay information option. • The *string* argument can be up to a maximum of 50 characters and can be alphanumeric. **Note** If more than 50 characters are configured, the string is truncated. **Note** The **ip dhcp relay information option subscriber-id**command is disabled by default to ensure backward capability.

Configuring DHCP Relay Agent Support for MPLS VPNs

Perform this task to configure DHCP relay agent support for MPLS VPNs.

Before configuring DHCP relay support for MPLS VPNs, you must configure standard MPLS VPNs.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp relay information option vpn**
4. **interface** *type number*
5. **ip helper-address vrf** *name* [**global**] *address*

DETAILED STEPS

Command or Action	Purpose
Step 1 **enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2 **configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3 **ip dhcp relay information option vpn**
 	
Example:
 	
`Router(config)# ip dhcp relay`
`information option vpn`
	Enables the system to insert VPN suboptions into the DHCP relay agent information option in forwarded BOOTREQUEST messages to a DHCP server and sets the gateway address to the outgoing interface toward the DHCP server.
	
	• The VPN suboptions are also added to the BOOTP broadcast packets when the command is configured.

Step 4 **interface** *type number*
 	
Example:
 	
`Router(config)# interface`
`GigabitEthernet0/0/0`
	Configures an interface and enters interface configuration mode.

Step 5 **ip helper-address vrf** *name* [**global**] *address*
 	
Example:
 	
`Router(config-if)# ip helper-address`
`vrf blue 172.27.180.232`
	Forwards UDP broadcasts, including BOOTP, received on an interface.
	
	• If the DHCP server resides in a different VPN or global space that is different from the VPN, then the **vrf** *name* or **global** options allow you to specify the name of the VRF or global space in which the DHCP server resides.

Setting the Gateway Address of the DHCP Broadcast to a Secondary Address Using Smart Relay Agent Forwarding

Perform this task to configure smart relay agent forwarding.

You only need to configure helper addresses on the interface where the UDP broadcasts that you want to forward to the DHCP server are being received, and you only need the **ip dhcp smart-relay** command configured if you have secondary addresses on that interface and you want the router to step through each IP network when forwarding DHCP requests. Without the smart relay agent configured, all requests are forwarded using the primary IP address on the interface.

If the **ip dhcp smart-relay** command is configured, the relay agent counts the number of times the client retries sending a request to the DHCP server when there is no DHCPOFFER message from the DHCP server. After three retries, the relay agent sets the gateway address to the secondary address. If the DHCP server still does not respond after three more retries, then the next secondary address is used as the gateway address.

This functionality is useful when the DHCP server cannot be configured to use secondary pools.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp smart-relay**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip dhcp smart-relay** **Example:** `Router(config)# ip dhcp smart-relay`	Allows the DHCP relay agent to switch the gateway address (giaddr field of a DHCP packet) to secondary addresses when there is no DHCPOFFER message from a DHCP server.

Configuring Relay Agent Information Option Encapsulation Support

Perform this task to enable support for the encapsulation of the DHCP relay agent information option (option 82).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip dhcp relay information option**
4. **ip dhcp relay information option vpn**
5. **ip dhcp relay information policy encapsulate**
6. **interface** *type number*
7. **ip dhcp relay information policy-action encapsulate**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip dhcp relay information option** **Example:** `Router(config)# ip dhcp relay information option`	Enables the system to insert the DHCP relay agent information option (option-82 field) in forwarded BOOTREQUEST messages to a DHCP server. • This function is disabled by default.
Step 4	**ip dhcp relay information option vpn** **Example:** `Router(config)# ip dhcp relay information option vpn`	(Optional) Enables the system to insert VPN suboptions into the DHCP relay agent information option in forwarded BOOTREQUEST messages to a DHCP server and sets the gateway address to the outgoing interface toward the DHCP server. • The VPN suboptions are also added to the BOOTP broadcast packets when the command is configured.

Command or Action	Purpose
Step 5 **ip dhcp relay information policy encapsulate** **Example:** `Router(config)# ip dhcp relay information policy encapsulate`	Enables the system to encapsulate the DHCP relay agent information option (option-82 field) received from a prior relay agent in forwarded BOOTREQUEST messages to a DHCP server. • Option 82 information from both relay agents will be forwarded to the DHCP server.
Step 6 **interface** *type number* **Example:** `Router(config)# interface FastEthernet0/0`	(Optional) Configures an interface and enters interface configuration mode. • If you configure the **ip dhcp relay information** command in global configuration mode, there is no need to configure the command in interface configuration mode unless you want a different configuration to apply on specific interfaces.
Step 7 **ip dhcp relay information policy-action encapsulate** **Example:** `Router(config-if)# ip dhcp relay information policy-action encapsulate`	(Optional) Enables the system to encapsulate the DHCP relay agent information option (option-82 field) received on an interface from a prior relay agent in forwarded BOOTREQUEST messages to a DHCP server on an interface. • This function is disabled by default. This command has precedence over any global configuration. However, if support for the relay agent information option encapsulation support is configured in global configuration mode, but not in interface configuration mode, the interface inherits the global configuration.

