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SCS3309 LAB 1

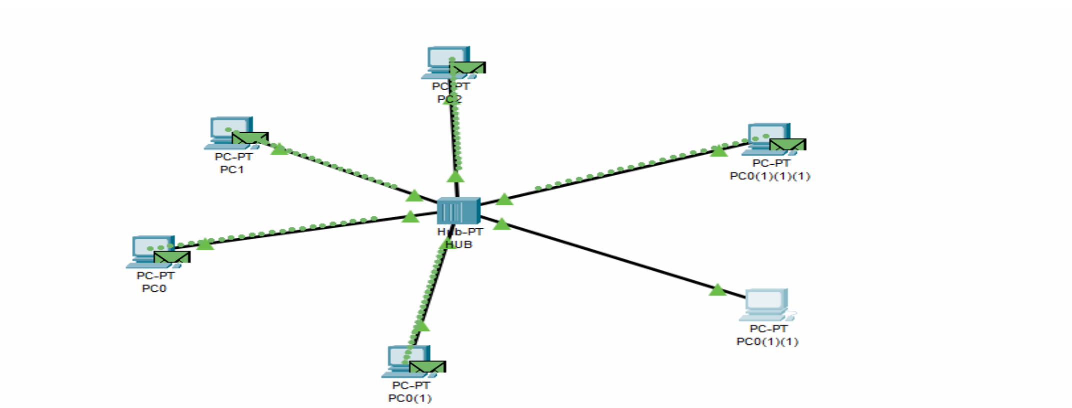
QUESTION 1

(a) What is a collision domain?

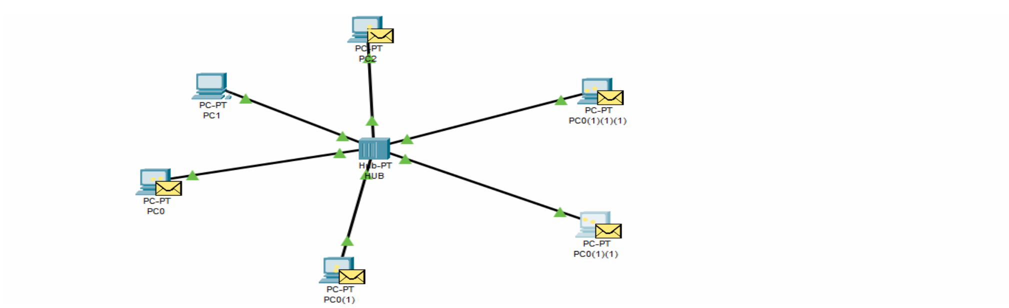
A collision domain is a group of nodes that can hear each other

(b) Do you consider the ports in a network

(c) (i) hub —--------For a hub, All devices connected to a hub share the same collision domain. This means if any two devices on the hub attempt to send data simultaneously, a collision occurs. The hub has only one collision domain because it broadcasts incoming packets to all connected devices, causing all nodes to be in the same collision domain.as shown below diagrams

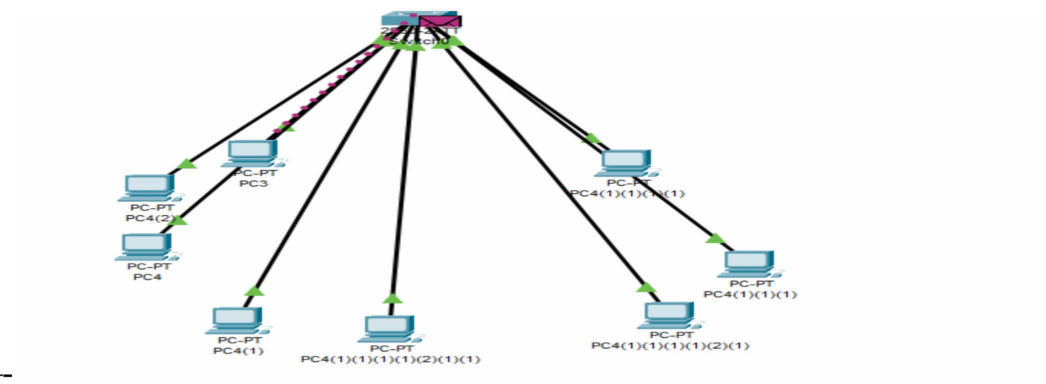


(d) —

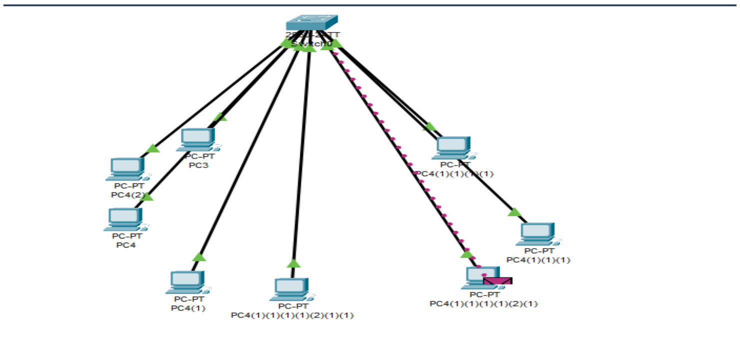


(e)

(f) (ii) switch —-------switch creates a separate collision domain for each of its ports. This means that if one device sends data to another device connected to the same switch, only the target device will receive it, and other devices will not be affected. Each port on a switch is its own collision domain, so collisions are isolated to each port's segment.as shown in the below diagram message from PC3 is reach to only PC-4.



