INSTITUTE OF ENGINEERING
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COMPUTER NETWORK

LAB #8

VLAN Configuration, Forwarding Packets within VLAN and Routing packets between VLANs

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1 Title

VLAN Configuration, Forwarding Packets within VLAN and Routing packets between VLANs

2 Objective

- To be familiar with VLAN and its use
- To create VLANs and deliver packets between computers that are within the same VLAN
- To route packets between computers at different VLANs

3 Requirement

- Network simulation tool: Packet Tracer

4 Procedure

With the help of Cisco Packet Tracer we simulated VLANs. we also explored the packet forwarding within VLAN and Routing them between VLANs.

5 Exercises:

5.1 Question -1

What is VLAN? Explain its importance in networking.

Answer:

VLAN (Virtual LAN) divides broadcast domain in devices like Switch. In other terms its a technique to create a sub network of devices situated physically on different LANs.

The needs of VLAN in networking are as follows :

- Improve security as it limits access to devices and users.
- Improved manageability as it has feature to group devices and user with similar requirement or function
- Reduces overall IT cost as it eliminated the need of actual physical hardware and wires.

5.2 Question -2

How VLAN can be configured? Explain each step in detail.

VLAN can be Configures in two steps :

- **Creating VLANs**

```
Switch> enable
Switch# configure terminal
Switch(config)# vlan vlan_ID
Switch(config-vlan)# name Vlan_2
Switch(config-vlan)# end
Switch#
```

- **Assigning an Interface to Particular Vlan**

```
Switch> enable
Switch# configure terminal
Switch(config)#interface FastEthernet0/11
Switch(config-if)#switchport access vlan 2
Switch(config-if)#end
Switch#
```

5.3 Question -3

How packets can be forwarded between computers within same VLAN but connected at different switches? Explain.

Answer:

Concept Trunk can be implemented if two devices on same VLAN but different Switches has to communicate. In trunk mode Trunking protocols include VLAN information in each frame transmitting through it.The receiving end forwards the packets to destination after deframing the VLAN info. This has been implemented and tested starting from **Activity B.1** .

Another Simpler method is to simply add extra interface corresponding to particular VLAN .This has been implemented and tested in **Activity A.7**

5.4 Question -4

How packets can be routed between computers at different VLANs? Explain.

Answer:

An Router can provide a viable solution to our problem as its primary task is to route the packets between different network or sub network like VLAN.Router can be connected in two ways . One is to separately connects interfaces connecting belonging to VLANs and other is to use trunk and sub interface technique to achieve similar functionality using single interface. These are Implemented in **Activity C and D**

Another Simpler method is to introduce 3^{rd} Switch that simply connects the interfaces belonging to different VLAN.For this to work they must belong to same subnet.This has been implemented and tested in **Activity B.6**

5.5 Question -5

Note down the results of each and step of above exercise also explain with reason.

5.5.1 Activities A

A. Create the network topology as shown in figure 1 below and perform the following activities:

1. **Connect the computers and switches as followings:**
   - **Connect PC0 and PC1 to interfaces FastEthernet 0/1 and FastEthernet 0/11 of switch0 respectively**
   - **Connect PC2 and PC3 to interfaces FastEthernet 0/1 and FastEthernet 0/11 of switch1 respectively**
   - **Connect interfaces FastEthernet 0/10 of Switch0 with FastEthernet 0/10 of Switch1**
   - **Assign IP address and subnet mask of computers as:**
     - **PC0: 200.1.1.2/24**
     - **PC1: 200.1.1.66/24**
     - **PC2: 200.1.1.3/24**
     - **PC3: 200.1.1.67/24**

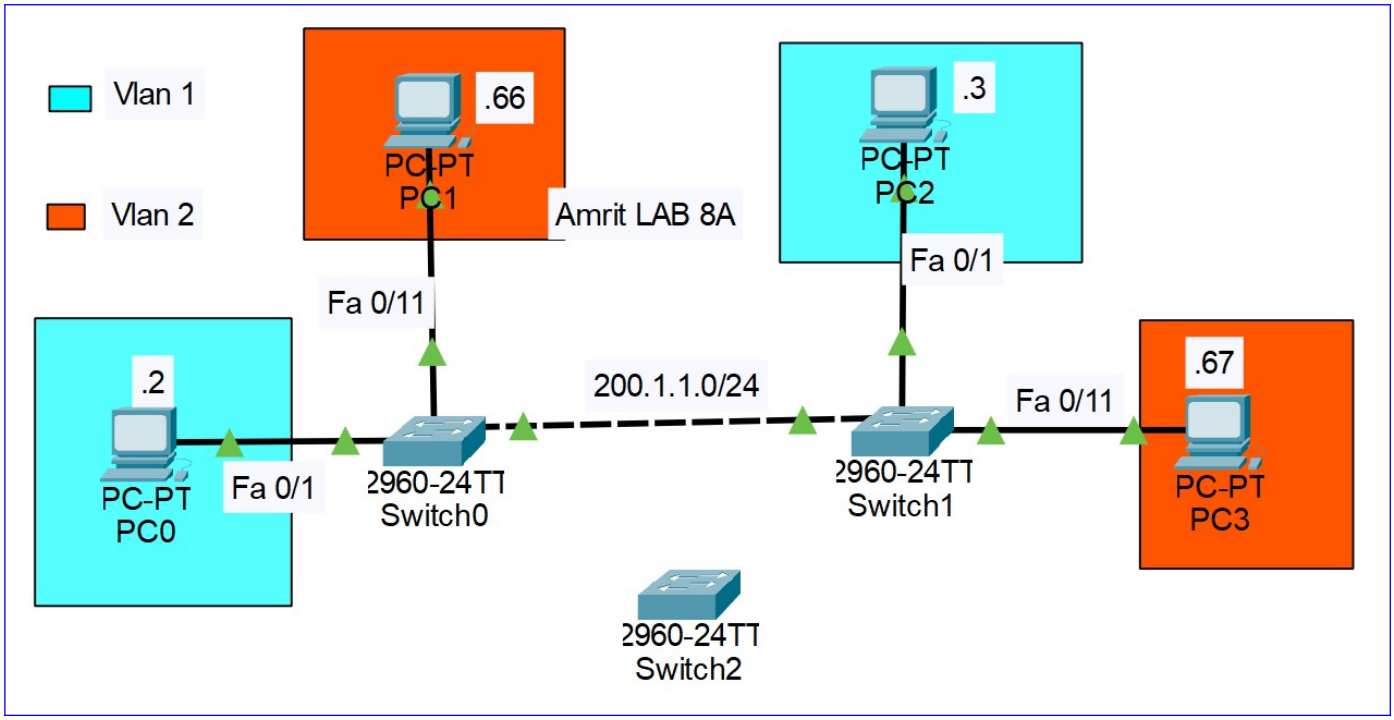

Figure 1: Network topology Lab 8A

2. **Observe the result by testing the connectivity between each computers**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

