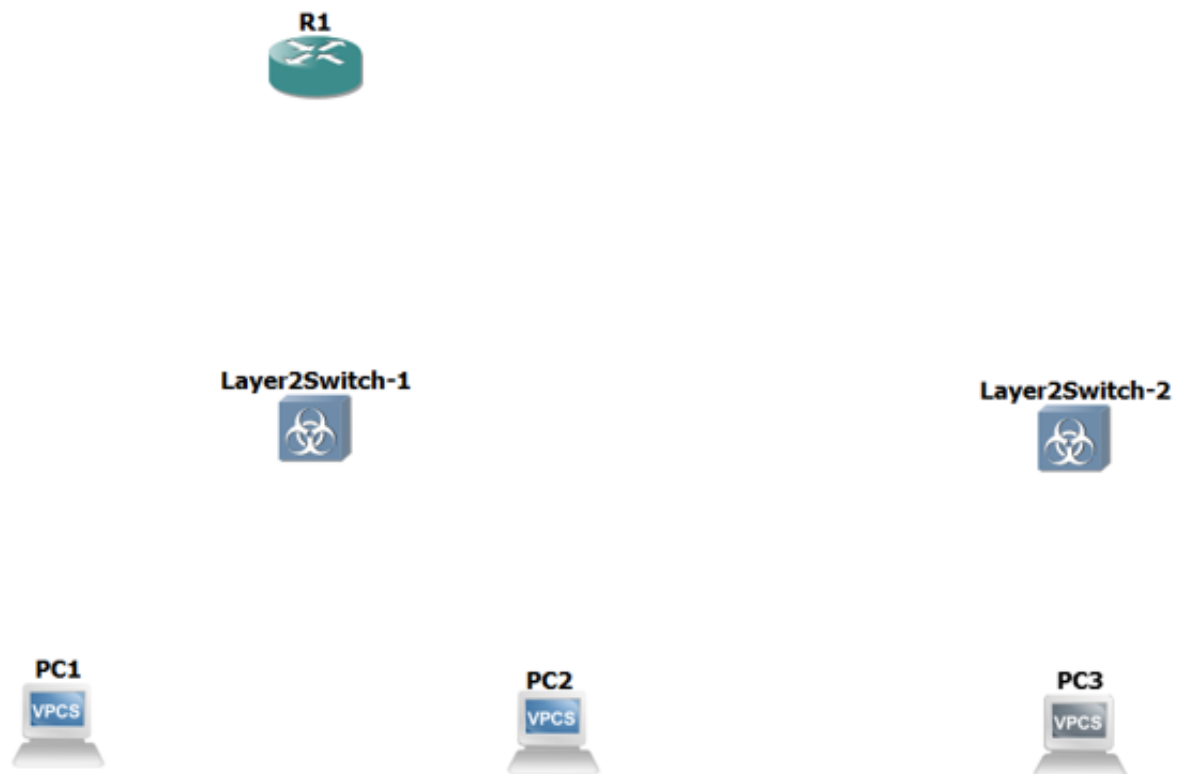## Practical 5

Aim: Implement Inter-VLAN Routing.

What is Inter-VLAN Routing?
- Inter-VLAN routing can be defined as a way to forward traffic between different VLAN by implementing a router in the network.

- Inter-VLAN routing refers to the movement of packets across the network between hosts in different network segments.

- The user nodes in the VLANs forwards traffic to the router which then forwards the traffic to the destination network regardless of the VLAN configured on the switch.

**Step 1: Download and install The Layer 2 Switch.**
- You can download the Layer 2 Switch from this link: https://www.sysnettechsolutions.com/en/download-vios-l2-image-for-gns3/

- To install it on GNS3 follow the steps given here: https://www.sysnettechsolutions.com/en/add-layer-2-switch-in-gns3/