(g) —-



(h) (iii) router—--------- Routers do not create or manage collision domains directly. Instead, they segment collision domains by connecting different network segments. Each interface on a router represents a separate collision domain, as the router forwards packets between segments but does not allow direct communication between devices on different interfaces

Devices on different router interfaces are in separate collision domains. For instance, if a device on Router A's interface sends a packet to a device on Router B's interface, the packet must pass through the router, isolating the collision domains of the devices connected to each router interface.

to be in the same or different collision domains? Explain! Subsequently explain/show how you could support your answer using packet tracer.

(i) What is a broadcast domain?

—------a broadcast domain is a group of devices which will receive a broadcast frame (MAC destination:FFFF.FFFF.FFFF.FFFF) sent by the any of the members.

Do you consider the ports in a network

(i) hub —- A hub has only one broadcast domain. Since a hub broadcasts all incoming signals to all connected devices, any broadcast frame sent by any device is received by every device connected to the hub.

(ii) switch– it has only one broadcast domain. This means that all ports on a single switch are part of the same broadcast domain. Consequently, if a device sends out a broadcast frame, every other device connected to that switch will receive the frame.

(iii) router —-----

Routers segment broadcast domains. Each interface on a router represents a separate broadcast domain. Broadcast frames are not forwarded by routers, so devices on different router interfaces are in different broadcast domains.

to be in the same or different broadcast domains? Explain! Subsequently explain/show how you could support your answer using packet tracer.

(j) Given your answers in (a) and (b) above, determine the number of collision and broadcast domains in each of the following network scenarios and fill in the table below. Subsequently explain/show how you could support your answer using packet tracer.

Network Scenario	Number of collision domains	Number of broadcast domains	How would you support your answer using packet tracer
An ethernet hub interconnects four hosts A,B,C and D	1	1	
An ethernet hub interconnects four hubs A,B,C and D and each hub interconnects four hosts	1	1	
An ethernet switch interconnects four hubs A,B,C and D and and each hub interconnects four hosts	16	1	
An ethernet switch interconnects four hosts A,B,C and D.	4	1	
An ethernet router interconnects four hosts A,B,C and D	4	4	
An ethernet router interconnects four switches A,B,C and D and each switch interconnects four hosts.	16	4	

QUESTION 2

(a) When the **size** (number of users or devices) of a collision domain **reduces**, does the network performance improve or does it degrade? When the size of a collision domain reduces, network performance generally improves.

Discuss any **two** factors that contribute to the change in performance that you have highlighted. **Latency and Retransmissions:**

- **Factor:** Larger collision domains lead to higher collision rates, which increases the time spent in retransmitting data. Each collision introduces delay as devices need to wait for a random backoff period

  Network Bandwidth Utilization:

- **Factor:** In a larger collision domain, the available bandwidth is shared among more devices. As the number of devices increases, the bandwidth available to each device decreases because of the higher probability of collisions and the increased overhead from managing those collisions.

(b) Does the network performance improve or does it degrade when you split a broadcast domain into smaller (reducing the size) broadcast domains? –Splitting a broadcast domain into smaller broadcast domains usually **improves network performance**.

Discuss any **two** factors that contribute to the change in performance that you have highlighted.

1.Reduced Broadcast Traffic

In a single, large broadcast domain, all broadcast traffic (such as ARP requests, DHCP discover messages, etc.) is sent to every device within the domain. As the number of devices increases, so does the amount of broadcast traffic, which can cause congestion and degrade performance

2.Improved Security and Isolation

When you split a large broadcast domain into smaller segments, you also gain better control over security and isolation. Devices within different broadcast domains cannot directly communicate with each other unless routed

(c) An ethernet hub interconnects four hosts A,B,C and D. Does the network performance improve or does it degrade when you replace the hub with a switch?

network performance improves significantly,

Discuss any **three** factors that contribute to the change in performance that you have highlighted.

1.Collision Domain Reduction:

- **Hub**: All devices connected to a hub share the same **collision domain**

2. Full-Duplex Communication:

- **Hub**: A hub operates in **half-duplex mode**, meaning devices can either send or receive data at a time, but not both simultaneously. This limits bandwidth and increases the chance of collisions.

