Lecture Introduction

- Jeremy's IT Lab is a free, complete course for the CCNA
- The professor requests that viewers subscribe, like, leave a comment, and share the video to help spread the free series

What is DHCP?

- DHCP stands for Dynamic Host Configuration Protocol
- Just like DNS, DHCP is a protocol that you're certainly using every day, even if you're not aware of it
- DHCP allows DHCP clients, usually end devices like PCs, phones, etc., to automatically learn which IP address to use from a DHCP server, instead of us having to manually configure it
- DHCP allows devices to learn much more than just their IP address, as will be seen in this video

Exam Topics Covered

- DHCP is part of exam topics:
  - 4.3: explain the role of DHCP and DNS within the network
  - 4.6: configure and verify DHCP client and relay
- DHCP is also mentioned in section 5.0, security fundamentals, but that will be left for a separate section of the course

What Will Be Covered in This Lecture

- First: the basic purpose of DHCP and why we use it
- Then: the basic functions of DHCP, specifically the four-message exchange that clients use to get an IP address from a DHCP server

- Then: how to configure DHCP in Cisco IOS
  - A Cisco router can be a DHCP server
  - A Cisco router can be a DHCP client
  - A Cisco router can be a DHCP relay agent
  - All of these configurations will be shown
- There is a bonus practice question at the end of the video from Boson Software's ExSim for CCNA, described as the best practice exams for the CCNA

Brief Overview of DHCP

- DHCP is used to allow hosts to automatically and dynamically learn various aspects of their network configuration
- Configuration parameters learned include:
  - IP address
  - Subnet mask
  - Default gateway
  - DNS server
  - etc.
- This happens without manual and static configuration
- DHCP is an essential part of modern networks

Example: Connecting a Phone to WiFi

- When you connect a phone to WiFi, you don't ask the network admin which IP address, subnet mask, default gateway, etc., the phone or laptop should use
- We all expect that once we connect to WiFi, we'll automatically have access to the network and the Internet

Example: Home Network with a PC

- If you connect your PC to your home router, you probably don't need to manually configure your PC's IP address, default gateway, etc.
- You can do that manually if you want, and some people do
- In a small network, manual configuration isn't such a difficult task
- However, in large networks, DHCP's role is very important

DHCP Usage

- DHCP is typically used for 'client' devices such as:
  - Workstations
  - PCs
  - Phones
  - etc.
- Devices such as routers, servers, etc., are usually manually configured
- This is because they need to have a fixed IP address to perform their function
- If the default gateway of the network kept changing, it would obviously not be ideal

DHCP Server in Different Network Sizes

- In small networks (such as home networks), the router typically acts as the DHCP server for hosts in the LAN
- If you have a router in your home, it's probably acting as the DHCP server for all of your devices
- In larger networks, such as a large enterprise network, the DHCP server is usually a Windows or Linux server

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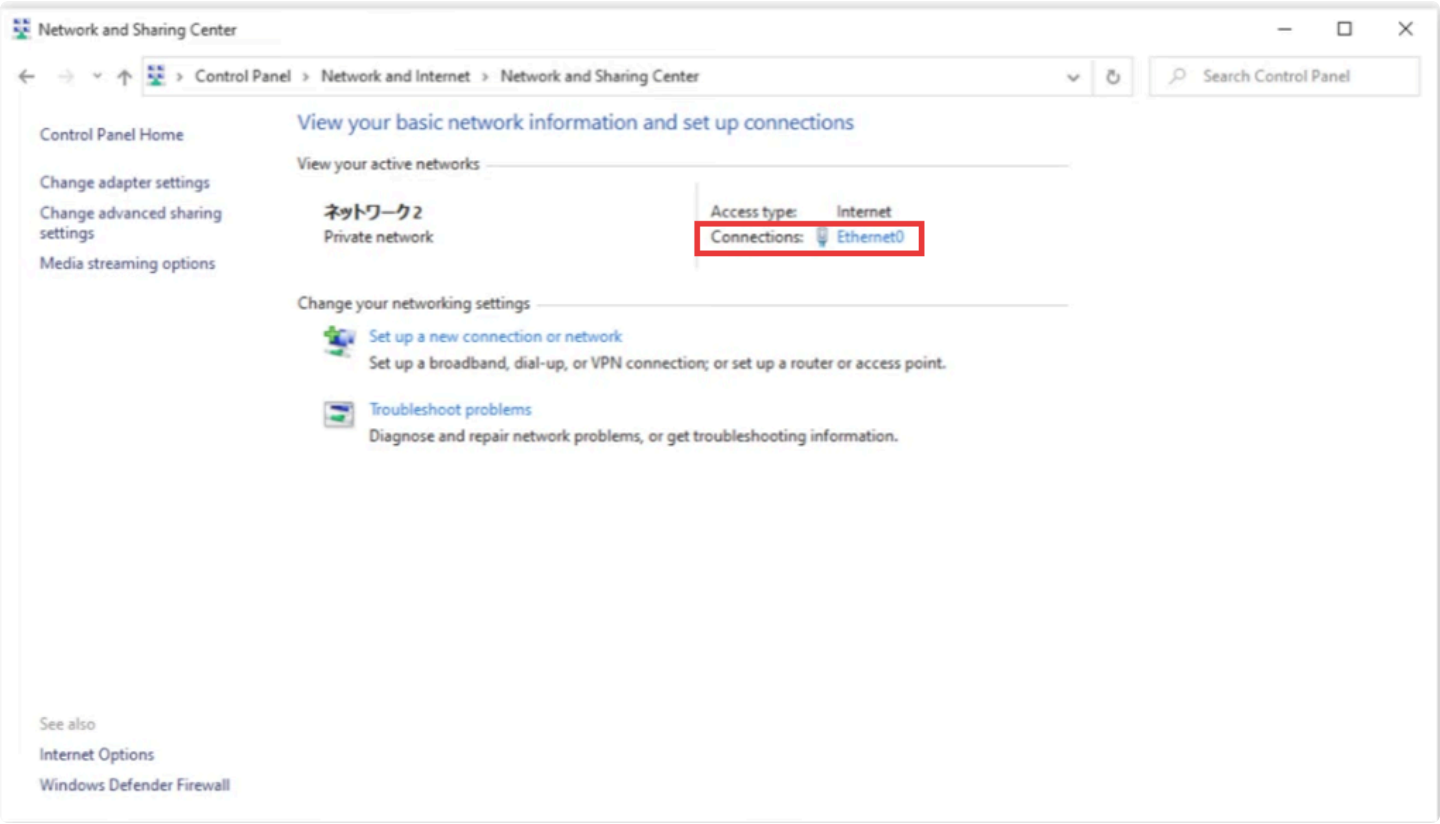
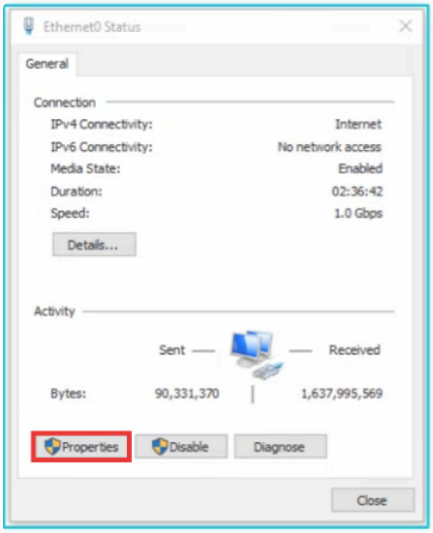
Demonstration of DHCP Using a Windows 10 PC

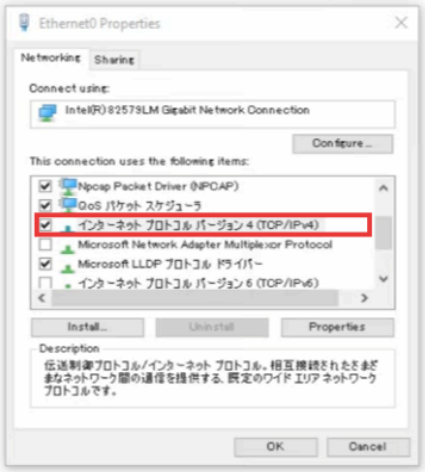
- The professor gives a brief demonstration of DHCP's function using his own PC, which is running Windows 10
- If your PC is running Windows, he recommends following along

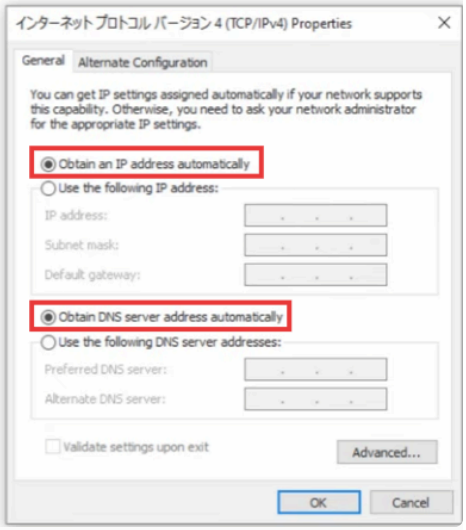
Accessing the Network and Sharing Center



- The 'Network and Sharing Center' can be accessed from the Control Panel
- He selects his PC's Ethernet0 connection, which is connected to his home router via an Ethernet cable



