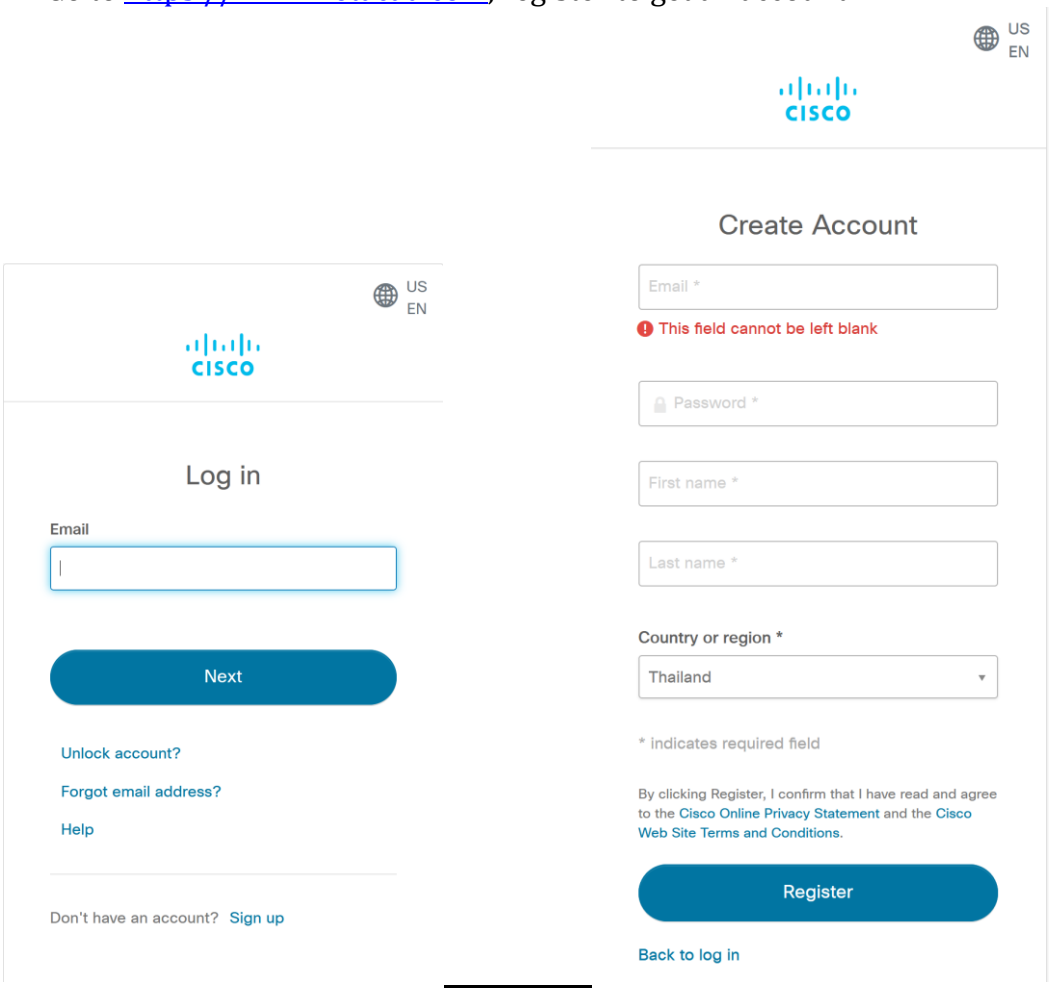
Lab 2: Routing Protocols

Agenda

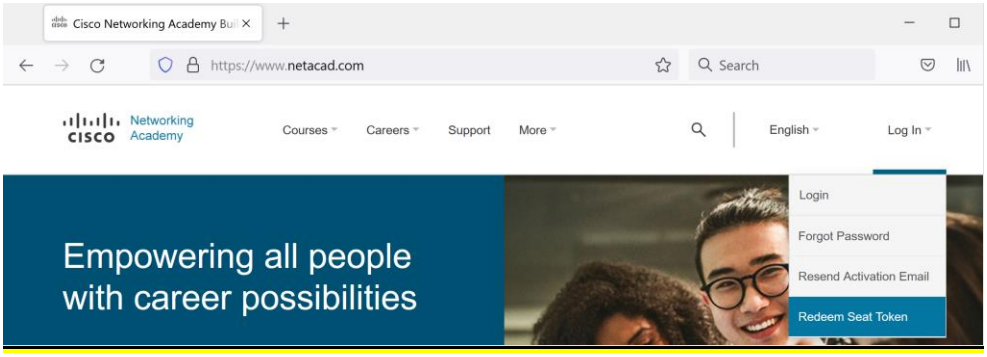
- **Part0 CCNA7 Registration with Redeem Token**
- **Part1 Warm up: Identify MAC and IP addresses**
- **Part2 RIP Routing Protocol**
- **Part3 OSPF Routing Protocol**

Part 0: CCNA7 (Switching & Enterprise) Registration with Redeem Token + Install & Start Packet Tracer v8.2.0

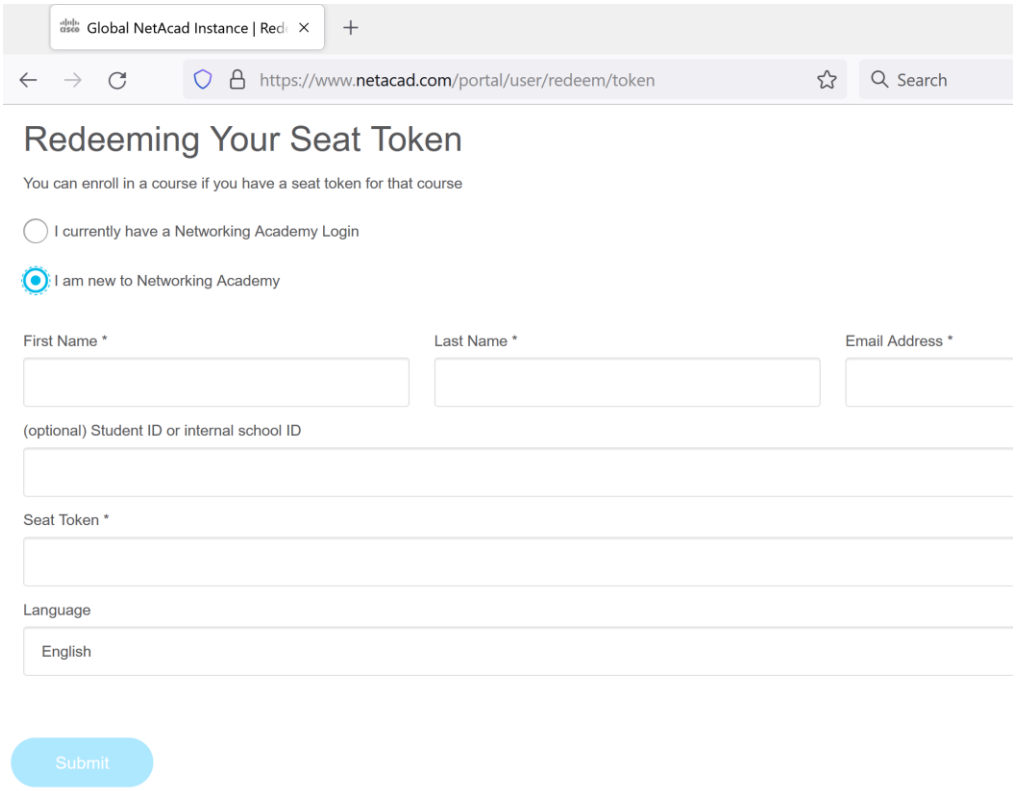
1. Go to https://www.netacad.com, register to get an account.