Reply from 200.1.1.66: bytes=32 time<1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=8ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 8ms, Average = 2ms
```

Output 1: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 2: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 3: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 4: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 5: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 6: Ping from PC2 to PC3

Since all PCs falls under same VLAN *i.e.* 1 and all assigned IPs belongs to same subnet all PCs can communicate with each other.

3. **Create the VLAN 2 in both switches i.e. Switch0 and Switch1**

```
Switch0>enable
Switch0#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch0(config)#vlan 2
Switch0(config-vlan)#name Vlan_2
Switch0(config-vlan)#end
Switch0#
%SYS-5-CONFIG_I: Configured from console by console
```

Output 7: Create VLAN in switch 0

```
Switch1>enable
Switch1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch1(config)#vlan 2
Switch1(config-vlan)#name Vlan_2
Switch1(config-vlan)#end
Switch1#
%SYS-5-CONFIG_I: Configured from console by console
```

Output 8: Create VLAN in switch 1

4. **Assign interfaces FastEthernet 0/11, 0/12, 0/13, 0/14 of both switches to VLAN 2**

```
Switch1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch1(config)#interface FastEthernet 0/11
Switch1(config-if)#switchport access vlan 2
Switch1(config-if)#exit
Switch1(config)#interface FastEthernet 0/12
Switch1(config-if)#switchport access vlan 2
Switch1(config-if)#exit
Switch1(config)#interface FastEthernet 0/13
Switch1(config-if)#switchport access vlan 2
Switch1(config-if)#exit
Switch1(config)#interface FastEthernet 0/14
Switch1(config-if)#switchport access vlan 2
Switch1(config-if)#end
Switch1#
%SYS-5-CONFIG_I: Configured from console by console
```

Output 9: Assigning Interfaces to VLAN in Switch 1

```
Switch0>enable
Switch0#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch0(config)#interface FastEthernet 0/11
Switch0(config-if)#switchport access vlan 2
Switch0(config-if)#exit
Switch0(config)#interface FastEthernet 0/12
Switch0(config-if)#switchport access vlan 2
Switch0(config-if)#exit
Switch0(config)#interface FastEthernet 0/13
Switch0(config-if)#switchport access vlan 2
Switch0(config-if)#exit
Switch0(config)#interface FastEthernet 0/14
Switch0(config-if)#switchport access vlan 2
Switch0(config-if)#end
Switch0#
```

```
%SYS-5-CONFIG_I: Configured from console by console
```

Output 10: Assigning Interfaces to VLAN in Switch 0

5. **Observe the result by testing the connectivity between each computers**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

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

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 11: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=3ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

Output 12: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 13: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

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

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 14: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 15: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 16: Ping from PC2 to PC3

Though the assigned IPs belongs to same subnet the PC0 and PC2 falls under same VLAN *i.e.* 1 and (PC1 and PC3) falls under another VLAN *i.e.* 2. PCs of different VlAN cant communicate with each other as only one interface corresponding to VlAN 1 is connected between switch.

6. **Does the ping from PC1 to PC3 succeed? State reason.**

   Ping failed as shown in above Output. Though, they both belongs to same VLAN and same subnet only interface for VLAN 1 is connected between switch 0 and switch 1 ping failed.

7. **Connect interface FastEthernet 0/12 of Switch0 with FastEthernet 0/12 of Switch1**

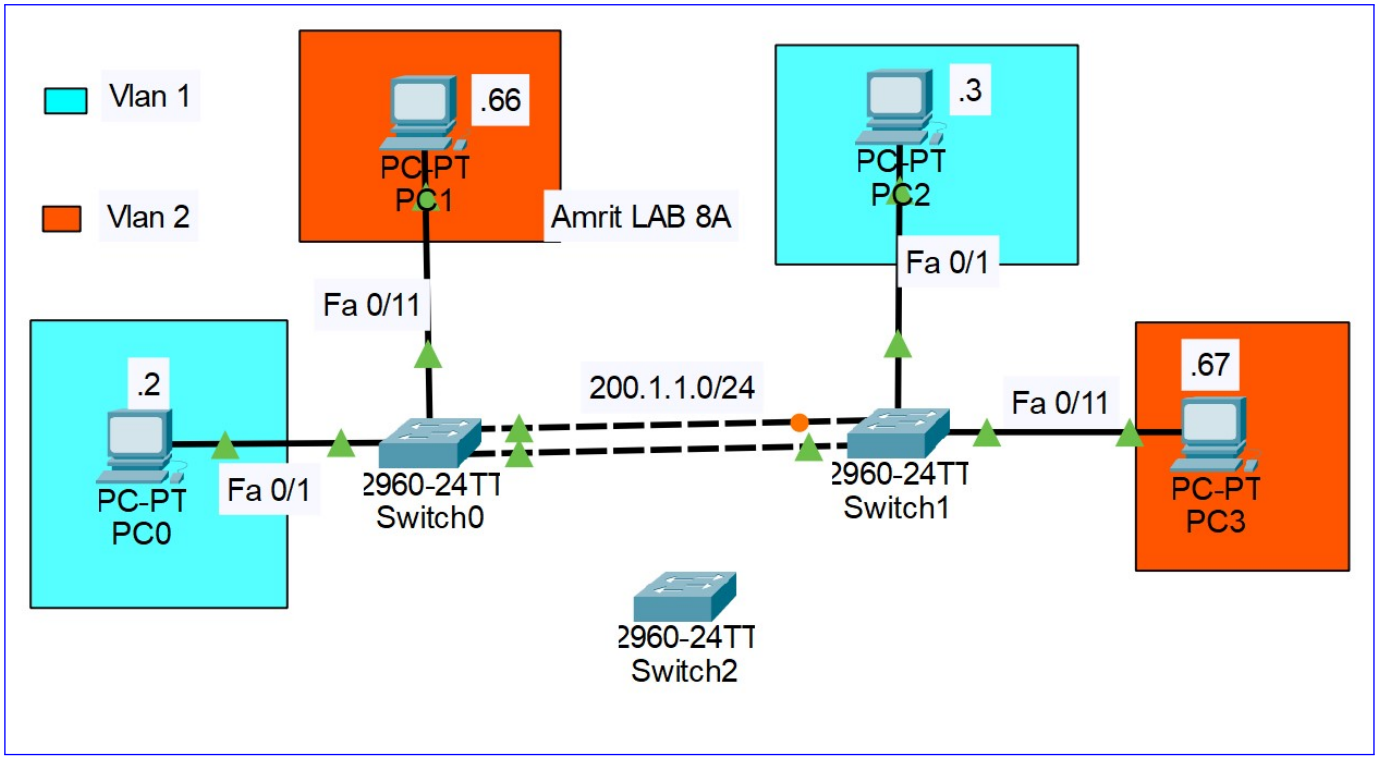

Figure 2: Network topology Lab 8A after interconnecting additional interface between Switch0 and Switch 1

8. **Observe the result by testing the connectivity between each computers**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

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

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 17: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=3ms TTL=128
Reply from 200.1.1.3: bytes=32 time=3ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
```

Output 18: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 19: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

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

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 20: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=3ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

Output 21: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 22: Ping from PC2 to PC3

9. **Does the ping from PC1 to PC3 succeed? State reason.**

   Yes ping from PC1 to PC3 succeed. Here we introduced additional interface between the switches FastEthernet 0/12 belonging to VLAN 2 the communication between the PCs belonging to same VLAN but connected to different switches is possible.

