

[Solutions](#) [Products](#) [Ordering](#) [Support](#) [Partners](#) [Training](#) [Corporate](#)

Tech Notes

Understanding and Troubleshooting DHCP in Catalyst Switch or Enterprise Networks

[TAC Notice: What's Changing on TAC Web](#)

Contents

[Introduction](#)

[Prerequisites](#)

[Requirements](#)

[Components Used](#)

[Conventions](#)

[Key Concepts](#)

[Example Scenarios](#)

[Background Information](#)

[Understanding DHCP](#)

[Current DHCP RFC References](#)

[DHCP Message Table](#)

[Renewing the Lease](#)

[DHCP Packet](#)

[Client-Server Conversation for Client Obtaining DHCP Address](#)

[Where Client and DHCP Server Reside on Same Subnet](#)

[Role of DHCP/BootP Relay Agent](#)

[Configuring DHCP/BootP Relay Agent Feature on Cisco IOS](#)

[Router](#)

[Setting Manual Bindings](#)

[How to make DHCP Work on Secondary IP Segments](#)

[DHCP Client-Server Conversation with DHCP Relay Function](#)

[Pre-Execution Enviroment \(PXE\) Bootup DHCP Considerations](#)

[Understanding and Troubleshooting DHCP Using Sniffer Traces](#)

[Decoding Sniffer Trace of DHCP Client and Server on Same LAN Segment](#)

[Decoding Sniffer Trace of DHCP Client and Server Separated by a Router that is](#)

[Configured as a DHCP Relay Agent](#)

[Troubleshooting DHCP when Client Workstations are Unable to Obtain DHCP Addresses](#)

[Case Study #1: DHCP Server on Same LAN Segment or VLAN as DHCP Client](#)

[Case Study #2: DHCP Server and DHCP Client are Separated by a Router](#)

[Configured for DHCP/BootP Relay Agent Functionality](#)

[DHCP Server on Router Fails to Assign Addresses with a POOL EXHAUSTED Error](#)

[DHCP Troubleshooting Modules](#)

[Understanding Where DHCP Problems Can Occur](#)

[Keywords Entered after the ip dhcp pool command option {option_number} ASCII are in Double Quotes](#)

[Appendix A: IOS DHCP Sample Configuration](#)

[Related Information](#)

Help us help you.

Please rate this document.

☐ Excellent

☐ Good

☐ Average

☐ Fair

☐ Poor

This document solved my problem.

☐ Yes

☐ No

☐ Just browsing

Suggestions for improvement:

(256 character limit)

Send

Introduction

This document contains information on how to troubleshoot several common Dynamic Host Configuration Protocol (DHCP) issues that can arise within a Cisco Catalyst switch network. This document includes troubleshooting the use of the Cisco IOS® DHCP/BootP Relay Agent feature.

Prerequisites

Requirements

There are no specific prerequisites for this document.

Components Used

This document is not restricted to specific software and hardware versions.

The information presented in this document was created from devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If you are working in a live network, ensure that you understand the potential impact of any command before using it.

Conventions

For more information on document conventions, see the [Cisco Technical Tips Conventions](#).

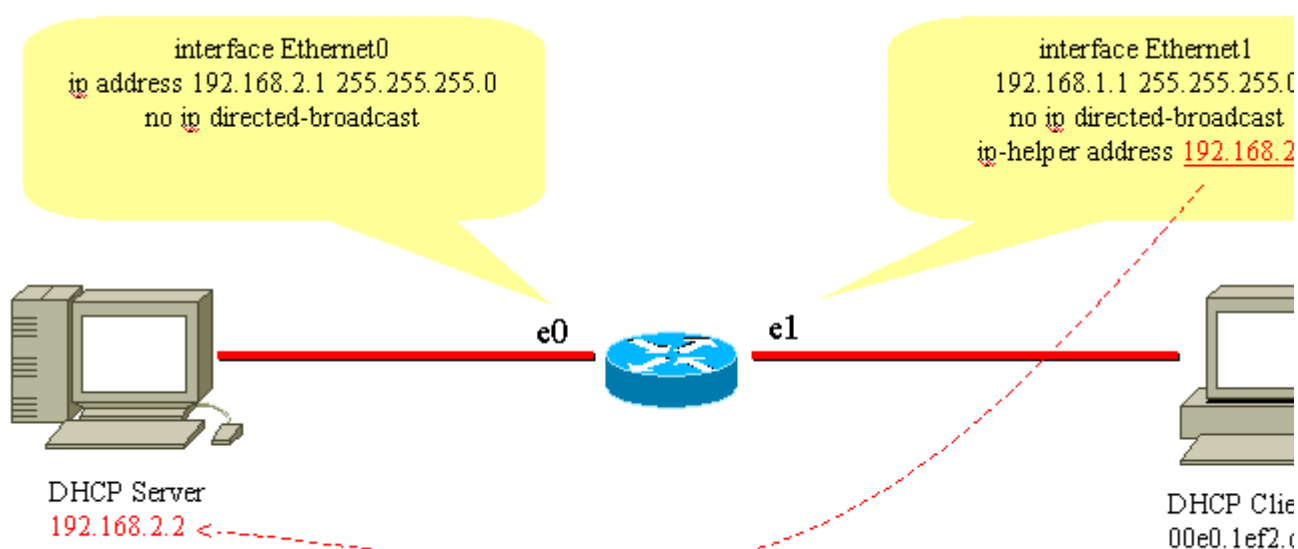
Key Concepts

Below are several key concepts of DHCP:

- DHCP clients initially have no configured IP address, and must therefore send a broadcast request to obtain an IP address from a DHCP server.
- Routers, by default, do not forward broadcasts. It is necessary to accommodate client DHCP broadcast requests if the DHCP server is on another broadcast domain (Layer 3 (L3) network). This is performed by use of a DHCP Relay Agent.
- The Cisco router implementation of DHCP Relay is provided via interface-level **ip helper** commands

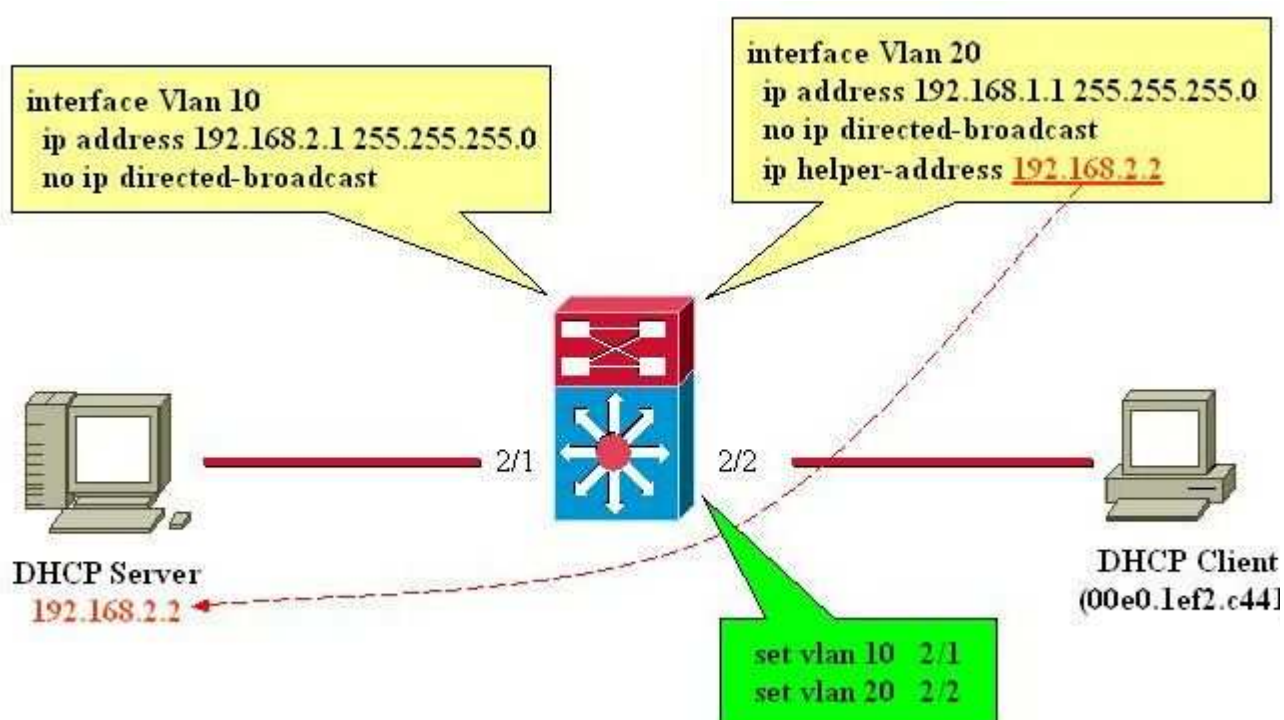
Example Scenarios

Scenario 1: Cisco Router Routing between DHCP Client and Server's Networks





As configured in the diagram above, interface Ethernet1 will forward the client's broadcasted DHCPDISCOVER to 192.168.2.2 via interface Ethernet1. The DHCP server will fulfill the request via unicast. No further configuration to the router is necessary in this example.

Scenario 2: Cisco Catalyst Switch with L3 Module Routing between DHCP Client and Server's Networks



As configured in the diagram above, interface VLAN20 will forward the client's broadcasted DHCPDISCOVER to 192.168.2.2 via interface VLAN10. The DHCP server will fulfill the request via unicast. No further configuration to the router is necessary in this example. The switch ports will need to be configured as host ports and have Spanning-Tree Protocol (STP) portfast enabled, and trunking and channeling disabled.




Background Information

DHCP provides a mechanism through which computers using Transmission Control Protocol/Internet Protocol (TCP/IP) can obtain protocol configuration parameters automatically through the network. DHCP is an open standard that was developed by the [Dynamic Host Configuration-Working Group](#)  (DHC-WG) of the [Internet Engineering Task Force](#)  (IETF).

DHCP is based on a client-server paradigm, in which the DHCP client, for example, a desktop computer, contacts a DHCP server for configuration parameters. The DHCP server is typically centrally located and operated by the network administrator. Because the server is run by a network administrator, DHCP clients can be reliably and dynamically configured with parameters appropriate to the current network architecture.

Most enterprise networks consist of multiple subnets divided into subnetworks referred to as Virtual LANS (VLANs), where routers route between the subnetworks. Since routers do not pass broadcasts by default, a DHCP server would be needed on each subnet unless the routers are configured to forward the DHCP broadcast using the DHCP Relay Agent feature.

Understanding DHCP

DHCP was originally defined in [Requests for Comments \(RFCs\) 1531](#) , and has since been obsoleted by [RFC 2131](#) . DHCP is based on the Bootstrap Protocol (BootP), which is defined in [RFC 951](#) .

DHCP is used by workstations (hosts) to get initial configuration information, such as an IP address, subnet mask, and default gateway upon bootup. Since each host needs an IP address to communicate in an IP network, DHCP eases the administrative burden of manually configuring each host with an IP address. Furthermore, if a host moves to a different IP subnet, it has to use a different IP address than the one it was previously using. DHCP takes care of this automatically, by allowing the host to choose an IP address in the correct IP subnet.

Current DHCP RFC References

- RFC 2131 - DHCP
- RFC 2132 - DHCP Options and BootP Vendor Extensions
- RFC 1534 - Interoperation between DHCP and BootP
- RFC 1542 - Clarifications and Extensions for the BootP
- RFC 2241 - DHCP Options for Novell Directory Services
- RFC 2242 - Netware/IP Domain Name and Information
- RFC 2489 - Procedure for Defining New DHCP Options

DHCP uses a client-server model where one or more servers (DHCP servers) allocate IP addresses and other optional configuration parameters to clients (hosts) upon client bootup. These configuration parameters are leased by the server to the client for some specified amount of time. When a host boots up, the TCP/IP stack in the host transmits a broadcast (DHCPDISCOVER) message in order to gain an IP address and subnet mask, among other configuration parameters. This

initiates an exchange between the DHCP server and the host. During this exchange, the client passes through the several well defined states listed below:

1. Initializing
2. Selecting
3. Requesting
4. Bound
5. Renewing
6. Rebinding

In moving between the states listed above, the client and server may exchange the types of messages listed in the DHCP Message Table below.

