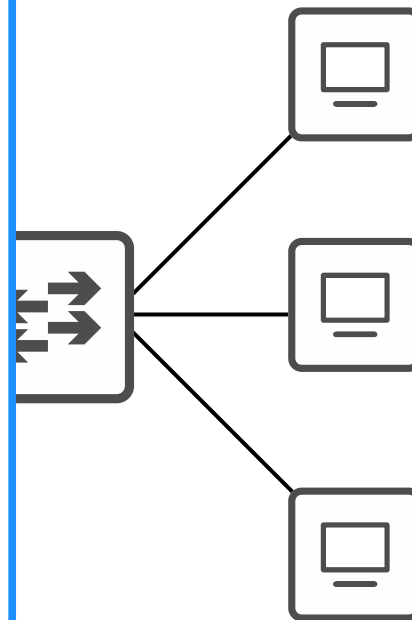


CCNA Day 39

Dynamic Host Configuration Protocol



1.0 Network Fundamentals	20%	▼
2.0 Network Access	20%	▼
3.0 IP Connectivity	25%	▼
4.0 IP Services	10%	▲
4.1 Configure and verify inside source NAT using static and pools		
4.2 Configure and verify NTP operating in a client and server mode		
4.3 Explain the role of DHCP and DNS within the network		
4.4 Explain the function of SNMP in network operations		
4.5 Describe the use of syslog features including facilities and levels		
4.6 Configure and verify DHCP client and relay		
4.7 Explain the forwarding per-hop behavior (PHB) for QoS such as classification, marking, queuing, congestion, policing, shaping		
4.8 Configure network devices for remote access using SSH		
4.9 Describe the capabilities and function of TFTP/FTP in the network		
5.0 Security Fundamentals	15%	▼
6.0 Automation and Programmability	10%	▼



