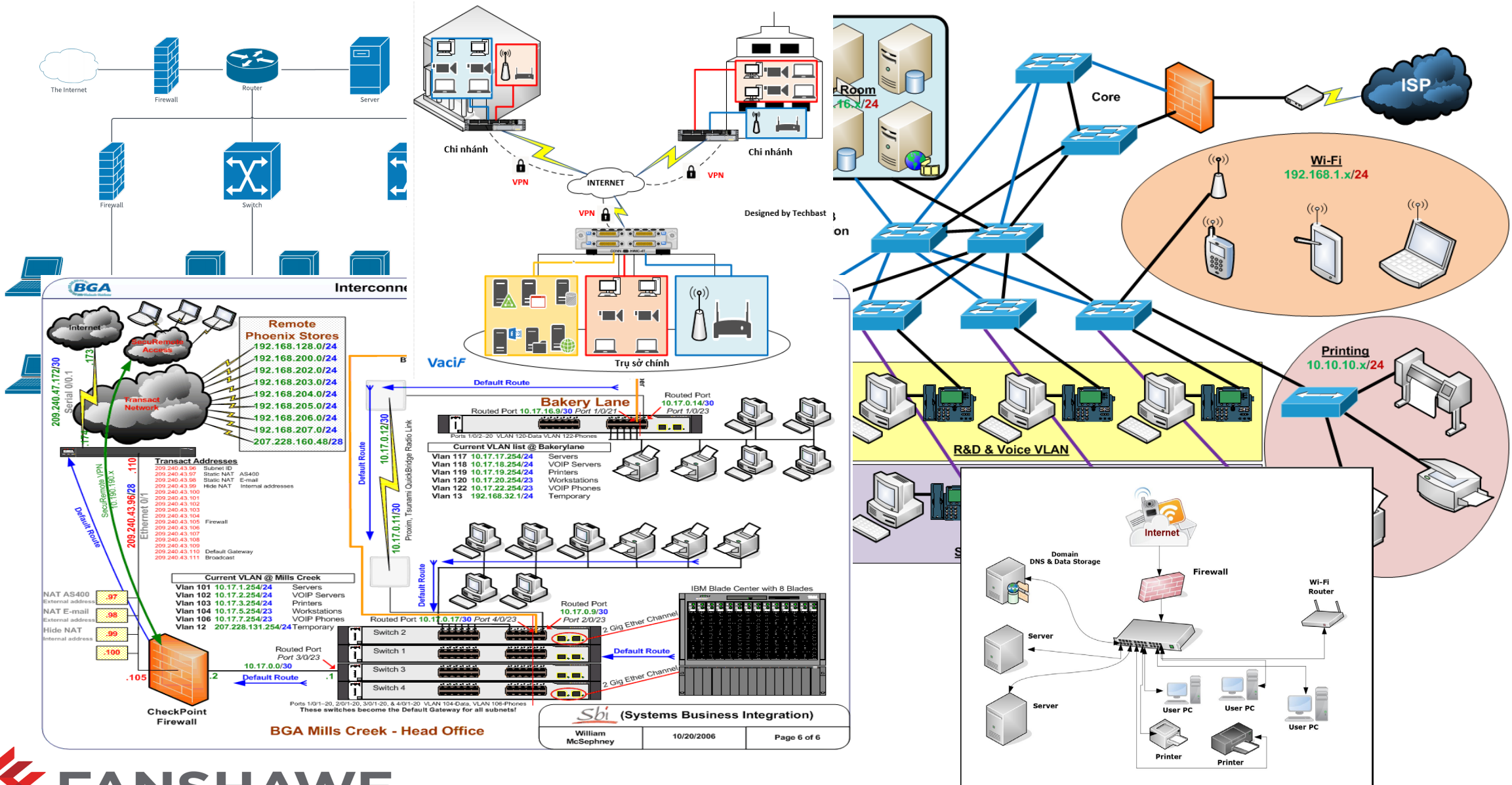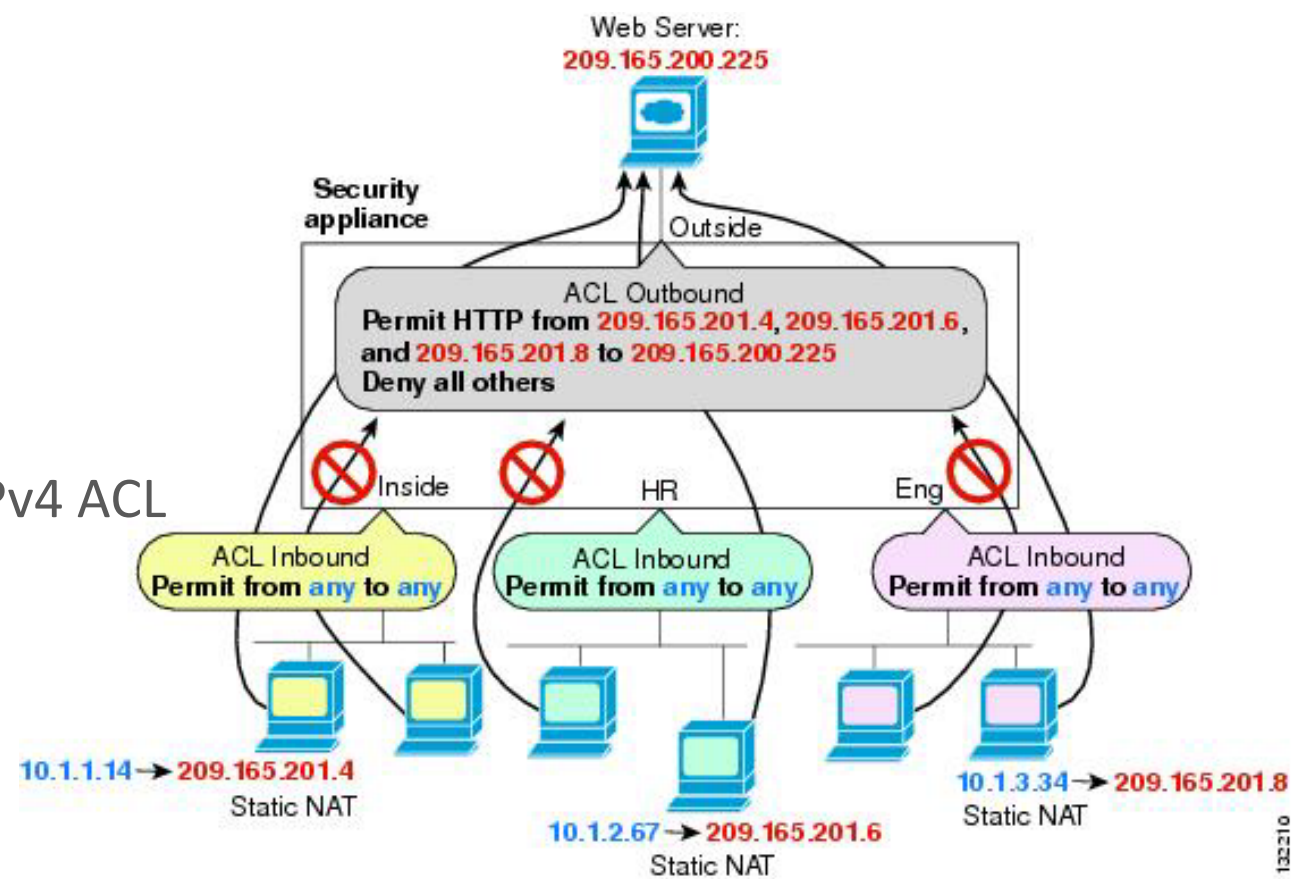# DHCP