10. **Does the ping from PC0 to PC1 succeed? State reason.**

    No, the Ping failed simply because they belong to different VLAN.

11. **Now connect interface FastEthernet 0/9 of Switch1 with FastEthernet 0/9 of Switch2 and FastEthernet 0/13 of Switch1 with FastEthernet 0/13 of Switch2**

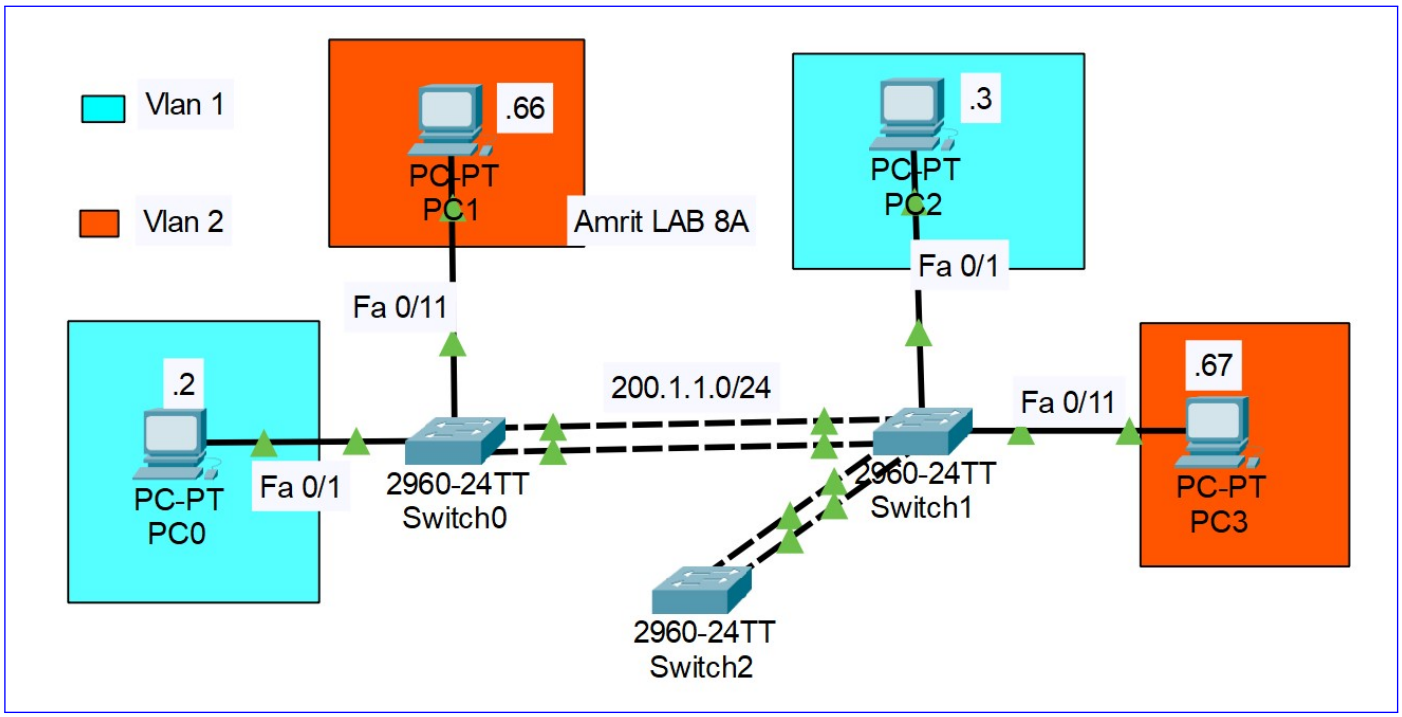

Figure 3: Network topology Lab 8A after interconnecting 2 additional interface between Switch0 and Switch 1

12. **Observe the result by testing the connectivity between each computers**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

Reply from 200.1.1.66: bytes=32 time<1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=8ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 8ms, Average = 2ms
```

Output 23: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.3:
```

