

## Practical – 9

Aim of the Practical :- To implement and simulate VLAN (Virtual LAN) in Packet Tracer for network segmentation and verify inter-VLAN communication using a router.

### Objective:

To understand the concept of VLANs and how they help in network segmentation within a switched network.

1. To create and configure multiple VLANs on a managed switch and assign ports to specific VLANs.
2. To configure inter-VLAN communication using a router (Router-on-a-Stick configuration).
3. To verify VLAN functionality and inter-VLAN communication using network testing commands.

### LAB TASK:

#### 1. IP Address and VLAN Number Generation

Generated VLAN and IP Address Details			
Two separate tables are generated for <b>VLAN-1</b> and <b>VLAN-2</b> with their PC configurations.			
VLAN-1 Configuration		VLAN-2 Configuration	
FIELD	VALUE	FIELD	VALUE
Student Number	202352304	Student Number	202352304
VLAN-1 ID	14	VLAN-2 ID	24
VLAN-1 Subnet	192.168.2.0/24	VLAN-2 Subnet	192.168.20.0/24
Default Gateway	192.168.2.1	Default Gateway	192.168.20.1
PC0 IP	192.168.2.11	PC2 IP	192.168.20.21
PC1 IP	192.168.2.12	PC3 IP	192.168.20.22

Image1: Screenshot showing the generated IP addresses and VLAN numbers of my number 202352304.

## 2. Network Topology Diagram

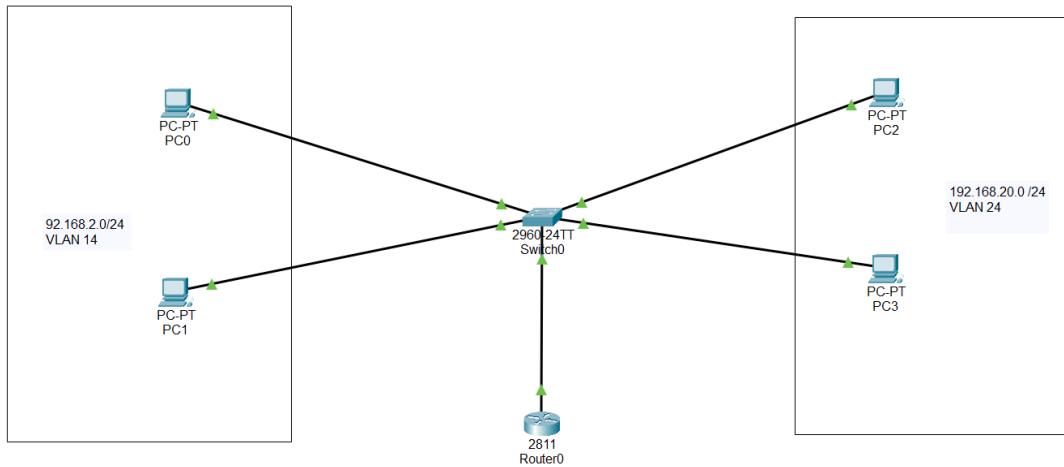


Image2: This network diagram shows two VLANs (VLAN 14 and VLAN 24) connected to a central switch, which uses a single router (Router0) to enable communication between them.

## 3. Configuration of All Devices

### a) PC Configurations:

Two windows are shown, one for PC0 and one for PC1, both displaying their IP configuration settings. Both devices are using static IP addresses in the 192.168.2.x range and have 192.168.2.1 set as their default gateway.

Setting	PC0 (192.168.2.11)	PC1 (192.168.2.12)
IPv4 Address	192.168.2.11	192.168.2.12
Subnet Mask	255.255.255.0	255.255.255.0
Default Gateway	192.168.2.1	192.168.2.1
DNS Server	0.0.0.0	0.0.0.0
IPv6 Configuration	Static (Address: FE80::260:47FF:FEDE:AB0B)	Static (Address: FE80::2D:BDFF:FE5B:88BB)
802.1X	<input type="checkbox"/> Use 802.1X Security Authentication: MD5 Username: [redacted] Password: [redacted]	<input type="checkbox"/> Use 802.1X Security Authentication: MD5 Username: [redacted] Password: [redacted]

Image 3 and 4: PC0 is assigned 192.168.2.11 and PC1 is assigned 192.168.2.12, with both devices using 192.168.2.1 as their default gateway.