INFO-6047 Switching and Routing

ISM1 - Information Security Management (ISM1-ITY-20189)   **Detailed Weekly Content**

Week	Date of Lecture or Tests, 7:00 – 9:00 PM EST	Lecture/Test	Reading	Lab Time INFO-6047-01 Wednesday 5:00 – 8:00 PM EST INFO-6047-02 Tuesday 5:00 – 8:00 PM EST	Grade
Week 01	Monday, January 02, 2023	College-Wide Orientation			
Week 02	Monday, January 09, 2023	Introduction	N/A	Lab 01 - Basics of PT	3.0%
Week 03	Monday, January 16, 2023	Basics of Routing	Chapter 01 & 02 *(Introduction to Networking, Network Media Copper)*	Lab 02 - Intro to Routing	3.0%
Week 04	Monday, January 23, 2023	Basics of Switching	Chapter 03 & 04 *(Network Media Fiber Network Media Wireless)*	Lab 03 - Intro to Switching	3.0%
Week 05	Monday, January 30, 2023	VLANs	Chapter 05 *(Data Encoding & Transmission)*	Lab 04 - VLANs	3.0%
Week 06	Monday, February 06, 2023	Routing	Chapter 06 *(Network OS & Communications)*	Lab 05 - Routing	3.0%
Week 07	Monday, February 13, 2023	Mid-Term Test		Mid-Term (Test 1)	32.0%
Study Break	Monday, February 20, 2023	Study Break - No Class This Week			
Week 08	Monday, February 27, 2023	Inter-VLAN Routing	Chapter 10 *(TCP/IP Fundamentals)*	Lab 06 - Inter VLAN Routing	3.0%
Week 09	Monday, March 06, 2023	Static Routing	Chapter 11 *(Subnetting)*	Lab 07 - Static & Default Routs	3.0%
Week 10	Monday, March 13, 2023	Dynamic Routing - RIP	Chapter 12 *(Additional Transmission Modalities)*	Lab 08 - RIP Protocol	3.0%
Week 11	Monday, March 20, 2023	Dynamic Routing - OSPF	Chapter 14 *(RA & LD Communications)*	Lab 09 - OSPF Protocol	3.0%
Week 12	Monday, March 27, 2023	Access Control Lists	Chapter 15 *(Network Security)*	Lab 10 - ACLs	3.0%
Week 13	Monday, April 03, 2023	DHCP	Chapter 16 *Maintaining the Network)*	Lab 11 - DHCP	3.0%
Week 14	Monday, April 10, 2023	NAT	Chapter 17 *(Troubleshooting Fundamentals of a Network)*	Lab 12 - NAT	3.0%
Week 15	Monday, April 17, 2023	Final Test		Final Test (Test 2)	32%

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Final Exam

- Section 1 and 2
- When: Monday April 17th at 7:00 PM
- Where: B1071
- How: Open book (120 minutes for 120 points)
  - Allowed resources: Lecture slides, labs, and textbook
  - Not allowed: Phones, Google, and instant messaging.
- Note: Bring your laptop charger as you will be asked to keep your screen brightness up and to avoid having your laptop battery dying.

- Online and part-time
- When: Tuesday April 18th 12:00 AM to 11:59 PM (24 hours to begin exam)
- Where: Online (120 minutes for 120 points)
- How: Open book
  - Allowed resources: Lecture slides, labs, and textbook
  - Not allowed: Phones, Google, and instant messaging.

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Review - Lecture 10 – ACLs

- Purpose of ACLs
- Standard versus Extended IPv4 ACLs
- Wildcard Masks in ACLs
- Guidelines for ACL creation
- Guidelines for ACL Placement
- Configure Standard IPv4 ACLs
- Modify IPv4 ACLs
- Securing VTY ports with a Standard IPv4 ACL
- Configure Extended IPv4 ACLs
- Processing Packets with ACLs
- Common ACLs Errors
- IPv6 ACL Creation
- Configuring IPv6 ACLs
- Summary

Summary - DHCP

- ## DHCPv4 Operation
  - Introducing DHCPv4
  - DHCPv4 Message Format
  - DHCP – Options
  - Verifying a DHCPv4 Server
  - DHCPv4 Relay

- ## Configuring a DHCPv4 Client

- ## SLAAC and DHCPv6
  - Dynamic Interface ID
  - DHCPv6 Relay Agent

- ## Lab

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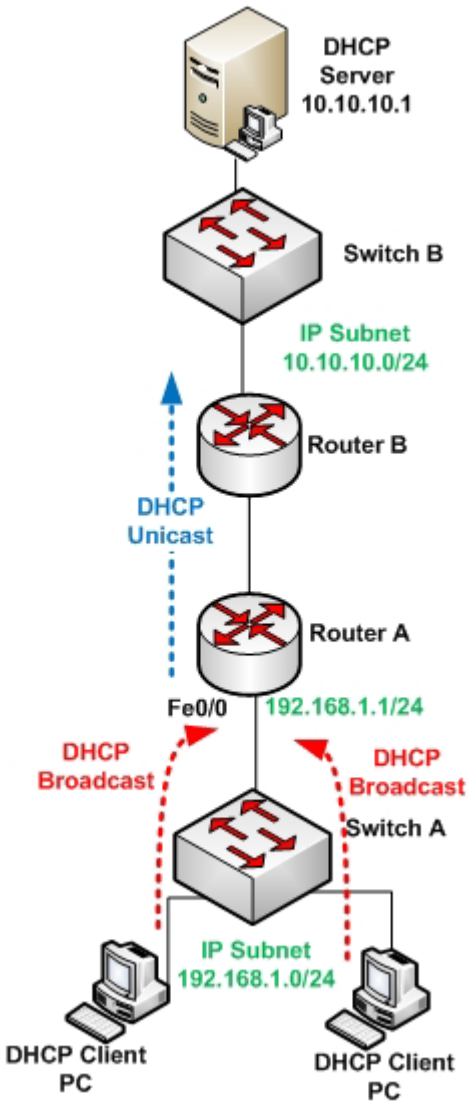
DHCPv4 Operation

- ## Introducing DHCPv4
  - ### DHCPv4 uses three different address allocation methods:
    - **Manual Allocation** – The administrator assigns a pre-allocated IPv4 address to the client, and DHCPv4 communicates only the IPv4 address to the device.
    - **Automatic Allocation** – DHCPv4 automatically assigns a static IPv4 address permanently to a device, selecting it from a pool of available addresses.
    - **Dynamic Allocation** – DHCPv4 dynamically assigns, or leases, an IPv4 address from a pool of addresses for a limited period of time chosen by the server, or until the client no longer needs the address. This method is the most commonly used.

