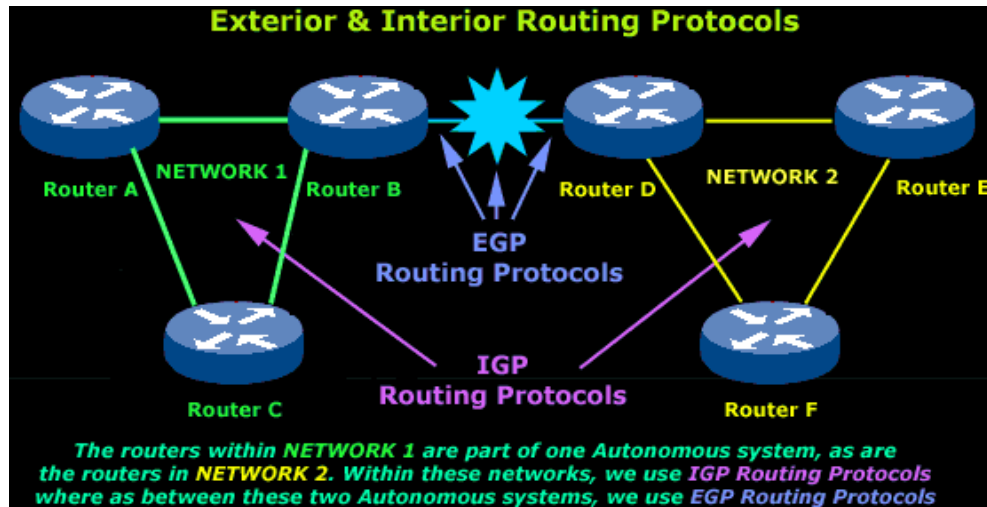


CIS 3210

DHCP



In the beginning ...

- Hosts were assigned an IP address manually.
- Next came BOOTP.
- Now we have DHCP.

BOOTP

- The Bootstrap Protocol (BOOTP), defined in RFC 951, is the predecessor of DHCP.
- BOOTP provided a method for diskless workstations to download IP address configurations.
 - Diskless workstations are workstation or PCs without disk drives
 - E.g., Thin clients, cash register systems.

Both BOOTP and DHCP ...

- Both are client/server based.
 - The server has a static IP address and allocates, distributes, and manages IP configuration data allocation.
 - Each allocation (IP configuration data) is stored on the server in a data set called a **binding**.
- Both can assign IP configuration data.
 - IP address, subnet mask, default gateway, and DNS server address.
- Both use the same UDP ports known as BOOTP ports.
 - 67/UDPBootstrap Protocol (BOOTP) Server
 - 68/UDPBootstrap Protocol (BOOTP) Client

Differences Between BOOTP and DHCP ...

- When a BOOTP client requests an IP address:
 - The BOOTP server searches a predefined table for an entry that matches the MAC address for the client.
 - If an entry exists, the corresponding IP address for that entry is returned to the client.
- This means that the binding between the MAC address and the IP address must have already been configured in the BOOTP server.
- Therefore, if a new host boots and is not in the BOOTP configuration file, *the IP address cannot be assigned “dynamically”*

Differences Between BOOTP and DHCP ...

- DHCP allows for recovery and reallocation of network addresses through a finite leasing mechanism.
 - When the lease expires, the IP address can be assigned to another client later.
 - Clients may also renew leases and keep the same IP address.
- BOOTP does not use leases.
 - Clients have reserved IP address which cannot be assigned to any other host.

Differences Between BOOTP and DHCP ...

- BOOTP provides a limited amount of information to a host.
- DHCP provides additional IP configuration parameters, such as WINS and domain name.

Dynamic Host Configuration Protocol v4

Dynamic vs. Static IP Addressing Quiz

Desktop computer	Server	Router	Switch
Laptop	IP phone	Printer	RADIUS server
AP	PDA	iTouch	Fridge

Static IP Address



Dynamic (DHCP) IP Address



Dynamic Host Configuration Protocol (DHCP)

- DHCP emerged as a standard protocol in October 1993 as defined in [RFC 1531](#), succeeding the [BOOTP](#) protocol.
- DHCP allows a host to quickly and dynamically obtain configuration parameters from a DHCP Server.
 - In an Enterprise, DHCP is almost exclusively always configured on a dedicated server.

Dynamic Host Configuration Protocol (DHCP)

- The client's configuration parameters can include:
 - IP Address
 - Subnet Mask
 - Default Gateway
 - DNS Server address
 - Domain Names
 - WINS Server address
 - ...

3 DHCP Address Allocation Mechanisms

- **Static (Manual) Allocation:**

- The administrator statically assigns a pre-allocated IP address to the client and DHCP only communicates the IP address to the device.

- **Dynamic Allocation:**

- DHCP automatically assigns an IP address from a pool of addresses.
- The address is leased for a limited period of time configured on the server, or until the client no longer needs the address.

- **Automatic Static Allocation:**

- DHCP automatically assigns a static IP address permanently to a device, selecting it from a pool of available addresses.
- There is no lease and the address is permanently assigned to a device.

DHCP Operation and Message Format

How Does DHCP Work?

- A DHCP Server must be available.
 - Must have pre-configured range (scope) of addresses.

Scope Properties - (Local)

IP Address Pool

Start Address: 10 . 10 . 10 . 11

End Address: 10 . 10 . 10 . 255

Subnet Mask: 255 . 255 . 255 . 0

Exclusion Range:

Start Address: . . .

End Address: . . .

Excluded Addresses:

Lease Duration

Unlimited

Limited To: 3 Day(s) 00 Hour(s) 00 Minutes

Name: _____

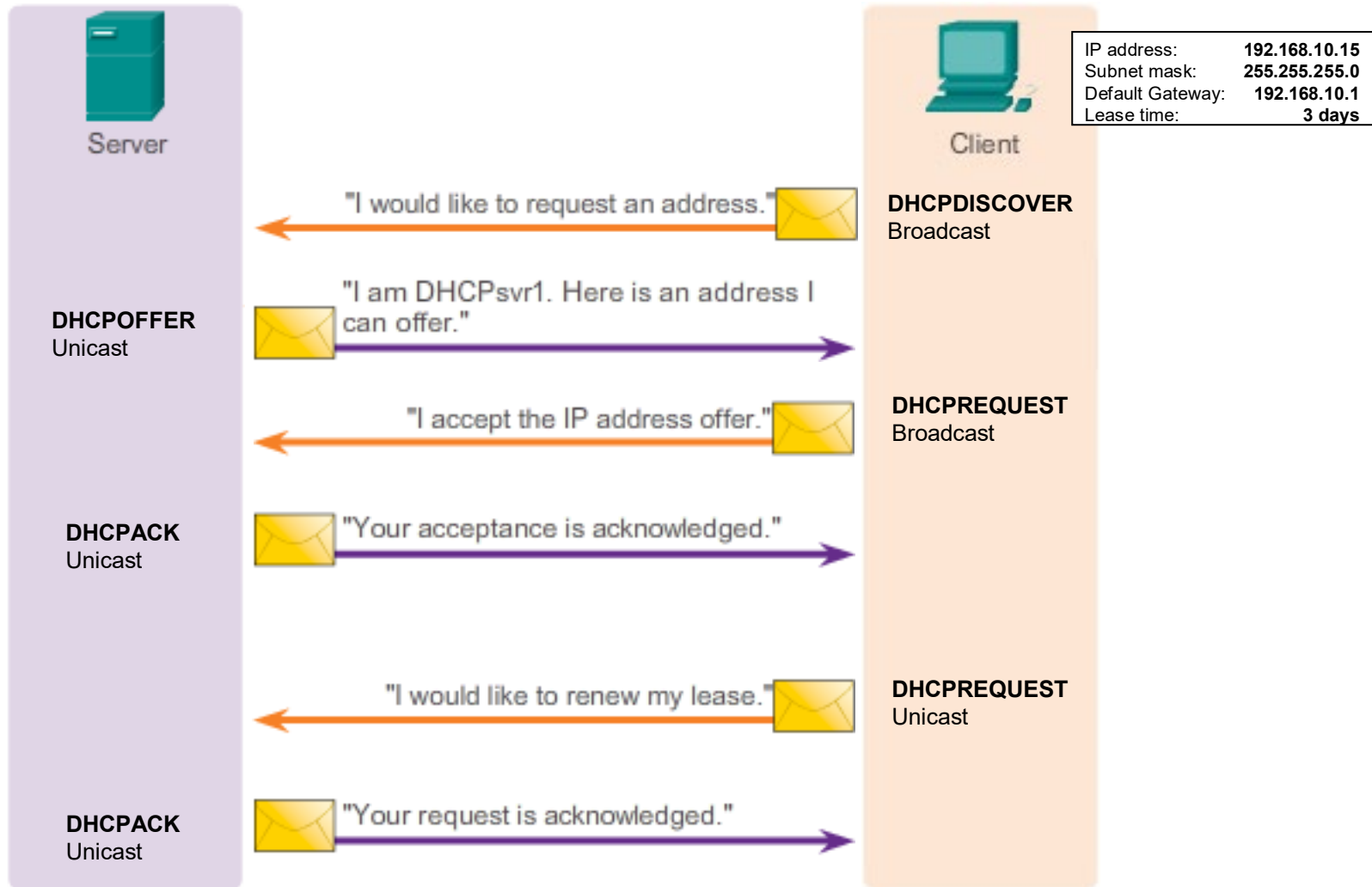
Comment: _____

OK Cancel Help

DHCP Operation

- As clients come online they contact the DHCP server and request an address.
- The DHCP server chooses an address and allocates it to that host.
- DHCPv4 messages are encapsulated within the UDP transport protocol.
 - DHCPv4 messages from the client use UDP source port 68 and destination port 67.
 - DHCPv4 messages from the server to the client use UDP source port 67 and destination port 68.