(d) An ethernet switch sw1 interconnects four switches sw2, sw3, sw4 and sw5. Each of the four switches (sw2 - sw5) interconnects four hosts A,B,C and D. Does the network performance improve or does it degrade when you **replace** the switch sw1 with a router? Discuss any **two** factors that contribute to the change in performance that you have highlighted

(e) **degrade** in terms of speed,

(f) 1. **Network Segmentation (Broadcast Domains)**: 2. **Routing vs. Switching Latency**:

QUESTION 3

An Ethernet router R1 interconnects two switches sw1 and sw2. Sw1 interconnects two hosts PC1 and PC2 via their Fa0/2 and Fa0/3 ports. Similarly sw2 interconnects two hosts PC3 and PC4 via their Fa0/2 and Fa0/3 ports. sw1 and sw2 each connect to Router R1 via their Fa0/1 interfaces. R1 connects to sw1 and sw2 via its Fa0/1 and Fa0/2 interfaces respectively. The networks are subnets of the following network NetIDs:132.108.0.0 (Explain your subnetting decisions in networks A and B referred to in this question)

Part A

(a) Draw a well labeled network diagram of the above described network A using packet tracer. Show the list of IP addresses that you would assign to the network devices and the end user devices.

Network A (for PC1 and PC2, connected through sw1):

- **Subnet**: 132.108.1.0/24
- **Router R1 Fa0/1**: 132.108.1.1
- **Switch sw1**: No IP needed, just Layer 2
- **PC1**: 132.108.1.2 /24, Default Gateway: 132.108.1.1
- **PC2**: 132.108.1.3 /24, Default Gateway: 132.108.1.1

Network B (for PC3 and PC4, connected through sw2):

(b) **Subnet**: 132.108.2.0/24

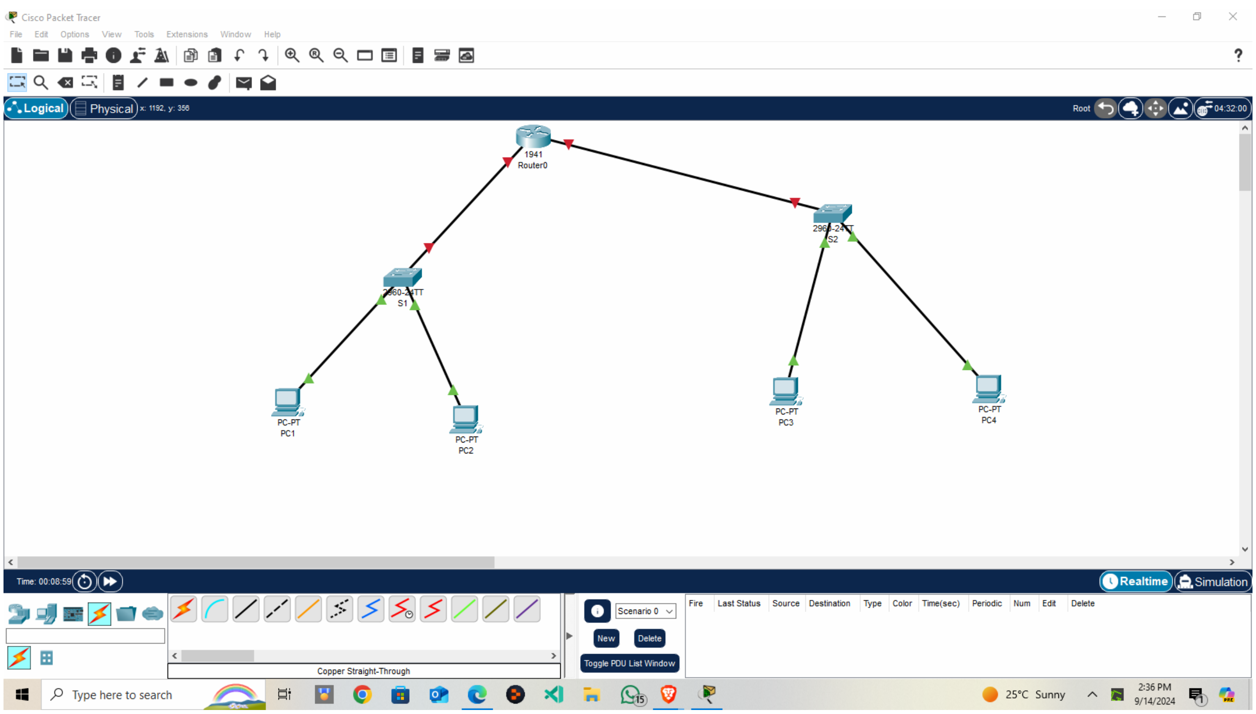
(c) **Router R1 Fa0/2**: 132.108.2.1

(d) **Switch sw2**: No IP needed, just Layer 2

(e) **PC3**: 132.108.2.2 /24, Default Gateway: 132.108.2.1

(f) **PC4**: 132.108.2.3 /24, Default Gateway: 132.108.2.1

(g)



(h) Display the content of the routing table before configuration.