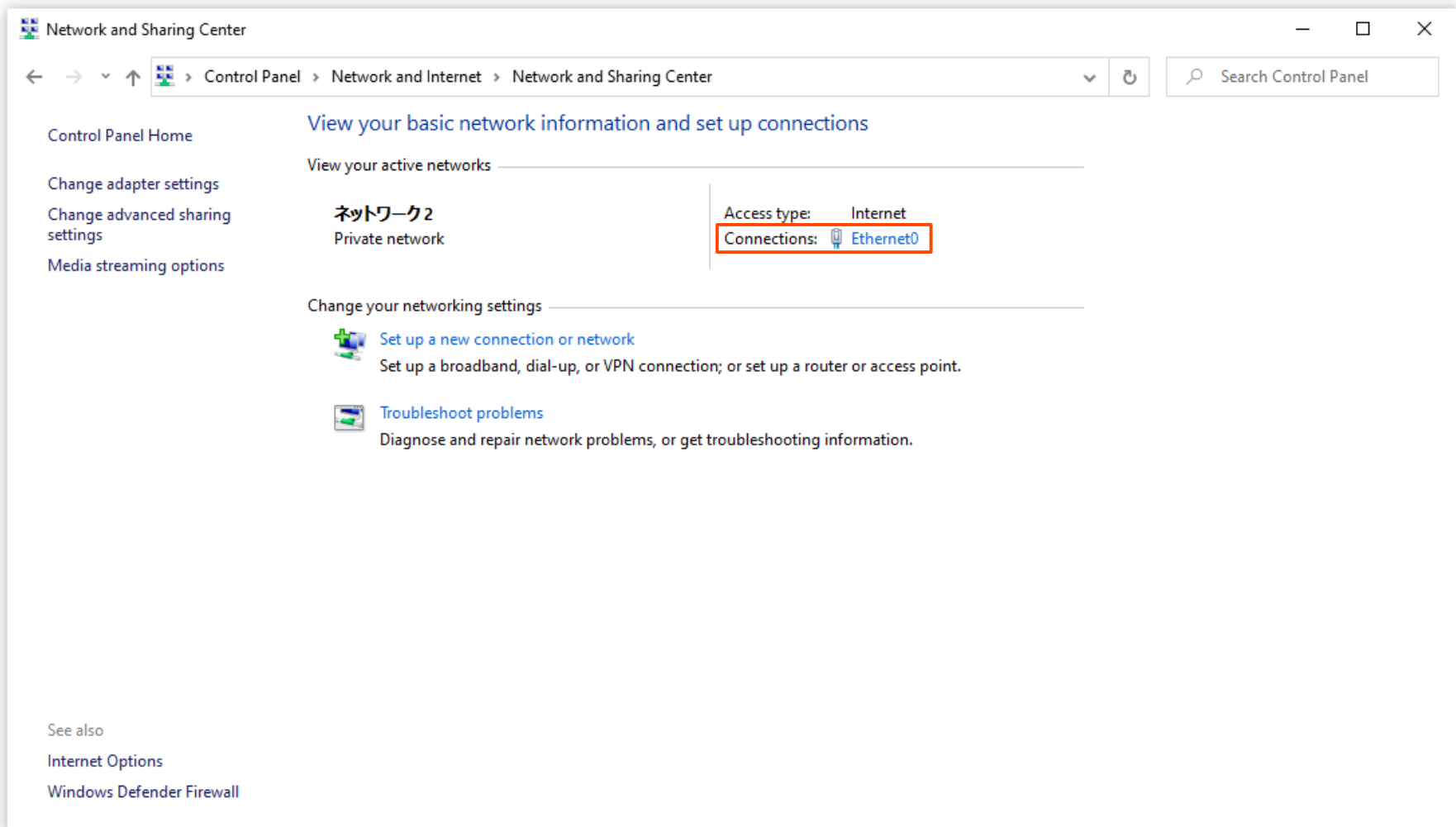
Things we'll cover

- The purpose of DHCP
- Basic functions of DHCP
- Configuring DHCP in Cisco IOS

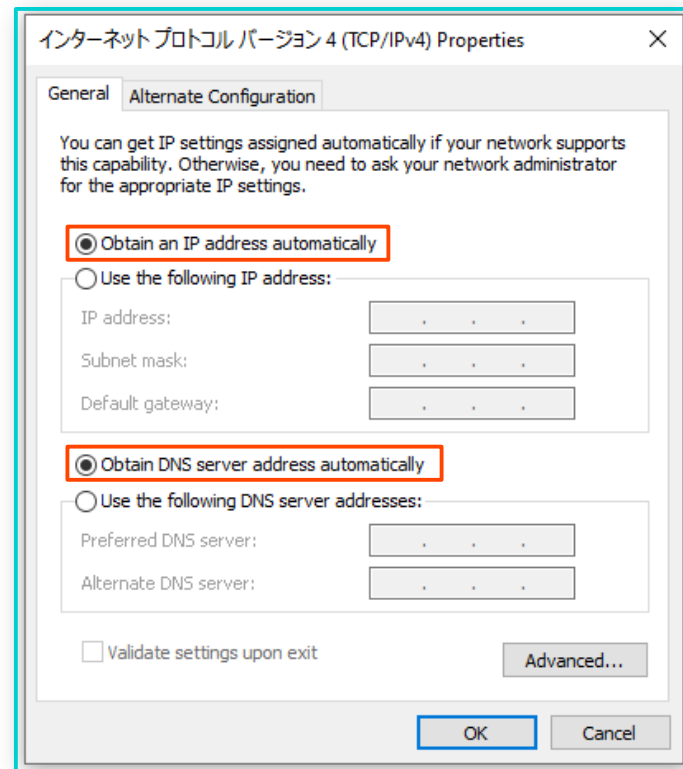
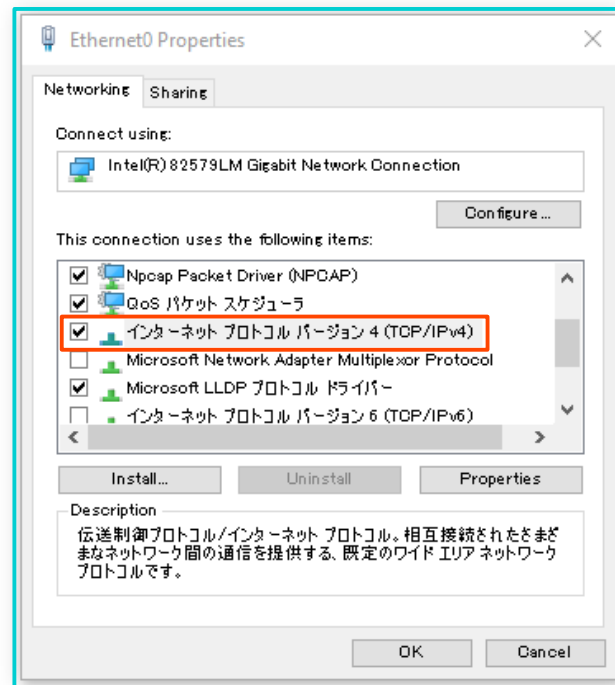
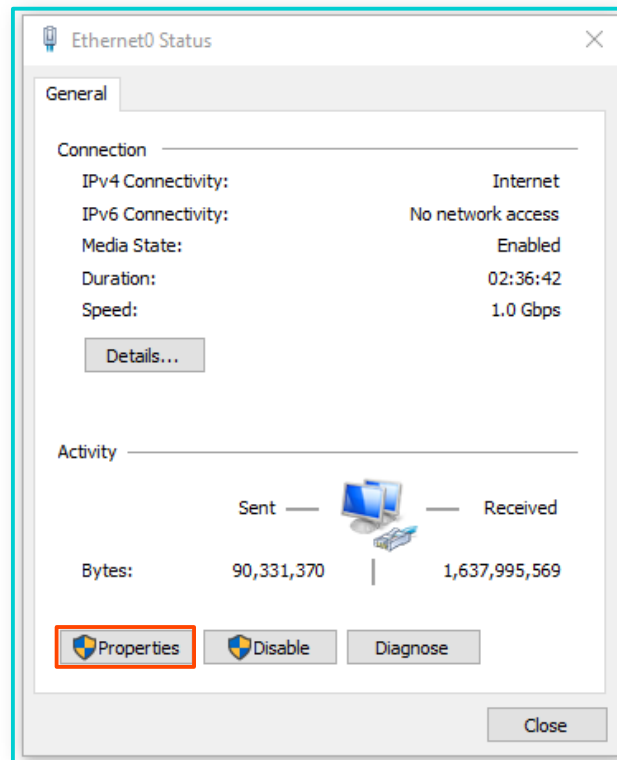
The Purpose of DHCP