DHCP Message Table

Reference	Message	Use
0x01	DHCPDISCOVER	The client is looking for available DHCP servers.
0x02	DHCPOFFER	The server response to the client DHCPDISCOVER.
0x03	DHCPREQUEST	The client broadcasts to the server, requesting offered parameters from one server specifically, as defined in the packet.
0x04	DHCPDECLINE	The client-to-server communication, indicating that the network address is already in use.
0x05	DHCPACK	The server-to-client communication with configuration parameters, including committed network address.
0x06	DHCPNAK	The server-to-client communication, refusing the request for configuration parameter.
0x07	DHCPRELEASE	The client-to-server communication, relinquishing network address and canceling remaining lease.

0x08	DHCPINFORM	The client-to-server communication, asking for only local configuration parameters that the client already has externally configured as an address.
------	------------	---

DHCPDISCOVER

When a client boots up for the first time, it is said to be in the Initializing state, and transmits a DHCPDISCOVER message on its local physical subnet over User Datagram Protocol (UDP) port 67 (BootP server). Since the client has no way of knowing the subnet to which it belongs, the DHCPDISCOVER is an all subnets broadcast (destination IP address of 255.255.255.255), with a source IP address of 0.0.0.0. The source IP address is 0.0.0.0, since the client does not have a configured IP address. If a DHCP server exists on this local subnet and is configured and operating correctly, the DHCP server will hear the broadcast and respond with a DHCPOFFER message. If a DHCP server does not exist on the local subnet, there must be a DHCP/BootP Relay Agent on this local subnet to forward the DHCPDISCOVER message to a subnet that contains a DHCP server.

This relay agent can either be a dedicated host (for example, Microsoft Windows Server), or router (for example, a Cisco router configured with interface level IP helper statements).

DHCPOFFER

A DHCP server that receives a DHCPDISCOVER message may respond with a DHCPOFFER message on UDP port 68 (BootP client). The client receives the DHCPOFFER and moves into the Selecting state. This DHCPOFFER message contains initial configuration information for the client. For example, the DHCP server will fill in the yiaddr field of the DHCPOFFER message with the requested IP address. The subnet mask and default gateway are specified in the options field, subnet mask and router options, respectively. Other common options in the DHCPOFFER message include IP Address lease time, renewal time, domain name server, and NetBIOS name server (WINS). The DHCP server will send the DHCPOFFER to the broadcast address, but will include the clients hardware address in the chaddr field of the offer, so the client knows that it is the intended destination. In the event that the DHCP server is not on the local subnet, the DHCP server will send the DHCPOFFER, as a unicast packet, on UDP port 67, back to the DHCP/BootP Relay Agent from which the DHCPDISCOVER came. The DHCP/BootP Relay Agent will then either broadcast or unicast the DHCPOFFER on the local subnet on UDP port 68, depending on the Broadcast flag set by the Bootp client.

DHCPREQUEST

After the client receives a DHCPOFFER, it responds with a DHCPREQUEST message, indicating its intent to accept the parameters in the DHCPOFFER, and moves into the Requesting state. The client may receive multiple DHCPOFFER messages, one from each DHCP server that received the original DHCPDISCOVER message. The client chooses one DHCPOFFER and responds to that DHCP server only, implicitly declining all other DHCPOFFER messages. The client identifies the selected server by populating the Server Identifier option field with the DHCP server's IP address. The DHCPREQUEST is also a broadcast, so all DHCP servers that sent a DHCPOFFER will see the DHCPREQUEST, and each will know whether its DHCPOFFER was accepted or declined. Any additional configuration options that the client requires will be included in the options field of the DHCPREQUEST message. Even though the client has been offered an IP address, it will send the DHCPREQUEST message with a source IP address of 0.0.0.0. At this time, the client has not yet

received verification that it is clear to use the IP address.

DHCPACK

After the DHCP server receives the DHCPREQUEST, it acknowledges the request with a DHCPACK message, thus completing the initialization process. The DHCPACK message has a source IP address of the DHCP server, and the destination address is once again a broadcast and contains all the parameters that the client requested in the DHCPREQUEST message. When the client receives the DHCPACK, it enters into the Bound state, and is now free to use the IP address to communicate on the network. Meanwhile, the DHCP server stores the lease in its database and uniquely identifies it using the client identifier or chaddr, and the associated IP address. Both the client and server will use this combination of identifiers to refer to the lease. The client identifier is the Mac address of the device plus the media type.

Before the DHCP client begins using the new address, the DHCP client must calculate the time parameters associated with a leased address, which are Lease Time (LT), Renewal Time (T1), and Rebind Time (T2). The typical default LT is 72 hours. You can use shorter lease times to conserve addresses, if needed.

DHCPNAK

If the selected server is unable to satisfy the DHCPREQUEST message, the DHCP server will respond with a DHCPNAK message. When the client receives a DHCPNAK message, or does not receive a response to a DHCPREQUEST message, the client restarts the configuration process by going into the Requesting state. The client will retransmit the DHCPREQUEST at least four times within 60 seconds before restarting the Initializing state.

DHCPDECLINE

The client receives the DHCPACK and will optionally perform a final check on the parameters. The client performs this procedure by sending Address Resolution Protocol (ARP) requests for the IP address provided in the DHCPACK. If the client detects that the address is already in use by receiving a reply to the ARP request, the client will send a DHCPDECLINE message to the server and restart the configuration process by going into the Requesting state.

DHCPINFORM

If a client has obtained a network address through some other means or has a manually configured IP address, a client workstation may use a DHCPINFORM request message to obtain other local configuration parameters, such as the domain name and Domain Name Servers (DNSs). DHCP servers receiving a DHCPINFORM message construct a DHCPACK message with any local configuration parameters appropriate for the client without allocating a new IP address. This DHCPACK will be sent unicast to the client.

DHCPRELEASE

A DHCP client may choose to relinquish its lease on a network address by sending a DHCPRELEASE message to the DHCP server. The client identifies the lease to be released by the use of the `client identifier` field and network address in the DHCPRELEASE message. If you need to extend the current DHCP pool range, remove the current pool of addresses and specify the new range of IP addresses under the DHCP pool. In order to remove specific IP addresses or a range of addresses that you want to be in the DHCP pool, use the command **ip dhcp excluded-address**.

Note: If devices use BOOTP, infinite length leases are shown in the DHCP bindings of routers.

Renewing the Lease

Since the IP address is only leased from the server, the lease must be renewed from time to time. When one half of the lease time has expired ($T1 = 0.5 \times LT$), the client will try to renew the lease. The client enters the Renewing state and sends a DHCPREQUEST message to the server, which holds the current lease. The server will reply to the request to renew with a DHCPACK message if it agrees to renew the lease. The DHCPACK message will contain the new lease and any new configuration parameters, in the event that any changes are made to the server during the time of the previous lease. If the client is unable to reach the server holding the lease for some reason, it will attempt to renew the address from any DHCP server after the original DHCP server has not responded to the renewal requests within a time $T2$. The default value of $T2$ is $(7/8 \times LT)$. This means $T1 < T2 < LT$.

If the client previously had a DHCP assigned IP address and it is restarted, the client will specifically request the previously leased IP address in a DHCPREQUEST packet. This DHCPREQUEST will still have the source IP address as 0.0.0.0, and the destination as the IP broadcast address 255.255.255.255.

A client sending a DHCPREQUEST during a reboot must not fill in the server identifier field, and must instead fill in the requested IP address option field. Strictly RFC compliant clients will populate the ciaddr field with the address requested instead of the DHCP option field. The DHCP server will accept either method. The behavior of the DHCP server depends on a number of factors, such as in the case of Windows NT DHCP servers, the version of the operating system being used, as well as other factors, such as superscoping. If the DHCP server determines that the client can still use the requested IP address, it will either remain silent or send a DHCPACK for the DHCPREQUEST. If the server determines that the client cannot use the requested IP address, it will send a DHCPNACK back to the client. The client will then move to the Initializing state, and send a DHCPDISCOVER message.

DHCP Packet

The DHCP message is variable in length and consists of fields listed in the table below.

Note: This packet is a modified version of the original BootP packet.

Field	Bytes	Name	Description
op	1	OpCode	Identifies the packet as an request or reply: 1=BOOTREQUEST, 2=BOOTREPLY
htype	1	Hardware Type	Specifies the network hardware address type.
hlen	1	Hardware Length	Specifies the length hardware address length.
hops	1	Hops	The client sets the value to zero and the value increments if the request is forwarded across a router.
		Transaction	A random number that is chosen by the client. All DHCP messages

xid	4	ID	exchanged for a given DHCP transaction use the ID (xid).
secs	2	Seconds	Specifies number of seconds since the DHCP process started.
flags	2	Flags	Indicates whether the message will be broadcast or unicast.
ciaddr	4	Client IP address	Only used when client knows its IP address as in the case of the Bound, Renew, or Rebinding states.
yiaddr	4	Your IP address	If the client IP address is 0.0.0.0, the DHCP server will place the offered client IP address in this field.
siaddr	4	Server IP address	If the client knows the IP address of the DHCP server, this field will be populated with the DHCP server address. Otherwise, it is used in DHCPOFFER and DHCPACK from DHCP server.
giaddr	4	Router IP address (GI ADDR)	The Gateway IP address, filled in by the DHCP/BootP Relay Agent.
chaddr	16	Client MAC address	The DHCP client MAC address.
sname	64	Server name	The optional server host name.
file	128	Boot file name	The boot file name.
options	variable	Option parameters	The optional parameters that can be provided by the DHCP server. RFC 2132 gives all possible options.

Client-Server Conversation for Client Obtaining DHCP Address Where Client and DHCP Server Reside on Same Subnet

		Destination		
--	--	-------------	--	--

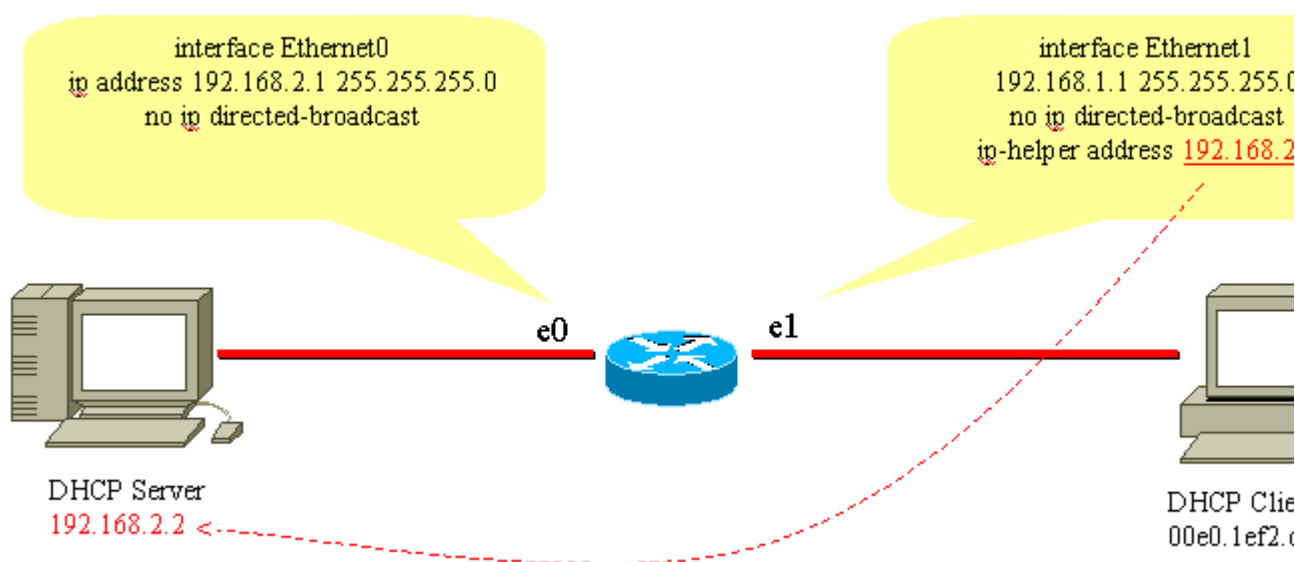
Packet Description	Source MAC Addr	MAC Addr	Source IP Addr	Destination IP Addr
DHCPDISCOVER	Client	Broadcast	0.0.0.0	255.255.255.255
DHCPOFFER	DHCP Server	Broadcast	DHCP Server	255.255.255.255
DHCPREQUEST	Client	Broadcast	0.0.0.0	255.255.255.255
DHCPACK	DHCP Server	Broadcast	DHCP Server	255.255.255.255

Role of DHCP/BootP Relay Agent

Routers, by default, will not forward broadcast packets. Since DHCP client messages use the destination IP address of 255.255.255.255 (all Nets Broadcast), DHCP clients will not be able to send requests to a DHCP server on a different subnet unless the DHCP/BootP Relay Agent is configured on the router. The DHCP/BootP Relay Agent will forward DHCP requests on behalf of a DHCP client to the DHCP server. The DHCP/BootP Relay Agent will append its own IP address to the source IP address of the DHCP frames going to the DHCP server. This allows the DHCP server to respond via unicast to the DHCP/BootP Relay Agent. The DHCP/BootP Relay Agent will also populate the Gateway IP address field with the IP address of the interface on which the DHCP message is received from the client. The DHCP server uses the Gateway ip address field to determine the subnet from which the DHCPDISCOVER, DHCPREQUEST, or DHCPINFORM message originates.

