

# CSCI 5010 – Fundamentals of Data Communications

## Lab 4 – VLANs, trunking and inter-VLAN routing

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## Summary

The foundational layer to any network revolves around switching. This lab is intended to be an overview of VLANs, trunk links and inter-VLAN routing.

The questions in the lab are intentionally vague. The purpose of this is for you not only to research, investigate, and learn the technologies, but also become proficient at interpreting both non-technical and technical questions. Being able to research and discover answers on your own will be critical as you progress in your career.

- Learn how to create VLANs within a single switch
- Learn how to create VLANs across multiple switches
- Learn how to achieve Inter-VLAN communication using trunking (802.1q) and “routing on a stick”

## Objective 1 - Switch VLAN Configuration

This objective will configure multiple VLANs on a single switch.

Diagram 1

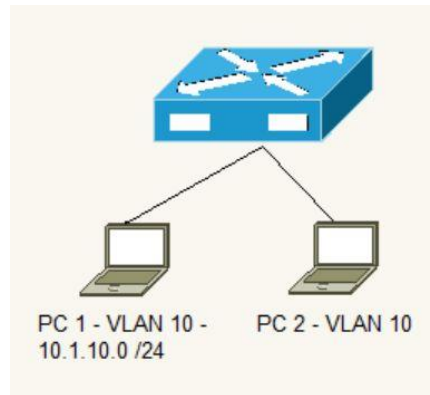
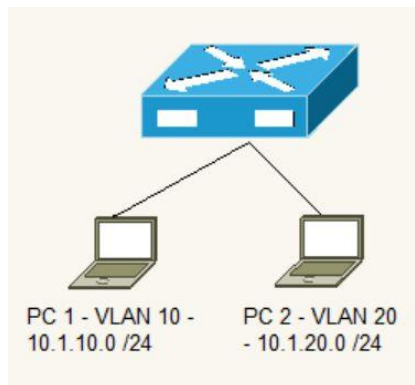


Diagram 2



1. Use diagram 1 to verify connectivity within same VLAN (VLAN 10)
2. Assign IP addresses to the PCs
  - a. Make sure the PCs are in the same subnet

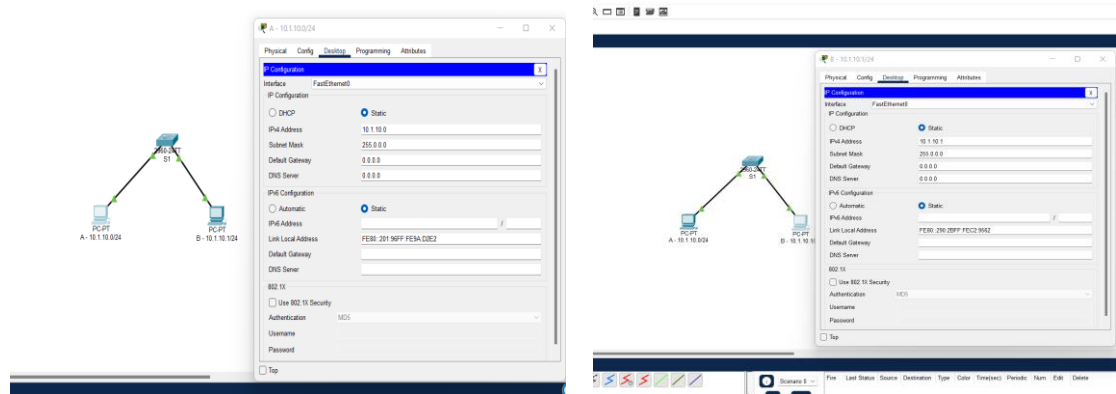
The screenshot shows a network simulation with a switch S1 connected to two PCs, A and B. PC A has IP 10.1.10.0/24 and PC B has IP 10.1.10.1/24. The switch configuration window is open, showing the CLI interface with the command 'show vlan' and the output of the command.

```
Switch#show vlan
VLAN Name                Status    Ports
-----
1    default                active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                           Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                           Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                           Fa0/13, Fa0/14, Fa0/15,
Fa0/16
                                           Fa0/17, Fa0/18, Fa0/19,
Fa0/20
                                           Fa0/21, Fa0/22, Fa0/23,
Fa0/24
10   vlan10                 active    Gig0/1, Gig0/2
1002 fddi-default         active
1003 token-ring-default   active
1004 fddinet-default      active
1005 trnet-default        active

VLAN Type  SAID      MTU    Parent RingNo BridgeNo Stp    BrgdMode Transl
-----
1    enet    100001   1500    -      -      -      -      0      0
10   enet    100010   1500    -      -      -      -      0      0
1002 fddi    101002   1500    -      -      -      -      0      0
1003 tr     101003   1500    -      -      -      -      0      0
--More--
```

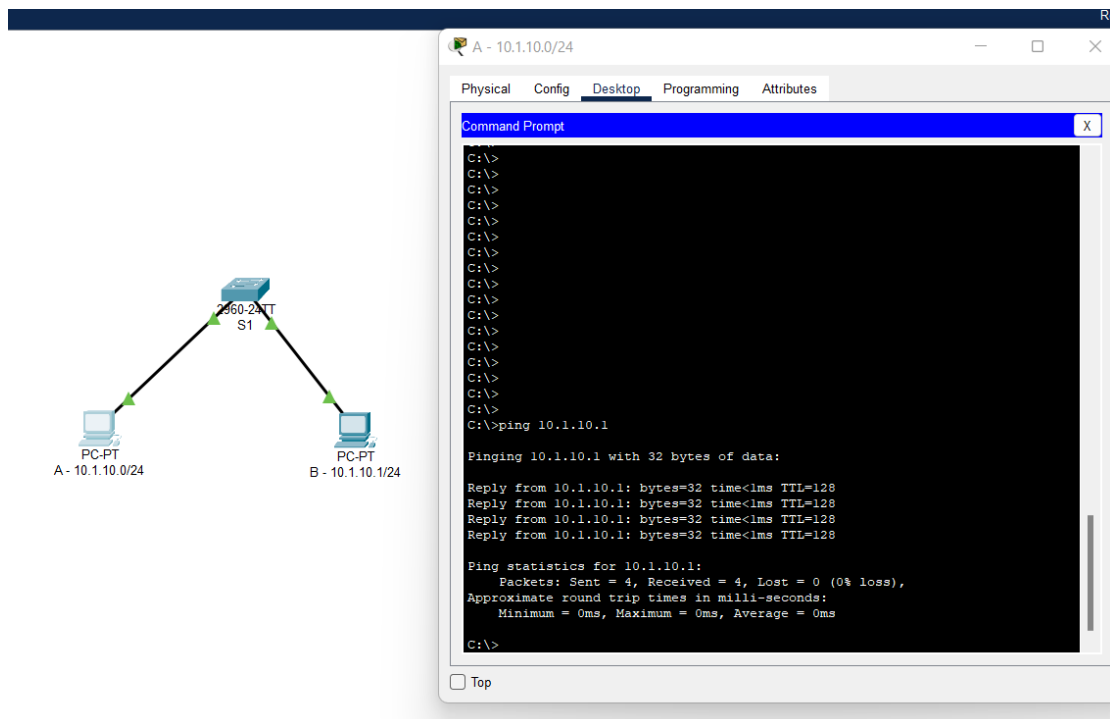
- b. What are the IPs you assigned to both PCs? Why do these IP subnets have to be in the same subnet? [5 points]

Ans: PC1: 10.1.10.0/24, PC2: 10.1.10.1/24. The IP Subnets have to be in the same subnet to route/communicate with one another within one VLAN Network. Precisely, the IP subnets of host devices within a same VLAN should have same subnet to talk to each other. The IP Addresses within the same subnet are considered to be a single network and allocated a VLAN ID. And the hosts with similar VLAN ID can traverse data traffic b/w each.

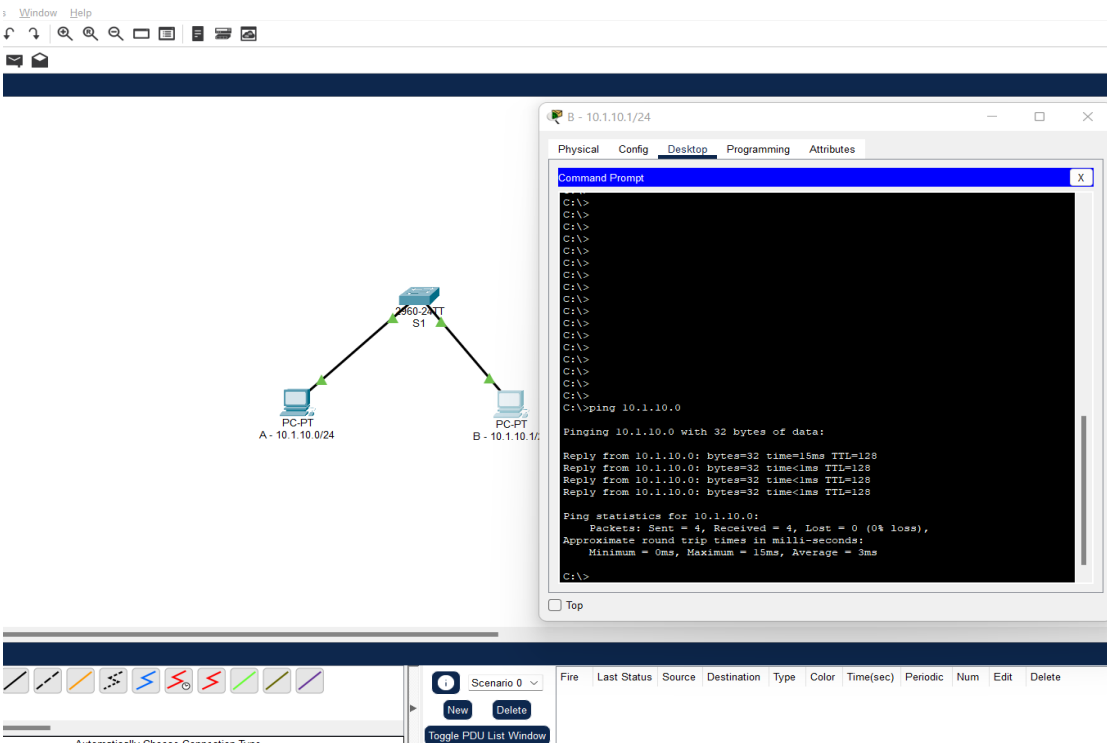


- c. Verify Ping connectivity between PCs. Paste screenshot [2 points]

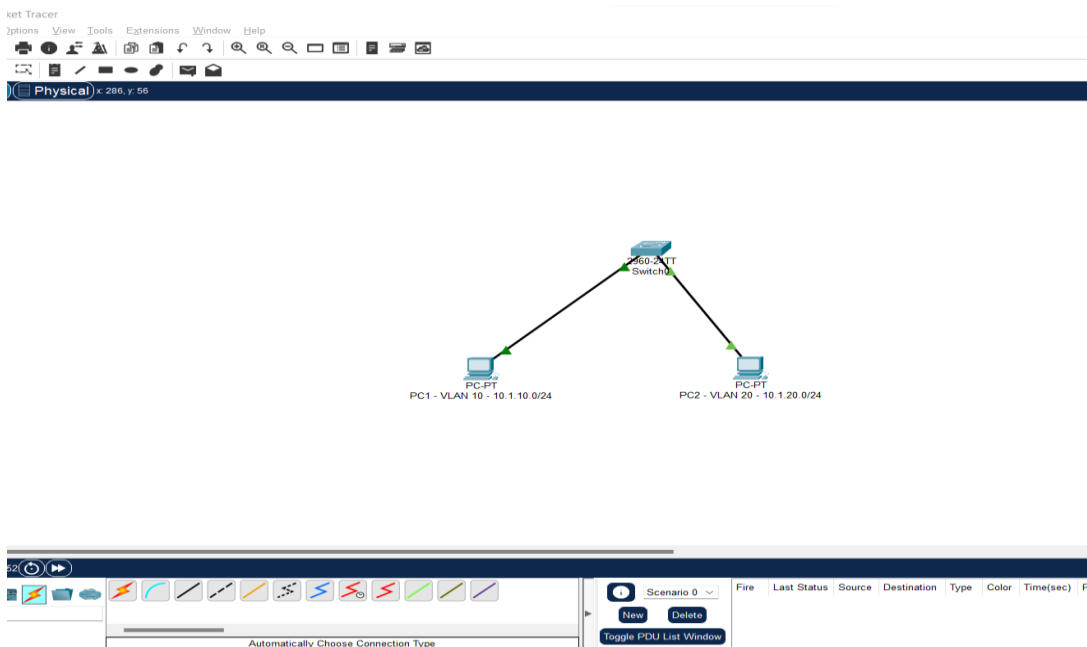
Successful Ping from PC-A to PC-B (10.1.10.0) to (10.1.10.1)



Successful Ping from PC-B to PC-A (10.1.10.1) to (10.1.10.0)



3. Now create two different VLANs (diagram 2)



- a. VLAN 10 should be named Engineering
- b. VLAN 20 should be named Sales
  - i. Use the appropriate **show** commands on the switch to indicate this [5 points]

Using SHOW VLAN, SHOW Interfaces FastEthernet0/1 switchport, SHOW VLAN ALL PORTS, SHOW RUNNING-CONFIG we can see VLAN 10 is named Engineering, VLAN 20 is Sales.

```

Switch0
Physical Config CLI Attributes
IOS Command Line Interface

Switch#
Switch#show vlan

VLAN Name                Status    Ports
-----
1    default                active    Fa0/3, Fa0/4, Fa0/5, Fa0/6
                                           Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                           Fa0/11, Fa0/12, Fa0/13,
                                           Fa0/14
                                           Fa0/15, Fa0/16, Fa0/17,
                                           Fa0/18
                                           Fa0/19, Fa0/20, Fa0/21,
                                           Fa0/22
                                           Fa0/23, Fa0/24, Gig0/1,
                                           Gig0/2
3    VLAN0003                active
10   Engineering              active    Fa0/1
20   Sales                   active    Fa0/2
1002 fddi-default            active
1003 token-ring-default     active
1004 fddinet-default        active
1005 trnet-default          active

VLAN Type  SAID      MTU    Parent RingNo BridgeNo Stp    BrdgMode Transl
Trans2
-----
1    enet     1000001  1500   -       -       -       -       -       0       0

```

#### 4. Assign PC1 to Engineering

```

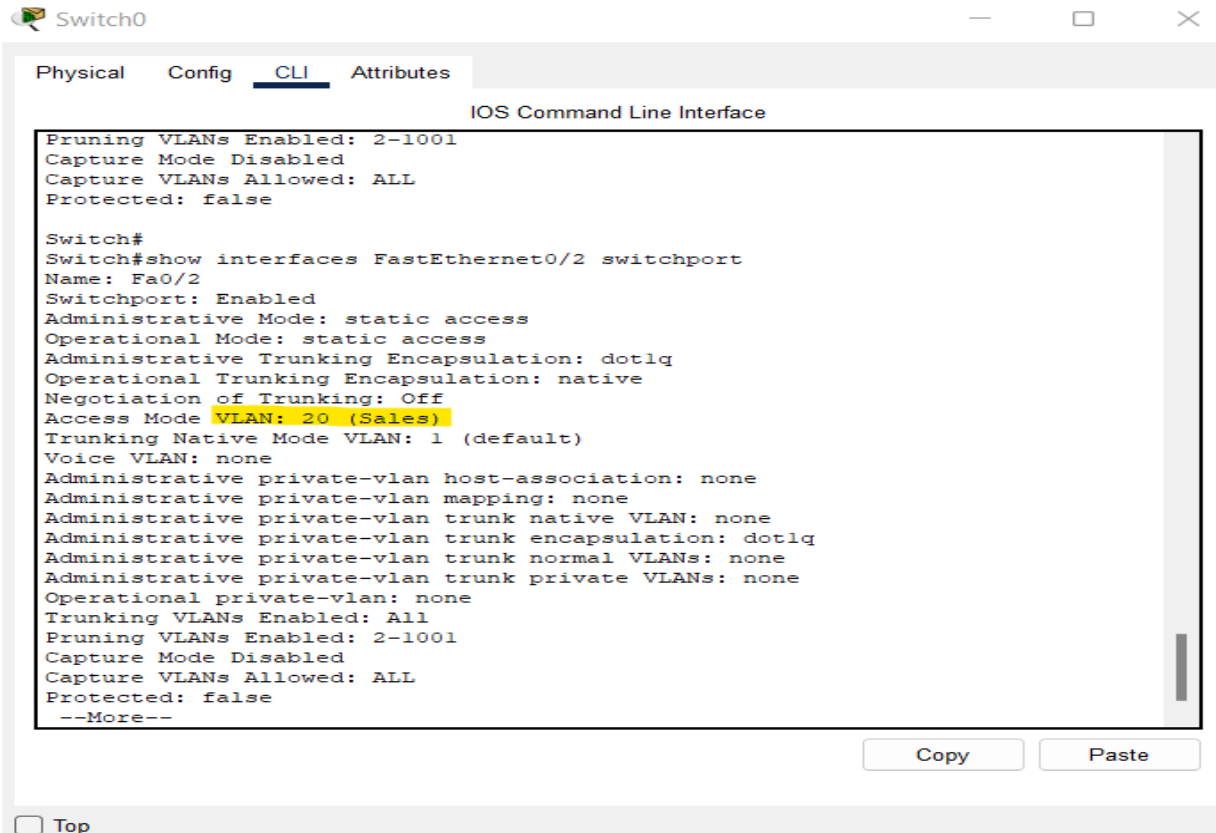
Physical Config CLI Attributes
IOS Command Line Interface

1    enet     1000001  1500   -       -       -       -       -       0       0
3    enet     1000003  1500   -       -       -       -       -       0       0
10   enet     1000010  1500   -       -       -       -       -       0       0

Switch#
Switch#
Switch#show interfaces FastEthernet0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 10 (Engineering)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
--More--

```

## 5. Assign PC2 to Sales



The screenshot shows a network switch configuration window titled "Switch0". The "CLI" tab is selected, displaying the "IOS Command Line Interface". The output of the command "show interfaces FastEthernet0/2 switchport" is shown, indicating that the interface is configured as an access mode VLAN 20 (Sales). The configuration includes details about pruning, capture mode, and trunking.

```
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false

Switch#
Switch#show interfaces FastEthernet0/2 switchport
Name: Fa0/2
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 20 (Sales)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
--More--
```

Buttons for "Copy" and "Paste" are visible at the bottom right of the CLI window. A "Top" button is located at the bottom left of the window.