- DHCP is used to allow hosts to automatically/dynamically learn various aspects of their network configuration, such as IP address, subnet mask, default gateway, DNS server, etc, without manual/static configuration.
- It is an essential part of modern networks.
 - When you connect a phone/laptop to WiFi, do you ask the network admin which IP address, subnet mask, default gateway, etc, the phone/laptop should use?
- Typically used for 'client devices' such as workstations (PCs), phones, etc.
- Devices such as routers, servers, etc, are usually manually configured.
- In small networks (such as home networks) the router typically acts as the DHCP server for hosts in the LAN.
- In larger networks, the DHCP server is usually a Windows/Linux server.

The Basic Functions of DHCP



The Basic Functions of DHCP



The Basic Functions of DHCP

```
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]
```

This PC was previously assigned this IP address by the DHCP server, so it asked to receive the same address again this time.

DHCP server 'lease' IP address to clients.
These leases are usually not permanent, and the client must give up the address at the end of the lease.

ipconfig /release

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

```
Windows IP Configuration
```

```
[output omitted]
```

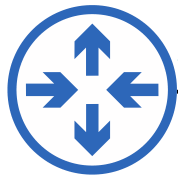
```
Ethernet adapter Ethernet0:
```

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

```
[output omitted]
```

192.168.0.167 is now free
to assign to another client.

DHCP Release:
I don't need this address
anymore.



.1

192.168.0.0/24

.167



DHCP Release

[illegible]

ipconfig /renew

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

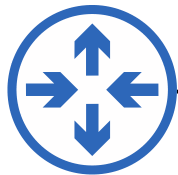
```
C:\Users\user>ipconfig /all
```

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 3:07:39 PM
Lease Expires . . . . . : Saturday, January 23, 2021 5:07:38 PM
Default Gateway . . . . . : 192.168.0.1
DHCP Server . . . . . : 192.168.0.1
DNS Servers . . . . . : 192.168.0.1
NetBIOS over Tcpip. . . . . : Enabled

```



.1

192.168.0.0/24

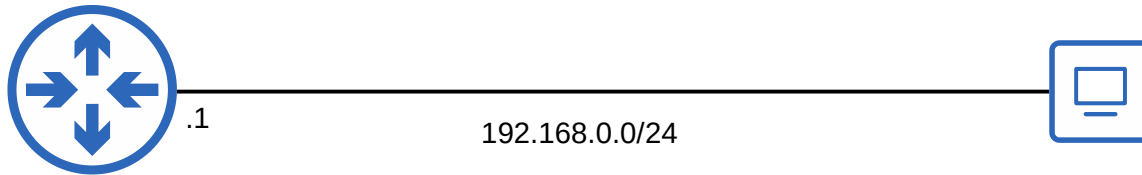
.167



DHCP Discover

DHCP Discover:

Are there any DHCP servers in this network?
I need an IP address.





No.	Time	Source	Destination	Protocol	Length	Info
261	13:27:34.561617	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0xd7a1c480

```

> Frame 261: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface \Device\NPF_{9956EC07-3774-4B11-970D-...}
> Ethernet II, Src: Dell_ac:08:67 (78:2b:cb:ac:08:67), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
> Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
> User Datagram Protocol, Src Port: 68, Dst Port: 67
< Dynamic Host Configuration Protocol (Discover)
  Message type: Boot Request (1)
  Hardware type: Ethernet (0x01)
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0xd7a1c480
  Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
  Client IP address: 0.0.0.0
  Your (client) IP address: 0.0.0.0
  Next server IP address: 0.0.0.0
  Relay agent IP address: 0.0.0.0
  Client MAC address: Dell_ac:08:67 (78:2b:cb:ac:08:67)
  Client hardware address padding: 00000000000000000000
  Server host name not given
  Boot file name not given
  Magic cookie: DHCP
  > Option: (53) DHCP Message Type (Discover)
  > Option: (61) Client identifier
  > Option: (50) Requested IP Address (192.168.0.167)
  > Option: (12) Host Name
  > Option: (60) Vendor class identifier
  > Option: (55) Parameter Request List
  > Option: (255) End
  Padding: 000000000000000000000000
  
```

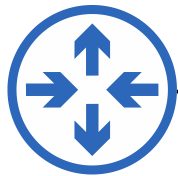
DHCP Offer

DHCP Discover:

Are there any DHCP servers in this network?
I need an IP address.

DHCP Offer:

How about this IP address?

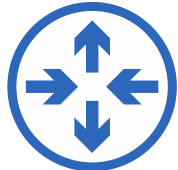


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192.168.0.0/24



DHCP Offer



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192.168.0.0/24



No.	Time	Source	Destination	Protocol	Length	Info
262	13:27:34.562795	192.168.0.1	192.168.0.167	DHCP	342	DHCP Offer - Transaction ID 0xd7a1c480