DHCP Operation



Filter: Expression... Clear Apply

No. -	Time	Source	Destination	Protocol	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xb3e3564c
2	0.049313	Cisco-Li_a0:d1:be	Broadcast	ARP	Who has 192.168.2.5? Tell 192.168.2.1
3	1.680223	192.168.2.1	192.168.2.5	DHCP	DHCP Offer - Transaction ID 0xb3e3564c
4	1.680688	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xb3e3564c
5	1.687128	192.168.2.1	192.168.2.5	DHCP	DHCP ACK - Transaction ID 0xb3e3564c
6	1.810827	Intel_9e:f7:15	Broadcast	ARP	Gratuitous ARP for 192.168.2.5 (Request)

- Frame 1 (342 bytes on wire, 342 bytes captured)
 - Ethernet II, Src: Intel_9e:f7:15 (00:19:d2:9e:f7:15), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
 - Destination: Broadcast (ff:ff:ff:ff:ff:ff)
 - Source: Intel_9e:f7:15 (00:19:d2:9e:f7:15)
 - Type: IP (0x0800)
 - Internet Protocol, Src: 0.0.0.0 (0.0.0.0), Dst: 255.255.255.255 (255.255.255.255)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - Total Length: 328
 - Identification: 0x5439 (21561)
 - Flags: 0x00
 - Fragment offset: 0
 - Time to live: 128
 - Protocol: UDP (0x11)
 - Header checksum: 0xe56c [correct]
 - Source: 0.0.0.0 (0.0.0.0)
 - Destination: 255.255.255.255 (255.255.255.255)
 - User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
 - Source port: bootpc (68)
 - Destination port: bootps (67)
 - Length: 308

```

0000 ff ff ff ff ff 00 19 d2 9e f7 15 08 00 45 00 .....E.
0010 01 48 54 39 00 00 80 11 e5 6c 00 00 00 ff ff .HT9...l.....
0020 ff ff 00 44 00 43 01 34 a6 09 01 01 06 00 b3 e3 ...D.C.4 .....
0030 56 4c 00 00 00 00 00 00 00 00 00 00 00 00 VL.....
0040 00 00 00 00 00 00 00 19 d2 9e f7 15 00 00 00 .....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

Filter: Expression... Clear Apply

No. -	Time	Source	Destination	Protocol	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xb3e3564c
2	0.049313	Cisco-Li_a0:d1:be	Broadcast	ARP	Who has 192.168.2.5? Tell 192.168.2.1
3	1.680223	192.168.2.1	192.168.2.5	DHCP	DHCP Offer - Transaction ID 0xb3e3564c
4	1.680688	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xb3e3564c
5	1.687128	192.168.2.1	192.168.2.5	DHCP	DHCP ACK - Transaction ID 0xb3e3564c
6	1.810827	Intel_9e:f7:15	Broadcast	ARP	Gratuitous ARP for 192.168.2.5 (Request)

```

+ Frame 2 (60 bytes on wire, 60 bytes captured)
- Ethernet II, Src: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  + Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  + Source: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be)
    Type: ARP (0x0806)
    Trailer: 0000000000000000000000000000000000000000000000000000000000000000
- Address Resolution Protocol (request)
  Hardware type: Ethernet (0x0001)
  Protocol type: IP (0x0800)
  Hardware size: 6
  Protocol size: 4
  Opcode: request (0x0001)
  Sender MAC address: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be)
  Sender IP address: 192.168.2.1 (192.168.2.1)
  Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
  Target IP address: 192.168.2.5 (192.168.2.5)

```

```

0000 ff ff ff ff ff 00 18 39 a0 d1 be 08 06 00 01 ..... 9.....
0010 08 00 06 04 00 01 00 18 39 a0 d1 be c0 a8 02 01 ..... 9.....
0020 00 00 00 00 00 00 c0 a8 02 05 00 00 00 00 00 ..... ..
0030 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

Filter: Expression... Clear Apply

No. -	Time	Source	Destination	Protocol	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xb3e3564c
2	0.049313	Cisco-Li_a0:d1:be	Broadcast	ARP	Who has 192.168.2.5? Tell 192.168.2.1
3	1.680223	192.168.2.1	192.168.2.5	DHCP	DHCP Offer - Transaction ID 0xb3e3564c
4	1.680688	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xb3e3564c
5	1.687128	192.168.2.1	192.168.2.5	DHCP	DHCP ACK - Transaction ID 0xb3e3564c
6	1.810827	Intel_9e:f7:15	Broadcast	ARP	Gratuitous ARP for 192.168.2.5 (Request)

Frame 3 (590 bytes on wire, 590 bytes captured)

- Ethernet II, Src: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be), Dst: Intel_9e:f7:15 (00:19:d2:9e:f7:15)
 - Destination: Intel_9e:f7:15 (00:19:d2:9e:f7:15)
 - Source: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be)
 - Type: IP (0x0800)
- Internet Protocol, Src: 192.168.2.1 (192.168.2.1), Dst: 192.168.2.5 (192.168.2.5)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - Total Length: 576
 - Identification: 0x0000 (0)
 - Flags: 0x00
 - Fragment offset: 0
 - Time to live: 64
 - Protocol: UDP (0x11)
 - Header checksum: 0xf356 [correct]
 - Source: 192.168.2.1 (192.168.2.1)
 - Destination: 192.168.2.5 (192.168.2.5)
- User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
 - Source port: bootps (67)
 - Destination port: bootpc (68)
 - Length: 556

```

0000  00 19 d2 9e f7 15 00 18 39 a0 d1 be 08 00 45 00  ..... 9.....E.
0010  02 40 00 00 00 00 40 11 f3 56 c0 a8 02 01 c0 a8  .@....@. .V.....
0020  02 05 00 43 00 44 02 2c 7e 7d 02 01 06 00 b3 e3  ...C.D., ~}.....
0030  56 4c 00 00 00 00 00 00 00 00 c0 a8 02 05 00 00  VL.....
0040  00 00 00 00 00 00 00 19 d2 9e f7 15 00 00 00 00  .....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....

```

Filter: Expression... Clear Apply

No. -	Time	Source	Destination	Protocol	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xb3e3564c
2	0.049313	Cisco-Li_a0:d1:be	Broadcast	ARP	Who has 192.168.2.5? Tell 192.168.2.1
3	1.680223	192.168.2.1	192.168.2.5	DHCP	DHCP Offer - Transaction ID 0xb3e3564c
4	1.680688	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xb3e3564c
5	1.687128	192.168.2.1	192.168.2.5	DHCP	DHCP ACK - Transaction ID 0xb3e3564c
6	1.810827	Intel_9e:f7:15	Broadcast	ARP	Gratuitous ARP for 192.168.2.5 (Request)

Frame 4 (343 bytes on wire, 343 bytes captured)

- Ethernet II, Src: Intel_9e:f7:15 (00:19:d2:9e:f7:15), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
 - Destination: Broadcast (ff:ff:ff:ff:ff:ff)
 - Source: Intel_9e:f7:15 (00:19:d2:9e:f7:15)
 - Type: IP (0x0800)
- Internet Protocol, Src: 0.0.0.0 (0.0.0.0), Dst: 255.255.255.255 (255.255.255.255)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - Total Length: 329
 - Identification: 0x543a (21562)
 - Flags: 0x00
 - Fragment offset: 0
 - Time to live: 128
 - Protocol: UDP (0x11)
 - Header checksum: 0xe56a [correct]
 - Source: 0.0.0.0 (0.0.0.0)
 - Destination: 255.255.255.255 (255.255.255.255)
- User Datagram Protocol, Src Port: bootpc (68), Dst Port: bootps (67)
 - Source port: bootpc (68)
 - Destination port: bootps (67)
 - Length: 309

```

0000 ff ff ff ff ff ff 00 19 d2 9e f7 15 08 00 45 00 .....E.
0010 01 49 54 3a 00 00 80 11 e5 6a 00 00 00 00 ff ff .IT:.....j.....
0020 ff ff 00 44 00 43 01 35 6b af 01 01 06 00 b3 e3 ...D.C.5 k.....
0030 56 4c 00 00 00 00 00 00 00 00 00 00 00 00 00 VL.....
0040 00 00 00 00 00 00 00 19 d2 9e f7 15 00 00 00 00 .....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

Filter: Expression... Clear Apply

No. -	Time	Source	Destination	Protocol	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xb3e3564c
2	0.049313	Cisco-Li_a0:d1:be	Broadcast	ARP	Who has 192.168.2.5? Tell 192.168.2.1
3	1.680223	192.168.2.1	192.168.2.5	DHCP	DHCP Offer - Transaction ID 0xb3e3564c
4	1.680688	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xb3e3564c
5	1.687128	192.168.2.1	192.168.2.5	DHCP	DHCP ACK - Transaction ID 0xb3e3564c
6	1.810827	Intel_9e:f7:15	Broadcast	ARP	Gratuitous ARP for 192.168.2.5 (Request)

Frame 5 (590 bytes on wire, 590 bytes captured)

- Ethernet II, Src: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be), Dst: Intel_9e:f7:15 (00:19:d2:9e:f7:15)
 - Destination: Intel_9e:f7:15 (00:19:d2:9e:f7:15)
 - Source: Cisco-Li_a0:d1:be (00:18:39:a0:d1:be)
 - Type: IP (0x0800)
- Internet Protocol, Src: 192.168.2.1 (192.168.2.1), Dst: 192.168.2.5 (192.168.2.5)
 - Version: 4
 - Header length: 20 bytes
 - Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00)
 - Total Length: 576
 - Identification: 0x0000 (0)
 - Flags: 0x00
 - Fragment offset: 0
 - Time to live: 64
 - Protocol: UDP (0x11)
 - Header checksum: 0xf356 [correct]
 - Source: 192.168.2.1 (192.168.2.1)
 - Destination: 192.168.2.5 (192.168.2.5)
- User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
 - Source port: bootps (67)
 - Destination port: bootpc (68)
 - Length: 556