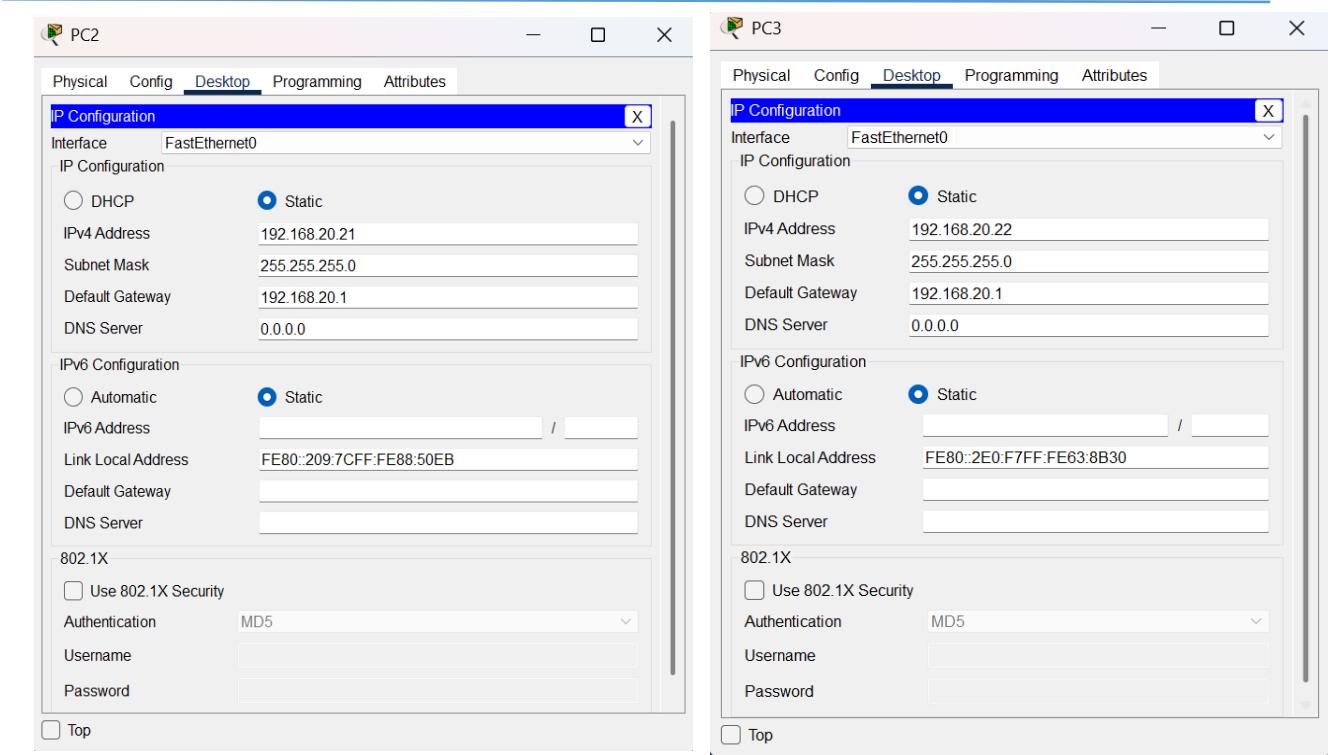


Image 5 and 6: The above images display the static IP configurations for PC2 and PC3, which belong to a different subnet. PC2 has the IP address 192.168.20.21, and PC3 has 192.168.20.22, with both using 192.168.20.1 as their default gateway.