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

Output 24: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 25: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 26: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 27: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
```

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

Output 28: Ping from PC2 to PC3

Ping is successful between all PCs when third switch is used to interconnect VLAN 1 and VLAN 2. The third switch simply acts as switch to connect two different LAN. Additionally, all assigned IPs falls under same subnet.

13. **Does the ping from PC0 to PC1 succeed? State reason.** As shown in above outputs the ping success. Though PC0 and PC1 belongs to different VLAN the new switch connects these VLAN as normal LAN and enable communication between them.

5.5.2 Activities B

B. From the above network topology remove all links between switches, and perform the followings:

1. **Configure interfaces FastEthernet0/20 of both switches Switch0 and Switch1 as Trunk port and establish connection between two switches using these ports**

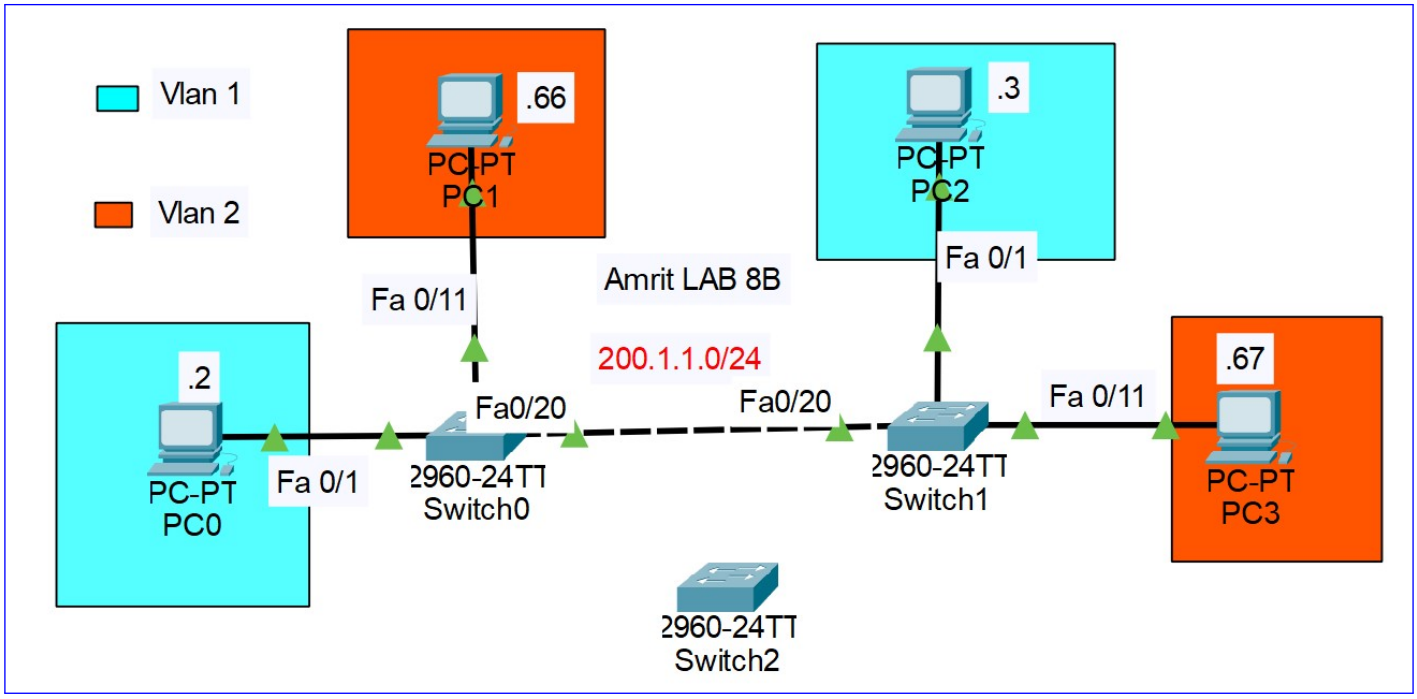

Figure 4: Network topology Lab 8B after configuring Trunk port

Here we reduced the number of interface needed to connect both VLAN in Both switches with the help of trunk protocol.

```
Switch0>enable

Switch0#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch0(config)#interface FastEthernet0/20
Switch0(config-if)#switchport mode trunk
```

Output 29: Configure Fa 0/20 for trunk in switch 0

```
Switch1>enable

Switch1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch1(config)#interface FastEthernet0/20
Switch1(config-if)#switchport mode trunk
```

Output 30: Configure Fa 0/20 for trunk in switch 1

2. **Observe the result by testing the connectivity between each computers**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

Request timed out.
Request timed out.
```

```
Request timed out.
Request timed out.

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 31: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Output 32: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 33: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

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

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 34: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

```
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 35: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 36: Ping from PC2 to PC3

In this activity we only reduced the number of Interface connected between Switch 0 and Switch 1 and additionally disconnect the switch 1 and switch 2 which make the communication between VLAN 1 and VLAN 2 impossible.

3. **Does the ping from PC0 to PC1 succeed? State reason** PC0 and PC1 falls under same subnet but belongs to different VLAN and here we disconnected the interfaces with switch 2 that was previously used to make connection between VLANs.

4. **Does the ping from PC0 to PC2 succeed? State reason** Yes the ping between PC0 and PC2 succeed as they belong to same VLAN, same Subnet and there is trunk to connect two switches.

5. **Does the ping from PC1 to PC3 succeed? State reason**

   Yes the ping between PC1 and PC3 succeed as they belong to same VLAN, same Subnet and there is trunk to connect two switches.

6. **Interconnect two VLANs using another switch as: Connect interface FastEthernet0/9 of Switch1 with FastEthernet0/9 of Switch2 and FastEthernet0/13 of Switch1 with FastEthernet0/13 of Switch2 and repeat from ii to v**

