Department of Computer Science and Engineering
Islamic University of Technology (IUT)
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Lab Report 04

CSE 4412: Data Communication and Networking Lab

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Title: Understanding the basics of Inter-VLAN communication using Router, L3 Switch along with basics of Static Routing

Objectives:

1. Implement Inter-VLAN Routing via Router-on-a-Stick.
2. Implement Inter-VLAN Communication with Layer 3 Switch.
3. Demonstrate Static Routing.
4. Ensure Proper Segmentation and Security.
5. Document and Provide Clear Explanations.

Task 1:
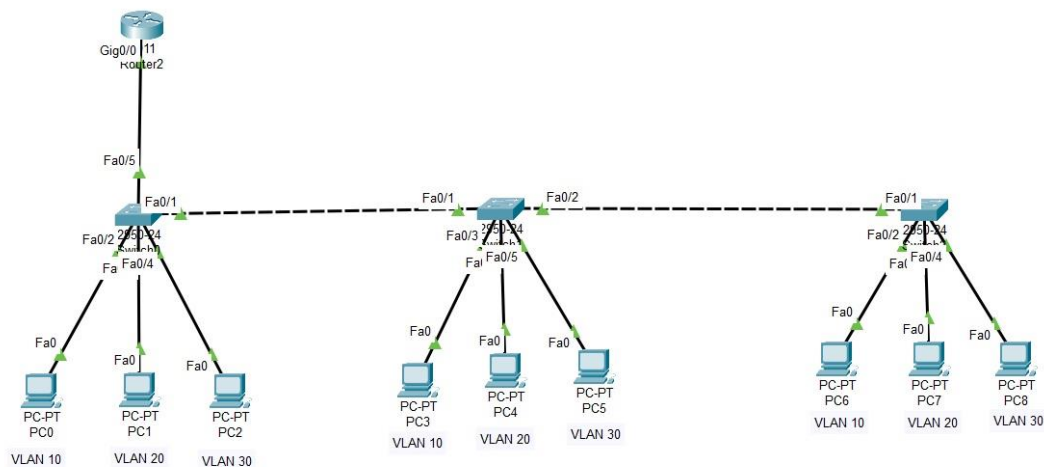
Step 1: Configuring Switches

At first, I configured 3 VLANs with VLAN IDs 10, 20, and 30 inside the switch and assigned appropriate names. To do this, I have used the following commands:

```
Switch> enable
Switch# config t
Switch(config)# vlan 10
Switch(config-vlan)# name student
Switch(config-vlan)# exit
Switch(config)# vlan 20
Switch(config-vlan)# name teacher
Switch(config-vlan)# exit
Switch(config)# vlan 30
Switch(config-vlan)# name admin
Switch(config-vlan)# exit
```

Then I configured the Interfaces belonging to each VLAN. For that, I used the following commands:

```
Switch(config)# interface fastEthernet 0/2
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/3
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 20
Switch(config-if)# no shutdown
Switch(config-if)# exit

Switch(config)# interface fastEthernet 0/4
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 30
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/1
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all
Switch(config-if)# no shutdown
Switch(config-if)# exit
```

This way I have configured the interfaces. For Switch2, the commands are exactly same as Switch1. There is a bit of difference in Switch1.

```
Switch(config)# interface fastEthernet 0/3
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/4
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 20
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/5
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 30
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/1
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/2
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all
Switch(config-if)# no shutdown
Switch(config-if)# exit
```