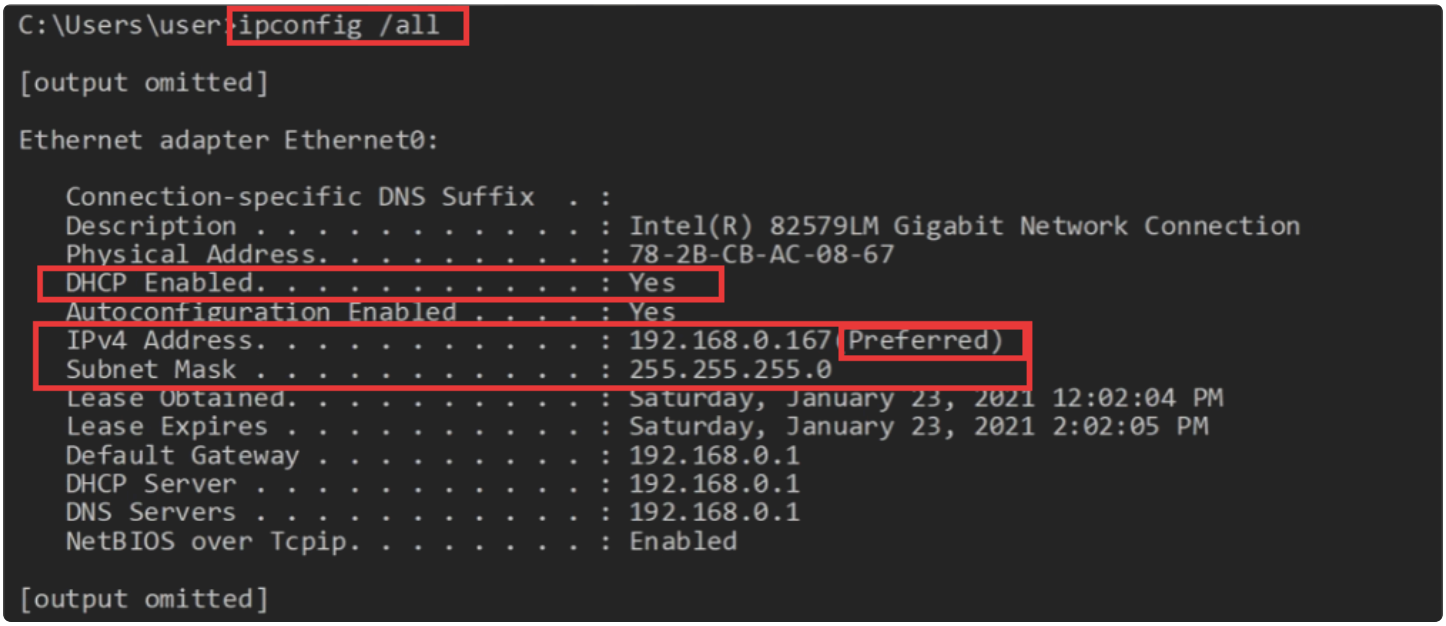




- After opening it, he selects the properties of his PC's Ethernet connection, Ethernet0
- The properties are displayed, and he selects the IPv4 properties

- This window opens up, and he can confirm that his PC is using DHCP
  - Here it says 'obtain an IP address automatically'
  - Down here it says 'obtain DNS server address automatically'
- 'Automatically' means that his PC will use DHCP to learn which IP address, subnet mask, default gateway, and DNS server it should use

Checking the Automatically Configured Information with IPCONFIG /ALL



- The professor used the IPCONFIG /ALL command, which the viewers already know, to look at what was automatically configured
- First off, the output tells us that DHCP is enabled
  - If the PC had been manually configured in the previous menu, 'No' would display here
- The IPv4 address the PC was assigned is 192.168.0.167 with a /24 subnet mask

- It says 'preferred' next to the address
  - This means the PC was previously assigned this IP address by the DHCP server
  - When it asked the server for an IP address again, it asked to receive the same address again
  - If this address was no longer available, the PC would have been assigned a different address
  - However, the address was available, so the PC got its preferred IP address

Lease Time

```
C:\Users\user>ipconfig /all

[output omitted]

Ethernet adapter Ethernet0:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) 82579LM Gigabit Network Connection
   Physical Address. . . . . . . . . : 78-2B-CB-AC-08-67
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 192.168.0.167(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Saturday, January 23, 2021 12:02:04 PM
   Lease Expires . . . . . . . . . . : Saturday, January 23, 2021 2:02:05 PM
   Default Gateway . . . . . . . . . : 192.168.0.1
   DHCP Server . . . . . . . . . . . : 192.168.0.1
   DNS Servers . . . . . . . . . . . : 192.168.0.1
   NetBIOS over Tcpip. . . . . . . . : Enabled

[output omitted]
```

- IPCONFIG /ALL displays what time the lease was obtained and what time it will expire
- DHCP servers 'lease' IP addresses to clients
- These leases are usually not permanent, and the client must give up the IP address at the end of the lease
- A client can also release the address before the lease is up if it no longer needs it
- The professor said 'usually' not permanent because it is possible to configure the DHCP server to permanently assign IP addresses
- However, it's almost always best to set a lease time

Example: Cafe Providing WiFi

- Think about a cafe that provides WiFi network access to its customers

- If the IP address leases were permanent, every time a new customer comes into the cafe and connects to the WiFi, the customer's devices would be permanently assigned IP addresses, unless the client device releases it

Example: Airport Providing WiFi

- Or how about an airport that provides WiFi?
- The professor explains why it's best to limit the lease time, to preserve the available IP addresses
- If the customer stays longer than the lease time, their device will simply automatically request a new IP address
- But if they stop using the network, the IP addresses will be free for someone else to use

Other Information Learned from the DHCP Server

```
C:\Users\user>ipconfig /all

[output omitted]

Ethernet adapter Ethernet0:

   Connection-specific DNS Suffix  . :
   Description . . . . . . . . . . . : Intel(R) 82579LM Gigabit Network Connection
   Physical Address. . . . . . . . . : 78-2B-CB-AC-08-67
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 192.168.0.167(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Saturday, January 23, 2021 12:02:04 PM
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   DHCP Server . . . . . . . . . . . : 192.168.0.1
   DNS Servers . . . . . . . . . . . : 192.168.0.1
   NetBIOS over Tcpip. . . . . . . . : Enabled

[output omitted]
```

- At the bottom of the IPCONFIG /ALL output, some other info the PC learned from the DHCP server is displayed
- The default gateway, DHCP server, and DNS server are all 192.168.0.1, which is the home router
- This is common in home networks; the home router provides all of these services to devices on the local network

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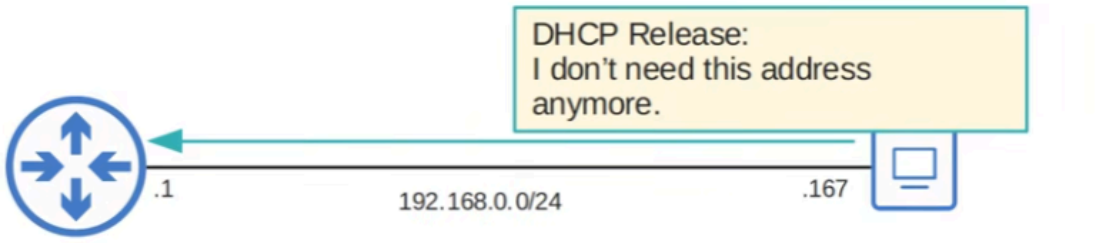
Demonstration of the DHCP Client Process

```
C:\Users\user>ipconfig /release

Windows IP Configuration

[output omitted]

Ethernet adapter Ethernet0:

   Connection-specific DNS Suffix  . :
   Default Gateway . . . . . . . . . :

[output omitted]
```



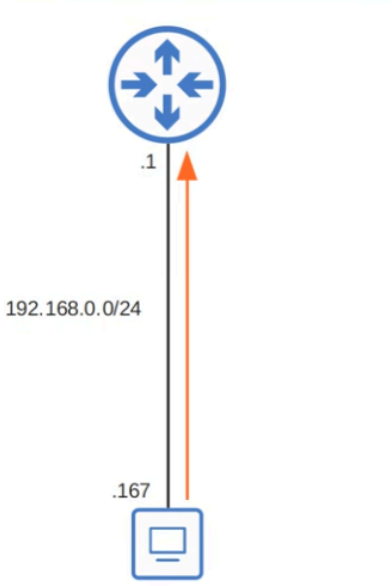
- The professor wants to demonstrate the process that a DHCP client goes through to get an IP address from a DHCP server
- But first, he needs to make his PC release its IP address, so it can ask the server again
- The command in the Windows command prompt to release the DHCP-learned IP address is IPCONFIG /RELEASE

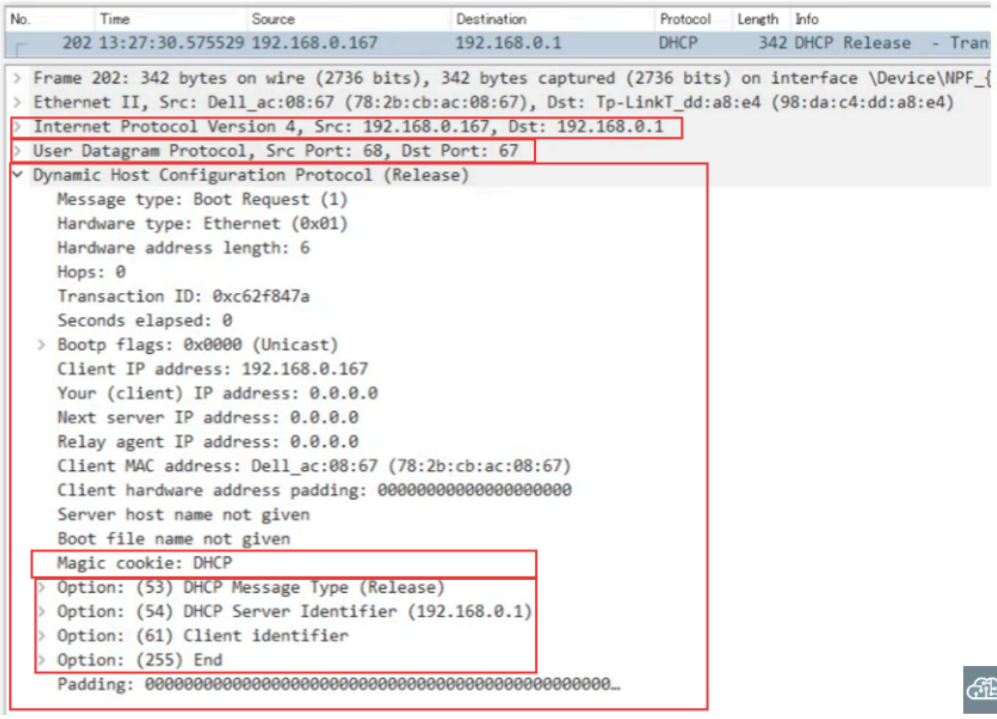
```
C:\> IPCONFIG /RELEASE
```

- After running the command, no information is displayed for the Ethernet0 interface
- The professor demonstrates what just happened: his PC sent a DHCP Release message to the DHCP server, his router, telling it that the IP address isn't needed anymore
- Therefore, 192.168.0.167 is now free to assign to another client

