Department of Computer Science and Engineering

Islamic University of Technology (IUT)

A subsidiary organ of OIC

Lab Report 04

CSE 4412: Data Communication and Networking Lab

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Section: B(Even)

Semester: 4th(Summer)

Academic Year: 2022-2023

Date of Submission: 17th February 2024

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

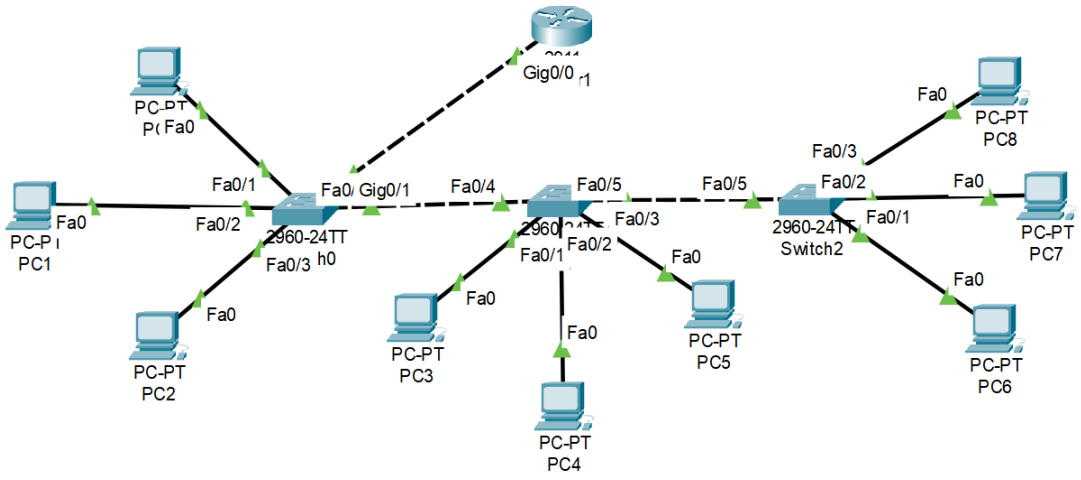
Objectives:

1. Design and implement Inter-VLAN routing using Router on a stick
2. Design and implement Inter-VLAN routing using Multilayer Switch
3. Understand and implement Static Routing

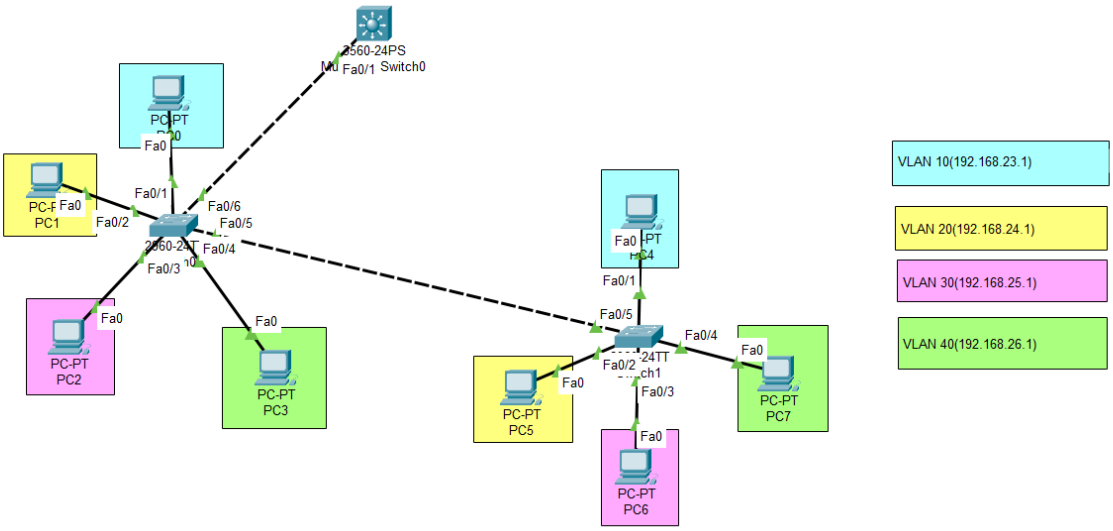
Diagram of the experiment:

(Provide screenshot of the final network topology. Make sure to label the network components.)

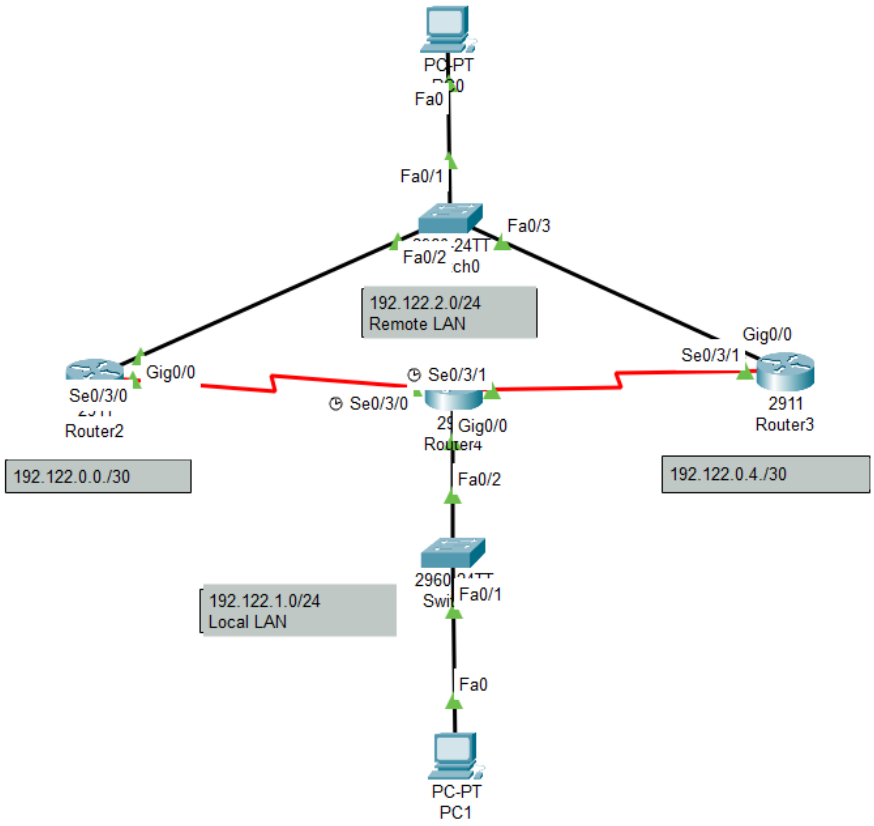
TASK 1:



TASK 2:


2560-24PS
Fa0/1
Switch0
PC-PT
Fa0
PC-F
PC1
Fa0
Fa0/1
Fa0/2
Fa0/6
Fa0/5
Fa0/4
Fa0/3
Fa0
PC-PT
PC2
Fa0
PC-PT
PC3
Fa0
PC-PT
Fa0/1
Fa0/5
Fa0/4
Fa0/2
Fa0/3
Fa0
PC-PT
PC5
Fa0
PC-PT
PC7
Fa0
PC-PT
PC6
VLAN 10(192.168.23.1)
VLAN 20(192.168.24.1)
VLAN 30(192.168.25.1)
VLAN 40(192.168.26.1)

TASK 3:

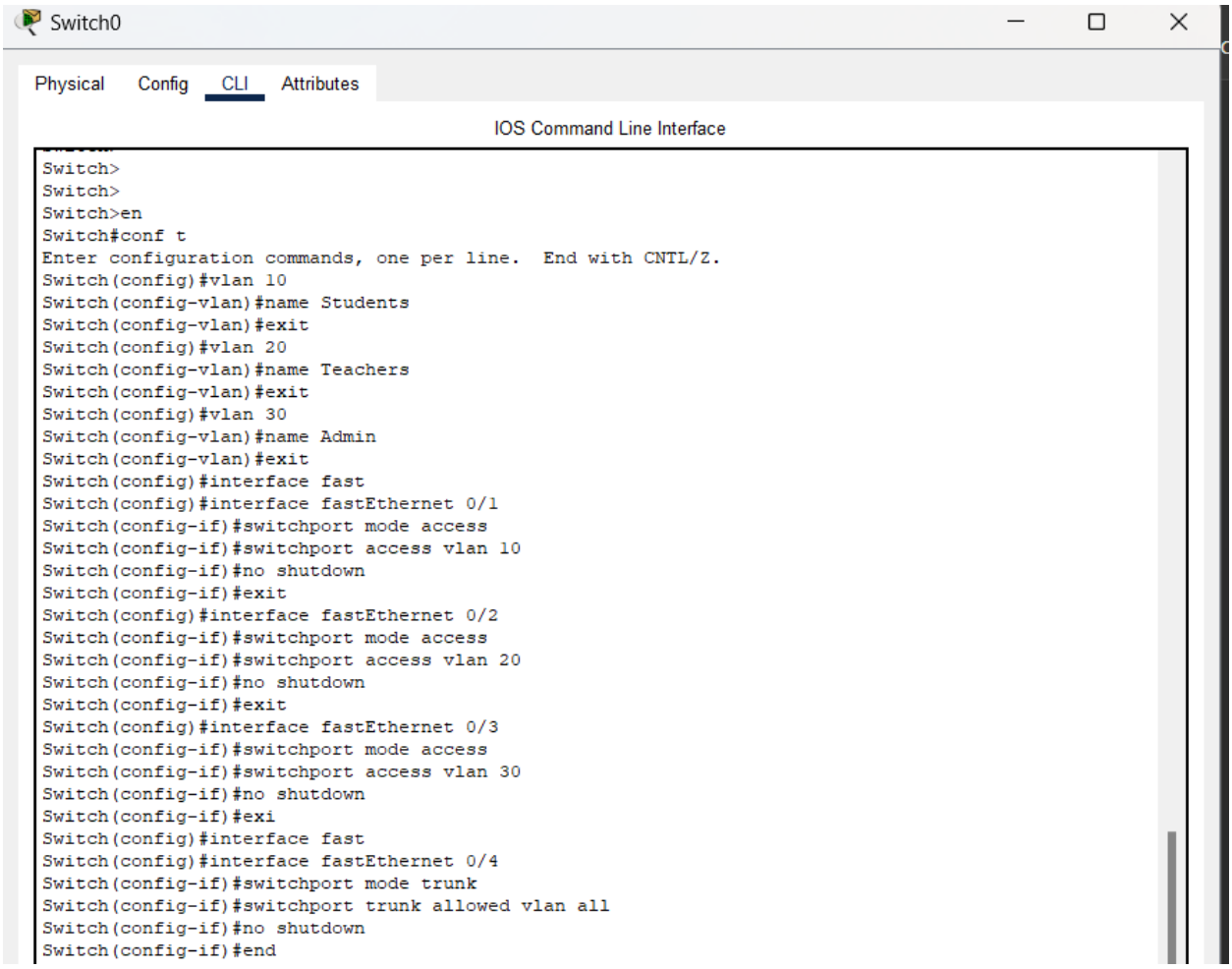


Working Procedure:

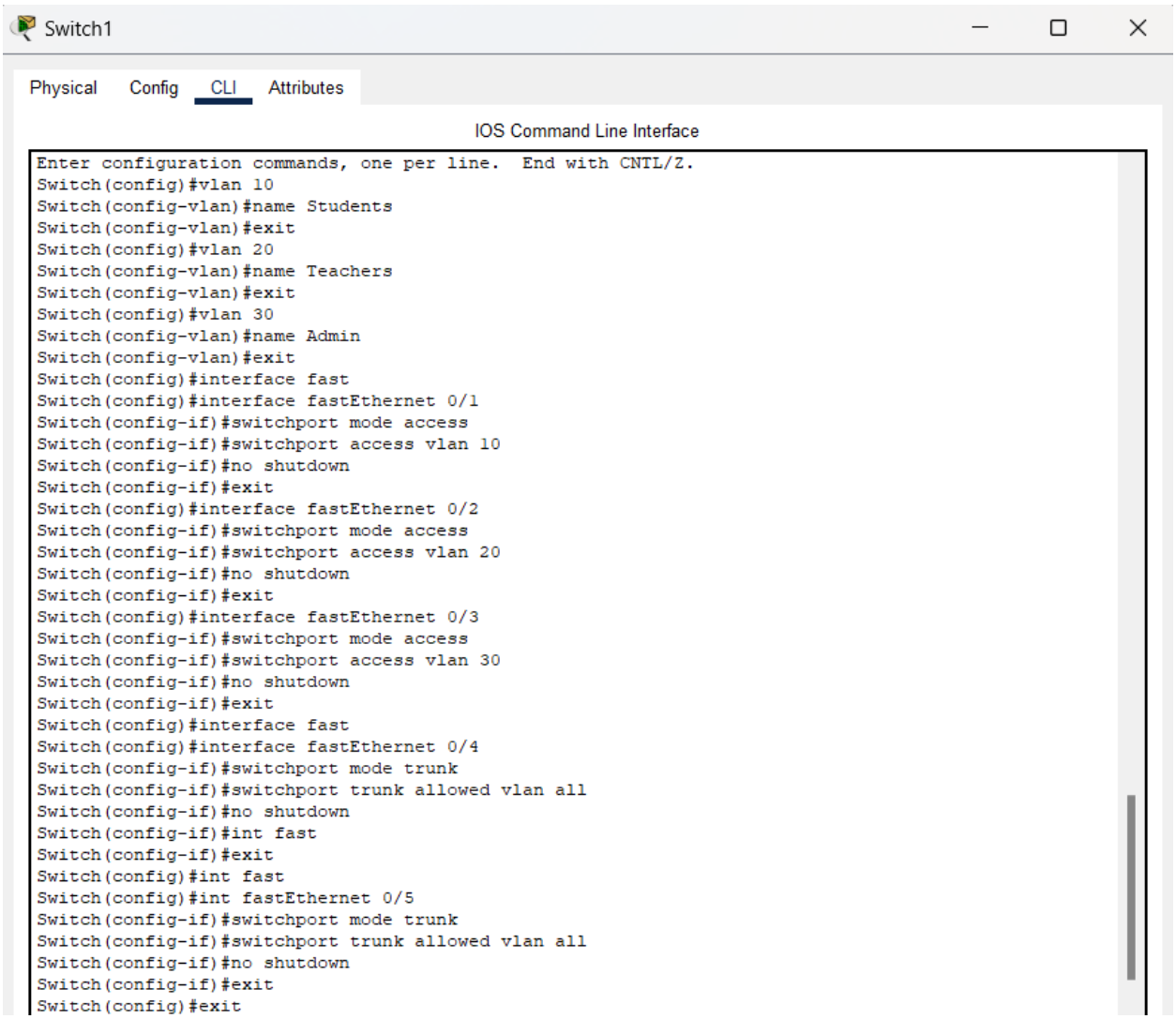
(Explain in brief how you completed the tasks. Provide necessary screenshots of used commands for each task.)

TASK 1:

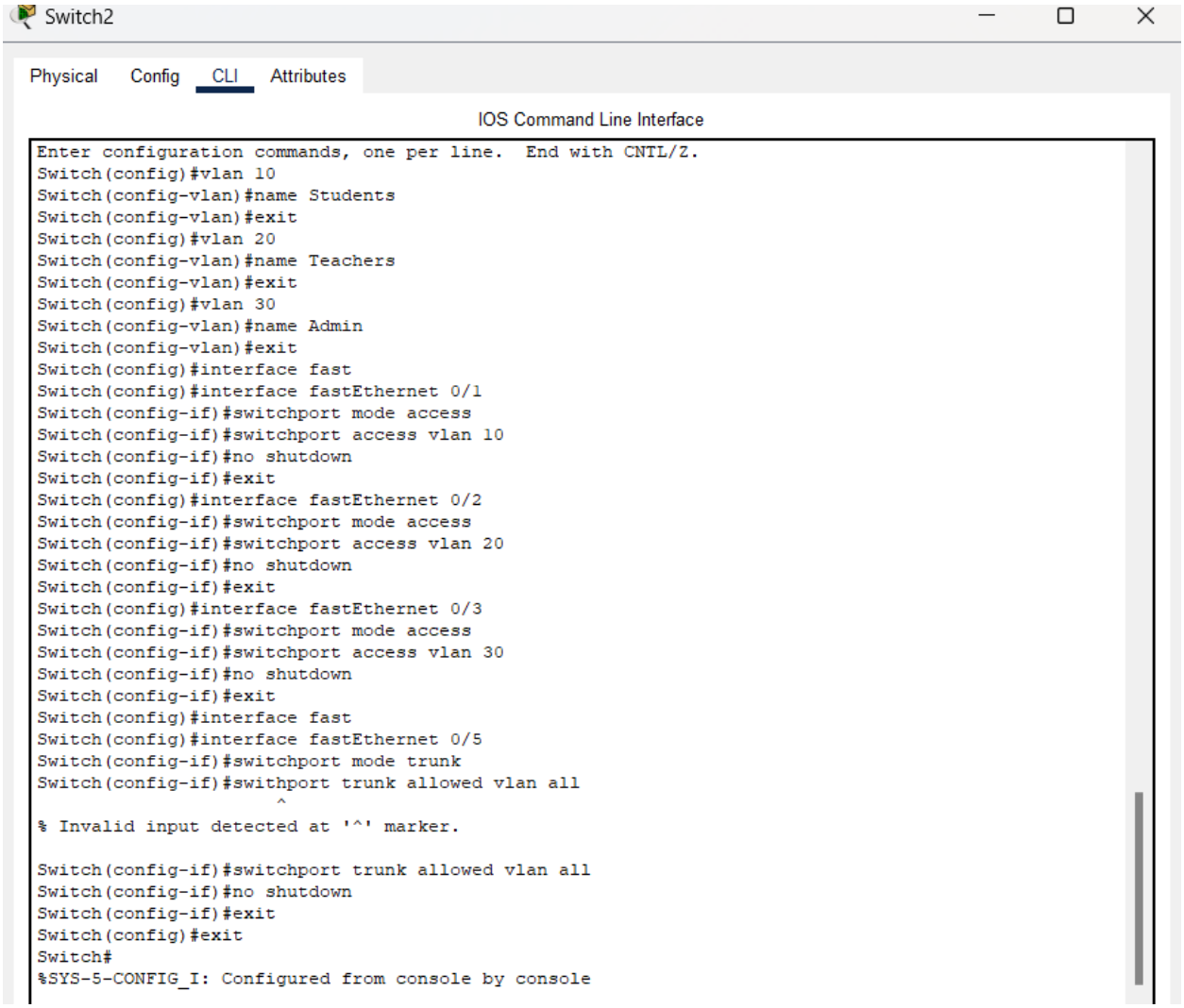
For the switch configurations:
SWITCH0:



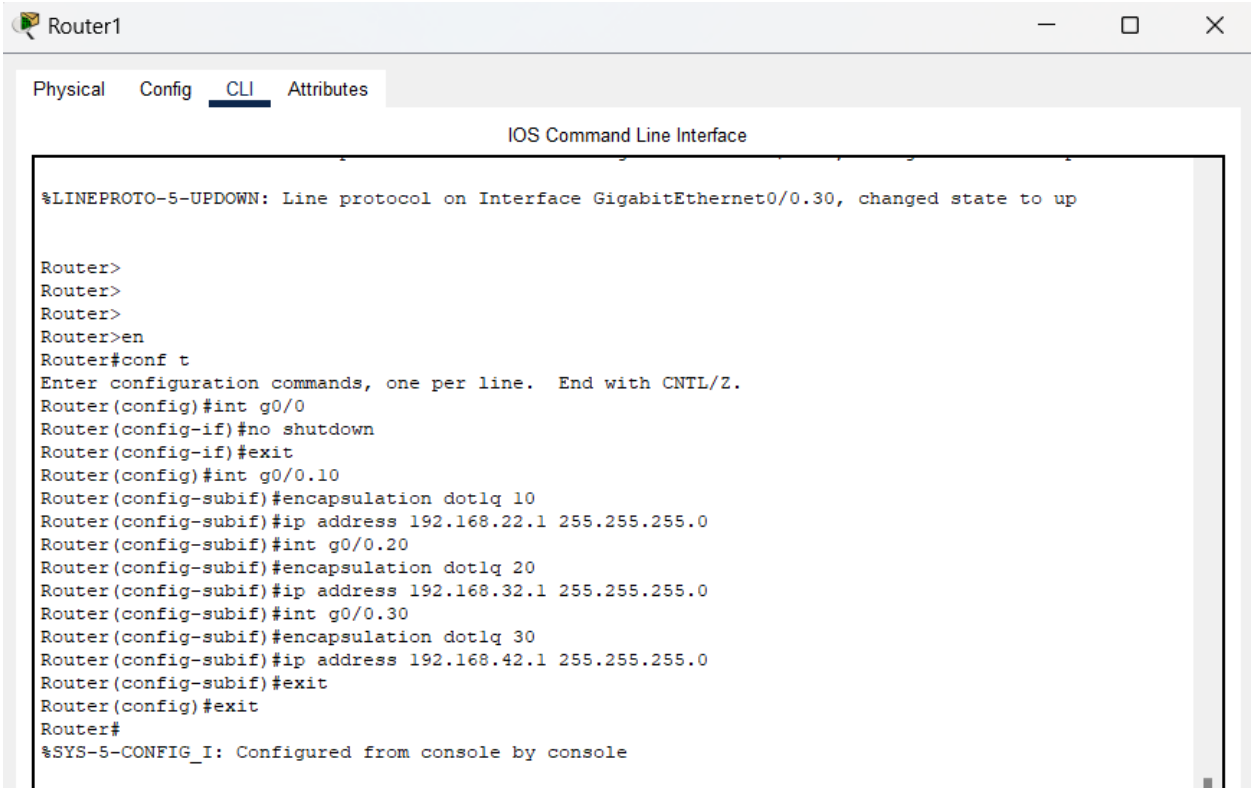
SWITCH1:


Switch1
Physical
Config
CLI
Attributes
IOS Command Line Interface
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name Students
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name Teachers
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 0/1
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 0/2
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 0/3
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 fast
Switch(config)#interface fastEthernet 0/4
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#no shutdown
Switch(config-if)#int fast
Switch(config-if)#exit
Switch(config)#int fast
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

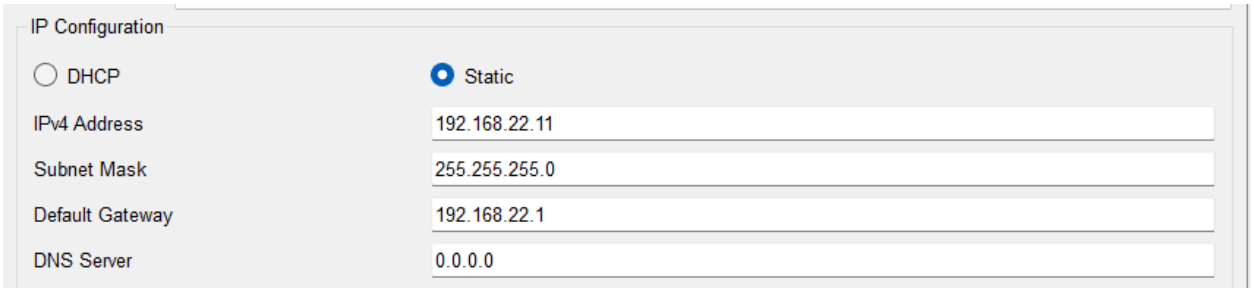
SWITCH2:


Switch2
Physical
Config
CLI
Attributes
IOS Command Line Interface
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name Students
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name Teachers
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 0/1
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 0/2
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 0/3
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 fast
Switch(config)#interface fastEthernet 0/5
Switch(config-if)#switchport mode trunk
Switch(config-if)#swithport trunk allowed vlan all
                 ^
% Invalid input detected at '^' marker.
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

For the router configuration:

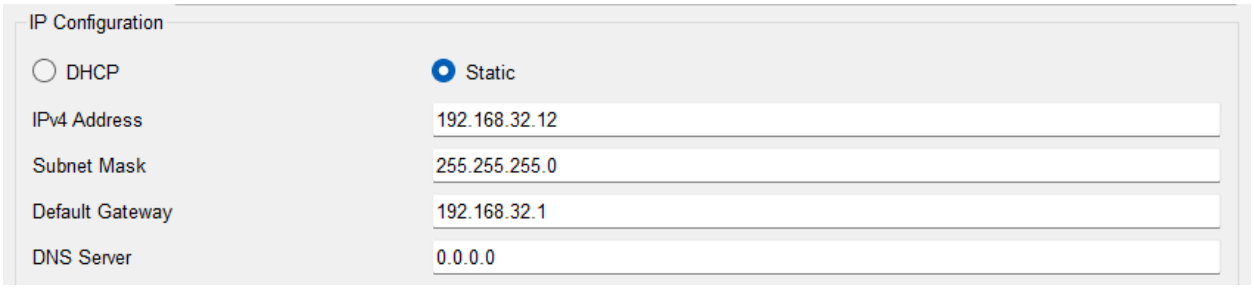


The PCs for VLAN 10:



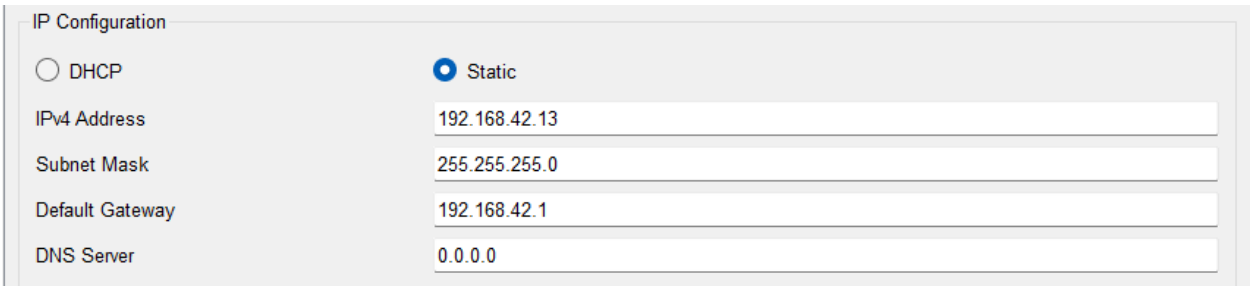
(The rest of the pcs of vlan 10 are configured like this as well.)

The PCs for VLAN 20:



(The rest of the pcs of vlan 20 are configured like this as well.)

The PCs for VLAN 30:



(The rest of the pcs of vlan 30 are configured like this as well.)

Pinging PC from the VLAN 10 to other PC in VLAN 10 and to the PCs of the other VLANs:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.22.14

Pinging 192.168.22.14 with 32 bytes of data:

Reply from 192.168.22.14: bytes=32 time<1ms TTL=128
Reply from 192.168.22.14: bytes=32 time<1ms TTL=128
Reply from 192.168.22.14: bytes=32 time<1ms TTL=128
Reply from 192.168.22.14: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.22.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.32.12

Pinging 192.168.32.12 with 32 bytes of data:

Reply from 192.168.32.12: bytes=32 time<1ms TTL=127
Reply from 192.168.32.12: bytes=32 time<1ms TTL=127
Reply from 192.168.32.12: bytes=32 time<1ms TTL=127
Reply from 192.168.32.12: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.32.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.42.19

Pinging 192.168.42.19 with 32 bytes of data:

Request timed out.
Reply from 192.168.42.19: bytes=32 time<1ms TTL=127
Reply from 192.168.42.19: bytes=32 time<1ms TTL=127
Reply from 192.168.42.19: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.42.19:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Pinging PC from the VLAN 20 to other PC in VLAN 20 and to the PCs of the other VLANs:

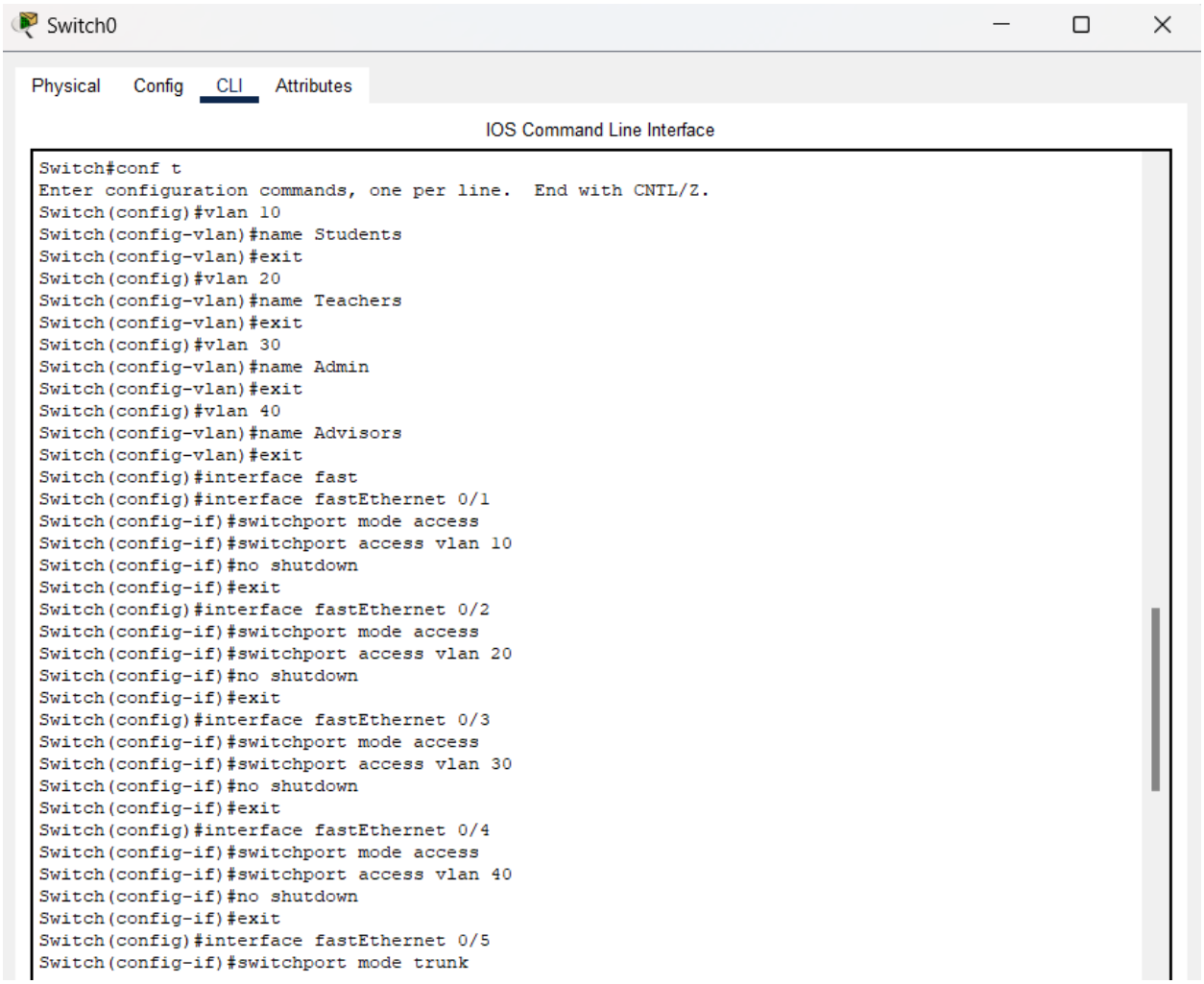
```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.32.15

Pinging 192.168.32.15 with 32 bytes of data:

Reply from 192.168.32.15: bytes=32 time=10ms TTL=128
Reply from 192.168.32.15: bytes=32 time=10ms TTL=128
Reply from 192.168.32.15: bytes=32 time=8ms TTL=128
Reply from 192.168.32.15: bytes=32 time=9ms TTL=128

Ping statistics for 192.168.32.15:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 8ms, Maximum = 10ms, Average = 9ms

C:\>ping 192.168.22.17

Pinging 192.168.22.17 with 32 bytes of data:

Request timed out.
Reply from 192.168.22.17: bytes=32 time<1ms TTL=127
Reply from 192.168.22.17: bytes=32 time=1ms TTL=127
Reply from 192.168.22.17: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.22.17:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.42.16

Pinging 192.168.42.16 with 32 bytes of data:

Request timed out.
Reply from 192.168.42.16: bytes=32 time=1ms TTL=127
Reply from 192.168.42.16: bytes=32 time<1ms TTL=127
Reply from 192.168.42.16: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.42.16:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Pinging PC from the VLAN 30 to other PC in VLAN 30 and to the PCs of the other VLANs:

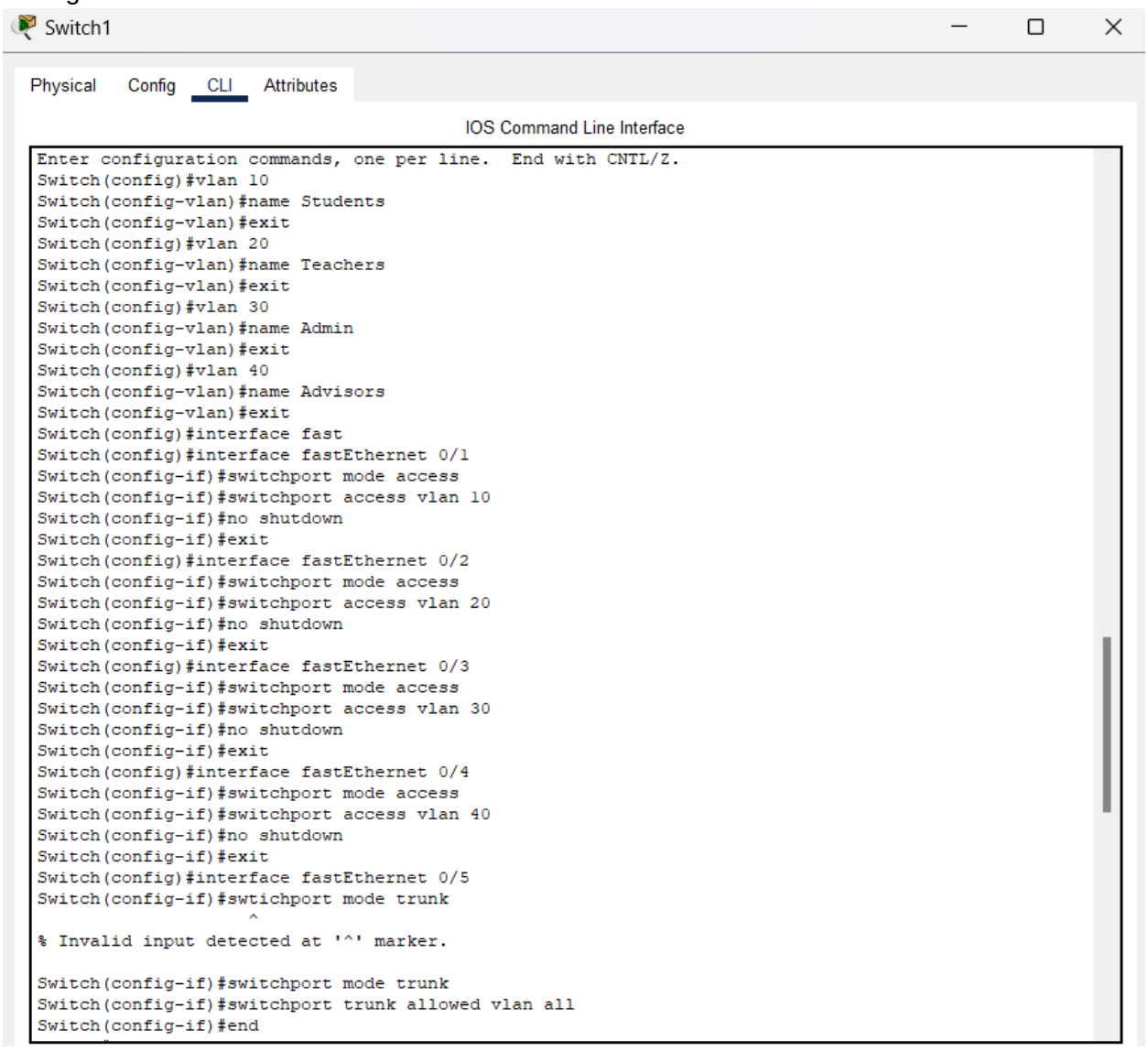
```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.42.13