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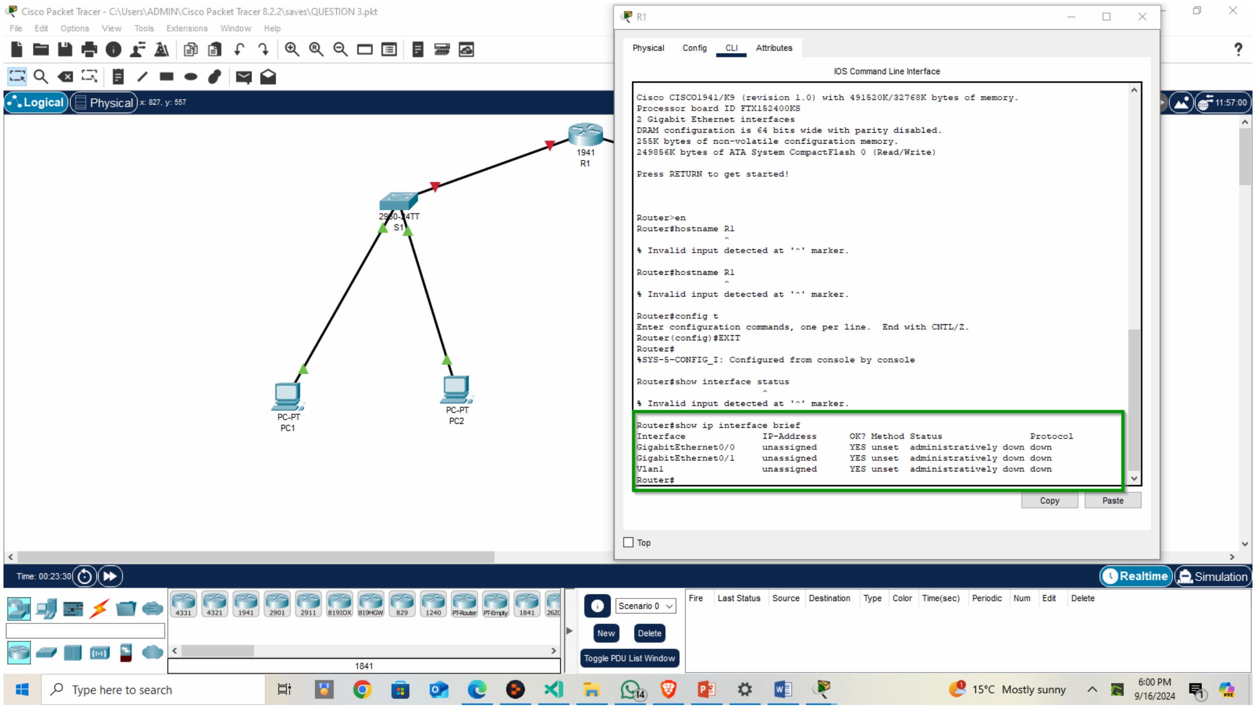

(i) Configure the network that you have drawn in (a) above. List every configuration that you have made on each (i)