```

> Frame 262: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface \Device\NPF_{9956EC07-3774-4B11-9700-...}
> Ethernet II, Src: Tp-LinkT_dd:a8:e4 (98:da:c4:dd:a8:e4), Dst: Dell_ac:08:67 (78:2b:cb:ac:08:67)
> Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.167
> User Datagram Protocol, Src Port: 67, Dst Port: 68
  Dynamic Host Configuration Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0xd7a1c480
    Seconds elapsed: 0
    > Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.0.167
    Next server IP address: 192.168.0.1
    Relay agent IP address: 0.0.0.0
    Client MAC address: Dell_ac:08:67 (78:2b:cb:ac:08:67)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    > Option: (53) DHCP Message Type (Offer)
    > Option: (54) DHCP Server Identifier (192.168.0.1)
    > Option: (51) IP Address Lease Time
    > Option: (58) Renewal Time Value
    > Option: (59) Rebinding Time Value
    > Option: (1) Subnet Mask (255.255.255.0)
    > Option: (28) Broadcast Address (192.168.0.255)
    > Option: (6) Domain Name Server
    > Option: (3) Router
    > Option: (255) End
    Padding: 0000000000000000
  
```

The DHCP Offer message can be either **broadcast** or **unicast**.

DHCP Request

DHCP Discover:

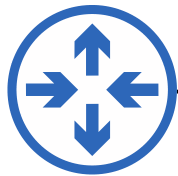
Are there any DHCP servers in this network?
I need an IP address.

DHCP Offer:

How about this IP address?

DHCP Request:

I want to use the IP address you
offered me.

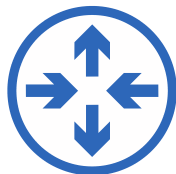


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192.168.0.0/24



DHCP Request



1

192.168.0.0/24



No.	Time	Source	Destination	Protocol	Length	Info
263	13:27:34.563458	0.0.0.0	255.255.255.255	DHCP	344	DHCP Request - Transaction ID 0xd7a1c480
<p>> Frame 263: 344 bytes on wire (2752 bits), 344 bytes captured (2752 bits) on interface \Device\NPF_{9956EC07-3774-4B11-970D-...}</p> <p>> Ethernet II, Src: Dell ac:08:67 (78:2b:cb:ac:08:67), Dst: Broadcast (ff:ff:ff:ff:ff:ff)</p> <p>> Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255</p> <p>> User Datagram Protocol, Src Port: 68, Dst Port: 67</p> <p>> Dynamic Host Configuration Protocol (Request)</p> <p>Message type: Boot Request (1)</p> <p>Hardware type: Ethernet (0x01)</p> <p>Hardware address length: 6</p> <p>Hops: 0</p> <p>Transaction ID: 0xd7a1c480</p> <p>Seconds elapsed: 0</p> <p>> Bootp flags: 0x0000 (Unicast)</p> <p>Client IP address: 0.0.0.0</p> <p>Your (client) IP address: 0.0.0.0</p> <p>Next server IP address: 0.0.0.0</p> <p>Relay agent IP address: 0.0.0.0</p> <p>Client MAC address: Dell_ac:08:67 (78:2b:cb:ac:08:67)</p> <p>Client hardware address padding: 00000000000000000000</p> <p>Server host name not given</p> <p>Boot file name not given</p> <p>Magic cookie: DHCP</p> <p>> Option: (53) DHCP Message Type (Request)</p> <p>> Option: (61) Client identifier</p> <p>> Option: (50) Requested IP Address (192.168.0.167)</p> <p>> Option: (54) DHCP Server Identifier (192.168.0.1)</p> <p>> Option: (12) Host Name</p> <p>> Option: (81) Client Fully Qualified Domain Name</p> <p>> Option: (60) Vendor class identifier</p> <p>> Option: (55) Parameter Request List</p> <p>> Option: (255) End</p>						

DHCP Ack

DHCP Discover:

Are there any DHCP servers in this network?
I need an IP address.

DHCP Offer:

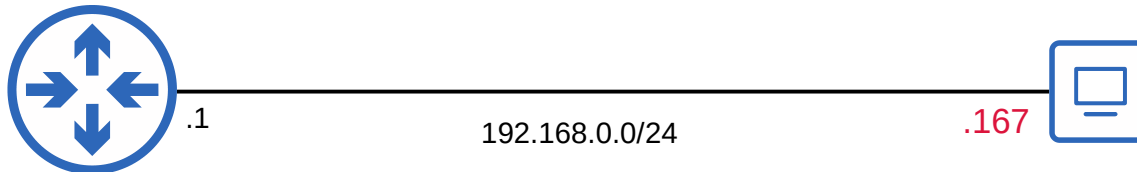
How about this IP address?

DHCP Request:

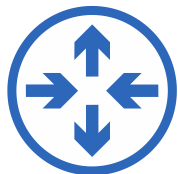
I want to use the IP address you
offered me.

DHCP Ack:

Okay, you may use it.



DHCP Ack



.1

192.168.0.0/24



No.	Time	Source	Destination	Protocol	Length	Info
264	13:27:34.564862	192.168.0.1	192.168.0.167	DHCP	342	DHCP ACK - Transaction ID 0xd7a1c480