Step 2: Create the Topology as below

R1

Layer2Switch-1   Layer2Switch-2

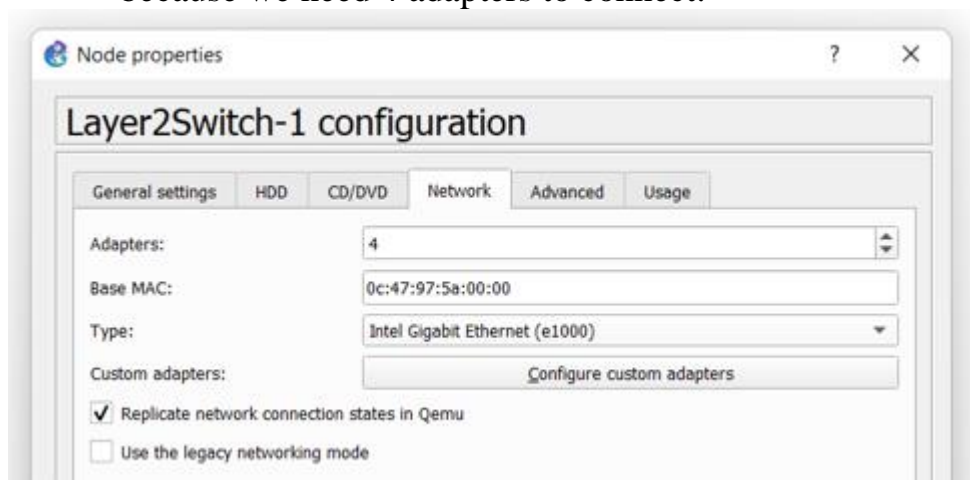PC1   PC2   PC3

Step 3: Now we have do configuration in the switches

- **Configure the Layer2Switch-1.**
- Open its configuration menu.
- Once that is done set the RAM to 400 MB in the general settings tab.
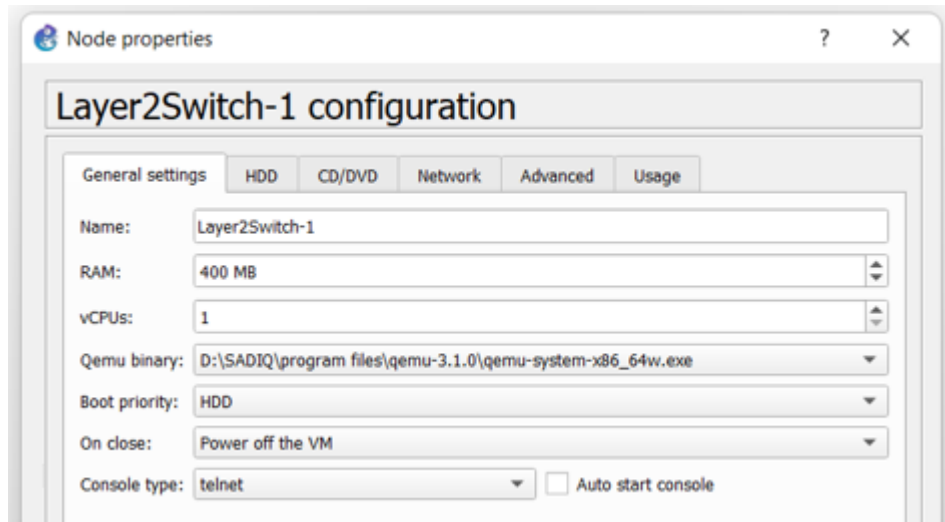

- Navigate to the network tab and set the number of adapters to 4 because we need 4 adapters to connect.

- **Once that is done click on 'Apply' followed by 'OK'.**

- **Now we have configure the Layer2Switch-2.**
- Follow the same steps open its configuration menu.
- Once that is done set the RAM to 300 MB and Set adapters to 2 because we are only going to need 2 adapters.