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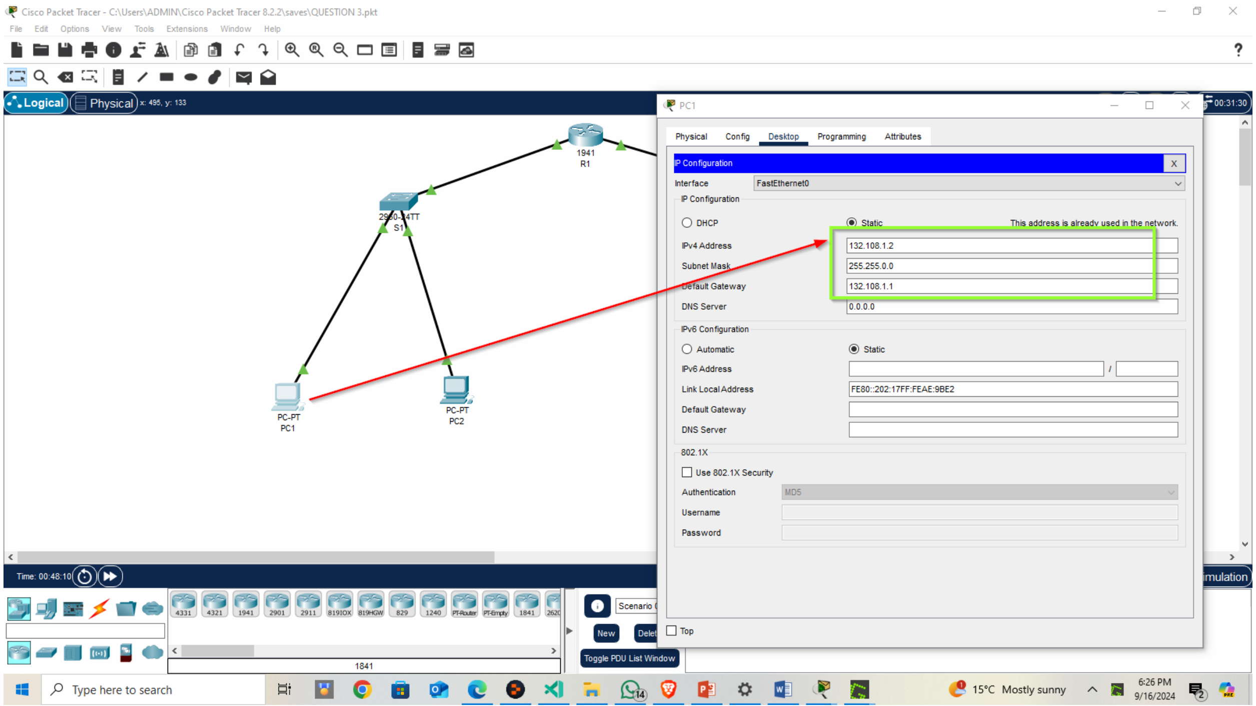
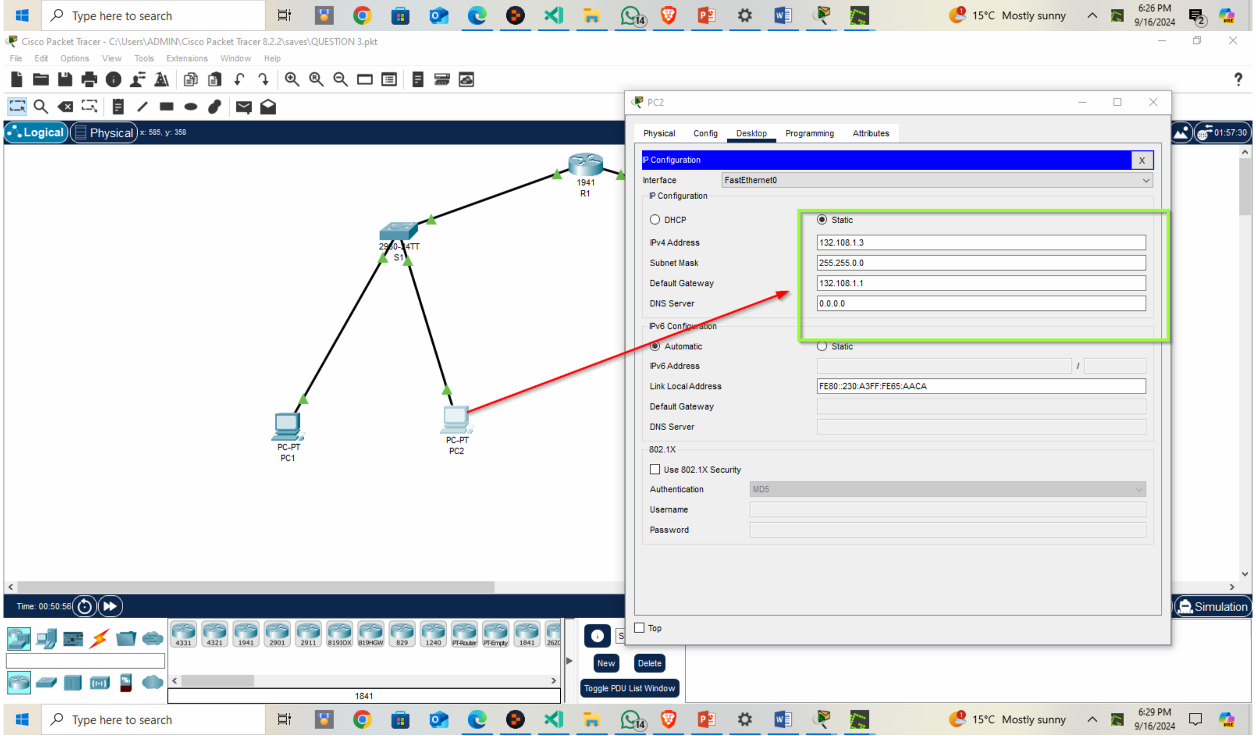
(j) host