```

> Frame 264: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits) on interface \Device\NPF_{9956EC07-3774-4B11-970
> Ethernet II, Src: Tp-LinkT_dd:a8:e4 (98:da:c4:dd:a8:e4), Dst: Dell_ac:08:67 (78:2b:cb:ac:08:67)
> Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.167
> User Datagram Protocol, Src Port: 67, Dst Port: 68
✓ Dynamic Host Configuration Protocol (ACK)
  Message type: Boot Reply (2)
  Hardware type: Ethernet (0x01)
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0xd7a1c480
  Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.0.167
    Next server IP address: 192.168.0.1
    Relay agent IP address: 0.0.0.0
    Client MAC address: Dell_ac:08:67 (78:2b:cb:ac:08:67)
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
  > Option: (53) DHCP Message Type (ACK)
  > Option: (54) DHCP Server Identifier (192.168.0.1)
  > Option: (51) IP Address Lease Time
  > Option: (58) Renewal Time Value
  > Option: (59) Rebinding Time Value
  > Option: (1) Subnet Mask (255.255.255.0)
  > Option: (28) Broadcast Address (192.168.0.255)
  > Option: (6) Domain Name Server
  > Option: (81) Client Fully Qualified Domain Name
  > Option: (3) Router
  > Option: (255) End
  Padding: 00
  
```

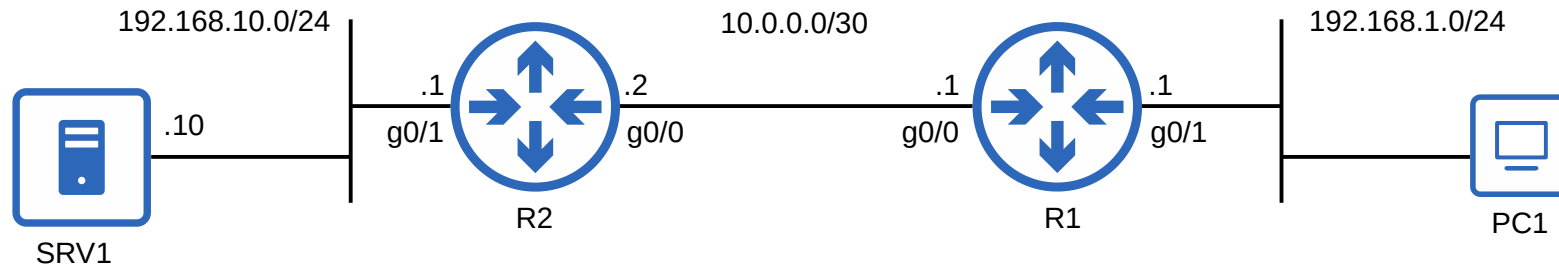
The DHCP Ack message can be either **broadcast** or **unicast**.

DHCP D-O-R-A

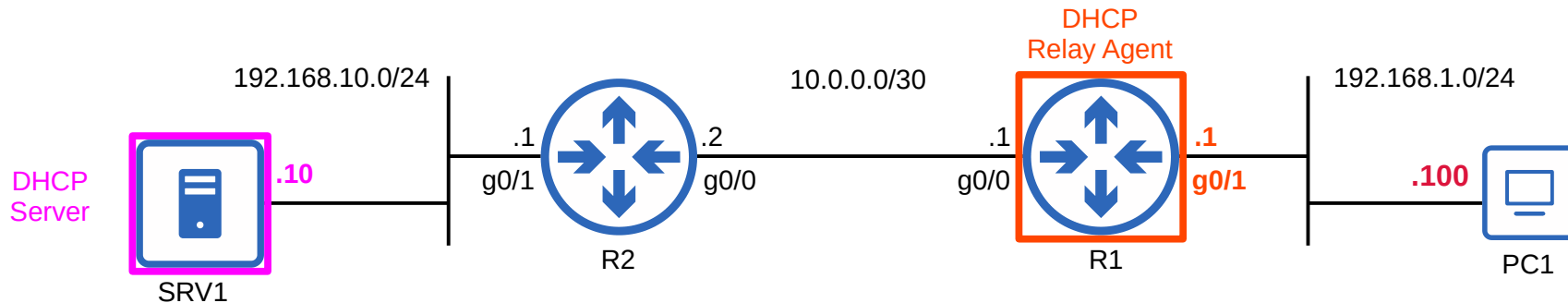
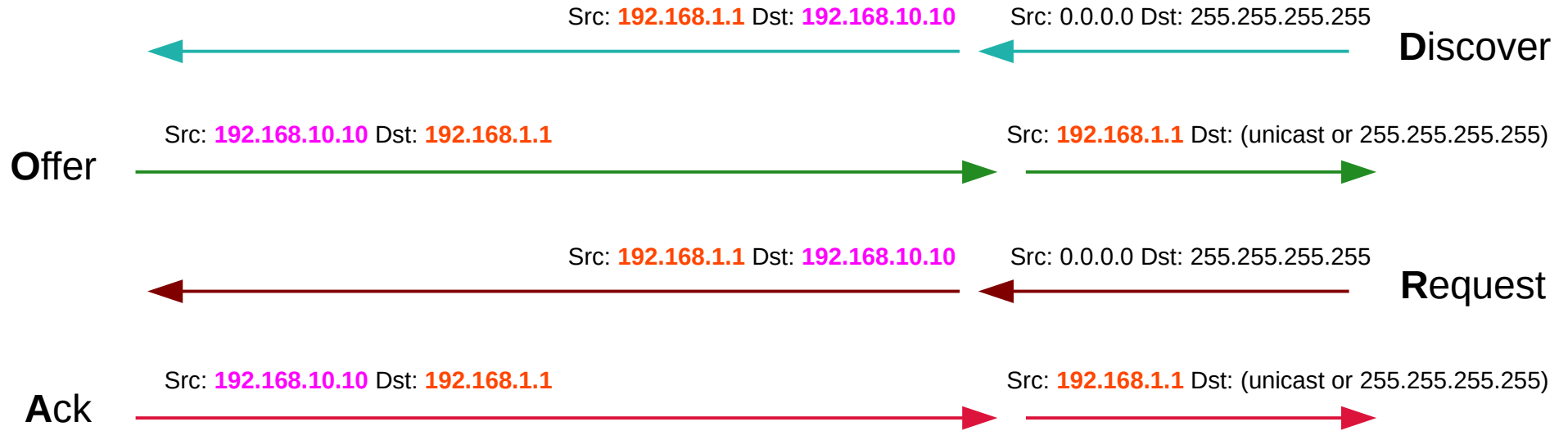
Discover	Client → Server	Broadcast
Offer	Server → Client	Broadcast or Unicast
Request	Client → Server	Broadcast
Ack	Server → Client	Broadcast or Unicast
Release	Client → Server	Unicast

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.
- If the server is centralized, it won't receive the DHCP clients' broadcast DHCP messages. (broadcast messages don't leave the local subnet)
- 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.



DHCP Relay



DHCP Server Configuration in IOS

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

Specify a range of addresses that **won't** be given to DHCP clients.

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

Create a DHCP pool.