2. Go to https://www.netacad.com, click Redeem Seat Token.

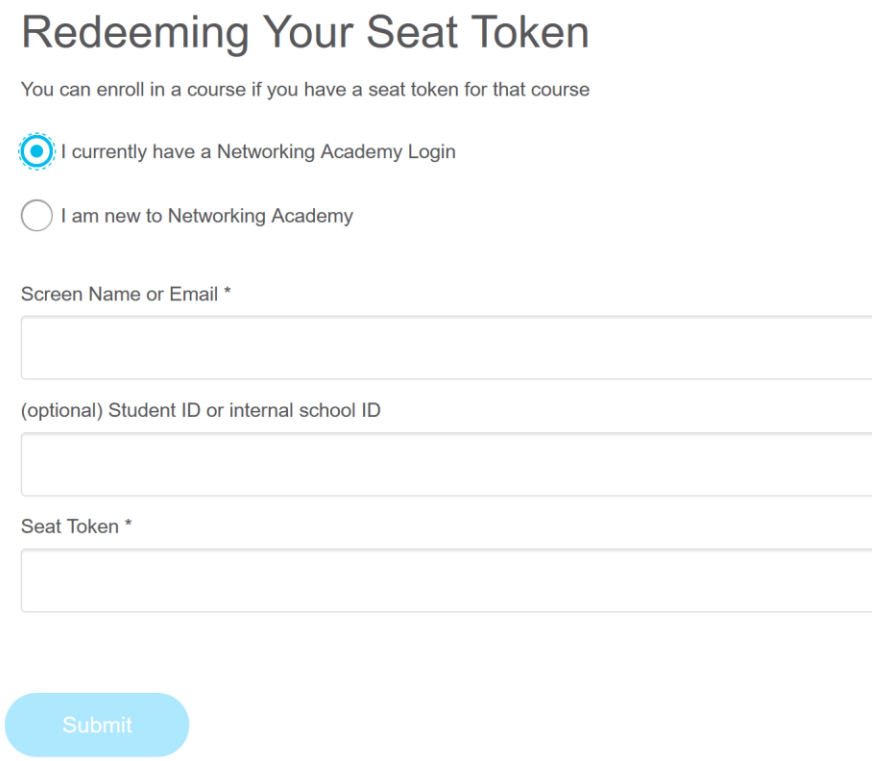


3. Choose I am new to Networking Academy, then fill in your information, and your **assigned Seat Token** for CCNA7 SwitchingRouting course, then click Submit.



You will get an email please confirm it.

4. Continue to redeem CCNA7 EnterpriseNetwork course. Choose I currently have a Networking Academy Login, then fill in your email and your **assigned "Seat Token",** for CCNA7 EnterpriseNetwork then click Submit.



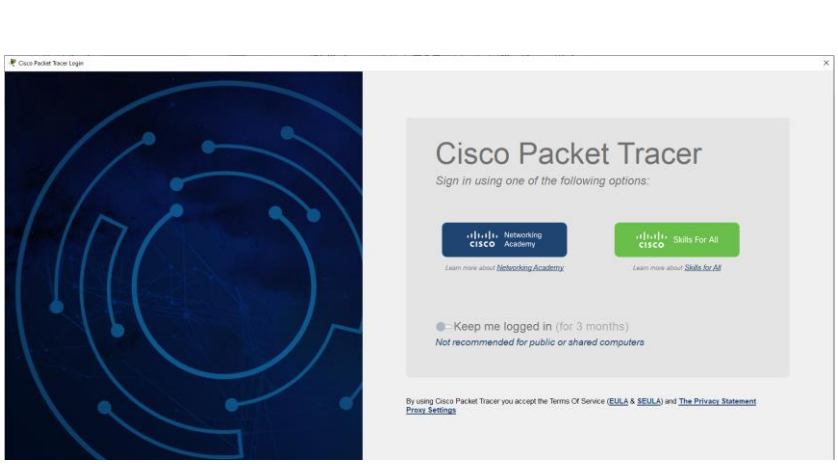
You should see two courses that you can learn from Cisco Network Academy.

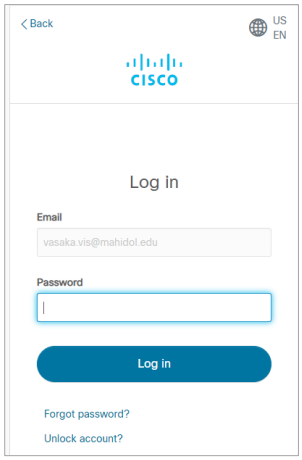
Part 1: Warm up: Identify MAC and IP Address

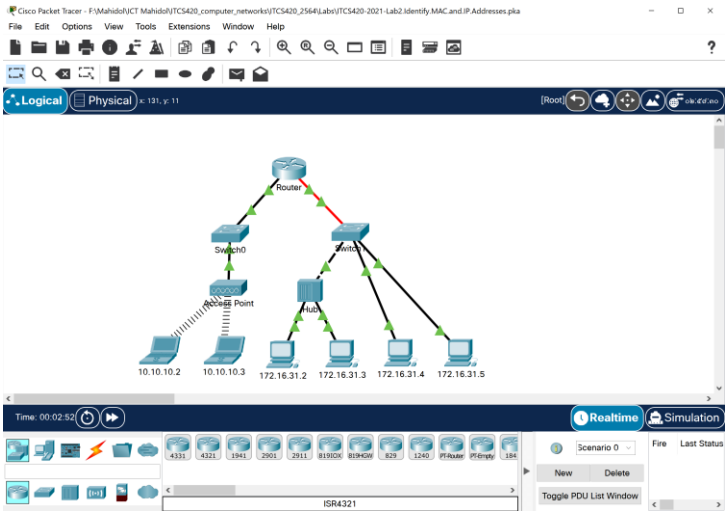
Background

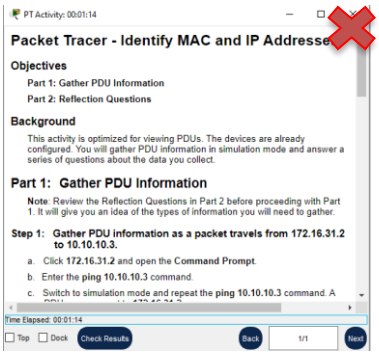
This activity is optimized for viewing PDUs. The devices are already configured. You will gather PDU information in simulation mode and answer a series of questions about the data you collect.

Step 0: Open "ITCS420-2022-Lab2.Identify.MAC.and.IP.Addresses.pka, you will obtain the screen as below. Click the Dark Blue icon "Cisco Networking Academy" on the left, and login with your Netacad email address and password. If success, you will get the screen as below. You can close X the Packet Tracer (PT Activity window).