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DHCPv4 Operation (continued)

L4
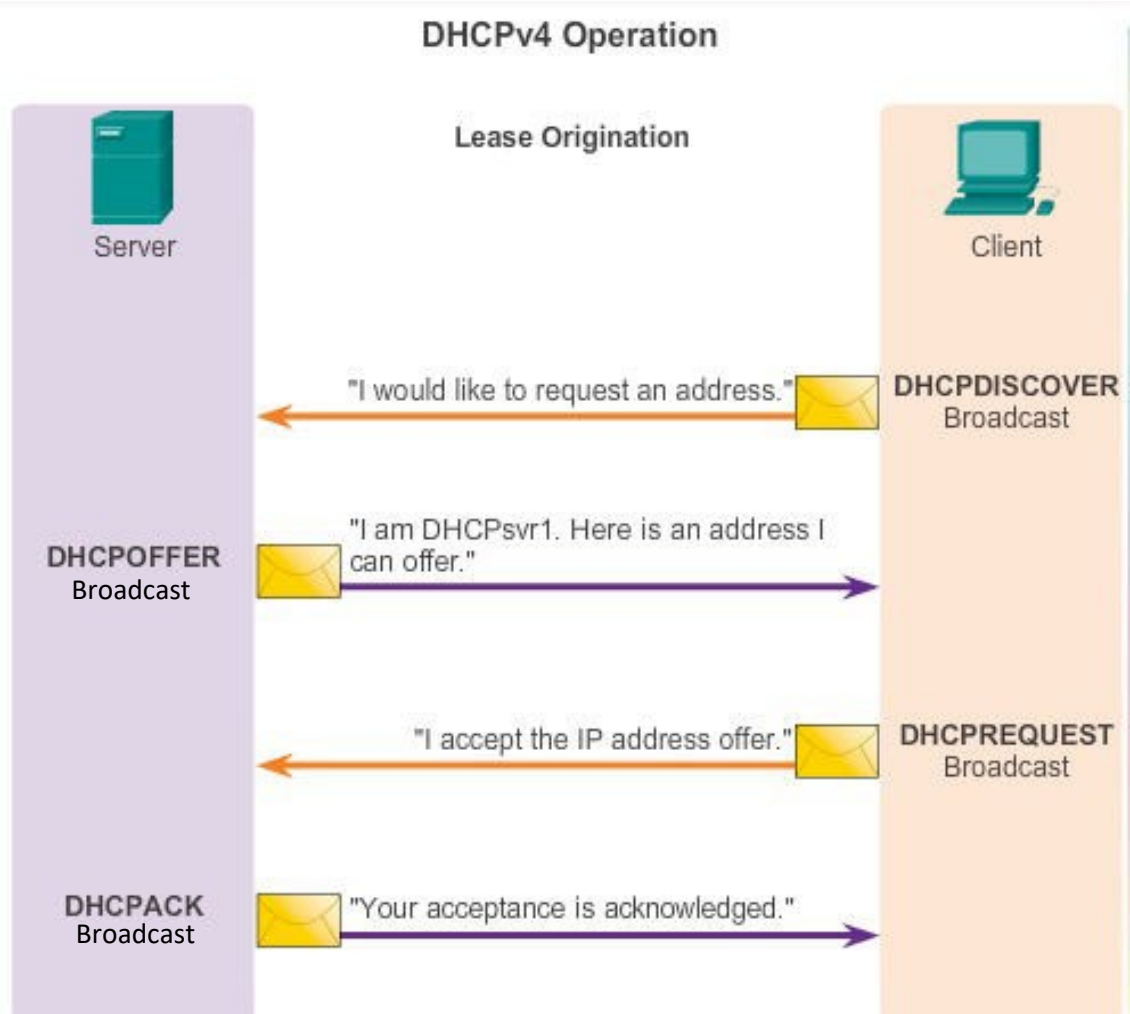
DHCPv4 Message Format

- **op Message op code / message type**
  - 1 = BOOTREQUEST
  - 2 = BOOTREPLY
- **htype Hardware address type**
  - Example: 1 for Ethernet
- **hlen Hardware address length**
  - Example: 6 for # of octets (MAC address)
- **hops Client sets to zero**
  - optionally used by relay agents when booting via a relay agent
- **xid Transaction ID**
  - Random number chosen by the client, used by the client and server to associate messages and responses between a client and a server.
- **secs Filled in by client**
  - Seconds elapsed since client began address acquisition or renewal process
- **flags 1st bit is the Broadcast flag**
  - The rest Must Be Zero
- **ciaddr Client IP address**
  - Only filled in if client is in BOUND, RENEW or REBINDING state and can respond to ARP requests
- **yiaddr Client IP address**
  - "y" stands for You

- **siaddr DHCP Server address**
  - returned in DHCPOFFER, DHCPACK by server
- **giaddr Gateway address**
- **chaddr Client hardware address (MAC)**
- **sname Optional server host name**
- **file   Boot file name**
- **options Optional parameters field (There are > 100 options)**

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			

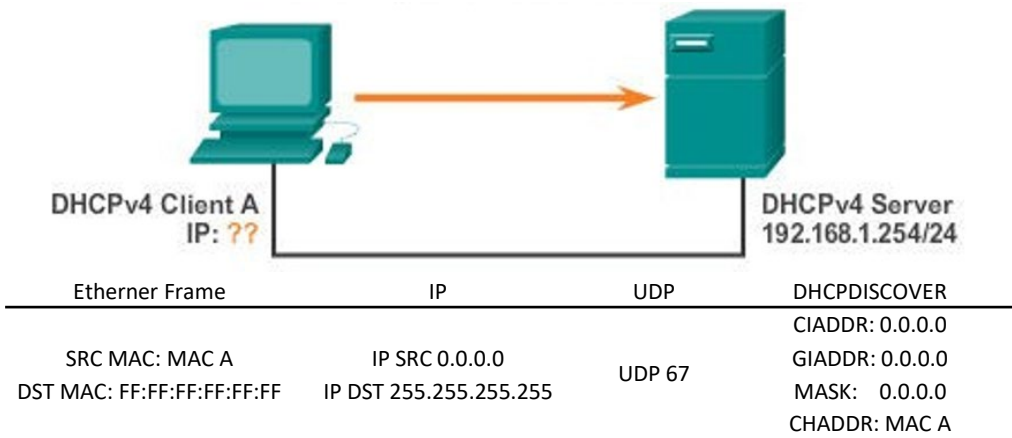**FANSHAWE**

DHCPv4 Operation (continued)