Configuring DHCP/BootP Relay Agent Feature on Cisco IOS Router

Configuring a Cisco router to forward BootP or DHCP requests is simple - configure an IP helper-address pointing to the DHCP/BootP server, or pointing to the subnet broadcast address of the network the server is on. For example, consider the following network diagram:



To forward the BootP/DHCP request from the client to the DHCP server, the **ip helper-address interface** command is used. The IP helper-address can be configured to forward any UDP broadcast based on UDP port number. By default, the IP helper-address will forward the following UDP

broadcasts:

- Trivial File Transfer Protocol (TFTP) (port 69)
- DNS (port 53), time service (port 37)
- NetBIOS name server (port 137)
- NetBIOS datagram server (port 138)
- Boot Protocol (DHCP/BootP) client and server datagrams (ports 67 and 68)
- Terminal Access Control Access Control System (TACACS) service (port 49)
- IEN-116 name service (port 42)

IP helper-addresses can direct UDP broadcasts to a unicast or broadcast IP address. **However, it is not recommended to use the IP helper-address to forward UDP broadcasts from one subnet to the broadcast address of another subnet, due to the large amount of broadcast flooding that may occur.** Multiple IP helper-address entries on a single interface are supported as well, as shown below:

```
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname router
!
!
!
interface Ethernet0
ip address 192.168.2.1 255.255.255.0
no ip directed-broadcast
!
interface Ethernet1
ip address 192.168.1.1 255.255.255.0
ip helper-address 192.168.2.2
ip helper-address 192.168.2.3

!--- IP helper-address pointing to DHCP server

no ip directed-broadcast
!
!
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
end
```

Cisco routers do not support load balancing of DHCP servers that are configured as DHCP Relay Agents. Cisco routers forward the DHCPDISCOVER message to all the helper addresses mentioned

for that interface. Having two or more DHCP servers to serve a subnet only increases the DHCP traffic as the DHCPDISCOVER, DHCPOFFER, and DHCPREQUEST / DHCPDECLINE messages are exchanged between each pair of DHCP client and server.

Setting Manual Bindings

There are two ways to set up manual bindings; one is for the Windows host, and the other is for non-Windows hosts. There are two different commands used to configure; one is for Microsoft DHCP clients, and the other is for non-Microsoft DHCP clients: **DHCP client-identifier** (manual binding - Microsoft DHCP clients) and **DHCP hardware-address** (manual binding - non-Microsoft DHCP clients). The reason for two different commands is that a PC that runs with Windows modifies its MACs, and a **01** is added at the beginning of the address. These are the sample configurations:

- The following is the configuration for Microsoft DHCP clients

```
configuration terminal
ip dhcp pool new_pool
host ip_address subnet_mask
client-identifier 01XXXXXXXXXXXX
```

!--- xxxxxx represents 48 bit MAC address prepended with 01

- The following is the configuration for non-Microsoft DHCP clients

```
configuration terminal
ip dhcp pool new_pool
host ip_address subnet_mask
hardware-address XXXXXXXXXXXX
```

!--- xxxxxx represents 48 bit MAC address

How to make DHCP Work on Secondary IP Segments

By default, DHCP has a limitation in that the reply packets are sent only if the request is received from the interface configured with the primary IP address. DHCP traffic uses the broadcast address. When the DHCP request is received by the router interface, it forwards it to the DHCP server (when IP helper-address is configured) with a source address of the primary IP configured on the interface to let the DHCP server know which IP pool it must use (for the client) in the DHCP reply packet.

There is no way for the router to know if the DHCP broadcast request comes from a device that is on the secondary IP network configured on the interface. As a workaround, sub-interface configuration (provided that the device connected to the router supports dot1q tagging) to separate the two subnets can be configured, so both of them get their correspondent IP addresses properly.

If the secondary address is the preferred way, there is another workaround, which is to enable the global configuration command **ip dhcp smart-relay**. This has a limitation in that it only uses the secondary IP to relay the DHCP request if there is no response from the DHCP server after three consecutive requests for the primary address pool.

DHCP Client-Server Conversation with DHCP Relay Function

The table below illustrates the process for a DHCP client to obtain an IP address from a DHCP server. This table is modeled after the [network diagram](#) above. Each numerical value in the diagram

represents a packet that is described below. This table is a point of reference for understanding the packet flow of DHCP client-server conversation. This table is also useful for determining where DHCP problems may be occurring.

Packet	Client IP Address	Server IP Address	GI Address	Packet Source MAC Address	Packet Source IP Address	Packet Destination MAC Address
1. DHCPDISCOVER is sent from client.	0.0.0.0	0.0.0.0	0.0.0.0	0005.DCC9.C640	0.0.0.0	ffff.ffff (broadcast)
2. The router receives the DHCPDISCOVER on the E1 interface. The router recognizes that this packet is a DHCP UDP broadcast. The router will now act as a DHCP/BootP Relay Agent and fill in the Gateway IP address field with the incoming interface IP address, change the source IP address to an incoming interface IP address, and forward the request directly to the DHCP server.	0.0.0.0	0.0.0.0	192.168.1.1	Interface E2 MAC Address	192.168.1.1	MAC Address of DHCP Server
3. The DHCP server has received the DHCPDISCOVER and is sending a DHCPOFFER to the DHCP Relay Agent.	192.168.1.2	192.168.2.2	192.168.1.1	MAC Address of DHCP Server	192.168.2.2	Interface E2 MAC Address
4. The DHCP Relay Agent receives a DHCPOFFER, and will forward the DHCPOFFER broadcast on the local LAN.	192.168.1.2	192.168.2.2	192.168.1.1	Interface E1 MAC Address	192.168.1.1	ffff.ffff (broadcast)

5. DHCPREQUEST sent from client.	0.0.0.0	0.0.0.0	0.0.0.0	0005.DCC9.C640	0.0.0.0	ffff.ffff (broadc
6. The router receives the DHCPREQUEST on the E1 Interface. The router recognizes that this packet is DHCP UDP broadcast. The router will now act as a DHCP Relay Agent and fill in the Gateway IP address field with the incoming interface IP Address, change the source IP address to an incoming interface IP address, and forward the request directly to the DHCP server.	0.0.0.0	0.0.0.0	192.168.1.1	Interface E2 MAC Address	192.168.1.1	MAC Address DHCP Server
7. The DHCP server has received the DHCPREQUEST and is sending a DHCPACK to the DHCP/BootP Relay Agent.	192.168.1.2	192.168.2.2	192.168.1.1	MAC Address of DHCP Server	192.168.2.2	Interfac E2 MA Address
8. The DHCP/BootP Relay Agent receives the DHCPACK, and will forward the DHCPACK broadcast on the local LAN. The client will accept the ACK and use the client's IP address.	192.168.1.2	192.168.2.2	192.168.1.1	Interface E1 MAC Address	192.168.1.1	ffff.ffff (broadc

Pre-Execution Enviroment (PXE) Bootup DHCP Considerations

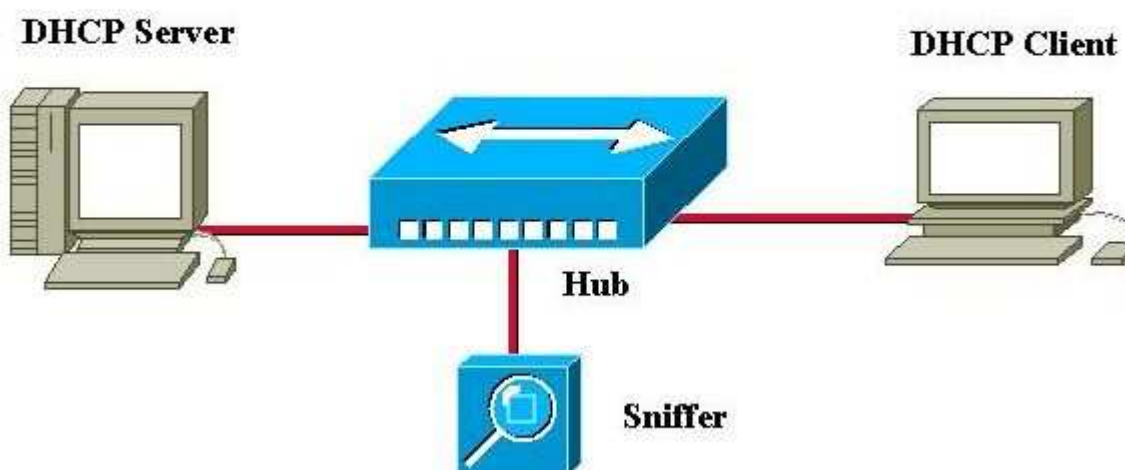
Pre-Execution Environment (PXE) allows a workstation to boot from a server on a network prior to booting the operating system on the local hard drive. A network administrator does not have to physically visit the specific workstation and manually boot it. Operating systems and other software, such as diagnostic programs, can be loaded onto the device from a server over the network. PXE environment uses DHCP to configure its IP address.

The DHCP/BootP Relay Agent configuration must be done on the router if the DHCP server is located on another routed segment of the network. The **ip helper address** command on the local router interface must be configured. Refer to the [Configuring DHCP/BootP Relay Agent Feature on Cisco IOS Router](#) section of this document for configuration information.

Understanding and Troubleshooting DHCP Using Sniffer Traces

Decoding Sniffer Trace of DHCP Client and Server on Same LAN Segment

Network Topology where DHCP Client and Server Reside on Same LAN Segment



The sniffer trace below is comprised of six frames. These six frames illustrate a working scenario for DHCP, where the DHCP client and server reside on the same physical or logical segment. When troubleshooting DHCP, it is important to match your sniffer trace to the traces below. There may be some differences compared to the traces below, but the general packet flow should be exactly the same. The packet trace follows previous discussions of how DHCP works.

- - - - - Frame 1 - DHCPDISCOVER - - - - -

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
1[0.0.0.0] [255.255.255.255] 618 0:01:26.810 0.575.244 05/07/2001 11:52:03 Al
Message type: DHCP Discover
DLC: ----- DLC Header -----
DLC:
DLC: Frame 1 arrived at 11:52:03.8106; frame size is 618 (026A hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station 0005DCC9C640
DLC: Ethertype = 0800 (IP)

```

```

DLC:
IP: ----- IP Header -----
IP:
IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput
IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 604 bytes
IP: Identification = 9
IP: Flags = 0X
IP: .0.. .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = B988 (correct)
IP: Source address = [0.0.0.0]
IP: Destination address = [255.255.255.255]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 68 (BootPc/DHCP)
UDP: Destination port = 67 (BootPs/DHCP)
UDP: Length = 584
UDP: No checksum
UDP: [576 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 1 (Request)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 0
DHCP: Transaction id = 00000882
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [0.0.0.0]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [0.0.0.0]
DHCP: Client hardware address = 0005DCC9C640
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 1 (DHCP Discover)
DHCP: Maximum message size = 1152
DHCP: Client identifier = 00636973636F2D303030352E646363392E633634302D564C31
DHCP: Parameter Request List: 7 entries
DHCP: 1 = Client's subnet mask
DHCP: 66 = TFTP Option
DHCP: 6 = Domain name server
DHCP: 3 = Routers on the client's subnet
DHCP: 67 = Boot File Option
DHCP: 12 = Host name server
DHCP: 150 = Unknown Option

```



```
DHCP: Class identifier = 646F63736973312E30
DHCP: Option overload =3 (File and Sname fields hold options)
DHCP:
```

```
- - - - - Frame 2 - DHCP OFFER - - - - -
```

```
Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
2[192.168.1.1] [255.255.255.255] 331 0:01:26.825 0.015.172 05/07/2001 11:52:
```

```
Message type: DHCP Offer
```

```
DLC: ----- DLC Header -----
```

```
DLC:
```

```
DLC: Frame 2 arrived at 11:52:03.8258; frame size is 331 (014B hex) bytes.
```