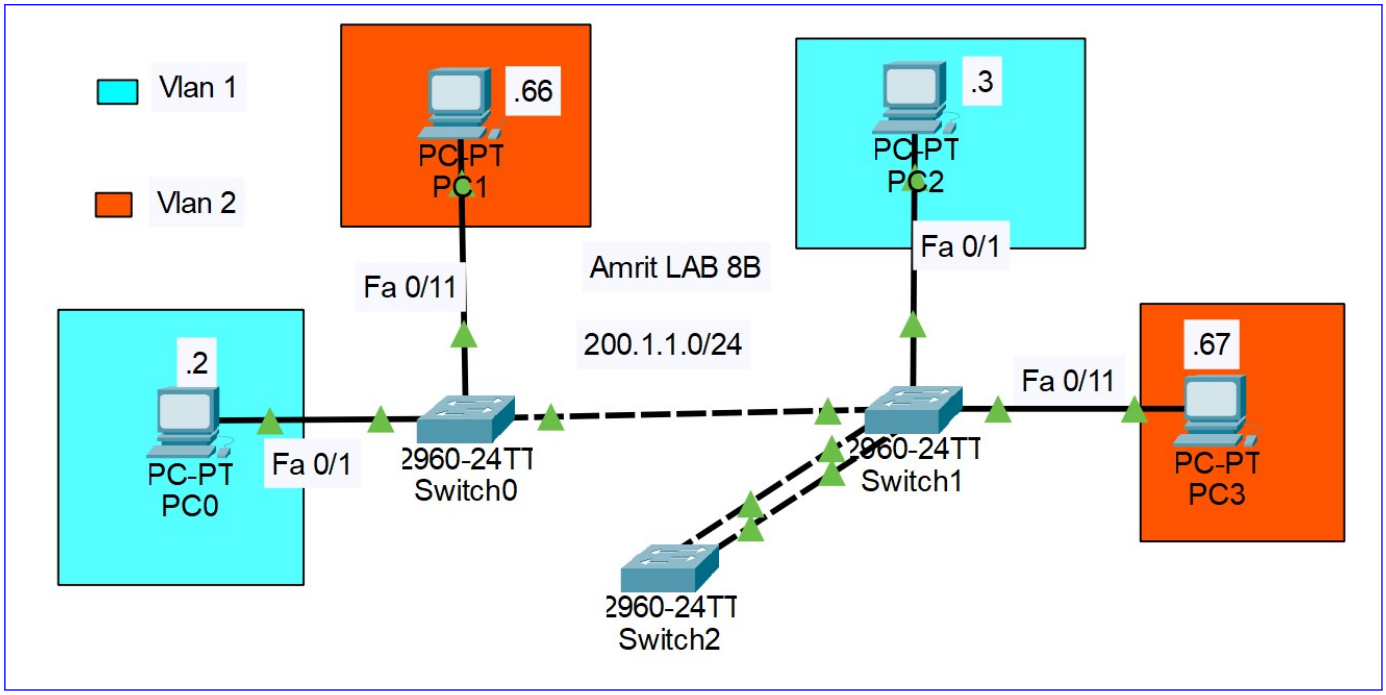

Figure 5: Network topology Lab 8B after connecting Switch 2

(a) **Observe the result by testing the connectivity between each computers**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 37: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 38: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms
```

Output 39: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=2ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 40: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 41: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 42: Ping from PC2 to PC3

In this activity we only reduced the number of Interface connected between Switch 0 and Switch 1 with the help of Trunk mode and additionally connect the switch 1 and switch 2 which make the communication between VLAN 1 and VLAN 2 possible.

(b) **Does the ping from PC0 to PC1 succeed? State reason** Ping is successful as PC0 and PC1 falls under same subnet but belongs to different VLAN and here we connected the interfaces with switch 2 that is used to make connection between VLANs.

(c) **Does the ping from PC0 to PC2 succeed? State reason** Yes the ping between PC0 and PC2 succeed as they belong to same VLAN, same Subnet and there is trunk to connect two switches.

(d) **Does the ping from PC1 to PC3 succeed? State reason**

Yes the ping between PC1 and PC3 succeed as they belong to same VLAN, same Subnet and there is trunk to connect two switches.

7. **Compare the current configuration with above**

Here we have Introduced the Switch 2 that connect VLAN 1 and VLAN 2 and make connection possible between them.

5.5.3 Activities C

C. From the above condition of question no. 2, change the subnet mask to 255.255.255.192, and perform the followings:

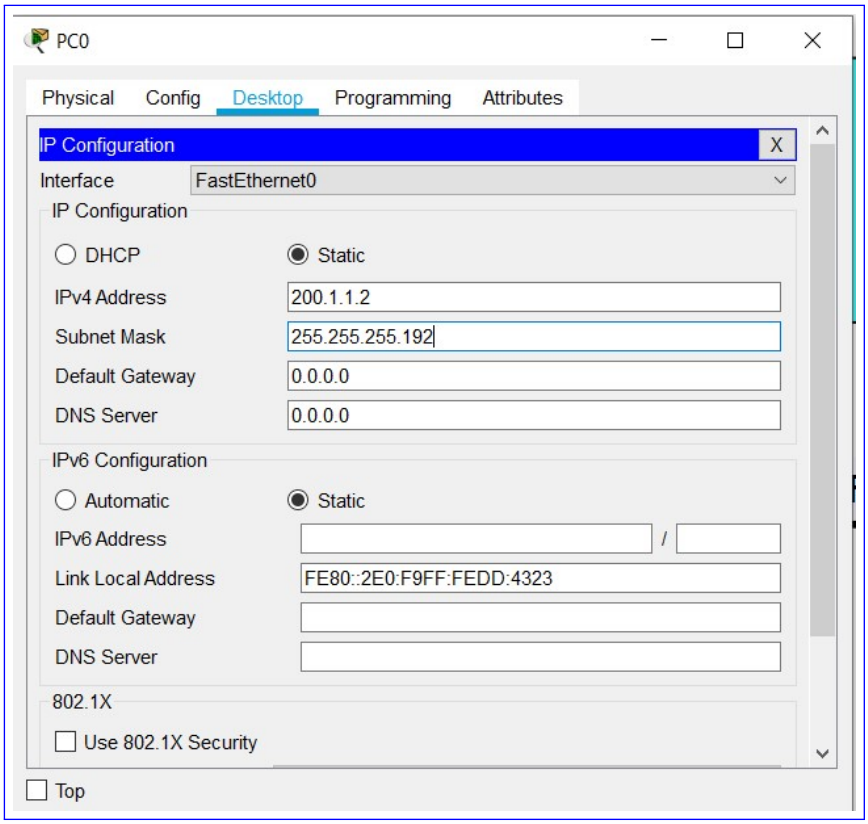

Figure 6: Changing Subnet for Lab 8c in PC0 to 255.255.255.192 or /26

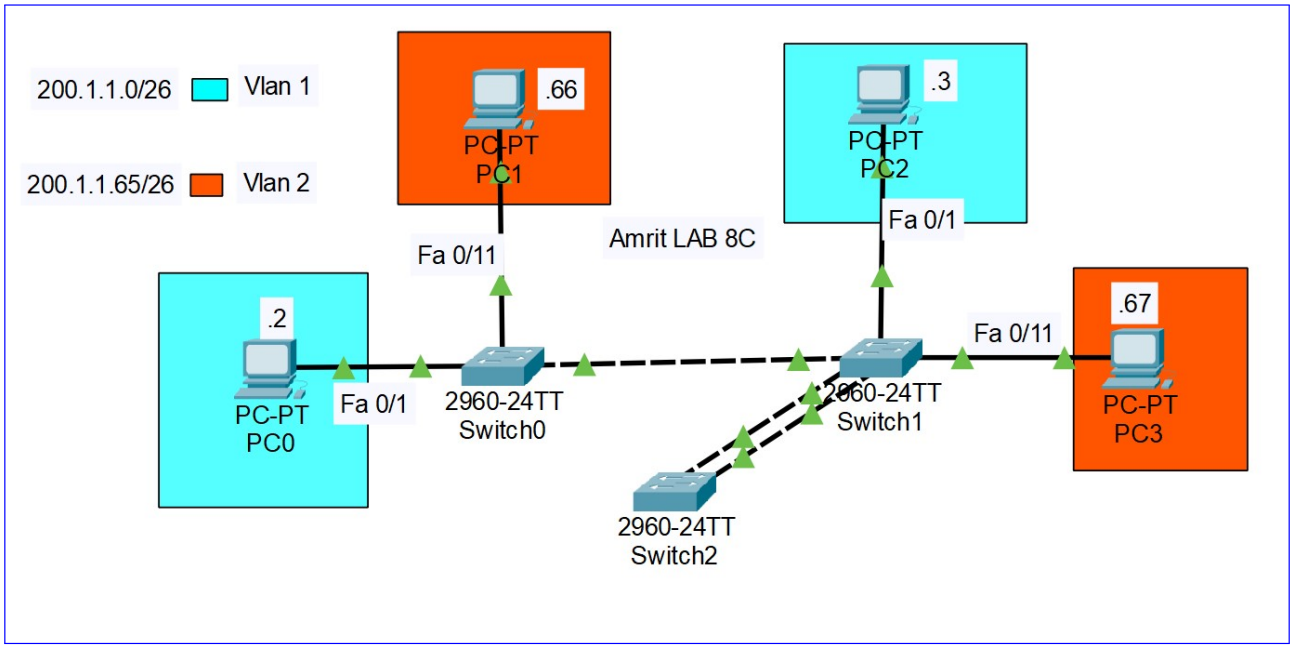

Figure 7: Network topology Lab 8C

1. **Test the connectivity from each computer to another computer. Does ping succeed in all cases? State reason**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

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

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 43: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=3ms TTL=128
Reply from 200.1.1.3: bytes=32 time=3ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
```

Output 44: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 45: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

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

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 46: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
```

```
Reply from 200.1.1.67: bytes=32 time=3ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

Output 47: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

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

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Output 48: Ping from PC2 to PC3

Here we created the two subnets each having usable 62 host . So VLAN 1 and VLAN 2 falls under different subnet and switch is incapable to forward packets between different network. Hence Ping between PCs of same VLAN only succeed.