```

0000  00 19 d2 9e f7 15 00 18 39 a0 d1 be 08 00 45 00  .....9.....E.
0010  02 40 00 00 00 00 40 11 f3 56 c0 a8 02 01 c0 a8  .@....@. .V.....
0020  02 05 00 43 00 44 02 2c 7b 7d 02 01 06 00 b3 e3  ...C.D., {}.....
0030  56 4c 00 00 00 00 00 00 00 00 c0 a8 02 05 00 00  VL.....
0040  00 00 00 00 00 00 00 19 d2 9e f7 15 00 00 00 00  .....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....

```

DHCP Message Format

- The DHCPv4 message format is used for all DHCPv4 transactions.

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

- [Wireshark capture](#)

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	314	DHCP
2	0.000295	192.168.0.1	192.168.0.10	DHCP	342	DHCP
3	0.070031	0.0.0.0	255.255.255.255	DHCP	314	DHCP
4	0.070345	192.168.0.1	192.168.0.10	DHCP	342	DHCP

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)

Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)

Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)

User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)

Bootstrap Protocol

Message type: Boot Reply (2)

Hardware type: Ethernet

Hardware address length: 6

Hops: 0

Transaction ID: 0x00003d1e

Seconds elapsed: 0

Bootp flags: 0x0000 (unicast)

Client IP address: 0.0.0.0 (0.0.0.0)

Your (client) IP address: 192.168.0.10 (192.168.0.10)

Next server IP address: 0.0.0.0 (0.0.0.0)

Relay agent IP address: 0.0.0.0 (0.0.0.0)

Client MAC address: Grandstr_01:fc:42 (00:0b:82:01:fc:42)

Client hardware address padding: 00000000000000000000

server host name not given

Boot file name not given

Magic cookie: DHCP

Option: (53) DHCP Message Type

Option: (58) Renewal Time Value

Option: (59) Rebinding Time value

Option: (51) IP Address Lease Time

Operation (OP) Code

- Specifies the general type of message.
- A value of 1 indicates a request message
- A value of 2 is a reply message.

```

0000  00 0b 82 01 fc 42 00 08 74 ad f1 9b 08 00 45 00  ....B.. t.....E.
0010  01 48 04 46 00 00 80 11 00 00 c0 a8 00 01 c0 a8  .H.F....
0020  00 0a 00 43 00 44 01 34 df db 02 01 06 00 00 00  ...C.D.4
0030  3d 1e 00 00 00 00 00 00 00 00 c0 a8 00 0a 00 00  =.....
0040  00 00 00 00 00 00 00 0b 82 01 fc 42 00 00 00 00  ....B....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
    
```


DHCP-Wireshark.pcap [Wireshark 1.8.2 (SVN Rev 44520 from /trunk-1.8)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	314	DHCP
2	0.000295	192.168.0.1	192.168.0.10	DHCP	342	DHCP
3	0.070031	0.0.0.0	255.255.255.255	DHCP	314	DHCP
4	0.070345	192.168.0.1	192.168.0.10	DHCP	342	DHCP

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

```

Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
Bootstrap Protocol
  Message type: Boot Reply (2)
  Hardware type: Ethernet
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0x00003d1e
  Seconds elapsed: 0
  Bootp flags: 0x0000 (unicast)
  Client IP address: 0.0.0.0 (0.0.0.0)
  Your (client) IP address: 192.168.0.10 (192.168.0.10)
  Next server IP address: 0.0.0.0 (0.0.0.0)
  Relay agent IP address: 0.0.0.0 (0.0.0.0)
  Client MAC address: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
  Client hardware address padding: 00000000000000000000
  server host name not given
  Boot file name not given
  Magic cookie: DHCP
  Option: (53) DHCP Message Type
  Option: (58) Renewal Time Value
  Option: (59) Rebinding Time Value
  Option: (51) IP Address Lease Time
  
```

Hardware Type

- Identifies the type of hardware used in the network.
- 1 is Ethernet, 15 is Frame Relay, and 20 is a serial line.

```

0000  00 0b 82 01 fc 42 00 08 74 ad f1 9b 08 00 45 00  .....B.. t.....E.
0010  01 48 04 46 00 00 80 11 00 00 c0 a8 00 01 c0 a8  .H.F....
0020  00 0a 00 43 00 44 01 34 df db 02 01 06 00 00 00  ...C.D.4
0030  3d 1e 00 00 00 00 00 00 00 00 c0 a8 00 0a 00 00  =.....
0040  00 00 00 00 00 00 00 0b 82 01 fc 42 00 00 00 00  ..... ..B....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
  
```


No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	314	DHCP
2	0.000295	192.168.0.1	192.168.0.10	DHCP	342	DHCP
3	0.070031	0.0.0.0	255.255.255.255	DHCP	314	DHCP
4	0.070345	192.168.0.1	192.168.0.10	DHCP	342	DHCP

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

```

Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
Bootstrap Protocol
  Message type: Boot Reply (2)
  Hardware type: Ethernet
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0x00003d1e
  Seconds elapsed: 0
  Bootp flags: 0x0000 (unicast)
  Client IP address: 0.0.0.0 (0.0.0.0)
  Your (client) IP address: 192.168.0.10 (192.168.0.10)
  Next server IP address: 0.0.0.0 (0.0.0.0)
  Relay agent IP address: 0.0.0.0 (0.0.0.0)
  Client MAC address: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
  Client hardware address padding: 00000000000000000000
  server host name not given
  Boot file name not given
  Magic cookie: DHCP
  Option: (53) DHCP Message Type
  Option: (58) Renewal Time Value
  Option: (59) Rebinding Time Value
  Option: (51) IP Address Lease Time
  
```

Client IP Address

- Used by a client during lease renewal when the address of the client is valid and usable.
- The client puts its own IPv4 address in this field if and only if it has a valid IPv4 address while in the bound state; otherwise, it sets the field to 0.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	314	DHCP
2	0.000295	192.168.0.1	192.168.0.10	DHCP	342	DHCP
3	0.070031	0.0.0.0	255.255.255.255	DHCP	314	DHCP
4	0.070345	192.168.0.1	192.168.0.10	DHCP	342	DHCP

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

```

Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
Bootstrap Protocol
  Message type: Boot Reply (2)
  Hardware type: Ethernet
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0x00003d1e
  Seconds elapsed: 0
  Bootp flags: 0x0000 (unicast)
  Client IP address: 0.0.0.0 (0.0.0.0)
  Your (client) IP address: 192.168.0.10 (192.168.0.10)
  Next server IP address: 0.0.0.0 (0.0.0.0)
  Relay agent IP address: 0.0.0.0 (0.0.0.0)
  Client MAC address: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
  Client hardware address padding: 00000000000000000000
  server host name not given
  Boot file name not given
  Magic cookie: DHCP
  Option: (53) DHCP Message Type
  Option: (58) Renewal Time Value
  Option: (59) Rebinding Time Value
  Option: (51) IP Address Lease Time
    
```

Requesting Client IP Address

- Used by the server to assign an IPv4 address to the client

```

0000  00 0b 82 01 fc 42 00 08 74 ad f1 9b 08 00 45 00  ....B.. t.....E.
0010  01 48 04 46 00 00 80 11 00 00 c0 a8 00 01 c0 a8  .H.F....
0020  00 0a 00 43 00 44 01 34 df db 02 01 06 00 00 00  ...C.D.4
0030  3d 1e 00 00 00 00 00 00 00 00 c0 a8 00 0a 00 00  =.....
0040  00 00 00 00 00 00 00 0b 82 01 fc 42 00 00 00 00  ..... ..B....
0050  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
    
```

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	314	DHCP
2	0.000295	192.168.0.1	192.168.0.10	DHCP	342	DHCP
3	0.070031	0.0.0.0	255.255.255.255	DHCP	314	DHCP
4	0.070345	192.168.0.1	192.168.0.10	DHCP	342	DHCP

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

```

Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
Bootstrap Protocol
  Message type: Boot Reply (2)
  Hardware type: Ethernet
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0x00003d1e
  Seconds elapsed: 0
  Bootp flags: 0x0000 (unicast)
  Client IP address: 0.0.0.0 (0.0.0.0)
  Your (client) IP address: 192.168.0.10 (192.168.0.10)
  Next server IP address: 0.0.0.0 (0.0.0.0)
  Relay agent IP address: 0.0.0.0 (0.0.0.0)
  Client MAC address: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
  Client hardware address padding: 00000000000000000000
  server host name not given
  Boot file name not given
  Magic cookie: DHCP
  Option: (53) DHCP Message Type
  Option: (58) Renewal Time Value
  Option: (59) Rebinding Time Value
  Option: (51) IP Address Lease Time
  
```

Client Hardware Address

- Specifies the physical layer of the client.