```
R1(dhcp-config)#network 192.168.1.0 ?  
/nn or A.B.C.D Network mask or prefix length  
<cr>
```

Specify the subnet of addresses to be assigned to clients (except the excluded addresses)

```
R1(dhcp-config)#network 192.168.1.0 /24
```

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

Specify the DNS server that DHCP clients should use.

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

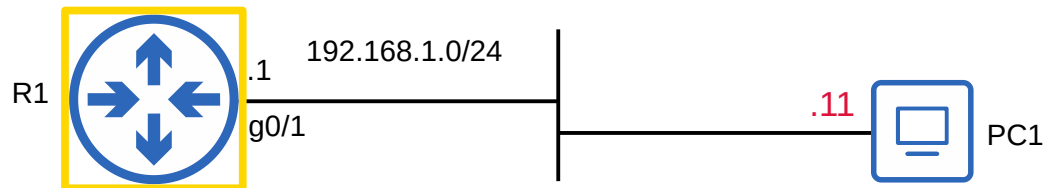
Specify the domain name of the network.
(ie. PC1 = pc1.jeremysitlab.com)

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

Specify the default gateway.

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

Specify the lease time.
lease *days hours minutes* OR
lease infinite



DHCP Server Configuration in IOS

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

Bindings from all pools not associated with VRF:

IP address	Client-ID/ Hardware address/ User name	Lease expiration	Type
192.168.1.11	0100.0c29.e727.39	Jan 24 2021 10:52 AM	Automatic

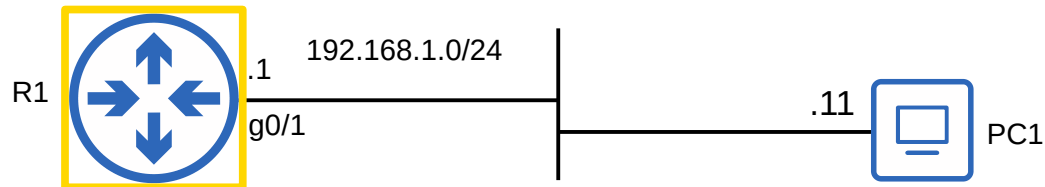
```
C:\Users\user>ipconfig /all
```

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