Wireshark Capture of the DHCP Release Message

- The professor used Wireshark to capture the DHCP Release message
- For the CCNA, students should focus on learning the four-message process used to lease an IP address from a DHCP server, which will be shown next
- However, he looks at the DHCP Release message anyway





Ethernet and IPv4 Headers

- The message is an Ethernet frame, so there is an Ethernet header
- An IPv4 header is inside
  - Source IP address: 192.168.0.167, the PC
  - Destination IP: 192.168.0.1, the router

UDP Header and Ports

- Inside is a UDP header
- Notice the ports: source port 68, destination port 67
- DHCP servers use UDP port 67 and DHCP clients use UDP port 68
- The source port is 68 because it's the DHCP client

- The destination port is 67 because it's the DHCP server
- This is different than DNS, for example, in which only the port of the server is decided and the client uses a random ephemeral port

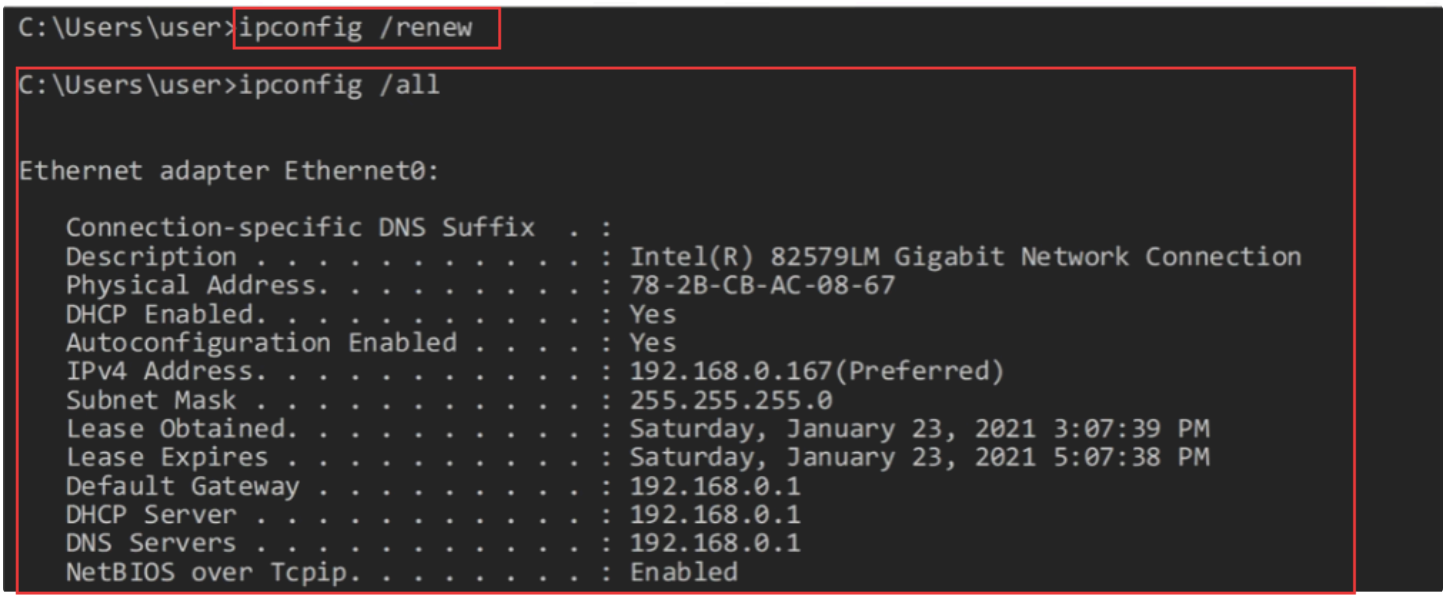
DHCP Release Message Contents

- Inside of the UDP segment, we have the DHCP Release message
- The client IP is indicated here
- Notice the 'options' down here
- DHCP has various options used for different purposes
- For example, option 53, at the top, indicates what kind of DHCP message it is

The Magic Cookie

- The professor points out the magic cookie as his favorite part of DHCP messages
- He suggests doing a Google search to learn about it

The DHCP Four-Message Process



- Now that the PC's IP address has been released, the professor demonstrates how the PC can get an IP address from the DHCP server
- From the Windows command prompt, he used the command IPCONFIG /RENEW

```
C:\> IPCONFIG /RENEW
```

- The PC contacts the DHCP server, and now the PC has the same configuration as before
- This process involves four messages, which he introduces next

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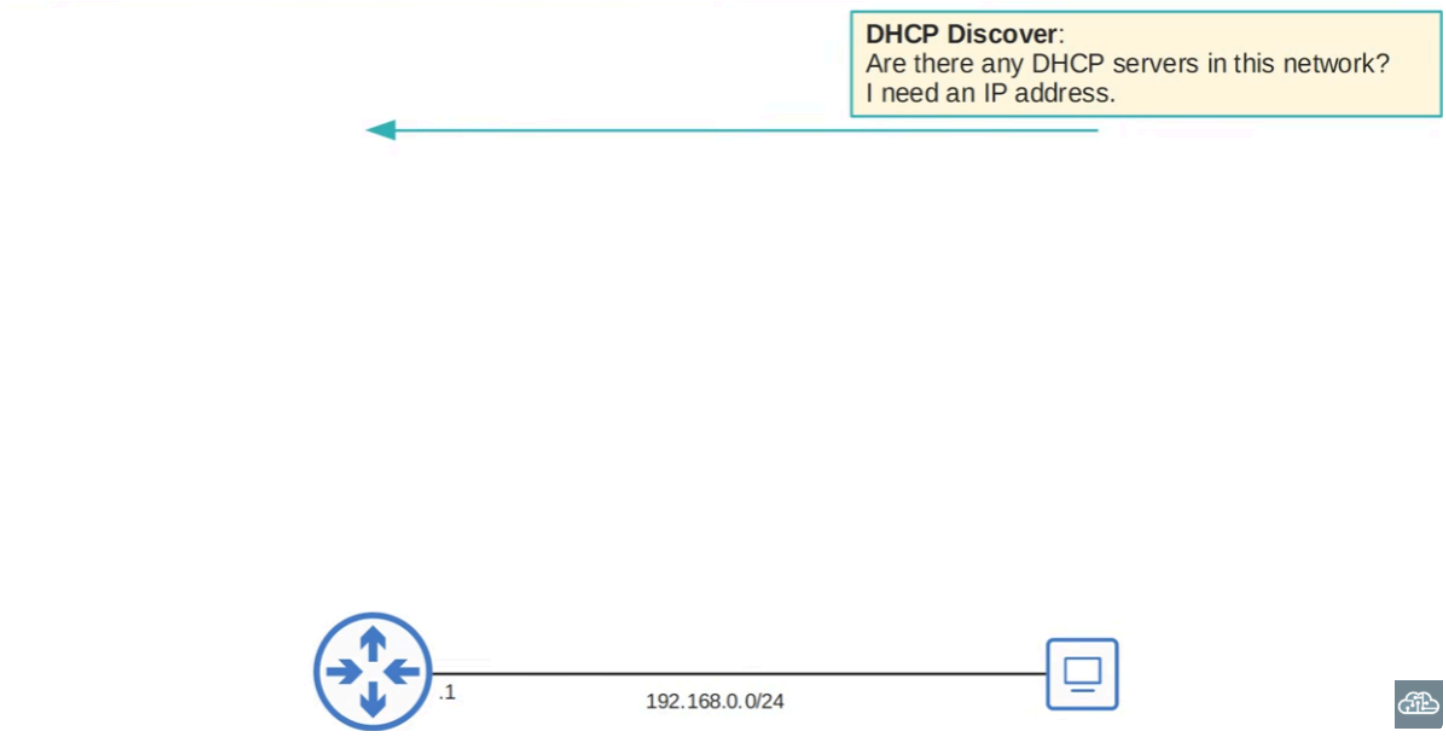
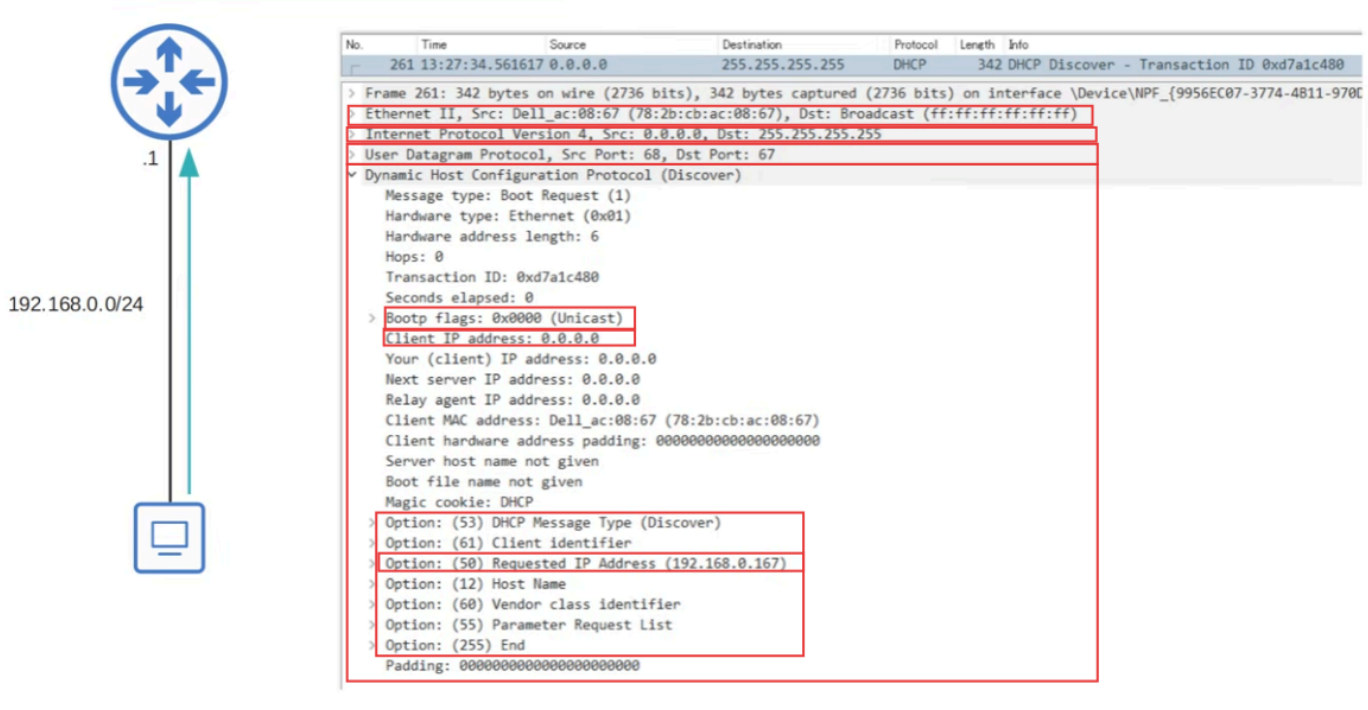
The DHCP Four-Message Process