### b) Switch Configuration:

#### VLAN creation

```

Switch>en
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 14
Switch(config-vlan)#name lab-9a
Switch(config-vlan)#exit
Switch(config)#vlan 24
Switch(config-vlan)#name lab-9b
Switch(config-vlan)#exit
Switch(config)#exit
Switch#

```

Image 7: This image shows the switch configuration commands used to create two new VLANs. VLAN 14 is created with the name "lab-9a", and VLAN 24 is created with the name "lab-9b".

## VLAN Port Assignment Image

```
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface fastE
Switch(config)#interface fastEthernet 0/1
Switch(config-if)#switchport mode
Switch(config-if)#switchport mode ac
Switch(config-if)#switchport mode access
Switch(config-if)#switchport ac
Switch(config-if)#switchport access vlan
Switch(config-if)#switchport access vlan 14
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 14
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/3
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 24
Switch(config-if)#exit
Switch(config)#interface fastEthernet 0/4
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 24
Switch(config-if)#exit
Switch(config)#exit
```

Image 8: This switch configuration output shows interfaces FastEthernet 0/1 and 0/2 being assigned to VLAN 14, while interfaces FastEthernet 0/3 and 0/4 are assigned to VLAN 24.

## Switch Running Configuration Image

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

Current configuration : 1284 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
  switchport access vlan 14
  switchport mode access
!
interface FastEthernet0/2
  switchport access vlan 14
  switchport mode access
!
interface FastEthernet0/3
  switchport access vlan 24
  switchport mode access
!
interface FastEthernet0/4
  switchport access vlan 24
  switchport mode access
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
```

Image 9: Output of the show running-config command on the switch.

### c) Router Configuration:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface fastEthernet 0/0
Router(config-if)#no shut
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#interface fa0/0.14
Router(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.14, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.14, changed state to up

Router(config-subif)#encapsulation dot
Router(config-subif)#encapsulation dot1Q 14
Router(config-subif)#ip add 192.168.2.1
% Incomplete command.
Router(config-subif)#ip add 192.168.2.1 255.255.255.0
Router(config-subif)#interface fa0/0.24
Router(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.24, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.24, changed state to up

Router(config-subif)#encapsulation dot1Q 24
Router(config-subif)#ip add 192.168.20.1 255.255.255.0
Router(config-subif)#exit
```