```

0000 00 0b 82 01 fc 42 00 08 74 ad f1 9b 08 00 45 00  ....B.. t.....E.
0010 01 48 04 46 00 00 80 11 00 00 c0 a8 00 01 c0 a8  .H.F....
0020 00 0a 00 43 00 44 01 34 df db 02 01 06 00 00 00  ...C.D.4
0030 3d 1e 00 00 00 00 00 00 00 00 c0 a8 00 0a 00 00  =.....
0040 00 00 00 00 00 00 00 0b 82 01 fc 42 00 00 00 00  ....B....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
  
```

DHCP-Wireshark.pcap [Wireshark 1.8.2 (SVN Rev 44520 from /trunk-1.8)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	314	DHCP
2	0.000295	192.168.0.1	192.168.0.10	DHCP	342	DHCP
3	0.070031	0.0.0.0	255.255.255.255	DHCP	314	DHCP
4	0.070345	192.168.0.1	192.168.0.10	DHCP	342	DHCP

8	16	24	32
OP Code (1)	Hardware Type (1)	Hardware Address Length (1)	Hops (1)
Transaction Identifier			
Seconds - 2 bytes		Flags - 2 bytes	
Client IP Address (CIADDR) - 4 bytes			
Your IP Address (YIADDR) - 4 bytes			
Server IP Address (SIADDR) - 4 bytes			
Gateway IP Address (GIADDR) - 4 bytes			
Client Hardware Address (CHADDR) - 16 bytes			
Server Name (SNAME) - 64 bytes			
Boot Filename - 128 bytes			
DHCP Options - variable			

```

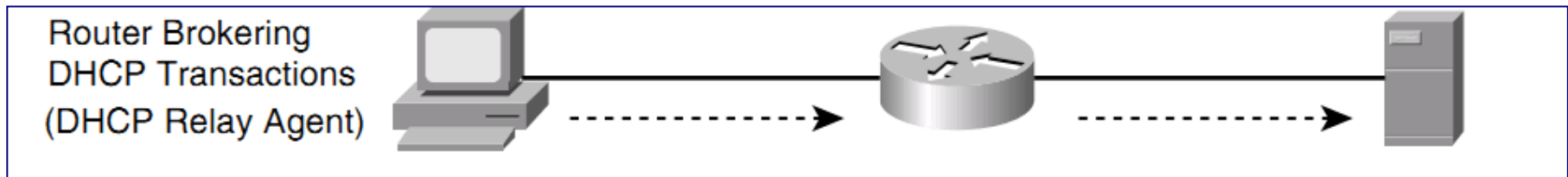
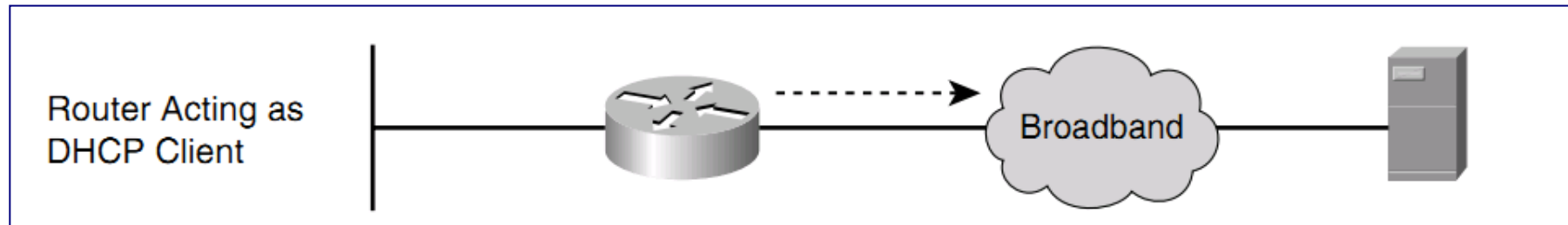
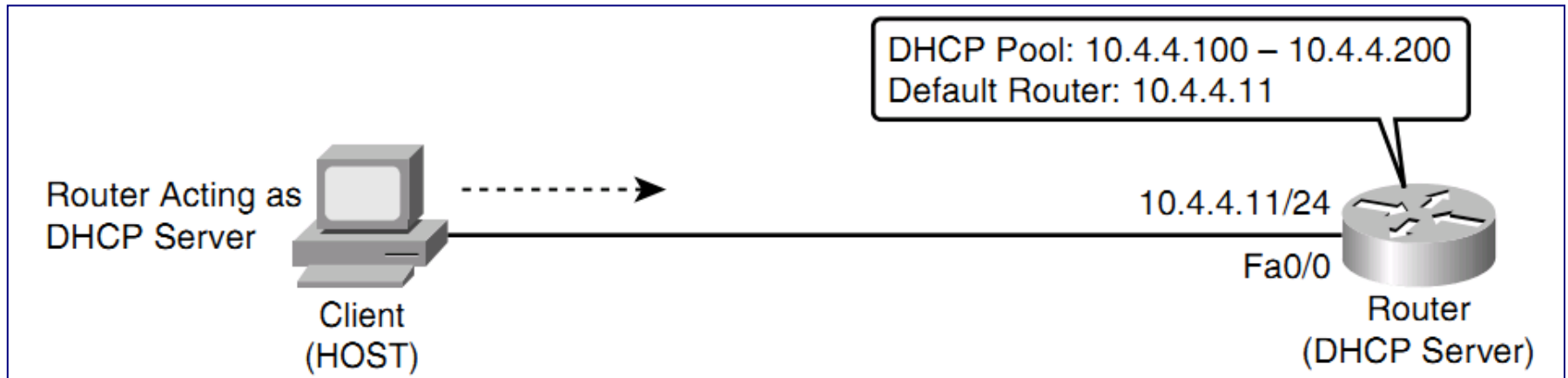
Frame 4: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: DellComp_ad:f1:9b (00:08:74:ad:f1:9b), Dst: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
Internet Protocol Version 4, Src: 192.168.0.1 (192.168.0.1), Dst: 192.168.0.10 (192.168.0.10)
User Datagram Protocol, Src Port: bootps (67), Dst Port: bootpc (68)
Bootstrap Protocol
  Message type: Boot Reply (2)
  Hardware type: Ethernet
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0x00003d1e
  Seconds elapsed: 0
  Bootp flags: 0x0000 (unicast)
  Client IP address: 0.0.0.0 (0.0.0.0)
  Your (client) IP address: 192.168.0.10 (192.168.0.10)
  Next server IP address: 0.0.0.0 (0.0.0.0)
  Relay agent IP address: 0.0.0.0 (0.0.0.0)
  Client MAC address: Grandstr_01:fc:42 (00:0b:82:01:fc:42)
  Client hardware address padding: 00000000000000000000
  server host name not given
  Boot file name not given
  Magic cookie: DHCP
  Option: (53) DHCP Message Type
  Option: (58) Renewal Time Value
  Option: (59) Rebinding Time Value
  Option: (51) IP Address Lease Time
  
```

DHCP Options

- Used to identify the type of DHCP packet (DHCP DISCOVER, DHCPOFFER, ...)
- DHCP options can also be used to retrieve an IP address, a text string, or a hexadecimal number from the server.
- For example,
 - DHCP option 66 and 150 are used by Cisco IP Phones to identify TFTP servers.
 - Option 43 is used by WLANAPs to identify the WLC.
- This field is variable in length.
- Both client and server may use this field.
- DHCP options are listed in RFC 2132.

Configuring DHCP

Router DHCP Roles



Why configure an IOS DHCP Server?

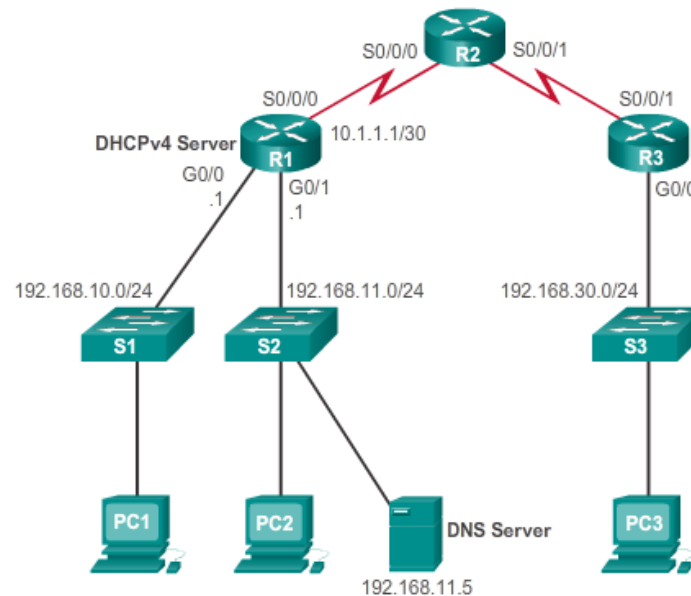
- In an enterprise, DHCP Services are usually provided by a Windows Server or a UNIX server platform.
 - They are relatively easy to manage and highly scalable.
- In smaller locations (SOHO, Branch) DHCP services can be provided by a Cisco router or Cisco switch.
 - Reduces DHCP deployment costs since a dedicated server is not warranted.
 - Cisco IOS leases IP addresses for 24 hours (default).
 - Newer Catalyst switches (2960) can also provide DHCP services.

IOS DHCP Server

- The DHCP service is enabled by default on newer IOS.
- To disable DHCP, in global config mode:
 - `no service dhcp`
- To re-enable:
 - `service dhcp global`

Step 1: Exclude Addresses From the Pool

- Define a range of addresses that DHCP is not to allocate.
 - These are usually static addresses reserved for the router interfaces, SVIs, servers, and local network printers.