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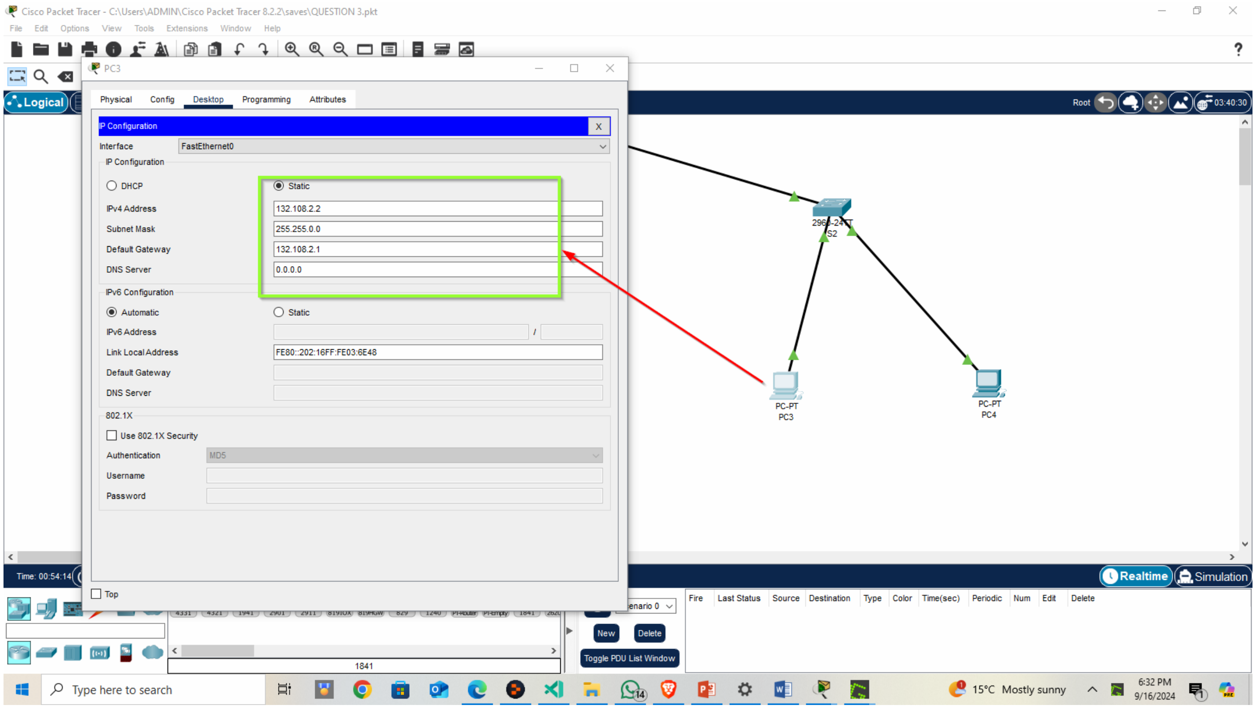
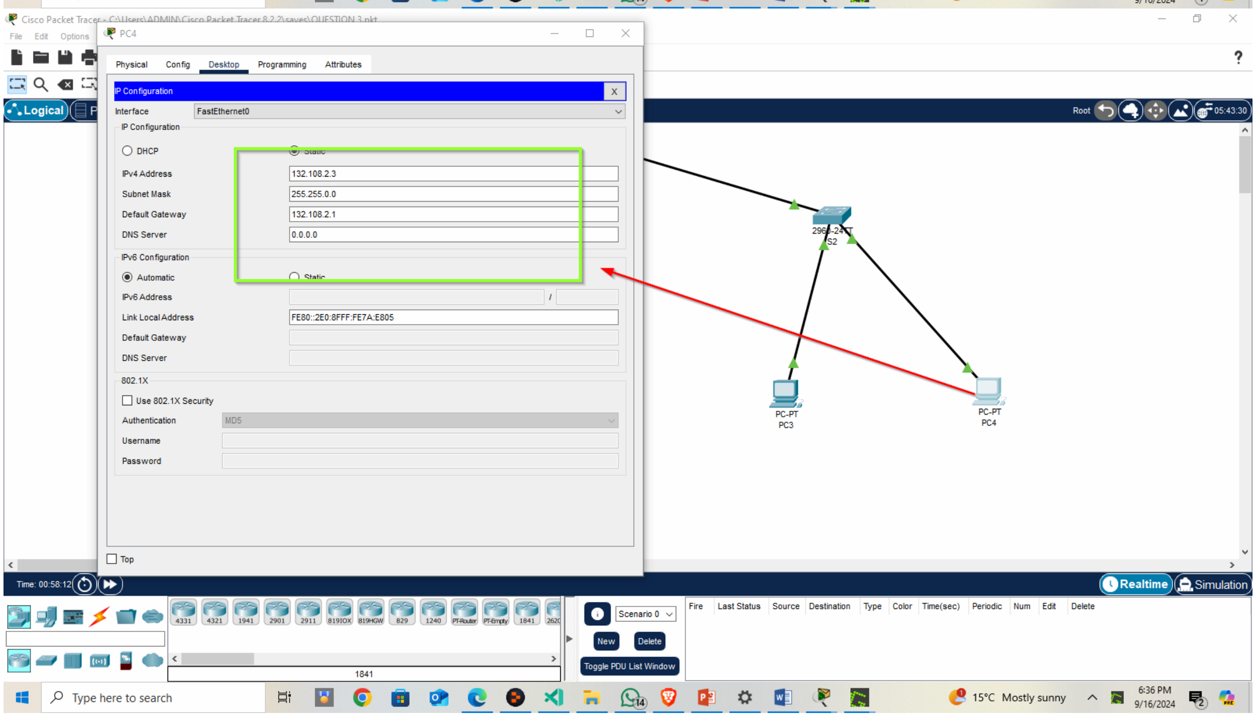
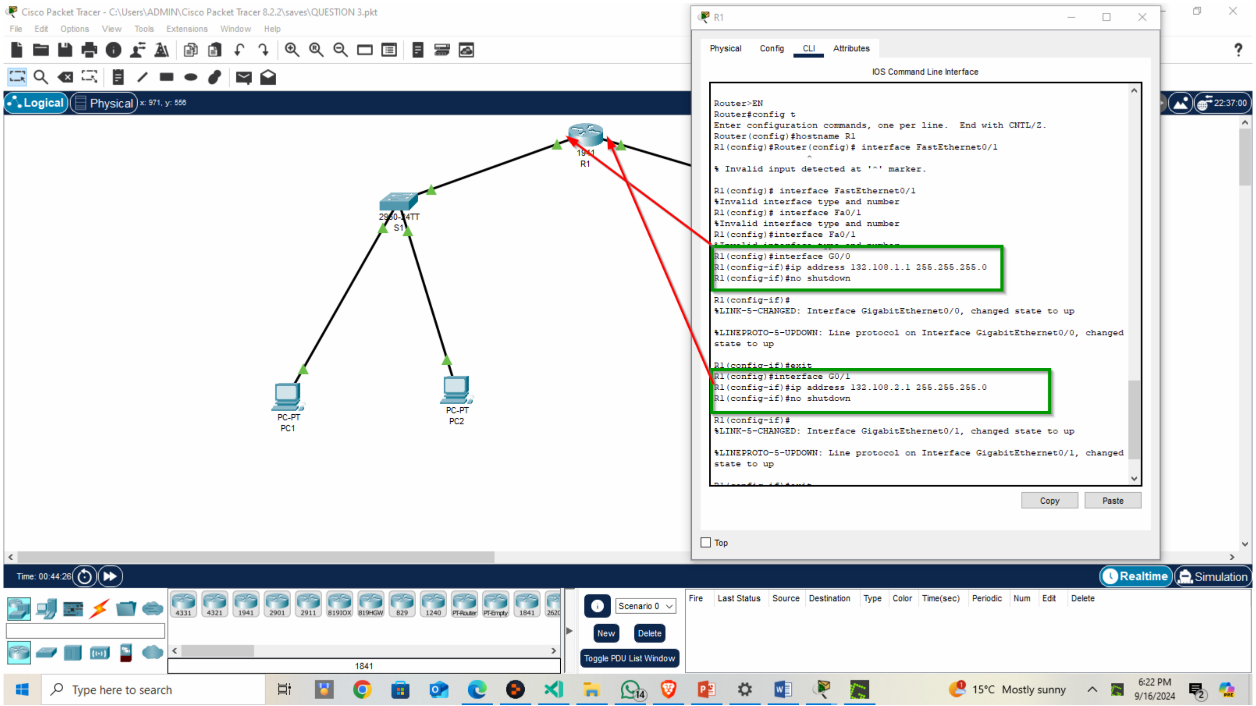