### Router Running Configuration

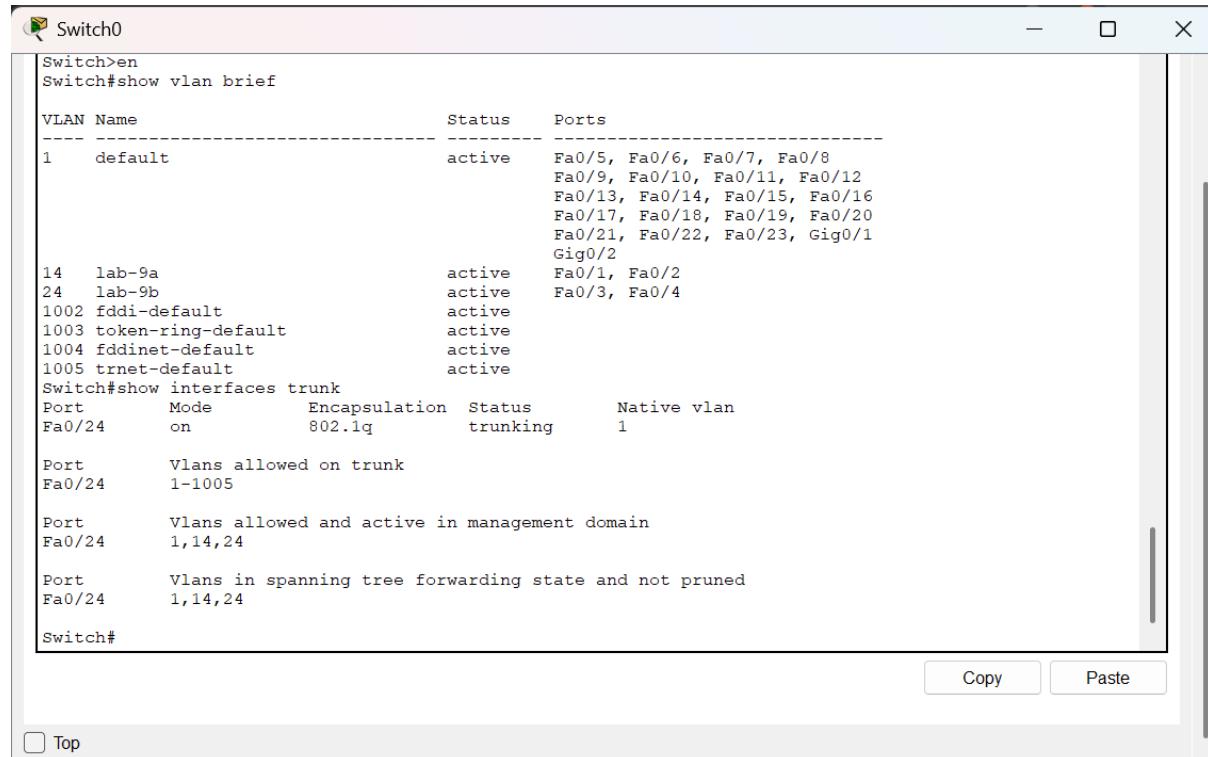
```
Router#show running-config
Building configuration...

Current configuration : 779 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
license udi pid CISCO2811/K9 sn FTX1017E4V6-
```

```
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
interface FastEthernet0/0
no ip address
duplex auto
speed auto
!
interface FastEthernet0/0.14
encapsulation dot1Q 14
ip address 192.168.2.1 255.255.255.0
!
interface FastEthernet0/0.24
encapsulation dot1Q 24
ip address 192.168.20.1 255.255.255.0
!
interface FastEthernet0/1
no ip address
duplex auto
speed auto
shutdown
!
interface Vlan1
no ip address
shutdown
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
end
```