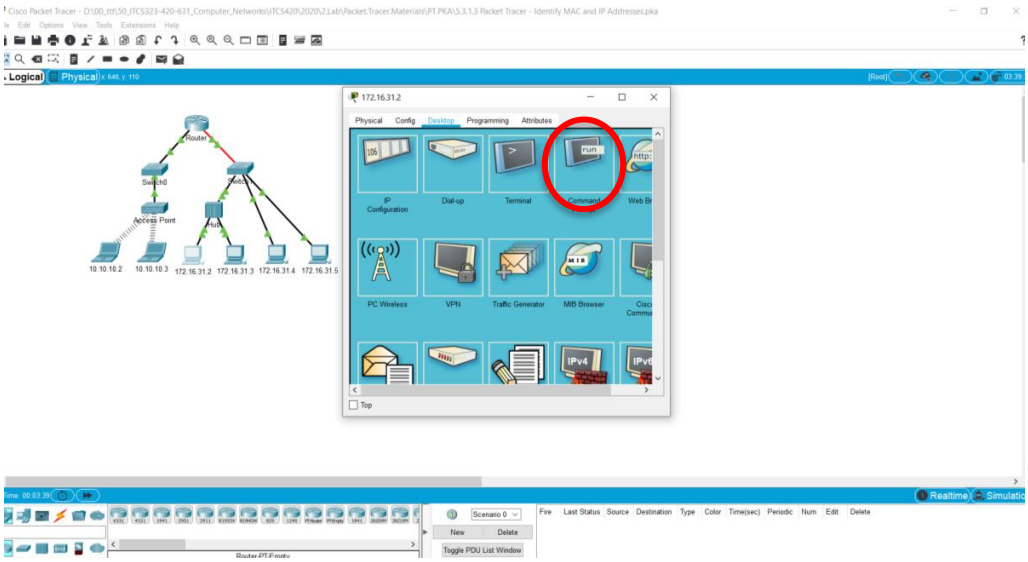




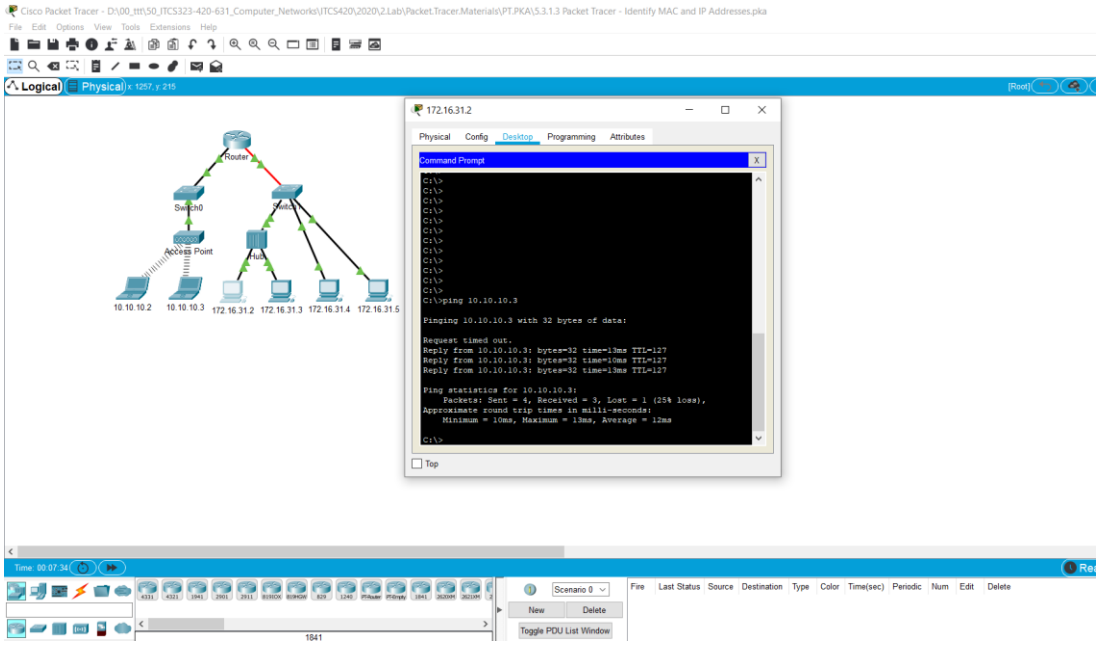


Step 1: Gather PDU information as a packet travels from 172.16.31.2 to 10.10.10.3.

a. Click **172.16.31.2** and open the **Command Prompt**.

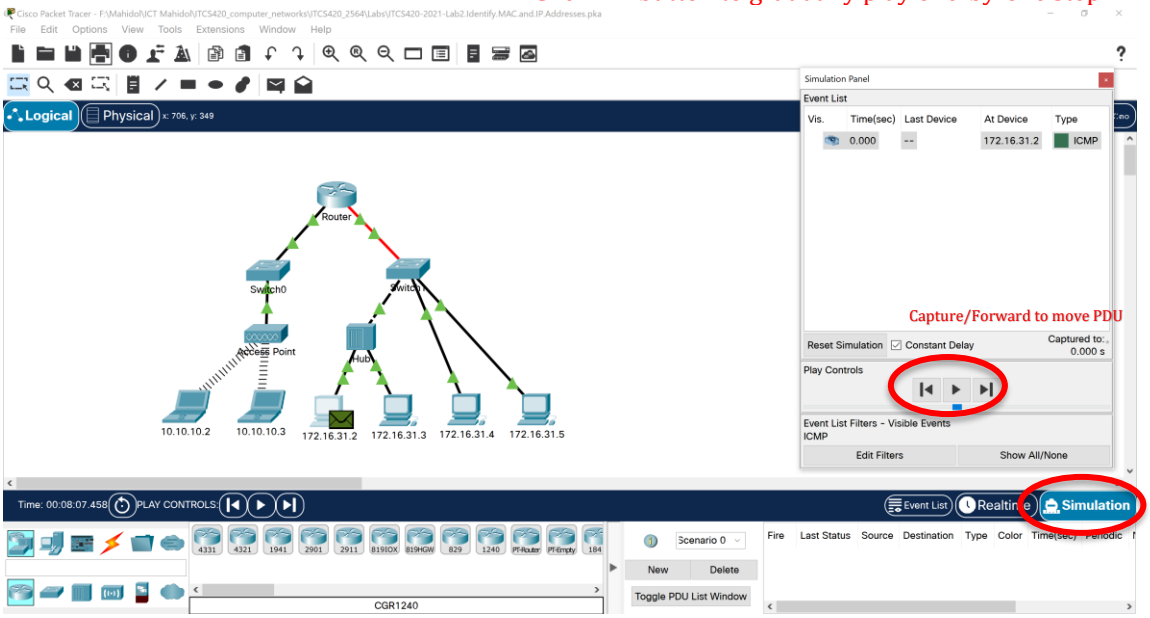


b. Enter the **ping 10.10.10.3** command.