- a. Assume no MAC entries exist in the switch. Explain step by step everything that happens in the network as soon as ping is initiated from PC1 towards PC2. Can PC1 ping PC2? Why or why not? [10 points]

Different Network = Different VLAN = Different Broadcast Domain.

Layer-2 MAC Addresses are only significant to the Local VLAN/ Network/Broadcast domain. So, PING Fails. Packet gets dropped.

1. When Ping is initiated from PC1, the host creates IP Packet with its own IP address (10.1.10.0) as the source and (10.1.20.0) as the destination. And the first question PC1 asks itself is – is the destination host in the same network/subnet or not?
2. It answers this question by looking at its own IP address, its subnet mask and the destination IP address: using "ipconfig" command

PC1-VLAN10-10.1.10.0

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ipconfig

FastEthernet0 Connection: (default port)

    Connection-specific DNS Suffix...: 
    Link-local IPv6 Address . . . . .: FE80::203:E4FF:FEAC:3549
    IPv6 Address . . . . .: ::
    IPv4 Address . . . . .: 10.1.10.0
    Subnet Mask . . . . .: 255.0.0.0
    Default Gateway . . . . .: ::
                                   10.0.0.1

Bluetooth Connection:

    Connection-specific DNS Suffix...: 
    Link-local IPv6 Address . . . . .: ::
    IPv6 Address . . . . .: ::
    IPv4 Address . . . . .: 0.0.0.0
    Subnet Mask . . . . .: 0.0.0.0
    Default Gateway . . . . .: ::
                                   0.0.0.0
```

PC2-VLAN20-10.1.20.0

Physical Config Desktop Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection: (default port)

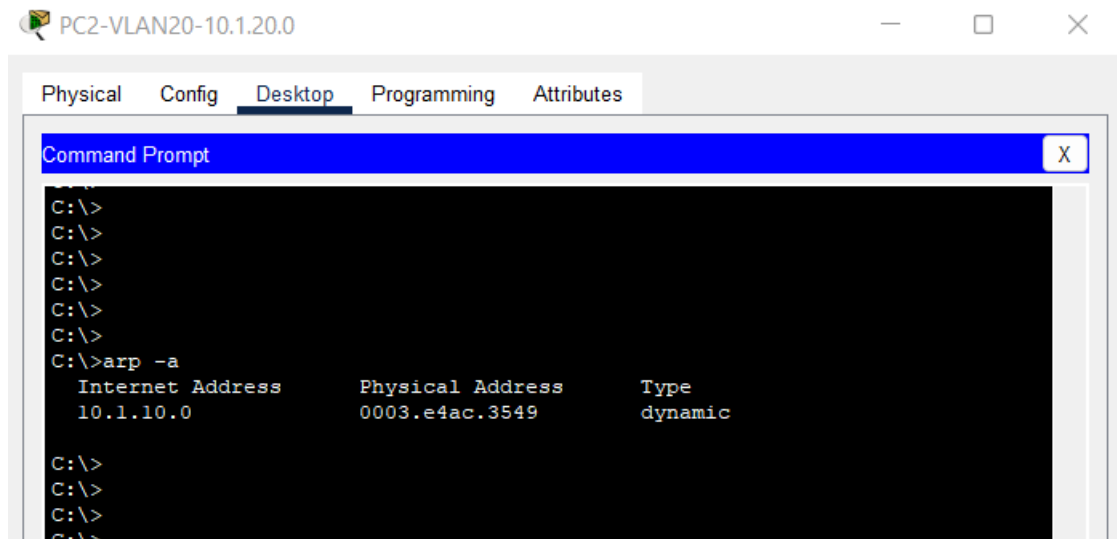
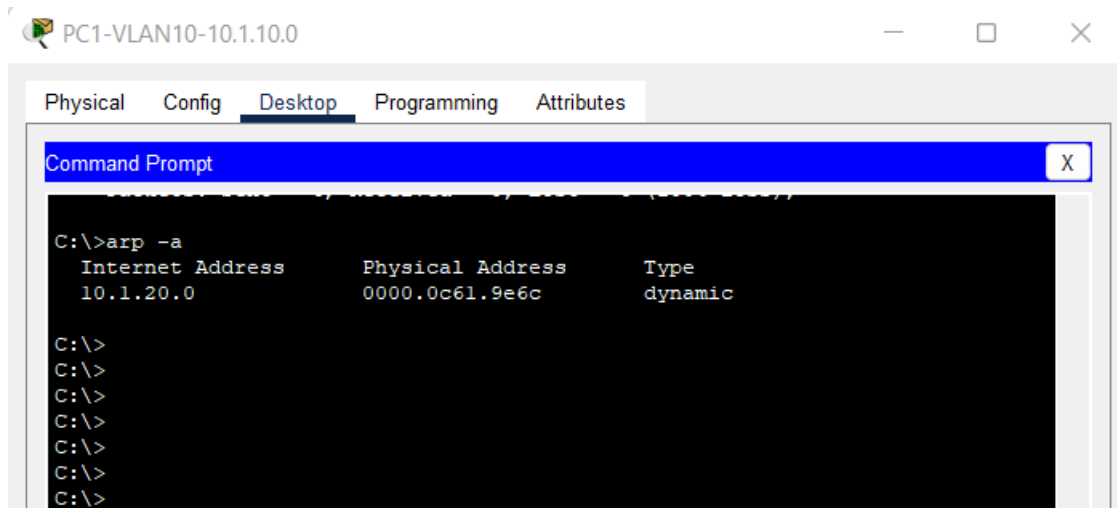
    Connection-specific DNS Suffix...: 
    Link-local IPv6 Address . . . . .: FE80::200:CFF:FE61:9E6C
    IPv6 Address . . . . .: ::
    IPv4 Address . . . . .: 10.1.20.0
    Subnet Mask . . . . .: 255.0.0.0
    Default Gateway . . . . .: ::
                                   0.0.0.0

Bluetooth Connection:

    Connection-specific DNS Suffix...: 
    Link-local IPv6 Address . . . . .: ::
    IPv6 Address . . . . .: ::
    IPv4 Address . . . . .: 0.0.0.0
    Subnet Mask . . . . .: 0.0.0.0
    Default Gateway . . . . .: ::
                                   0.0.0.0
```

3. PC1 will now build an Ethernet frame, enters its own source MAC address and asks itself the do I know the destination MAC address of the switch. It checks ARP Table to find an entry. If the entry is found (it is found because before enabling the vlan I tried to ping to PC2)





The Switch stores the MAC and ARP entries in the ARP Table. But the PING cannot happen because the VLAN 20 is configured on a different port and VLAN 10 is configured on a different port. And they belong to different Network. Assigning a different VLAN to switch port in a network means creating a different LANS hence the name VLAN.

6. Enable Telnet on the switch

- a. What should be done so PC1 can Telnet to the switch? [5 points]

To enable telnet to the switch, the interface FastEthernet 0/1 connecting to the VLAN10 port must be configured with telnet access. And can be done

(Config)#Int Vlan 10

(Config-if)#Ip add 192.168.10.1 255.255.255.0

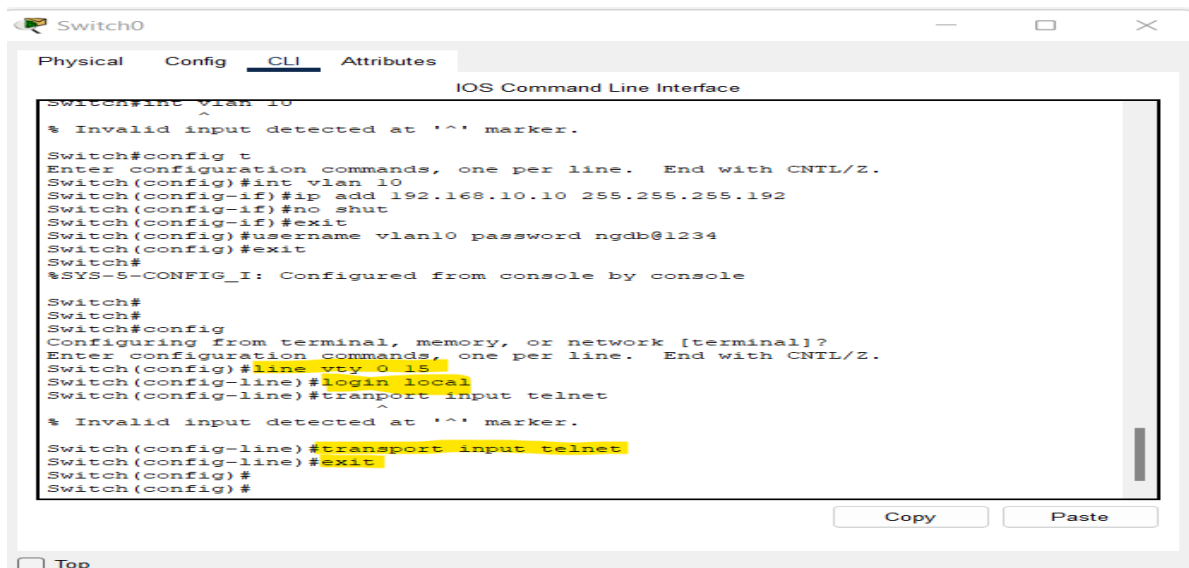
(Config-if)#no shut

(Config-if)#username Vlan10 Password Cisco

(Config-if)#line vty 0 15

(Config-if)#login local

(Config-if)#transport input telnet



```
Switch0
Physical  Config  CLI  Attributes
IOS Command Line Interface

Switch#int vlan 10
^
% Invalid input detected at '^' marker.

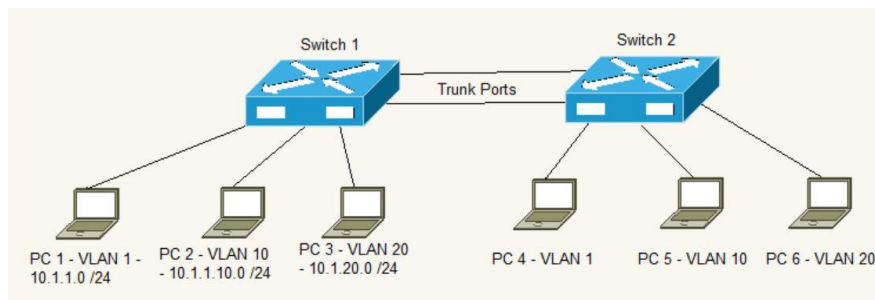
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int vlan 10
Switch(config-if)#ip add 192.168.10.10 255.255.255.192
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#username vlan10 password ngdb@1234
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#
Switch#
Switch#config
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#line vty 0 15
Switch(config-line)#login local
Switch(config-line)#transport input telnet
^
% Invalid input detected at '^' marker.

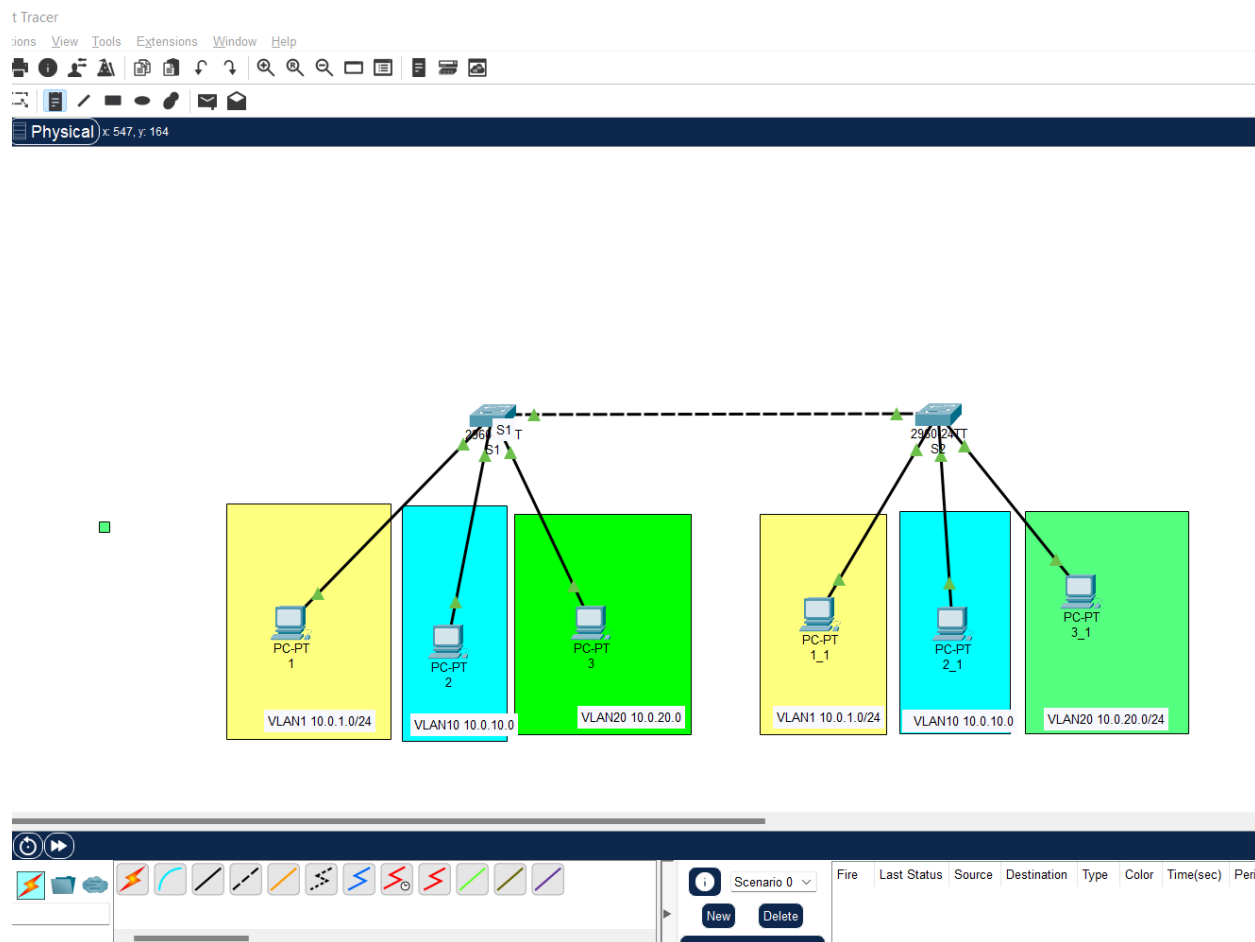
Switch(config-line)#transport input telnet
Switch(config-line)#exit
Switch(config)#
Switch(config)#
```

## Objective 2 - Switch VLAN and Trunk Configuration

This objective will configure multiple VLANs on multiple switches and connect the switches via ports.