```



DHCP Relay Agent Configuration in IOS

```
R1(config)#interface g0/1
```

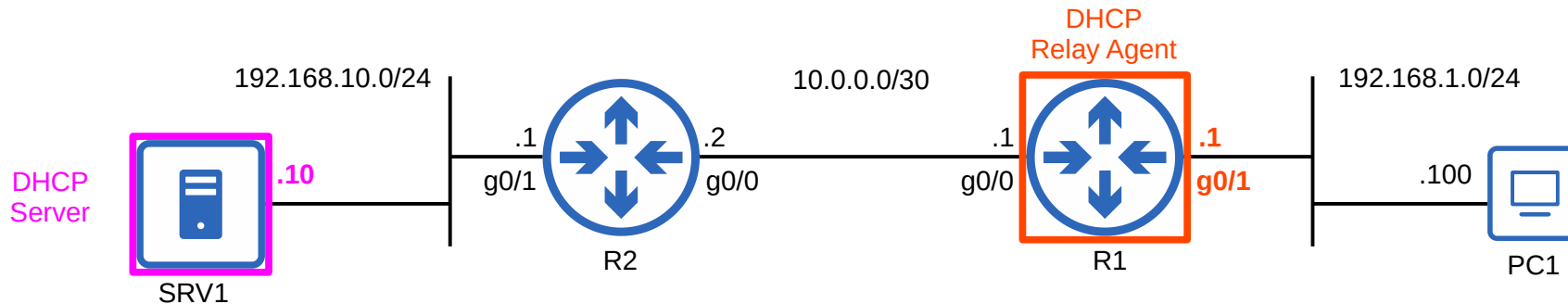
Configure the interface connected to the subnet of the client devices.

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

Configure the IP address of the DHCP server as the 'helper' address.

```
R1(config-if)#do show ip interface g0/1
GigabitEthernet0/1 is up, line protocol is up
Internet address is 192.168.1.1/24
Broadcast address is 255.255.255.255
Address determined by non-volatile memory
MTU is 1500 bytes
Helper address is 192.168.10.10
```

[output omitted]



DHCP Client Configuration in IOS

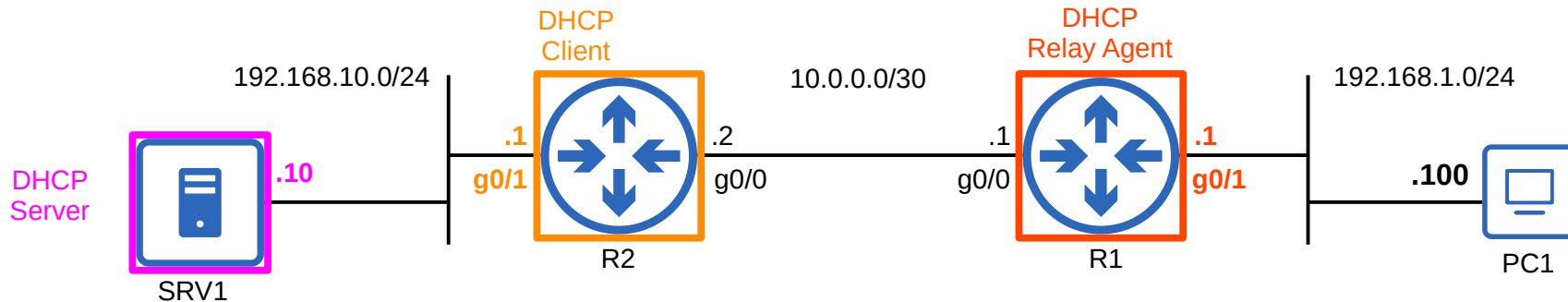
```
R2(config)#interface g0/1
```

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

```
R2(config-if)#do sh ip interface g0/1
GigabitEthernet0/1 is up, line protocol is up
Internet address is 192.168.10.1/24
Broadcast address is 255.255.255.255
Address determined by DHCP
```

[output omitted]

Use the **ip address dhcp** mode to tell the router to use DHCP to learn its IP address.