- The first message is the DHCP Discover message
- It is a broadcast message from the client
- Basically, it's asking if there are any DHCP servers in the local network, telling them it needs an IP address

DHCP Discover Message in Wireshark



- The professor uses Wireshark to look at the DHCP Discover message his PC sent

Ethernet Header

- Notice the destination broadcast MAC address of all Fs
- The PC doesn't know the IP address or MAC address of the DHCP server
- In fact, it doesn't even know if there is a DHCP server on the network, so it has no choice but to broadcast the message

IPv4 Header

- Notice the source IP address of 0.0.0.0
- This means the PC doesn't have an IP address yet
- The destination is 255.255.255.255, so it's a broadcast message

UDP Header and Ports

- Since this is a message from the DHCP client to the server, the source port is UDP 68 and the destination is UDP 67

DHCP Message Fields

- The professor notes that you don't need to know the contents of any of these messages in detail, just their basic purpose

- Bootp flags field:
  - Bootp is the predecessor of DHCP, but you don't need to learn Bootp for the CCNA
  - The professor points out the value of 'unicast' here, represented by 0000
  - This may seem odd because the message is broadcast but this field says unicast
  - He will explain it when looking at the next message
- Client IP address is 0.0.0.0, since the PC doesn't have an IP address yet
- The client MAC is also displayed here
- The options are different than the ones used in the DHCP Release message looked at before

Requested IP Address Option

- The professor points out the Requested IP Address option
- Because his PC previously had the IP address 192.168.0.167, it requested that address again
- If the address is available, the server might grant it that same IP address again
- But if it's not, the PC would get a different IP address
- If this is the first time the PC is using DHCP, it won't request an IP address like this; it will simply leave it up to the server to decide

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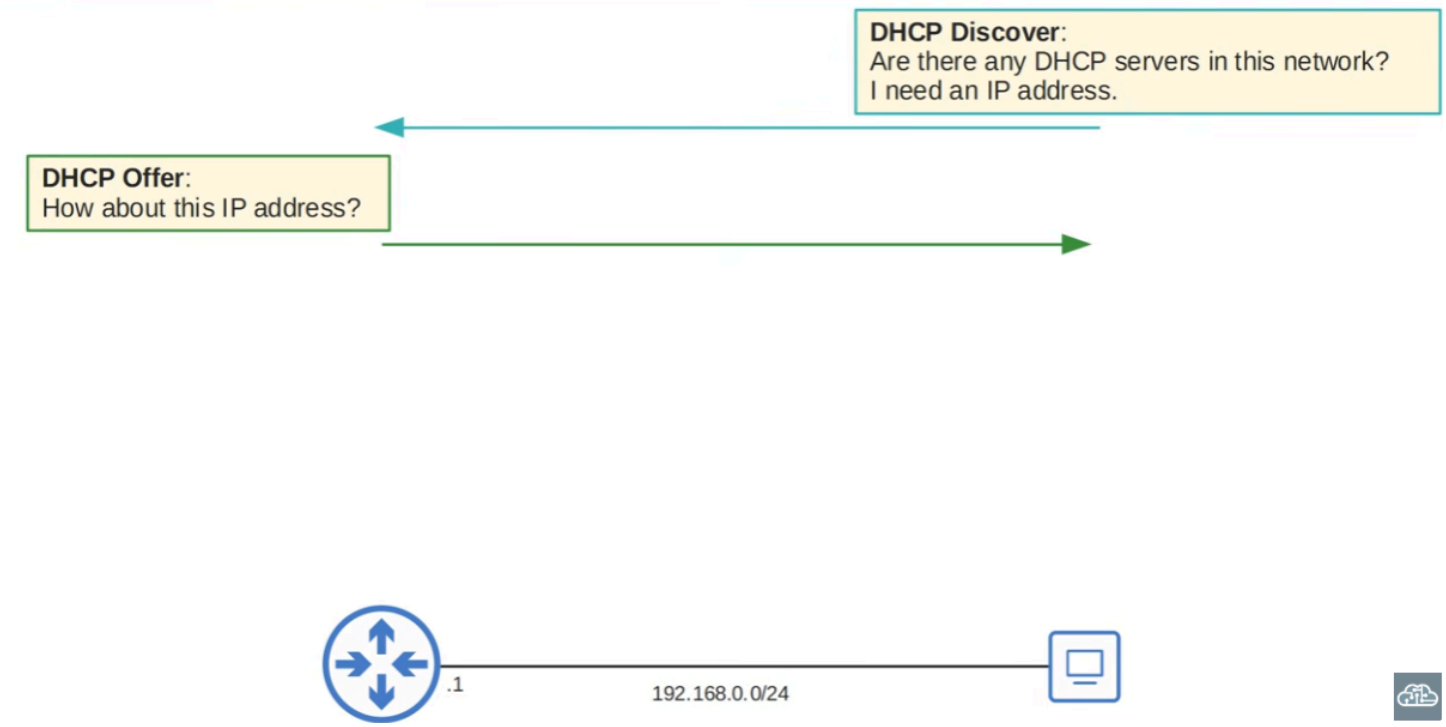
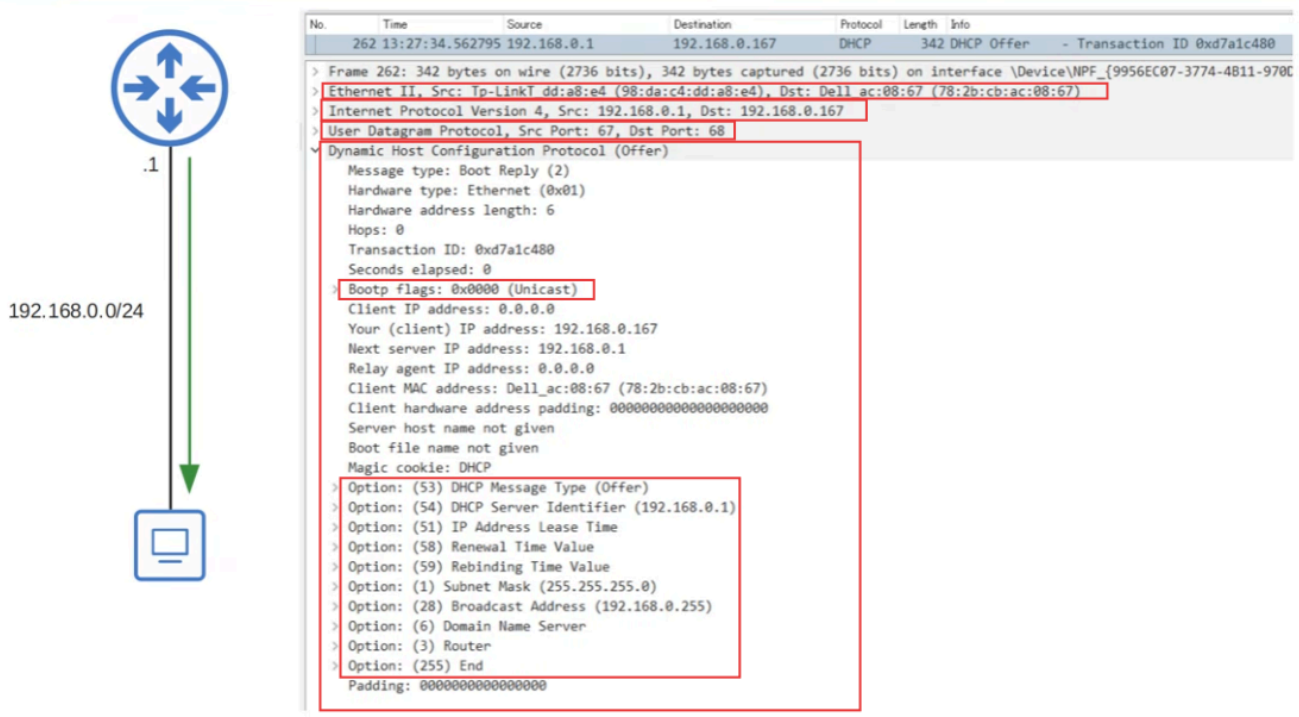
DHCP Offer Message



- The next message is the DHCP Offer message
- It is sent from the DHCP server to the client
- It offers an address for the client to use, as well as other information like default gateway, DNS server, etc.

DHCP Offer Message in Wireshark



- The professor checks out the DHCP Offer his router sent to his PC

Unicast Delivery of the Offer

- The Offer is sent as a unicast frame to the client's MAC address
  - This is because the server learned the client's MAC address from the Discover message
- It's also unicast at Layer 3
  - The destination is the IP address being offered to the client

UDP Header and Ports

- The source and destination port numbers are reversed, since it's a message from the server to the client
- The source is UDP 67 and the destination is UDP 68

Bootp Flags Field

- The professor looks at the 'Bootp flags' field again
- Once again, it says unicast
- When the PC sent the DHCP Discover message, this field was also set to 0000, unicast
- This means that the server will send its messages using unicast, as shown above
- However, that's not always the case
- The DHCP Offer message can be sent to the client using either broadcast or unicast
  - It depends on the client
  - In this case, the PC told the router to send the Offer using unicast, so it did
  - If the PC told the router to send the Offer using broadcast, the destination MAC would be all F's and the destination IP would be 255.255.255.255

Note: At this point in the DHCP process, the client's IP address isn't actually configured. Some clients won't accept unicast messages before their IP address is actually configured, so that's why sometimes broadcast must be used instead of unicast.