```
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
```

```
DLC: Source = Station 0005DCC42484
```

```
DLC: Ethertype = 0800 (IP)
```

```
DLC:
```

```
IP: ----- IP Header -----
```

```
IP:
```

```
IP: Version = 4, header length = 20 bytes
```

```
IP: Type of service = 00
```

```
IP: 000. .... = routine
```

```
IP: ...0 .... = normal delay
```

```
IP: .... 0... = normal throughput
```

```
IP: .... .0.. = normal reliability
```

```
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
```

```
IP: .... ...0 = CE bit - no congestion
```

```
IP: Total length = 317 bytes
```

```
IP: Identification = 5
```

```
IP: Flags = 0X
```

```
IP: .0.. .... = may fragment
```

```
IP: ..0. .... = last fragment
```

```
IP: Fragment offset = 0 bytes
```

```
IP: Time to live = 255 seconds/hops
```

```
IP: Protocol = 17 (UDP)
```

```
IP: Header checksum = F901 (correct)
```

```
IP: Source address = [192.168.1.1]
```

```
IP: Destination address = [255.255.255.255]
```

```
IP: No options
```

```
IP:
```

```
UDP: ----- UDP Header -----
```

```
UDP:
```

```
UDP: Source port = 67 (BootPs/DHCP)
```

```
UDP: Destination port = 68 (BootPc/DHCP)
```

```
UDP: Length = 297
```

```
UDP: No checksum
```

```
UDP: [289 byte(s) of data]
```

```
UDP:
```

```
DHCP: ----- DHCP Header -----
```

```
DHCP:
```

```
DHCP: Boot record type = 2 (Reply)
```

```
DHCP: Hardware address type = 1 (10Mb Ethernet)
```

```
DHCP: Hardware address length = 6 bytes
```

```
DHCP:
```

```
DHCP: Hops = 0
```

```
DHCP: Transaction id = 00000882
```

```
DHCP: Elapsed boot time = 0 seconds
```

```
DHCP: Flags = 8000
```

```
DHCP: 1... .... = Broadcast IP datagrams
```

```
DHCP: Client self-assigned IP address = [0.0.0.0]
```

```
DHCP: Client IP address = [192.168.1.2]
```

```
DHCP: Next Server to use in bootstrap = [0.0.0.0]
```

```
DHCP: Relay Agent = [0.0.0.0]
```

```
DHCP: Client hardware address = 0005DCC9C640
```

```
DHCP:
```

```

DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 2 (DHCP Offer)
DHCP: Server IP address = [192.168.1.1]
DHCP: Request IP address lease time = 85535 (seconds)
DHCP: Address Renewal interval = 42767 (seconds)
DHCP: Address Rebinding interval = 74843 (seconds)
DHCP: Subnet mask = [255.255.255.0]
DHCP: Domain Name Server address = [192.168.1.3]
DHCP: Domain Name Server address = [192.168.1.4]
DHCP: Gateway address = [192.168.1.1]
DHCP:

```

```

- - - - - Frame 3 - DHCPREQUEST - - - - -

```

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
3[0.0.0.0] [255.255.255.255] 618 0:01:26.829 0.003.586 05/07/2001 11:52:03 Al

```

```

    Message type: DHCP Request

```

```

DLC: ----- DLC Header -----

```

```

DLC:

```

```

DLC: Frame 56 arrived at 11:52:03.8294; frame size is 618 (026A hex) bytes.

```

```

DLC: Destination = BROADCAST FFFFFFFF, Broadcast

```

```

DLC: Source = Station 0005DCC9C640

```

```

DLC: Ethertype = 0800 (IP)

```

```

DLC:

```

```

IP: ----- IP Header -----

```

```

IP:

```

```

IP: Version = 4, header length = 20 bytes

```

```

IP: Type of service = 00

```

```

IP: 000. .... = routine

```

```

IP: ...0 .... = normal delay

```

```

IP: .... 0... = normal throughput

```

```

IP: .... .0.. = normal reliability

```

```

IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit

```

```

IP: .... ...0 = CE bit - no congestion

```

```

IP: Total length = 604 bytes

```

```

IP: Identification = 10

```

```

IP: Flags = 0X

```

```

IP: .0.. .... = may fragment

```

```

IP: ..0. .... = last fragment

```

```

IP: Fragment offset = 0 bytes

```

```

IP: Time to live = 255 seconds/hops

```

```

IP: Protocol = 17 (UDP)

```

```

IP: Header checksum = B987 (correct)

```

```

IP: Source address = [0.0.0.0]

```

```

IP: Destination address = [255.255.255.255]

```

```

IP: No options

```

```

IP:

```

```

UDP: ----- UDP Header -----

```

```

UDP:

```

```

UDP: Source port = 68 (BootPc/DHCP)

```

```

UDP: Destination port = 67 (BootPs/DHCP)

```

```

UDP: Length = 584

```

```

UDP: No checksum

```

```

UDP: [576 byte(s) of data]

```

```

UDP:

```

```

DHCP: ----- DHCP Header -----

```

```

DHCP:

```

```

DHCP: Boot record type = 1 (Request)

```

```

DHCP: Hardware address type = 1 (10Mb Ethernet)

```

```

DHCP: Hardware address length = 6 bytes

```

```

DHCP:

```

```

DHCP: Hops = 0
DHCP: Transaction id = 00000882
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [0.0.0.0]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [0.0.0.0]
DHCP: Client hardware address = 0005DCC9C640
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 3 (DHCP Request)
DHCP: Maximum message size = 1152
DHCP: Client identifier = 00636973636F2D303030352E646363392E633634302D564C31
DHCP: Server IP address = [192.168.1.1]
DHCP: Request specific IP address = [192.168.1.2]
DHCP: Request IP address lease time = 85535 (seconds)
DHCP: Parameter Request List: 7 entries
DHCP: 1 = Client's subnet mask
DHCP: 66 = TFTP Option
DHCP: 6 = Domain name server
DHCP: 3 = Routers on the client's subnet
DHCP: 67 = Boot File Option
DHCP: 12 = Host name server
DHCP: 150 = Unknown Option
DHCP: Class identifier = 646F63736973312E30
DHCP: Option overload = 3 (File and Sname fields hold options)
DHCP:

```

- - - - - **Frame 4 - DHCPACK** - - - - -

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
4[192.168.1.1] [255.255.255.255] 331 0:01:26.844 0.014.658 05/07/2001 11:52:
  Message type: DHCP Ack
DLC: ----- DLC Header -----
DLC:
DLC: Frame 57 arrived at 11:52:03.8440; frame size is 331 (014B hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station 0005DCC42484
DLC: Ethertype = 0800 (IP)
DLC:
IP: ----- IP Header -----
IP:
IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput
IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 317 bytes
IP: Identification = 6
IP: Flags = 0X
IP: .0.. .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = F900 (correct)

```

```

IP: Source address = [192.168.1.1]
IP: Destination address = [255.255.255.255]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 67 (BootPs/DHCP)
UDP: Destination port = 68 (BootPc/DHCP)
UDP: Length = 297
UDP: No checksum
UDP: [289 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 2 (Reply)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 0
DHCP: Transaction id = 00000882
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [192.168.1.2]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [0.0.0.0]
DHCP: Client hardware address = 0005DCC9C640
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 5 (DHCP Ack)
DHCP: Server IP address = [192.168.1.1]
DHCP: Request IP address lease time = 86400 (seconds)
DHCP: Address Renewal interval = 43200 (seconds)
DHCP: Address Rebinding interval = 75600 (seconds)
DHCP: Subnet mask = [255.255.255.0]
DHCP: Domain Name Server address = [192.168.1.3]
DHCP: Domain Name Server address = [192.168.1.4]
DHCP: Gateway address = [192.168.1.1]
DHCP:

```

```

- - - - - Frame 5 - ARP - - - - -

```

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
5 0005DCC9C640 Broadcast 60 0:01:26.846 0.002.954 05/07/2001 11:52:03 AM ARP
HA=0005DCC9C640 PRO=IP
DLC: ----- DLC Header -----
DLC:
DLC: Frame 58 arrived at 11:52:03.8470; frame size is 60 (003C hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station 0005DCC9C640
DLC: Ethertype = 0806 (ARP)
DLC:
ARP: ----- ARP/RARP frame -----
ARP:
ARP: Hardware type = 1 (10Mb Ethernet)
ARP: Protocol type = 0800 (IP)
ARP: Length of hardware address = 6 bytes
ARP: Length of protocol address = 4 bytes
ARP: Opcode 2 (ARP reply)
ARP: Sender's hardware address = 0005DCC9C640

```

```

ARP: Sender's protocol address = [192.168.1.2]
ARP: Target hardware address = FFFFFFFF
ARP: Target protocol address = [192.168.1.2]
ARP:
ARP: 18 bytes frame padding
ARP:

```

----- Frame 6 - ARP -----

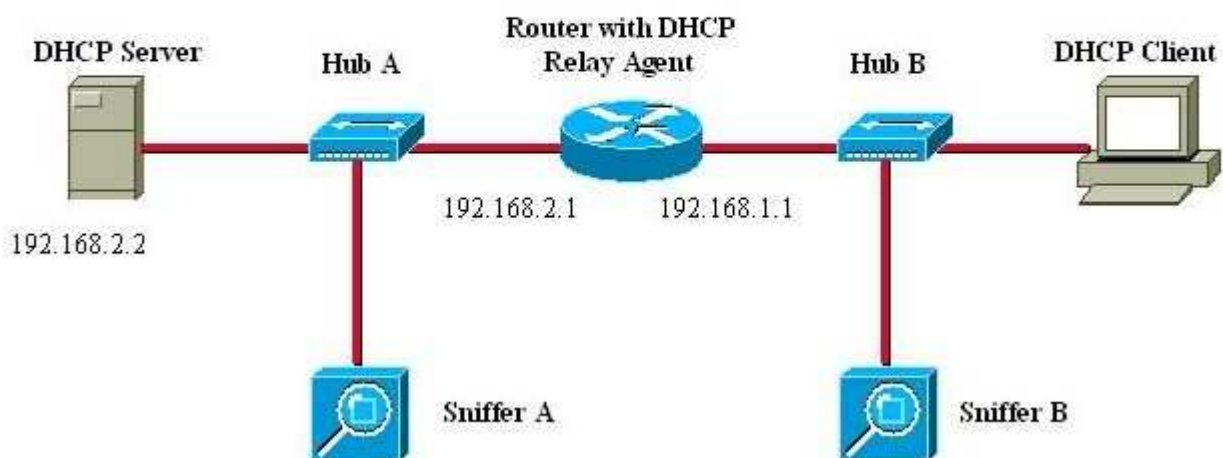
```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
6 0005DCC9C640 Broadcast 60 0:01:27.355 0.508.778 05/07/2001 11:52:04 AM ARP
HA=0005DCC9C640 PRO=IP
DLC: ----- DLC Header -----
DLC:
DLC: Frame 59 arrived at 11:52:04.3557; frame size is 60 (003C hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station 0005DCC9C640
DLC: Ethertype = 0806 (ARP)
DLC:
ARP: ----- ARP/RARP frame -----
ARP:
ARP: Hardware type = 1 (10Mb Ethernet)
ARP: Protocol type = 0800 (IP)
ARP: Length of hardware address = 6 bytes
ARP: Length of protocol address = 4 bytes
ARP: Opcode 2 (ARP reply)
ARP: Sender's hardware address = 0005DCC9C640
ARP: Sender's protocol address = [192.168.1.2]
ARP: Target hardware address = FFFFFFFF
ARP: Target protocol address = [192.168.1.2]
ARP:
ARP: 18 bytes frame padding
ARP:

```

Decoding Sniffer Trace of DHCP Client and Server Separated by a Router that is Configured as a DHCP Relay Agent