- **Click on 'Apply' followed by 'OK'.**

Step 4: Then we set up the wires to the topology we have create as below.
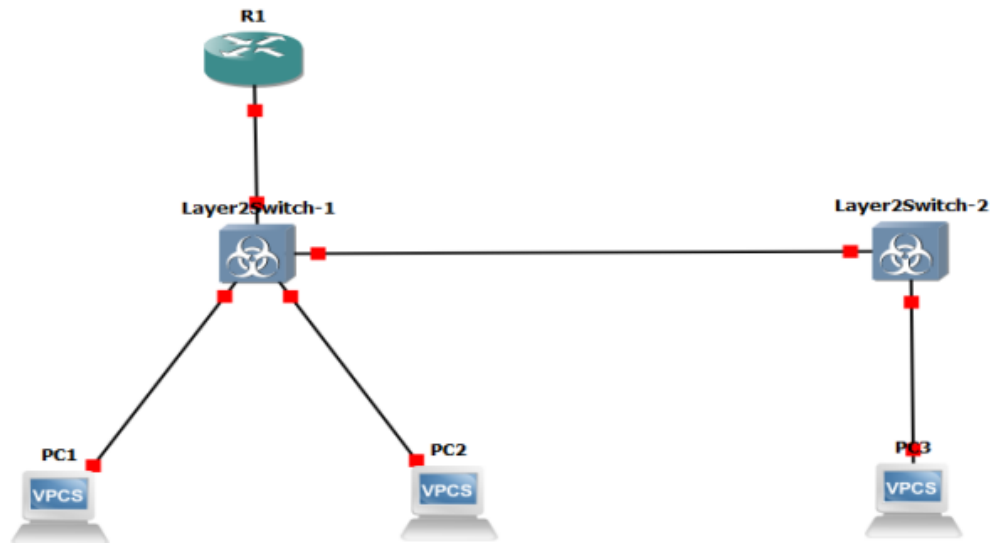
Step 5: We will now configure IP Address to the PC's as below.
PC1:

PC2:

PC3:

```
PC3> ip 192.168.5.10/24 192.168.5.1
Checking for duplicate address...
PC1 : 192.168.5.10 255.255.255.0 gateway 192.168.5.1

PC3> sh ip

NAME        : PC3[1]
IP/MASK     : 192.168.5.10/24
GATEWAY     : 192.168.5.1
DNS         :
MAC         : 00:50:79:66:68:02
LPORT       : 10018
RHOST:PORT  : 127.0.0.1:10019
MTU:        : 1500

PC3> save
Saving startup configuration to startup.vpc
.  done

PC3>
```

Step 6: Let's configure both the switches now

Layer 2 Switch 1:

```
vIOS-L2-01>en
vIOS-L2-01#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#vlan 5
vIOS-L2-01(config-vlan)#name QA
vIOS-L2-01(config-vlan)#ex
vIOS-L2-01(config)#vlan 10
vIOS-L2-01(config-vlan)#name HR
vIOS-L2-01(config-vlan)#ex
vIOS-L2-01(config)#end
vIOS-L2-01#wr
Building configuration...
Compressed configuration from 4946 bytes to 1891 bytes
*Oct  2 11:30:28.737: %SYS-5-CONFIG_I: Configured from console by console[OK]
*Oct  2 11:30:32.458: %GRUB-5-CONFIG_WRITING: GRUB configuration is being updated on disk. Please wait...
*Oct  2 11:30:33.222: %GRUB-5-CONFIG_WRITTEN: GRUB configuration was written to disk successfully.
vIOS-L2-01#
```

Layer 2 Switch 2:

```
vIOS-L2-01>en
vIOS-L2-01#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#vlan 5
vIOS-L2-01(config-vlan)#name QAA
vIOS-L2-01(config-vlan)#name QA
vIOS-L2-01(config-vlan)#ex
vIOS-L2-01(config)#end
vIOS-L2-01#wr
Building configuration...
Compressed configuration from 4795 bytes to 1820 bytes
*Oct  2 11:30:16.584: %SYS-5-CONFIG_I: Configured from console by console[OK]
*Oct  2 11:30:19.952: %GRUB-5-CONFIG_WRITING: GRUB configuration is being updated on disk. Please wait...
vIOS-L2-01#
*Oct  2 11:30:21.368: %GRUB-5-CONFIG_WRITTEN: GRUB configuration was written to disk successfully.
vIOS-L2-01#
```

Step 7: Enter 'show vlan' to check the Vlan we have assigned

Layer 2 Switch 1:

```
vIOS-L2-01#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi0/0, Gi0/1, Gi0/2
5    QA                               active
10   HR                               active
100  VLAN100                          active
200  VLAN0200                         active
300  VLAN0300                         active
```

Layer 2 Switch 2:

```
vIOS-L2-01#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi0/1
5    QA                               active
100  VLAN100                          active
```

Step 8: Now we have to configure trunk and the access interface for the Switches.