- **DHCP – Options**
    - The list of DHCP options is available on the IANA website
        - http://www.iana.org/assignments/bootp-dhcp-parameters/bootp-dhcp-parameters.xhtml#options
    - Each option is defined by its own RFC
    - Some of the most common DHCP options:

Code	Description
1	Subnet Mask
3	Router (Default Gateway)
4	Time Server
5	Name Server
6	DNS Server(s)
15	DNS domain name
43	Vendor Specific Information
44	WINS server (NetBIOS name server)
46	NetBIOS Node Type
150	TFTP Server address

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DHCPv4 Operation (continued)

- ## Format DHCPv4 Discover and Offer Messages

| Etherner Frame	IP	UDP	DHCPDISCOVER
			CIADDR: 0.0.0.0
SRC MAC: MAC A	IP SRC 0.0.0.0		GIADDR: 0.0.0.0
DST MAC: FF:FF:FF:FF:FF:FF	IP DST 255.255.255.255	UDP 67	MASK: 0.0.0.0
			CHADDR: MAC A

- ## Configuring a DHCPv4 Server

  - A Cisco router running the Cisco IOS software can be configured to act as a DHCPv4 server. To set up DHCP:

    1. Exclude addresses from the pool.

    2. Set up the DHCP pool name.

    3. Define the range of addresses and subnet mask. Use the default-router command for the default gateway. Optional parameters that can be included in the pool – dns server, domain-name.

  - To disable DHCP, use the **no service dhcp** command.

```
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-1
R1(dhcp-config)# network 192.168.10.0 255.255.255.0
R1(dhcp-config)# default-router 192.168.10.1
R1(dhcp-config)# dns-server 192.168.11.5
R1(dhcp-config)# domain-name example.com
R1(dhcp-config)# end
```

DHCPv4 Operation (continued)

- ## Verifying a DHCPv4 Server

  - ### Commands to verify DHCP:

    - **show rinning-config | Section dhcp**

    - **show ip dhcp binding**

    - **show ip dhcp server statistics**

 - ### On the PC, issue the **ipconfig /all** command.
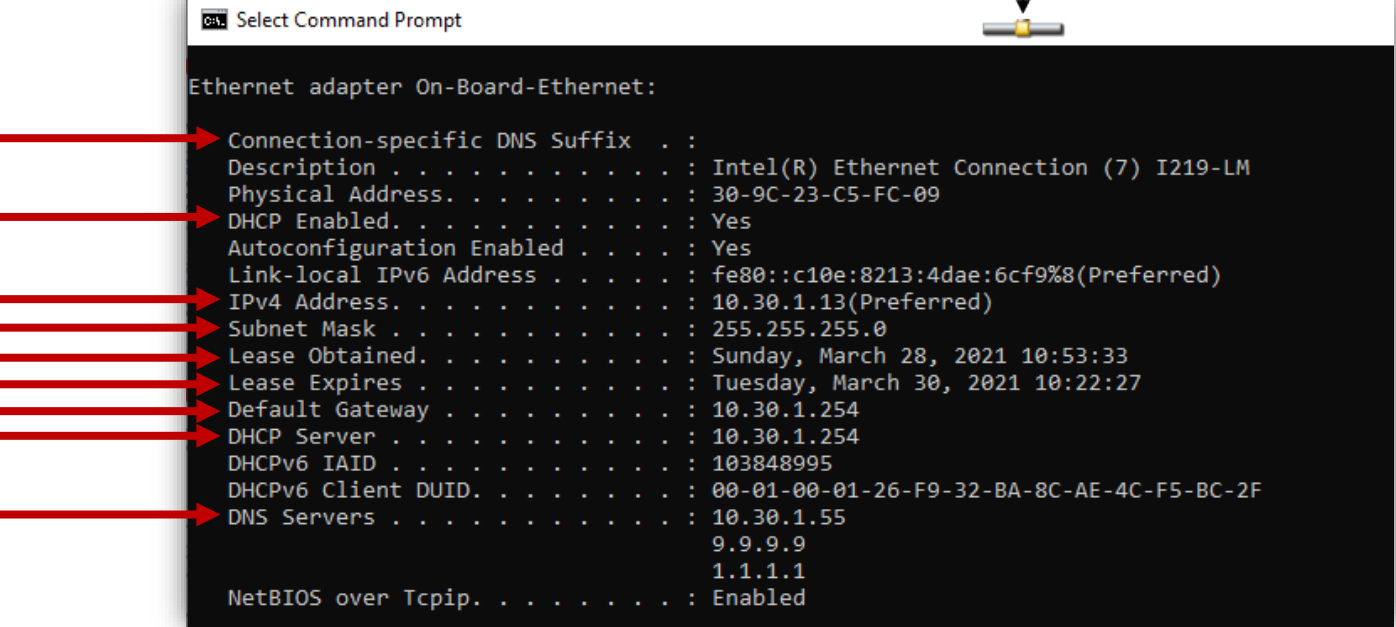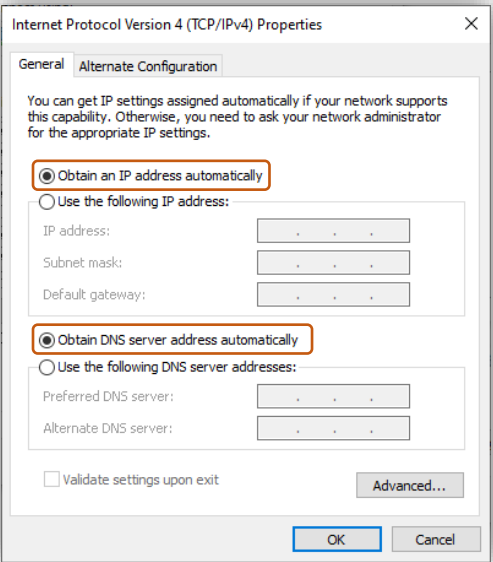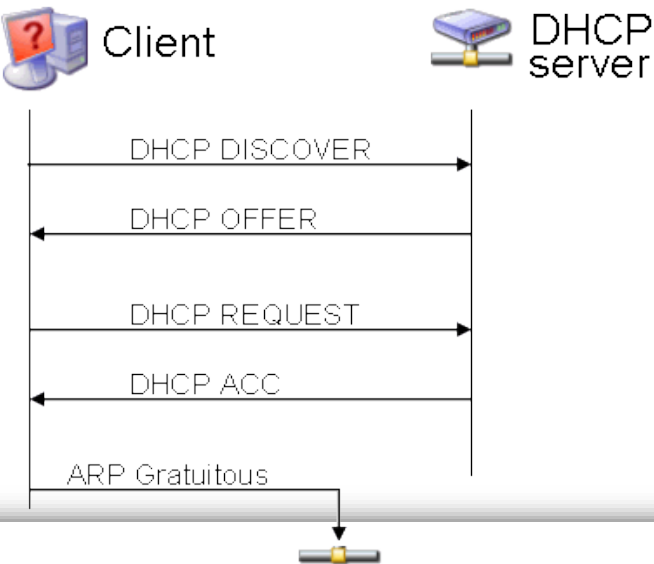
DHCPv4 Operation (continued)