DHCP Client and Server separated by router configured as DHCP Relay Agent



Sniffer-B Trace

----- Frame 1 - DHCPDISCOVER -----

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
1 [0.0.0.0] [255.255.255.255] 618 0:02:05.759 0.025.369 05/31/2001 06:53:04 .
  Message type: DHCP Discover
  DLC: ----- DLC Header -----
  DLC:
  DLC: Frame 124 arrived at 06:53:04.2043; frame size is 618 (026A hex) bytes.
  DLC: Destination = BROADCAST FFFFFFFF, Broadcast
  DLC: Source = Station 0005DCF2C441
  DLC: Ethertype = 0800 (IP)
  DLC:
  IP: ----- IP Header -----
  IP:
  IP: Version = 4, header length = 20 bytes
  IP: Type of service = 00
  IP: 000. .... = routine
  IP: ...0 .... = normal delay
  IP: .... 0... = normal throughput
  IP: .... .0.. = normal reliability
  IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
  IP: .... ...0 = CE bit - no congestion
  IP: Total length = 604 bytes
  IP: Identification = 183
  IP: Flags = 0X
  IP: .0.. .... = may fragment
  IP: ..0. .... = last fragment
  IP: Fragment offset = 0 bytes
  IP: Time to live = 255 seconds/hops
  IP: Protocol = 17 (UDP)
  IP: Header checksum = B8DA (correct)
  IP: Source address = [0.0.0.0]
  IP: Destination address = [255.255.255.255]
  IP: No options
  IP:
  UDP: ----- UDP Header -----
  UDP:
  UDP: Source port = 68 (BootPc/DHCP)
  UDP: Destination port = 67 (BootPs/DHCP)
  UDP: Length = 584
  UDP: No checksum
  UDP: [576 byte(s) of data]
  UDP:
  DHCP: ----- DHCP Header -----
  DHCP:
  DHCP: Boot record type = 1 (Request)
  DHCP: Hardware address type = 1 (10Mb Ethernet)
  DHCP: Hardware address length = 6 bytes
  DHCP:
  DHCP: Hops = 0
  DHCP: Transaction id = 00001425
  DHCP: Elapsed boot time = 0 seconds
  DHCP: Flags = 8000
  DHCP: 1... .... = Broadcast IP datagrams
  DHCP: Client self-assigned IP address = [0.0.0.0]
  DHCP: Client IP address = [0.0.0.0]
  DHCP: Next Server to use in bootstrap = [0.0.0.0]
  DHCP: Relay Agent = [0.0.0.0]
  DHCP: Client hardware address = 0005DCF2C441
  DHCP:
  DHCP: Host name = ""
  DHCP: Boot file name = ""
  DHCP:
  DHCP: Vendor Information tag = 63825363
  DHCP: Message Type = 1 (DHCP Discover)

```

```

DHCP: Maximum message size = 1152
DHCP: Client identifier = 00636973636F2D303065302E316566322E633434312D457430
DHCP: Parameter Request List: 7 entries
DHCP: 1 = Client's subnet mask
DHCP: 6 = Domain name server
DHCP: 15 = Domain name
DHCP: 44 = NetBIOS over TCP/IP name server
DHCP: 3 = Routers on the client's subnet
DHCP: 33 = Static route
DHCP: 150 = Unknown Option
DHCP: Class identifier = 646F63736973312E30
DHCP: Option overload = 3 (File and Sname fields hold options)
DHCP:

```

```

- - - - - Frame 2 - DHCPOFFER - - - - -

```

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
125 [192.168.1.1] [255.255.255.255] 347 0:02:05.772 0.012.764 05/31/2001 06:
  Message type: DHCP Offer
DLC: ----- DLC Header -----
DLC:
DLC: Frame 125 arrived at 06:53:04.2171; frame size is 347 (015B hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station 003094248F71
DLC: Ethertype = 0800 (IP)
DLC:
IP: ----- IP Header -----
IP:
IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput
IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 333 bytes
IP: Identification = 45
IP: Flags = 0X
IP: .0... .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = F8C9 (correct)
IP: Source address = [192.168.1.1]
IP: Destination address = [255.255.255.255]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 67 (BootPs/DHCP)
UDP: Destination port = 68 (BootPc/DHCP)
UDP: Length = 313
UDP: Checksum = 8517 (correct)
UDP: [305 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 2 (Reply)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 0

```

```

DHCP: Transaction id = 00001425
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [192.168.1.2]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [192.168.1.1]
DHCP: Client hardware address = 0005DCF2C441
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 2 (DHCP Offer)
DHCP: Server IP address = [192.168.2.2]
DHCP: Request IP address lease time = 99471 (seconds)
DHCP: Address Renewal interval = 49735 (seconds)
DHCP: Address Rebinding interval = 87037 (seconds)
DHCP: Subnet mask = [255.255.255.0]
DHCP: Domain Name Server address = [192.168.10.1]
DHCP: Domain Name Server address = [192.168.10.2]
DHCP: NetBIOS Server address = [192.168.10.1]
DHCP: NetBIOS Server address = [192.168.10.3]
DHCP: Domain name = "cisco.com"
DHCP:

```

```

- - - - - Frame 3 - DHCPREQUEST - - - - -

```

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Time
3 [0.0.0.0] [255.255.255.255] 618 0:02:05.774 0.002.185 05/31/2001 06:53:04
Message type: DHCP Request
DLC: ----- DLC Header -----
DLC:
DLC: Frame 126 arrived at 06:53:04.2193; frame size is 618 (026A hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station Cisc14F2C441
DLC: Ethertype = 0800 (IP)
DLC:
IP: ----- IP Header -----
IP:
IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput
IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 604 bytes
IP: Identification = 184
IP: Flags = 0X
IP: .0.. .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = B8D9 (correct)
IP: Source address = [0.0.0.0]
IP: Destination address = [255.255.255.255]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:

```



```

UDP: Source port = 68 (BootPc/DHCP)
UDP: Destination port = 67 (BootPs/DHCP)
UDP: Length = 584
UDP: No checksum
UDP: [576 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 1 (Request)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 0
DHCP: Transaction id = 00001425
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [0.0.0.0]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [0.0.0.0]
DHCP: Client hardware address = 0005DCF2C441
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 3 (DHCP Request)
DHCP: Maximum message size = 1152
DHCP: Client identifier = 00636973636F2D303065302E3165666322E633434312D457430
DHCP: Server IP address = [192.168.2.2]
DHCP: Request specific IP address = [192.168.1.2]
DHCP: Request IP address lease time = 99471 (seconds)
DHCP: Parameter Request List: 7 entries
DHCP: 1 = Client's subnet mask
DHCP: 6 = Domain name server
DHCP: 15 = Domain name
DHCP: 44 = NetBIOS over TCP/IP name server
DHCP: 3 = Routers on the client's subnet
DHCP: 33 = Static route
DHCP: 150 = Unknown Option
DHCP: Class identifier = 646F63736973312E30
DHCP: Option overload = 3 (File and Sname fields hold options)
DHCP:

- - - - - Frame 4 - DHCPACK - - - - -

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
4 [192.168.1.1] [255.255.255.255] 347 0:02:05.787 0.012.875 05/31/2001 06:53
  Message type: DHCP Ack
DLC: ----- DLC Header -----
DLC:
DLC: Frame 127 arrived at 06:53:04.2321; frame size is 347 (015B hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station 003094248F71
DLC: Ethertype = 0800 (IP)
DLC:
IP: ----- IP Header -----
IP:
IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput

```

```

IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 333 bytes
IP: Identification = 47
IP: Flags = 0X
IP: .0.. .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = F8C7 (correct)
IP: Source address = [192.168.1.1]
IP: Destination address = [255.255.255.255]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 67 (BootPs/DHCP)
UDP: Destination port = 68 (BootPc/DHCP)
UDP: Length = 313
UDP: Checksum = 326F (correct)
UDP: [305 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 2 (Reply)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 0
DHCP: Transaction id = 00001425
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [192.168.1.2]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [192.168.1.1]
DHCP: Client hardware address = 0005DCF2C441
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 5 (DHCP Ack)
DHCP: Server IP address = [192.168.2.2]
DHCP: Request IP address lease time = 172800 (seconds)
DHCP: Address Renewal interval = 86400 (seconds)
DHCP: Address Rebinding interval = 151200 (seconds)
DHCP: Subnet mask = [255.255.255.0]
DHCP: Domain Name Server address = [192.168.10.1]
DHCP: Domain Name Server address = [192.168.10.2]
DHCP: NetBIOS Server address = [192.168.10.1]
DHCP: NetBIOS Server address = [192.168.10.3]
DHCP: Domain name = "cisco.com"
DHCP:

```

```

- - - - - Frame 5 - ARP - - - - -

```

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
5 Cisc14F2C441 Broadcast 60 0:02:05.798 0.011.763 05/31/2001 06:53:04 AM ARP
  HA=Cisc14F2C441 PRO=IP
DLC: ----- DLC Header -----

```

```

DLC:
DLC: Frame 128 arrived at 06:53:04.2439; frame size is 60 (003C hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station Cisc14F2C441
DLC: Ethertype = 0806 (ARP)
DLC:
ARP: ----- ARP/RARP frame -----
ARP:
ARP: Hardware type = 1 (10Mb Ethernet)
ARP: Protocol type = 0800 (IP)
ARP: Length of hardware address = 6 bytes
ARP: Length of protocol address = 4 bytes
ARP: Opcode 2 (ARP reply)
ARP: Sender's hardware address = 00E01EF2C441
ARP: Sender's protocol address = [192.168.1.2]
ARP: Target hardware address = FFFFFFFF
ARP: Target protocol address = [192.168.1.2]
ARP:
ARP: 18 bytes frame padding
ARP:
- - - - - Frame 6 - ARP - - - - -

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
5 Cisc14F2C441 Broadcast 60 0:02:05.798 0.011.763 05/31/2001 06:53:04 AM ARP
  HA=Cisc14F2C441 PRO=IP
DLC: ----- DLC Header -----
DLC:
DLC: Frame 128 arrived at 06:53:04.2439; frame size is 60 (003C hex) bytes.
DLC: Destination = BROADCAST FFFFFFFF, Broadcast
DLC: Source = Station Cisc14F2C441
DLC: Ethertype = 0806 (ARP)
DLC:
ARP: ----- ARP/RARP frame -----
ARP:
ARP: Hardware type = 1 (10Mb Ethernet)
ARP: Protocol type = 0800 (IP)
ARP: Length of hardware address = 6 bytes
ARP: Length of protocol address = 4 bytes
ARP: Opcode 2 (ARP reply)
ARP: Sender's hardware address = 00E01EF2C441
ARP: Sender's protocol address = [192.168.1.2]
ARP: Target hardware address = FFFFFFFF
ARP: Target protocol address = [192.168.1.2]
ARP:
ARP: 18 bytes frame padding
ARP:

```

Sniffer-A Trace

```

- - - - - Frame 1 - DHCPDISCOVER - - - - -

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
118 [192.168.1.1] [192.168.2.2] 618 0:00:51.212 0.489.912 05/31/2001 07:02:5
  Message type: DHCP Discover
DLC: ----- DLC Header -----
DLC:
DLC: Frame 118 arrived at 07:02:54.7463; frame size is 618 (026A hex) bytes.
DLC: Destination = Station 0005DC0BF2F4
DLC: Source = Station 003094248F72
DLC: Ethertype = 0800 (IP)
DLC:
IP: ----- IP Header -----
IP:

```

```

IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput
IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 604 bytes
IP: Identification = 52
IP: Flags = 0X
IP: .0.. .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = 3509 (correct)
IP: Source address = [192.168.1.1]
IP: Destination address = [192.168.2.2]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 67 (BootPs/DHCP)
UDP: Destination port = 67 (BootPs/DHCP)
UDP: Length = 584
UDP: Checksum = 0A19 (correct)
UDP: [576 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 1 (Request)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 1
DHCP: Transaction id = 000005F4
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [0.0.0.0]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [192.168.1.1]
DHCP: Client hardware address = 0005DCF2C441
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 1 (DHCP Discover)
DHCP: Maximum message size = 1152
DHCP: Client identifier = 00636973636F2D303065302E316566322E633434312D457430
DHCP: Parameter Request List: 7 entries
DHCP: 1 = Client's subnet mask
DHCP: 6 = Domain name server
DHCP: 15 = Domain name
DHCP: 44 = NetBIOS over TCP/IP name server
DHCP: 3 = Routers on the client's subnet
DHCP: 33 = Static route
DHCP: 150 = Unknown Option
DHCP: Class identifier = 646F63736973312E30
DHCP: Option overload = 3 (File and Sname fields hold options)
DHCP:

```

```

- - - - - Frame 2 - DHCPOFFER - - - - -

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
2 [192.168.2.2] [192.168.1.1] 347 0:00:51.214 0.002.133 05/31/2001 07:02:54
  Message type: DHCP Offer
  DLC: ----- DLC Header -----
  DLC:
  DLC: Frame 119 arrived at 07:02:54.7485; frame size is 347 (015B hex) bytes.
  DLC: Destination = Station 003094248F72
  DLC: Source = Station 0005DC0BF2F4
  DLC: Ethertype = 0800 (IP)
  DLC:
  IP: ----- IP Header -----
  IP:
  IP: Version = 4, header length = 20 bytes
  IP: Type of service = 00
  IP: 000. .... = routine
  IP: ...0 .... = normal delay
  IP: .... 0... = normal throughput
  IP: .... .0.. = normal reliability
  IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
  IP: .... ...0 = CE bit - no congestion
  IP: Total length = 333 bytes
  IP: Identification = 41
  IP: Flags = 0X
  IP: .0.. .... = may fragment
  IP: ..0. .... = last fragment
  IP: Fragment offset = 0 bytes
  IP: Time to live = 255 seconds/hops
  IP: Protocol = 17 (UDP)
  IP: Header checksum = 3623 (correct)
  IP: Source address = [192.168.2.2]
  IP: Destination address = [192.168.1.1]
  IP: No options
  IP:
  UDP: ----- UDP Header -----
  UDP:
  UDP: Source port = 67 (BootPs/DHCP)
  UDP: Destination port = 67 (BootPs/DHCP)
  UDP: Length = 313
  UDP: Checksum = A1F8 (correct)
  UDP: [305 byte(s) of data]
  UDP:
  DHCP: ----- DHCP Header -----
  DHCP:
  DHCP: Boot record type = 2 (Request)
  DHCP: Hardware address type = 1 (10Mb Ethernet)
  DHCP: Hardware address length = 6 bytes
  DHCP:
  DHCP: Hops = 0
  DHCP: Transaction id = 000005F4
  DHCP: Elapsed boot time = 0 seconds
  DHCP: Flags = 8000
  DHCP: 1... .... = Broadcast IP datagrams
  DHCP: Client self-assigned IP address = [0.0.0.0]
  DHCP: Client IP address = [192.168.1.2]
  DHCP: Next Server to use in bootstrap = [0.0.0.0]
  DHCP: Relay Agent = [192.168.1.1]
  DHCP: Client hardware address = 0005DCF2C441
  DHCP:
  DHCP: Host name = ""
  DHCP: Boot file name = ""
  DHCP:

```

```

DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 2 (DHCP Offer)
DHCP: Server IP address = [192.168.2.2]
DHCP: Request IP address lease time = 172571 (seconds)
DHCP: Address Renewal interval = 86285 (seconds)
DHCP: Address Rebinding interval = 150999 (seconds)
DHCP: Subnet mask = [255.255.255.0]
DHCP: Domain Name Server address = [192.168.10.1]
DHCP: Domain Name Server address = [192.168.10.2]
DHCP: NetBIOS Server address = [192.168.10.1]
DHCP: NetBIOS Server address = [192.168.10.3]
DHCP: Domain name = "cisco.com"
DHCP:

```

- - - - - Frame 3 - DHCPREQUEST - - - - -

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
3 [192.168.1.1] [192.168.2.2] 618 0:00:51.240 0.025.974 05/31/2001 07:02:54
Message type: DHCP Request
DLC: ----- DLC Header -----
DLC:
DLC: Frame 120 arrived at 07:02:54.7745; frame size is 618 (026A hex) bytes.
DLC: Destination = Station 0005DC0BF2F4
DLC: Source = Station 003094248F72
DLC: Ethertype = 0800 (IP)
DLC:
IP: ----- IP Header -----
IP:
IP: Version = 4, header length = 20 bytes
IP: Type of service = 00
IP: 000. .... = routine
IP: ...0 .... = normal delay
IP: .... 0... = normal throughput
IP: .... .0.. = normal reliability
IP: .... ..0. = ECT bit - transport protocol will ignore the CE bit
IP: .... ...0 = CE bit - no congestion
IP: Total length = 604 bytes
IP: Identification = 54
IP: Flags = 0X
IP: .0.. .... = may fragment
IP: ..0. .... = last fragment
IP: Fragment offset = 0 bytes
IP: Time to live = 255 seconds/hops
IP: Protocol = 17 (UDP)
IP: Header checksum = 3507 (correct)
IP: Source address = [192.168.1.1]
IP: Destination address = [192.168.2.2]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 67 (BootPs/DHCP)
UDP: Destination port = 67 (BootPs/DHCP)
UDP: Length = 584
UDP: Checksum = 4699 (correct)
UDP: [576 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 1 (Request)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 1

```

```

DHCP: Transaction id = 000005F4
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [0.0.0.0]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [192.168.1.1]
DHCP: Client hardware address = 0005DCF2C441
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 3 (DHCP Request)
DHCP: Maximum message size = 1152
DHCP: Client identifier = 00636973636F2D303065302E316566322E633434312D457430
DHCP: Server IP address = [192.168.2.2]
DHCP: Request specific IP address = [192.168.1.2]
DHCP: Request IP address lease time = 172571 (seconds)
DHCP: Parameter Request List: 7 entries
DHCP: 1 = Client's subnet mask
DHCP: 6 = Domain name server
DHCP: 15 = Domain name
DHCP: 44 = NetBIOS over TCP/IP name server
DHCP: 3 = Routers on the client's subnet
DHCP: 33 = Static route
DHCP: 150 = Unknown Option
DHCP: Class identifier = 646F63736973312E30
DHCP: Option overload = 3 (File and Sname fields hold options)
DHCP:

```

- - - - - **Frame 4 - DHCPACK** - - - - -

```

Frame Status Source Address Dest. Address Size Rel. Time Delta Time Abs. Tim
4 [192.168.2.2] [192.168.1.1] 347 0:00:51.240 0.000.153 05/31/2001 07:02:54

```

Message type: **DHCP Ack**

DLC: ----- DLC Header -----

DLC:

DLC: Frame 121 arrived at 07:02:54.7746; frame size is 347 (015B hex) bytes.

DLC: **Destination = Station 003094248F72**

DLC: **Source = Station 0005DC0BF2F4**

DLC: Ethertype = 0800 (IP)

DLC:

IP: ----- IP Header -----

IP:

IP: Version = 4, header length = 20 bytes

IP: Type of service = 00

IP: 000. = routine

IP: ...0 = normal delay

IP: 0... = normal throughput

IP:0.. = normal reliability

IP:0. = ECT bit - transport protocol will ignore the CE bit

IP:0 = CE bit - no congestion

IP: Total length = 333 bytes

IP: Identification = 42

IP: Flags = 0X

IP: .0.. = may fragment

IP: ..0. = last fragment

IP: Fragment offset = 0 bytes

IP: Time to live = 255 seconds/hops

IP: Protocol = 17 (UDP)

IP: Header checksum = 3622 (correct)

IP: **Source address = [192.168.2.2]**

```

IP: Destination address = [192.168.1.1]
IP: No options
IP:
UDP: ----- UDP Header -----
UDP:
UDP: Source port = 67 (BootPs/DHCP)
UDP: Destination port = 67 (BootPs/DHCP)
UDP: Length = 313
UDP: Checksum = 7DF6 (correct)
UDP: [305 byte(s) of data]
UDP:
DHCP: ----- DHCP Header -----
DHCP:
DHCP: Boot record type = 2 (Request)
DHCP: Hardware address type = 1 (10Mb Ethernet)
DHCP: Hardware address length = 6 bytes
DHCP:
DHCP: Hops = 0
DHCP: Transaction id = 000005F4
DHCP: Elapsed boot time = 0 seconds
DHCP: Flags = 8000
DHCP: 1... .... = Broadcast IP datagrams
DHCP: Client self-assigned IP address = [0.0.0.0]
DHCP: Client IP address = [192.168.1.2]
DHCP: Next Server to use in bootstrap = [0.0.0.0]
DHCP: Relay Agent = [192.168.1.1]
DHCP: Client hardware address = 0005DCF2C441
DHCP:
DHCP: Host name = ""
DHCP: Boot file name = ""
DHCP:
DHCP: Vendor Information tag = 63825363
DHCP: Message Type = 5 (DHCP Ack)
DHCP: Server IP address = [192.168.2.2]
DHCP: Request IP address lease time = 172800 (seconds)
DHCP: Address Renewal interval = 86400 (seconds)
DHCP: Address Rebinding interval = 151200 (seconds)
DHCP: Subnet mask = [255.255.255.0]
DHCP: Domain Name Server address = [192.168.10.1]
DHCP: Domain Name Server address = [192.168.10.2]
DHCP: NetBIOS Server address = [192.168.10.1]
DHCP: NetBIOS Server address = [192.168.10.3]
DHCP: Domain name = "cisco.com"
DHCP:

```

Troubleshooting DHCP when Client Workstations are Unable to Obtain DHCP Addresses

Case Study #1: DHCP Server on Same LAN Segment or VLAN as DHCP Client

When the DHCP server and client reside on the same LAN segment or VLAN and the client is unable to obtain an IP address from a DHCP server, it is unlikely that the local router is causing a DHCP problem. The problem is most likely related to the devices that connect the DHCP server and DHCP client. However, the problem may be with the DHCP server or client itself. Following the troubleshooting modules below should determine what device is causing the issue.

Note: To configure the DHCP server on a per vlan basis, define different DHCP pools for every VLAN serving DHCP addresses to your clients.

Case Study #2: DHCP Server and DHCP Client are Separated by a Router

Configured for DHCP/BootP Relay Agent Functionality

When the DHCP server and client reside on the different LAN segments or VLANs, the router functioning as a DHCP/BootP Relay Agent is responsible for forwarding the DHCPREQUEST to the DHCP server. Additional troubleshooting steps are required to troubleshoot the DHCP/BootP Relay Agent, as well as the DHCP server and client. Following the troubleshooting modules below should determine which device is causing the issue.

DHCP Server on Router Fails to Assign Addresses with a POOL EXHAUSTED Error

It is possible that some addresses are still held by clients, even if they are released from the pool. This can be verified by the **show dhcp conflict** output. An address conflict occurs when two hosts use the same IP address. At the address assignment, the DHCP checks for conflicts with ping and gratuitous ARP.

If a conflict is detected, the address is removed from the pool. The address is assigned until the administrator resolves the conflict. Configure **no ip dhcp conflict logging** to resolve this issue.

DHCP Troubleshooting Modules

Understanding Where DHCP Problems Can Occur

DHCP problems can arise due to a multitude of reasons. The most common reasons are configuration issues. However, many DHCP problems can be caused by software defects in operating systems, Network Interface Card (NIC) drivers, or DHCP/BootP Relay Agents running on routers. Due to the number of potentially problematic areas, a systematic approach to troubleshooting is required.

Short List of Possible Causes of DHCP Problems:

- Catalyst switch default configuration
- DHCP/BootP Relay Agent configuration
- NIC compatibility issue or DHCP feature issue
- Faulty NIC or improper NIC driver installation
- Intermittent network outages due to frequent spanning tree computations
- Operating system behavior or software defect
- DHCP server scope configuration or software defect
- Cisco Catalyst switch or IOS DHCP/BootP Relay Agent software defect
- Unicast Reverse Path Forwarding (uRPF) check failing because the DHCP offer is received on a different interface than expected. When the Reverse Path Forwarding (RPF) feature is enabled on an interface, a Cisco router can drop Dynamic Host Configuration Protocol (DHCP) and BOOTstrap Protocol (BOOTP) packets that have source addresses of 0.0.0.0 and destination addresses of 255.255.255.255. The router can also drop all IP packets that have a

multicast IP destination at the interface. This issue is documented in [CSCdw31925](#) ([registered customers only](#)) .

- DHCP database agent is not used, but DHCP conflict logging is *not* disabled

This document will use troubleshooting modules below to determine the root cause, as indicated in the list above.

A. Verify Physical Connectivity

This procedure is applicable to all case studies.

First, verify physical connectivity of a DHCP client and server. If connected to a Catalyst switch, verify that both the DHCP client and server have physical connectivity.

For Catalyst CatOS switches such as the 2948G, 4000, 5000, and 6000 series switches, use the **show port <mod#>/<port_range>** command to note the port status. If the port status is anything other than `connected`, the port will not pass any traffic, including DHCP client requests. The output from the commands is as follows:

```
Switch (enable) show port 5/1
Port Name Status Vlan Duplex Speed Type
-----
5/1 connected 1 a-full a-100 10/100BaseTX
```

For IOS based switches such as the Catalyst 2900XL/3500XL/2950/3550, the equivalent command to **show port status** is **show interface <interface>**. If the state of the interface is anything other than `<interface>` is up, line protocol is up, the port will not pass traffic, including DHCP client requests. The output from the commands is as follows:

```
Switch#show interface fastEthernet 0/1
FastEthernet0/1 is up, line protocol is up
Hardware is Fast Ethernet, address is 0030.94dc.ac1 (bia 0030.94dc.ac1)
```

If the physical connection has been verified and there is indeed no link between the Catalyst switch and DHCP client, consult the [Troubleshooting Cisco Catalyst Switches to NIC Compatibility Issues](#) document for additional troubleshooting in regards to the physical layer connectivity issue.

Excessive data link errors cause ports on some Catalyst switches to go into an `errdisabled` state. Refer to [Recovering From errDisable Port State on the CatOS Platforms](#) and [Errdisable Port State Recovery on the Cisco IOS Platforms](#), which describe the `errdisable` state, explain how to recover from it, and provide examples of recovery from this state.

B. Test Network Connectivity by Configuring Client Workstation with Static IP Address

This procedure is applicable to all case studies.

When troubleshooting any DHCP Issue, it is important to verify network connectivity by configuring a static IP address on a client workstation. If the workstation is unable to reach network resources despite having a statically configured IP address, the root cause of the problem is not DHCP. At this point, network connectivity troubleshooting is required.

C. Verify Issue as a Startup Problem

This procedure is applicable to all case studies.

If the DHCP client is unable to obtain an IP address from the DHCP server on startup, attempt to obtain an IP address from the DHCP server by manually forcing the client to send a DHCP request. Issue the following steps to manually obtain an IP address from a DHCP server for the operating systems listed below.

Microsoft Windows 95/98/ME: Click the **Start** button, and run the WINIPCFG.exe program. Click the **Release All** button, followed by the **Renew All** button. Is the DHCP client now able to obtain an IP address?



Microsoft Windows NT/2000: Open a command prompt window by typing **cmd** in the **Start/Run** field. Issue the command **ipconfig/renew** in the command prompt window, as shown below. Is the DHCP client now able to obtain an IP Address?