Layer 2 Switch 1:

```
vIOS-L2-01#int gig
vIOS-L2-01#
vIOS-L2-01#
vIOS-L2-01#
vIOS-L2-01#
vIOS-L2-01#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#int gig
vIOS-L2-01(config)#int gigabitEthernet 0/1
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 5
vIOS-L2-01(config-if)#ex
vIOS-L2-01(config)#int gigabitEthernet 0/2
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 10
vIOS-L2-01(config-if)#ex
vIOS-L2-01(config)#int gigabitEthernet 0/3
vIOS-L2-01(config-if)#switchport trunk encapsulation dot1q
vIOS-L2-01(config-if)#switchport mode trunk
vIOS-L2-01(config-if)#ex
vIOS-L2-01(config)#int gigabitEthernet 0/0
vIOS-L2-01(config-if)#switchport trunk encapsulation dot1q
vIOS-L2-01(config-if)#switchport mode trunk
vIOS-L2-01(config-if)#ex
vIOS-L2-01(config)#ex
% Ambiguous command:  "ex"
vIOS-L2-01(config)#end
vIOS-L2-01#wr
Building configuration...
Compressed configuration from 5121 bytes to 1992 bytes
*Oct  2 11:42:15.113: %SYS-5-CONFIG_I: Configured from console by console[OK]
vIOS-L2-01#
```

Layer 2 Switch 2:

```
vIOS-L2-01>
vIOS-L2-01>en
vIOS-L2-01#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vIOS-L2-01(config)#int gig
vIOS-L2-01(config)#int gigabitEthernet 0/1
vIOS-L2-01(config-if)#switchport mode access
vIOS-L2-01(config-if)#switchport access vlan 5
vIOS-L2-01(config-if)#ex
vIOS-L2-01(config)#int gigabitEthernet 0/0
vIOS-L2-01(config-if)#switchport trunk encapsulation dot1q
vIOS-L2-01(config-if)#switchport mode trunk
vIOS-L2-01(config-if)#ex
vIOS-L2-01(config)#end
vIOS-L2-01#wr
Building configuration...
Compressed configuration from 4882 bytes to 1875 bytes
*Oct  2 11:43:11.553: %SYS-5-CONFIG_I: Configured from console by console[OK]
vIOS-L2-01#
```

Step 9: Enter 'show interfaces switchport' to check all the configuration done in switchport.

I have just pasted the Screenshot of Switch 1 gig0/0 but you can check all the port information.
Do the same for Switch 2.

```
vIOS-L2-01#show interfaces switchport
Name: Gi0/0
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk associations: none
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Appliance trust: none
```