(k) (ii) Switch ----------uisng default switches..

(l) and (iii) Router.



(m) Verify the connectivity between computers in different networks. **video**

(n) Display the content of the routing table of Router R1 and explain its content. **Video**

https://drive.google.com/file/d/1Q27rY47SYHB9FHpdOupBJ7Gb4nIG_rM5/view?usp=sharing

(o) A message is sent from PC1 on sw1 to PC3 on sw2.

- Based on the routing table described in (c) above, how will the message be processed by the router?

PC1 sends packet to **PC3**'s IP (different subnet).
PC1 forwards to **Router R1** (default gateway **132.108.1.1**).
R1 receives packet on **GigabitEthernet0/0** (subnet **132.108.1.0/24**).
R1 checks routing table:

- Finds **132.108.2.0/24** connected to **GigabitEthernet0/1**.

R1 forwards packet out of **GigabitEthernet0/1** (towards **sw2**).
sw2 delivers packet to **PC3**.
PC3 receives the packet (destined for its IP).

- Using packet tracer, determine the source and destination IP addresses of the (i) inbound and (ii) outbound packet at Router 1? Explain! **Video** https://drive.google.com/file/d/1VvAfweNhD-cyYGSNS1ZvALaNjebjNmsa/view?usp=sharing

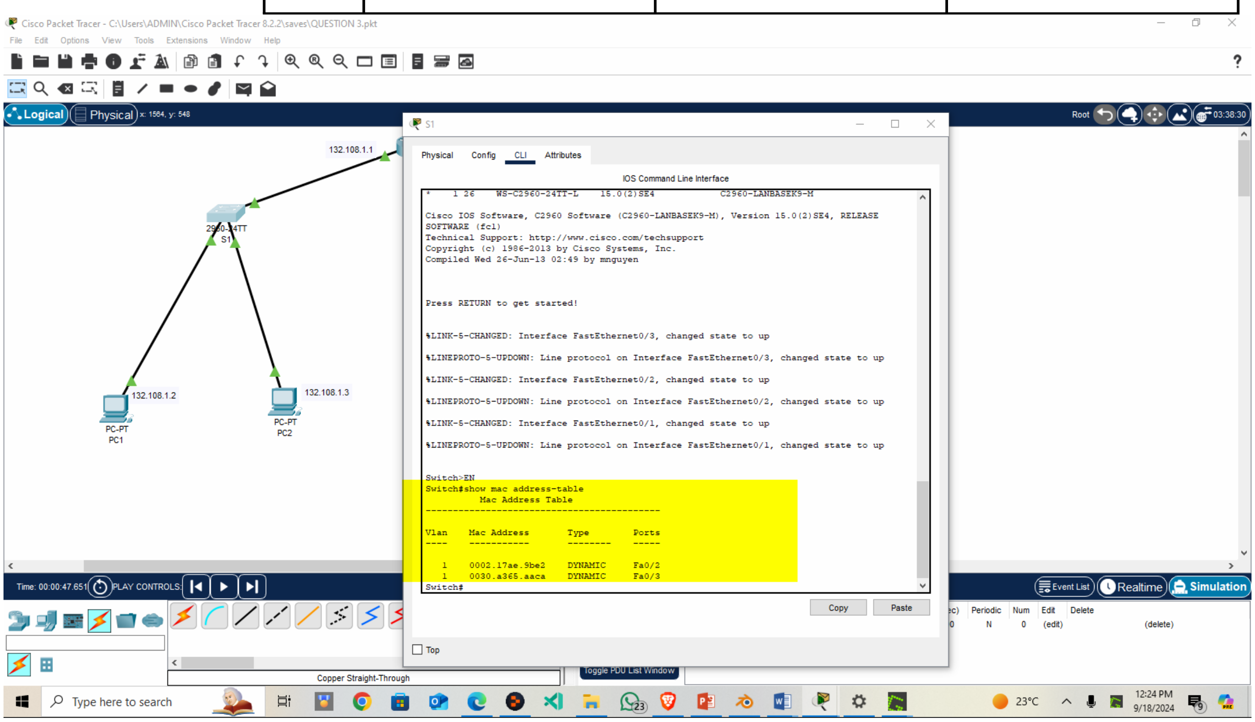
- Determine the source and destination MAC addresses of the (i) inbound and (ii) outbound message at Router 1? Explain!**video**