2. **Now the different computers became on different networks, so routing is necessary to forward packets between networks. For this set default gateway of PC0 and PC2 as 200.1.1.1. Similarly the default gateway of PC1 and PC3 as 200.1.1.65.**

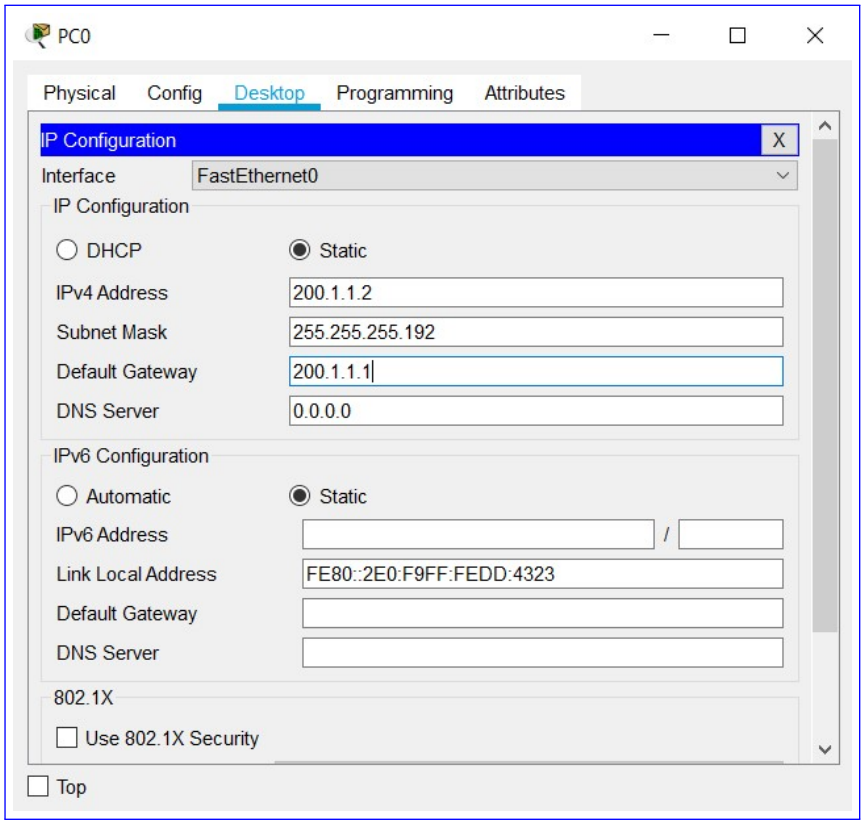

Figure 8: Changing Changing Default gateway of PC0 to 200.1.1.1

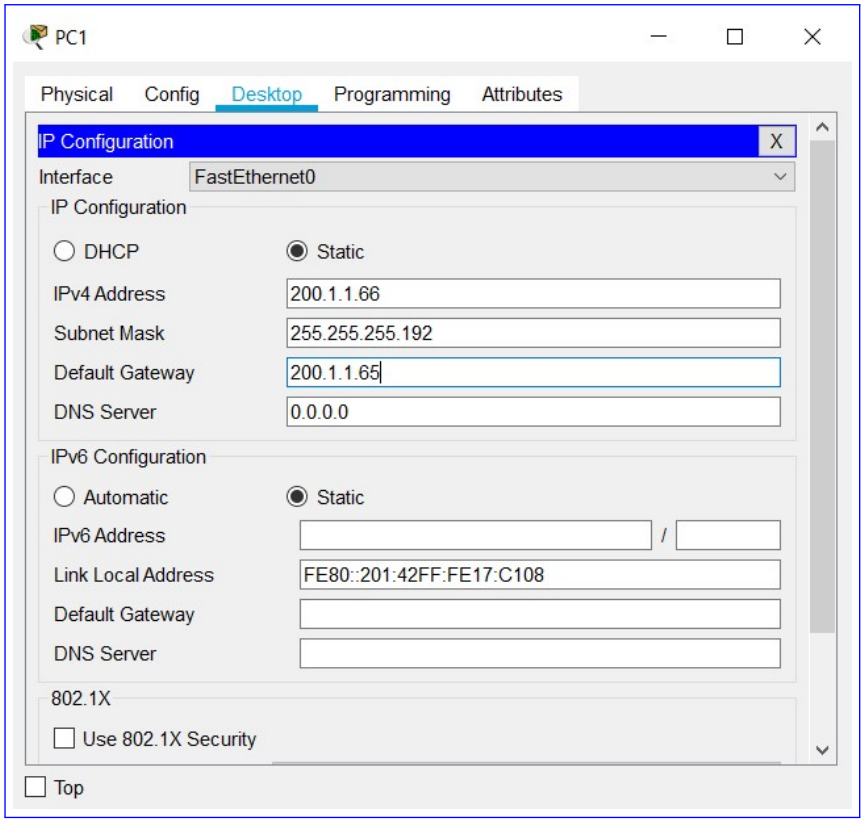

Figure 9: Changing Changing Default gateway of PC0 to 200.1.1.65

3. **Replace Switch2 with a router as Router0 as shown in Figure2 below.**

4. **Connect interface FastEthernet0/8 of Switch1 to GigabitEthernet0/0 of Router0 having IP Address of 200.1.1.1/26, similarly connect interface FastEthernet0/14 of Switch1 to GigabitEthernet0/1 of Router0 having IP Address of 200.1.1.65/26**