```
R1 (config) # ip dhcp excluded-address low-address [high-address]
```

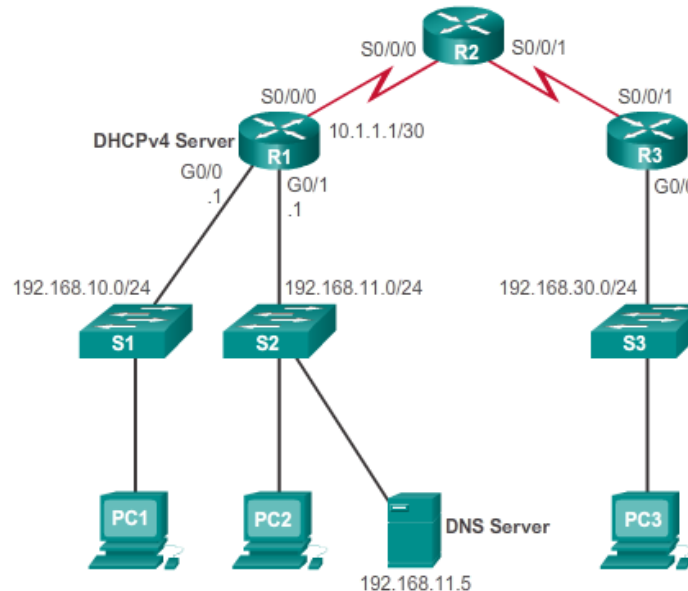
```
R1 (config) # ip dhcp excluded-address 192.168.10.1 192.168.10.9
```

```
R1 (config) # ip dhcp excluded-address 192.168.10.254
```

Step 2: Create the Address Pool

- Create the DHCP pool using the `ip dhcp pool` command.
 - Enters you into DHCP configuration mode

```
R1 (config) #ip dhcp pool POOL-NAME
```



```
R1 (config) #ip dhcp pool LAN-POOL-1
```

```
R1 (dhcp-config) #
```

Step 3: Configure the Specifics of the Pool

- Enter DHCP configuration mode and configure the specifics.
 - R1 (dhcp-config) #

Tasks	Command
Define the address pool	<code>network network-address [mask /prefix-length]</code>
Define the default gateway.	<code>default-router address [address2...address8]</code>

Optional Tasks	Command
Define a DNS server.	<code>dns-server address [address2...address8]</code>
Define the domain name.	<code>domain-name domain</code>
Define the duration of the DHCP lease.	<code>lease {days [hours] [minutes] infinite}</code>
Define an option code	<code>option code [instance number] {ascii string hex string ip-address}</code> <code>option 150 ip 192.168.1.254</code>

DHCP Parameters and Options

DHCP Option	Code	Description
Subnet Mask	1	<ul style="list-style-type: none">Specifies the subnet mask for the client to use (as per RFC 950)
Router	3	<ul style="list-style-type: none">The list of routers the client can use (usually, in order of preference)
Domain Name Server	6	<ul style="list-style-type: none">The list of DNS servers the client can use (usually, in order of preference)
ARP Cache Timeout	35	<ul style="list-style-type: none">Specifies the timeout (seconds) for ARP cache entries
IP Address Lease Time	51	<ul style="list-style-type: none">Specifies the period over which the IP address is leased (it must be renewed)
Relay Agent Information	82	<ul style="list-style-type: none">Information about the port from which the DHCP request originates
TFTP Server IP Address	150	<ul style="list-style-type: none">Typically used by devices such as IP Phones to download their configuration files

Step 3: Configure the Specifics of the Pool

```
R1(dhcp-config)# ?
DHCP pool configuration commands:
  accounting          Send Accounting Start/Stop messages
  bootfile            Boot file name
  class              Specify a DHCP class
  client-identifier  Client identifier
  client-name        Client name
  default-router     Default routers
  dns-server         DNS servers
  domain-name       Domain name
  exit              Exit from DHCP pool configuration mode
  hardware-address   Client hardware address
  host              Client IP address and mask
  import            Programatically importing DHCP option parameters
  lease            Address lease time
  netbios-name-server NetBIOS (WINS) name servers
  netbios-node-type NetBIOS node type
  network          Network number and mask
  next-server      Next server in boot process
  no              Negate a command or set its defaults
  odap            Configure ODAP
  option          Raw DHCP options
  origin          Configure the origin of the pool
  relay           Function as a DHCP relay
  remember        Remember released bindings
  renew          Configure renewal policy
  server         Configure the server ID option value
  subnet        Subnet allocation commands
  update        Dynamic updates
  utilization    Configure various utilization parameters
  vrf           Associate this pool with a VRF
```

Verification Commands

```
R1# show ip dhcp ?
binding      DHCP address bindings
conflict     DHCP address conflicts
database     DHCP database agents
import       Show Imported Parameters
pool         DHCP pools information
relay        Miscellaneous DHCP relay information
server       Miscellaneous DHCP server information
snooping     DHCP snooping
```

```
R1# show ip dhcp
```

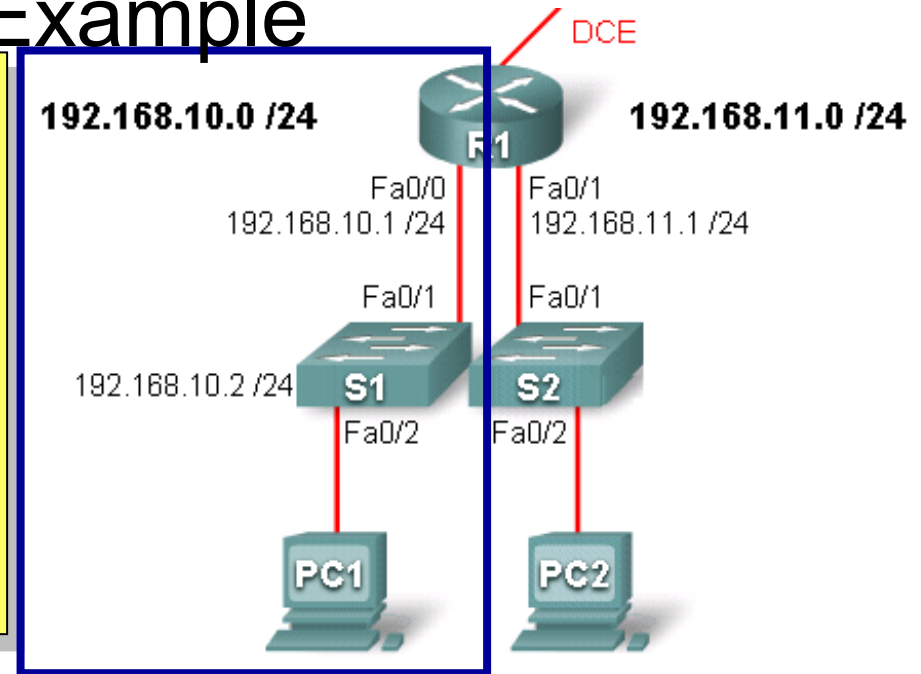
Command	Description
<code>show ip dhcp binding [address]</code>	Displays a list of all bindings created on a specific DHCP server
<code>show ip dhcp conflict [address]</code>	Displays a list of all address conflicts recorded by a specific DHCP server.
<code>show ip dhcp database [url]</code>	Displays recent activity on the DHCP database. (Use this command in privileged EXEC mode.)
<code>show ip dhcp server statistics</code>	Displays count information about server statistics and messages sent and received.

show ip dhcp Commands

- **show ip dhcp server statistics**
 - Displays counts for server statistics and messages sent and received for an IOS-based DHCP server.
- **show ip dhcp binding**
 - Displays DHCP binding information for IP address assignment and subnet allocation.
- **show ip dhcp conflict**
 - Displays address conflicts found by a Cisco IOS DHCP server when addresses are offered to the client.
- **show ip dhcp pool *name***
 - Displays the subnets pool allocated and the current utilization level for the pool or all the pools if the name argument is not used.

DHCP Configuration Example

- Exclude the first 9 addresses and the last host address.
- Call the pool: **LAN-POOL-10**
 - Assign the network address
 - Identify the default router.
 - Configure the domain name `span.com`



```
R1(config)# ip dhcp excluded-address 192.168.10.1 192.168.10.9
R1(config)# ip dhcp excluded-address 192.168.10.254
R1(config)# ip dhcp pool LAN-POOL-10
R1(dhcp-config)# network 192.168.10.0 255.255.255.0
R1(dhcp-config)# default-router 192.168.10.1
R1(dhcp-config)# domain-name span.com
R1(dhcp-config)# end
```


Before PC1 Boots

```
R1# show ip dhcp binding
```

```
Bindings from all pools not associated with VRF:
```

IP address	Client-ID/ Hardware address/ User name	Lease expiration	Type
------------	--	------------------	------

```
R1# show ip dhcp server statistics
```

Memory usage	23543
Address pools	1
Database agents	0
Automatic bindings	0
Manual bindings	0
Expired bindings	0
Malformed messages	0
Secure arp entries	0

Message	Received
BOOTREQUEST	0
DHCPDISCOVER	0
DHCPREQUEST	0
DHCPDECLINE	0
DHCPRELEASE	0
DHCPINFORM	0

Message	Sent
BOOTREPLY	0
DHCPOFFER	0
DHCPACK	0
DHCPNAK	0