Router#

## 4. VLAN Verification



```

Switch>en
Switch#show vlan brief

VLAN Name          Status    Ports
----  -----
1     default       active    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, Gig0/1
                           Gig0/2
14    lab-9a        active    Fa0/1, Fa0/2
24    lab-9b        active    Fa0/3, Fa0/4
1002   fddi-default active
1003   token-ring-default active
1004   fddinet-default active
1005   trnet-default active

Switch#show interfaces trunk
Port      Mode      Encapsulation  Status      Native vlan
Fa0/24    on        802.1q         trunking    1

Port      Vlans allowed on trunk
Fa0/24    1-1005

Port      Vlans allowed and active in management domain
Fa0/24    1,14,24

Port      Vlans in spanning tree forwarding state and not pruned
Fa0/24    1,14,24

Switch#

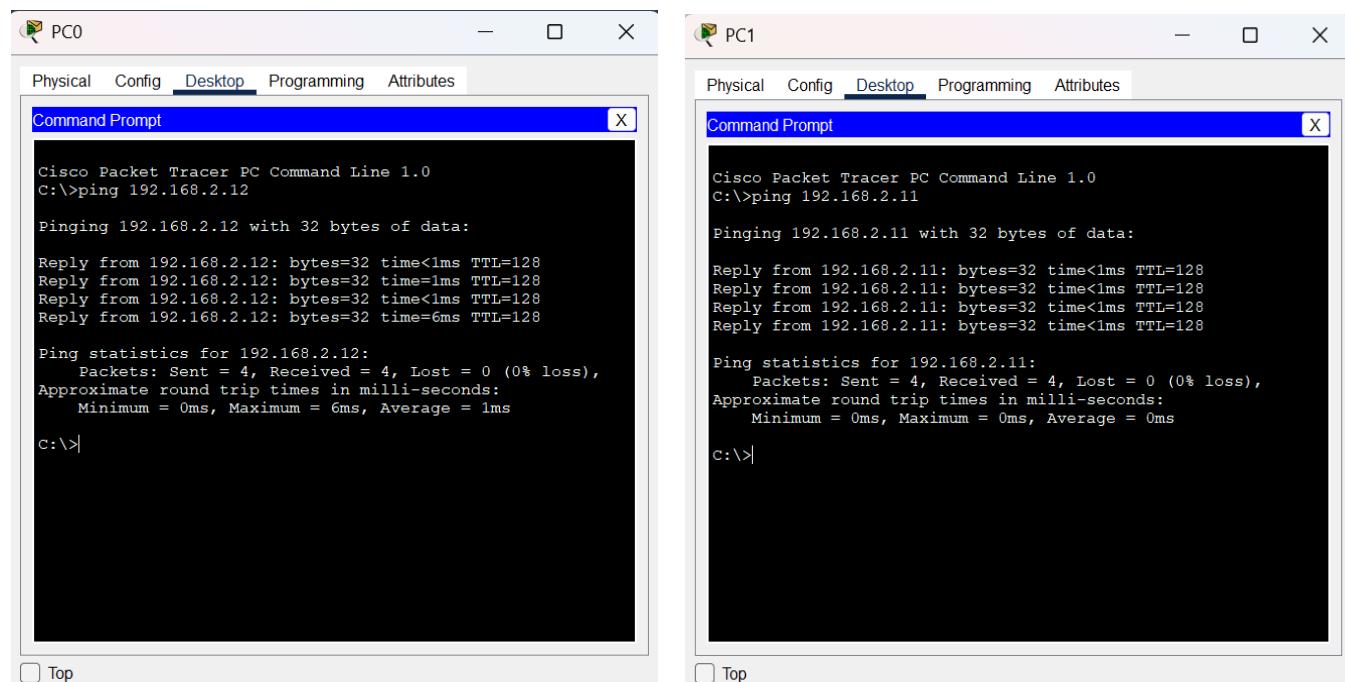
```

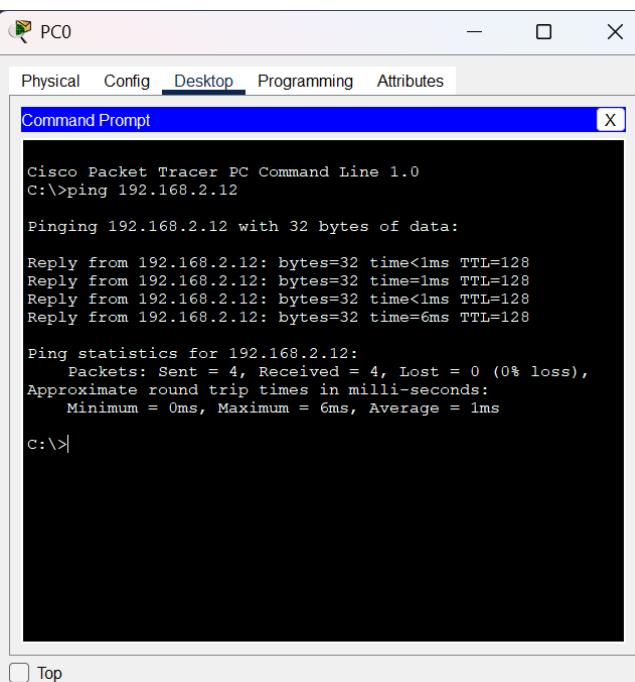
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Image 10: This CLI output verifies VLAN port assignments for VLANs 14 and 24, and confirms port Fa0/24 is operating as a trunk.