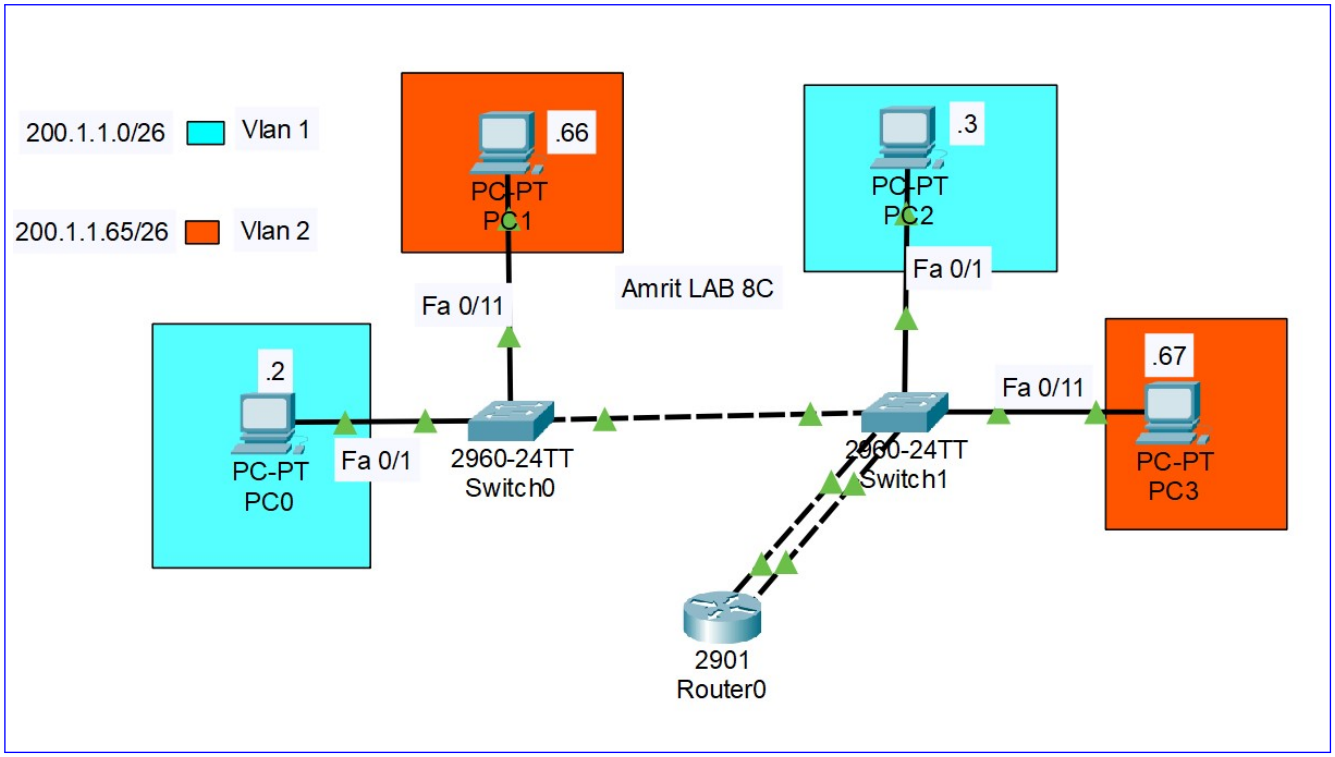

Figure 10: Replacing Switch with Router in Lab 8C

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.

Router(config)#interface GigabitEthernet0/0
Router(config-if)#ip address 200.1.1.1 255.255.255.192
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed
    state to up
```

Output 49: Assigning IP to interface 0/0 in Router 0

```
Router(config)#interface GigabitEthernet0/1
Router(config-if)#ip address 200.1.1.65 255.255.255.192
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed
    state to up
```

Output 50: Assigning IP to interface 0/1 in Router 0

5. **Again test the connectivity from each computer to another computer. Does ping succeed in all cases? State reason**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
```

```
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 51: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 52: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms
```

Output 53: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=2ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 54: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
```

```
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 55: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 56: Ping from PC2 to PC3

Ping between and among all PCs is successful because Router is introduced and Configured both interface 0/0 and 0/1 to forward packets between two VLAN1 and VLAN 2 belonging to different subnet.

5.5.4 Activities D

D. There are still more than one connections from switch to router. Remove all links between Switch1 and Router0. Also reset the IP addresses of all interfaces of router and perform the followings:

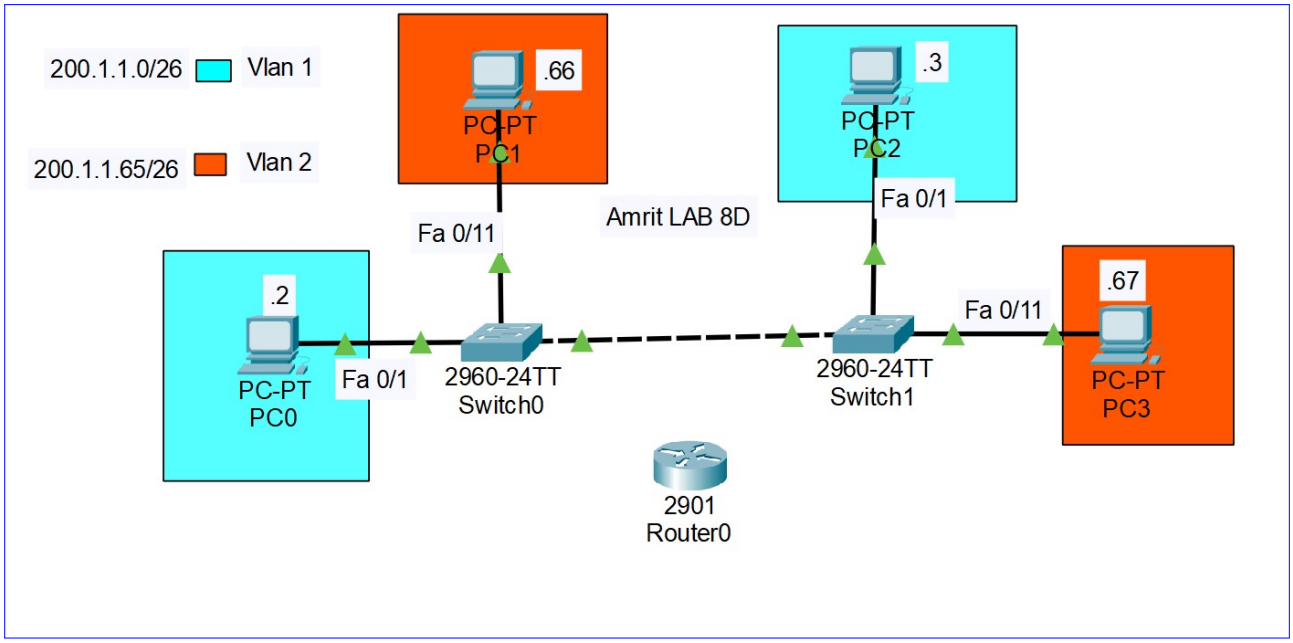

Figure 11: Network topology Lab 8D after removing all connection

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.