```

C:\WINNT\System32\cmd.exe
(C) Copyright 1985-1999 Microsoft Corp.
C:\>ipconfig

Windows 2000 IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : 
    IP Address. . . . . : 0.0.0.0
    Subnet Mask . . . . . : 0.0.0.0
    Default Gateway . . . . . : 

C:\>ipconfig /renew

Windows 2000 IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : cisco.com
    IP Address. . . . . : 64.102.47.137
    Subnet Mask . . . . . : 255.255.255.192
    Default Gateway . . . . . : 64.102.47.129

C:\>

```

If the DHCP client is able to obtain an IP address by manually renewing the IP address after the PC has completed the bootup process, the issue is most likely a DHCP startup issue. If the DHCP client is attached to a Cisco Catalyst switch, the problem is most likely due to a configuration issue dealing with STP portfast and/or channeling and trunking. Other possibilities include NIC card issues and switch port startup issues. Troubleshooting [Steps D](#) and [E](#) should be reviewed to rule out switch port

configuration and NIC card issues as the root cause of the DHCP problem.

D. Verify Switch Port Configuration (STP Portfast and Other Commands)

If the switch is a Catalyst 2900/4000/5000/6000, verify that the port has STP portfast enabled and trunking/channeling disabled. The default configuration is STP portfast disabled and trunking/channeling auto, if applicable. For the 2900XL/3500XL/2950/3550 switches, STP portfast is the only required configuration. These configuration changes resolve the most common DHCP client issues that occur with an initial installation of a Catalyst switch.

For more documentation regarding the necessary switch port configuration requirements for DHCP to operate properly when connected to Catalyst switches, please review the following document:

[Using Portfast and Other Commands to Fix Workstation Startup Connectivity Delays](#)

After reviewing the configuration guidelines in the document above, return to this document for additional troubleshooting.

E. Check for Known NIC Card or Catalyst Switch Issues

If the Catalyst switch configuration is correct, it is possible that a software compatibility issue may exist on the Catalyst switch or DHCP client's NIC that could be causing DHCP issues. The next step in troubleshooting is to review the following document and rule out any software issues with the Catalyst switch or NIC that may be contributing to the problem:

[Troubleshooting Cisco Catalyst Switches to NIC Compatibility Issues](#)

Knowledge of the DHCP client's operating system as well as specific NIC information such as the manufacturer, model, and driver version will be needed to properly rule out any compatibility issues.

F. Distinguishing whether DHCP Clients Obtain IP Address on the Same Subnet or VLAN as DHCP Server

It is important to distinguish whether or not DHCP is functioning correctly when the client is on same subnet or VLAN as the DHCP server. If the DHCP is working correctly on the same subnet or VLAN as the DHCP server, the DHCP issue may be with the DHCP/BootP Relay Agent. If the problem persists even with testing DHCP on the same subnet or VLAN as the DHCP server, the problem may actually be with the DHCP server.

G. Verify Router DHCP/BootP Relay Configuration

Issue the steps below to verify the configuration:

1. When configuring DHCP relay on a router, verify that the **ip helper-address** command is located on the correct interface. The **ip helper-address** command must be present on the inbound interface of the DHCP client workstations and must be directed to the correct DHCP server.
2. Verify that the global configuration command **no service dhcp** is not present. This configuration parameter will disable all DHCP server and relay functionality on the router. The default configuration, `service dhcp`, will not appear in the configuration, and is the default configuration command. If the **service dhcp** is not enabled, the clients do not receive the IP addresses from the DHCP server.

Note: In routers that run older Cisco IOS releases, the **ip bootp server** command handles the DHCP relay agent function instead of the **service dhcp** command. Because of this, the **ip bootp server** command needs to be enabled in these routers if the **ip helper-address** command is configured to forward DHCP UDP broadcasts and properly act as a DHCP relay agent on behalf of the DHCP client.

3. When applying **ip helper-address** commands to forward UDP broadcasts to a subnet broadcast address, verify that `no ip directed-broadcast` is not configured on any outbound interface that the UDP broadcast packets needs to traverse. The `no ip directed-broadcast` will block on any translation of a directed broadcast to physical broadcasts. This interface configuration is default configuration in software versions 12.0 and higher.
4. Forwarding DHCP broadcasts to the DHCP server's subnet broadcast address is an occasional software issue. When troubleshooting DHCP, always attempt to forward DHCP UDP broadcasts to the DHCP server's IP address, as shown below:

```
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption

no service dhcp !- (2)

This configuration command will disable all DHCP server and relay functiona.

!
hostname router
!
!
!
interface Ethernet0
ip address 192.168.2.1 255.255.255.0
no ip directed-broadcast !- (3)

This configuration will prevent translation of a directed broadcast to a ph

!
interface Ethernet1 !- (1)

DHCP client workstations reside of this interface.

ip address 192.168.1.1 255.255.255.0
ip helper-address 192.168.2.255 !- (4)

IP helper-address pointing to DHCP server's subnet.

no ip directed-broadcast
!
!
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
end
```

H. Subscriber Identification (82) Option Turned On

The DHCP relay agent information (option 82) feature enables the DHCP relay agents (Catalyst switches) to include information about itself and the attached client when it forwards DHCP requests from a DHCP client to a 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.

When DHCP snooping is enabled on a switch, it automatically enables option 82.

If the DHCP server is not configured to handle the packets with option 82, it ceases to allocate the address to that request.

In order to resolve this issue, disable the subscriber identification option (82) in the switches (relay agents) with the global configuration command, **no ip dhcp relay information option**.

I. DHCP Database Agent and DHCP Conflict Logging

A DHCP database agent is any host—for example, an FTP, TFTP, or RCP server—that stores the DHCP bindings database. You can configure multiple DHCP database agents, and you can configure the interval between database updates and transfers for each agent. Use the **ip dhcp database** command to configure a database agent and database agent parameters.

If you choose not to configure a DHCP database agent, disable the recording of DHCP address conflicts on the DHCP server. Execute the **no ip dhcp conflict logging** command to disable the DHCP address conflict logging. Clear the previously logged conflicts with **clear ip dhcp conflict**.

If this fails to disable the conflict logging, this error message appears:

```
%DHCPD-4-DECLINE_CONFLICT: DHCP address conflict: client
```

J. Check CDP for IP Phone Connections

When the switchport that is connected to the Cisco IP phone has Cisco Discovery Protocol (CDP) disabled, the DHCP server cannot assign an appropriate IP address to the phone. The DHCP server tends to assign the IP address that belongs to the data VLAN / subnet of the switchport. If the CDP is enabled, the switch is able to detect that the Cisco IP Phone requests the DHCP and can provide the correct subnet information. The DHCP server then is able to allot an IP address from the voice VLAN / subnet pool. There are no explicit steps required to bind the dhcp service to the voice vlan.

K. Removing Down SVI Disrupts DHCP Snooping Operation

On the Cisco Catalyst 6500 series switches, an SVI (in shutdown state) is created automatically after it configures the DHCP to snoop for a particular VLAN. The presence of this SVI has direct implications on the correct operation of DHCP snooping.

DHCP snooping on the Cisco Catalyst 6500 series switches that run Native IOS is implemented mostly on Route Processor (RP or MSFC), not on Switch Processor (SP or Supervisor). The Cisco Catalyst 6500 series intercepts packets in hardware with VACLs that supply the packets to a Local Target Logic (LTL) subscribed to by the RP. Once the frames enter the RP, they first need to be associated with an L3 Interface (SVI) IDB before they can be passed off to the snooping part. Without an SVI, this IDB does not exist, and the packets get dropped in the RP.

L. Limited Broadcast Address

When a DHCP client sets the broadcast bit in a DHCP packet, the DHCP server and relay agent send DHCP messages to clients with the all-ones broadcast address (255.255.255.255). If the **ip broadcast-address** command has been configured to send a network broadcast, the all-ones broadcast sent by DHCP is overridden. In order to remedy this situation, use the **ip dhcp limited-broadcast-address** command to ensure that a configured network broadcast does not override the default DHCP behavior.

Some DHCP clients can only accept an all-ones broadcast and are not able to acquire a DHCP address unless this command is configured on the router interface connected to the client.

M. Debugging DHCP Using Router debug Commands

Verify Router is Receiving DHCP Request Using debug Commands

On routers that support software processing of DHCP packets, you can verify whether a router is receiving the DHCP request from the client. The DHCP process will fail if the router is not receiving requests from the client. This troubleshooting step involves configuring an access-list for debugging output. This access-list is for debugging purposes only and is not intrusive to the router.

In global configuration mode, enter the following access-list:

```
access-list 100 permit ip host 0.0.0.0 host 255.255.255.255
```

In exec mode, enter the following debug command:

```
debug ip packet detail 100
```

Sample output:

```
Router#debug ip packet detail 100
IP packet debugging is on (detailed) for access list 100
Router#
00:16:46: IP: s=0.0.0.0 (Ethernet4/0), d=255.255.255.255, len 604, rcvd 2
00:16:46: UDP src=68, dst=67
00:16:46: IP: s=0.0.0.0 (Ethernet4/0), d=255.255.255.255, len 604, rcvd 2
00:16:46: UDP src=68, dst=67
```

From the output above, it is clear that the router is receiving the DHCP requests from the client. This output only shows a summary of the packet and not the packet itself. Therefore, it is not possible to determine if the packet is correct. Nevertheless, the router did receive a broadcast packet with the source and destination IP and UDP ports that are correct for DHCP.

Verify Router is Receiving DHCP Request and Forwarding Requests to DHCP Server Using debug Commands

Additional entries in the access-list can be added to see if the router is communicating successfully with the DHCP server. Again, these debugs do not look into the packet, but you can confirm whether or not the DHCP relay agent is forwarding requests to the DHCP server.

In global configuration mode, create the following access-list:

```
access-list 100 permit ip host 0.0.0.0 host 255.255.255.255
```

access-list 100 permit udp host <dhcp_relay_agent> host <dhcp_server> eq 67

access-list 100 permit udp host <dhcp_server> host <dhcp_relay_agent> eq 67

For example:

access-list 100 permit ip host 0.0.0.0 host 255.255.255.0

access-list 100 permit udp host 192.168.1.1 host 192.168.2.2 eq 67

access-list 100 permit udp host 192.168.1.1 host 192.168.2.2 eq 68

access-list 100 permit udp host 192.168.2.2 host 192.168.1.1 eq 67

access-list 100 permit udp host 192.168.2.2 host 192.168.1.1 eq 68

In exec mode, enter the following debug command:

```
Router#
00:23:44: IP: s=0.0.0.0 (Ethernet4/0), d=255.255.255.255, len 604, rcvd 2
00:23:44: UDP src=68, dst=67

!--- Router receiving DHCPDISCOVER from DHCP client.

00:23:44: IP: s=192.168.1.1 (local), d=192.168.2.2 (Ethernet4/1), len 604, s
00:23:44: UDP src=67, dst=67

!--- Router forwarding DHCPDISCOVER unicast to DHCP server using DHCP/BootP .

00:23:44 IP: s=192.168.2.2 (Ethernet1), d=192.168.1.1, len 328, rcvd 4
00:23:44 UDP src=67, dst=67

!--- DHCP server sending DHCPOFFER to DHCP/BootP Relay Agent.