```
R1#
```

A **binding** is a collection of configuration parameters, including at least an IP address associated with or "bound to" a DHCP client.

Bindings are managed by DHCP servers.

After PC1 Boots

```
R1# show ip dhcp binding
```

```
Bindings from all pools not associated with VRF:
```

IP address	Client-ID/ Hardware address/ User name	Lease expiration	Type
192.168.10.10	0100.e018.5bdd.35	Oct 03 2007 05:05 PM	Automatic

```
R1# show ip dhcp server statistics
```

```
Memory usage          23786
```

```
Address pools         1
```

```
Database agents       0
```

```
Automatic bindings   1
```

```
Manual bindings       0
```

```
Expired bindings      0
```

```
Malformed messages   0
```

```
Secure arp entries    0
```

```
Message               Received
```

```
BOOTREQUEST           0
```

```
DHCPDISCOVER         6
```

```
DHCPREQUEST          1
```

```
DHCPDECLINE           0
```

```
DHCPRELEASE           0
```

```
DHCPINFORM            0
```

```
Message               Sent
```

```
BOOTREPLY             0
```

```
DHCPOFFER            1
```

```
DHCPACK              1
```

```
DHCPNAK               0
```

Verify PC1

```
C:\Documents and Settings\Bob> ipconfig /all
```

Windows IP Configuration

```
Host Name . . . . . : cicolab
Primary Dns Suffix . . . . . :
Node Type . . . . . : Unknown
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
```

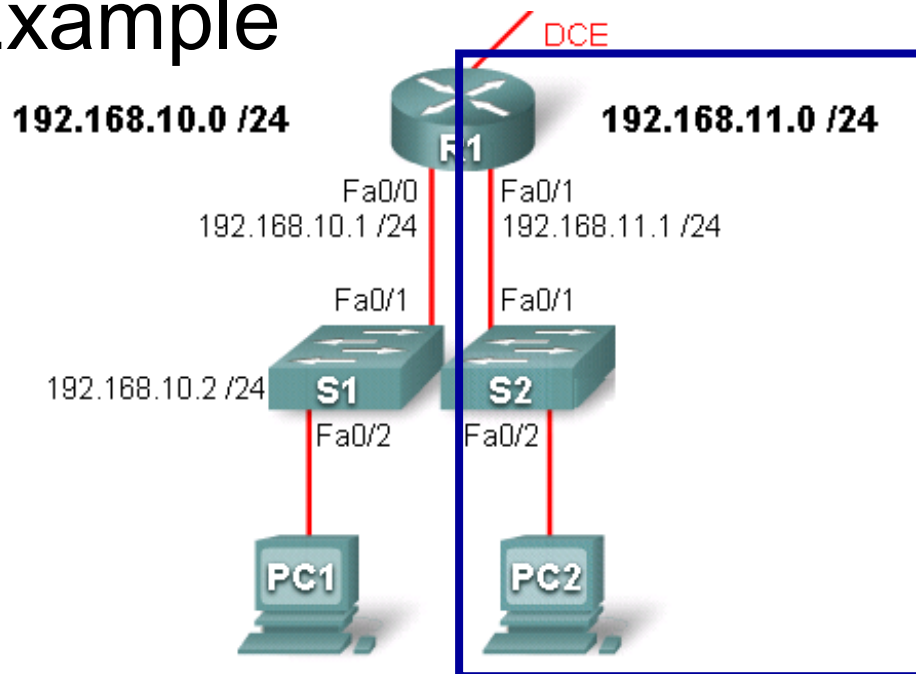
Ethernet adapter Local Area Connection:

```
Connection-specific DNS Suffix . : span.com
Description . . . . . : SiS 900 PCI Fast Ethernet Adapter
Physical Address. . . . . : 00-E0-18-5B-DD-35
Dhcp Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes
IP Address. . . . . : 192.168.10.10
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.10.1
DHCP Server . . . . . : 192.168.10.1
Lease Obtained. . . . . : Tuesday, October 02, 2008 1:06:22 PM
Lease Expires . . . . . : Wednesday, October 03, 2008 1:06:22 PM
```

```
C:\Documents and Settings\Bob>
```

DHCP Configuration Example

- Exclude the first 9 addresses and the last host address.
- Call the pool: **LAN-POOL-11**
 - Assign the network address
 - Identify the default router.
 - Configure the domain name **span.com**



```
R1(config)# ip dhcp excluded-address 192.168.11.1 192.168.10.9
R1(config)# ip dhcp excluded-address 192.168.11.254
R1(config)# ip dhcp pool LAN-POOL-11
R1(dhcp-config)# network 192.168.11.0 255.255.255.0
R1(dhcp-config)# default-router 192.168.11.1
R1(dhcp-config)# domain-name span.com
R1(dhcp-config)# end
```

After PC2 Boots

```
R1# show ip dhcp binding
Bindings from all pools not associated with VRF:
IP address          Client-ID/
                   Hardware address/
                   User name
192.168.10.10      0100.e018.5bdd.35    Oct 03 2007 06:14 PM    Automatic
192.168.11.10      0100.b0d0.d817.e6    Oct 03 2007 06:18 PM    Automatic

R1# show ip dhcp server statistics
Memory usage        25307
Address pools       2
Database agents     0
Automatic bindings  2
Manual bindings     0
Expired bindings    0
Malformed messages 0
Secure arp entries 0

Message             Received
BOOTREQUEST         0
DHCPDISCOVER        8
DHCPREQUEST         3
DHCPCDECLINE        0
DHCPRELEASE         0
DHCPINFORM          0

Message             Sent
BOOTREPLY           0
DHCPOFFER           3
DHCPACK             3
DHCPNAK             0
```

After PC2 Boots

```
R1# show ip dhcp pool
```

```
Pool LAN-POOL-10 :
```

```
Utilization mark (high/low)      : 100 / 0
```

```
Subnet size (first/next)         : 0 / 0
```

```
Total addresses                  : 254
```

```
Leased addresses                 : 1
```

```
Pending event                    : none
```

```
1 subnet is currently in the pool :
```

Current index	IP address range	Leased addresses
192.168.10.11	192.168.10.1 - 192.168.10.254	1

```
Pool LAN-POOL-11 :
```

```
Utilization mark (high/low)      : 100 / 0
```

```
Subnet size (first/next)         : 0 / 0
```

```
Total addresses                  : 254
```

```
Leased addresses                 : 1
```

```
Pending event                    : none
```

```
1 subnet is currently in the pool :
```

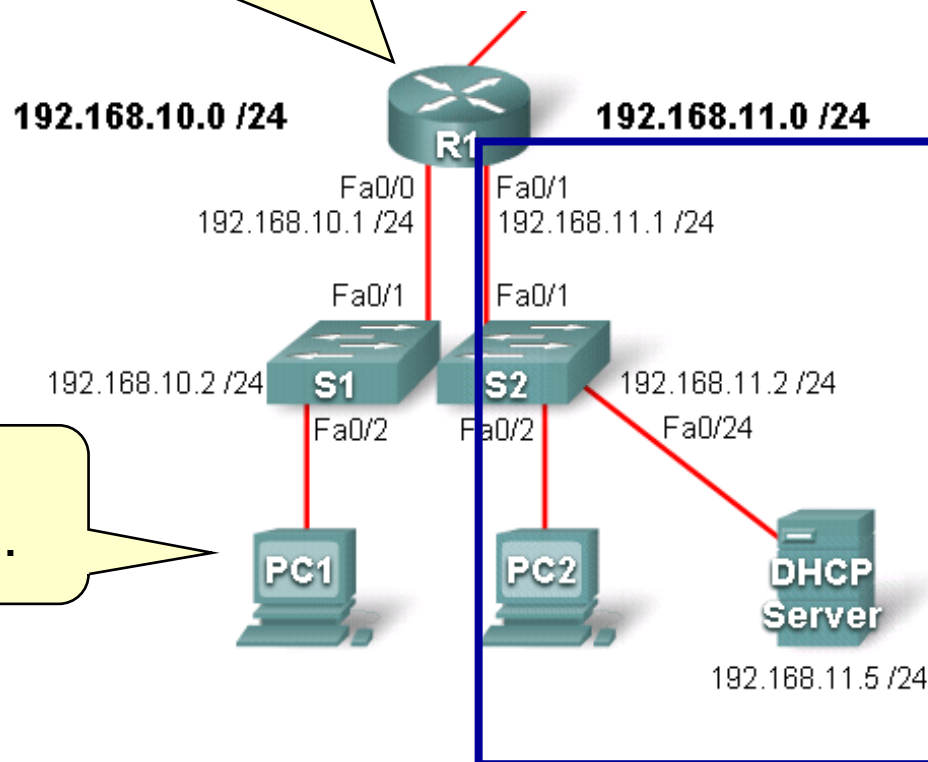
Current index	IP address range	Leased addresses
192.168.11.11	192.168.11.1 - 192.168.11.254	1