Router(config)#interface GigabitEthernet0/0
Router(config)#interface GigabitEthernet0/0
Router(config-if)#no ip address 200.1.1.1 255.255.255.192
Router(config-if)#shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to administratively
    down

Router(config-if)#exit
Router(config)#interface GigabitEthernet0/1
Router(config-if)#no ip address 200.1.1.65 255.255.255.192
Router(config-if)#shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to administratively
    down
```

Output 57: Resetting all interface in Router 0

1. **Configure interfaces FastEthernet0/21 of Switch1 as Trunk port and establish connection to the GigabitEthernet0/0 interface of Router0**

```
Switch1 >enable
Switch1#configure terminal
Enter configuration commands , one per line. End with CNTL/Z.
Switch1(config)#interface FastEthernet0/21
Switch1(config -if)#switchport mode trunk
```

Output 58: Configuring Trunk port to Fa 0/21

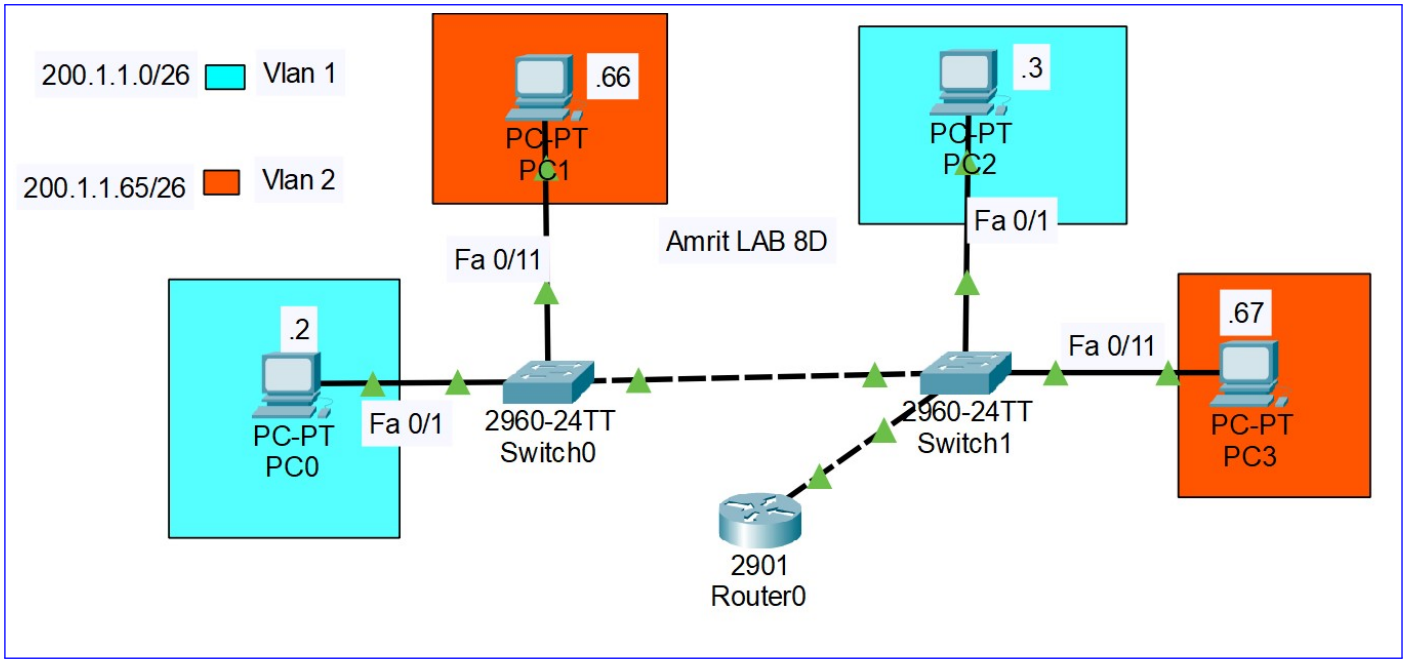

Figure 12: Network topology Lab 8D Connection after Trunk configuraton

2. **Now configure sub-interfaces as:**

```
 Router0>
Router0>enable
Router0#
Router0\#config t
Router0(config)#
Router0(config)#interface gigabitethernet 0/0.1
Router0(config-subif)#
Router0(config-subif)#encapsulation dot1Q [VLAN ID i.e. 1 or 2]
Router0(config-subif)#
Router0(config-subif)#ip address 200.1.1.1 255.255.255.192
```

Similarly configure another sub-interface as GigabitEthernet0/0.2 on same physical interface for another VLAN with IP address of 200.1.1.65/26. And finally activate this physical interface by using no shutdown command.

```
Router>enable
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet 0/0.1
Router(config-subif)#encapsulation dot1Q 1
Router(config-subif)#ip address 200.1.1.1 255.255.255.192
Router(config-subif)#exit
Router(config)#interface GigabitEthernet 0/0.2
Router(config-subif)#encapsulation dot1Q 2
Router(config-subif)#ip address 200.1.1.65 255.255.255.192
Router(config-subif)#exit
Router(config)#interface GigabitEthernet 0/0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.2, changed state to up
```

Output 59: Configuring Sub-interfaces 0/0.1 and 0/0.2 and activate

3. **Again test the connectivity from each computer to another computer. Does ping succeed in all cases? State reason**

```
C:\>ping 200.1.1.66

Pinging 200.1.1.66 with 32 bytes of data:

Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128
Reply from 200.1.1.66: bytes=32 time=1ms TTL=128
Reply from 200.1.1.66: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 60: Ping from PC0 to PC1

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time=1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 61: Ping from PC0 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms
```

Output 62: Ping from PC0 to PC3

```
C:\>ping 200.1.1.3

Pinging 200.1.1.3 with 32 bytes of data:

Reply from 200.1.1.3: bytes=32 time=2ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128
Reply from 200.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
```

```
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 63: Ping from PC1 to PC2

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Output 64: Ping from PC1 to PC3

```
C:\>ping 200.1.1.67

Pinging 200.1.1.67 with 32 bytes of data:

Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time<1ms TTL=128
Reply from 200.1.1.67: bytes=32 time=2ms TTL=128

Ping statistics for 200.1.1.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Output 65: Ping from PC2 to PC3

Here we configured Fa 0/21 of switch 1 in Trunk mode and configured the interface 0/0 of router as sub interfaces 0/0.1 and 0/0.2 having IP belonging to VLAN 1 and VLAN 2 respectively and different subnet too. Here Router forwards packets between those sub interfaces.

4. **Compare this configuration with previous (i.e. in question no 3).**

   The only physical difference with activity C is it has single interface consisting sub interface in trunk mode between switch 1 and Router 0.

6 Conclusion

In this Lab we familiarize ourselves with VLAN , its uses and importance. We also learned to communicate between VLANs on same and different subnets.