Practical No. 4

Aim: Implement Inter-VLAN Routing.

Step 1: What is Inter-VLAN Routing.

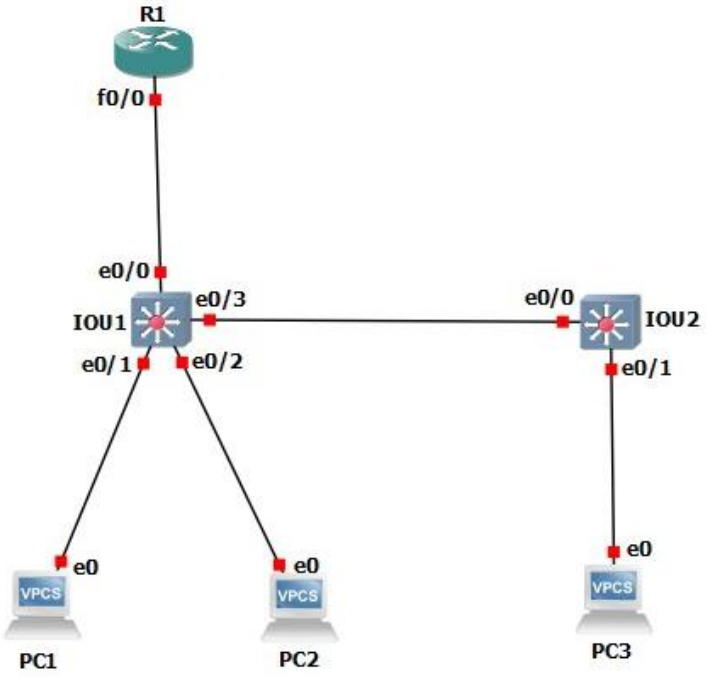
- Inter-VLAN routing is a method of forwarding traffic between various VLANs in a network by deploying a router.
- When a router is present, VLAN logically divides the switch into distinct subnets.
- When connected to the switch, an administrator can configure the router to forward the traffic between the switch's multiple VLANs.
- The user nodes in the VLANs forward traffic to the router, which then forwards the traffic to the target network regardless of the VLAN configuration on the switch.

Step 2: Get The Layer 2 Switch and install it.

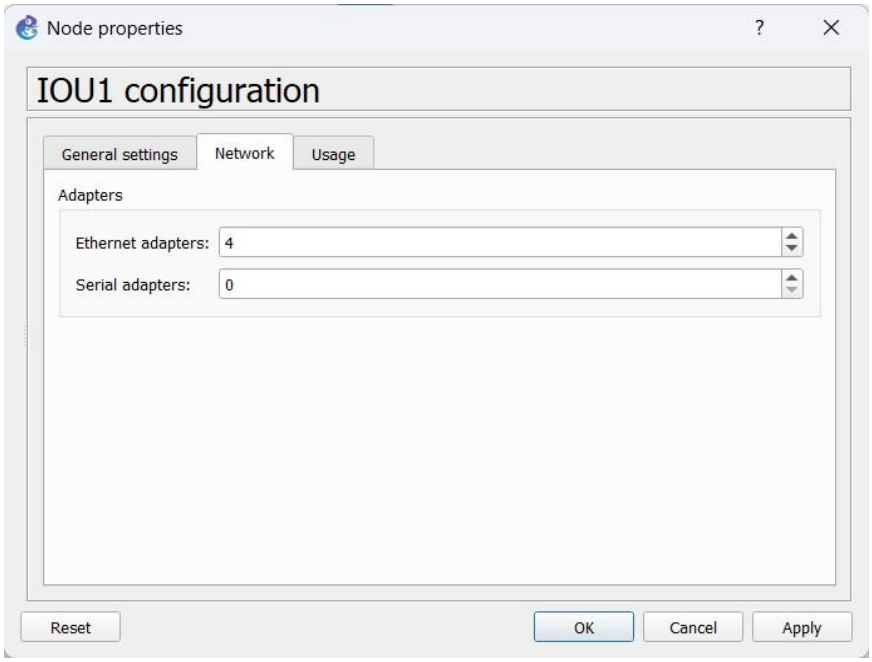
- **The Layer 2 Switch may be downloaded from this page:** **https://www.sysnettechsolutions.com/en/download-vios-l2-image-for-gns3/**
- **Follow the instructions here to install it on GNS3:** https://www.sysnettechsolutions.com/en/add**-layer-2-switch-in-gns3/**

Step 3: Design the network Topology and set its configuration.