As Switch5 has 2 trunk connections that's why the changes in the command.
For Router-on-a-stick, we configured Switch0 with the following:

```
Switch(config)# interface fastEthernet 0/5
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all
Switch(config-if)# no shutdown
Switch(config-if)# exit
```
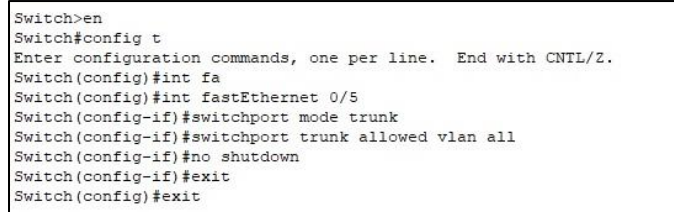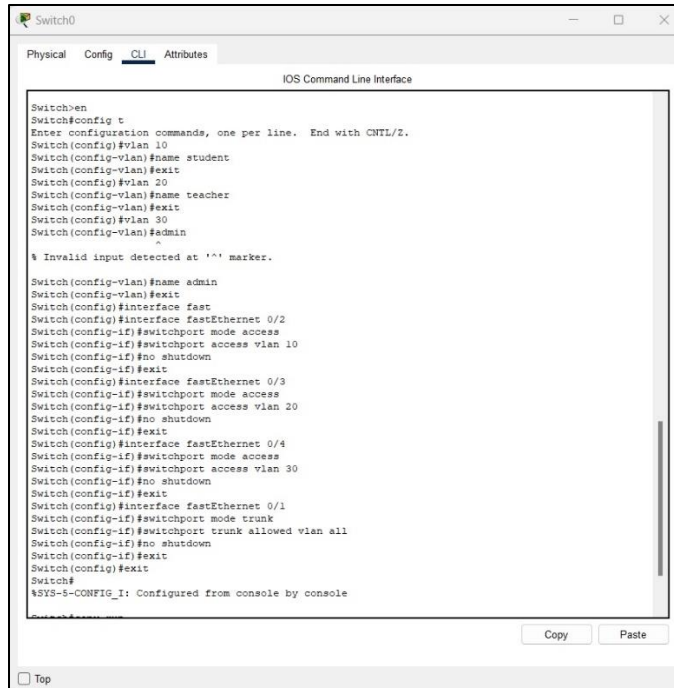
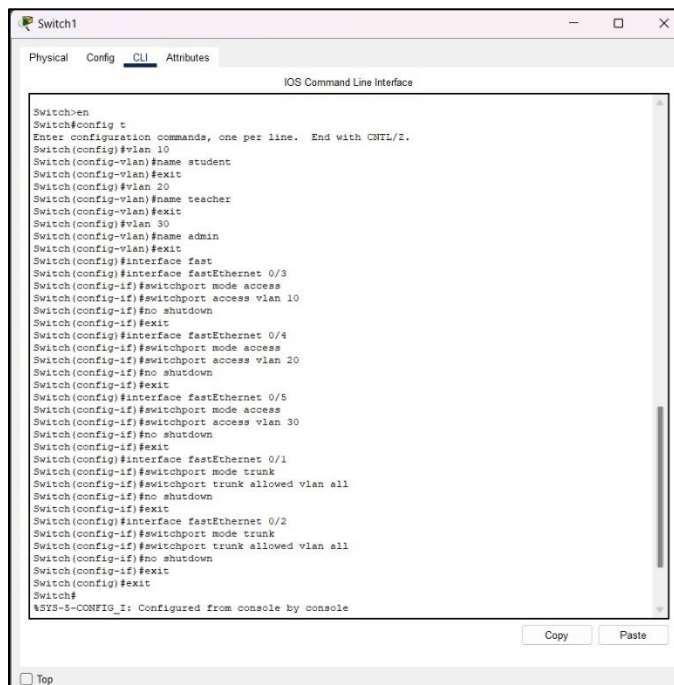Here are the screenshots of the three switches:

```
Switch>en
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name student
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name teacher
Switch(config-vlan)#exit
Switch(config)#vlan 30
Switch(config-vlan)#admin
                    ^
% Invalid input detected at '^' marker.

Switch(config-vlan)#name admin
Switch(config-vlan)#exit
Switch(config)#interface fast
Switch(config)#interface fastEthernet 0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/3
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/4
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 30
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch>en
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int fa
Switch(config)#int fastEthernet 0/5
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
```