Step 10: The topology should look similar to this.
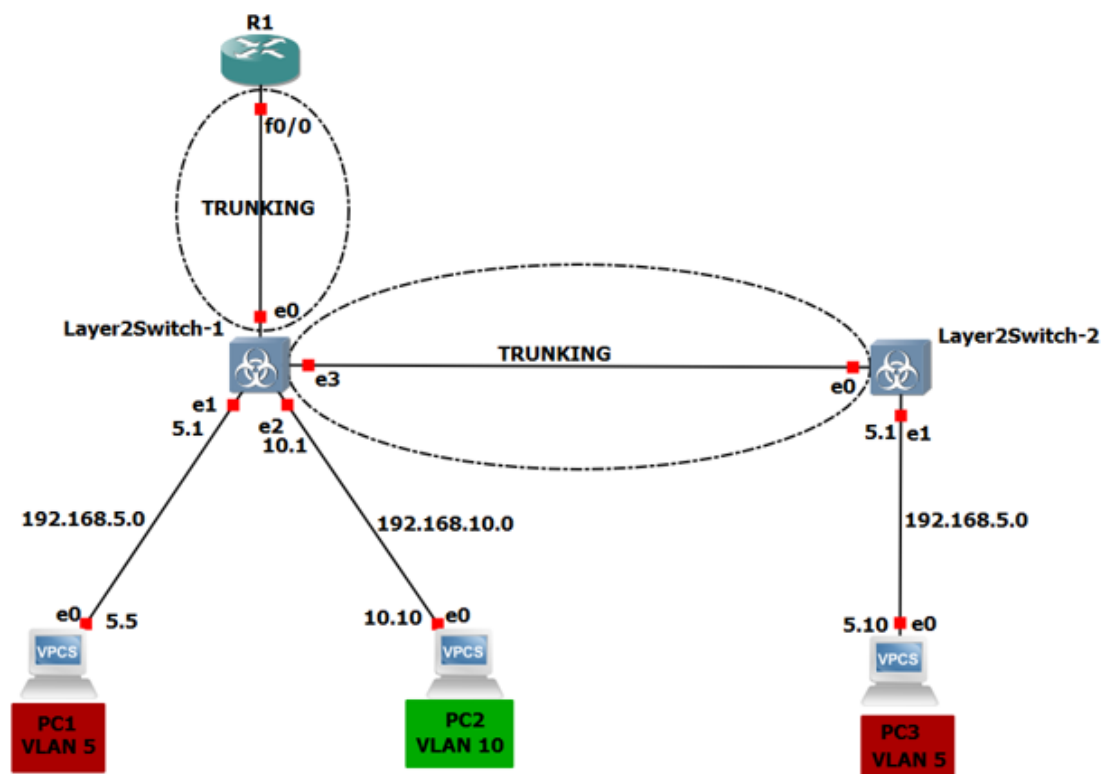
Step 11: PC1 and PC3 are in the same VLAN i.e. 5.
So try to ping PC 1 from PC3 or ping PC3 from PC1.
It should successfully ping.
And also try to ping PC2 from PC1 or PC3. It won't ping.

```
PC3> ping 192.168.5.5
84 bytes from 192.168.5.5 icmp_seq=1 ttl=64 time=49.126 ms
84 bytes from 192.168.5.5 icmp_seq=2 ttl=64 time=76.717 ms
84 bytes from 192.168.5.5 icmp_seq=3 ttl=64 time=61.583 ms
84 bytes from 192.168.5.5 icmp_seq=4 ttl=64 time=30.735 ms
84 bytes from 192.168.5.5 icmp_seq=5 ttl=64 time=6.320 ms

PC3> ping 192.168.10.10
host (192.168.5.1) not reachable
```

As checked PC3 or PC1 was able to ping each other but not PC2 because
they are in different VLAN.

**Step 12:To make them able to ping we will configure R1 now as
below.**

```
R1#en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int f0/0
R1(config-if)#no shut
R1(config-if)#ex
R1(config)#i
*Mar  1 01:16:32.923: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar  1 01:16:33.923: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config)#int f0/0.5
R1(config-subif)#en
R1(config-subif)#encapsulation d
R1(config-subif)#encapsulation dot1Q 5
R1(config-subif)#ip addre
*Mar  1 01:16:55.099: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
R1(config-subif)#ip address 192.168.5.1 255.255.255.0
R1(config-subif)#no shut
R1(config-subif)#ex
R1(config)#int f0/0.10
R1(config-subif)#encapsulation dot1Q 10
R1(config-subif)#ip address 192.168.10.1 255.255.255.0
R1(config-subif)#no shut
R1(config-subif)#ex
R1(config)#end
R1#w
*Mar  1 01:17:44.867: %SYS-5-CONFIG_I: Configured from console by console
R1#wr
Building configuration...
[OK]
R1#
```

**Now we have configure router also. To confirm enter 'sh ip int br'
R1:**

```
[OK]
R1#sh ip int br
Interface            IP-Address      OK? Method Status                Protocol
FastEthernet0/0      unassigned      YES unset  up                    up
FastEthernet0/0.5    192.168.5.1     YES manual up                    up
FastEthernet0/0.10   192.168.10.1    YES manual up                    up
Serial0/0            unassigned      YES unset  administratively down  down
```

Step 13: Router is also configured.
Now you can ping PC2 from PC1 or PC3.
They both are in different vlan but we will be able to ping.