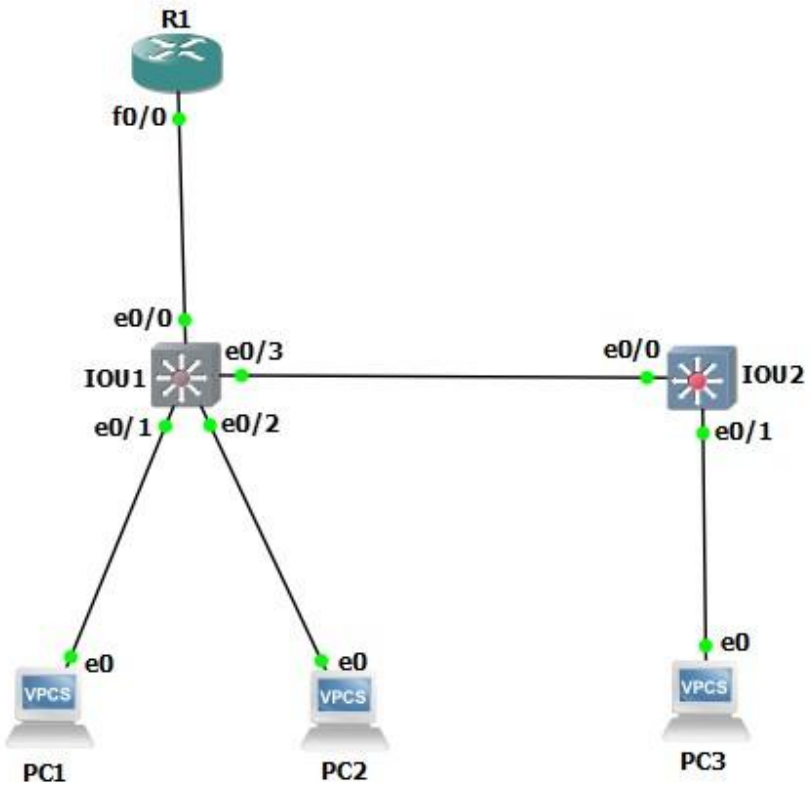
- Create the fundamental network design.



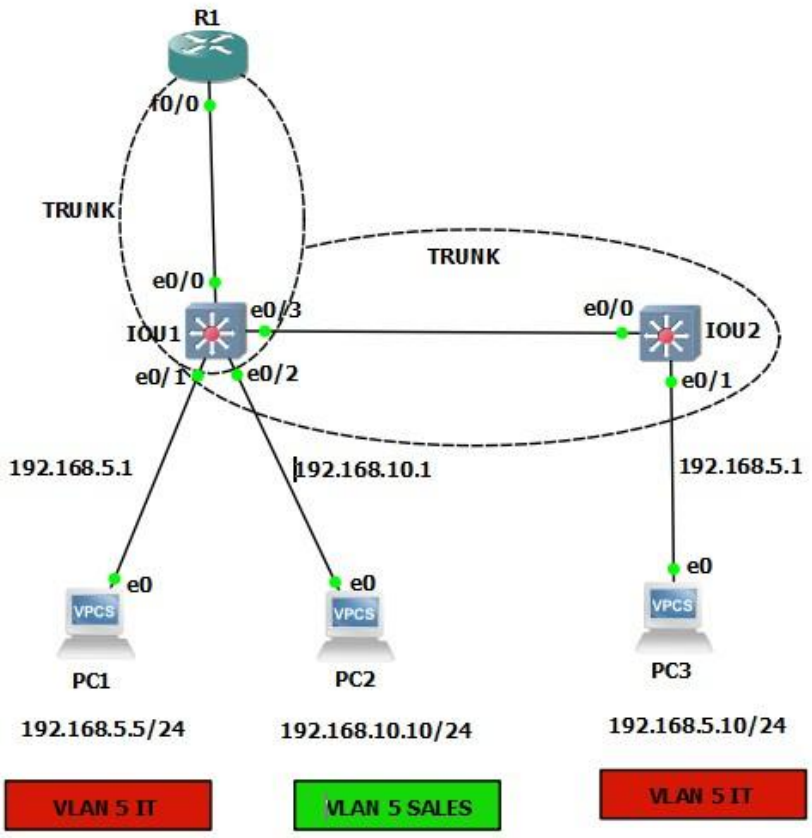
- After that, setup the Layer2Switch-1. Open the setup menu. After that, go to the network tab and change the number of adapters to four.