## 5. Connectivity Testing

### Ping Results: Same VLAN 14





```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.12

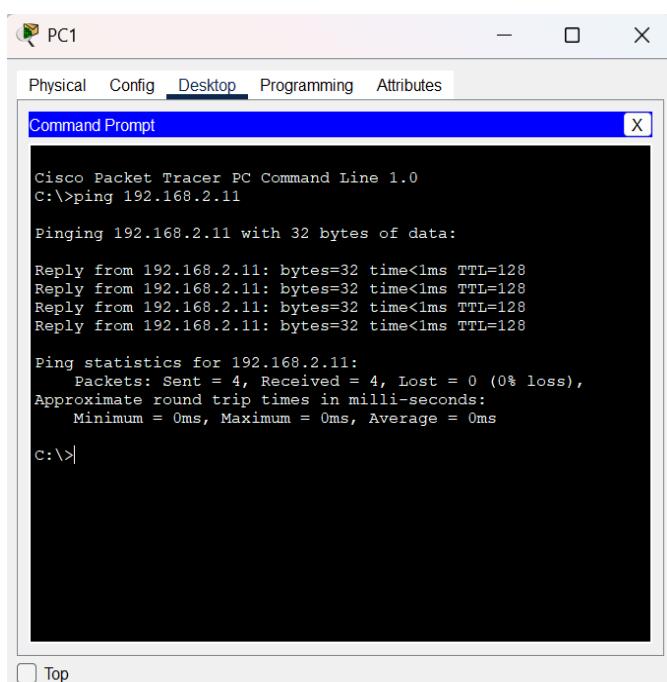
Pinging 192.168.2.12 with 32 bytes of data:

Reply from 192.168.2.12: bytes=32 time<1ms TTL=128
Reply from 192.168.2.12: bytes=32 time=1ms TTL=128
Reply from 192.168.2.12: bytes=32 time<1ms TTL=128
Reply from 192.168.2.12: bytes=32 time=6ms TTL=128

Ping statistics for 192.168.2.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 6ms, Average = 1ms
C:\>

```

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```

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.11

Pinging 192.168.2.11 with 32 bytes of data:

Reply from 192.168.2.11: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.2.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>

```

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**Image 11: Ping Test from PC0 to PC1 in same VLAN 14**

**Image 12: Ping Test from PC1 to PC0 in same VLAN 14**

### Same VLAN 24

The image contains two side-by-side screenshots of the Cisco Packet Tracer Command Line interface. Both windows are titled 'Command Prompt' and have a blue header bar with tabs for Physical, Config, Desktop, Programming, and Attributes. The left window is titled 'PC2' and the right is titled 'PC3'. Both show the output of a ping command.

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.20.22

Pinging 192.168.20.22 with 32 bytes of data:
Reply from 192.168.20.22: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.20.22:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.20.21

Pinging 192.168.20.21 with 32 bytes of data:
Reply from 192.168.20.21: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.20.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

**Image 13: Ping Test from PC2 to PC3 in same VLAN 24**

**Image 14: Ping Test from PC3 to PC2 in same VLAN 24**

### Inter-VLAN Routing

#### From VLAN 14 to VLAN 24

The image shows a single screenshot of the Cisco Packet Tracer Command Line interface for PC0. The window title is 'Command Prompt' and it has a blue header bar with tabs for Physical, Config, Desktop, Programming, and Attributes. The window body displays the results of two ping commands: one to PC2 in VLAN 24 and one to PC3 in VLAN 24.