Options in the Offer Message

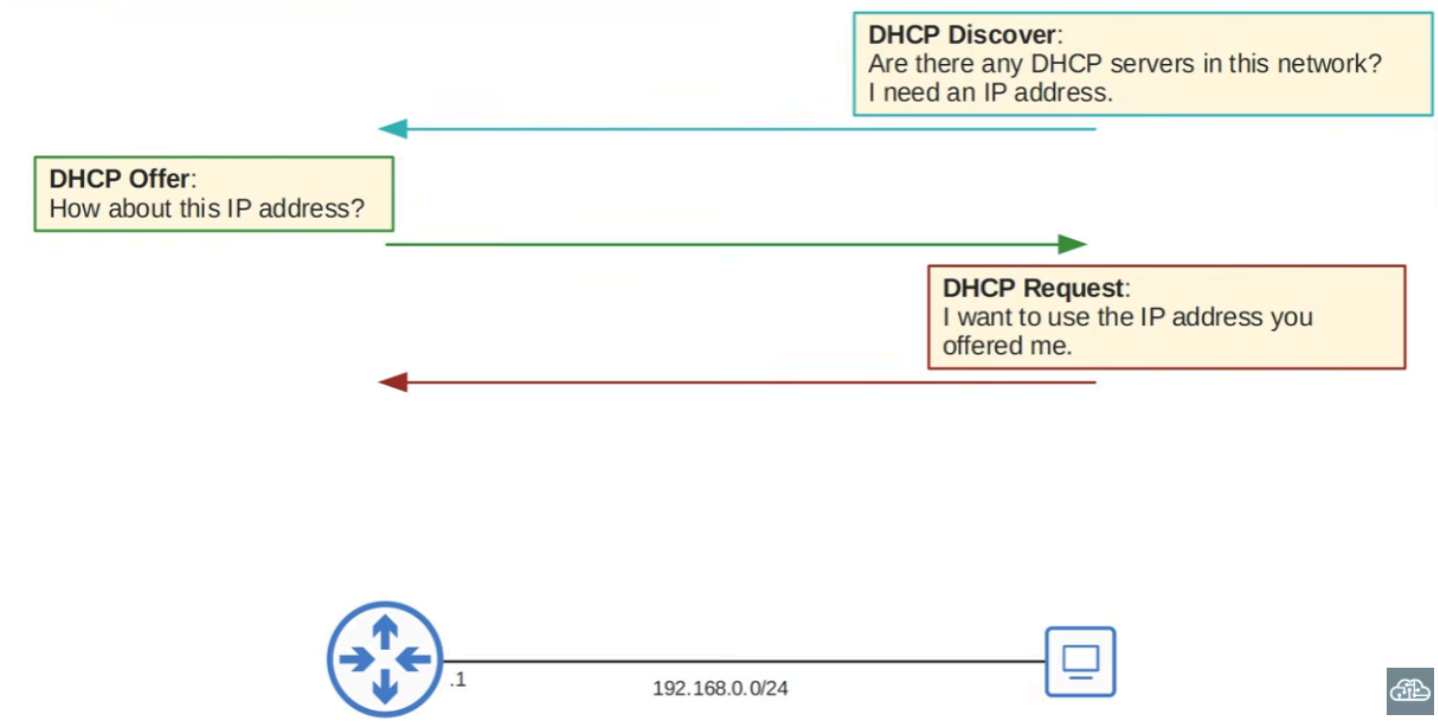
- Finally, here are the options

- For example:
  - Option 51 indicates the lease time
  - Option 6 is 'domain name server', that's the DNS server
  - Option 3 is 'router', which tells the client the default gateway

Note: You don't have to memorize these option numbers, definitely not at the CCNA level. The professor is just pointing them out.

The DHCP Four-Message Process

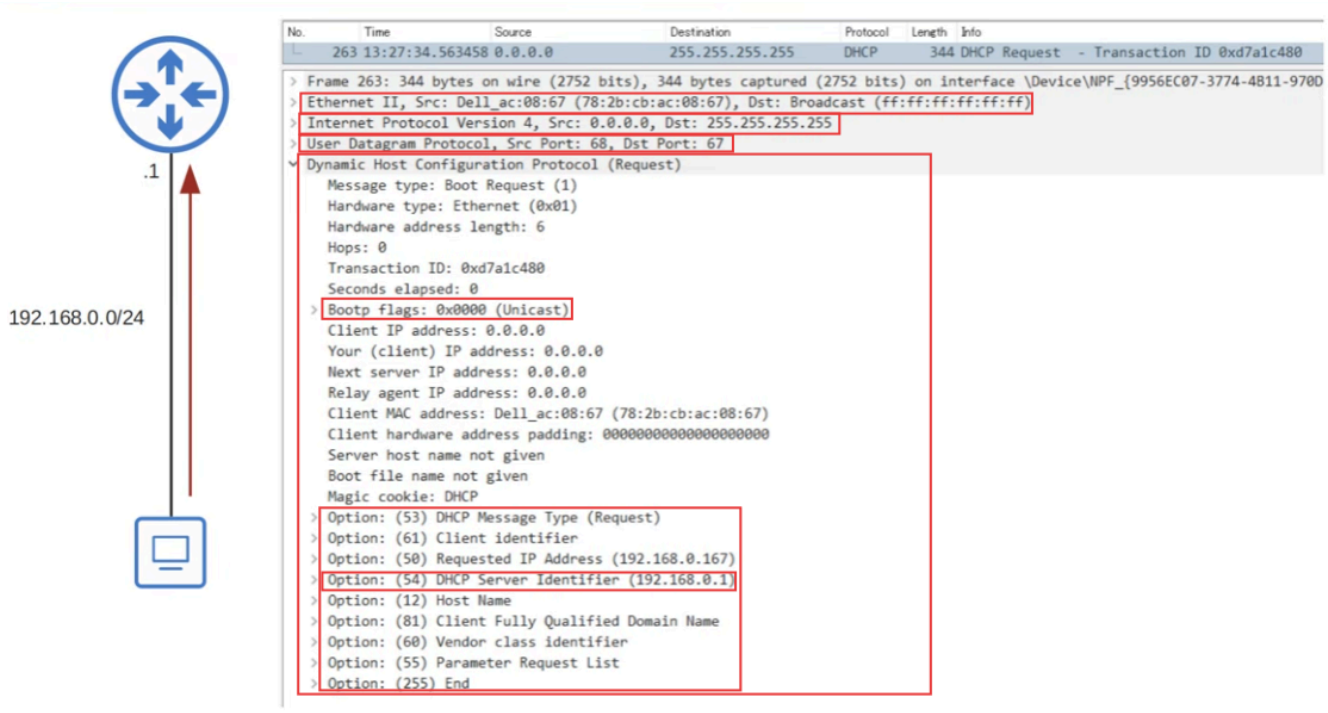
DHCP Request Message



- The next message is the DHCP Request message
- It is sent from the DHCP client to the server
- It tells the server that the client wants to use the IP address it was offered
- This is important because there may be multiple DHCP servers on the local network, and all of them will reply to the client's Discover message with an Offer

- The client has to tell which server it is accepting the offer from and request to use that IP address
- Typically, the client will accept the first Offer it receives

DHCP Request Message in Wireshark



- The professor looks at the Request message in Wireshark
- The destination MAC is all Fs, so this is once again a broadcast message
- If there are multiple DHCP servers on the network, all of them will receive this message
- One of the later fields will indicate which server the PC accepted the offer from

IPv4 Header

- The source IP is still 0.0.0.0, since the offered IP address hasn't actually been configured yet
- The destination is broadcast, 255.255.255.255

UDP Header and Ports

- Since it's a message from the client to the server, the source port is UDP 68 and the destination is UDP 67

Flags Field

- The flags field is shown again, telling the server to send its messages using unicast, even though the client itself uses broadcast

Options in the Request Message

- The server's IP address is indicated using option 54
- If there are multiple DHCP servers on the local network, this is how the client says which server it selected