- ## DHCPv4 Relay
  - ### Using an IP helper address enables a router to forward DHCPv4 broadcasts to the DHCPv4 server. Acting as a relay.

Discovery (without relay agent)

```
R1(config)# interface g0/0
R1(config-if)# ip helper-address 192.168.11.6
R1(config-if)# end
R1# show ip interface g0/0
GigabitEthernet0/0 is up, line protocol is up
  Internet address is 192.168.10.1/24
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper address is 192.168.11.6
<Output omitted>
```
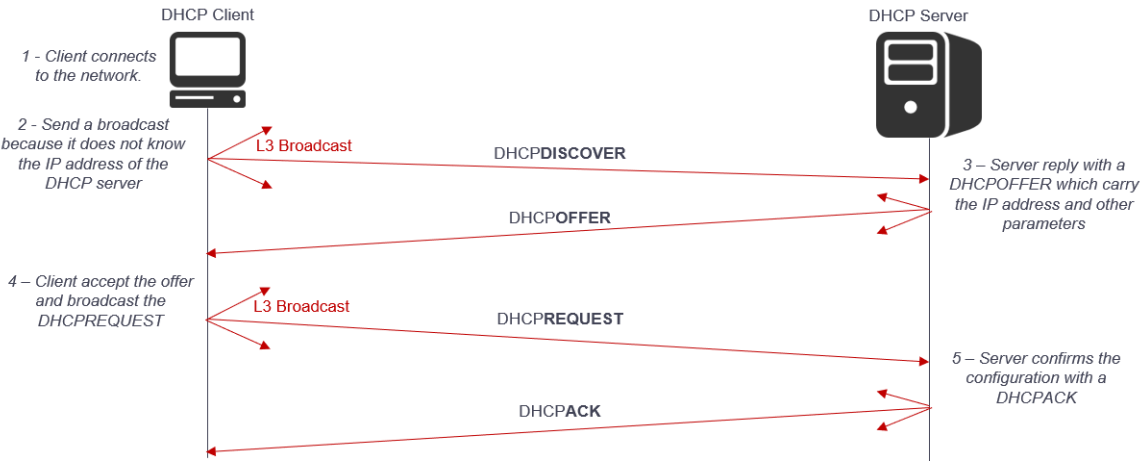
Discovery (with relay agent)
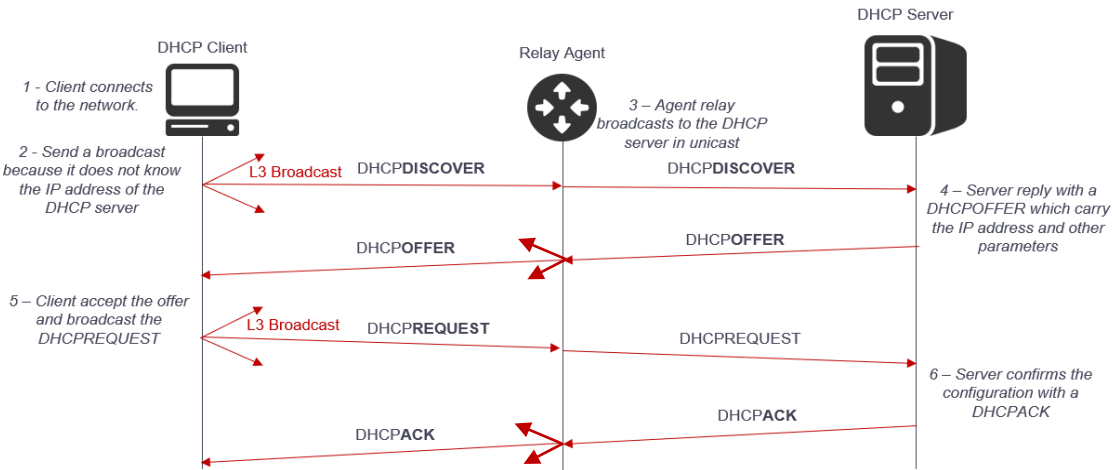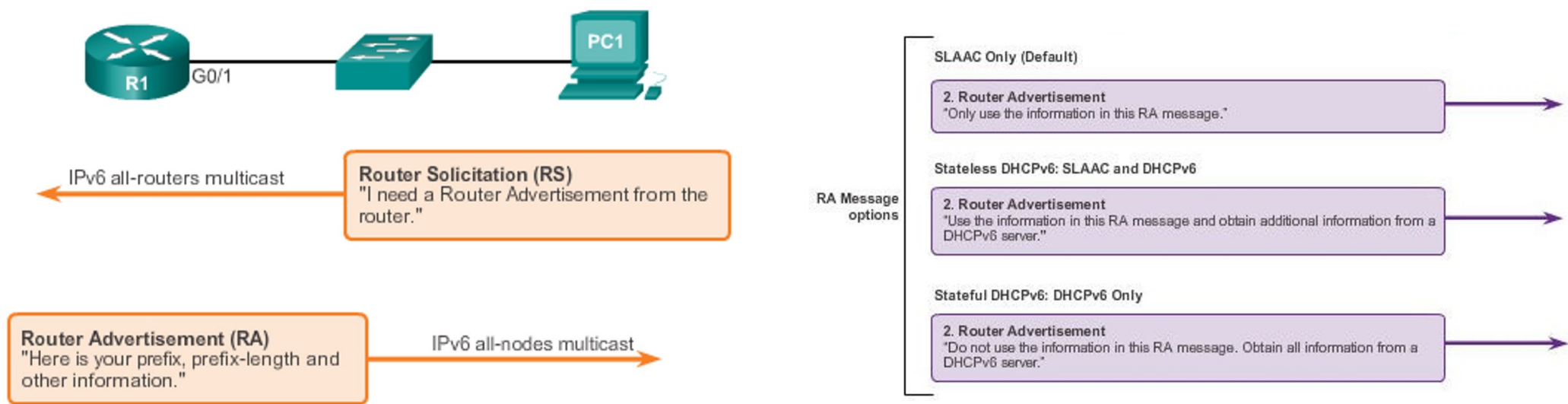
Configuring a DHCPv4 Client