```
C:\>ping 192.168.20.21

Pinging 192.168.20.21 with 32 bytes of data:
Reply from 192.168.20.21: bytes=32 time<1ms TTL=127
Reply from 192.168.20.21: bytes=32 time=1ms TTL=127
Reply from 192.168.20.21: bytes=32 time<1ms TTL=127
Reply from 192.168.20.21: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.20.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.20.22

Pinging 192.168.20.22 with 32 bytes of data:
Reply from 192.168.20.22: bytes=32 time<1ms TTL=127
Reply from 192.168.20.22: bytes=32 time<1ms TTL=127
Reply from 192.168.20.22: bytes=32 time=11ms TTL=127
Reply from 192.168.20.22: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.20.22:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 11ms, Average = 2ms

C:\>
```

**Image 15: Ping Test Result from PC0 of VLAN 14 to PC2 and PC3 of VLAN 24**

The screenshot shows a Windows Command Prompt window titled "PC1". The tab bar at the top has "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". The main area displays the following command and its output:

```
C:\>ping 192.168.20.21
Pinging 192.168.20.21 with 32 bytes of data:
Reply from 192.168.20.21: bytes=32 time<1ms TTL=127
Reply from 192.168.20.21: bytes=32 time<1ms TTL=127
Reply from 192.168.20.21: bytes=32 time=1ms TTL=127
Reply from 192.168.20.21: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.20.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.20.22
Pinging 192.168.20.22 with 32 bytes of data:
Reply from 192.168.20.22: bytes=32 time=2ms TTL=127
Reply from 192.168.20.22: bytes=32 time<1ms TTL=127
Reply from 192.168.20.22: bytes=32 time<1ms TTL=127
Reply from 192.168.20.22: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.20.22:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>
```

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**Image 16: Ping Test Result from PC1 of VLAN 14 to PC2 and PC3 of VLAN 24**

### From VLAN 24 to VLAN 14

The screenshot shows a Windows Command Prompt window titled "PC2". The tab bar at the top has "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". The main area displays the following command and its output:

```
C:\>ping 192.168.2.11
Pinging 192.168.2.11 with 32 bytes of data:
Reply from 192.168.2.11: bytes=32 time=18ms TTL=127
Reply from 192.168.2.11: bytes=32 time<1ms TTL=127
Reply from 192.168.2.11: bytes=32 time<1ms TTL=127
Reply from 192.168.2.11: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.2.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 18ms, Average = 4ms

C:\>ping 192.168.2.12
Pinging 192.168.2.12 with 32 bytes of data:
Reply from 192.168.2.12: bytes=32 time<1ms TTL=127
Reply from 192.168.2.12: bytes=32 time=1ms TTL=127
Reply from 192.168.2.12: bytes=32 time<1ms TTL=127
Reply from 192.168.2.12: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.2.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

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**Image 17: Ping Test Result from PC2 of VLAN 24 to PC0 and PC1 of VLAN 14**

The screenshot shows a Windows Command Prompt window titled "Command Prompt" on a machine named "PC3". The window contains the following command-line output:

```
C:\>ping 192.168.2.11
Pinging 192.168.2.11 with 32 bytes of data:
Reply from 192.168.2.11: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.2.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.2.12
Pinging 192.168.2.12 with 32 bytes of data:
Reply from 192.168.2.12: bytes=32 time<1ms TTL=127
Reply from 192.168.2.12: bytes=32 time=2ms TTL=127
Reply from 192.168.2.12: bytes=32 time<1ms TTL=127
Reply from 192.168.2.12: bytes=32 time=1ms TTL=127

Ping statistics for 192.168.2.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>
```

Image 18:  
Ping Test  
Result from  
PC3 of VLAN  
24 to PC0  
and PC1 of  
VLAN 14

## Conclusion

This practical successfully implemented a "Router-on-a-Stick" configuration, achieving the lab's goal of network segmentation. VLAN 14 (lab-9a) and VLAN 24 (lab-9b) were created and ports were assigned, successfully isolating the two networks. This was confirmed by successful ping tests between PCs within the same VLAN, such as PC0 to PC1 and PC2 to PC3.

Inter-VLAN communication was enabled by configuring 802.1Q sub interfaces on the router and a corresponding trunk port on the switch. The final ping tests, which showed successful communication from VLAN 14 to VLAN 24 (e.g., PC0 to PC2), confirmed that the router was correctly routing traffic between the two isolated networks, meeting all objectives.