- Turning the network on.



Topology:



Step 4: Build and configure the network.

- Configuration:

Configure PC1:

```
PC1> ip 192.168.5.5/24 192.168.5.1
Checking for duplicate address...
PC1 : 192.168.5.5 255.255.255.0 gateway 192.168.5.1

PC1> sh ip

NAME        : PC1[1]
IP/MASK     : 192.168.5.5/24
GATEWAY     : 192.168.5.1
DNS         :
MAC         : 00:50:79:66:68:00
LPORT       : 20009
RHOST:PORT  : 127.0.0.1:20010
MTU:        : 1500

PC1>
```

Configure PC2:

```
PC2> ip 192.168.10.10/24 192.168.10.1
Checking for duplicate address...
sh ip
PC1 : 192.168.10.10 255.255.255.0 gateway 192.168.10.1

PC2> sh ip

NAME        : PC2[1]
IP/MASK     : 192.168.10.10/24
GATEWAY     : 192.168.10.1
DNS         :
MAC         : 00:50:79:66:68:01
LPORT       : 20011
RHOST:PORT  : 127.0.0.1:20012
MTU:        : 1500

PC2>
```

Configure 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       : 20013
RHOST:PORT  : 127.0.0.1:20014
MTU:        : 1500

PC3>
```

This is where we configure Layer2Switch-1:

```
L2-S1#en
L2-S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
L2-S1(config)#hostname L2-S1
L2-S1(config)#vlan 5
L2-S1(config-vlan)#name SALES
VLAN #5 and #10 have an identical name: SALES
L2-S1(config-vlan)#no name SALES
L2-S1(config-vlan)#name IT
L2-S1(config-vlan)#exit
L2-S1(config)#vlan 10
L2-S1(config-vlan)#name SALES
L2-S1(config-vlan)#exit
L2-S1(config)#end
L2-S1#
*Nov 12 07:54:31.974: %SYS-5-CONFIG_I: Configured from console by console
L2-S1#wr
Building configuration...
Compressed configuration from 1514 bytes to 874 bytes[OK]
```

This is where we configure Layer2Switch-2:

```
L2-S2#
L2-S2#en
L2-S2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
L2-S2(config)#hostname L2-S2
L2-S2(config)#vlan 5
L2-S2(config-vlan)#name IT
L2-S2(config-vlan)#exit
L2-S2(config)#end
L2-S2#
*Nov 12 07:55:51.125: %SYS-5-CONFIG_I: Configured from console by console
L2-S2#wr
Building configuration...
Compressed configuration from 1514 bytes to 871 bytes[OK]
L2-S2#
```

We must now configure the trunk and access interface for L2 Switch-1:

```
L2-S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
L2-S1(config)#interface Et 0/1
L2-S1(config-if)#switchport mode access
L2-S1(config-if)#switchport access vlan 5
L2-S1(config-if)#exit
L2-S1(config)#interface Et 0/2
L2-S1(config-if)#switchport mode access
L2-S1(config-if)#switchport access vlan 10
L2-S1(config-if)#exit
L2-S1(config)#interface Et 0/3
L2-S1(config-if)#switchport trunk encapsulation dot1q
L2-S1(config-if)#switchport mode trunk
L2-S1(config-if)#exit
L2-S1(config)#interface Et 0/0
L2-S1(config-if)#switchport trunk encapsulation dot1q
L2-S1(config-if)#
*Nov 12 07:58:56.543: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/0, changed state to dow
n
L2-S1(config-if)#switchport mode trunk
L2-S1(config-if)#
*Nov 12 07:59:03.016: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/0, changed state to up
L2-S1(config-if)#exit
L2-S1(config)#exit
L2-S1#
*Nov 12 07:59:11.149: %SYS-5-CONFIG_I: Configured from console by console
L2-S1#wr
Building configuration...
Compressed configuration from 1737 bytes to 996 bytes[OK]
L2-S1#
```

We must now configure the trunk and access interface for L2 Switch-2:

```
L2-S2#
L2-S2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
L2-S2(config)#interface Et 0/1
L2-S2(config-if)#switchport mode access
L2-S2(config-if)#switchport access vlan 5
L2-S2(config-if)#exit
L2-S2(config)#interface Et 0/0
L2-S2(config-if)#switchport trunk encapsulation dot1q
L2-S2(config-if)#switchport mode trunk
L2-S2(config-if)#end
L2-S2#wr
*Nov 12 08:00:44.695: %SYS-5-CONFIG_I: Configured from console by console
L2-S2#wr
Building configuration...
Compressed configuration from 1625 bytes to 941 bytes[OK]
L2-S2#
```

Now we will configure Router 1

R1:

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface Fa 0/0
R1(config-if)#no shut
R1(config-if)#exit
R1(config)#
*Nov 12 13:32:20.319: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
R1(config)#
*Nov 12 13:32:21.319: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to
 up
R1(config)#interface Fa 0/0.5
R1(config-subif)#encapsulation dot1q 5
R1(config-subif)#ip address 192.168.5.1 255.255.255.0
R1(config-subif)#no shut
R1(config-subif)#exit
R1(config)#interface Fa 0/0.10
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)#exit
R1(config)#end
R1#wr
*Nov 12 13:32:53.603: %SYS-5-CONFIG_I: Configured from console by console
R1#wr
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
R1#wr
Building configuration...
[OK]
R1#
*Nov 12 13:33:07.611: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on FastEthernet0/0 (not half d
uplex), with L2-S1 Ethernet0/0 (half duplex).
R1#
```

Step 5: Test the network.

- We now ping PC1 to V2 member PC2 to test the connection. Check that the routing between VLANs is operational.

```
PC1> ping 192.168.5.1
84 bytes from 192.168.5.1 icmp_seq=1 ttl=255 time=29.077 ms
84 bytes from 192.168.5.1 icmp_seq=2 ttl=255 time=11.641 ms
84 bytes from 192.168.5.1 icmp_seq=3 ttl=255 time=14.025 ms
84 bytes from 192.168.5.1 icmp_seq=4 ttl=255 time=13.502 ms
84 bytes from 192.168.5.1 icmp_seq=5 ttl=255 time=13.829 ms

PC1> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=11.266 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=15.149 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=15.839 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=14.808 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=14.881 ms

PC1> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=63 time=55.985 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=63 time=29.853 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=63 time=29.903 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=63 time=30.677 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=63 time=29.927 ms

PC1> ping 192.168.5.10
84 bytes from 192.168.5.10 icmp_seq=1 ttl=64 time=0.219 ms
84 bytes from 192.168.5.10 icmp_seq=2 ttl=64 time=0.482 ms
84 bytes from 192.168.5.10 icmp_seq=3 ttl=64 time=0.520 ms
84 bytes from 192.168.5.10 icmp_seq=4 ttl=64 time=0.394 ms
84 bytes from 192.168.5.10 icmp_seq=5 ttl=64 time=0.516 ms
```