Troubleshooting the DHCP Relay Agent

Perform this task to troubleshoot the DHCP relay agent.

The **show ip route dhcp** command is useful to help you understand any problems with the DHCP relay agent adding routes to clients from unnumbered interfaces. All routes added to the routing table by the DHCP server and relay agent are displayed.

SUMMARY STEPS

1. **enable**
2. **show ip route dhcp**
3. **show ip route dhcp** *ip-address*
4. **show ip route vrf** *vrf-name* **dhcp**
5. **clear ip route** [**vrf** *vrf-name*] **dhcp** [*ip-address*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip route dhcp** **Example:** `Router# show ip route dhcp`	Displays all routes added by the Cisco IOS XE DHCP server and relay agent.
Step 3	**show ip route dhcp** *ip-address* **Example:** `Router# show ip route dhcp 172.16.1.3`	Displays all routes added by the Cisco IOS XE DHCP server and relay agent associated with an IP address.
Step 4	**show ip route vrf** *vrf-name* **dhcp** **Example:** `Router# show ip route vrf red dhcp`	Displays all routes added by the Cisco IOS XE DHCP server and relay agent associated with the named VRF.
Step 5	**clear ip route** [**vrf** *vrf-name*] **dhcp** [*ip-address*] **Example:** `Router# clear ip route dhcp`	Removes routes from the routing table added by the DHCP server and relay agent for the DHCP clients on unnumbered interfaces.

Configuration Examples for the DHCP Relay Agent

Example Configuring the DHCP Relay Agent and Relay Agent Information Option Support

The following example shows how to enable the DHCP server, the relay agent, and the insertion and removal of the DHCP relay information option (option 82). Note that the Cisco IOS XE DHCP server is enabled by default. In this example, the DHCP server was disabled:

```
!reenables the DHCP server
service dhcp
ip dhcp relay information option
!
interface GigabitEthernet 0/0/0
 ip address 192.168.100.1 255.255.255.0
 ip helper-address 10.55.11.3
```

Example Configuring the DHCP Relay Agent and Relay Agent Information Option Support per Interface

The following example shows that for subscribers being serviced by the same aggregation router, the relay agent information option needs to be processed differently for Asynchronous Transfer Mode (ATM) subscribers than for Gigabit Ethernet digital subscribers. For ATM subscribers, the relay agent information option is configured to be removed from the packet by the relay agent before forwarding to the client. For Gigabit Ethernet subscribers, the connected device provides the relay agent information option, and it is configured to remain in the packet and be forwarded to the client.

```
ip dhcp relay information trust-all
interface Loopback0
 ip address 10.16.0.1 255.255.255.0
!
interface ATM 3/0/0
 no ip address
!
interface ATM 3/0/0
 ip helper-address 10.16.1.2
 ip unnumbered loopback0
 ip dhcp relay information option-insert
!
interface Loopback1
 ip address 10.18.0.1 255.255.255.0
!
interface GigabitEthernet0/0/0
 no ip address
!
interface GigabitEthernet 0/0/1
 encap dot1q 123
 ip unnumbered loopback1
 ip helper-address 10.18.1.2
 ip dhcp relay information policy-action keep
```

Example Configuring the Subscriber Identifier Suboption

The following example shows how to add a unique identifier to the subscriber-identifier suboption of the relay agent information option.

```
ip dhcp relay information option
!
interface Loopback0
 ip address 10.1.1.129 255.255.255.192
!
```

```
interface ATM 4/0/0
 no ip address
!
interface ATM 4/0/1 point-to-point
 ip helper-address 10.16.1.2
 ip unnumbered Loopback0
 ip dhcp relay information option subscriber-id newperson123
 atm route-bridged ip
 pvc 88/800
 encapsulation aal5snap
```

Example Configuring DHCP Relay Agent Support for MPLS VPNs

In the following example, the DHCP relay agent receives a DHCP request on Gigabit Ethernet interface 0/0/0 and sends the request to the DHCP server located at IP helper address 10.44.23.7, which is associated with the VRF named red:

```
ip dhcp relay information option vpn
!
interface GigabitEthernet 0/0/0
 ip helper-address vrf red 10.44.23.7
!
```

Example Configuring DHCP Smart Relay Agent Forwarding

In the following example, the router will forward the DHCP broadcast received on Gigabit Ethernet interface 0/0 to the DHCP server (10.55.11.3), inserting 192.168.100.1 in the giaddr field of the DHCP packet. If the DHCP server has a scope or pool configured for the 192.168.100.0/24 network, it will respond; otherwise it will not respond.