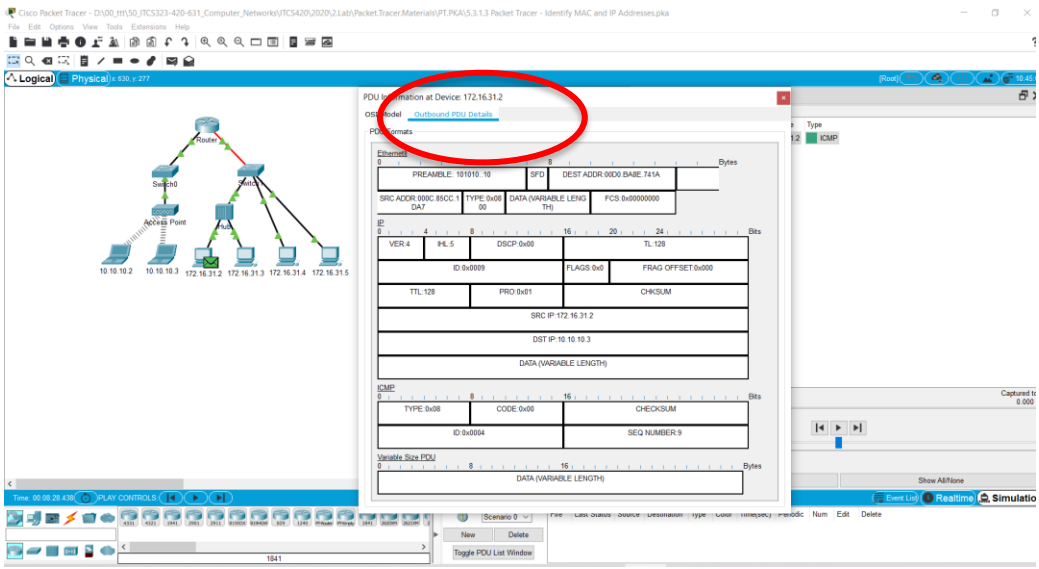
c. Switch to **simulation mode** and repeat the **ping 10.10.10.3** command.
A PDU appears next to **172.16.31.2**.

Click button to gradually play one-by-one step.



d. **Click** the PDU (**Envelope Icon** or from the **Simulation Panel**) and **fill-in** the following information from the **OSI Model tab** and **Outbound PDU Layer** tab:

- At Device: Computer 172.16.31.2
- Destination MAC Address: 00D0.BA8E.741A
- Source MAC Address: 000C.85CC.1DA7
- Source IP Address: 172.16.31.2
- Destination IP Address: 10.10.10.3



e. When you observe the **Outbound PDU Details** tab, what is the protocol used by the ping command? (Other than Ethernet and IP)

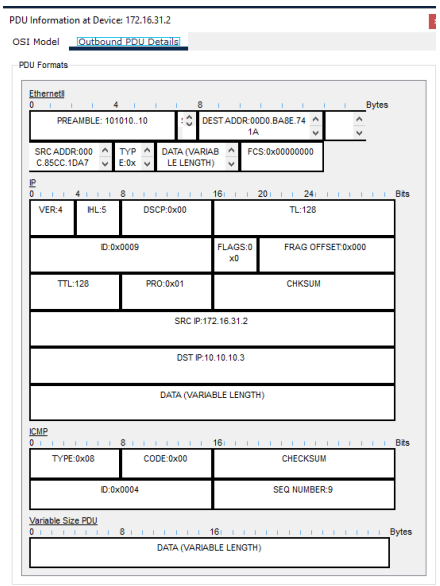
Answer: ICMP, Variable Size PDU

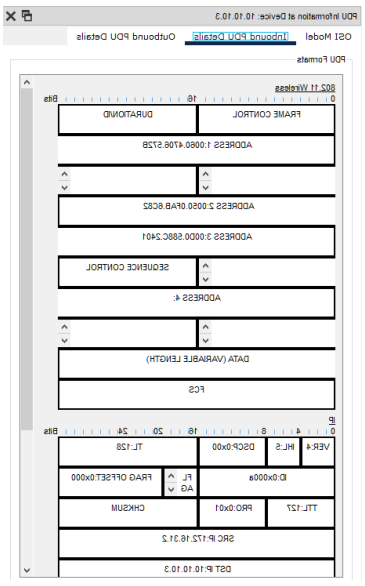
f. Click **Capture / Forward** to move the PDU to the next device. **Gather the same information from Step 1d.** Repeat this process until the PDU reaches its destination. Observe the **OSI Model tab (Out Layers)** information. You should get the same results as below table.

Example Spreadsheet Format

Test	At Device	Dest. MAC	Src MAC	Src IPv4	Dest IPv4
Ping from 172.16.31.2 to 10.10.10.3	172.16.31.2	00D0:BA8E:741A	000C:85CC:1DA7	172.16.31.2	10.10.10.3
	Hub	--	--	--	--
	Switch1	00D0:BA8E:741A	000C:85CC:1DA7	--	--
	Router	0060:4706:572B	00D0:588C:2401	172.16.31.2	10.10.10.3
	Switch0	0060:4706:572B	00D0:588C:2401	--	--
	Access Point	--	--	--	--
	10.10.10.3	0060:4706:572B	00D0:588C:2401	172.16.31.2	10.10.10.3

g. Screen Capture **Outbound PDU Details** tab you got *At 172.16.31.2* and **Inbound PDU Details** tab you got **At 10.10.10.3** and Paste them here.





h. Based on the results in the above screenshots, what protocols are different?
Answer: 172.16.31.2 has an ethernet but 10.10.10.3 has 802.11 wireless

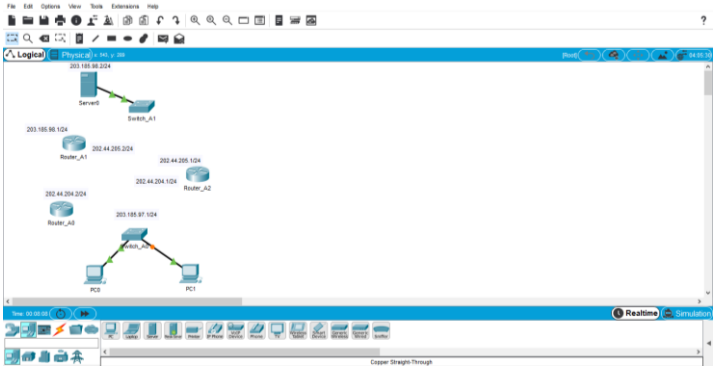
Step 3: Gather PDU information as a packet travels from 172.16.31.5 to 10.10.10.2.