Command Summary

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

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

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

```
R1(config)# ip dhcp pool pool-name
```

```
R1(dhcp-config)# network ip-address {/prefix-length | subnet-mask}
```

```
R1(dhcp-config)# dns-server ip-address
```

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

```
R1(dhcp-config)# default-router ip-address
```

```
R1(dhcp-config)# lease {days hours minutes | infinite}
```

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

DHCP server

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

DHCP relay agent

```
R1(config-if)# ip address dhcp
```

DHCP client

Things we covered

- The purpose of DHCP
- Basic functions of DHCP
- Configuring DHCP in Cisco IOS

What is the correct order of messages when a DHCP client gets an IP address from a server?

- a) Request – Discover – Offer – Ack
- b) Discover – Offer – Request – Ack
- c) Discover – Ack – Request – Offer
- d) Offer – Request – Discover - Ack

Which of the following Windows command prompt commands will cause a PC to broadcast a DHCP Discover message?

- a) `ipconfig /dhcp`
- b) `ipconfig /dhcpdiscover`
- c) `ipconfig /release`
- d) `ipconfig /renew`

Examine the following DHCP Offer message that SRV1 sent to R2. What destination IP address did SRV1 send it to?

- a) 0.0.0.0
- b) 192.168.10.1
- c) 192.168.10.10
- d) 255.255.255.255

[illegible]

Which of the following DHCP messages can be sent using unicast?
(select all that apply)

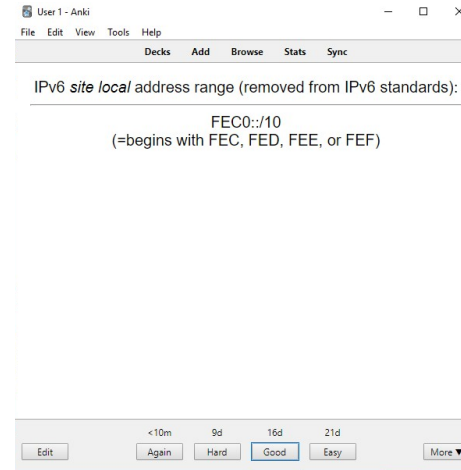
- a) DHCP Ack
- b) DHCP Discover
- c) DHCP Release
- d) DHCP Request
- e) DHCP Offer

In which of the following situations would you configure a router as a DHCP relay agent?

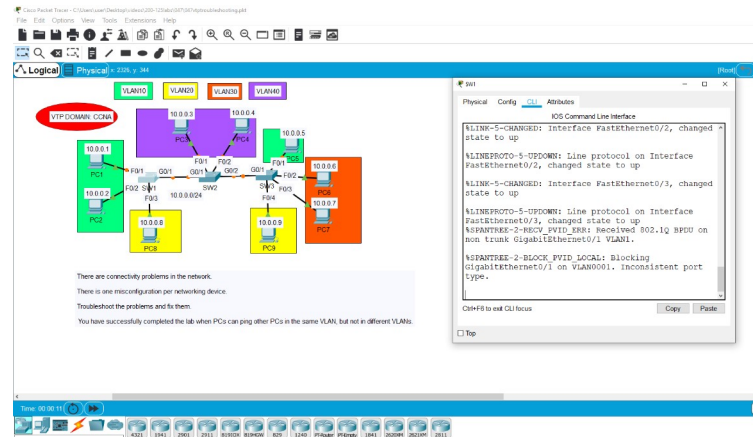
- a) When the router is not a DHCP server, there are DHCP clients in the router's connected LAN, and there is no other DHCP server in the connected LAN.
- b) When the router is a DHCP server, there are DHCP clients in the router's connected LAN, and there is no other DHCP server in the connected LAN.
- c) When the router is not a DHCP server, there are no DHCP clients in the router's connected LAN, and there is no other DHCP server in the connected LAN.
- d) When the router is a DHCP server, there are DHCP clients in the router's connected LAN, and there is another DHCP server in the connected LAN.

Supplementary Materials





































- Review flash cards
(link in the description)



- Packet Tracer lab



JCNP-Level Channel Members

 Brandon Byers	 Gustavo BR	 Nasir Chowdhury	 funnydart
 Samil Cañas	 Anthony Saab	 Erlison Santos	 velvijaykum
 Aaron Kagan	 Biraj Banker	 Apogee AOR	Channel failed to load
 tech alameda	 Junhong Park	 Marko Barbaric	 Mark von kanel
 Marcel Lord	 njabulo Shezi	 Daming Li	 M Yousif
 Magrathea	 Benjamin Robbins	 jhilmar molina	 Boson Software
 kone fine	 Tshepiso Mokoena	 Ed Velez	 Devin Sukhu
 Donald Sabusap	 justin watke	 #VALUE?	 Lito Castillejo
 C Mohd	 Prakaash Rajan	 john goff	 Yonatan Makara
			 Vance Simmons

*as of January 24th, 2021