- Configuring a Router as a DHCPv4 Client


```
SOHO(config)# interface g0/1
SOHO(config-if)# ip address dhcp
SOHO(config-if)# no shutdown
SOHO(config-if)#
*Jan 31 17:31:11.507: %DHCP-6-ADDRESS_ASSIGN: Interface
GigabitEthernet0/1 assigned DHCP address 209.165.201.12, mask
255.255.255.224, hostname SOHO
SOHO(config-if)# end
SOHO# show ip interface g0/1
GigabitEthernet0/1 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
  <Output omitted>
```

SLAAC and DHCPv6

- ## Stateless Address Autoconfiguration
  - Stateless Address Autoconfiguration (SLAAC) is a method in which a device can obtain an IPv6 global unicast address without the services of a DHCPv6 server.
  - Uses one of three methods
    - SLAAC (Stateless Address Autoconfiguration)
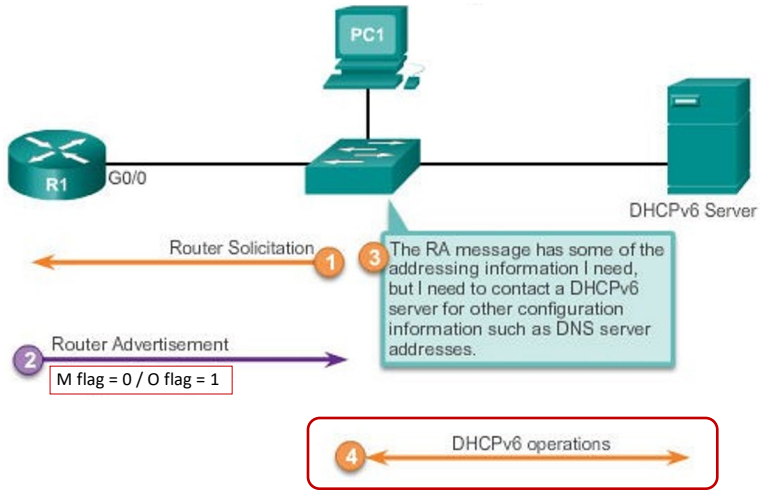   - Stateless DHCPv6
    - Stateful DHCPv6
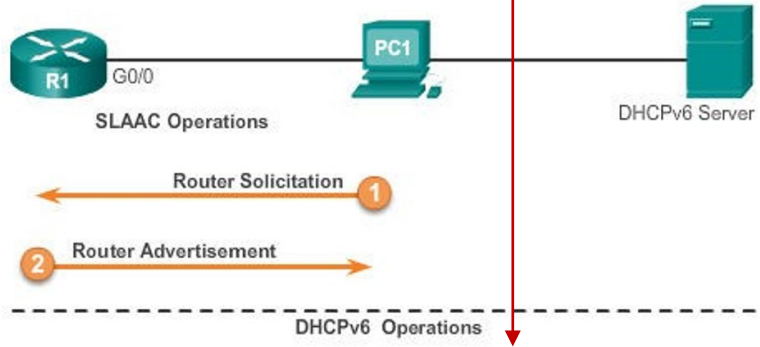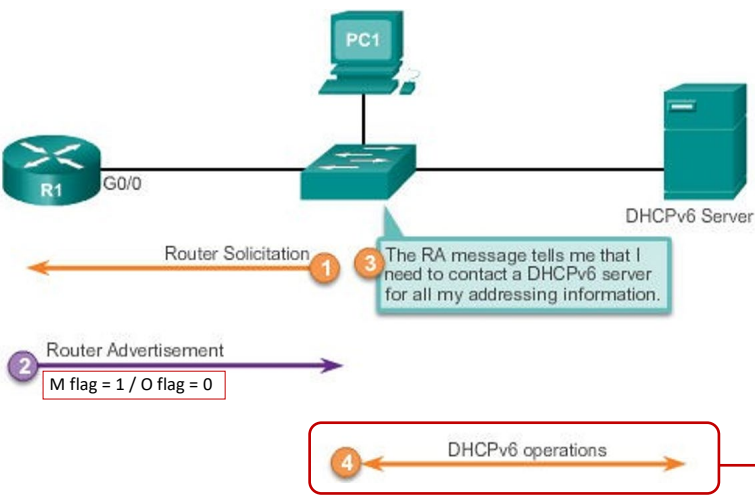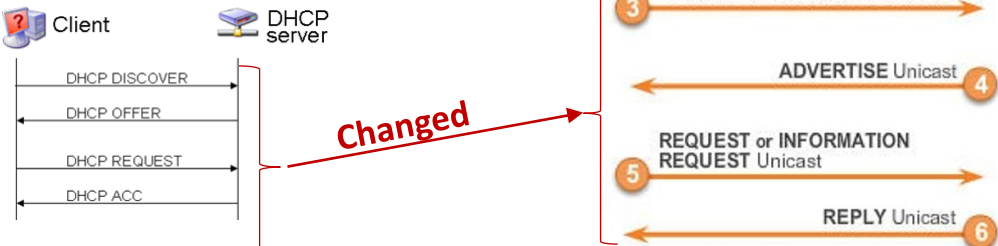
SLAAC and DHCPv6 (continued)

SLAAC and DHCPv6 (continued)