1. Setup the network as indicated in the diagram (*hint: Switch2 configuration should be a duplicate of Switch1*)

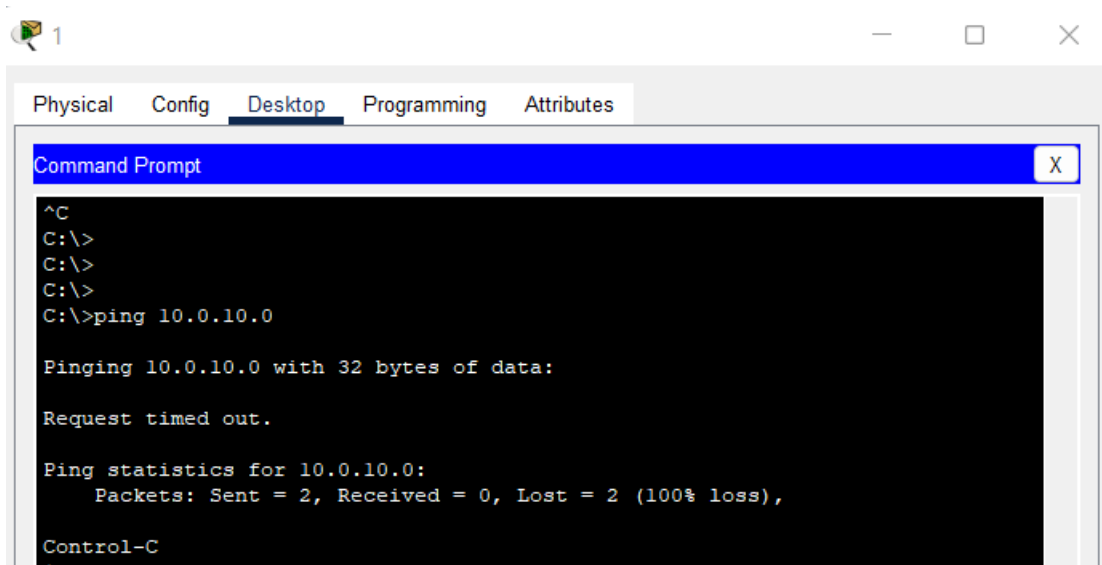


2. In what IP subnet is IP address of PC5 present? What design considerations did you have to make when choosing this IP subnet? **[3 points]**

IP Address of PC5 is 10.0.10.0 (same as PC2 because we duplicating) and its IP Subnet is a Class A network with default subnet mask of 255.0.0.0 and have 0-127 as first octet. The address is 10.0.10.0 who's first octet is "10" which is between 1 and 126. so it's a class A subnet.

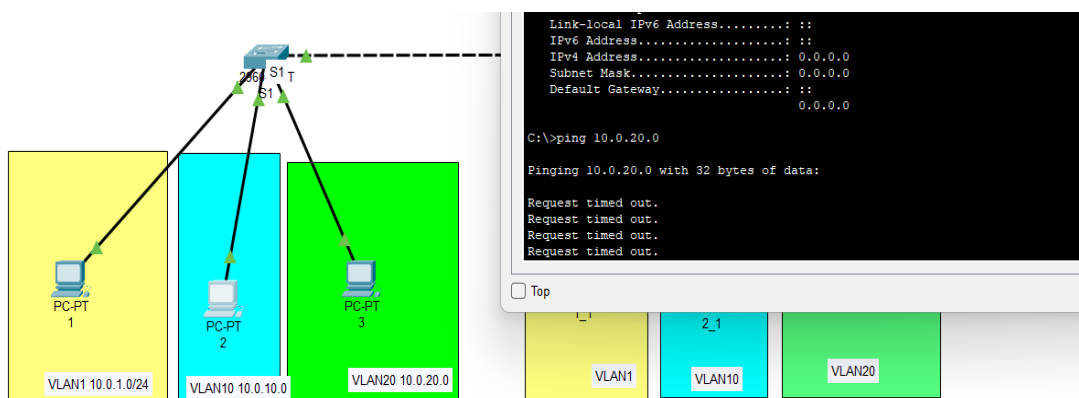
Can PC1 and PC2 Ping each other? Why or why not? [3 points]

No PC1 and PC2 cannot ping each other because they belong to different VLAN. And different network. Ping / communication can happen only b/w the the same VLAN. Different VLAN's means different LAN's but virtually configured switches. So ping Fails.



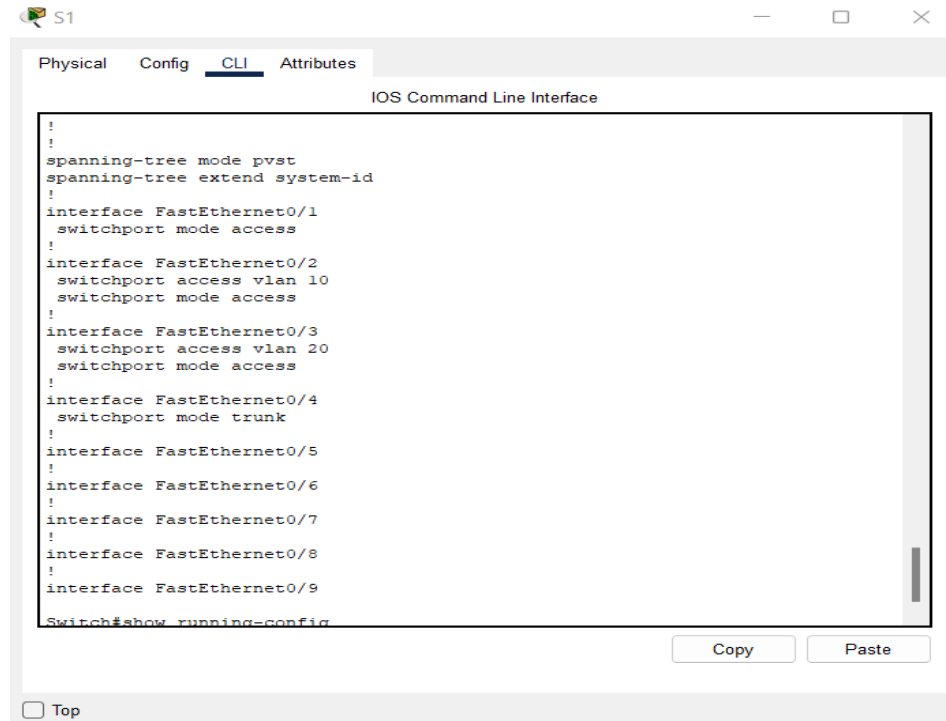
3. Can PC2 and PC3 Ping each other? Why or why not? [3 points]

No. PC2 and PC3 cannot ping each other because they belong to different VLAN. And different network. Like mentioned in the above answer, the objective of VLAN's is to connect the same VLAN's route/communicate with each other and enable higher security. (for ex : Sales\_1 VLAN will only talk to Sales\_2 not Engineering likewise PC2 can talk to PC5 but not PC2 to PC3.



4. Configure the switches so PCs can ping within the same VLAN.
  - a. Provide the relevant configuration from both switches [5 points]

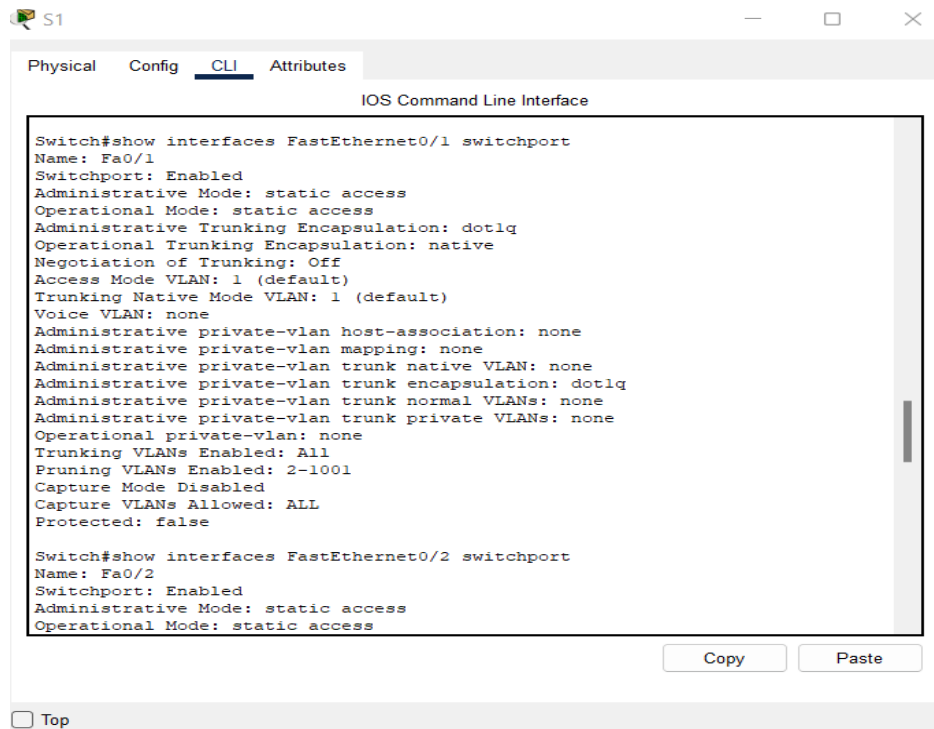
Switch 1: Configured with VLAN1, VLAN 10, VLAN 20 and Trunk Port



The screenshot shows the CLI configuration for Switch 1. The configuration includes spanning-tree settings, and configurations for interfaces Fa0/1 through Fa0/9. Fa0/1 is in VLAN 1, Fa0/2 is in VLAN 10, Fa0/3 is in VLAN 20, and Fa0/4 is configured as a trunk port. The other interfaces (Fa0/5 through Fa0/9) are shown without specific configurations. The prompt is Switch#.

```
Switch#show running-config
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport mode access
!
interface FastEthernet0/2
 switchport access vlan 10
 switchport mode access
!
interface FastEthernet0/3
 switchport access vlan 20
 switchport mode access
!
interface FastEthernet0/4
 switchport mode trunk
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
Switch#
```

Fa0/1 VLAN 1 Configuration on S1:

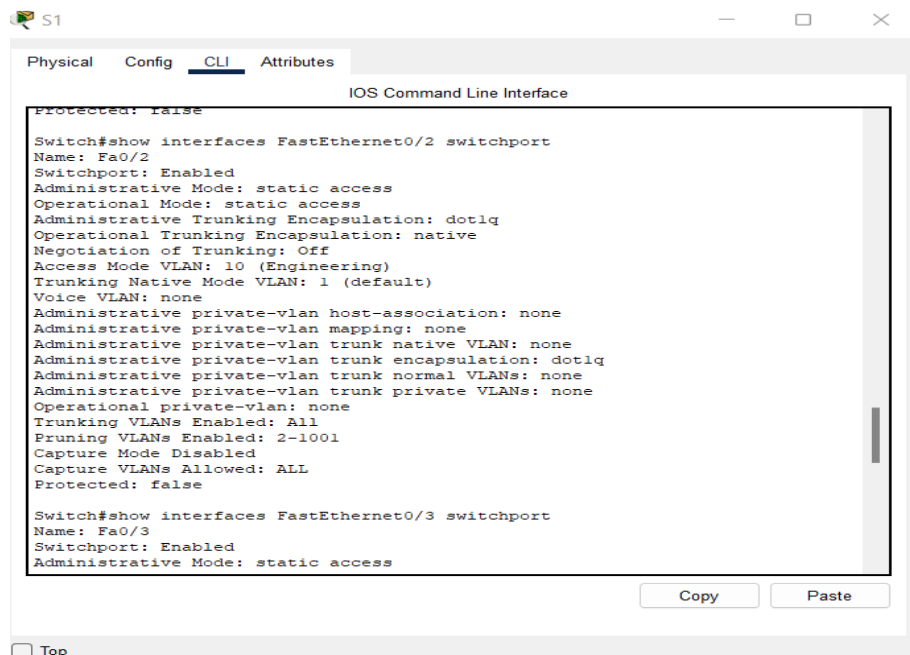


The screenshot shows the CLI configuration for Fa0/1 VLAN 1 on Switch 1. The configuration includes the command 'show interfaces FastEthernet0/1 switchport' and the output of the command. The output shows that Fa0/1 is configured as a static access port in VLAN 1. The prompt is Switch#.

```
Switch#show interfaces FastEthernet0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false

Switch#show interfaces FastEthernet0/2 switchport
Name: Fa0/2
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Switch#
```

## Fa0/2 VLAN 10 Configuration on S1:



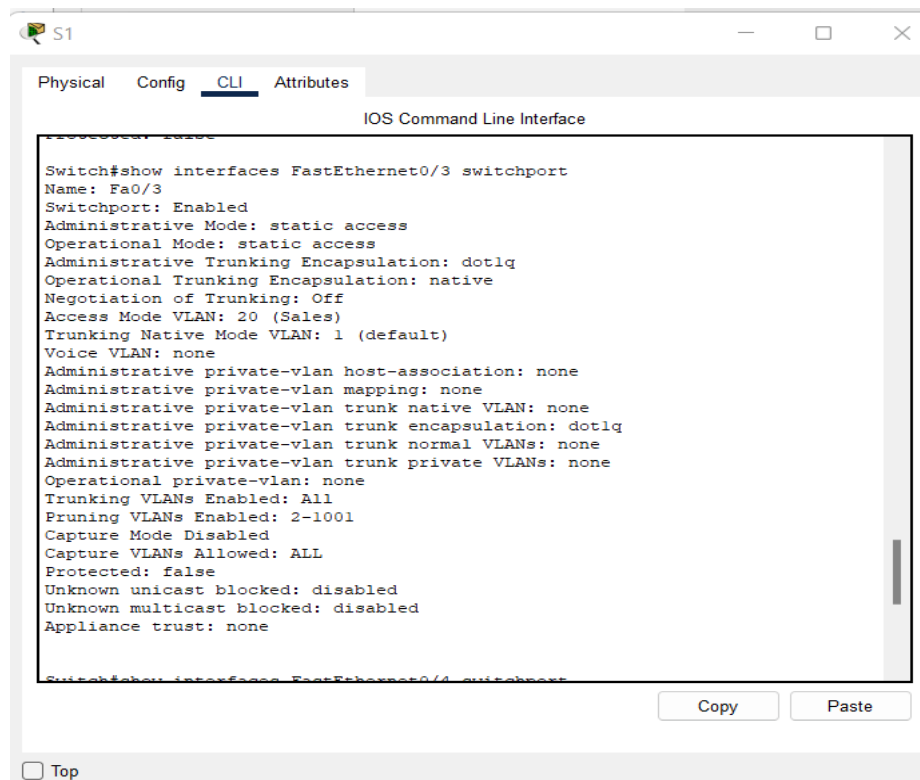
The screenshot shows a network simulator window titled 'S1' with tabs for Physical, Config, CLI, and Attributes. The CLI tab is active, displaying the 'IOS Command Line Interface'. The output of the command 'Switch#show interfaces FastEthernet0/2 switchport' is shown, indicating that Fa0/2 is configured as an access port for VLAN 10 (Engineering). Below this, the command 'Switch#show interfaces FastEthernet0/3 switchport' is shown, indicating that Fa0/3 is also configured as an access port, but its VLAN is not explicitly shown in the output.

```
Protected: false

Switch#show interfaces FastEthernet0/2 switchport
Name: Fa0/2
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 10 (Engineering)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false

Switch#show interfaces FastEthernet0/3 switchport
Name: Fa0/3
Switchport: Enabled
Administrative Mode: static access
```