00:23:44: IP: s=0.0.0.0 (Ethernet4/0), d=255.255.255.255, len 604, rcvd 2
00:23:44: UDP src=68, dst=67

!--- Router receiving DHCPREQUEST from DHCP client.

00:23:44: IP: s=192.168.1.1 (local), d=192.168.2.2 (Ethernet4/1), len 604, s
00:23:44: UDP src=67, dst=67

!--- Router forwarding DHCPDISCOVER unicast to DHCP server using DHCP/BootP .

00:23:44 IP: s=192.168.2.2 (Ethernet1), d=192.168.1.1, len 328, rcvd 4
00:23:44 UDP src=67, dst=67

!--- DHCP server sending DHCPACK back to DHCP/BootP Relay Agent.
```

From the output above, it is clear that the router is receiving the DHCP requests from the client and forwarding the request, per the DHCP/BootP Relay Agent configuration, to the DHCP server. The DHCP server also replied directly to the DHCP/BootP Relay Agent. This output only shows a summary of the packet and not the packet itself. Therefore, it is not possible to determine if the packet is correct or whether the server is replying with a DHCPNAK. Nevertheless, the router did receive a broadcast packet with the source and destination IP and UDP ports that are correct for DHCP, and there is two-way communication with the DHCP server.

Verify Router is Receiving and Forwarding DHCP Request Using debug ip udp Command

The **debug ip udp** command can be used to trace the path of a DHCP request through a router. However, this debug is intrusive in a production environment, since all processed switched UDP packets will be displayed to the console. This debug should not be used in production.



Warning: The **debug ip udp** command is intrusive, and may cause high Central Processing Unit (CPU) utilization.

In exec mode, enter the following debug command:

debug ip udp

Sample output:

```
Router#debug ip udp
UDP packet debugging is on
Router#

00:18:48: UDP: rcvd src=0.0.0.0(68), dst=255.255.255.255(67), length=584
!--- Router receiving DHCPDISCOVER from DHCP client.
00:18:48: UDP: sent src=192.168.1.1(67), dst=192.168.2.2(67), length=604
!--- Router forwarding DHCPDISCOVER unicast to DHCP server using DHCP/BootP .
00:18:48: UDP: rcvd src=192.168.2.2(67), dst=192.168.1.1(67), length=313
!--- Router receiving DHCPOFFER from DHCP server directed to DHCP/BootP Rela
00:18:48: UDP: sent src=0.0.0.0(67), dst=255.255.255.255(68), length=333
!--- Router forwarding DHCPOFFER from DHCP server to DHCP client via DHCP/Bo
00:18:48: UDP: rcvd src=0.0.0.0(68), dst=255.255.255.255(67), length=584
!--- Router receiving DHCPREQUEST from DHCP client.
00:18:48: UDP: sent src=192.168.1.1(67), dst=192.168.2.2(67), length=604
!--- Router forwarding DHCPDISCOVER unicast to DHCP server using DHCP/BootP .
00:18:48: UDP: rcvd src=192.168.2.2(67), dst=192.168.1.1(67), length=313
!--- Router receiving DHCPACK (or DHCPNAK) from DHCP directed to DHCP/Boot
00:18:48: UDP: sent src=0.0.0.0(67), dst=255.255.255.255(68), length=333
!--- Router forwarding DHCPACK (or DHCPNAK) to DHCP client via DHCP/BootP .
00:18:48: UDP: rcvd src=192.168.1.2(520), dst=255.255.255.255(520), length=3
!--- DHCP client verifying IP address not in use by sending ARP request for
00:18:50: UDP: rcvd src=192.168.1.2(520), dst=255.255.255.255(520), length=3
!--- DHCP client verifying IP address not in use by sending ARP request fo
```

Verify Router is Receiving and Forwarding DHCP Request Using `debug ip dhcp server packet` Command

If the router IOS is 12.0.x.T or 12.1 and supports the IOS DHCP server functionality, additional debugging can be done using the **debug ip dhcp server packet** command. This debug was intended for use with the IOS DHCP server feature, but can be used for troubleshooting the DHCP/BootP Relay Agent feature as well. As with the previous troubleshooting steps, router debugs do not provide an exact determination of the problem since the actual packet cannot be viewed. However, debugs do allow inferences to be made regarding DHCP processing.

In exec mode, enter the following debug command:

debug ip dhcp server packet

```
Router#debug ip dhcp server packet
00:20:54: DHCPD: setting giaddr to 192.168.1.1.

!--- Router received DHCPDISCOVER/REQUEST/INFORM and setting Gateway IP ad
00:20:54: DHCPD: BOOTREQUEST from 0063.6973.636f.2d30.3065.302e.3165.6632.2e
!--- BOOTREQUEST includes DHCPDISCOVER, DHCPREQUEST, and DHCPINFORM.

!--- 0063.6973.636f.2d30.3065.302e.3165.6632.2e63 indicates client identif
00:20:54: DHCPD: forwarding BOOTREPLY to client 00e0.1ef2.c441.
!--- BOOTREPLY includes DHCPPOFFER and DHCPNAK.

!--- Client's MAC address is 00e0.1ef2.c441.
00:20:54: DHCPD: broadcasting BOOTREPLY to client 00e0.1ef2.c441.
!--- Router is forwarding DHCPPOFFER or DHCPNAK broadcast on local LAN interf
00:20:54: DHCPD: setting giaddr to 192.168.1.1.
!--- Router received DHCPDISCOVER/REQUEST/INFORM and set Gateway IP addres
00:20:54: DHCPD: BOOTREQUEST from 0063.6973.636f.2d30.3065.302e.3165.6632.2e
!--- BOOTREQUEST includes DHCPDISCOVER, DHCPREQUEST, and DHCPINFORM.

!--- 0063.6973.636f.2d30.3065.302e.3165.6632.2e63 indicates client identifie
00:20:54: DHCPD: forwarding BOOTREPLY to client 00e0.1ef2.c441.
!--- BOOTREPLY includes DHCPPOFFER and DHCPNAK.

!--- Client's MAC address is 00e0.1ef2.c441.
00:20:54: DHCPD: broadcasting BOOTREPLY to client 00e0.1ef2.c441.
!--- Router is forwarding DHCPPOFFER or DHCPNAK broadcast on local LAN interf
```

Running Multiple Debugs Simultaneously

When running multiple debugs simultaneously, a fair amount of information can be discovered regarding the operation of the DHCP/BootP Relay Agent and server. Using the above troubleshooting outlines, you can make inferences about where the DHCP/BootP Relay Agent functionality may not be operating correctly.

```
IP: s=0.0.0.0 (Ethernet0), d=255.255.255.255, len 604, rcvd 2
UDP src=68, dst=67
UDP: rcvd src=0.0.0.0(68), dst=255.255.255.255(67), length=584
DHCPD: setting giaddr to 192.168.1.1.
UDP: sent src=192.168.1.1(67), dst=192.168.2.2(67), length=604
IP: s=192.168.1.1 (local), d=192.168.2.2 (Ethernet1), len 604, sending
UDP src=67, dst=67
DHCPD: BOOTREQUEST from 0063.6973.636f.2d30.3030.302e.3030.3030.2e30.3030.31
IP: s=192.168.2.2 (Ethernet1), d=192.168.1.1, len 328, rcvd 4
UDP src=67, dst=67
UDP: rcvd src=192.168.2.2(67), dst=192.168.1.1(67), length=308
DHCPD: forwarding BOOTREPLY to client 0000.0000.0001.
DHCPD: broadcasting BOOTREPLY to client 0000.0000.0001.
UDP: sent src=0.0.0.0(67), dst=255.255.255.255(68), length=328
IP: s=0.0.0.0 (Ethernet0), d=255.255.255.255, len 604, rcvd 2
UDP src=68, dst=67
UDP: rcvd src=0.0.0.0(68), dst=255.255.255.255(67), length=584
DHCPD: setting giaddr to 192.168.1.1.
UDP: sent src=192.168.1.1(67), dst=192.168.2.2(67), length=604
IP: s=192.168.1.1 (local), d=192.168.2.2 (Ethernet1), len 604, sending
UDP src=67, dst=67
DHCPD: BOOTREQUEST from 0063.6973.636f.2d30.3030.302e.3030.3030.2e30.3030.31
IP: s=192.168.2.2 (Ethernet1), d=192.168.1.1, len 328, rcvd 4
UDP src=67, dst=67
UDP: rcvd src=192.168.2.2(67), dst=192.168.1.1(67), length=308
DHCPD: forwarding BOOTREPLY to client 0000.0000.0001.
DHCPD: broadcasting BOOTREPLY to client 0000.0000.0001.
UDP: sent src=0.0.0.0(67), dst=255.255.255.255(68), length=328.
```

Obtain Sniffer Trace and Determine Root Cause of DHCP Problem

Using router debugging techniques will not always determine the exact root cause of a DHCP problem. The ultimate step in resolving a DHCP issue is to obtain a sniffer trace and note where the process is not functioning correctly. DHCP packet traces can be deciphered by referencing the [Decoding Sniffer Trace of DHCP Client and Server on Same LAN Segment](#) and [Decoding Sniffer Trace of DHCP Client and Server Separated by Router Configured as a DHCP Relay Agent](#) sections of this document.

For information on obtaining sniffer traces using the Switched Port Analyzer (SPAN) feature on Catalyst switches, refer to the following document:

- [Configuring the Catalyst Switched Port Analyzer \(SPAN\).](#)

Alternative Method of Packet Decoding Using debug on Router

By using the **debug ip packet detail dump <acl>** command on a Cisco router, it is possible to get an entire packet in hex displayed in the system log or Command Line Interface (CLI). Using the [Verify Router is Receiving DHCP Request Using debug Commands](#) and [Verify Router is Receiving DHCP Request and Forwarding Request to DHCP Server Using debug Commands](#) sections above, along with the dump keyword added to the access-list, will provide the same debug information, but with the packet detail in hex. To determine the contents of the packet, the packet will need to be translated. An example is given in Appendix A.

Keywords Entered after the ip dhcp pool command option {option_number} ASCII are in Double Quotes

A Cisco router with a DHCP option with the option number configured can encounter a failure if it tries to parse the URL because any keywords entered after the **ip dhcp pool command option option number** ASCII are in double quotes after the router is reloaded. This behavior is seen on devices that run the IOS 12.4(17a), which is a known bug and is documented in [CSCsk96976](#) ([registered](#) customers only) .

This issue is resolved in IOS versions 12.4(17b), 12.4(18a) and later, and 12.4(19)T1.

Appendix A: IOS DHCP Sample Configuration

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

For more information on how to configure DHCP and the commands associated with it, refer to the following link:

- [DHCP Configuration Task List](#)

```
version 12.1
!
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
enable password cisco
ip subnet-zero
no ip domain-lookup
ip dhcp excluded-address 10.10.1.1 10.10.1.199

!--- Address range excluded from DHCP pools.

!
ip dhcp pool test_dhcp

!--- DHCP pool (scope) name is test_dhcp.

network 10.10.1.0 255.255.255.0

!--- DHCP pool (address will be assigned in this range) for associated Gateway I.

default-router 10.10.1.1

!--- DHCP option for default gateway.

dns-server 10.30.1.1

!--- DHCP option for DNS server(s).

netbios-name-server 10.40.1.1
```

```
!--- DHCP option for NetBIOS name server(s) (WINS).
lease 0 0 1

!--- Lease time.
!
interface Ethernet0
description DHCP Client Network
ip address 10.10.1.1 255.255.255.0
no ip directed-broadcast
!
interface Ethernet1
description Server Network
ip address 10.10.2.1 255.255.255.0
no ip directed-broadcast
!
line con 0
transport input none
line aux 0
transport input all
line vty 0 4
login
!
end
```

Related Information

- [DHCP Relay Feature on the VPN 3000 Concentrator Configuration Example](#)
- [PIX/ASA 7.x as a DHCP Relay Configuration Example](#)
- [Tools and Utilities](#)
- [Technical Support - Cisco Systems](#)

Home	How to Buy	Login	Profile	Feedback	Site Map	Help
----------------------	----------------------------	-----------------------	-------------------------	--------------------------	--------------------------	----------------------

[Contacts & Feedback](#) | [Help](#) | [Site Map](#)

© 2007 - 2008 Cisco Systems, Inc. All rights reserved. [Terms & Conditions](#) | [Privacy Statement](#) | [Cookie Policy](#) | [Trademarks of Cisco Systems, Inc.](#)