Pinging 192.168.42.13 with 32 bytes of data:

Reply from 192.168.42.13: bytes=32 time<1ms TTL=128
Reply from 192.168.42.13: bytes=32 time<1ms TTL=128
Reply from 192.168.42.13: bytes=32 time<1ms TTL=128
Reply from 192.168.42.13: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.42.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.22.17

Pinging 192.168.22.17 with 32 bytes of data:

Reply from 192.168.22.17: bytes=32 time<1ms TTL=127
Reply from 192.168.22.17: bytes=32 time<1ms TTL=127
Reply from 192.168.22.17: bytes=32 time<1ms TTL=127
Reply from 192.168.22.17: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.22.17:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.32.18

Pinging 192.168.32.18 with 32 bytes of data:

Request timed out.
Reply from 192.168.32.18: bytes=32 time<1ms TTL=127
Reply from 192.168.32.18: bytes=32 time<1ms TTL=127
Reply from 192.168.32.18: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.32.18:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

TASK 2:

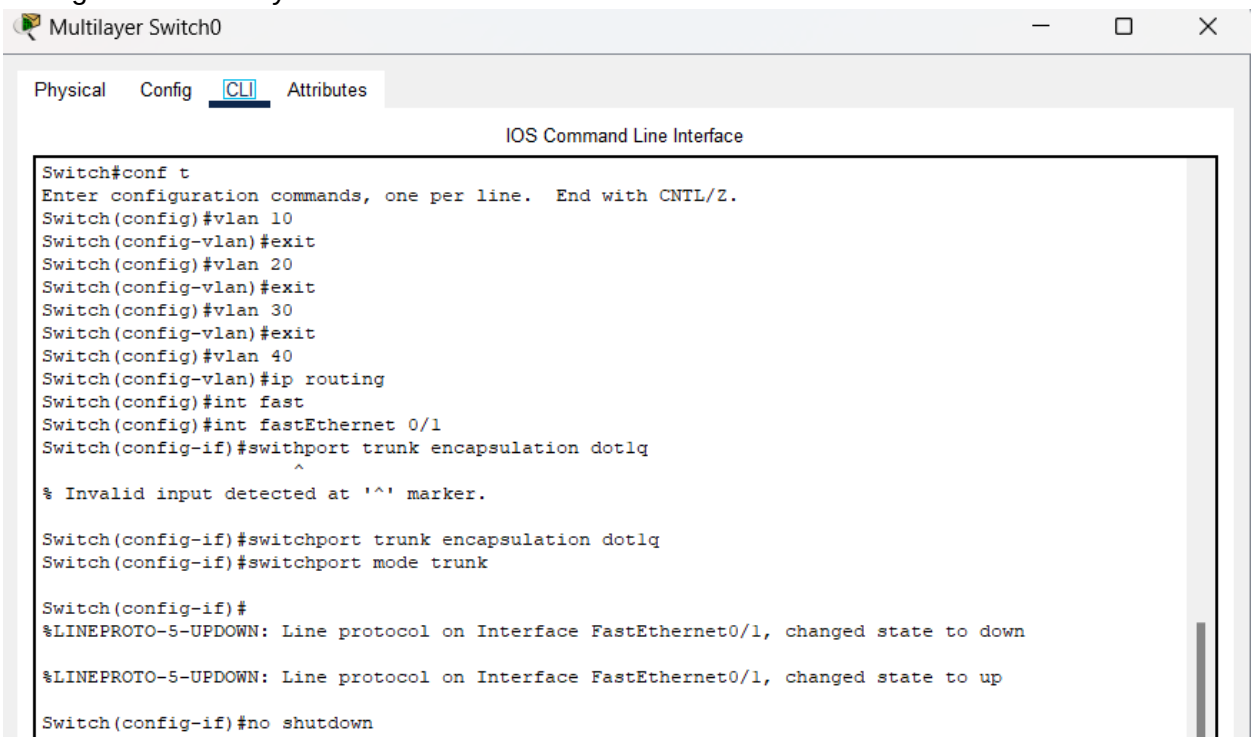
Configure Switch0:

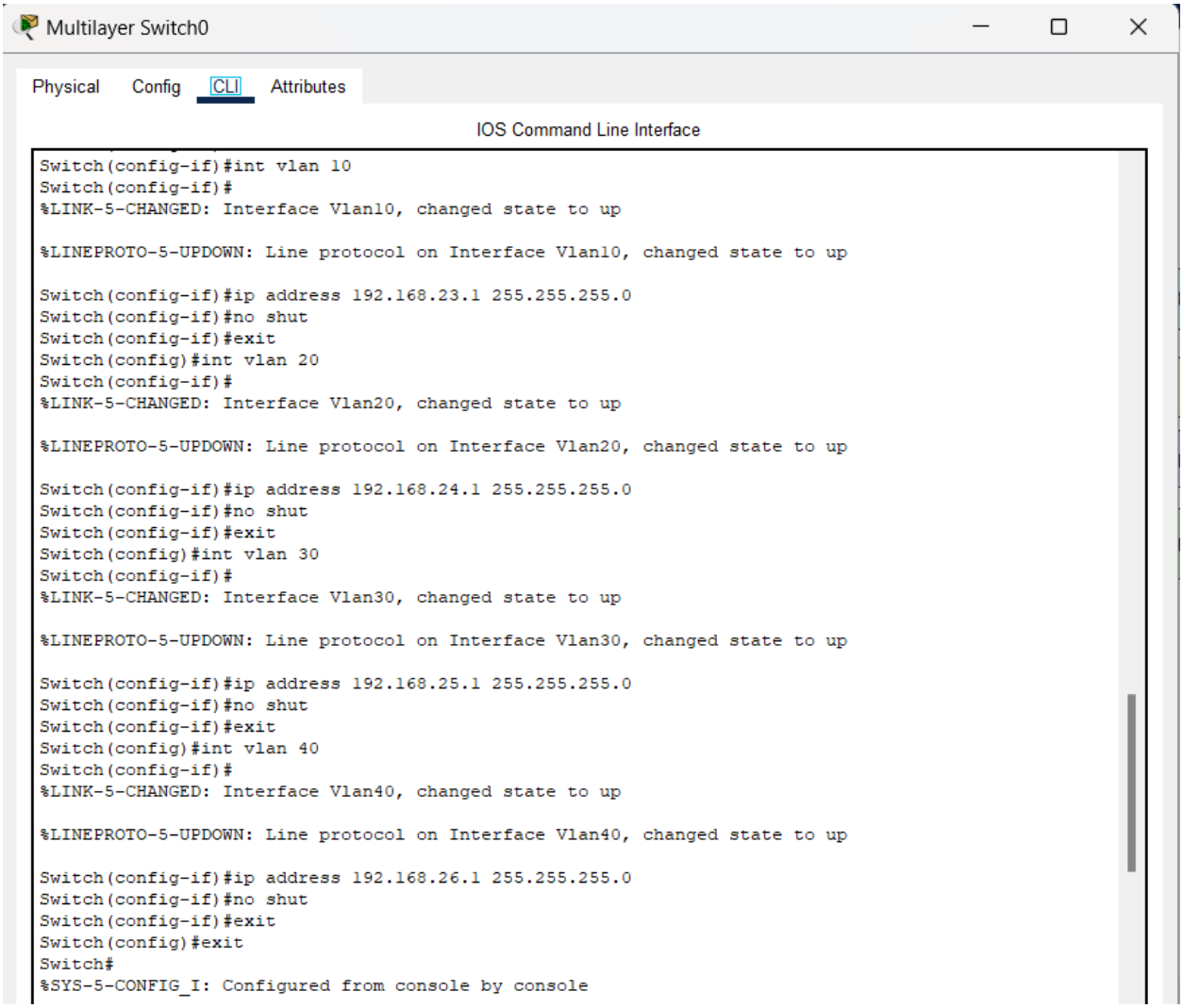


Configure Switch1:



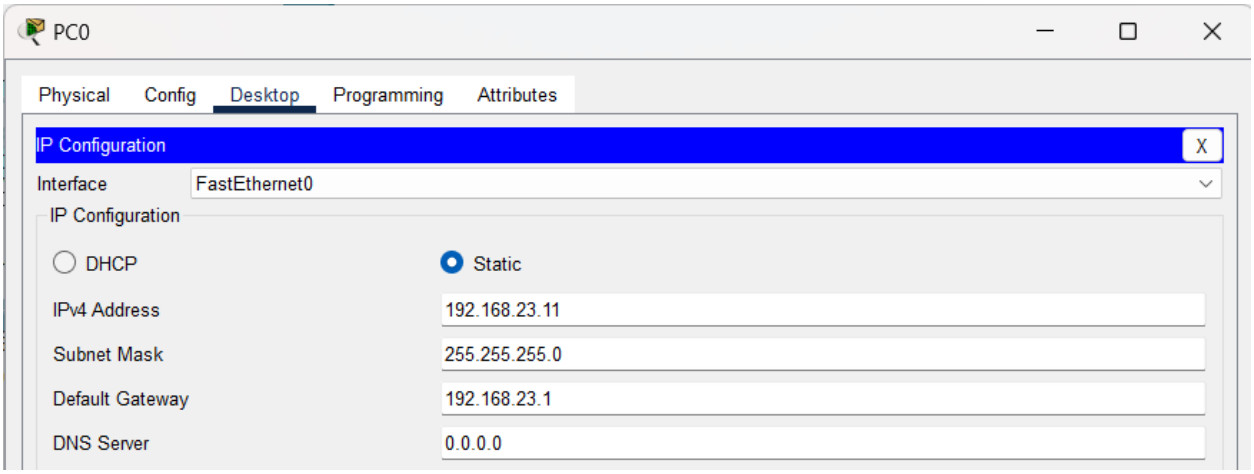
Configure the Multilayer Switch0:

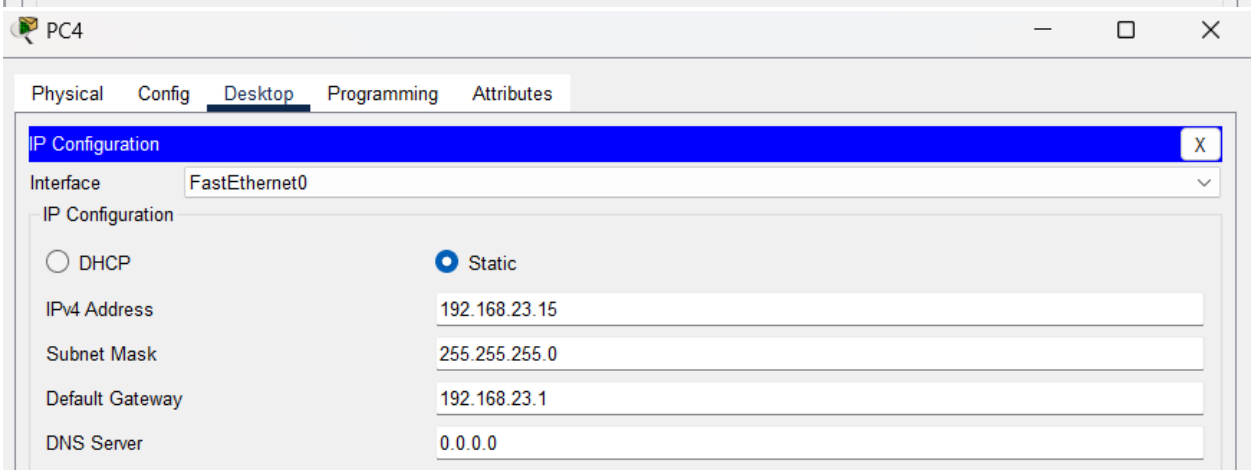



Multilayer Switch0
Physical
Config
CLI
Attributes
IOS Command Line Interface
Switch(config-if)#int vlan 10
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
Switch(config-if)#ip address 192.168.23.1 255.255.255.0
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 192.168.24.1 255.255.255.0
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 192.168.25.1 255.255.255.0
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 192.168.26.1 255.255.255.0
Switch(config-if)#no shut
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