## Fa0/3 VLAN 20 Configuration on S1:



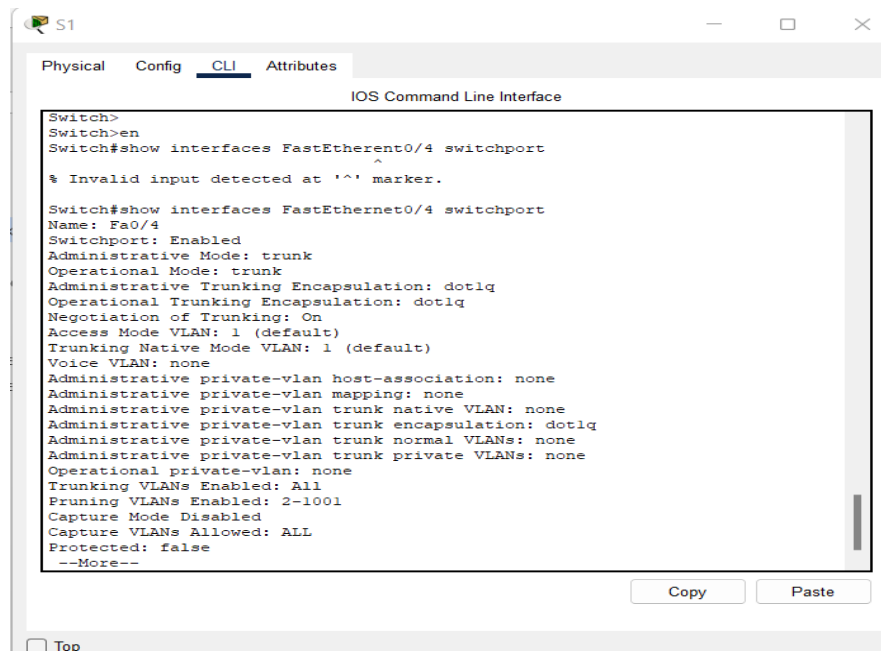
The screenshot shows the same 'S1' network simulator window. The CLI tab is active, displaying the output of the command 'Switch#show interfaces FastEthernet0/3 switchport'. This output shows that Fa0/3 is configured as an access port for VLAN 20 (Sales). Below this, the command 'Switch#show interfaces FastEthernet0/4 switchport' is shown, but its output is not visible in the screenshot.

```
Protected: false

Switch#show interfaces FastEthernet0/3 switchport
Name: Fa0/3
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 20 (Sales)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

Switch#show interfaces FastEthernet0/4 switchport
```

## Fa0/4 VLAN 20 Configuration on S1:



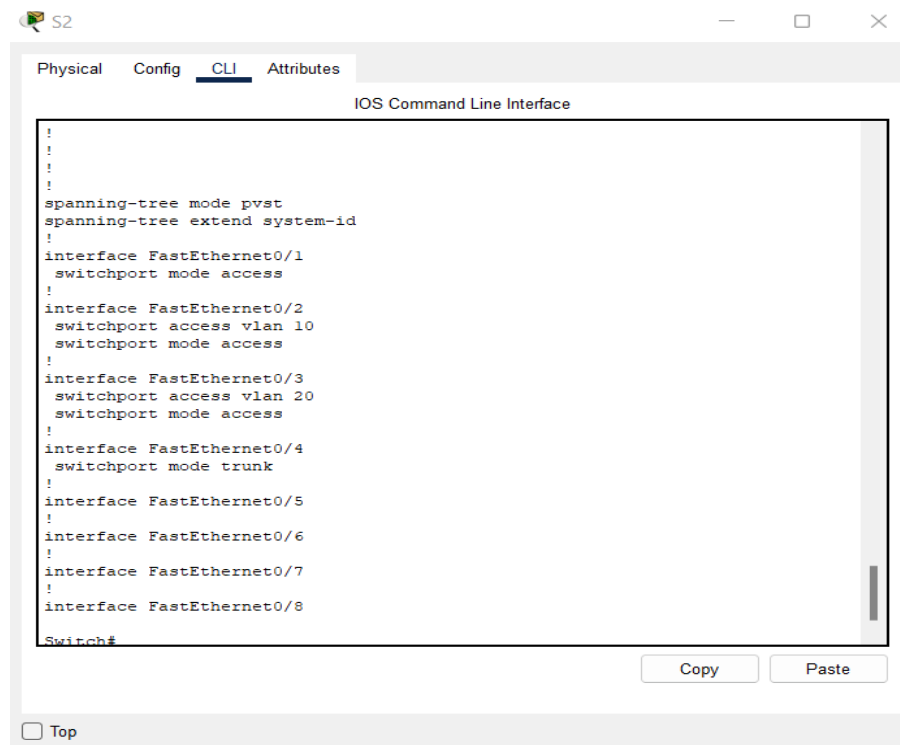
The screenshot shows the CLI window for switch S1. The 'Config' tab is selected, and the 'CLI' sub-tab is active. The command prompt is 'Switch>'. The user has entered 'en' to enter enable mode, followed by 'show interfaces FastEthernet0/4 switchport'. The output shows that Fa0/4 is configured as a trunk port with dot1q encapsulation and VLAN 1 as the native VLAN. The user has also entered 'show interfaces FastEthernet0/4 switchport' again, and the output is the same. The window has a 'Top' button at the bottom left and 'Copy' and 'Paste' buttons at the bottom right.

```
Switch>
Switch>en
Switch#show interfaces FastEthernet0/4 switchport

% Invalid input detected at '^' marker.

Switch#show interfaces FastEthernet0/4 switchport
Name: Fa0/4
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
--More--
```

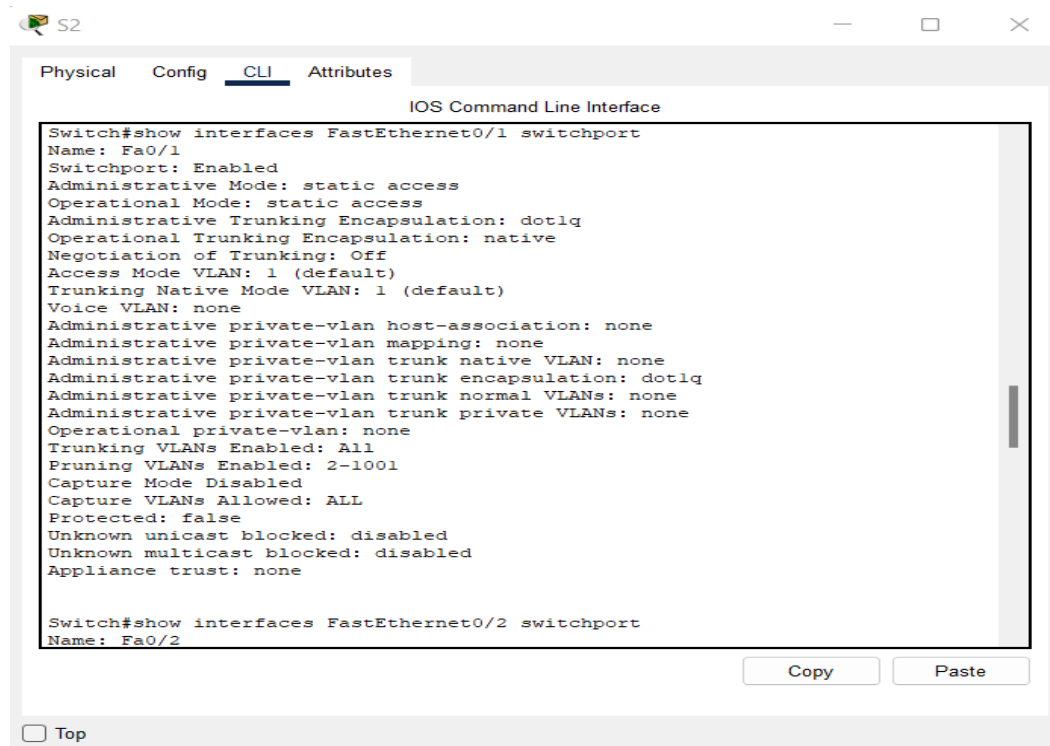
## Switch 2 : Configured with VLAN1, VLAN 10, VLAN 20 and Trunk Port



The screenshot shows the CLI window for switch S2. The 'Config' tab is selected, and the 'CLI' sub-tab is active. The command prompt is 'Switch#'. The user has entered a series of commands to configure the switch: 'spanning-tree mode pvst', 'spanning-tree extend system-id', and then configurations for interfaces Fa0/1 through Fa0/8. Fa0/1 is configured as an access port, Fa0/2 and Fa0/3 as access ports in VLAN 10 and 20 respectively, and Fa0/4 as a trunk port. The other interfaces (Fa0/5 through Fa0/8) are listed but not configured. The window has a 'Top' button at the bottom left and 'Copy' and 'Paste' buttons at the bottom right.

```
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
 switchport mode access
!
interface FastEthernet0/2
 switchport access vlan 10
 switchport mode access
!
interface FastEthernet0/3
 switchport access vlan 20
 switchport mode access
!
interface FastEthernet0/4
 switchport mode trunk
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
Switch#
```

## Fa0/1 VLAN 1 Configuration on S2:



The screenshot shows the CLI of switch S2 with the 'CLI' tab selected. The command 'Switch#show interfaces FastEthernet0/1 switchport' is entered, displaying the configuration for Fa0/1. The output shows it is an access port in VLAN 1. Below the main output, the command 'Switch#show interfaces FastEthernet0/2 switchport' is partially visible.

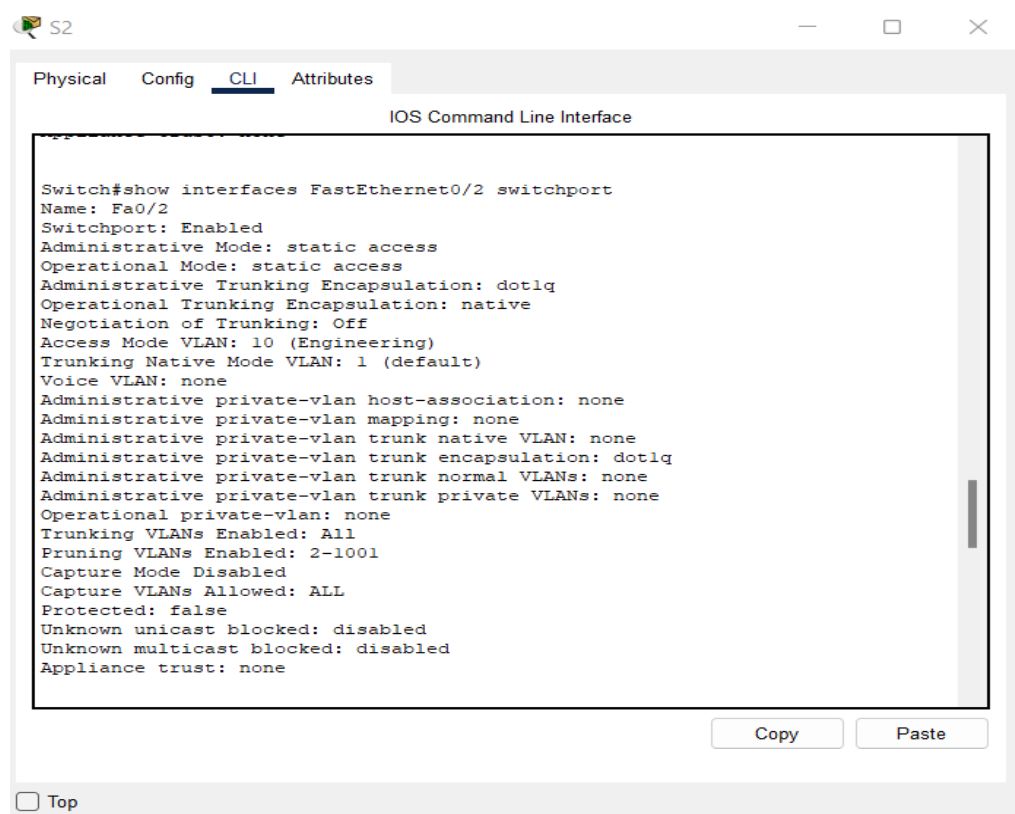
```
Switch#show interfaces FastEthernet0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

Switch#show interfaces FastEthernet0/2 switchport
Name: Fa0/2
```

Copy Paste

☐ Top

## Fa0/2 VLAN 10 Configuration on S2:



The screenshot shows the CLI of switch S2 with the 'CLI' tab selected. The command 'Switch#show interfaces FastEthernet0/2 switchport' is entered, displaying the configuration for Fa0/2. The output shows it is an access port in VLAN 10 (Engineering).

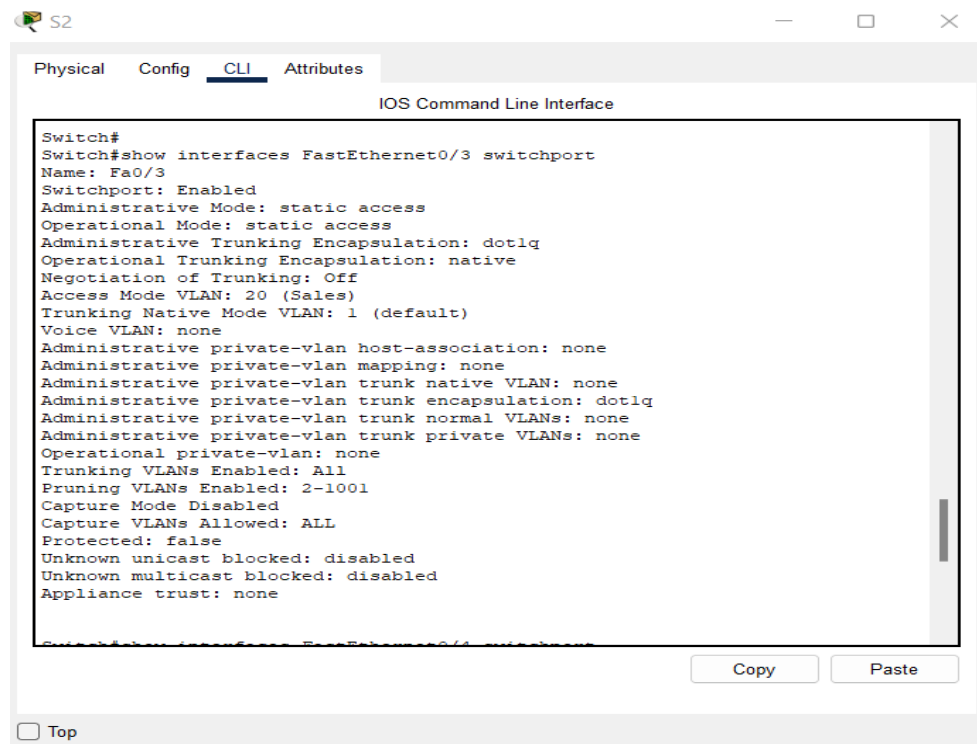
```
Switch#show interfaces FastEthernet0/2 switchport
Name: Fa0/2
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 10 (Engineering)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

Copy Paste

☐ Top



## Fa0/3 VLAN 20 Configuration on S2:

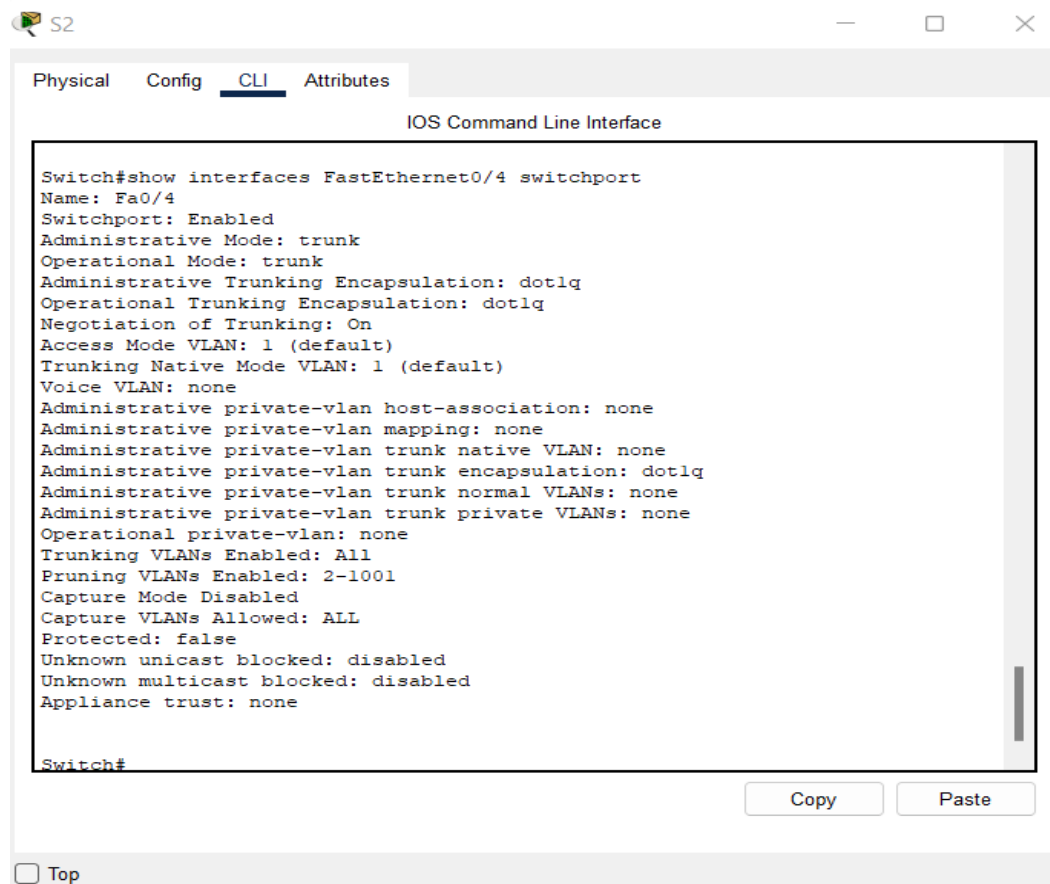


The screenshot shows the CLI of switch S2 with the 'CLI' tab selected. The command 'show interfaces FastEthernet0/3 switchport' has been entered, displaying the following configuration details for Fa0/3:

```
Switch#  
Switch#show interfaces FastEthernet0/3 switchport  
Name: Fa0/3  
Switchport: Enabled  
Administrative Mode: static access  
Operational Mode: static access  
Administrative Trunking Encapsulation: dot1q  
Operational Trunking Encapsulation: native  
Negotiation of Trunking: Off  
Access Mode VLAN: 20 (Sales)  
Trunking Native Mode VLAN: 1 (default)  
Voice VLAN: none  
Administrative private-vlan host-association: none  
Administrative private-vlan mapping: none  
Administrative private-vlan trunk native VLAN: none  
Administrative private-vlan trunk encapsulation: dot1q  
Administrative private-vlan trunk normal VLANs: none  
Administrative private-vlan trunk private VLANs: none  
Operational private-vlan: none  
Trunking VLANs Enabled: All  
Pruning VLANs Enabled: 2-1001  
Capture Mode Disabled  
Capture VLANs Allowed: ALL  
Protected: false  
Unknown unicast blocked: disabled  
Unknown multicast blocked: disabled  
Appliance trust: none  
Switch#
```

Buttons for 'Copy' and 'Paste' are visible at the bottom right of the CLI window. A 'Top' button is located at the bottom left of the window frame.

## Fa0/4 Trunk Port Configuration on S2:



The screenshot shows the CLI of switch S2 with the 'CLI' tab selected. The command 'show interfaces FastEthernet0/4 switchport' has been entered, displaying the following configuration details for Fa0/4:

```
Switch#  
Switch#show interfaces FastEthernet0/4 switchport  
Name: Fa0/4  
Switchport: Enabled  
Administrative Mode: trunk  
Operational Mode: trunk  
Administrative Trunking Encapsulation: dot1q  
Operational Trunking Encapsulation: dot1q  
Negotiation of Trunking: On  
Access Mode VLAN: 1 (default)  
Trunking Native Mode VLAN: 1 (default)  
Voice VLAN: none  
Administrative private-vlan host-association: none  
Administrative private-vlan mapping: none  
Administrative private-vlan trunk native VLAN: none  
Administrative private-vlan trunk encapsulation: dot1q  
Administrative private-vlan trunk normal VLANs: none  
Administrative private-vlan trunk private VLANs: none  
Operational private-vlan: none  
Trunking VLANs Enabled: All  
Pruning VLANs Enabled: 2-1001  
Capture Mode Disabled  
Capture VLANs Allowed: ALL  
Protected: false  
Unknown unicast blocked: disabled  
Unknown multicast blocked: disabled  
Appliance trust: none  
Switch#
```

Buttons for 'Copy' and 'Paste' are visible at the bottom right of the CLI window. A 'Top' button is located at the bottom left of the window frame.

5. Explain what must be done to allow all PCs to Ping each other [10 points]

Step 1 :: Create Network Topology and configure the IP address to the host's

Step 2: Login into Switch1 CLI and first check VLAN's using "SHOW VLAN".

```
Switch#show vlan
VLAN Name                Status    Ports
-----
1    default                active    Fa0/1, Fa0/5, Fa0/6, Fa0/7
                                           Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                           Fa0/12, Fa0/13, Fa0/14,
Fa0/15
Fa0/19
Fa0/23
10   Engineering            active    Fa0/24, Gig0/1, Gig0/2
20   Sales                 active    Fa0/2
                                           Fa0/3
1002 fddi-default          active
1003 token-ring-default   active
1004 fddinet-default     active
1005 trnet-default       active

VLAN Type  SAID      MTU    Parent RingNo BridgeNo Stp  BrgdMode Transl
-----
1    enet     100001    1500   -      -      -      -    0        0
10   enet     100010    1500   -      -      -      -    0        0
20   enet     100020    1500   -      -      -      -    0        0
1002 fddi     101002    1500   -      -      -      -    0        0
--More--
```

Then, Create the VLANs using :

Switch# Config t

Switch(Config) Vlan 10

Switch(Config-line) Name Engineering / PC1 or whatever is required

Step 3: Configure the VLANs to interfaces/port using "Switch mode access"

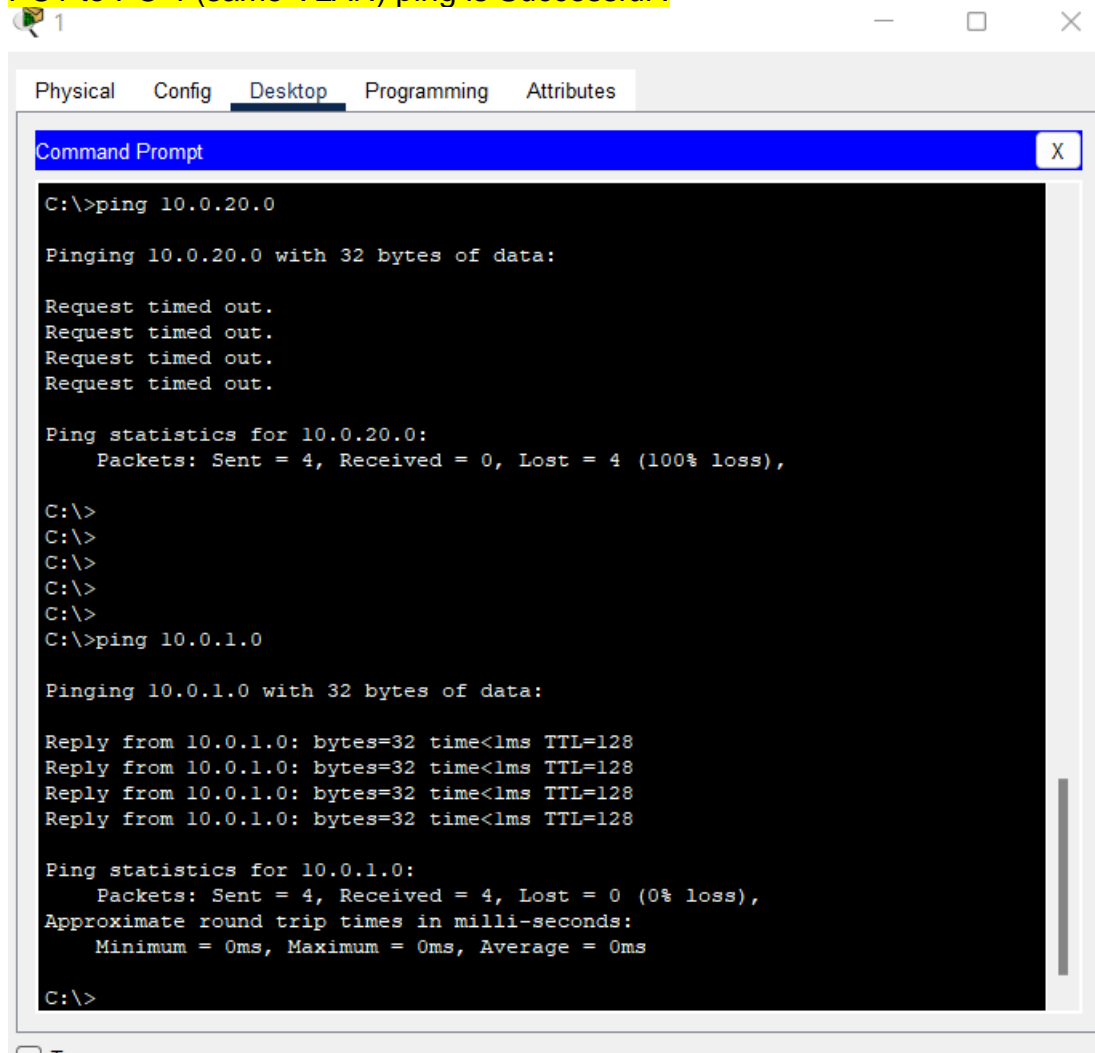
```
Switch#
Switch#
Switch#
Switch#
Switch#
Switch#
Switch#
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int fa0/1
Switch(config-if)#switch mode access
Switch(config-if)#switch access Vlan 1
Switch(config-if)#exit
Switch(config)#int fa0/2
Switch(config-if)#switch mode access
Switch(config-if)#switch access Vlan 10
Switch(config-if)#exit
Switch(config)#int fa0/3
Switch(config-if)#switch mode access
Switch(config-if)#switch access Vlan 20
Switch(config-if)#int fa0/4
Switch(config-if)#switch port trunking
```

Step 4: Check the running-config and state of the interface :

```
Switch#show running-config
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
switchport mode access
!
interface FastEthernet0/2
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/3
switchport access vlan 20
switchport mode access
!
interface FastEthernet0/4
switchport mode trunk
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
Switch#show ip interface brief
Interface          IP-Address      OK? Method Status
-----
FastEthernet0/1    unassigned      YES manual up
FastEthernet0/2    unassigned      YES manual up
FastEthernet0/3    unassigned      YES manual up
FastEthernet0/4    unassigned      YES manual up
FastEthernet0/5    unassigned      YES manual down
FastEthernet0/6    unassigned      YES manual down
FastEthernet0/7    unassigned      YES manual down
FastEthernet0/8    unassigned      YES manual down
FastEthernet0/9    unassigned      YES manual down
FastEthernet0/10   unassigned      YES manual down
FastEthernet0/11   unassigned      YES manual down
FastEthernet0/12   unassigned      YES manual down
FastEthernet0/13   unassigned      YES manual down
FastEthernet0/14   unassigned      YES manual down
FastEthernet0/15   unassigned      YES manual down
FastEthernet0/16   unassigned      YES manual down
FastEthernet0/17   unassigned      YES manual down
FastEthernet0/18   unassigned      YES manual down
```

Step 5: Once the VLA's are configured and the interfaces are mapped and trunk port is enabled using "switch port Trunking" the Network is ready to route / communicate with the same VLAN's

PC1 to PC 4 (same VLAN) ping is Successful :



```
C:\>ping 10.0.20.0

Pinging 10.0.20.0 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.20.0:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
C:\>
C:\>
C:\>
C:\>
C:\>ping 10.0.1.0

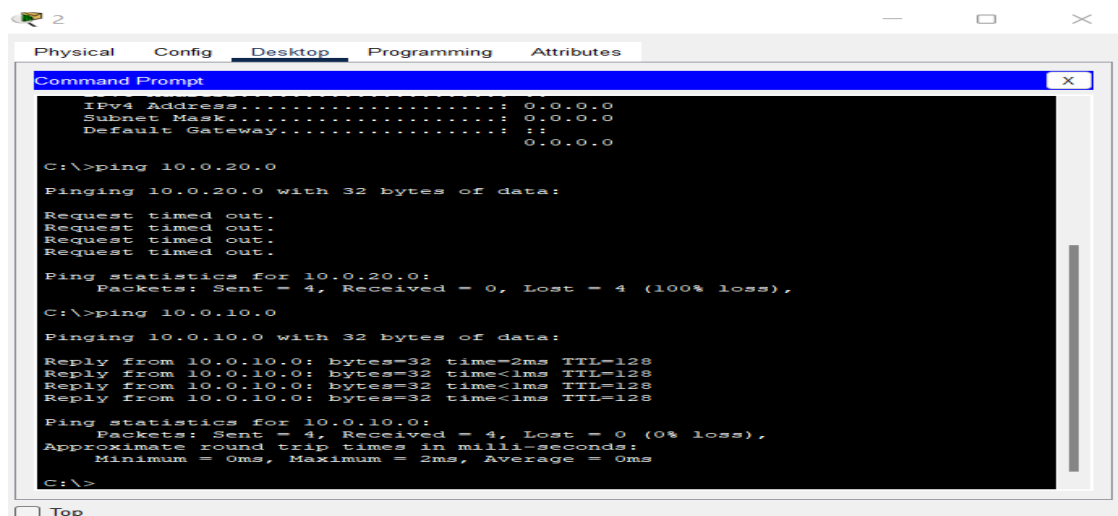
Pinging 10.0.1.0 with 32 bytes of data:

Reply from 10.0.1.0: bytes=32 time<1ms TTL=128
Reply from 10.0.1.0: bytes=32 time<1ms TTL=128
Reply from 10.0.1.0: bytes=32 time<1ms TTL=128
Reply from 10.0.1.0: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.1.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC 2 to PC 4 (Same VLAN) Ping is successful :



```
IPv4 Address.....: 0.0.0.0
Subnet Mask.....: 0.0.0.0
Default Gateway.....: 0.0.0.0

C:\>ping 10.0.20.0

Pinging 10.0.20.0 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.20.0:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 10.0.10.0

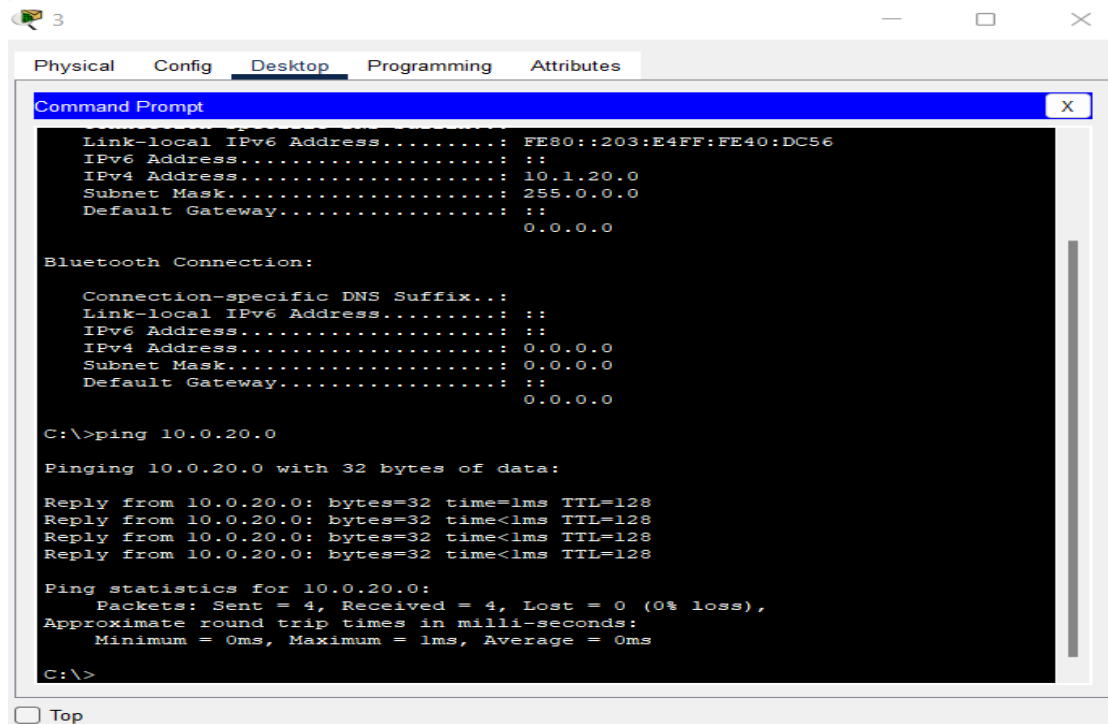
Pinging 10.0.10.0 with 32 bytes of data:

Reply from 10.0.10.0: bytes=32 time=2ms TTL=128
Reply from 10.0.10.0: bytes=32 time<1ms TTL=128
Reply from 10.0.10.0: bytes=32 time<1ms TTL=128
Reply from 10.0.10.0: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.10.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>
```