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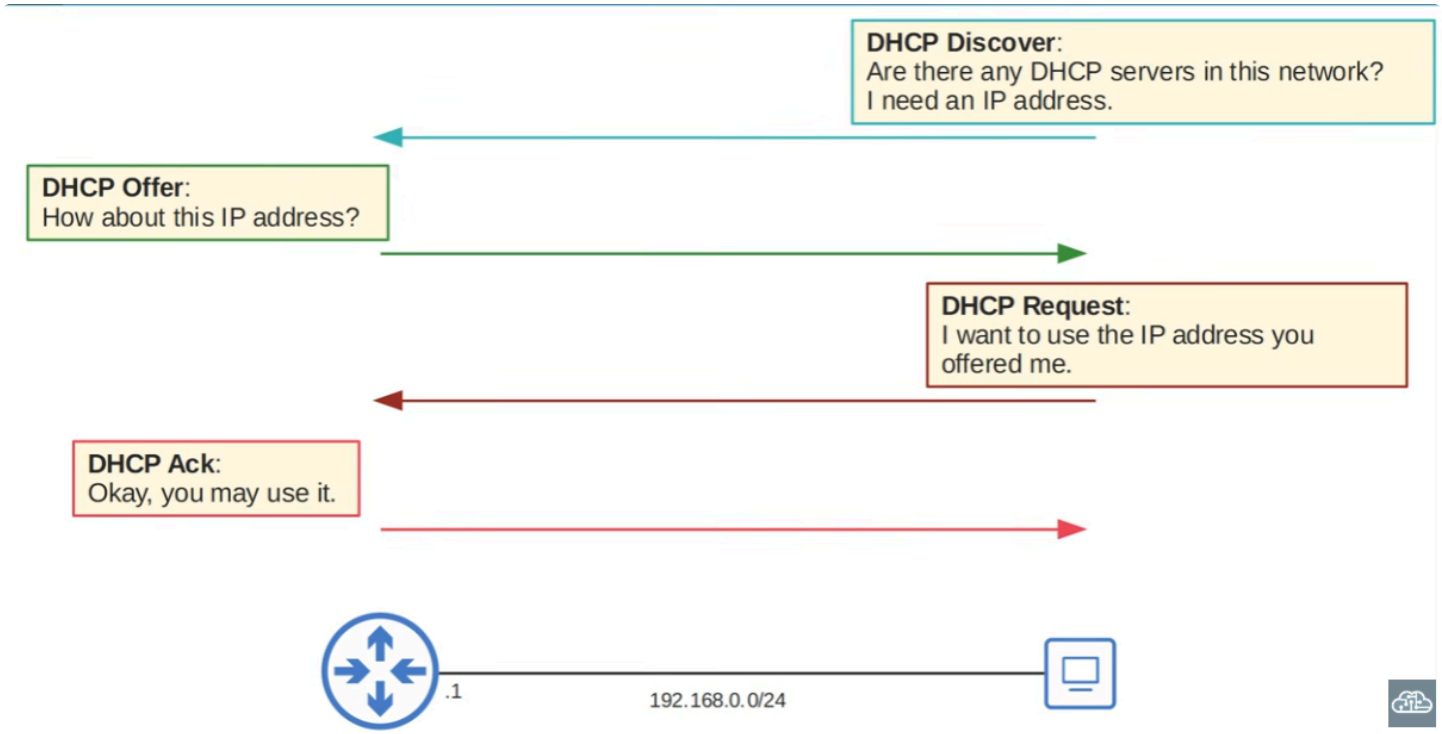
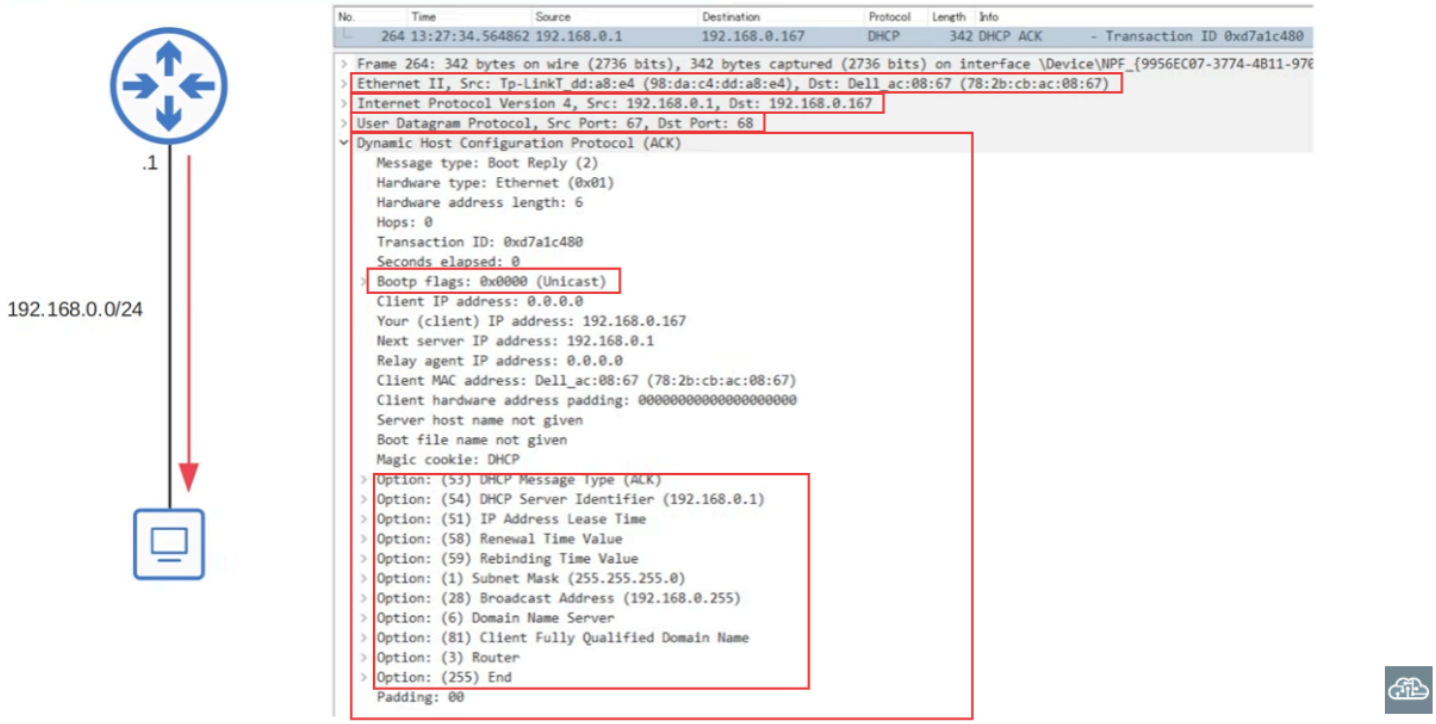
The DHCP Four-Message Process

DHCP Ack Message



- Now the final message in the process, the DHCP Ack, acknowledgement
- This is sent from the server to the client, confirming that the client may use the requested IP address
- Once this message is received, the client finally configures the IP address on its network interface

DHCP Ack Message in Wireshark



- The professor looks at the Ack message in Wireshark
- These messages from the server to the client are once again sent to unicast addresses, not broadcast

UDP Header and Ports

- The server uses UDP port 67, so that's the source port
- The client uses UDP port 68, so that's the destination port

Bootp Flags Field

- The Bootp flags field once again indicates unicast, because the client requested unicast messages
- Just like the DHCP Offer message, the DHCP Ack message can be either broadcast or unicast, depending on what the client requests

Options in the Ack Message

- These are the options for this Ack message
- There are many different DHCP options
- If you want to check out a list, the DHCP Wikipedia page lists a bunch of them, and a quick Google search will give you many explanations of their various functions

- However, that's just extra, not necessary for the CCNA exam

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Summary of the DHCP Four-Message Process

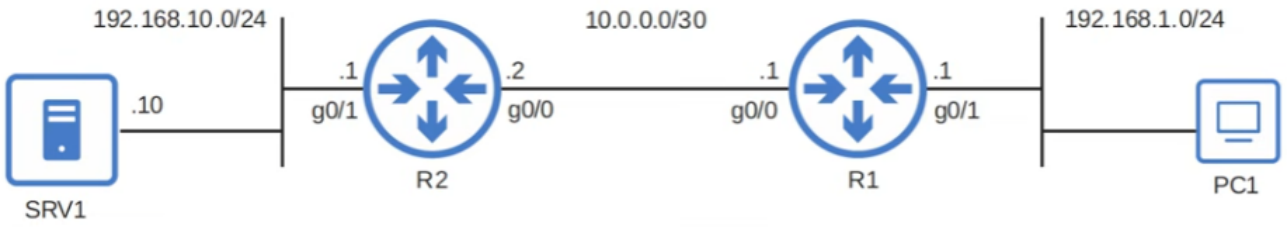
Discover	Client → Server	Broadcast
Offer	Server → Client	Broadcast or Unicast
Request	Client → Server	Broadcast
Ack	Server → Client	Broadcast or Unicast
Release	Client → Server	Unicast

- A common way to remember the messages is D-O-R-A, DORA
    - DORA stands for Discover, Offer, Request, and Ack
- Make sure you know which messages are sent from client to server and which are sent from server to client
- Make sure you know which messages must be sent broadcast and which can be sent either broadcast or unicast
- The Release message, shown first, is sent unicast from the client to the server
- There are actually many more DHCP message types than these, but if you know these message types, you'll be ready for the CCNA

Introduction to DHCP Relay

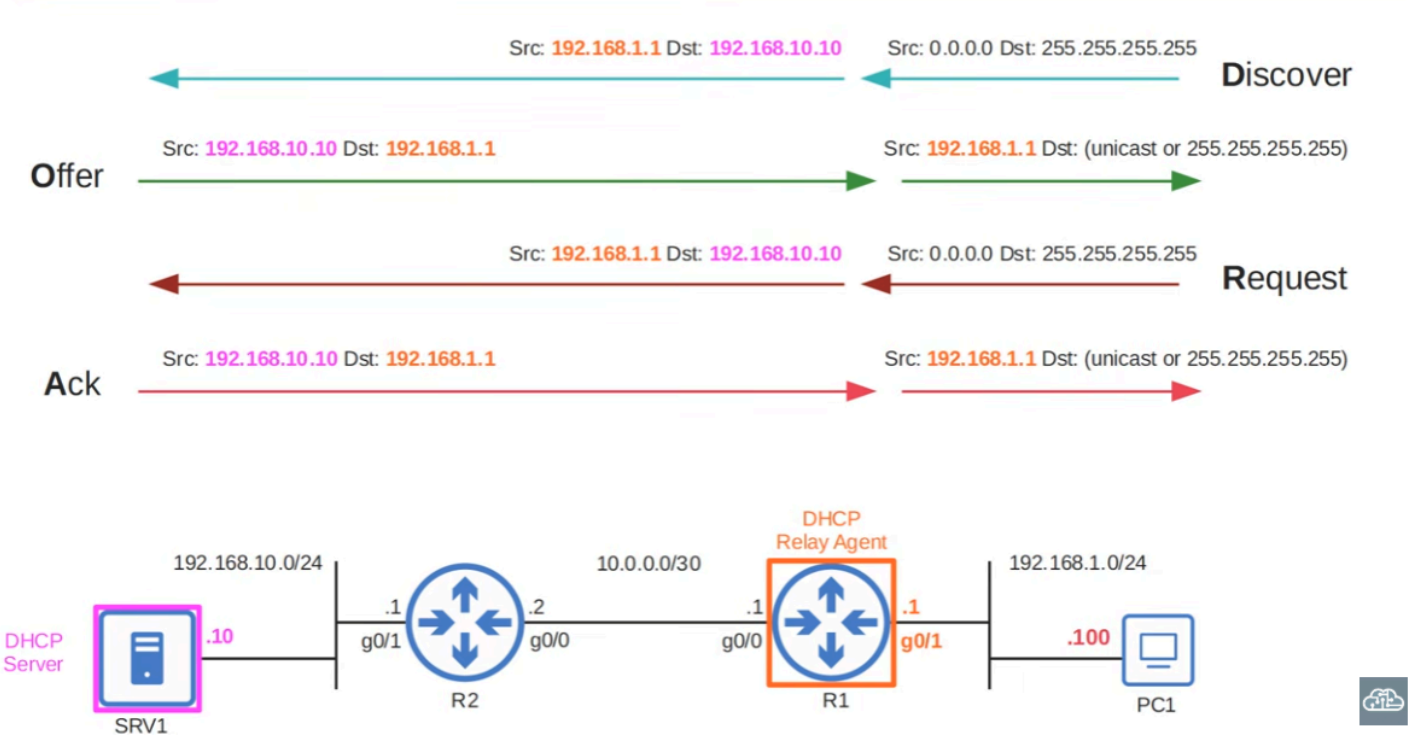
- Some network engineers might choose to configure each router to act as the DHCP server for its connected LANs
- However, large enterprises often choose to use a centralized DHCP server
  - It will assign IP addresses to DHCP clients in all subnets throughout the enterprise network
- If the server is centralized, it won't receive the DHCP clients' broadcast DHCP messages
  - Broadcast messages don't leave the local subnet
  - Routers don't forward them
- To fix this, you can configure a router to act as a 'DHCP relay agent'
  - The router will forward the clients' broadcast DHCP messages to the remote DHCP server as unicast messages