```
R1#
```

DHCP Relay

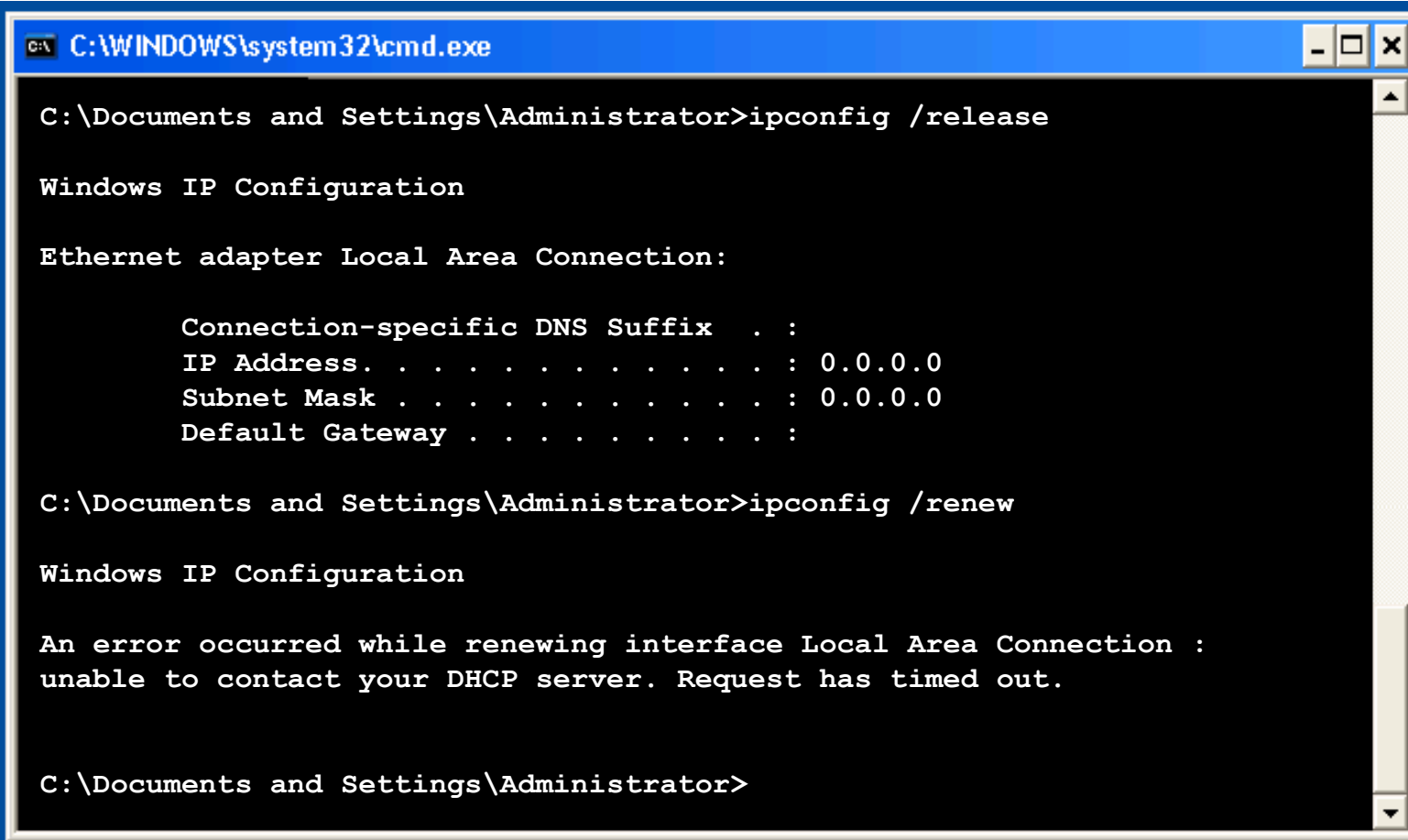
DHCP Problems

Sorry, I can't forward any broadcasts outside of your network subnet ...



Looking for a DHCP server...

DHCP Relay



```
C:\WINDOWS\system32\cmd.exe

C:\Documents and Settings\Administrator>ipconfig /release

Windows 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:\Documents and Settings\Administrator>ipconfig /renew

Windows IP Configuration

An error occurred while renewing interface Local Area Connection :
unable to contact your DHCP server. Request has timed out.

C:\Documents and Settings\Administrator>
```

Helper Addresses

- Remote clients may require DHCP services and send broadcasts to locate these servers.
- Routers, by default, will not forward client broadcasts beyond their subnet.
- Solution:
 - Place DHCP servers on all subnets
 - Use the Cisco IOS helper address feature.

Helper Addresses

- The IP helper address enables a router forward a UDP broadcast to a specific unicast IP address.
- Configured using the **ip helper-address** interface configuration command.
 - Command relays UDP broadcast requests.
 - Configured on the interface receiving the broadcast.

Helper Addresses

```
Router(config-if)#
```

```
ip helper-address address
```

- Enables forwarding and specifies destination address for main UDP broadcast packets
- Changes destination address from broadcast to unicast or directed broadcast address

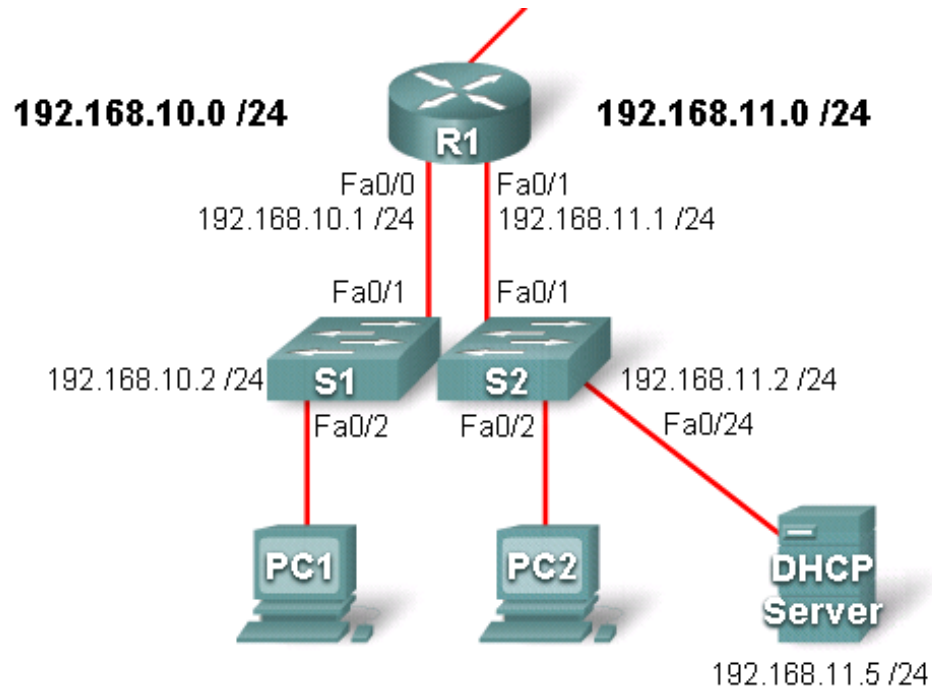
```
Router(config)#
```

```
ip forward-protocol { udp [ port ] }
```

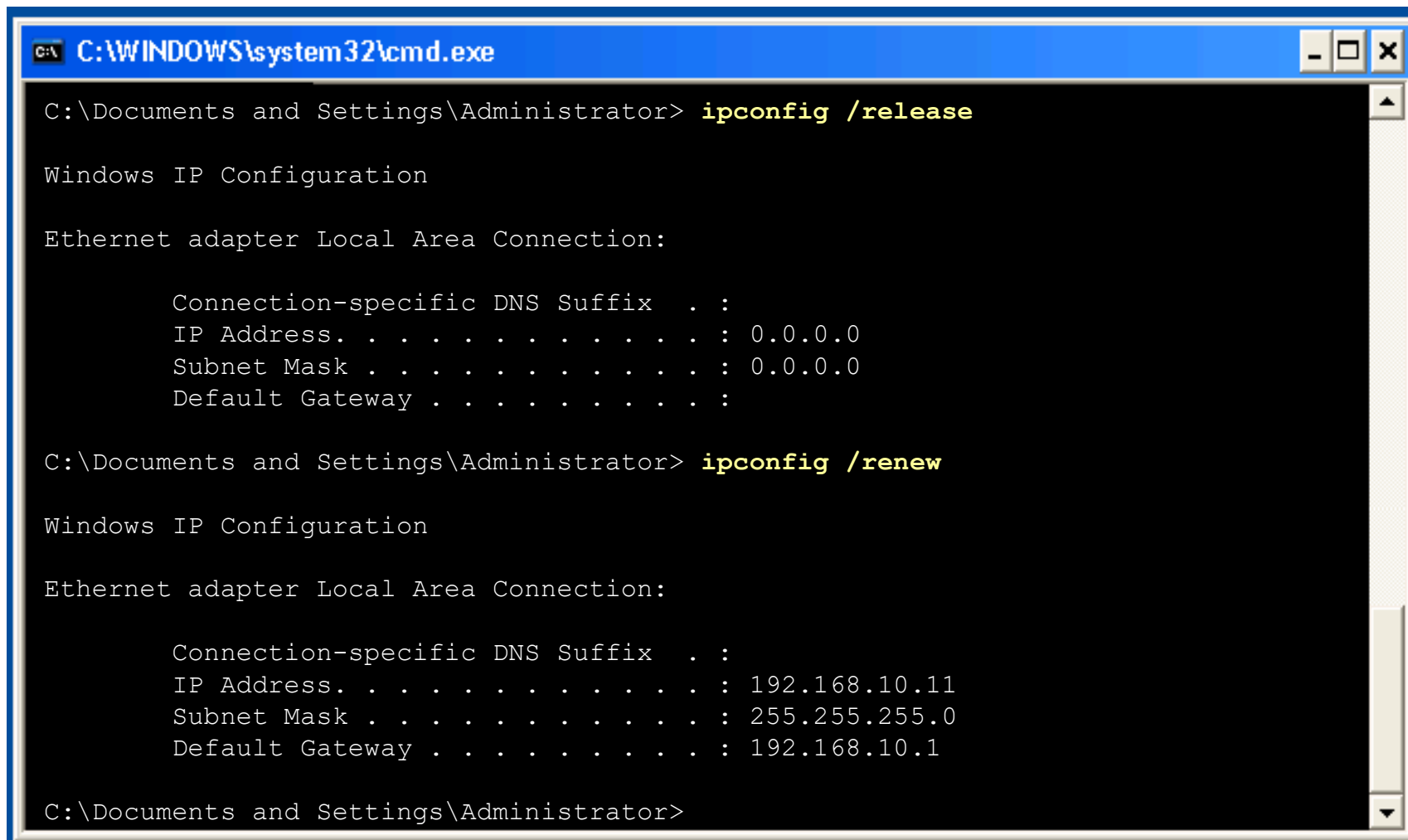
- Specifies which protocols will be forwarded

DHCP Relay