Ping from PC3 to PC6 is successful:



```
Link-local IPv6 Address.....: FE80::203:E4FF:FE40:DC56
IPv6 Address.....: ::
IPv4 Address.....: 10.1.20.0
Subnet Mask.....: 255.0.0.0
Default Gateway.....: ::
0.0.0.0

Bluetooth Connection:
Connection-specific DNS Suffix.:
Link-local IPv6 Address.....: ::
IPv6 Address.....: ::
IPv4 Address.....: 0.0.0.0
Subnet Mask.....: 0.0.0.0
Default Gateway.....: ::
0.0.0.0

C:\>ping 10.0.20.0

Pinging 10.0.20.0 with 32 bytes of data:

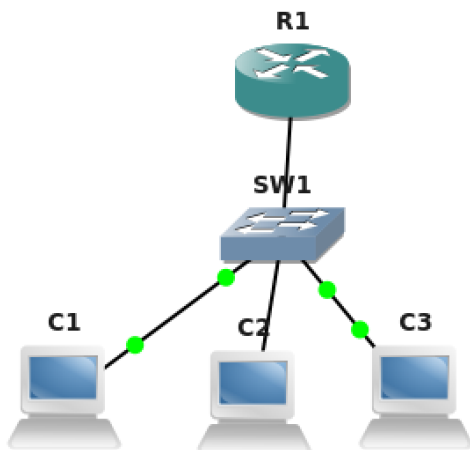
Reply from 10.0.20.0: bytes=32 time=1ms TTL=128
Reply from 10.0.20.0: bytes=32 time<1ms TTL=128
Reply from 10.0.20.0: bytes=32 time<1ms TTL=128
Reply from 10.0.20.0: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.20.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

### Objective 3 – Inter-VLAN Routing “Router on a Stick”

This objective will configure multiple VLANs on a switch, and uplink the switch to a router via a trunk port and we will use this router to route between VLANs. Since the router is using one physical port to route incoming and outgoing traffic, we call it “Router on a Stick”



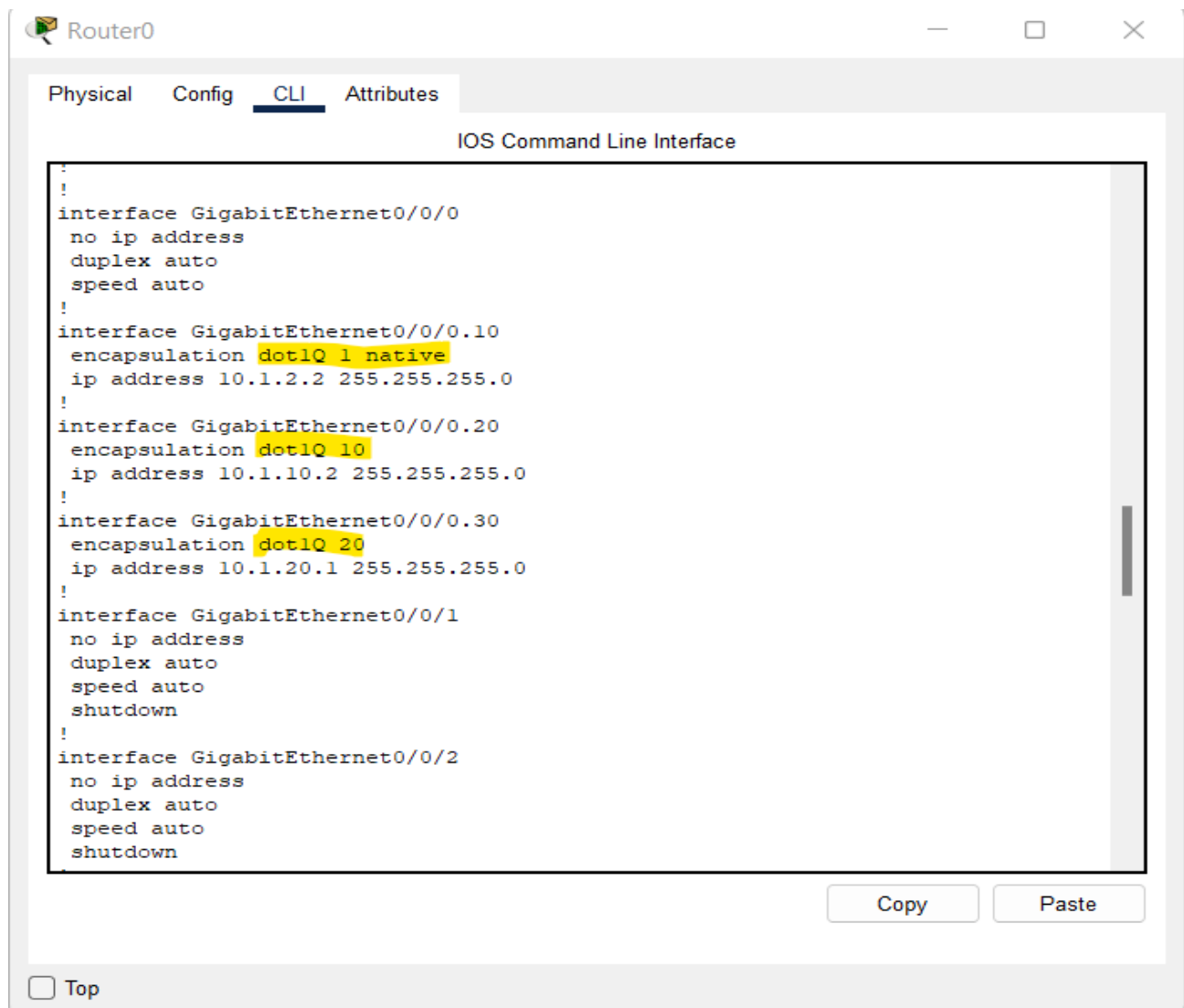
PC1- VLAN1 – 10.1.1.0/24	PC2- VLAN10 – 10.1.10.0/24	PC3- VLAN20 – 10.1.20.0/24
-----------------------------	-------------------------------	-------------------------------

1. What are sub-interfaces on a router? What are its advantages? [2 points]

A Sub-interface is a virtual interface created by dividing one physical interface into multiple logical interfaces. Example, in the below topology I have divided gigabitEthernet0/0/0 into gigabitEthernet0/0/0.10 for Vlan 1 , gigabitEthernet0/0/0.20, for Vlan 10 gigabitEthernet0/0/0.30 for Vlan 20.

2. Configure VLAN sub-interfaces on the router (VLAN1 “native”, VLAN 10, and VLAN 20).

VLAN sub-interfaces on the router (VLAN1 “native”, VLAN 10, and VLAN 20) are configured with encapsulation.



```
Router0
Physical Config CLI Attributes
IOS Command Line Interface
!
interface GigabitEthernet0/0/0
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/0/0.10
encapsulation dot1Q 1 native
ip address 10.1.2.2 255.255.255.0
!
interface GigabitEthernet0/0/0.20
encapsulation dot1Q 10
ip address 10.1.10.2 255.255.255.0
!
interface GigabitEthernet0/0/0.30
encapsulation dot1Q 20
ip address 10.1.20.1 255.255.255.0
!
interface GigabitEthernet0/0/1
no ip address
duplex auto
speed auto
shutdown
!
interface GigabitEthernet0/0/2
no ip address
duplex auto
speed auto
shutdown
Copy Paste
Top
```

- a. Submit the router configuration that indicates the trunking setup.

[10 points]

Router Configuration with encapsulation and sub-interfaces mapped to VLAN's:



Router0

Physical Config CLI Attributes

IOS Command Line Interface

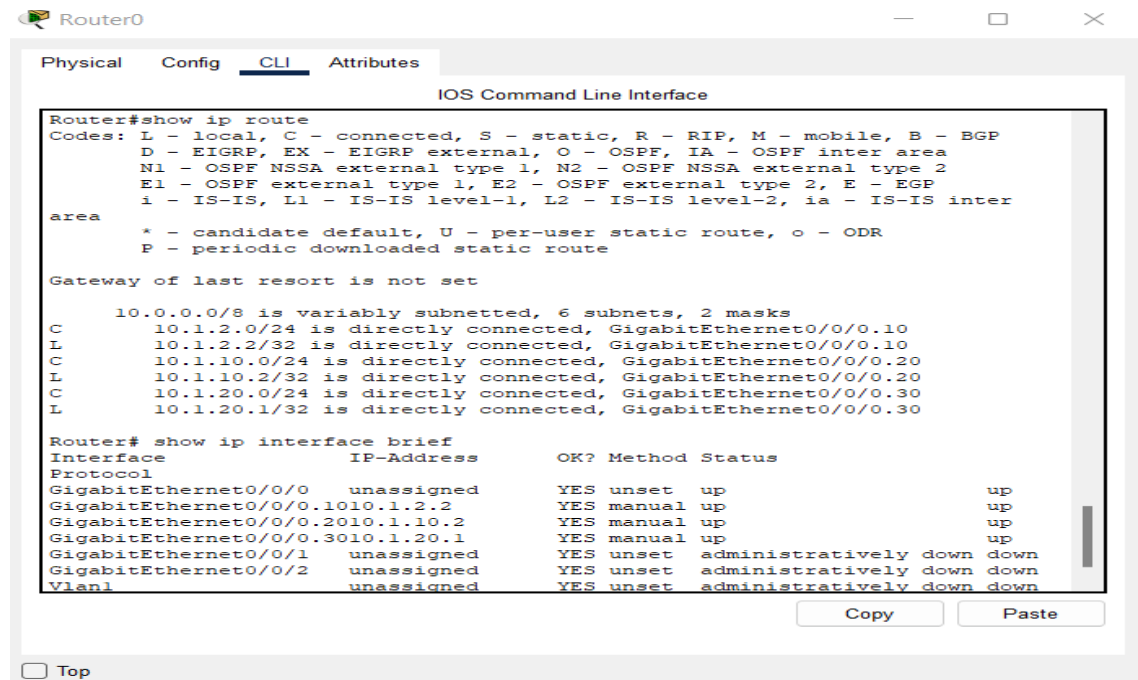
```
Router#SHOW INT GigaBitEthernet0/0/0.10
GigabitEthernet0/0/0.10 is up, line protocol is up (connected)
Hardware is PQUICC_FEC, address is 0002.17dc.4701 (bia 0002.17dc.4701)
Internet address is 10.1.2.2/24
MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
  reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 1
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never

Router#SHOW INT GigaBitEthernet0/0/0.20
GigabitEthernet0/0/0.20 is up, line protocol is up (connected)
Hardware is PQUICC_FEC, address is 0002.17dc.4701 (bia 0002.17dc.4701)
Internet address is 10.1.10.2/24
MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
  reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 10
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never

Router#SHOW INT GigaBitEthernet0/0/0.30
GigabitEthernet0/0/0.30 is up, line protocol is up (connected)
Hardware is PQUICC_FEC, address is 0002.17dc.4701 (bia 0002.17dc.4701)
Internet address is 10.1.20.1/24
MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
  reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID 20
  ARP type: ARPA, ARP Timeout 04:00:00,
  Last clearing of "show interface" counters never
```

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☐ Top



Router0

Physical Config CLI Attributes

IOS Command Line Interface

```
Router#show ip route
Codes: L - local, C - connected, S - static, 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

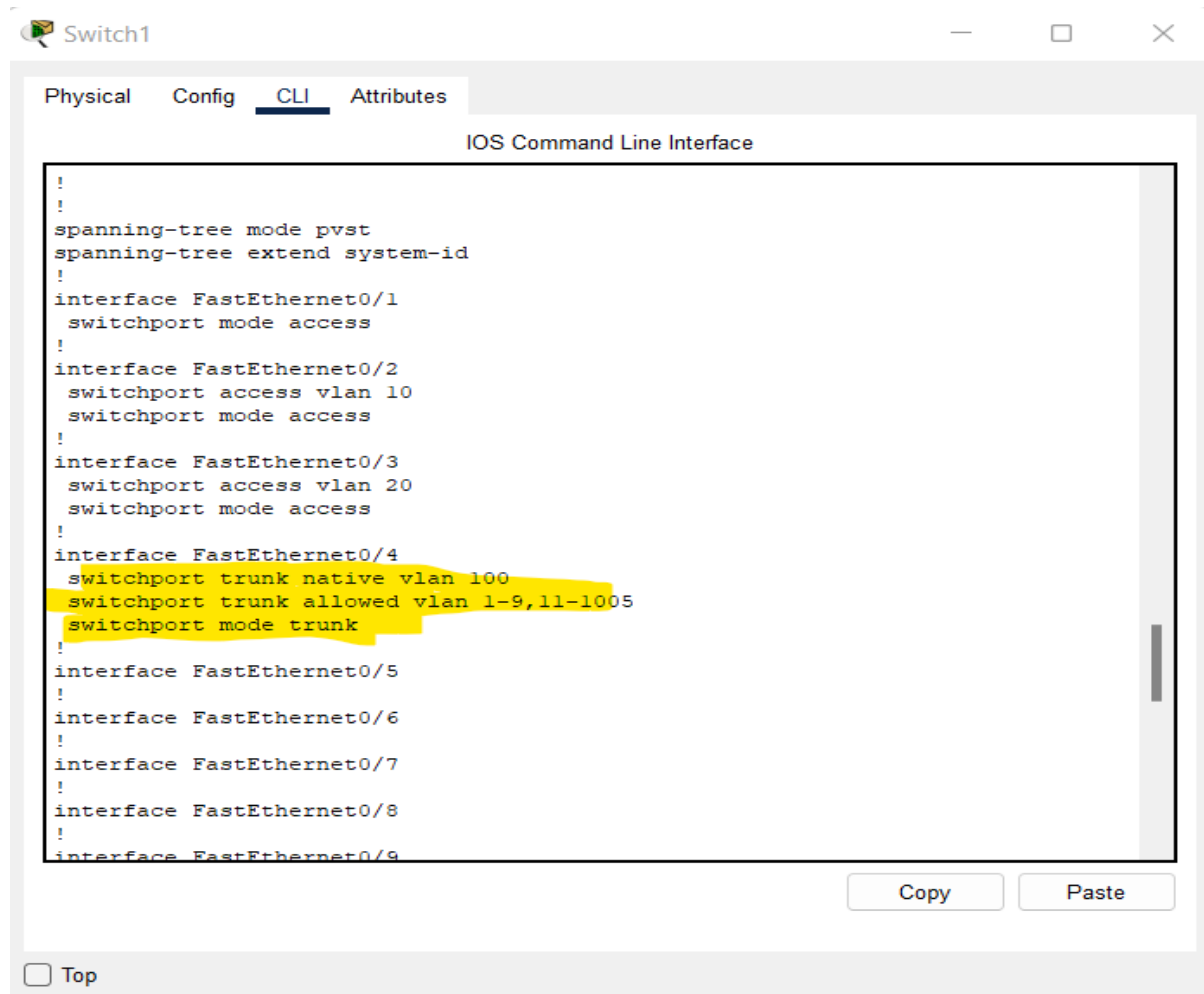
Gateway of last resort is not set

  10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C       10.1.2.0/24 is directly connected, GigabitEthernet0/0/0.10
L       10.1.2.2/32 is directly connected, GigabitEthernet0/0/0.10
C       10.1.10.0/24 is directly connected, GigabitEthernet0/0/0.20
L       10.1.10.2/32 is directly connected, GigabitEthernet0/0/0.20
C       10.1.20.0/24 is directly connected, GigabitEthernet0/0/0.30
L       10.1.20.1/32 is directly connected, GigabitEthernet0/0/0.30