PC1:

```
PC1> ping 192.168.5.1
84 bytes from 192.168.5.1 icmp_seq=1 ttl=255 time=52.066 ms
84 bytes from 192.168.5.1 icmp_seq=2 ttl=255 time=32.183 ms
84 bytes from 192.168.5.1 icmp_seq=3 ttl=255 time=32.140 ms
84 bytes from 192.168.5.1 icmp_seq=4 ttl=255 time=32.253 ms
84 bytes from 192.168.5.1 icmp_seq=5 ttl=255 time=40.194 ms

PC1> ping 192.168.5.10
84 bytes from 192.168.5.10 icmp_seq=1 ttl=64 time=48.498 ms
84 bytes from 192.168.5.10 icmp_seq=2 ttl=64 time=84.494 ms
84 bytes from 192.168.5.10 icmp_seq=3 ttl=64 time=25.617 ms
84 bytes from 192.168.5.10 icmp_seq=4 ttl=64 time=59.179 ms
84 bytes from 192.168.5.10 icmp_seq=5 ttl=64 time=70.163 ms

PC1> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=63 time=82.764 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=63 time=101.783 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=63 time=92.738 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=63 time=124.553 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=63 time=103.706 ms

PC1> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=76.750 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=34.208 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=60.727 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=51.071 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=63.128 ms
```

PC2:

```
PC2> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=49.551 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=34.125 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=42.805 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=31.281 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=36.850 ms

PC2> ping 192.168.5.5
84 bytes from 192.168.5.5 icmp_seq=1 ttl=63 time=193.975 ms
84 bytes from 192.168.5.5 icmp_seq=2 ttl=63 time=74.527 ms
84 bytes from 192.168.5.5 icmp_seq=3 ttl=63 time=82.668 ms
84 bytes from 192.168.5.5 icmp_seq=4 ttl=63 time=134.707 ms
84 bytes from 192.168.5.5 icmp_seq=5 ttl=63 time=81.028 ms

PC2> ping 192.168.5.1
84 bytes from 192.168.5.1 icmp_seq=1 ttl=255 time=36.304 ms
84 bytes from 192.168.5.1 icmp_seq=2 ttl=255 time=67.590 ms
84 bytes from 192.168.5.1 icmp_seq=3 ttl=255 time=50.151 ms
84 bytes from 192.168.5.1 icmp_seq=4 ttl=255 time=51.395 ms
84 bytes from 192.168.5.1 icmp_seq=5 ttl=255 time=63.024 ms

PC2> ping 192.168.5.10
192.168.5.10 icmp_seq=1 timeout
192.168.5.10 icmp_seq=2 timeout
84 bytes from 192.168.5.10 icmp_seq=3 ttl=63 time=131.881 ms
84 bytes from 192.168.5.10 icmp_seq=4 ttl=63 time=119.436 ms
84 bytes from 192.168.5.10 icmp_seq=5 ttl=63 time=124.353 ms

PC2> ping 192.168.5.10
84 bytes from 192.168.5.10 icmp_seq=1 ttl=63 time=156.607 ms
84 bytes from 192.168.5.10 icmp_seq=2 ttl=63 time=89.429 ms
84 bytes from 192.168.5.10 icmp_seq=3 ttl=63 time=131.088 ms
84 bytes from 192.168.5.10 icmp_seq=4 ttl=63 time=162.017 ms
84 bytes from 192.168.5.10 icmp_seq=5 ttl=63 time=228.357 ms
```

PC3:

```
PC3> ping 192.168.5.5
84 bytes from 192.168.5.5 icmp_seq=1 ttl=64 time=49.126 ms
84 bytes from 192.168.5.5 icmp_seq=2 ttl=64 time=76.717 ms
84 bytes from 192.168.5.5 icmp_seq=3 ttl=64 time=61.583 ms
84 bytes from 192.168.5.5 icmp_seq=4 ttl=64 time=30.735 ms
84 bytes from 192.168.5.5 icmp_seq=5 ttl=64 time=6.320 ms

PC3> ping 192.168.5.1
84 bytes from 192.168.5.1 icmp_seq=1 ttl=255 time=58.329 ms
84 bytes from 192.168.5.1 icmp_seq=2 ttl=255 time=91.427 ms
84 bytes from 192.168.5.1 icmp_seq=3 ttl=255 time=82.418 ms
84 bytes from 192.168.5.1 icmp_seq=4 ttl=255 time=75.578 ms
84 bytes from 192.168.5.1 icmp_seq=5 ttl=255 time=54.884 ms

PC3> ping 192.168.10.10
192.168.10.10 icmp_seq=1 timeout
192.168.10.10 icmp_seq=2 timeout
84 bytes from 192.168.10.10 icmp_seq=3 ttl=63 time=137.485 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=63 time=77.982 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=63 time=91.105 ms

PC3> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=63 time=123.662 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=63 time=93.147 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=63 time=156.707 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=63 time=154.254 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=63 time=100.972 ms

PC3> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=105.385 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=73.715 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=68.205 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=80.092 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=70.484 ms
```