We now can ping from PC2 to PCs on VLAN5.

```
PC2> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=14.778 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=7.091 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=8.415 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=10.239 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=8.153 ms

PC2> ping 192.168.5.5
192.168.5.5 icmp_seq=1 timeout
192.168.5.5 icmp_seq=2 timeout
84 bytes from 192.168.5.5 icmp_seq=3 ttl=63 time=22.646 ms
84 bytes from 192.168.5.5 icmp_seq=4 ttl=63 time=23.558 ms
84 bytes from 192.168.5.5 icmp_seq=5 ttl=63 time=20.736 ms

PC2> ping 192.168.5.5
84 bytes from 192.168.5.5 icmp_seq=1 ttl=63 time=18.321 ms
84 bytes from 192.168.5.5 icmp_seq=2 ttl=63 time=21.566 ms
84 bytes from 192.168.5.5 icmp_seq=3 ttl=63 time=22.646 ms
84 bytes from 192.168.5.5 icmp_seq=4 ttl=63 time=23.822 ms
84 bytes from 192.168.5.5 icmp_seq=5 ttl=63 time=20.930 ms

PC2> ping 192.168.5.10
84 bytes from 192.168.5.10 icmp_seq=1 ttl=63 time=46.043 ms
84 bytes from 192.168.5.10 icmp_seq=2 ttl=63 time=24.433 ms
84 bytes from 192.168.5.10 icmp_seq=3 ttl=63 time=22.992 ms
84 bytes from 192.168.5.10 icmp_seq=4 ttl=63 time=24.251 ms
84 bytes from 192.168.5.10 icmp_seq=5 ttl=63 time=23.899 ms
```

Similarly, we ping from PC3 to the other PCs in VLAN10.

```
PC3> ping 192.168.5.1
84 bytes from 192.168.5.1 icmp_seq=1 ttl=255 time=11.842 ms
84 bytes from 192.168.5.1 icmp_seq=2 ttl=255 time=9.586 ms
84 bytes from 192.168.5.1 icmp_seq=3 ttl=255 time=9.052 ms
84 bytes from 192.168.5.1 icmp_seq=4 ttl=255 time=10.449 ms
84 bytes from 192.168.5.1 icmp_seq=5 ttl=255 time=6.626 ms

PC3> ping 192.168.10.1
84 bytes from 192.168.10.1 icmp_seq=1 ttl=255 time=5.760 ms
84 bytes from 192.168.10.1 icmp_seq=2 ttl=255 time=8.940 ms
84 bytes from 192.168.10.1 icmp_seq=3 ttl=255 time=10.030 ms
84 bytes from 192.168.10.1 icmp_seq=4 ttl=255 time=7.979 ms
84 bytes from 192.168.10.1 icmp_seq=5 ttl=255 time=10.321 ms

PC3> ping 192.168.5.5
84 bytes from 192.168.5.5 icmp_seq=1 ttl=64 time=0.207 ms
84 bytes from 192.168.5.5 icmp_seq=2 ttl=64 time=0.298 ms
84 bytes from 192.168.5.5 icmp_seq=3 ttl=64 time=0.451 ms
84 bytes from 192.168.5.5 icmp_seq=4 ttl=64 time=0.317 ms
84 bytes from 192.168.5.5 icmp_seq=5 ttl=64 time=0.403 ms

PC3> ping 192.168.10.10
84 bytes from 192.168.10.10 icmp_seq=1 ttl=63 time=28.437 ms
84 bytes from 192.168.10.10 icmp_seq=2 ttl=63 time=25.500 ms
84 bytes from 192.168.10.10 icmp_seq=3 ttl=63 time=21.481 ms
84 bytes from 192.168.10.10 icmp_seq=4 ttl=63 time=22.802 ms
84 bytes from 192.168.10.10 icmp_seq=5 ttl=63 time=25.606 ms
```