Because the **ip dhcp smart-relay** global configuration command is configured, if the router sends three requests using 192.168.100.1 in the giaddr field, and doesn't get a response, it will move on and start using 172.16.31.254 in the giaddr field instead. Without the smart relay functionality, the route only uses 192.168.100.1 in the giaddr field.

```
ip dhcp smart-relay
!
interface GigabitEthernet0/0/0
 ip address 192.168.100.1 255.255.255.0
 ip address 172.16.31.254 255.255.255.0
 ip helper-address 10.55.11.3
!
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
DHCP commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS IP Addressing Services Command Reference*

Related Topic	Document Title
DHCP conceptual information	"DHCP Overview" module
DHCP server configuration	"Configuring the Cisco IOS XE DHCP Server" module
DHCP client configuration	"Configuring the Cisco IOS XE DHCP Client" module
DHCP server on-demand address pool manager configuration	"Configuring the DHCP Server On-Demand Address Pool Manager" module
DHCP advanced features	"Configuring DHCP Services for Accounting and Security" module

Standards

Standards	Title
No new or modified standards are supported by this functionality.	--

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 951	*Bootstrap Protocol (BOOTP)*
RFC 1542	*Clarifications and Extensions for the Bootstrap Protocol*
RFC 2131	*Dynamic Host Configuration Protocol*
RFC 2685	*Virtual Private Networks Identifier*
RFC 3046	*DHCP Relay Information Option*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.	http://www.cisco.com/cisco/web/support/index.html
To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.	
Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	

Feature Information for the Cisco IOS XE DHCP Relay Agent

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 1   *Feature Information for the Cisco IOS XE DHCP Relay Agent*

Feature Name	Releases	Feature Configuration Information
DHCP Relay Option 82 per Interface Support	Cisco IOS XE Release 2.1	This feature enables support for the DHCP relay agent information option (option 82) on a per interface basis. The interface configuration allows different DHCP servers, with different DHCP option 82 requirements to be reached from one Cisco router. The following commands were introduced by this feature: **ip dhcp relay information check-reply**, **ip dhcp relay information option-insert**, **ip dhcp relay information policy-action**.

Feature Name	Releases	Feature Configuration Information
DHCP Subscriber Identifier Suboption of Option 82	Cisco IOS XE Release 2.1	This feature enables an ISP to add a unique identifier to the subscriber-identifier suboption of the relay agent information option. The following command was introduced by this feature: **ip dhcp relay information option subscriber-id**.
DHCP Relay MPLS VPN Support	Cisco IOS XE Release 2.1	DHCP relay support for MPLS VPNs enables a network administrator to conserve address space by allowing overlapping addresses. The relay agent can support multiple clients on different VPNs, and many of these clients from different VPNs can share the same IP address. The following commands were modified by this feature: **ip dhcp relay information option**, **ip helper address**.
DHCP Relay Agent Support for Unnumbered Interfaces	Cisco IOS XE Release 2.1	The Cisco IOS XE DHCP relay agent supports the use of unnumbered interfaces.

Feature Name	Releases	Feature Configuration Information
DHCP Relay Option 82 Encapsulation	Cisco IOS XE Release 3.1S	This feature allows a second DHCP relay agent to encapsulate the relay agent information option (option 82) from a prior relay agent, add its own option 82, and forward the packet to the DHCP server. The DHCP server can use the VPN information from the second relay agent along with the option 82 information from the first relay agent to send correct address assignments and other configuration parameters for the client devices based on the VRF, option 60, and encapsulated option 82. The following commands were added or modified by this feature: **ip dhcp relay information policy**, **ip dhcp relay information policy-action**.

Glossary

client --A host trying to configure its interface (obtain an IP address) using DHCP or BOOTP protocols.

DHCP --Dynamic Host Configuration Protocol.

giaddr --Gateway IP address. The giaddr field of the DHCP message provides the DHCP server with information about the IP address subnet on which the client is to reside. It also provides the DHCP server with an IP address where the response messages are to be sent.

MPLS --Multiprotocol Label Switching. Emerging industry standard upon which tag switching is based.

relay agent --A router that forwards DHCP and BOOTP messages between a server and a client on different subnets.

server --DHCP or BOOTP server.

VPN --Virtual Private Network. Enables IP traffic to use tunneling to travel securely over a public TCP/IP network.

VRF --VPN routing and forwarding instance. A VRF consists of an IP routing table, a derived forwarding table, a set of interfaces that use the forwarding table, and a set of rules and routing protocols that determine what goes into the forwarding table. In general, a VRF includes the routing information that defines a customer VPN site that is attached to a PE router. Each VPN instantiated on the PE router has its own VRF.