```
R1# config t
R1(config)# interface Fa0/0
R1(config-if)# ip helper-address 192.168.11.5
R1(config-if)# end
```



DHCP Relay



```
C:\WINDOWS\system32\cmd.exe

C:\Documents and Settings\Administrator> ipconfig /release

Windows 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:\Documents and Settings\Administrator> ipconfig /renew

Windows IP Configuration

Ethernet adapter Local Area Connection:

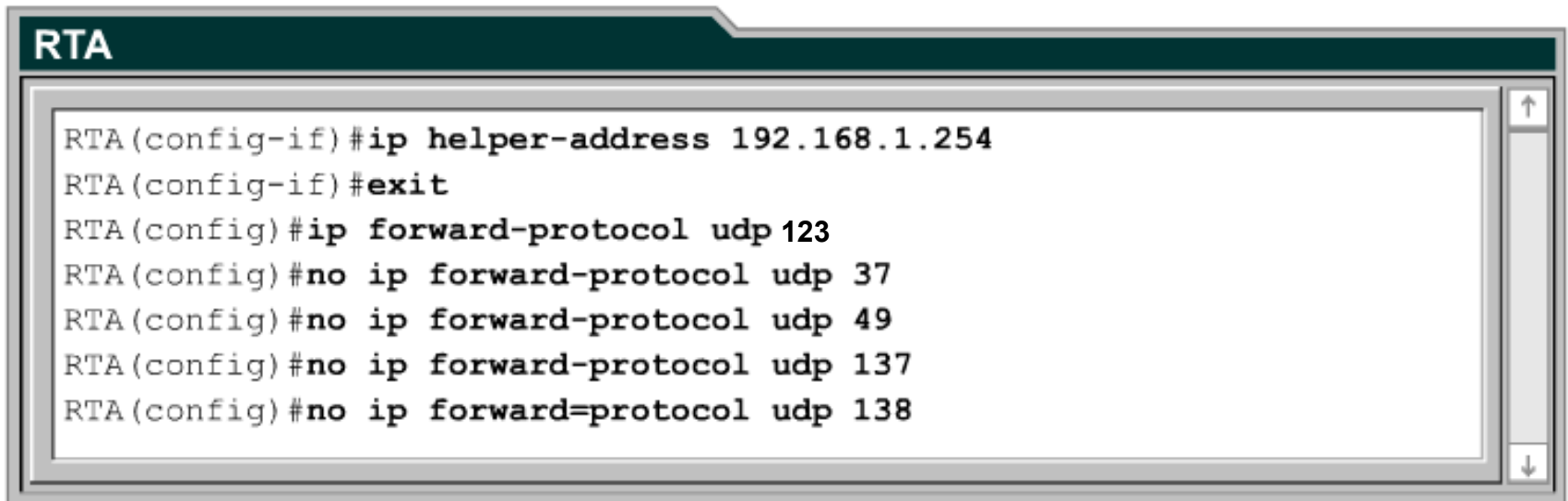
    Connection-specific DNS Suffix  . :
    IP Address. . . . . : 192.168.10.11
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.10.1

C:\Documents and Settings\Administrator>
```

Helper Addresses

- By default, the **ip helper-address** command forwards the following eight UDP services:
 - Port 37: Time
 - Port 49: TACACS
 - Port 53: DNS
 - Port 67: DHCP/BOOTP client
 - Port 68: DHCP/BOOTP server
 - Port 69: TFTP
 - Port 137: NetBIOS name service
 - Port 138: NetBIOS datagram service

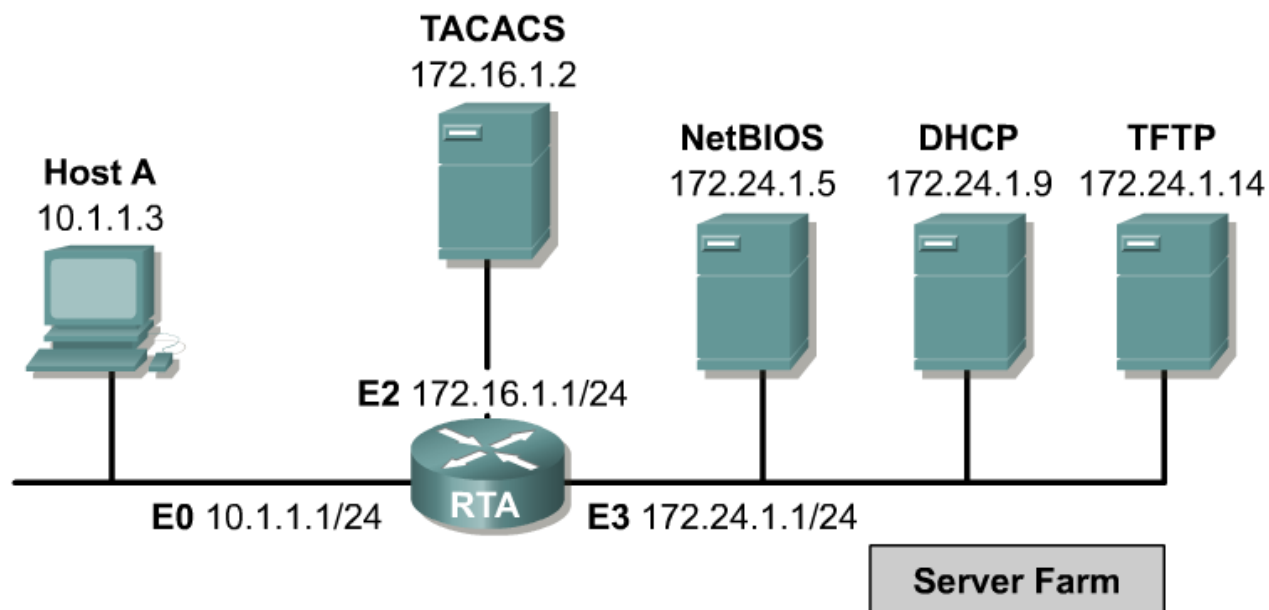
Helper Addresses



```
RTA
RTA(config-if)#ip helper-address 192.168.1.254
RTA(config-if)#exit
RTA(config)#ip forward-protocol udp 123
RTA(config)#no ip forward-protocol udp 37
RTA(config)#no ip forward-protocol udp 49
RTA(config)#no ip forward-protocol udp 137
RTA(config)#no ip forward=protocol udp 138
```

- Use the **ip forward-protocol** global configuration command to restrict or forward any UDP port in addition to the default eight.

Helper Addresses Example



```
RTA(config)# interface e0
```

```
RTA(config-if)# ip helper-address 172.16.1.2
```

```
RTA(config-if)# ip helper-address 172.24.1.9
```

```
RTA(config-if)# ip helper-address 172.24.1.255
```

The **ip helper-address 172.24.1.255** is a directed broadcast and is more efficient than entering the address of each server.

ip directed-broadcast

```
RTA
RTA#show ip interface e0
Ethernet0 is up, line protocol is up
  Internet address is 10.1.1.1/24
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper addresses are 172.24.1.255
                        172.16.1.2
  Directed broadcast forwarding is disabled
  <output omitted>

RTA#show ip interface e3
Ethernet3 is up, line protocol is up
  Internet address is 172.24.1.1/24
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  <output omitted>
```

To allow all the nodes in the server farm to receive directed broadcasts, configure interface e3 as follows:

```
RTA(config)#interface e3
```

```
RTA(config-if)#ip directed-broadcast
```

Configuring a DHCP Client

Configuring a DHCP Client

```
Router(config-if)#
```

```
ip address dhcp
```

Enables a Cisco IOS device to obtain an IP address dynamically from a DHCP server

- Sometimes, Cisco IOS routers in SOHO and branch sites have to be configured in a similar manner.
 - The method used depends on the ISP.
 - However, in its simplest configuration, the Ethernet interface is used to connect to a cable modem.
 - To configure an Ethernet interface as a DHCP client, the **ip address dhcp** command must be configured.

Configuring a DHCP Client



```
SOHO(config)# interface fa0/0
SOHO(config-if)# ip address dhcp
SOHO(config-if)# no shut
SOHO(config-if)#
*Oct  2 17:57:36.027: %DHCP-6-ADDRESS_ASSIGN: Interface
FastEthernet0/0 assigned DHCP address 209.165.201.12, mask
255.255.255.224, hostname SOHO

SOHO# show ip int fa0/0
FastEthernet0/0 is up, line protocol is up
Internet address is 209.165.201.12/27
Broadcast address is 255.255.255.255
Address determined by DHCP from host 209.165.201.1
MTU is 1500 bytes
Helper address is not set
Directed broadcast forwarding is disabled
Outgoing access list is not set
Inbound access list is not set
```