Example: Network Demonstration with PC1, R1, and SRV1



- The professor uses a network to demonstrate this concept
- PC1 is a DHCP client, so it will broadcast a DHCP Discover message to ask DHCP servers on the local network to assign it an IP address
- In this case, R1 isn't a DHCP server
- SRV1 is the central DHCP server for this network
- R1 will need to forward any DHCP messages from PC1 to SRV1

Visual Demonstration of DHCP Relay



- The professor demonstrates how DHCP relay works visually
- SRV1 is a DHCP server, and R1 is a DHCP relay agent

Step 1: DHCP Discover

- PC1 broadcasts a DHCP Discover message to get an IP address
- R1, a DHCP relay agent, relays the message to SRV1
- The source address changes to the address of R1's G0/1 interface
- The destination is SRV1's IP address
- So, it is a unicast message

Step 2: DHCP Offer

- SRV1 replies with the DHCP Offer, sending it to the address of R1's G0/1 interface, 192.168.1.1
- R1 then forwards it to PC1
- The source is R1's IP address
- The message is either sent unicast to PC1 or broadcast

Step 3: DHCP Request

- PC1 broadcasts a Request message
- R1 relays it to SRV1

Step 4: DHCP Ack

- SRV1 replies with a DHCP Ack
- R1 forwards that to PC1
- PC1 configures the IP address it was assigned, for example 192.168.1.100

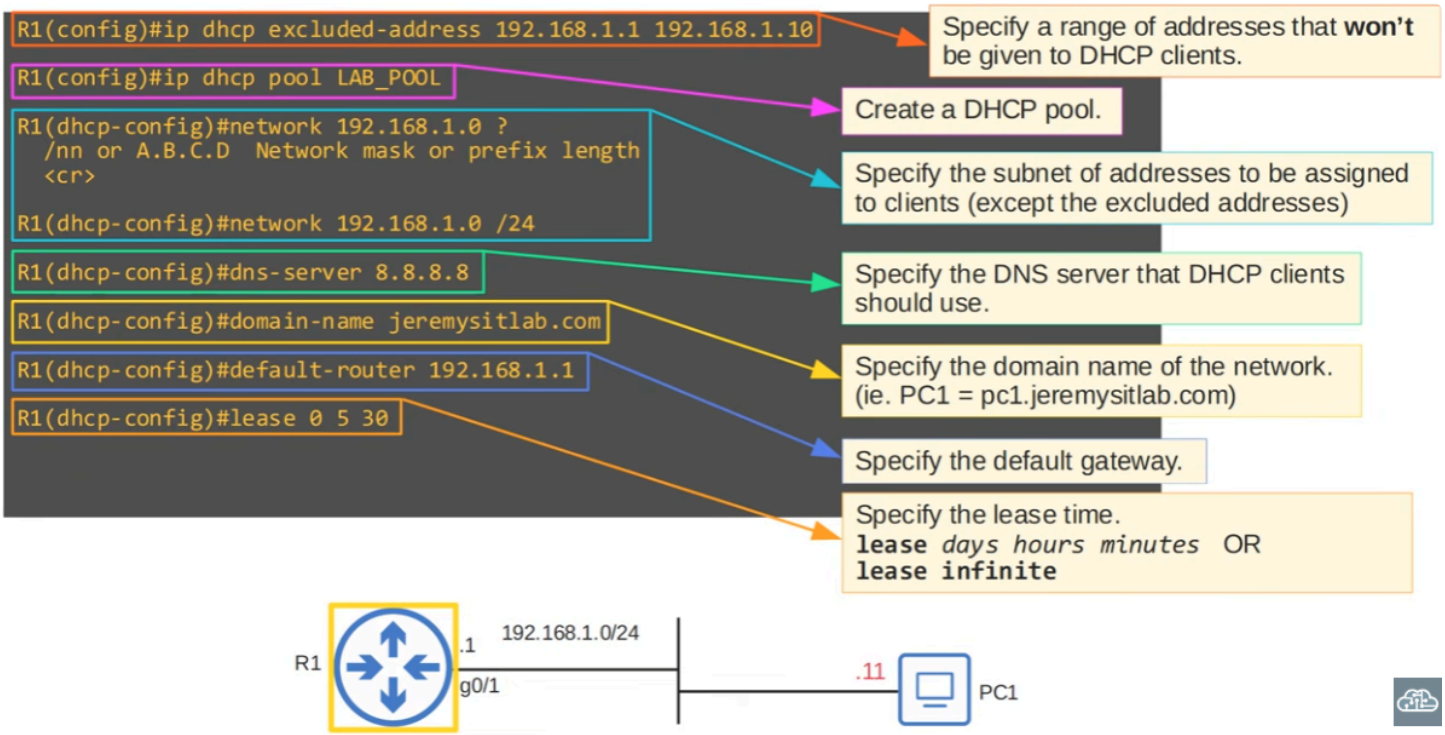
Summary of DHCP Relay Agents

- That's a quick overview of how DHCP relay agents work
- It's quite easy to configure a DHCP relay agent, you just need one command, and the professor will show how to do it

Upcoming Sections in This Lecture

- In the next section, the professor will show how to configure DHCP
- First: how to configure a Cisco router as a DHCP server
- Then: how to configure a Cisco router as a DHCP relay agent
- Finally: how to configure a Cisco router as a DHCP client

Configuring a Cisco Router as a DHCP Server



- The professor shows how to configure a Cisco router to function as a DHCP server
- He uses two devices for this example: R1 and PC1

IP DHCP EXCLUDED-ADDRESS Command

- The `IP DHCP EXCLUDED-ADDRESS` command is used to specify a range of addresses that will NOT be given to DHCP clients
- These are addresses you want to reserve, perhaps for network devices or servers in the local subnet
- The first address in the command is the low end of the range, and the second is the top of the range
- In this example, the command reserves all addresses from 192.168.1.1 through 192.168.1.10

```
R1(config)# ip dhcp excluded-address 192.168.1.1 192.168.1.10
```

Note: This command isn't necessary, but it's a good idea to reserve some addresses which can be statically assigned to servers, network devices, or whatever.

IP DHCP POOL Command

- The `IP DHCP POOL` command is used to create a DHCP pool
- What is a DHCP pool?
  - It's basically a subnet of addresses that can be assigned to DHCP clients
  - It also includes other info such as DNS server and default gateway
- You should create a separate DHCP pool for each network the router is acting as a DHCP server for
- In this case, R1 is only acting as the DHCP server for 192.168.1.0/24, so only one pool is needed

```
R1(config)# ip dhcp pool JEREMYSITLAB
```

NETWORK Command

- The `NETWORK` command is where you actually configure the range of addresses to be assigned to clients
- The command is followed by the network address and then either the network mask or prefix length
- You can write /24 or 255.255.255.0, either works
- In this example, R1 is told to assign addresses from 192.168.1.0/24 to clients, although it won't assign the addresses reserved above

```
R1(dhcp-config)# network 192.168.1.0 255.255.255.0
```

DNS-SERVER Command

- The `DNS-SERVER` command configures the DNS server that clients in the network should use
- In this case, R1 would tell PC1 to use Google's DNS server at 8.8.8.8 for its DNS queries

```
R1(dhcp-config)# dns-server 8.8.8.8
```

DOMAIN-NAME Command

- The `DOMAIN-NAME` command configures the domain name of the network
- In this case, R1 will tell PC1 that it is part of the domain 'jeremysitlab.com'

```
R1(dhcp-config)# domain-name jeremysitlab.com
```

DEFAULT-ROUTER Command

- The `DEFAULT-ROUTER` command configures the default gateway
- R1 will tell clients to use its address, 192.168.1.1, as their default gateway

```
R1(dhcp-config)# default-router 192.168.1.1
```

LEASE Command

- The `LEASE` command configures the lease time
- In this example, `0 5 30` is specified, which is 0 days, 5 hours, and 30 minutes
- You can also enter `LEASE INFINITE`

```
R1(dhcp-config)# lease 0 5 30
```

Note: As the professor has said before, entering `LEASE INFINITE` is not recommended.

Example: PC1 Receives an IP Address

- When PC1 comes online and sends its DHCP Discover message, perhaps it will be assigned .11
- This is the first available address since .1 through .10 are reserved

---

Verifying the DHCP Server Configuration

```
R1#show ip dhcp binding
Bindings from all pools not associated with VRF:
IP address          Client-ID/              Lease expiration        Type
                    Hardware address/
                    User name
192.168.1.11        0100.0c29.e727.39       Jan 24 2021 10:52 AM    Automatic
```

```
C:\Users\user>ipconfig /all

Ethernet adapter Ethernet0:

   Connection-specific DNS Suffix  . : jeremysitlab.com
   Description . . . . . . . . . . . : Intel(R) PRO/1000 MT Network Connection #2
   Physical Address. . . . . . . . . : 00-0C-29-E7-27-39
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv4 Address. . . . . . . . . . . : 192.168.1.11(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Saturday, January 24, 2021 2:22:35 PM
   Lease Expires . . . . . . . . . . : Saturday, January 24, 2021 7:52:35 PM
   Default Gateway . . . . . . . . . : 192.168.1.1
   DHCP Server . . . . . . . . . . . : 192.168.1.1
   DNS Servers . . . . . . . . . . . : 8.8.8.8
   NetBIOS over Tcpip. . . . . . . . : Enabled
```

- The professor demonstrates a useful command on a Cisco router acting as a DHCP server

Verification:

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

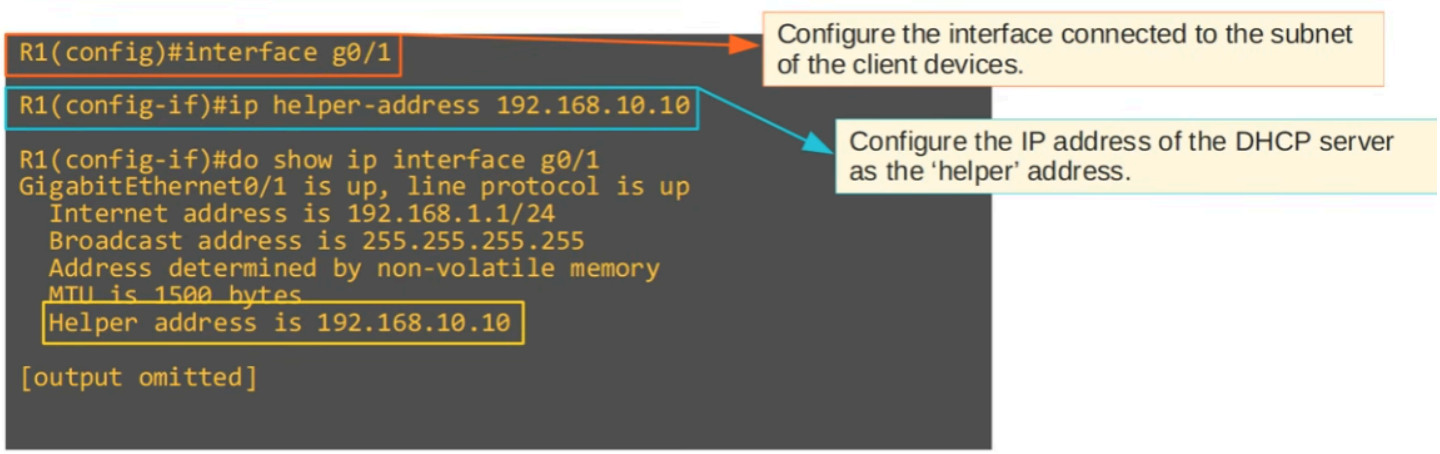
- This command shows all of the DHCP clients that are currently assigned IP addresses
- Here's PC1, with an IP address of 192.168.1.11
- Its MAC address is also displayed
- The lease expiration date and time are also displayed
- The binding type is also displayed
- DHCP bindings can be manually configured, but that was not done in this case

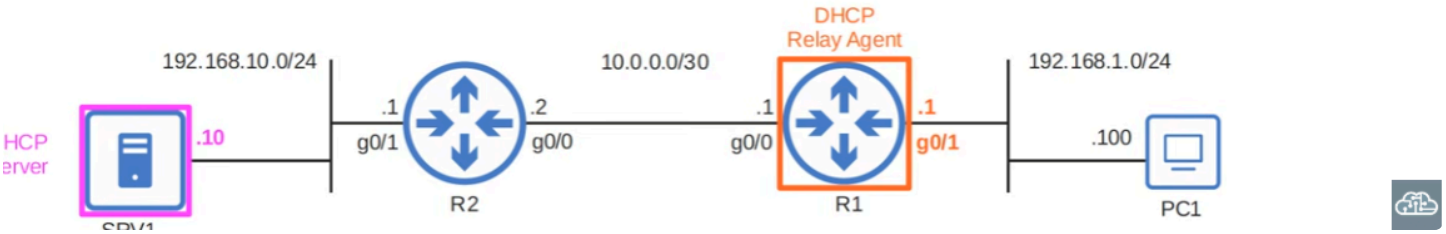
Checking PC1's Configuration

- The professor then checks on PC1
- Here's the domain name, jeremysitlab.com
- Here's the IP address and subnet mask it was assigned
- Here we can see when the lease was obtained and when it will expire
- Notice that the lease period is 5 hours and 30 minutes, as configured
- The lease expiration times on PC1 and R1 are different, but that's just because the professor didn't configure the time zone
- Finally, we can see the default gateway, DHCP server, and DNS server
- So, the professor successfully configured R1 as a DHCP server

---

Configuring a Cisco Router as a DHCP Relay Agent





- The professor explains how to configure DHCP relay agent configuration
- Here's that same network as before
- SRV1 is a DHCP server and R1 will be a DHCP relay agent after configuring it

Configuration Steps

- To configure it as a relay agent, first enter interface config mode for the interface connected to the client devices
- PC1 is connected to R1's g0/1, so we will configure that interface
- Then all you need is one command, `IP HELPER-ADDRESS`, followed by the IP address of the DHCP server

```
R1(config-if)# ip helper-address 192.168.10.10
```

Note: Make sure R1 actually has a route to the DHCP server. If it doesn't have a route, configure a static route or use a dynamic routing protocol like OSPF.

Verifying the DHCP Relay Agent Configuration

- After configuring that, the professor checked the interface

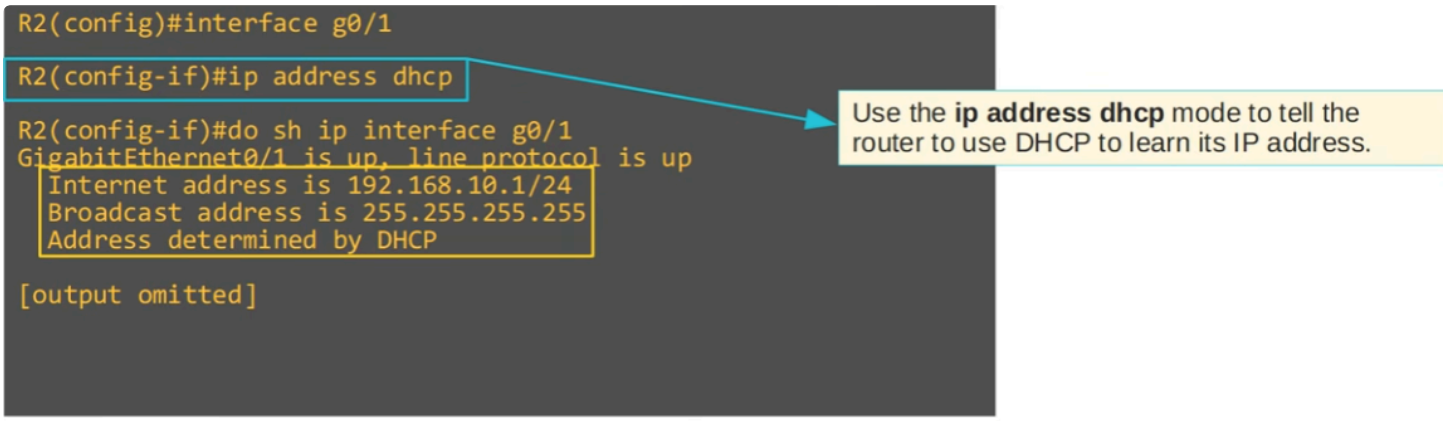
Verification:

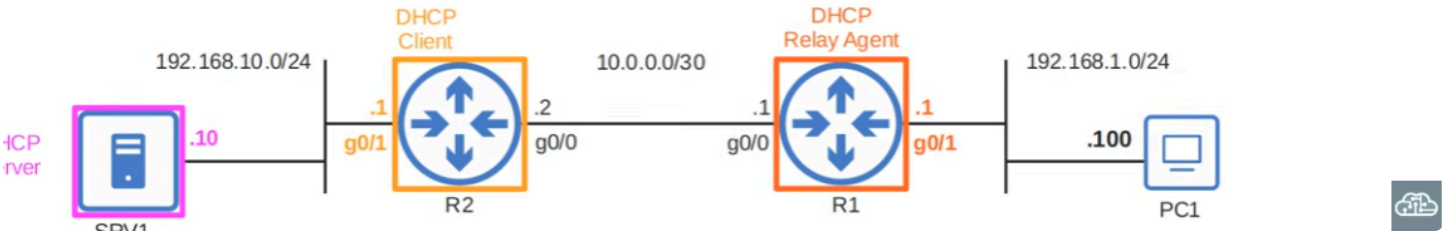
```
R1# show ip interface g0/1
```

- Notice that the 'helper address' is listed here, 192.168.10.10, which is SRV1
- And that's it, that's all you need to do to configure a router as a DHCP relay agent: `IP HELPER-ADDRESS`, then the DHCP server address

---

Configuring a Cisco Router as a DHCP Client





- The professor explains this is one last thing you need to be able to configure for the CCNA

- A Cisco router can be a DHCP client, meaning it can use DHCP to configure the IP address of its interfaces
- This is rare, as mentioned earlier; usually network devices will be configured with a fixed IP address
- However, here's how you can do it
- The professor makes R2 a DHCP client on its G0/1 interface
- From interface config mode for G0/1, use the command `IP ADDRESS DHCP`

```
R2(config-if)# ip address dhcp
```

- That's it, now R2 will broadcast a DHCP Discover message and get an IP address from SRV1

Verifying the DHCP Client Configuration

- Indeed it did, the professor checked with `SHOW IP INTERFACE G0/1`

Verification:

```
R2# show ip interface g0/1
```

- It states clearly, 'address determined by DHCP'
- Note that its G0/0 interface is still manually configured, it is not a DHCP client

---

Summary of Commands Covered

- The professor provides a summary of the commands covered in this video
- There are a couple of commands for the Windows command prompt

- There are Cisco IOS commands to configure:
  - A DHCP server
  - A DHCP relay agent
  - A DHCP client
- If you don't remember any of these commands, go back in the video to review
- You can also get practice with some of these commands in today's practice lab, which will be in the next video

CCNA Quick Reference

Command	Purpose
`ipconfig /release`	Releases the current DHCP IP address (Windows).
`ipconfig /renew`	Requests a new DHCP IP address (Windows).
`ip dhcp excluded-address`	Reserves IP addresses so DHCP won't assign them.
`ip dhcp pool`	Creates a DHCP pool.
`network`	Defines the DHCP network and subnet mask.
`dns-server`	Specifies the DNS server for clients.
`domain-name`	Assigns a domain name to clients.
`default-router`	Specifies the default gateway for clients.
`lease`	Sets the DHCP lease duration.
`show ip dhcp binding`	Displays active DHCP leases.
`ip helper-address`	Relays DHCP requests to a remote DHCP server.
`ip address dhcp`	Configures an interface as a DHCP client.

Lecture Review

- Before moving on to the quiz, the professor reviews what was covered in the video

- First, he introduced the purpose of DHCP
    - It allows devices to automatically learn various configuration parameters, such as their IP address, subnet mask, default gateway, etc.
- He introduced the basic functions of DHCP
    - Make sure you remember DORA: Discover, Offer, Request, and Ack
- You should also know the basic purpose and functions of a DHCP relay agent
- Finally, he showed how to configure DHCP in Cisco IOS
    - First: how to configure a Cisco router as a DHCP server
    - Then: a DHCP relay agent
    - Finally: a DHCP client
- Make sure to watch until the end of the quiz for a bonus question from Boson Software's ExSim for CCNA, the best practice exams for the CCNA