Switch to **simulation mode** and repeat the **ping** command from **172.16.31.5** to **10.10.10.2.** Observe the **OSI Model tab (Out Layers)** and **fill-in the table below:**

Test	At Device	Dest. MAC	Src MAC	Src IPv4	Dest IPv4
Ping from 172.16.31.5 to 10.10.10.2	172.16.31.5	00D0.BA8E.741A	00D0.D311.C788	172.16.31.5	10.10.10.2
	Hub	--	--	--	--
	Switch1	00D0.BA8E.741A	00D0.D311.C788	--	--
	Router	00D0.BA8E.741A	00D0.D311.C788	172.16.31.5	10.10.10.2
	Switch0	0060.2F84.4AB6	00D0.588C.2401	--	--
	Access Point	--	--	--	--
	10.10.10.2	Wireless	Wireless	10.10.10.2	172.16.31.5

Part 2: RIP Routing Protocol

Step 1: Download and open **"ITCS420-2022-Lab2.RIP-step0.pkt"** file. **Save it** as ***YourID-Name*-ITCS420-2022-Lab2.RIP.pkt**

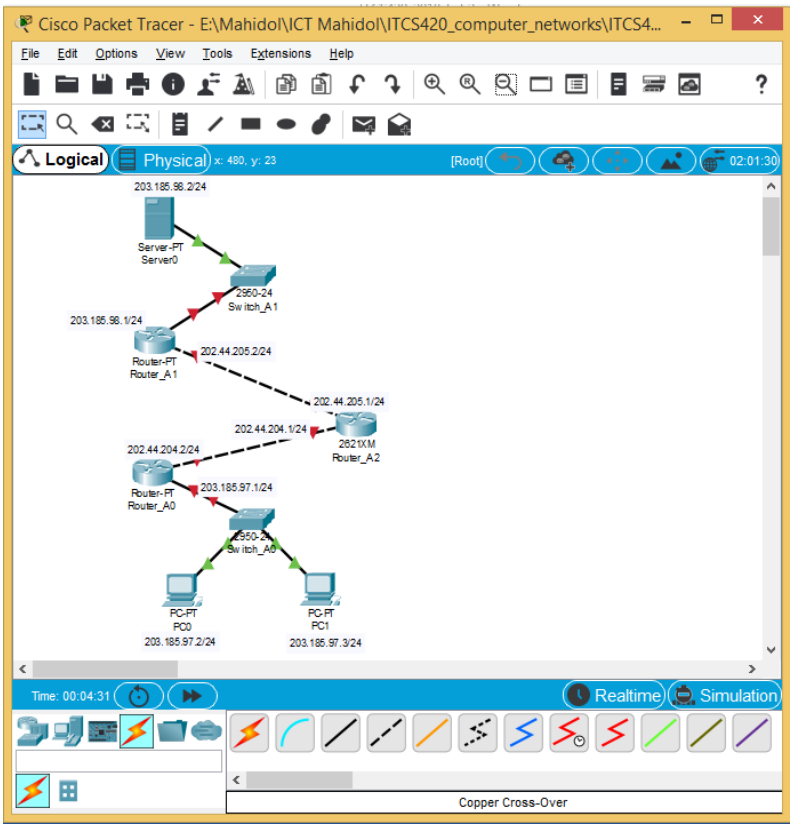


Step 2: Select **"Connections"** in **"Device-type Selection Box"** and select **"Copper Straight-through" cable.**

- Connect port FastEthernet 0/0 on Router_A0 with port FastEthernet0/1 on Switch_A0
- Connect port FastEthernet 0/0 on Router_A1 with port FastEthernet0/1 on Switch_A1

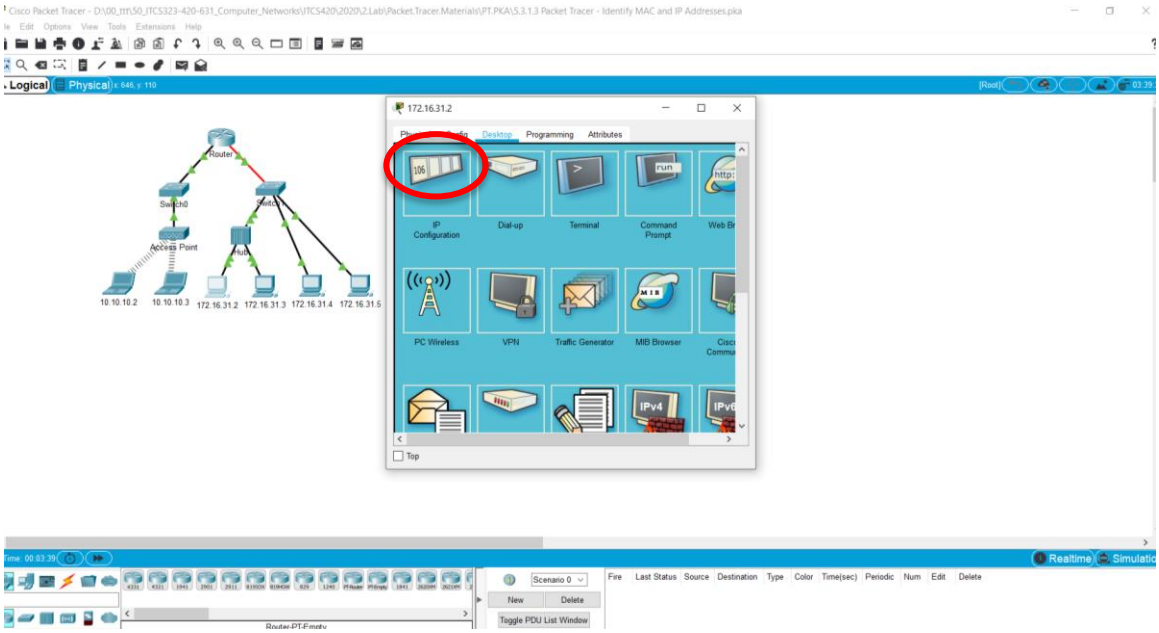
Select **"Connections"** in **"Device-type Selection Box"** and select **"Copper Cross-Over" cable.**

- Connect port FastEthernet 1/0 on Router_A0 with port FastEthernet0/0 on Router_A2
- Connect port FastEthernet 1/0 on Router_A1 with port FastEthernet0/1 on Router_A2

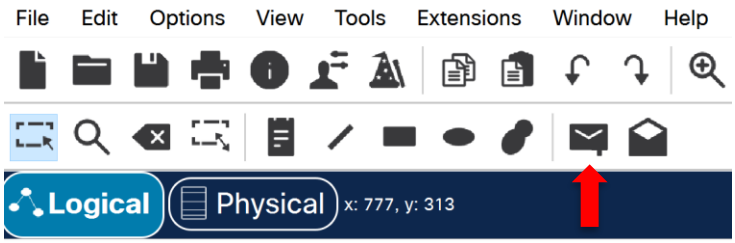


Step 3: Assign IP address to PC0 via IP Configuration

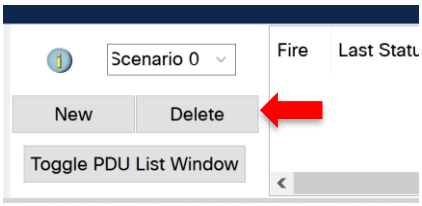
- IP Address: 203.185.97.2
- Subnet mask: 255.255.255.0
- Default Gateway: 203.185.97.1



Step 4: Click on <u>Add Simple PDU</u> and click PC0 and then click PC1 to generate PING packet from PC0 to PC1.



Note: if you want to delete the PDU, click Delete at the bottom.



Click Toggle PDU List Window to show or Hide the result table (observe the Last Status column).

Step 5: Click on Add Simple PDU and click PC0 and then click Server0 on the top to generate PING packet from PC0 to Server0.