  https://drive.google.com/file/d/1OoFk07LLfzvx8VanQhLx1A2jsOBmEKyq/view?usp=sharing

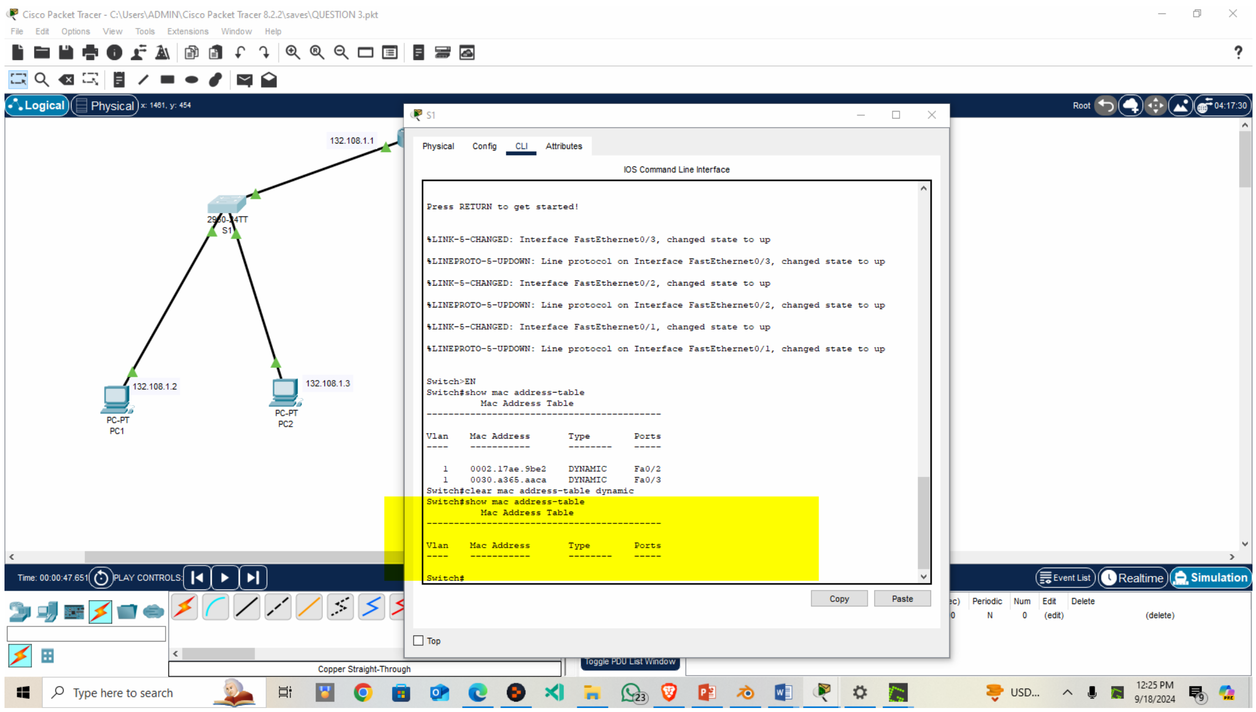
Part B

Example: MAC address table for sw1

VLAN	MAC address	Type	Port
1	000 .7d01.000A	DYNAMIC	Fa0/1
1	0000.8b01.000C	DYNAMIC	Fa0/2



- **Clear** the Mac address tables in sw1 & sw2 so you can have **empty MAC address tables.** **Clear the ARP cache** in all devices so you can have **empty ARP caches**.



Subsequently the following four transmissions take place in the network

- Step 1: PC1 pings PC2 at time t0.
- Step 2:PC2 pings PC1 at time t1.
- Step 3:PC1 pings PC3 at time t2
- Step 4:PC3 pings PC1 at time t3

- **For each** of the **four** transmissions display (**video**) the Mac address tables of each switch (sw1, sw2) **after each transmission**. Explain the content of your MAC address table at each step.
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https://drive.google.com/file/d/1SiFRp0Cna0CqAcZ8r4428r0jphItMwo2/view?usp=sharing

- **Question 1,2&3 are to be submitted on wednesday 18th september 2024: latest by 1:00 p.m.**