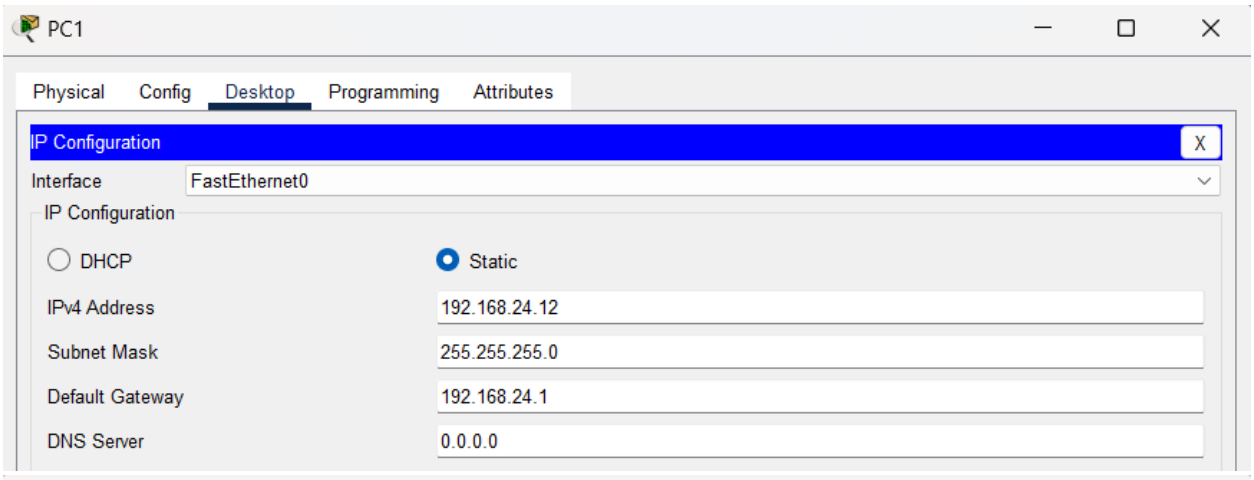
Configure the PCs:

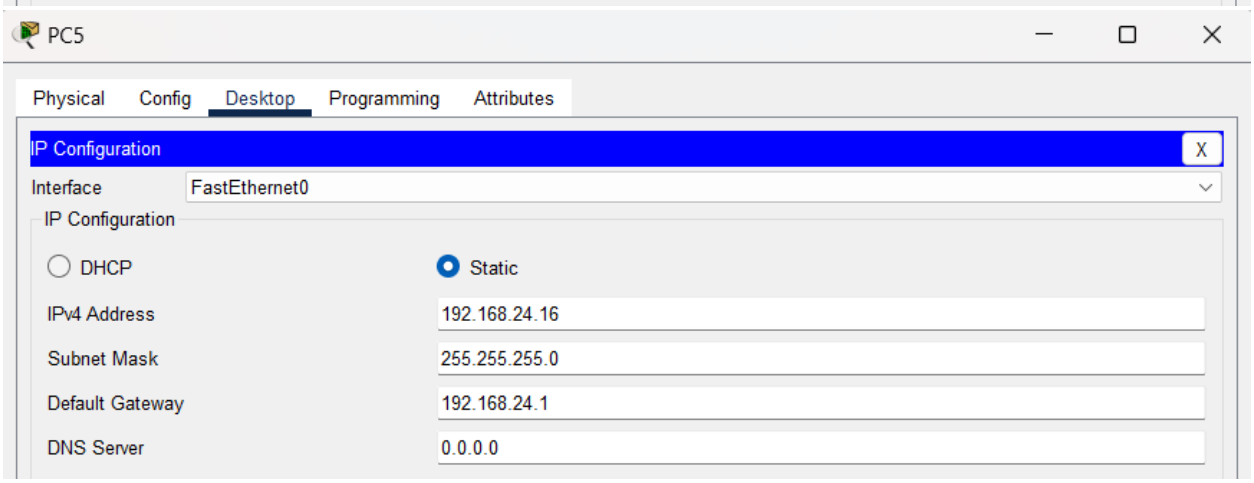
VLAN 10:



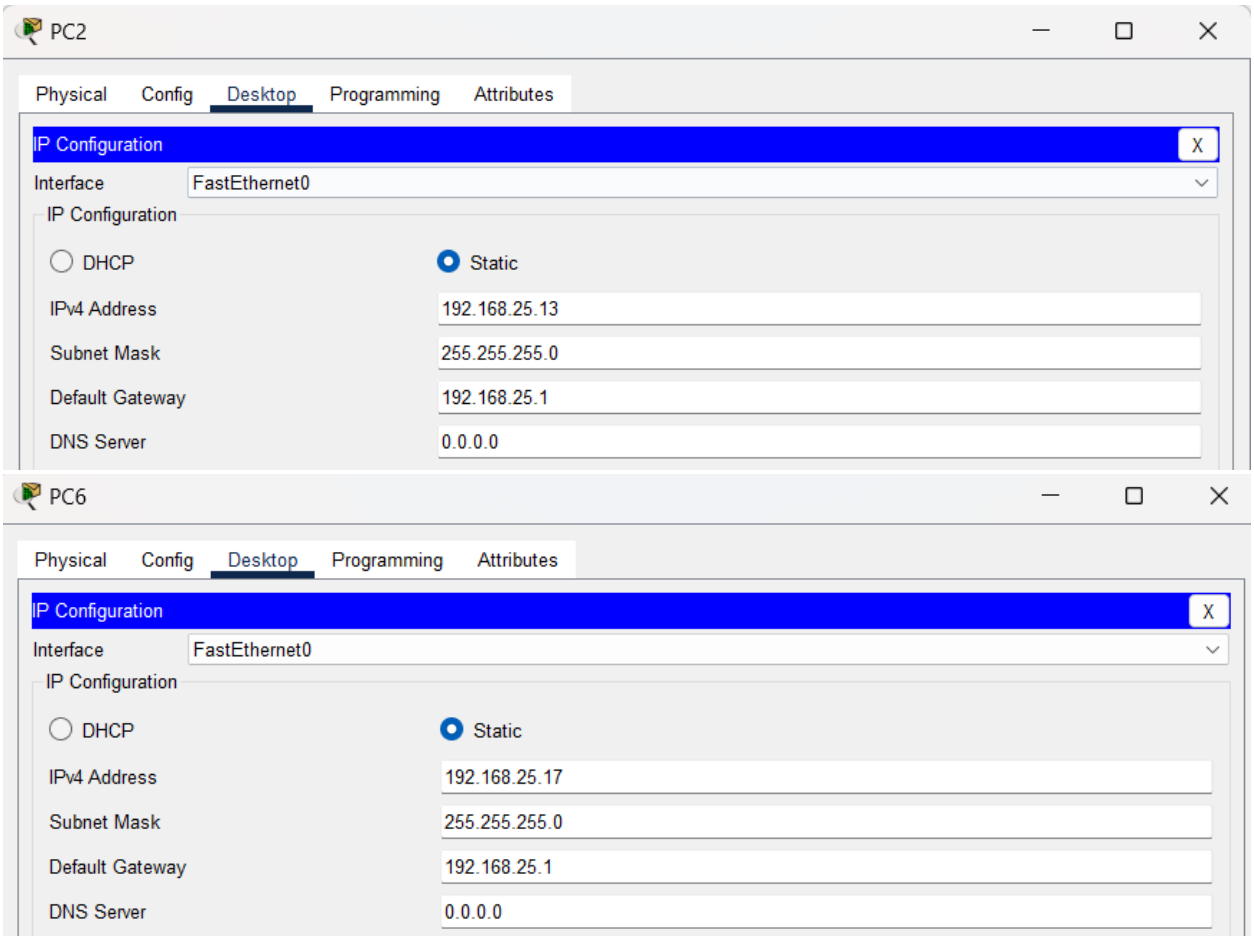


VLAN 20:

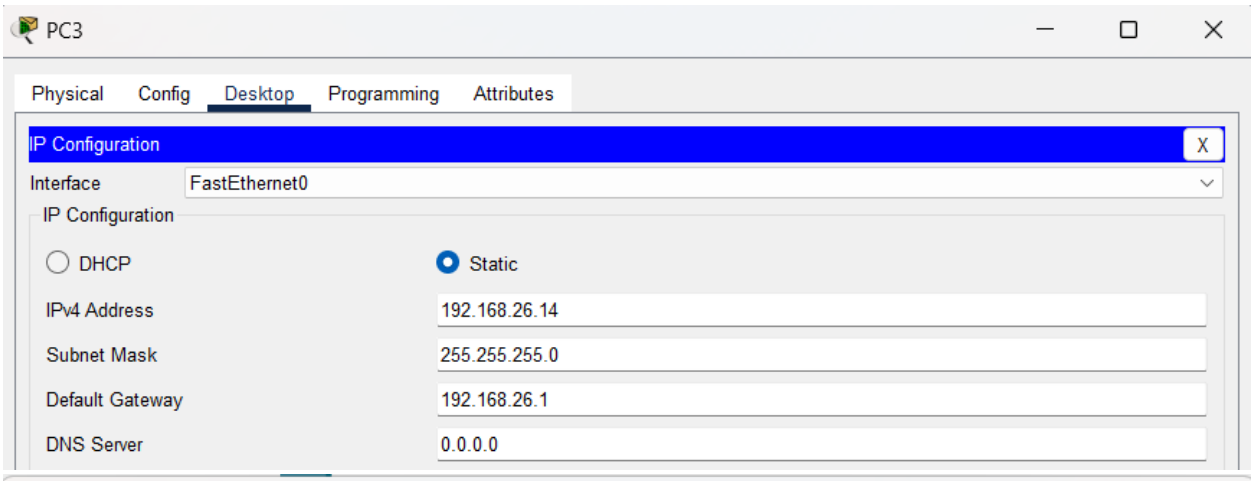

PC1
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.24.12
Subnet Mask
255.255.255.0
Default Gateway
192.168.24.1
DNS Server
0.0.0.0

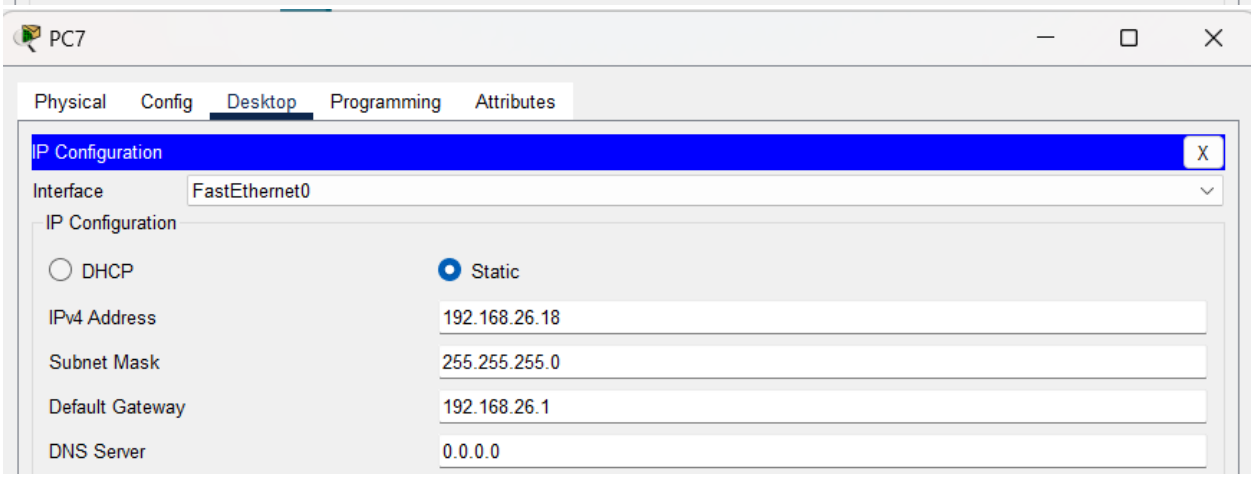

PC5
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.24.16
Subnet Mask
255.255.255.0
Default Gateway
192.168.24.1
DNS Server
0.0.0.0

VLAN 30:

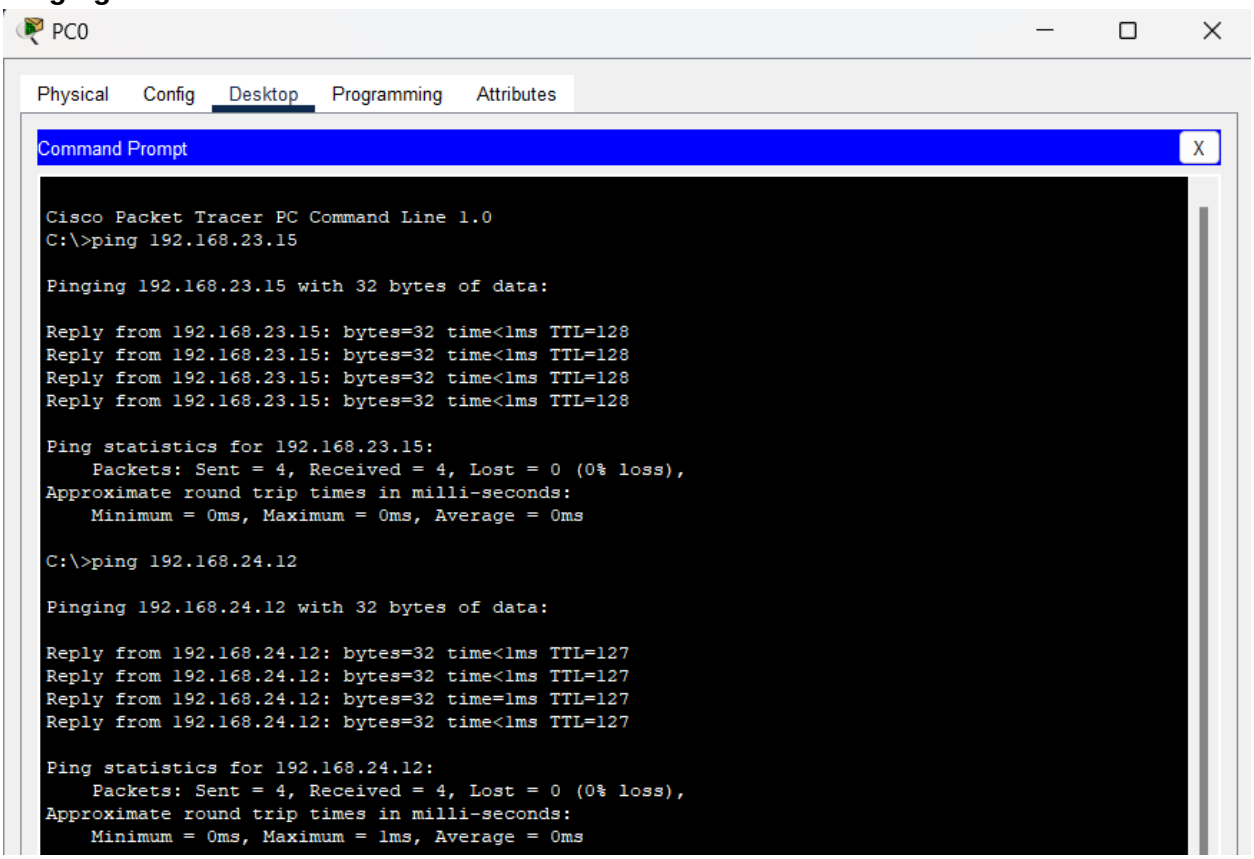

PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.25.13
Subnet Mask
255.255.255.0
Default Gateway
192.168.25.1
DNS Server
0.0.0.0
PC6
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.25.17
Subnet Mask
255.255.255.0
Default Gateway
192.168.25.1
DNS Server
0.0.0.0

VLAN 40:


PC3
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.26.14
Subnet Mask
255.255.255.0
Default Gateway
192.168.26.1
DNS Server
0.0.0.0

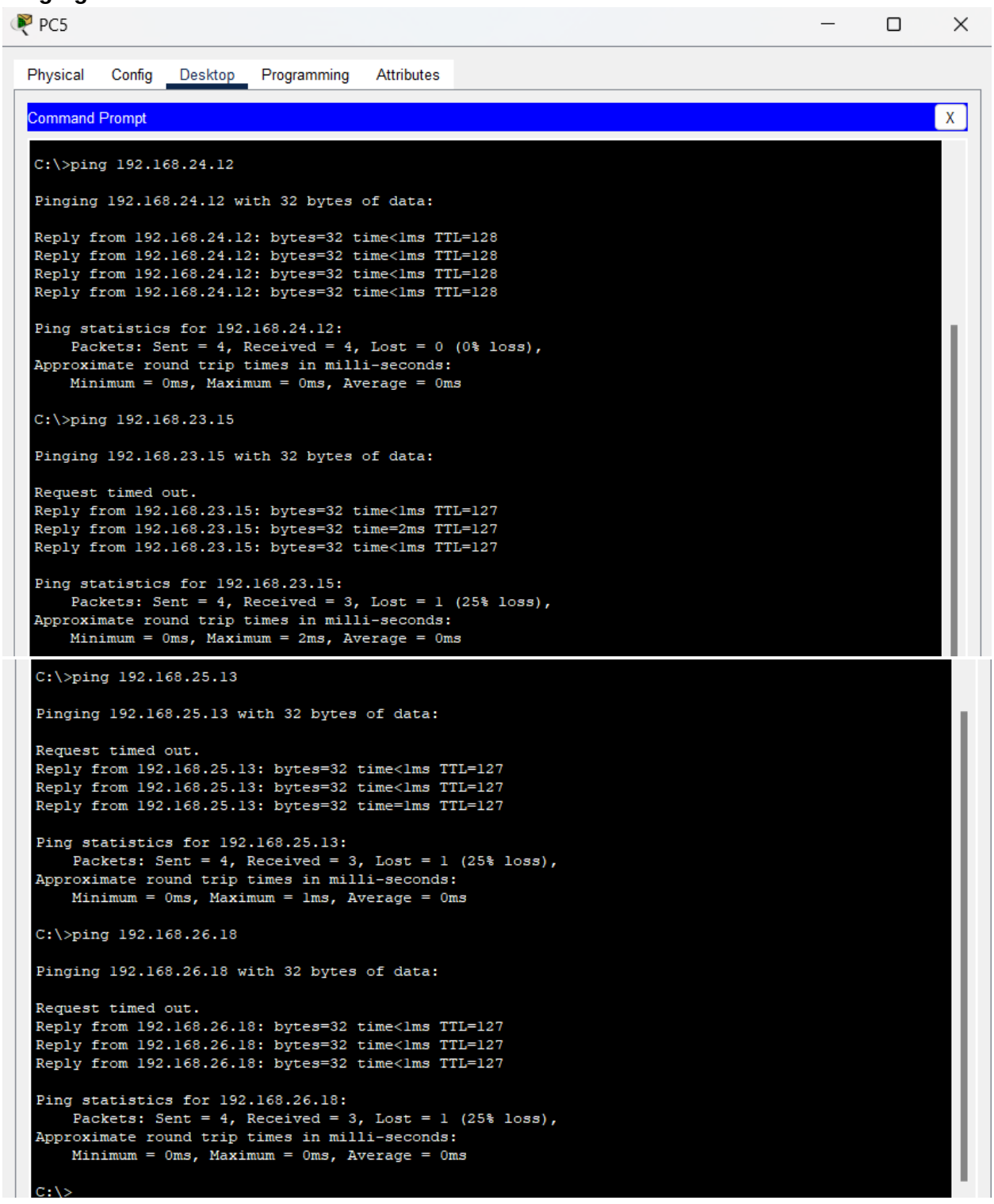

PC7
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.26.18
Subnet Mask
255.255.255.0
Default Gateway
192.168.26.1
DNS Server
0.0.0.0

Pinging from a VLAN 10 PC to another VLAN 10 PC and other VLAN PCs:

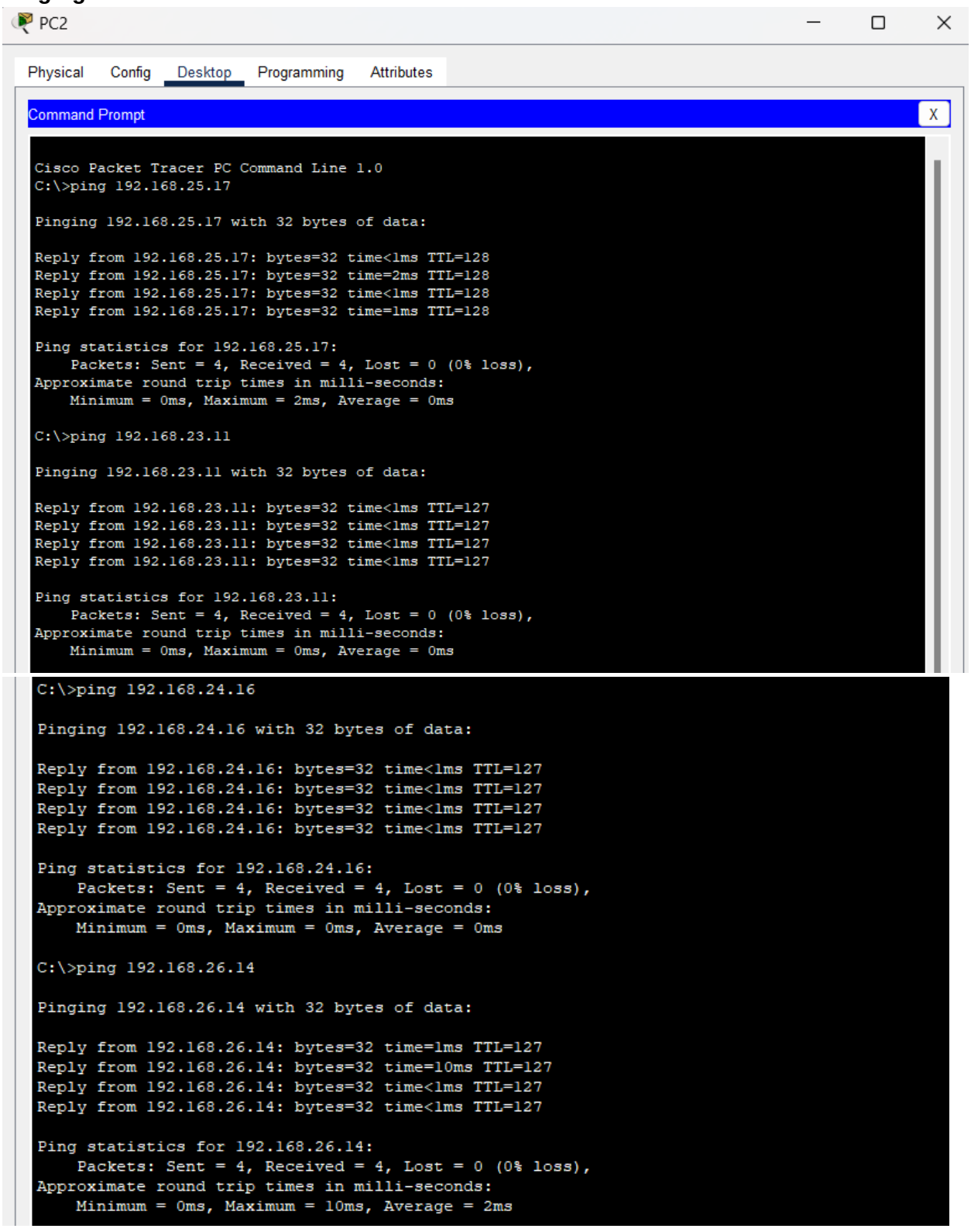



```
C:\>ping 192.168.25.17

Pinging 192.168.25.17 with 32 bytes of data:

Request timed out.
Reply from 192.168.25.17: bytes=32 time=1ms TTL=127
Reply from 192.168.25.17: bytes=32 time<1ms TTL=127
Reply from 192.168.25.17: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.25.17:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.26.14

Pinging 192.168.26.14 with 32 bytes of data:

Request timed out.
Reply from 192.168.26.14: bytes=32 time=1ms TTL=127
Reply from 192.168.26.14: bytes=32 time<1ms TTL=127
Reply from 192.168.26.14: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.26.14:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

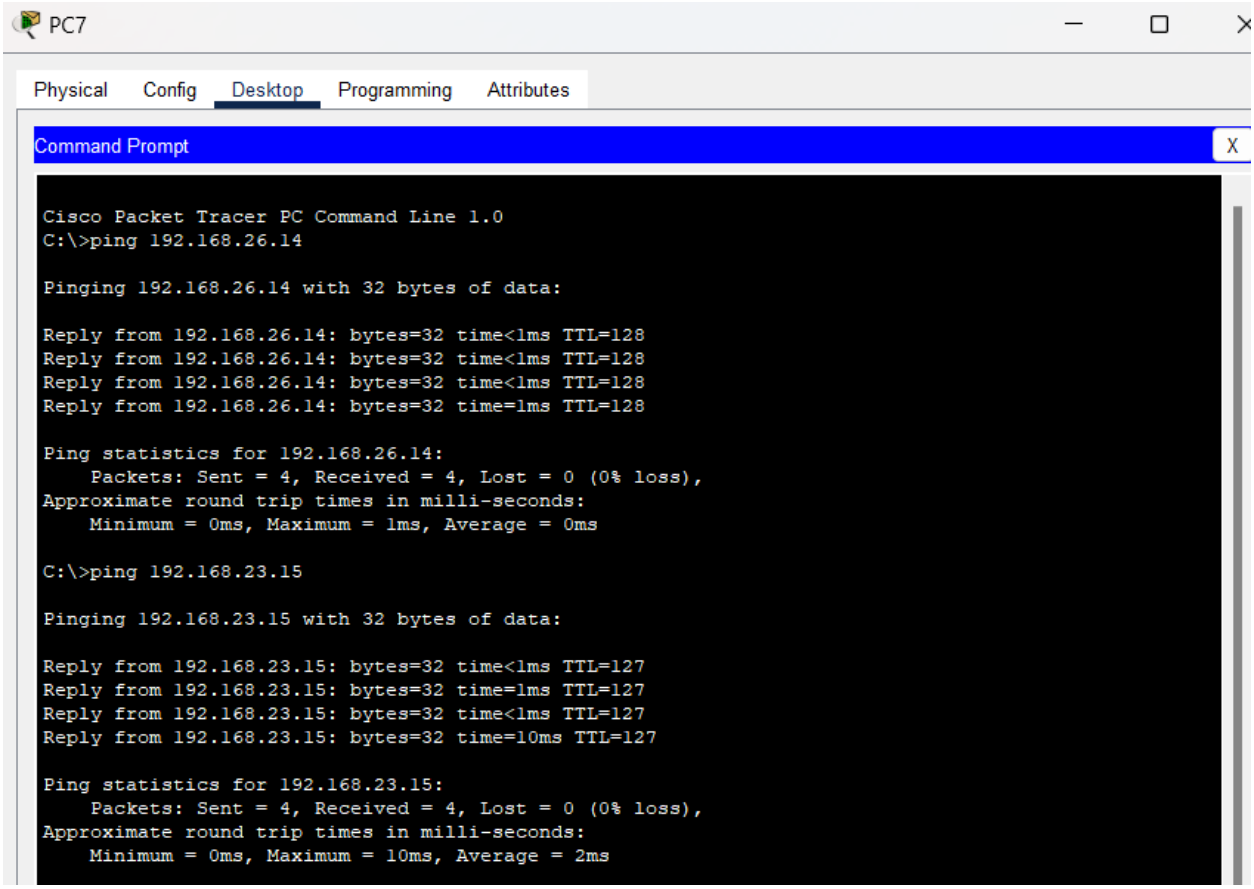
Pinging from a VLAN 20 PC to another VLAN 20 PC and other VLAN PCs:



Pinging from a VLAN 30 PC to another VLAN 30 PC and other VLAN PCs:



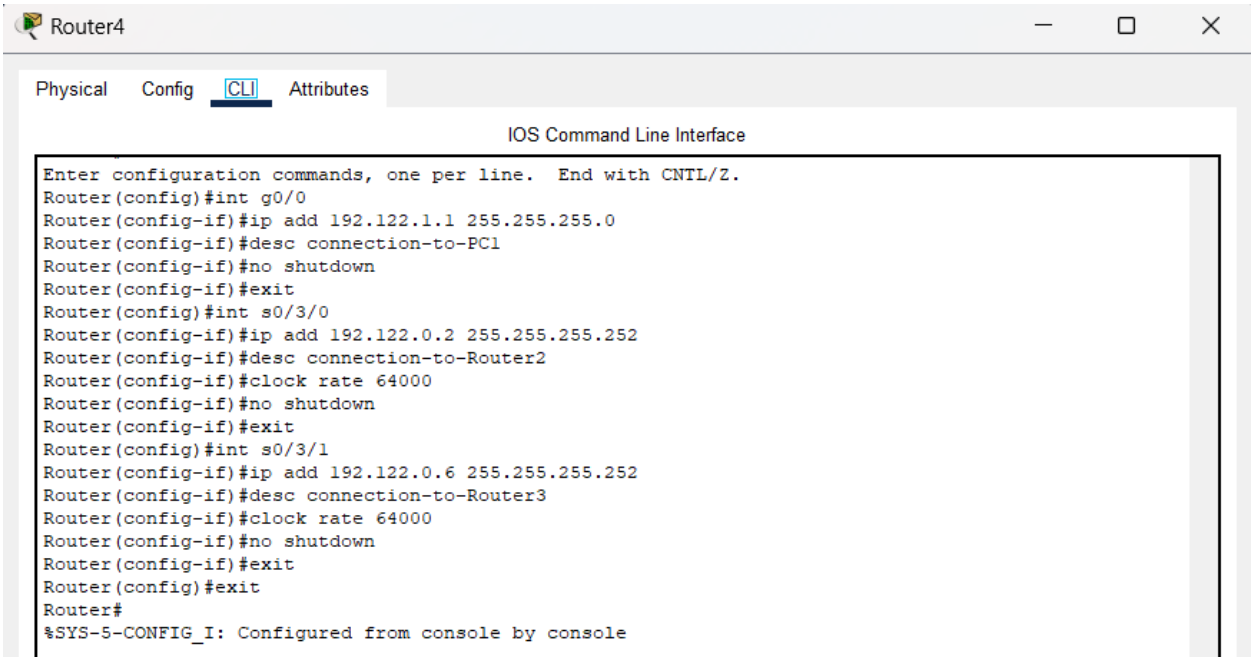
Pinging from a VLAN 40 PC to another VLAN 40 PC and other VLAN PCs:



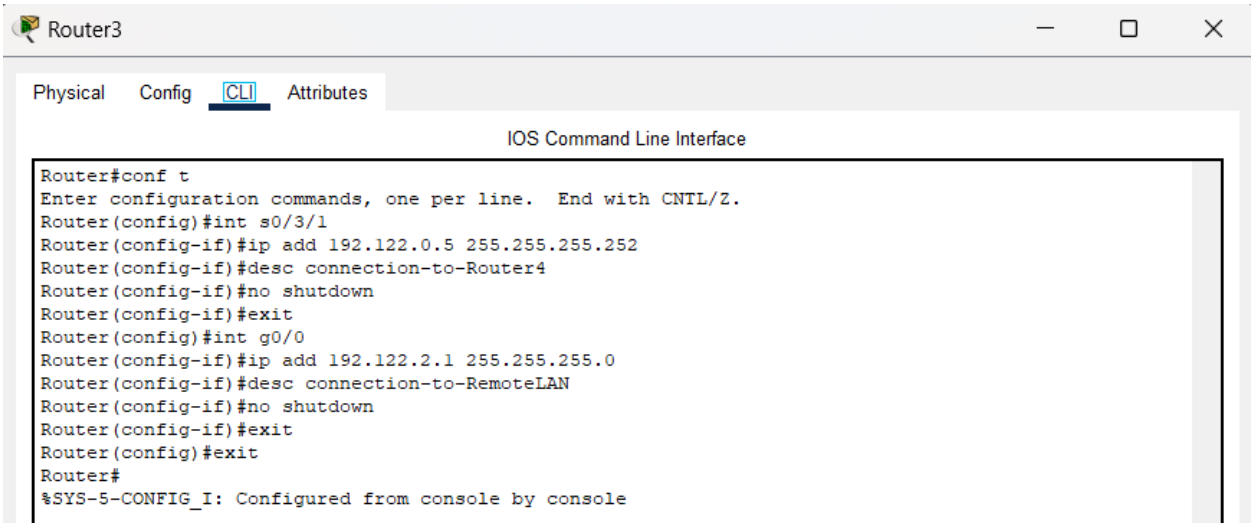

```
C:\>ping 192.168.24.12

Pinging 192.168.24.12 with 32 bytes of data:

Reply from 192.168.24.12: bytes=32 time=6ms TTL=127
Reply from 192.168.24.12: bytes=32 time<1ms TTL=127
Reply from 192.168.24.12: bytes=32 time=1ms TTL=127
Reply from 192.168.24.12: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.24.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 6ms, Average = 1ms

C:\>ping 192.168.25.17

Pinging 192.168.25.17 with 32 bytes of data:

Reply from 192.168.25.17: bytes=32 time<1ms TTL=127
Reply from 192.168.25.17: bytes=32 time<1ms TTL=127
Reply from 192.168.25.17: bytes=32 time<1ms TTL=127
Reply from 192.168.25.17: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.25.17:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

TASK 3:

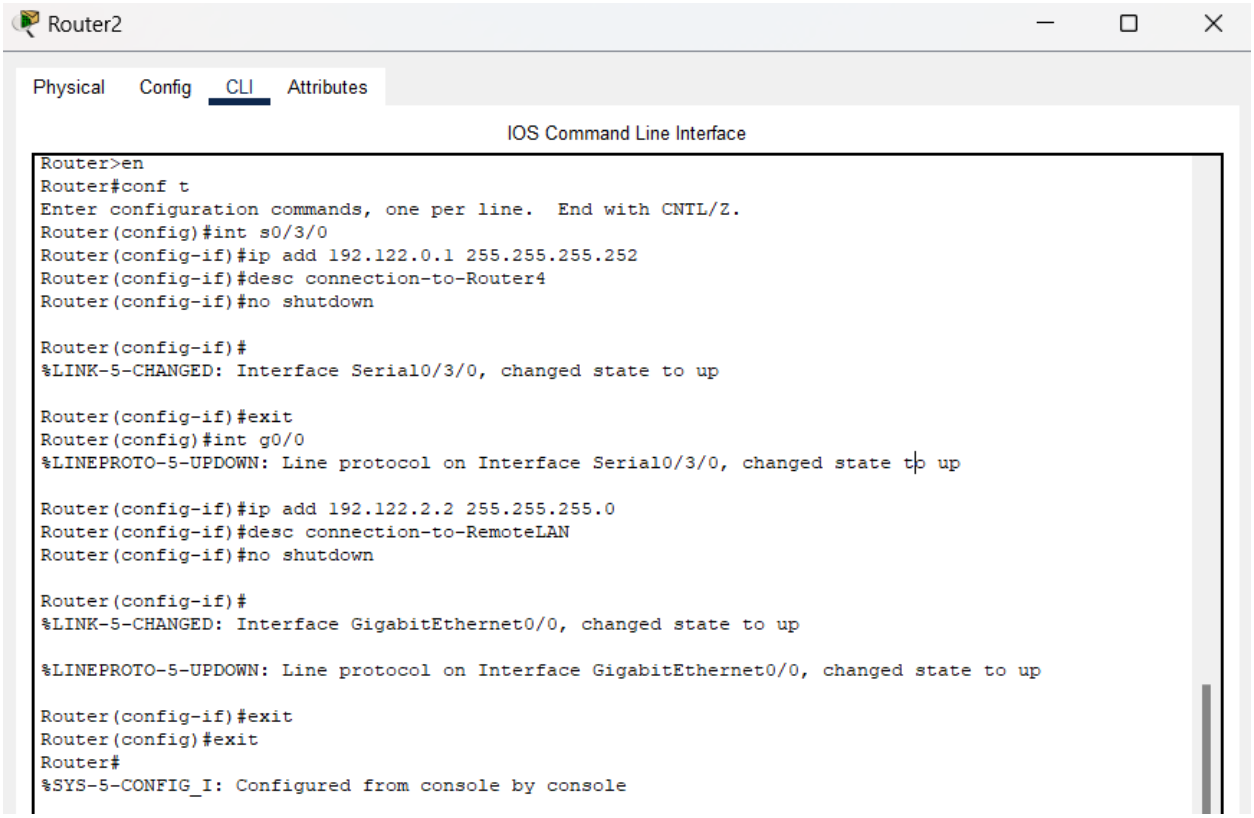
Configure Router4 Interfaces:



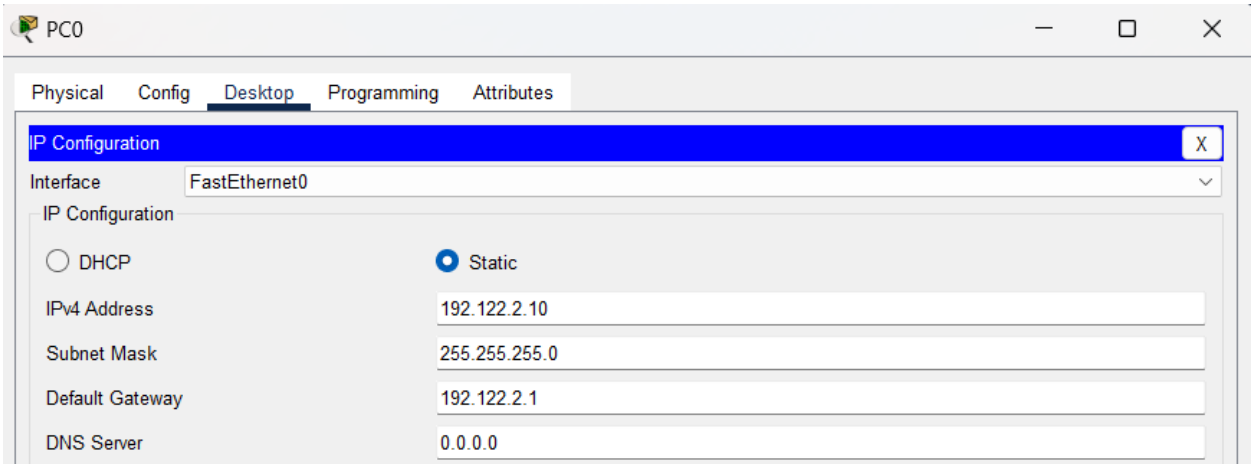
Configure Router3 Interfaces:



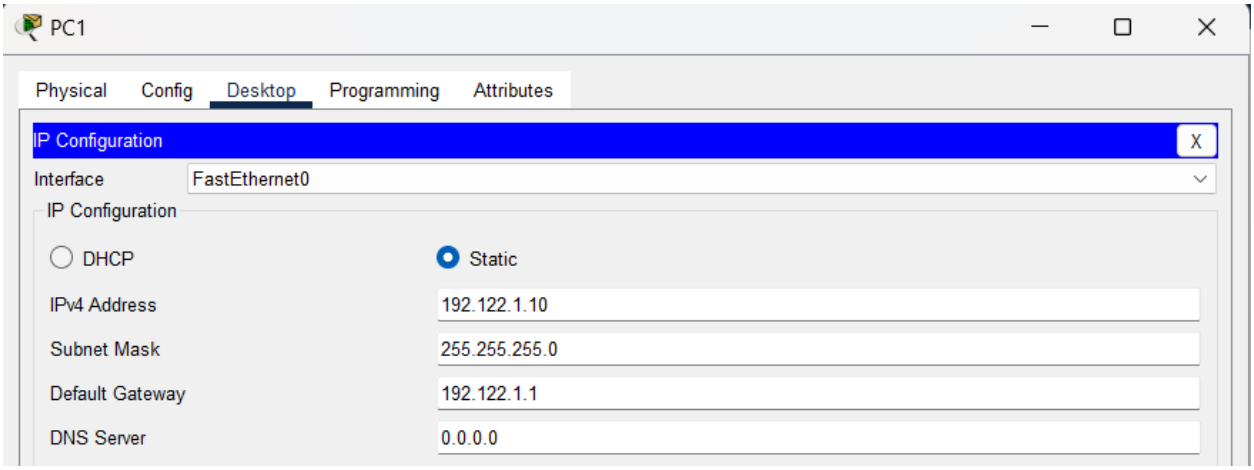
Configure Router2 Interfaces:



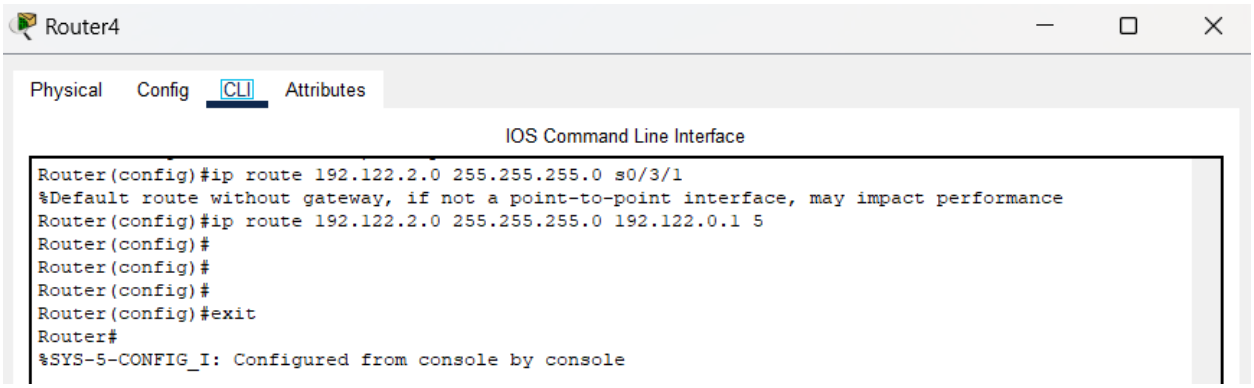
Configure PC0:



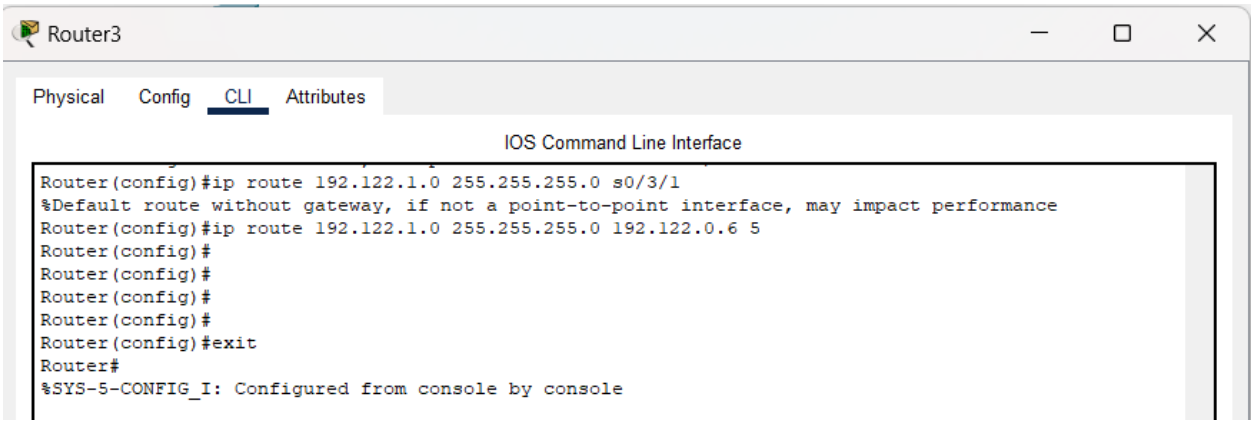
Configure PC1:



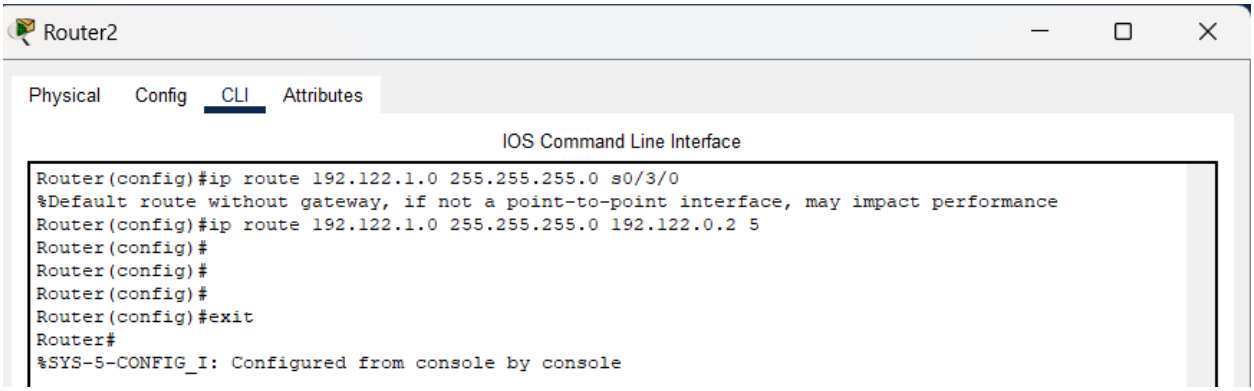
Configure static routing to Remote LAN in Router4:



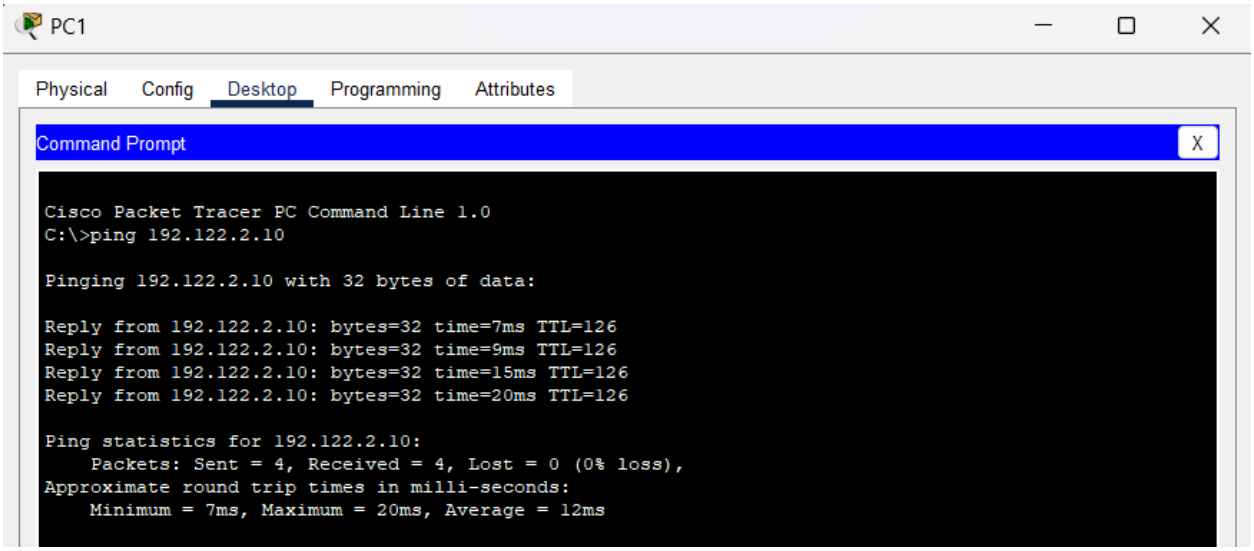
Configure static routing to Remote LAN in Router3:



Configure static routing to Remote LAN in Router2:



Ping PC0 from PC1:



Questions (Answer to the point):

1. Why do we need L3 Switches?

   Ans: L3 switches are needed for efficient Inter-VLAN routing. They can route traffic between VLANs at high speeds, reducing the load on external routers.

2. What is the use router in Inter-Vlan Routing?

   Ans: Routers are used in inter-VLAN routing to allow hosts 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 using L3 switches, there is no need for a separate router. The switch itself can perform routing between VLANs, simplifying the network architecture.

4. What is next-hop floating address?

Ans: The next-hop floating address is an alternate route specified in static routing with higher metric. It is used as a backup route if the primary route fails.

5. What is the disadvantage of static routing?
   Ans: One of the drawbacks is that static routing is not flexible or resilient to changes in the network topology, as it requires manual updates and modifications. Static routing also does not support load balancing or redundancy, which can affect the performance and availability of the network.

Challenges (if any):

For the Router-on-a-stick method it was kind of hard to notice that I had to trunk the router as well as it wasn't working for the inter-VLAN.