See the Last Status in the PDU List Window and answer the questions.

Lab questions:

2.1 Can PC0 ping PC1? Explain why.

Yes, because they are same sub-net.

2.2 Can PC0 ping Server0? Explain why.

No, because the router doesn't rounting.

Step 6: Assign IP addresses to all interfaces of each router. Click on Router and select CLI tab then press enter to get command prompt.

- **Router_A0**
  - **Router_A0>** enable
  - **Router_A0#** configure terminal
  - **Router_A0(config)#** interface fastEthernet0/0
  - **Router_A0(config-if)#** ip address 203.185.97.1 255.255.255.0
  - **Router_A0(config-if)#** no shutdown
  - **Router_A0(config-if)#**exit
  - **Router_A0(config)#** interface fastEthernet1/0
  - **Router_A0(config-if)#** ip address 202.44.204.2 255.255.255.0
  - **Router_A0(config-if)#** no shutdown
  - **Router_A0(config-if)# e**xit

- **Router_A2**
  - **Router_A2>** en
  - **Router_A2#** conf t
  - **Router_A2(config)#** int fa0/0
  - **Router_A2(config-if)#** ip addr 202.44.204.1 255.255.255.0
  - **Router_A2(config-if)#** no shut
  - **Router_A2(config-if)# exit**
  - **Router_A2(config)#** int fa0/1
  - **Router_A2(config-if)#** ip addr 202.44.205.1 255.255.255.0
  - **Router_A2(config-if)#** no shut
  - **Router_A2(config-if)# exit**

- **Router_A1**
  - **Router_A1>** en
  - **Router_A1#** conf t
  - **Router_A1(config)#** int fa0/0
  - **Router_A1(config-if)#** ip addr 203.185.98.1 255.255.255.0
  - **Router_A1(config-if)#** no shut
  - **Router_A1(config-if)# exit**
  - **Router_A1(config)#** int fa1/0
  - **Router_A1(config-if)#** ip addr 202.44.205.2 255.255.255.0
  - **Router_A1(config-if)#** no shut
  - **Router_A1(config-if)# exit**

- **Wait for all interfaces change from orange to green.**

2.3 How many subnets in this topology? What are they?

4 Subnets

2.4 Can PC0 ping server (203.185.98.2)? Explain why.

No, because routing table only 2 subnets but actually it has 4 subnets.

2.5 Select inspector tool  and click on router_A0 then select Routing table. Screen capture and Copy&Paste the routing tables of router_A0, router_A1, and router_A2 in the below boxes.

Types: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B – BGP, D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area, N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2, E1 - OSPF external type 1, E2 - OSPF external type 2, E – EGP, i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area, * - candidate default, U - per-user static route, o – ODR, P - periodic downloaded static route

Routing Table of A0

Routing Table for Router_A0

Type	Network	Port	Next Hop IP	Metric
C	202.44.204.0/24	FastEthernet1/0	---	0/0
C	203.185.97.0/24	FastEthernet0/0	---	0/0

Routing Table of A1

Routing Table for Router_A1

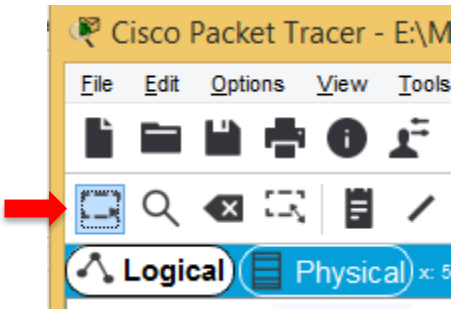
Type	Network	Port	Next Hop IP	Metric
C	202.44.205.0/24	FastEthernet1/0	---	0/0
C	203.185.98.0/24	FastEthernet0/0	---	0/0

Routing Table of A2

Routing Table for Router_A2

Type	Network	Port	Next Hop IP	Metric
C	202.44.204.0/24	FastEthernet0/0	---	0/0
C	202.44.205.0/24	FastEthernet0/1	---	0/0

Step 7: Change from "inspector tool" to "selector tool", (go back to the previous mode)



Step 8: Enable RIP routing protocol and configure route on each router. Open CLI on each router

- **Router_A0**
  - **Router_A0>** en
  - **Router_A0#** conf t
  - **Router_A0(config)#** router rip
  - **Router_A0(config-router)#** network 203.185.97.0
  - **Router_A0(config-router)#** network 202.44.204.0
  - **Router_A0(config-router)#** exit

- **Router_A2**
  - **Router_A2>** en
  - **Router_A2#** conf t
  - **Router_A2(config)#** router rip
  - **Router_A2(config-router)#** net 202.44.204.0
  - **Router_A2(config-router)#** net 202.44.205.0
  - **Router_A2(config-router)#** exit

- **Router_A1**
  - **Router_A1>** en
  - **Router_A1#** conf t
  - **Router_A1(config)#** router rip
  - **Router_A1(config-router)#** network 202.44.205.0
  - **Router_A1(config-router)#** net 203.185.98.0
  - **Router_A1(config-router)#** exit

- **Save the pkt file. Wait for a minute to let router broadcast routing table. Inspect the routing table on each router.**

2.6 After enabling RIP, select inspector tool and click on router_A0 then select Routing table. Screen capture and Copy&Paste the routing tables of router_A0, router_A1, and router_A2.

Types: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B – BGP, D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area, N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2, E1 - OSPF external type 1, E2 - OSPF external type 2, E – EGP, i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area, * - candidate default, U - per-user static route, o – ODR, P - periodic downloaded static route

Routing Table of A0

Routing Table for Router_A0

Type	Network	Port	Next Hop IP	Metric
C	202.44.204.0/24	FastEthernet1/0	---	0/0
R	202.44.205.0/24	FastEthernet1/0	202.44.204.1	120/1
C	203.185.97.0/24	FastEthernet0/0	---	0/0
R	203.185.98.0/24	FastEthernet1/0	202.44.204.1	120/2

Routing Table of A1

Routing Table for Router_A1

Type	Network	Port	Next Hop IP	Metric
R	202.44.204.0/24	FastEthernet1/0	202.44.205.1	120/1
C	202.44.205.0/24	FastEthernet1/0	---	0/0
R	203.185.97.0/24	FastEthernet1/0	202.44.205.1	120/2
C	203.185.98.0/24	FastEthernet0/0	---	0/0