Step 14: Now we check the brief of VLAN on Switches using 'show vlan brief'

Layer 2 Switch 1:

```
vIOS-L2-01>sh vlan br

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------
1    default                          active
5    QA                               active    Gi0/1
10   HR                               active    Gi0/2
100  VLAN100                          active
200  VLAN0200                         active
300  VLAN0300                         active
1002 fddi-default                     act/unsup
1003 trcrf-default                    act/unsup
1004 fddinet-default                  act/unsup
1005 trbrf-default                    act/unsup
vIOS-L2-01>
```

Layer 2 Switch 2:

```
vIOS-L2-01>sh vlan br

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------
1    default                          active
5    QA                               active    Gi0/1
100  VLAN100                          active
200  VLAN0200                         active
300  VLAN0300                         active
1002 fddi-default                     act/unsup
1003 trcrf-default                    act/unsup
1004 fddinet-default                  act/unsup
1005 trbrf-default                    act/unsup
vIOS-L2-01>
```

Step 15: Enter 'sh int trunk' to check the trunk interfaces on both the switches.

Layer 2 Switch 1:

```
vIOS-L2-01>sh int trunk

Port        Mode            Encapsulation  Status      Native vlan
Gi0/0       on              802.1q         trunking    1
Gi0/3       on              802.1q         trunking    1

Port        Vlans allowed on trunk
Gi0/0       1-4094
Gi0/3       1-4094

Port        Vlans allowed and active in management domain
Gi0/0       1,5,10,100,200,300
Gi0/3       1,5,10,100,200,300

Port        Vlans in spanning tree forwarding state and not pruned
Gi0/0       1,5,10,100,200,300
Gi0/3       1,5,10,100,200,300
vIOS-L2-01>
```

Layer 2 Switch 2:

```
vIOS-L2-01>sh int trunk

Port        Mode            Encapsulation  Status      Native vlan
Gi0/0       on              802.1q         trunking    1

Port        Vlans allowed on trunk
Gi0/0       1-4094

Port        Vlans allowed and active in management domain
Gi0/0       1,5,100,200,300

Port        Vlans in spanning tree forwarding state and not pruned
Gi0/0       1,5,100,200,300
vIOS-L2-01>
```

Step 16: Enter 'sh running-config' on switches and routers to check the running configuration.

I have pasted only R1 output.

```
R1#sh running-config
Building configuration...

Current configuration : 1939 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
memory-size iomem 5
no ip icmp rate-limit unreachable
ip cef
ip tcp synwait-time 5
!
!
!
no ip domain lookup
!
!
!
!
```

```
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet0/0.5
 encapsulation dot1Q 5
 ip address 192.168.5.1 255.255.255.0
!
interface FastEthernet0/0.10
 encapsulation dot1Q 10
 ip address 192.168.10.1 255.255.255.0
!
interface Serial0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/1
 no ip address
 shutdown
 clock rate 2000000
!
interface Serial0/2
 no ip address
 shutdown
 clock rate 2000000
!
interface Serial0/3
 no ip address
 shutdown
 clock rate 2000000
!
interface Serial0/4
 no ip address
!
interface Serial2/3
 no ip address
 shutdown
 serial restart-delay 0
!
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
!
!
!
!
control-plane
!
!
!
!
!
!
!
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line vty 0 4
 login
!
!
end
```

We can confirm we have successfully implemented Inter VLAN communication.