Router# show ip interface brief
Interface      IP-Address      OK? Method Status
Protocol
GigabitEthernet0/0/0    unassigned      YES unset   up
GigabitEthernet0/0/0.10 10.1.2.2        YES manual   up
GigabitEthernet0/0/0.20 10.1.10.2       YES manual   up
GigabitEthernet0/0/0.30 10.1.20.1       YES manual   up
GigabitEthernet0/0/1    unassigned      YES unset   administratively down
GigabitEthernet0/0/2    unassigned      YES unset   administratively down
Vlan1            unassigned      YES unset   administratively down
```

Copy Paste

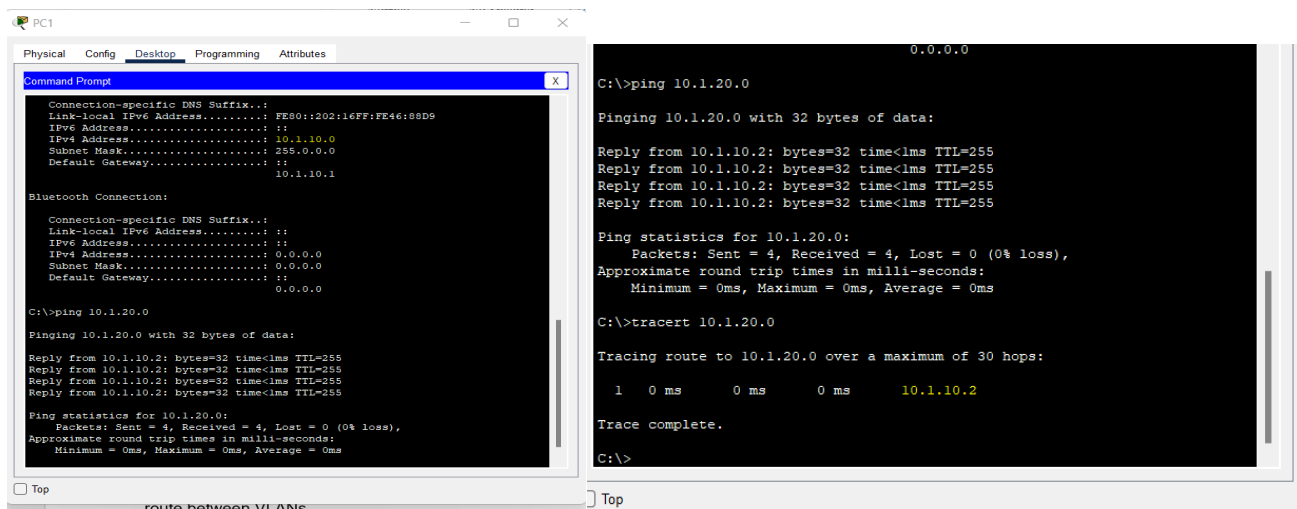
☐ Top



### 3. Verify all PCs can Ping each other.

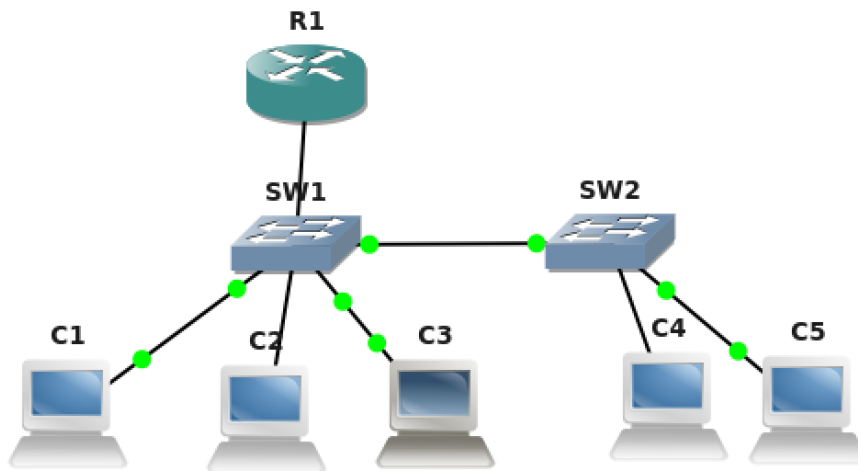
- Paste screenshots of trace route from the PC to indicate the packets are traversing through the router for inter-VLAN communication. **[5 points]**

The ping command from PC1 to PC2 (10.1.10.0 to 10.1.20.0) through router sub-interface 10.1.10.2. And the Tracert from PC1 to PC2 indicating packet traverse through router w hop



## Objective 4 – Inter-VLAN Routing 2: Multiple switches

This objective will configure multiple VLANs on multiple switches and use a router to route between VLANs.



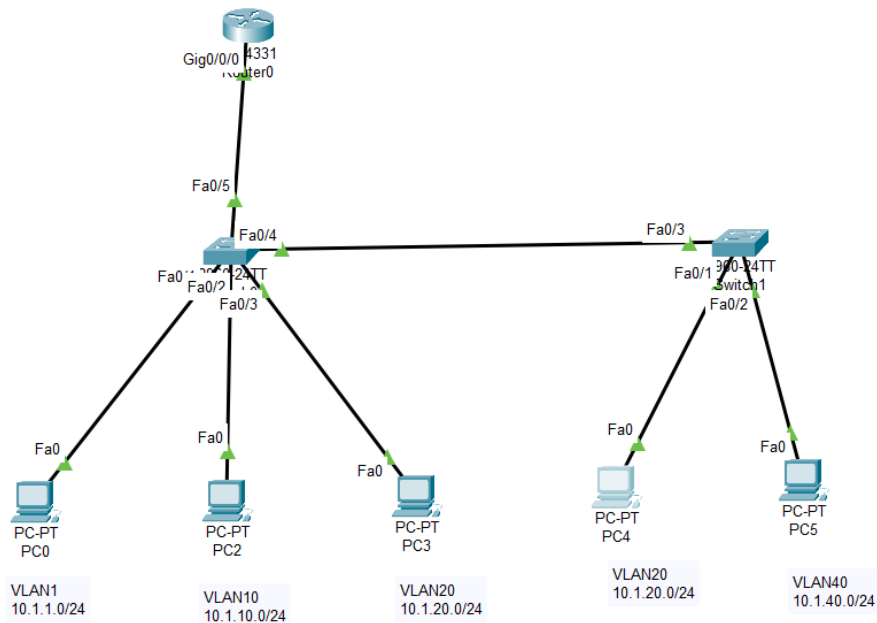
PC1- VLAN1 – 10.1.1.0/24	PC2- VLAN10 – 10.1.10.0/24	PC3- VLAN20 – 10.1.20.0/24	PC4- VLAN20 – IP subnet-?	PC5- VLAN40 – 10.1.40.0/24
-----------------------------	-------------------------------	-------------------------------	------------------------------	-------------------------------

1. Look at the above diagram. What is the type of port you should configure between the two switches? (Eg: access port **or** trunk port **or** routed port **or** any other port?) Why do you have to use this port type? Justify. **[3 points]**

I used Trunk port between sw1 and sw2. Because unlike access link, a trunk link doesn't belong to single vlan but can carry traffic from the any number of vlan's over a point-to-point link and here each switch is connected to more than single vlan hence the usage of trunk port.

2. At the end of this lab objective all hosts must be able to ping each other. From your previous setup, you added Switch2 and hosts PC4 and PC5. What extra configurations did you have to add to this setup to establish connectivity between all hosts? Mention each device you had to configure or make changes to achieve this. Just mention snippets of extra configuration you had to add on each device you configured. Also attach screenshot of successful pings and traceroute from PC2 to PC5. **[15 points]**





To add pc4, pc5 both the hosts are configured with ip addresses.

PC4

Physical Config Desktop Programming Attributes

Command Prompt

```

Connection-specific DNS Suffix...:
Link-local IPv6 Address...: ::
IPv6 Address...: ::
IPv4 Address...: 0.0.0.0
Subnet Mask...: 0.0.0.0
Default Gateway...: ::
0.0.0.0

C:\>ipconfig

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:
Link-local IPv6 Address...: FE80::2E0:F7FF:FE85:1647
IPv6 Address...: ::
IPv4 Address...: 10.1.20.1
Subnet Mask...: 255.0.0.0
Default Gateway...: ::
10.1.20.2

Bluetooth Connection:

Connection-specific DNS Suffix...:
Link-local IPv6 Address...: ::
IPv6 Address...: ::
IPv4 Address...: 0.0.0.0
Subnet Mask...: 0.0.0.0
Default Gateway...: ::
0.0.0.0

C:\>

```

PC5

Physical Config Desktop Programming Attributes

Command Prompt

```

Cisco Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix...:
Link-local IPv6 Address...: FE80::290:21FF:FE22:EE55
IPv6 Address...: ::
IPv4 Address...: 10.1.40.0
Subnet Mask...: 255.0.0.0
Default Gateway...: ::
0.0.0.0

Bluetooth Connection:

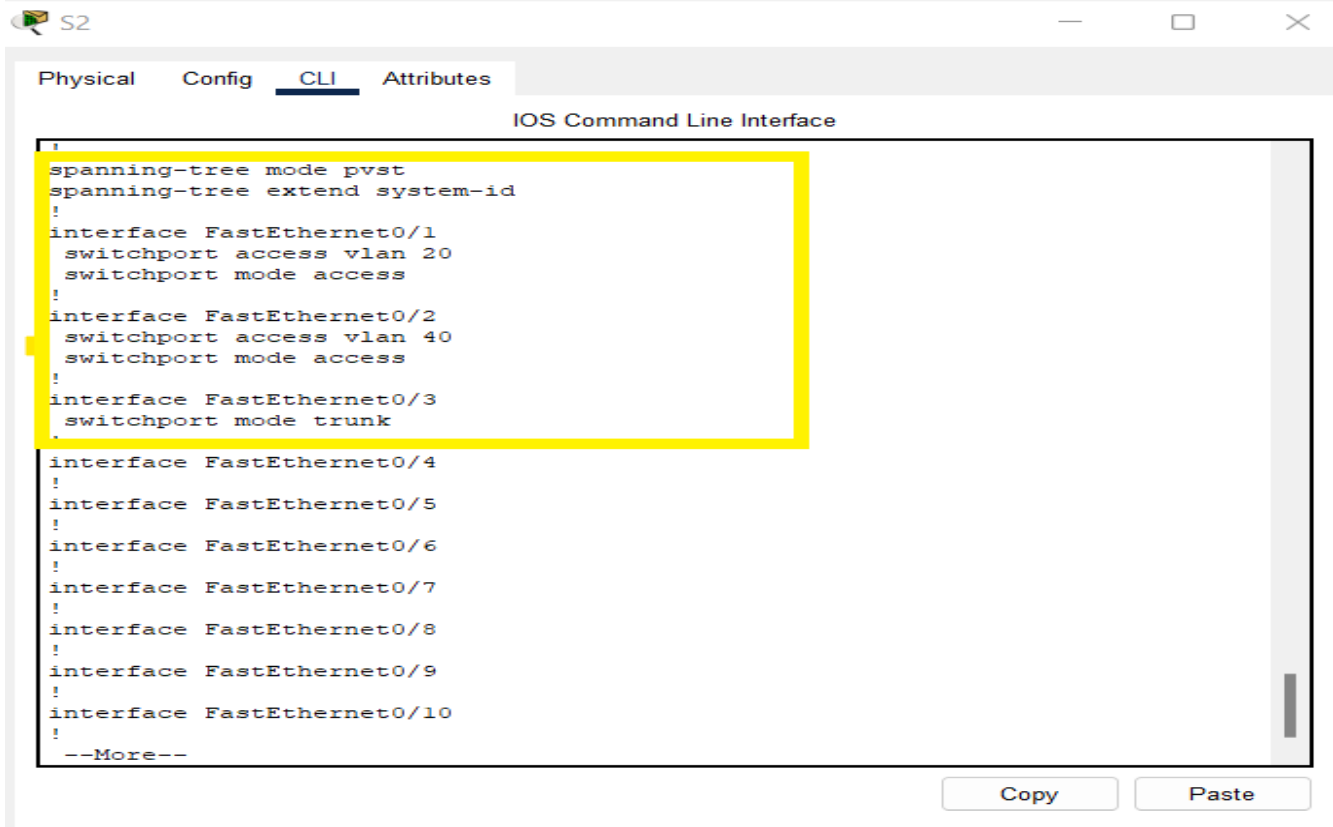
Connection-specific DNS Suffix...:
Link-local IPv6 Address...: ::
IPv6 Address...: ::
IPv4 Address...: 0.0.0.0
Subnet Mask...: 0.0.0.0
Default Gateway...: ::
0.0.0.0

C:\>

```

Lab: Switching 25

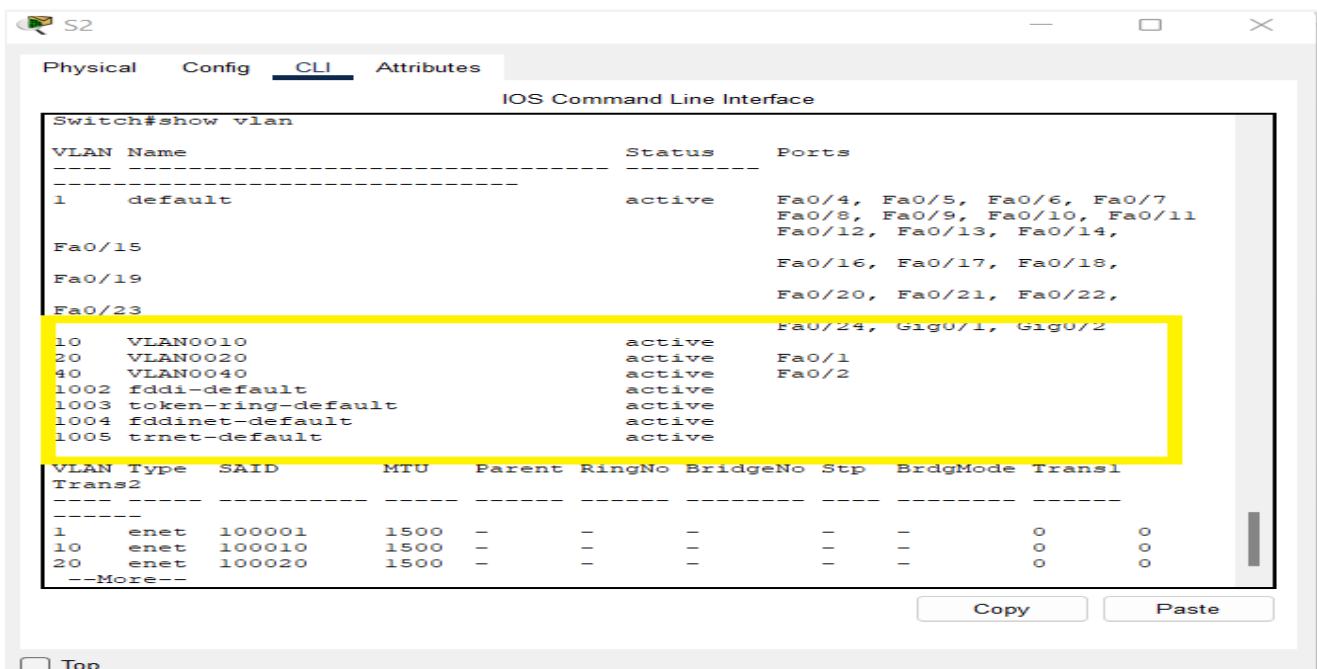
And the switch 2 is configured with the VLAN 20 and VLAN 40 configurations



The screenshot shows the configuration window for switch S2, specifically the CLI tab. The configuration includes spanning-tree settings and interface configurations for FastEthernet0/1 through FastEthernet0/10. The configuration is as follows:

```
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
  switchport access vlan 20
  switchport mode access
!
interface FastEthernet0/2
  switchport access vlan 40
  switchport mode access
!
interface FastEthernet0/3
  switchport mode trunk
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
--More--
```

Buttons for Copy and Paste are visible at the bottom right of the CLI window.



The screenshot shows the configuration window for switch S2, specifically the CLI tab. The output of the 'show vlan' command is displayed, showing the configuration for VLANs 1, 10, 20, and 40. The output is as follows:

```
Switch#show vlan

VLAN Name                Status    Ports
----
1    default                active    Fa0/4, Fa0/5, Fa0/6, Fa0/7
                                           Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                           Fa0/12, Fa0/13, Fa0/14,
                                           Fa0/15, Fa0/16, Fa0/17, Fa0/18,
                                           Fa0/19, Fa0/20, Fa0/21, Fa0/22,
                                           Fa0/23, Fa0/24, Gig0/1, Gig0/2
10   VLAN0010               active    Fa0/1
20   VLAN0020               active    Fa0/2
40   VLAN0040               active
1002 fddi-default            active
1003 token-ring-default    active
1004 fddinet-default        active
1005 trnet-default          active

VLAN Type  SAID      MTU    Parent RingNo BridgeNo Stp    BrdgMode Transl
-----
1    enet     100001    1500   -       -       -       -       -       0       0
10   enet     100010    1500   -       -       -       -       -       0       0
20   enet     100020    1500   -       -       -       -       -       0       0
--More--
```

Buttons for Copy and Paste are visible at the bottom right of the CLI window.

## IOS Command Line Interface

```
Switch#
Switch#
Switch#show interfaces Fa0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Access Mode VLAN: 20 (VLAN0020)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