- Dynamic Interface ID

Router Advertisement
2001:DB8:CAFE:1::/64

	/48	/64	64 bits
Global Routing Prefix		**Subnet ID**	Interface ID

SLAAC

EUI-64 Process   **Randomly Generated Number**
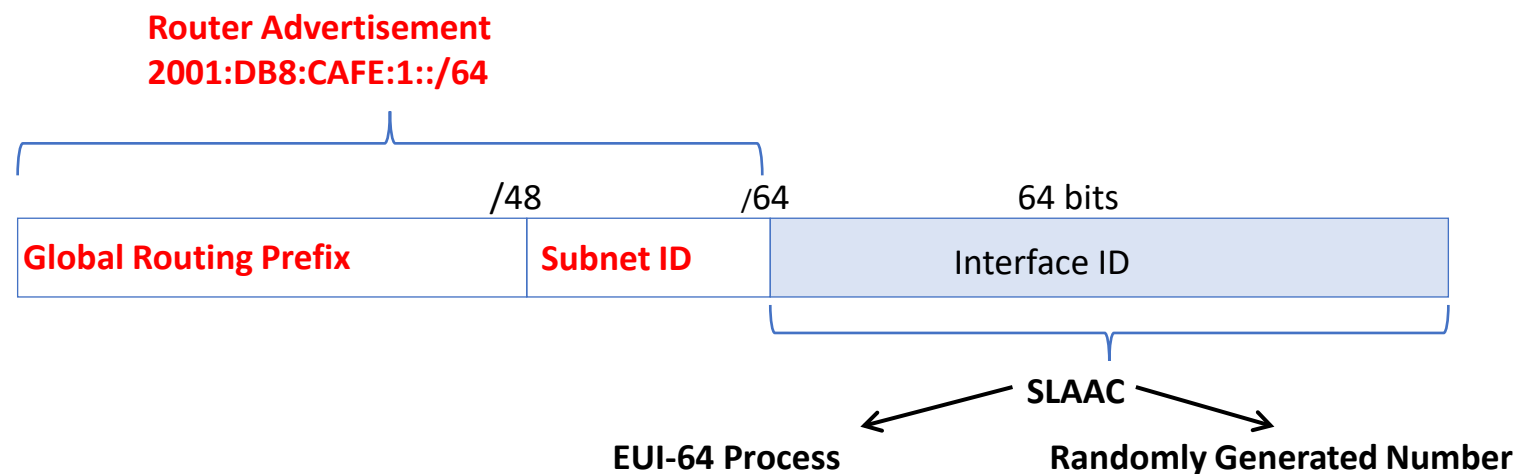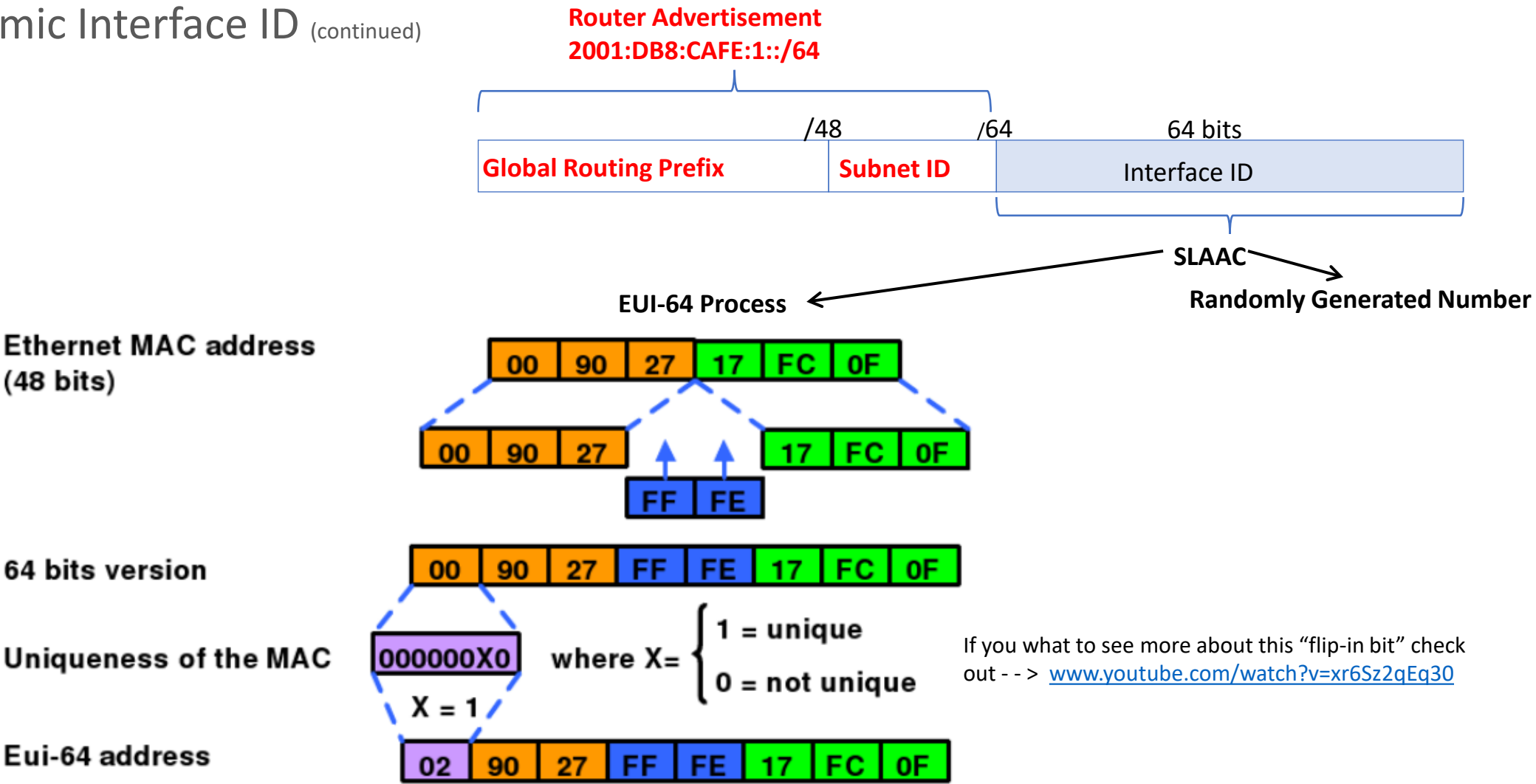
- Windows operating systems, Windows XP and Server 2003 use EUI-64
- Windows Vista and newer; hosts create a random 64-bit Interface ID
- Linux: Mostly use random 64-bit number

SLAAC and DHCPv6 (continued)

- ## Dynamic Interface ID (continued)

Router Advertisement
2001:DB8:CAFE:1::/64

	/48	/64	64 bits
Global Routing Prefix	**Subnet ID**		Interface ID

SLAAC

EUI-64 Process

Randomly Generated Number

Ethernet MAC address (48 bits)

| 00 | 90 | 27 | 17 | FC | 0F |

| 00 | 90 | 27 | | | 17 | FC | 0F |

| FF | FE |

64 bits version

| 00 | 90 | 27 | FF | FE | 17 | FC | 0F |

Uniqueness of the MAC

000000X0   where X = { 1 = unique / 0 = not unique }

X = 1

Eui-64 address

| 02 | 90 | 27 | FF | FE | 17 | FC | 0F |

If you what to see more about this "flip-in bit" check out - - > www.youtube.com/watch?v=xr6Sz2qEq30