Routing Table of A2

Routing Table for Router_A2

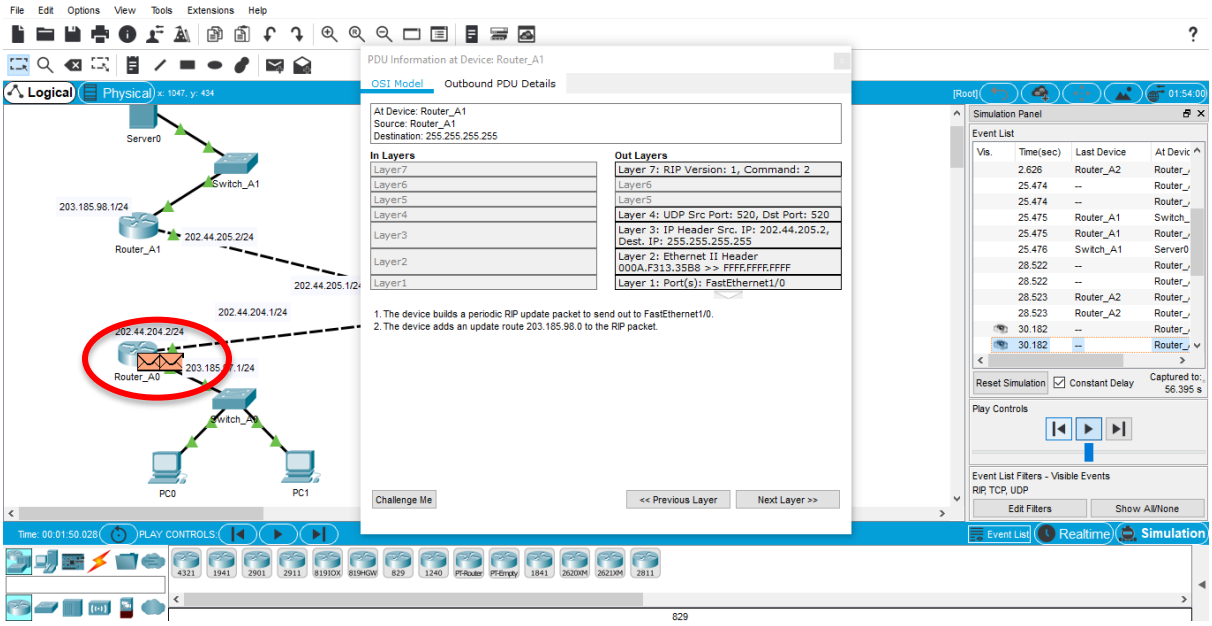
Type	Network	Port	Next Hop IP	Metric
C	202.44.204.0/24	FastEthernet0/0	---	0/0
C	202.44.205.0/24	FastEthernet0/1	---	0/0
R	203.185.97.0/24	FastEthernet0/0	202.44.204.2	120/1
R	203.185.98.0/24	FastEthernet0/1	202.44.205.2	120/1

2.7 Can PC0 ping Server0 now? Explain why. What is the routing protocol used in this topology?

Yes, because in the routing table it already has 4 subnets.

Step 9: Change to Simulation Mode. Click Show All/None to show "None". Choose Edit Filters → Select only RIP. Does ONE Capture/Forward

Step 10: Inspect RIP packets. Click on envelop to see RIP message content. See **Outbound PDU Details**.



2.8 What Transport layer (L4) protocol does the RIP use?

UDP

2.9 Observe PDU at Router_A0, what information is sent by RIP protocol? Explain.

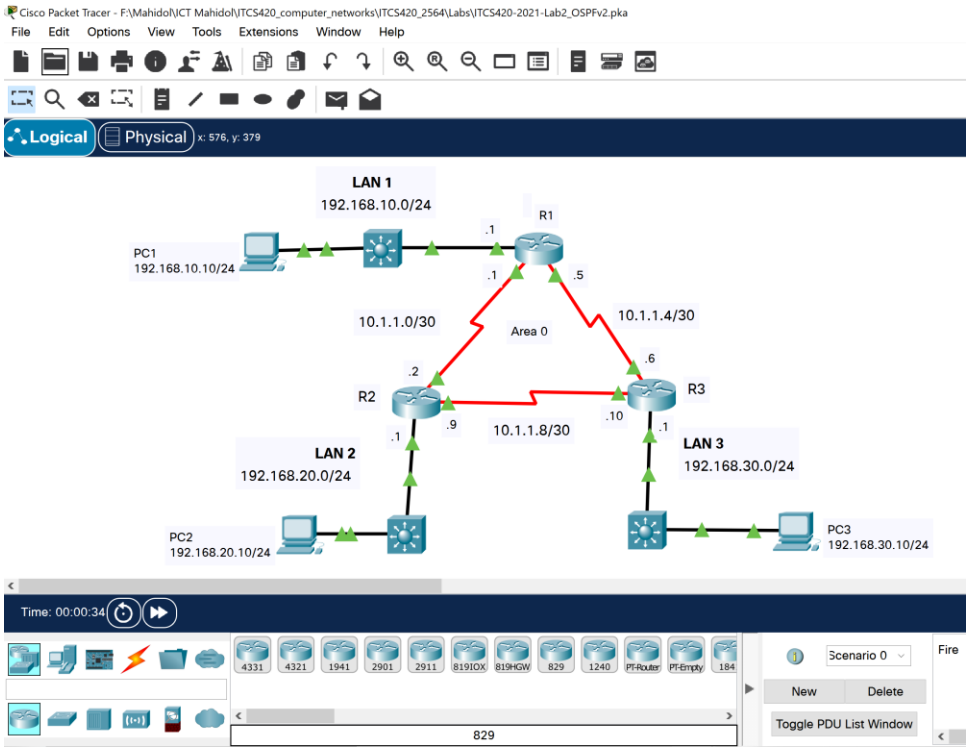
203.185.98.0

2.10 Observe PDUs at all three routers. Does the Router_A2 forward the RIP message that it got from Router_A0 (neighbor) to Router_A1? Is the content of the message the same?

Yes A0 to A2
Network Address: 202.44.205.0
Network Address: 203.185.98.0
A2 to A1
Network Address: 203.185.98.0

Part 3: OSPF Routing Protocol

Step 1: Download and open "ITCS420-2022-Lab2_OSPFv2.pka" file. **Save it** as ***YourID-Name*-ITCS420-2022-Lab2_OSPFv2.pka**



Addressing Table

Device	Interface	IP Address	Subnet Mask
R1	G0/0/0	192.168.10.1	/24
	S0/1/0	10.1.1.1	/30
	S0/1/1	10.1.1.5	/30
R2	G0/0/0	192.168.20.1	/24
	S0/1/0	10.1.1.2	/30
	S0/1/1	10.1.1.9	/30
R3	G0/0/0	192.168.30.1	/24
	S0/1/0	10.1.1.10	/30
	S0/1/1	10.1.1.6	/30
PC1	NIC	192.168.10.10	/24

Device	Interface	IP Address	Subnet Mask
PC2	NIC	192.168.20.10	/24
PC3	NIC	192.168.30.10	/24

Lab questions:

3.1 Screen capture the routing table R1, R2, R3 and paste them here.
Routing table of R1.

Routing Table for R1

Type	Network	Port	Next Hop IP	Metric
C	10.1.1.0/30	Serial0/1/0	---	0/0
L	10.1.1.1/32	Serial0/1/0	---	0/0
C	10.1.1.4/30	Serial0/1/1	---	0/0
L	10.1.1.5/32	Serial0/1/1	---	0/0
C	192.168.10.0/24	GigabitEthernet0/0/0	---	0/0
L	192.168.10.1/32	GigabitEthernet0/0/0	---	0/0

Routing table of R2.

Type	Network	Port	Next Hop IP	Metric
C	10.1.1.0/30	Serial0/1/0	---	0/0
L	10.1.1.2/32	Serial0/1/0	---	0/0
C	10.1.1.8/30	Serial0/1/1	---	0/0
L	10.1.1.9/32	Serial0/1/1	---	0/0
C	192.168.20.0/24	GigabitEthernet0/0/0	---	0/0
L	192.168.20.1/32	GigabitEthernet0/0/0	---	0/0

Routing table of R3.