--More--
```

Copy

Paste

## IOS Command Line Interface

```
Unknown multicast blocked: disabled
Appliance trust: none

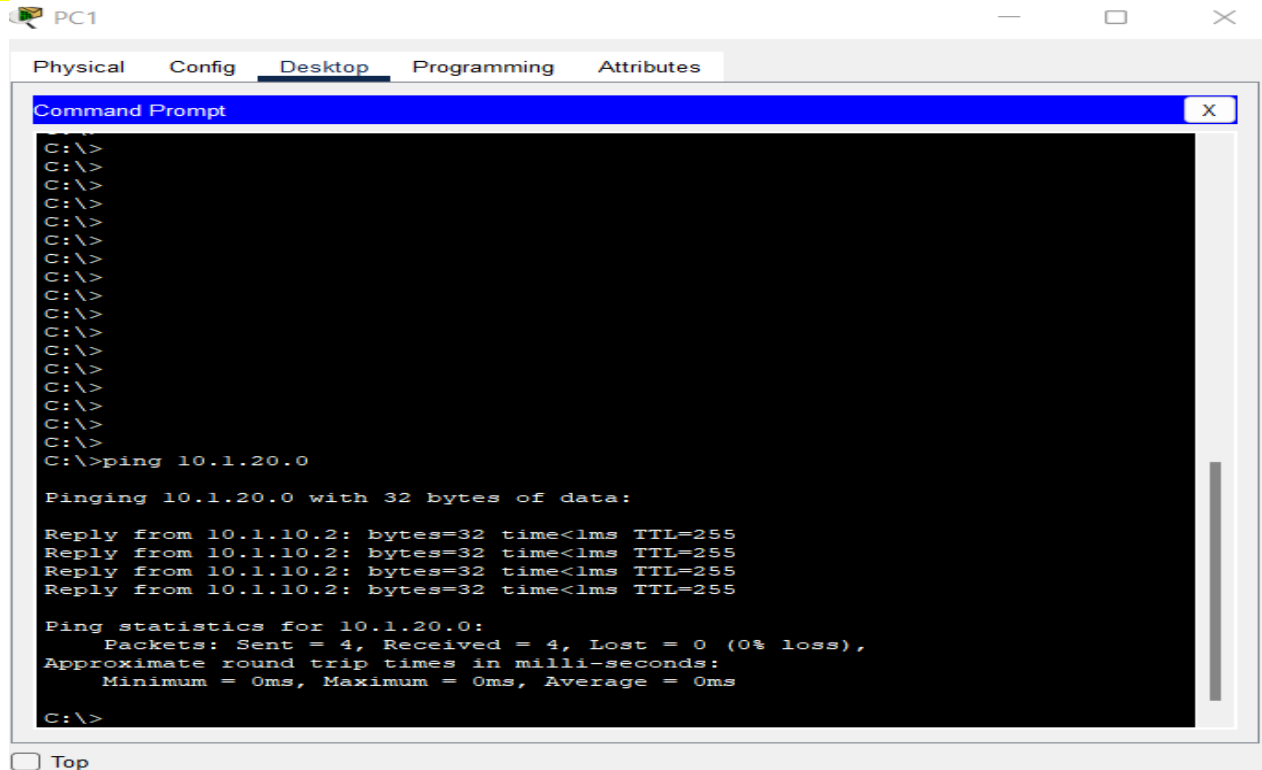
Switch#
Switch#
Switch#show interfaces Fa0/3 switchport
Name: Fa0/3
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false

--More--
```

Copy

Paste

## Successful ping between PC's



PC1

Physical Config **Desktop** Programming Attributes

Command Prompt

```
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>ping 10.1.20.0

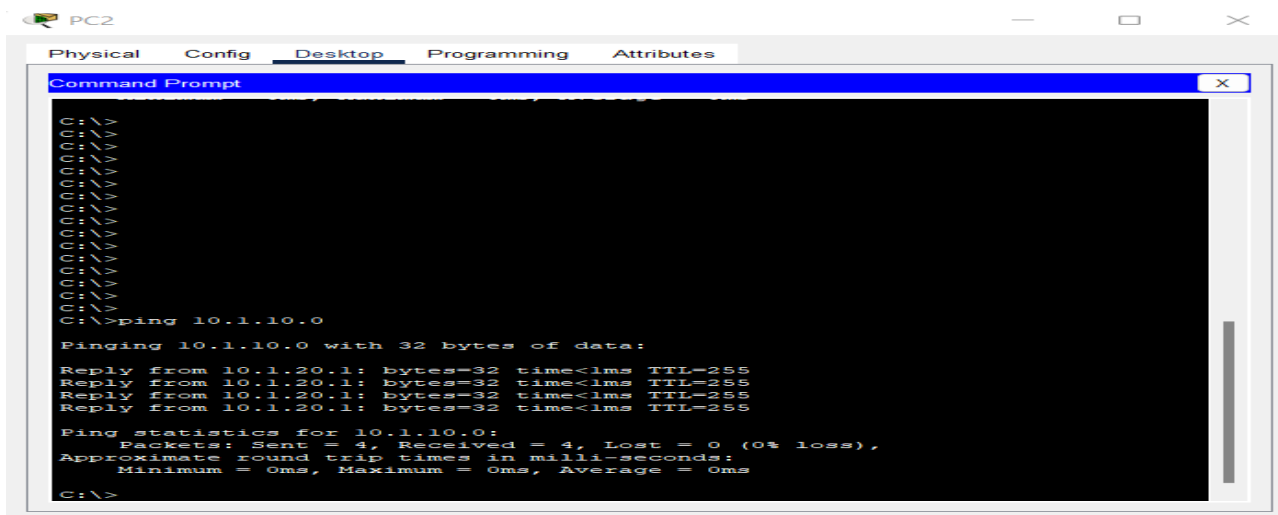
Pinging 10.1.20.0 with 32 bytes of data:

Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255

Ping statistics for 10.1.20.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

☐ Top



PC2

Physical Config **Desktop** Programming Attributes

Command Prompt

```
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>
C:\>ping 10.1.10.0

Pinging 10.1.10.0 with 32 bytes of data:

Reply from 10.1.20.1: bytes=32 time<1ms TTL=255
Reply from 10.1.20.1: bytes=32 time<1ms TTL=255
Reply from 10.1.20.1: bytes=32 time<1ms TTL=255
Reply from 10.1.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.1.10.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

## Report Questions [23 pts]

1. What are two advantages of using VLANs? [2 points]

VLANs reduce the size of broadcast domains

VLANs utilize packet filtering to enhance network security.

VLAN does logical grouping of devices by function rather than location

VLAN enhances the performances and reduces the latency.

2. Can a PC from any VLAN telnet into a switch? Why or why not? If not, what must be done to make it work? [2 points]

Not PC from any VLAN can telnet into a switch. The VLAN configured with telnet can only telnet. In order to access the switch via telnet, first configure the SVI on the switch with the ip address. This SVI could be part of VLAN 10 or 20 or any VLAN used. And create a username and password to do the telnet. Telnet can be done by following command

Line vty 0 15

Transport input telnet

Login

3. What are access ports and what are trunk ports? Explain the difference [3 points]

Access and Trunk ports are a medium to connect devices b/w switches and routers to enable communication.

Access port: An access port is connection on a switch that transmits data to and from a single / specific vlan.

Trunk port: A trunk port is able to transmit data from multiple vlans

**Access can be configured using following commands**

**(config)#interface fa0/0**

**(Config-if) #switchport mode access**

**Trunk port should be configured using following command**

**#Interface fa0/0**

**#Switchport trunk encapsulation dot1q**

**#Switchport mode trunk**

4. What is the benefit of using a trunk port? [2 points]

The trunk port allows Multi VLAN data transmission on it. Which can add bandwidth and reduce the latency between data transmission by using tagging in order to reach the right destination/end point.

5. Describe what must be done to route between VLANs. [2 points]

VLANs should be created and configured and mapped to interface/ports to which host VLAN is connected to.

(config)#Interface <interface>

(config-if)#Switch Mode Access

(config-if)#Switch Access VLAN ID

Should be configured in the switch network to enable route between VLANs.

6. In Objective 4, let us say you issued a ping from PC2 to PC5. Explain how the ping packets flow through the network, paying attention to each step when switches forward the packet and routers route the packet. If necessary, mention any ARPs that may need to be issued to establish this communication.

[12 points]

Step 1 :

**When PC2 initiates PING request, it** This host creates an IP packet with its own IP address (192.168.1.1) as the source and the (192.168.2.2) destination. And builds the ethernet frame entering its own MAC Address. But it requires MAC Address of PC5 to perform ping operation. So it checks the ARP Table to to identify if the MAC address of the default gateway is available or not. Checks its arp table usinghg “arp -a” command.

```
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255

Ping statistics for 10.1.20.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>arp -a
Internet Address      Physical Address      Type
10.1.20.0              0002.17dc.4701        dynamic

C:\>
```

Because ARP is not available in the table, it sends out for an ARP Request using the broadcast frame (ff:ff:ff:ff) on every port except the port in which its sending and receiving the information out. By default ARP is enabled. Else interface encapsulation should be configured to define static ARP entries.

Device > enable

Device(Config#) Config Terminal

Device(Config#) arp 10.0.0.1 aabb:gghh:cc03:8200:arpa

Device(Config#) end

And to display the type of ARP used on an interface execute the SHOW INTERFACES <interface> command

```

Switch>
Switch>en
Switch#show arp

Switch#
Switch#
Switch#show interfaces GigabitEthernet0/1
GigabitEthernet0/1 is up, line protocol is up (connected)
  Hardware is Lance, address is 00d0.97a7.cel9 (bia 00d0.97a7.cel9)
  BW 1000000 Kbit, DLY 1000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s
  input flow-control is off, output flow-control is off
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:08, output 00:00:05, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    956 packets input, 193351 bytes, 0 no buffer
      Received 956 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 watchdog, 0 multicast, 0 pause input
    0 input packets with dribble condition detected
  2357 packets output, 263570 bytes, 0 underruns
--More--

```

Once the destination MAC address is received from the destination device, the PC2 prepares a ethernet frame that carries packet with Source MAC | Destination MAC | Source IP | Destination IP.

And the frame will be routed to Switch0, switch checks the VLAN ID, and when the VLANID of the source MAC and destination MAC are different, the IP is routed to Layer3 device aka Default Gateway or Router using the Trunk Port. At the router, the sub-interfaces are configured with the VLAN ID using encapsulation to enable traffic flow between the VLAN's.

From the router the packet is forwarded to Switch1. The S1 performs the same operation as building the Ethernet Frame with SOURCE MAC| BROADCAST FRAME|SOURCE IP|DESTINATION IP and sends out ARP request. Once the ARP MAC is received the SWITCH 2 checks the VLAN ID and the port the VLAN ID is configured on and forward the packet to PC5.

```

Router>en
Router#show ip interface brief

```

Interface	IP-Address	OK?	Method	Status
Protocol				
GigabitEthernet0/0/0	unassigned	YES	unset	up
GigabitEthernet0/0/0.1010.1.2.2		YES	manual	up
GigabitEthernet0/0/0.2010.1.10.2		YES	manual	up
GigabitEthernet0/0/0.3010.1.20.1		YES	manual	up
GigabitEthernet0/0/1	unassigned	YES	unset	administratively down
GigabitEthernet0/0/2	unassigned	YES	unset	administratively down
Vlan1	unassigned	YES	unset	administratively down

```

Router#show vlan

```

VLAN Name	Status	Ports

```

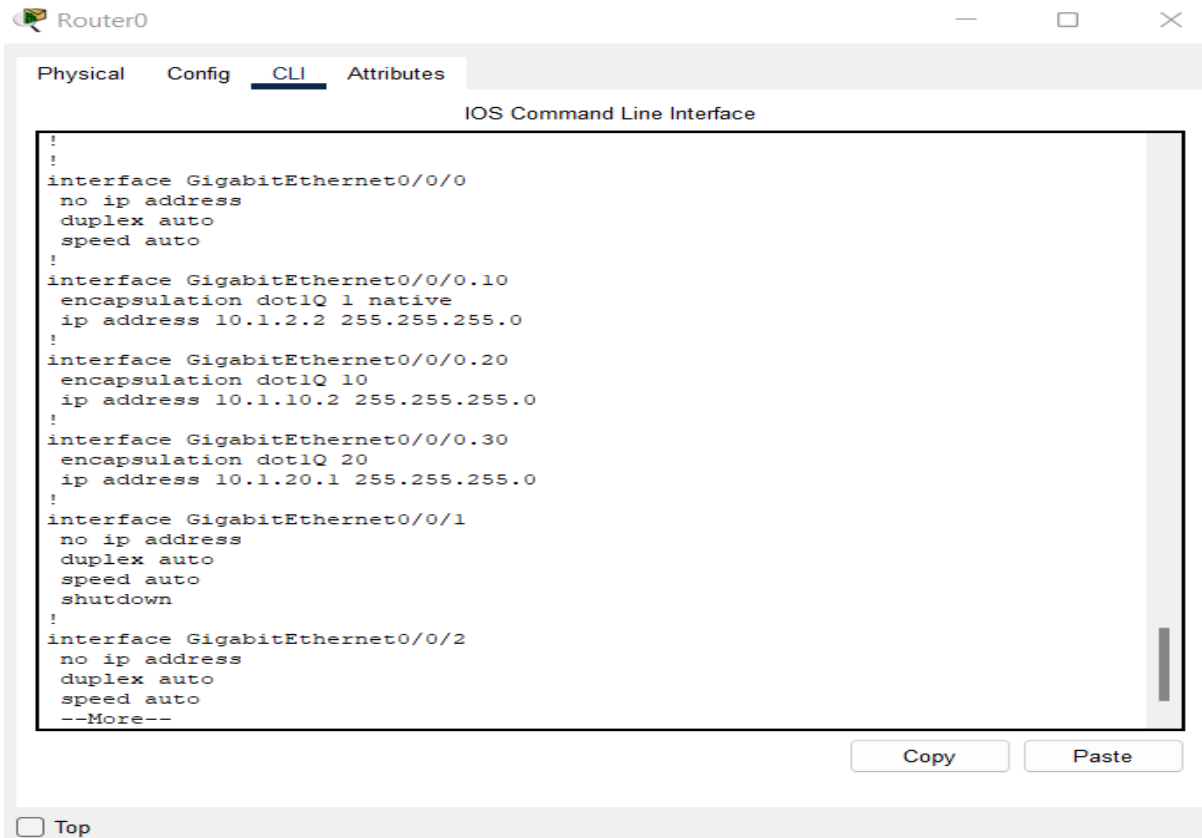
C:\>
C:\>ping 10.1.20.0

Pinging 10.1.20.0 with 32 bytes of data:

Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255
Reply from 10.1.10.2: bytes=32 time<1ms TTL=255

Ping statistics for 10.1.20.0:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

```

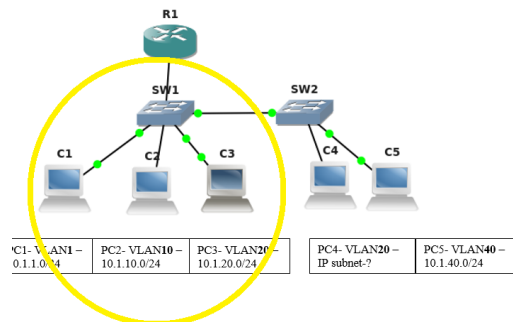


## Extra Credit [13 points]

1. What is a broadcast domain? How many broadcast domains are there in the topology in Objective 4? [3 points]

A broadcast domain is the logical division of the network in which all the nodes of the devices can reach other by broadcast at the data link layer (layer 2 segment). A broadcast domain can be within same LAN or can be bridged to other LAN's.

There is only one Broadcast domain in Objective4 topology





2. From your setup in objective 4,

- On Switch-1 port (connected to Switch-2), configure VLAN 10 as native-vlan.
- On Switch-2 port (connected to Switch-1), configure VLAN 20 as native-vlan.

Give it a minute. Do you observe any debug/warning messages on either of your switches? If yes, paste the message here. **[8 points]**

**YES. %CDP-4-NATIVE\_VLAN\_MISMATCH : NATIVE VLAN MISMATCH DISCOVERED**

On Switch1 :

```
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int fa0/4
Switch(config-if)#switch mode trunk
Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/4 (100), with Switch FastEthernet0/3 (1).
```

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On Switch2 :

Switch2

Physical Config **CLI** Attributes

IOS Command Line Interface

```
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/3 (1), with Switch FastEthernet0/4 (100).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/3 (1), with Switch FastEthernet0/4 (100).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/3 (1), with Switch FastEthernet0/4 (100).

Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int fa0/3
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk native vlan 20
Switch(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on
FastEthernet0/3 (20), with Switch FastEthernet0/4 (100).
```

Copy Paste

☐ Top

To your best knowledge, explain what you think it means **[2 points]**

The native VLAN is a VLAN that is not tagged in a trunk, making its frames transmission unchanged, I think, NATIVE VLAN MISMATCH DISCOVERED means, that you have a device plugged into your cisco switch that has different native vlan than the switch. And it occurs when two connected switch ports are configured with different VLANS. Basically, the receiving end of switch is not having the native vlan details, means it's not tagging your vlan details to the frame.

Total Score = \_\_\_\_\_/122