SLAAC and DHCPv6 (continued)
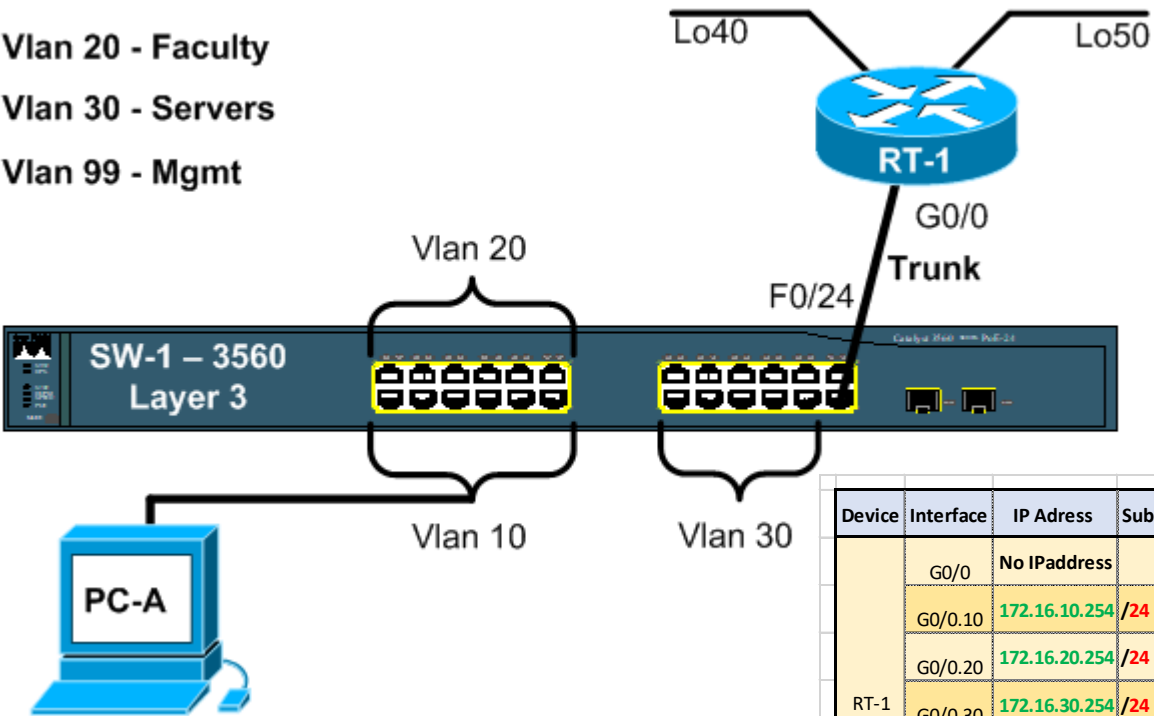
- ## DHCPv6 Relay Agent

```
R1(config)# interface g0/0
R1(config-if)# ipv6 dhcp relay destination 2001:db8:cafe:1::6
R1(config-if)# end
R1# show ipv6 dhcp interface g0/0
GigabitEthernet0/0 is in relay mode
  Relay destinations:
    2001:DB8:CAFE:1::6
R1#
```

- This needs to be done on G0/0 of both routers R1 and R3

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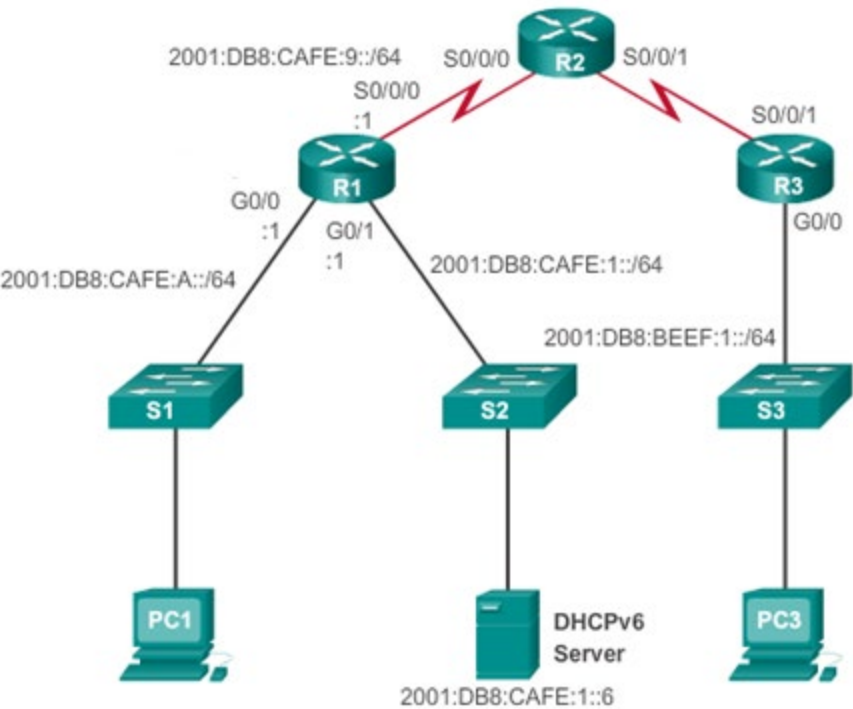
Lab

Vlan 10 - Workstations

Vlan 20 - Faculty

Vlan 30 - Servers

Vlan 99 - Mgmt

Device	Interface	IP Adress	Subnet Mask	Vlan Names	Ports
RT-1	G0/0	No IPaddress			
	G0/0.10	172.16.10.254	/24		
	G0/0.20	172.16.20.254	/24		
	G0/0.30	172.16.30.254	/24		
	G0/0.99	172.16.99.254	/24		
	Lo40	172.16.40.1	/24		
	Lo50	172.16.50.1	/24		
SW-1	Vlan 10			Workstations	2,4,6,8,10,12
	Vlan 20			Voice	1,3,5,7,9,11
	Vlan 30			Server	14,16,18,20,22
	Vlan 99	172.16.99.200	/24	Mgmt	13,15,17,19,21,23
	F0/24	Trunk			
PC-A		DHCP			

Device	Interface	IP Adress	Subnet Mask	Vlan Names	Ports
RT-1	G0/0	No IPaddress			
	G0/0.10	2001:acad:db8:10::254	/64		
	G0/0.20	2001:acad:db8:20::254	/64		
	G0/0.30	2001:acad:db8:30::254	/64		
	G0/0.99	2001:acad:db8:99::254	/64		
	Lo40	2001:acad:db8:40::254	/64		
	Lo50	2001:acad:db8:50::254	/64		
SW-1	Vlan 10			Workstations	2,4,6,8,10,12
	Vlan 20			Voice	1,3,5,7,9,11
	Vlan 30			Server	14,16,18,20,22
	Vlan 99	172.16.99.200	/24	Mgmt	13,15,17,19,21,23
	F0/24	Trunk			
PC-A		DHCP			

Lab (continued)

Zip file with basic configurations for the IPv4 router, IPv4 switch,
And IPv6 router….

QUESTIONS

?

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