Routing Table for R3

Type	Network	Port	Next Hop IP	Metric
C	10.1.1.4/30	Serial0/1/1	---	0/0
L	10.1.1.6/32	Serial0/1/1	---	0/0
C	10.1.1.8/30	Serial0/1/0	---	0/0
L	10.1.1.10/32	Serial0/1/0	---	0/0
C	192.168.30.0/24	GigabitEthernet0/0/0	---	0/0
L	192.168.30.1/32	GigabitEthernet0/0/0	---	0/0

3.2 Can PC2 ping PC1? Explain why? What is the direction that the packet passed through?

No, because in routing we have information LAN1 and LAN3. But we don't have LAN2.

Step 2: Configure router IDs.

a. Start the OSPF routing process on R1. Use process ID **10**.

```
Router(config)# router ospf process-id
```

b. Use the router-id command to set the OSPF IDs of the three routers as follows

- R1: **1.1.1.1**
- R2: **2.2.2.2**
- R3: **3.3.3.3**

Use the following command:

```
Router(config-router)# router-id rid
```

Configure R1, R2, R3 as following commands:

- **Router_R1**
  - **Router_R1>** en
  - **Router_R1#** conf t
  - **Router_R1(config)#** router ospf 10
  - **Router_R1(config-router)#** router-id 1.1.1.1

- **Router_R2**
  - **Router_R2>** en
  - **Router_R2#** conf t
  - **Router_R2(config)#** router ospf 10
  - **Router_R2(config-router)#** router-id 2.2.2.2

- **Router_R3**
  - **Router_R3>** en
  - **Router_R3#** conf t
  - **Router_R3(config)#** router ospf 10
  - **Router_R3(config-router)#** router-id 3.3.3.3

Step 3: Configure Networks for OSPF Routing

Configure networks for OSPF routing using network commands and wildcard masks.

How many statements are required to configure OSPF to route all the networks attached to router R1?

The LAN attached to router R1 has a /24 mask. What is the equivalent of this mask in dotted decimal representation?

Subtract the dotted decimal subnet mask from 255.255.255.255. What is the result?

What is the dotted decimal equivalent of the /30 subnet mask?

Subtract the dotted decimal representation of the /30 mask from 255.255.255.255. What is the result?

a. Configure the routing process on R1 and R2 with the network statements and wildcard masks that are required to activate OSPF routing for all the attached networks. The network statement values should be the network or subnet addresses of the configured networks. Use the area-id 0.

```
Router(config-router)# network network-address wildcard-
mask area area-id
```

Configure R1 and R2 as following commands:

- **Router_R1**
  - **Router_R1(config-router)#** network 192.168.10.0 0.0.0.255 area 0
  - **Router_R1(config-router)#** network 10.1.1.0 0.0.0.3 area 0
  - **Router_R1(config-router)#** network 10.1.1.4 0.0.0.3 area 0

- **Router_R2**
  - **Router_R2(config-router)#** network 192.168.20.0 0.0.0.255 area 0
  - **Router_R2(config-router)#** network 10.1.1.0 0.0.0.3 area 0

Note that, if you type incorrectly and want to remove the routing information, put "no" in front of the network command. For example.

- **Router_R2(config-router)# no** network 10.1.1.0 0.0.0.3 area 0

3.3 Can PC2 ping PC1? Explain why? What is the direction that the packet passed through?

Yes, we already set R1 and R2 that why we can ping PC1 and PC2.

3.4 Can PC2 ping PC3? Explain why? What is the direction that the packet passed through?

NO, because we have not set up routing between R2 and R3.

Configure R3 as following commands:

- **Router_R3**
  - **Router_R3(config-router)#** network 10.1.1.4 0.0.0.3 area 0
  - **Router_R3(config-router)#** network 192.168.30.0 0.0.0.255 area 0

3.5 Can PC2 ping PC3? Explain why? What is the direction that the packet passed through?

Yes, because we set R2 and R3 already that why we can ping PC2 and PC3.

3.6 Screen capture and Copy&Paste the routing tables of R1, R2, R3.
Routing table of R1.

Routing Table for R1

Type	Network	Port	Next Hop IP	Metric
C	10.1.1.0/30	Serial0/1/0	---	0/0
L	10.1.1.1/32	Serial0/1/0	---	0/0
C	10.1.1.4/30	Serial0/1/1	---	0/0
L	10.1.1.5/32	Serial0/1/1	---	0/0
C	192.168.10.0/24	GigabitEthernet0/0/0	---	0/0
L	192.168.10.1/32	GigabitEthernet0/0/0	---	0/0
O	192.168.20.0/24	Serial0/1/0	10.1.1.2	110/65

Routing table of R2.

Routing Table for R2

Type	Network	Port	Next Hop IP	Metric
C	10.1.1.0/30	Serial0/1/0	---	0/0
L	10.1.1.2/32	Serial0/1/0	---	0/0
O	10.1.1.4/30	Serial0/1/0	10.1.1.1	110/128
C	10.1.1.8/30	Serial0/1/1	---	0/0
L	10.1.1.9/32	Serial0/1/1	---	0/0
O	192.168.10.0/24	Serial0/1/0	10.1.1.1	110/65
C	192.168.20.0/24	GigabitEthernet0/0/0	---	0/0
L	192.168.20.1/32	GigabitEthernet0/0/0	---	0/0

Routing table of R3.

Routing Table for R3

Type	Network	Port	Next Hop IP	Metric
C	10.1.1.4/30	Serial0/1/1	---	0/0
L	10.1.1.6/32	Serial0/1/1	---	0/0
C	10.1.1.8/30	Serial0/1/0	---	0/0
L	10.1.1.10/32	Serial0/1/0	---	0/0
C	192.168.30.0/24	GigabitEthernet0/0/0	---	0/0
L	192.168.30.1/32	GigabitEthernet0/0/0	---	0/0

3.7 At R3 in the enable console, run the below command to show the current running configuration. Push space bar to see the next page and screen capture the OSPF configuration part, and paste it here.

Router_R3# `show running-config`

```
R3#
R3#show running-config
Building configuration...

Current configuration : 828 bytes
!
version 15.4
no service timestamps log datetime msec
no service timestamps debug datetime mse
no service password-encryption
!
hostname R3
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface GigabitEthernet0/0/0
 ip address 192.168.30.1 255.255.255.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/1/0
 ip address 10.1.1.10 255.255.255.252
!
interface Serial0/1/1
 ip address 10.1.1.6 255.255.255.252
!
interface Vlan1
 no ip address
 shutdown
!
router ospf 10
 router-id 3.3.3.3
 log-adjacency-changes
 network 10.1.1.4 0.0.0.3 area 0
 network 192.168.30.0 0.0.0.255 area 0
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

3.8 What do we have to do, if we want the ping packet from PC2 to PC3 to pass the network 10.1.1.8/30? Explain.

If we want to ping we have to config of 10.1.1.8/30 on both R2 and R3.

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