Fig 1.2: Switch0 configuration


```
Switch>en
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name student
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name teacher
Switch(config-vlan)#exit
Switch(config)#vlan 30
Switch(config-vlan)#name admin
Switch(config-vlan)#exit
Switch(config)#interface fast
Switch(config)#interface fastEthernet 0/3
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/4
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/5
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 30
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/2
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```
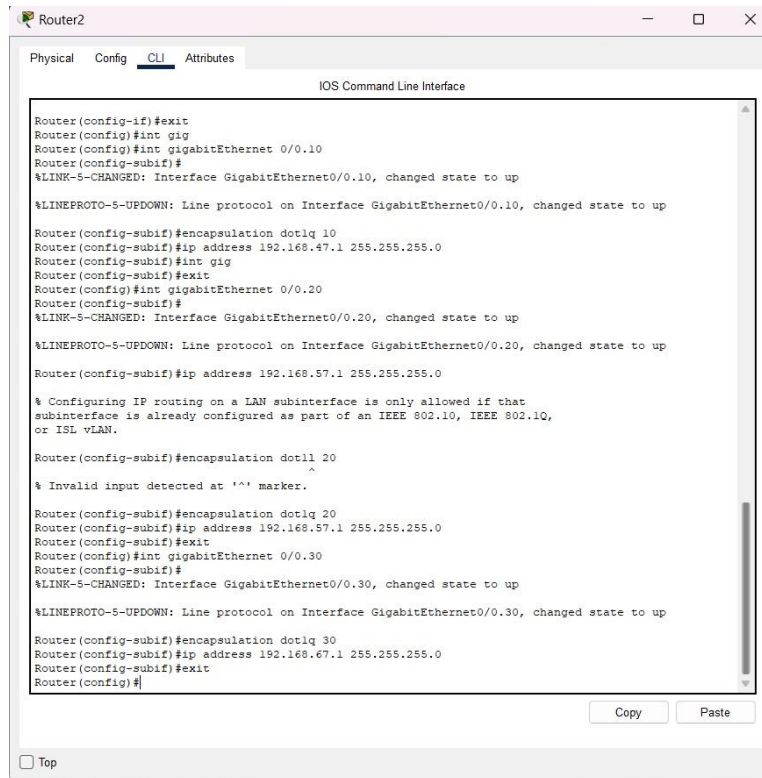
Fig 1.3: Switch1 configuration

Fig 1.4: Switch3 configuration

Step 2: Configuring Router

Now for router configuration, I used the following commands on router's CLI:

```
Router> enable
Router# config t
Router(config)# interface gigabitEthernet 0/0
Router(config-if)#no shutdown
Router(config)#int g0/0.10
Router(config-subif)#encapsulation dot1q 10
Router(config-subif)#ip address 192.168.47.1 255.255.255.0
Router(config-subif)#exit
Router(config)#int g0/0.20
Router(config-subif)#encapsulation dot1q 20
Router(config-subif)#ip address 192.168.57.1 255.255.255.0
Router(config-subif)#exit
Router(config)#int g0/0.20
Router(config-subif)#encapsulation dot1q 20
Router(config-subif)#ip address 192.168.67.1 255.255.255.0
Router(config-subif)#exit
```

Here are the screenshots of the router:

Fig 1.5: Router configuration

Step 3: Setting Up IPs

As my ID's last 2 digits are 37, IP addresses are:

VLAN 10 host's IP address:
1. PC0: 192.167.47.2
2. PC3: 192.167.47.3
3. PC6: 192.167.47.4

VLAN 20 host's IP address:
1. PC1: 192.167.57.2
2. PC4: 192.167.47.3
3. PC7: 192.167.47.4

VLAN 30 host's IP address:
1. PC2: 192.167.67.2
2. PC5: 192.167.67.3
3. PC8: 192.167.67.4

Here are the screenshots:

Fig 1.6: IP Address of PC0

Fig 1.7: IP Address of PC1

Fig 1.8: IP Address of PC2

Step 4: Using the ping command from the Terminal

To ping, I clicked on PC0, went to Desktop, then Command Prompt. In the command prompt, I wrote:

```
Ping 192.167.47.3
```

We saw that 4 packets were sent, 4 packets were received, 0 packets were lost as they are on VLAN 10.
But when I sent a ping to PC6 using this:

```
Ping 192.167.57.3
```

We saw that, 4 packets were sent, 0 packets were received, 4 packets were lost as they are on different VLANs.
But when I sent a ping to PC1 using this:

```
Ping 192.167.57.2
```

We saw that, 4 packets were sent, 4 packets were received, 0 packets were lost as they are under same switch.

Here is the screenshot of the command prompt of PC0:

Fig 1.9: Command Prompt of PC0

Task 2:
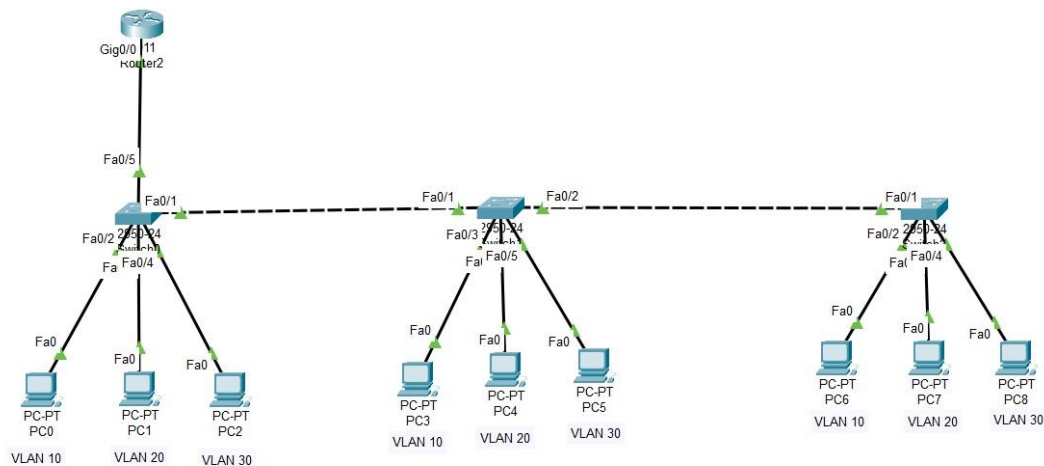
Step 1: Configuring Switches

At first, I configured 4 VLANs with VLAN IDs 10, 20, 30, and 40 inside the switch and assigned appropriate names. To do this, I have used the following commands:

```
Switch> enable
Switch# config t
Switch(config)# vlan 10
Switch(config-vlan)# exit
Switch(config)# vlan 20
Switch(config-vlan)# exit
Switch(config)# vlan 30
Switch(config-vlan)# exit
Switch(config)# vlan 40
Switch(config-vlan)# exit
```

Then I configured the Interfaces belonging to each VLAN. For that, I used the following commands:

```
Switch(config)# interface fastEthernet 0/3
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/4
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 20
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/5
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 30
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/6
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 40
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/2
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface fastEthernet 0/1
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all
Switch(config-if)# no shutdown
Switch(config-if)# exit
```

This way I have configured the interfaces. For Switch1, the commands are exactly same as Switch0. The screen shots are given below:
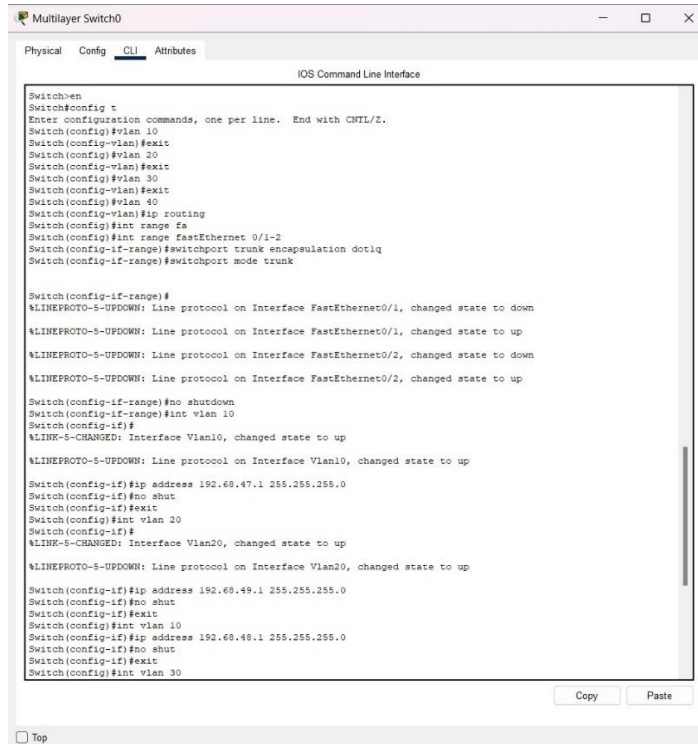
Step 2: Configuring Multilayer Switch
Now for router configuration, I used the following commands on router's CLI:

```
Switch> enable
Switch# config t
Switch(config)# vlan 10
Switch(config-vlan)# exit
Switch(config)# vlan 20
Switch(config-vlan)# exit
Switch(config)# vlan 30
Switch(config-vlan)# exit
```

```
Switch(config)# vlan 40
Switch(config-vlan)#ip routing
Switch(config)#int range fa0/1-2
Switch(config-if-range)#switchport trunk encapsulation dot1q
Switch(config-if-range)#switchport mode trunk
Switch(config-if-range)#no shutdown
Switch(config-if-range)#int vlan 10
Switch(config-if)#ip address 192.168.48.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config-if-range)#int vlan 20
Switch(config-if)#ip address 192.168.49.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config-if-range)#int vlan 30
Switch(config-if)#ip address 192.168.50.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config-if-range)#int vlan 40
Switch(config-if)#ip address 192.168.51.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
```
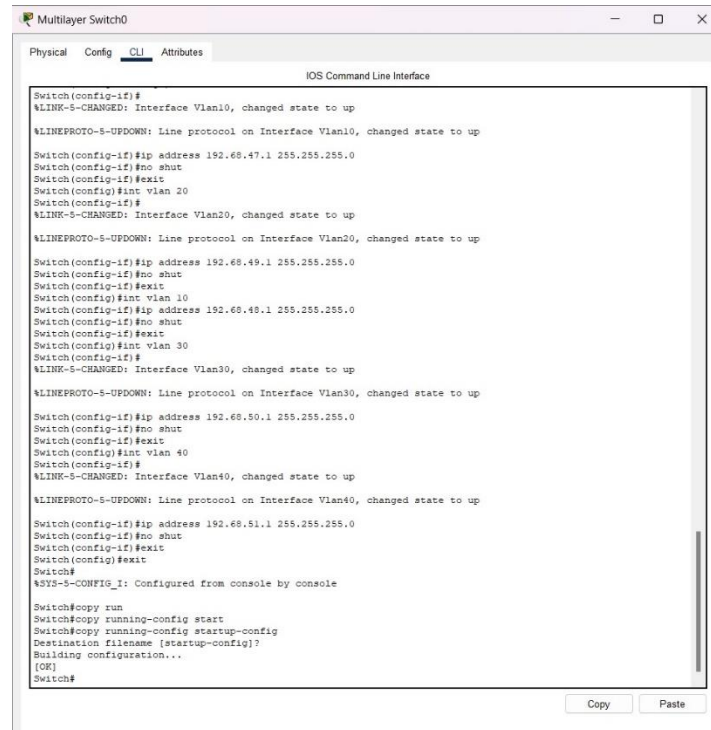
Here are the screenshots of the switch:

```
Multilayer Switch0                                          —   □   ×

Physical   Config   CLI   Attributes
                        IOS Command Line Interface
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up

Switch(config-if)#ip address 192.68.47.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#int vlan 20
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

Switch(config-if)#ip address 192.68.49.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#int vlan 10
Switch(config-if)#ip address 192.68.48.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#int vlan 30
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan30, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan30, changed state to up

Switch(config-if)#ip address 192.68.50.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#int vlan 40
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan40, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan40, changed state to up

Switch(config-if)#ip address 192.68.51.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#copy run
Switch#copy running-config start
Switch#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Switch#

                                        Copy        Paste
```

Step 3: Setting Up IPs

As my ID's last 2 digits are 37, IP addresses are:

VLAN 10 host's IP address:
1. PC0: 192.167.48.2
2. PC4: 192.167.48.3

VLAN 20 host's IP address:
1. PC2: 192.167.49.2
2. PC5: 192.167.49.3

VLAN 30 host's IP address:
1. PC2: 192.167.50.2
2. PC5: 192.167.50.3

VLAN 40 host's IP address:
1. PC2: 192.167.51.2
2. PC5: 192.167.51.3

PC0

Physical · Config · Desktop · Programming · Attributes

IP Configuration

Interface	FastEthernet0

IP Configuration

○ DHCP   ● Static

IPv4 Address	192.168.48.2
Subnet Mask	255.255.255.0
Default Gateway	192.168.48.1
DNS Server	0.0.0.0

IPv6 Configuration

○ Automatic   ● Static

IPv6 Address	/
Link Local Address	FE80::20C:85FF:FE19:C57
Default Gateway	
DNS Server	

802.1X

☐ Use 802.1X Security

Authentication	MD5
Username	
Password	

☐ Top

PC1

Physical · Config · Desktop · Programming · Attributes

IP Configuration

Interface	FastEthernet0

IP Configuration

○ DHCP   ● Static

IPv4 Address	192.168.49.2
Subnet Mask	255.255.255.0
Default Gateway	192.168.49.1
DNS Server	0.0.0.0

IPv6 Configuration

○ Automatic   ● Static

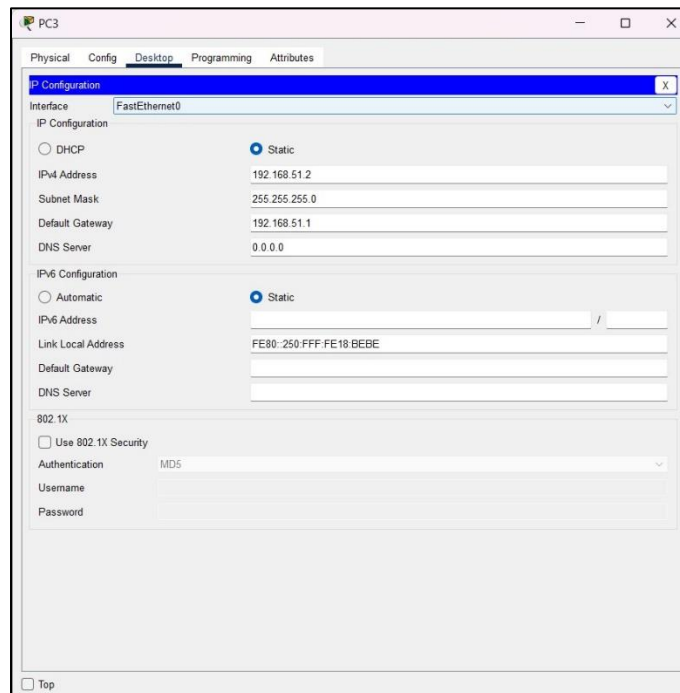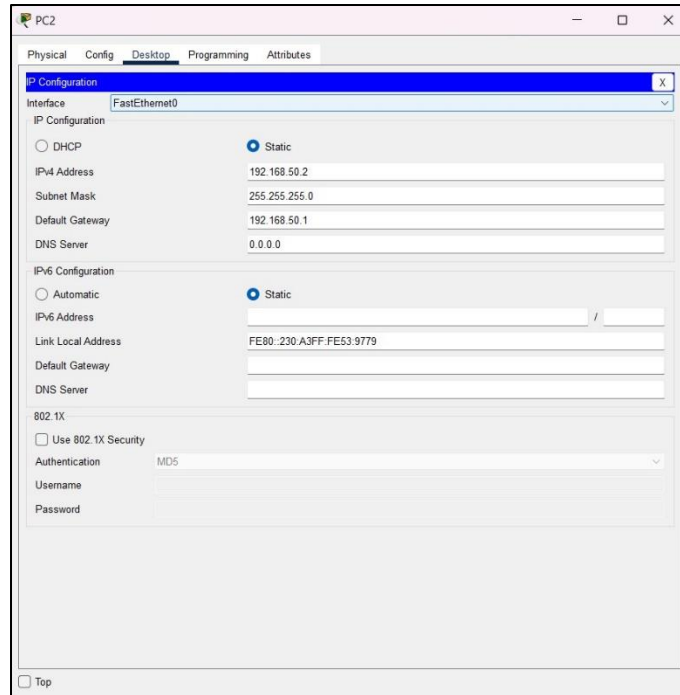|	
IPv6 Address	/
Link Local Address	FE80::200:CFF:FE97:B732
Default Gateway	
DNS Server	

802.1X

☐ Use 802.1X Security

Authentication	MD5
Username	
Password	

☐ Top

Step 4: Using the ping command from the Terminal

To ping, I clicked on PC0, went to Desktop, then Command Prompt. In the command prompt, I wrote:

```
Ping 192.167.48.3
```

We saw that 4 packets were sent, 4 packets were received, 0 packets were lost as they are on VLAN 10.
But when I sent a ping to PC6 using this:

```
Ping 192.167.49.3
```

We saw that, 4 packets were sent, 0 packets were received, 4 packets were lost as they are on different VLANs.
But when I sent a ping to PC1 using this:

```
Ping 192.167.49.2
```

We saw that, 4 packets were sent, 4 packets were received, 0 packets were lost as they are under same switch.

Task 3:

Questions (Answer to the point):

1. **Why do we need L3 Switches?**
   Ans: L3 switches are needed to perform routing functions at the network layer (Layer 3) of the OSI model.

2. **What is the use router in Inter-Vlan Routing?**
   Ans: Routers are used in Inter-VLAN Routing to facilitate communication between different VLANs. They route traffic between VLANs, allowing devices in different VLANs to communicate with each other.

3. **What changes are needed while configuring VLANs using L3 switches instead of Router-on-a-stick approach?**
   Ans: When configuring VLANs using L3 switches instead of the Router-on-a-stick approach, changes involve configuring VLAN interfaces directly on the switch and enabling routing between them. This eliminates the need for a separate router interface for each VLAN and allows for faster inter-VLAN communication within the switch itself.

4. **What is next-hop floating address?**
   Ans: A next-hop floating address is a backup route used in routing protocols such as OSPF or EIGRP. It is configured with a higher administrative distance than the primary route and is used only if the primary route becomes unavailable.

5. **What is the disadvantage of static routing?**
   Ans: A disadvantage of static routing is its lack of flexibility and scalability. Static routes require manual configuration and do not adapt to changes in the network topology automatically. This makes them less suitable for large or dynamic networks where routing needs may change frequently.

Challenges (if any):

No challenges faced