We'll now check if PC1 has been correctly configured.

```
PC1> sh ip

NAME        : PC1[1]
IP/MASK     : 192.168.5.5/24
GATEWAY     : 192.168.5.1
DNS         :
MAC         : 00:50:79:66:68:00
LPORT       : 20009
RHOST:PORT  : 127.0.0.1:20010
MTU:        : 1500
```

We'll now check if PC2 has been correctly configured.

```
PC2> sh ip

NAME        : PC2[1]
IP/MASK     : 192.168.10.10/24
GATEWAY     : 192.168.10.1
DNS         :
MAC         : 00:50:79:66:68:01
LPORT       : 20011
RHOST:PORT  : 127.0.0.1:20012
MTU:        : 1500
```

We'll now check if PC3 has been correctly configured.

```
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       : 20013
RHOST:PORT  : 127.0.0.1:20014
MTU:        : 1500
```

Now we check the brief of VLAN on Layer2Switch-1.

```
L2-S1#sh vlan bri

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Et1/0, Et1/1, Et1/2, Et1/3
                                                Et2/0, Et2/1, Et2/2, Et2/3
                                                Et3/0, Et3/1, Et3/2, Et3/3
5    IT                               active    Et0/1
10   SALES                            active    Et0/2
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
L2-S1#
```

Now we check the brief of VLAN on Layer2Switch-2.

```
L2-S2#sh vlan bri

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Et0/2, Et0/3, Et1/0, Et1/1
                                                Et1/2, Et1/3, Et2/0, Et2/1
                                                Et2/2, Et2/3, Et3/0, Et3/1
                                                Et3/2, Et3/3
5    IT                               active    Et0/1
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
L2-S2#
```

Now we check the running configuration of the Layer 2 Switch – 1.

```
L2-S1#sh running-config
Building configuration...

Current configuration : 1737 bytes
!
! Last configuration change at 07:59:11 UTC Tue Nov 12 2024
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
service compress-config
!
hostname L2-S1
!
boot-start-marker
boot-end-marker
!
!
logging discriminator EXCESS severity drops 6 msg-body drops EXCESSCOLL
logging buffered 50000
logging console discriminator EXCESS
!
no aaa new-model
no ip icmp rate-limit unreachable
!
ip cef
!
!
no ip domain-lookup
no ipv6 cef
ipv6 multicast rpf use-bgp
 --More--
*Nov 12 08:24:19.347: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethernet0/0 (not full duple
x), with R1 FastEthernet0/0 (full duplex).
spanning-tree mode pvst
spanning-tree extend system-id
!
!
!
!
!
!
vlan internal allocation policy ascending
!
 --More--
```

Now we check the running configuration of the Layer 2 Switch – 2.

```
L2-S2#sh running-config
Building configuration...

Current configuration : 1625 bytes
!
! Last configuration change at 08:00:44 UTC Tue Nov 12 2024
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
service compress-config
!
hostname L2-S2
!
boot-start-marker
boot-end-marker
!
!
logging discriminator EXCESS severity drops 6 msg-body drops EXCESSCOLL
logging buffered 50000
logging console discriminator EXCESS
!
no aaa new-model
no ip icmp rate-limit unreachable
!
ip cef
!
!
no ip domain-lookup
no ipv6 cef
ipv6 multicast rpf use-bgp
spanning-tree mode pvst
spanning-tree extend system-id
!
!
!
!
!
!
vlan internal allocation policy ascending
!
ip tcp synwait-time 5
!
!
 --More--
```

Now we see the interfaces that have been set to the trunk mode in Layer2Switch-1.

```
L2-S1#sh int trunk

Port        Mode             Encapsulation  Status        Native vlan
Et0/0       on               802.1q         trunking      1
Et0/3       on               802.1q         trunking      1

Port        Vlans allowed on trunk
Et0/0       1-4094
Et0/3       1-4094

Port        Vlans allowed and active in management domain
Et0/0       1,5,10
Et0/3       1,5,10

Port        Vlans in spanning tree forwarding state and not pruned
Et0/0       1,5,10
Et0/3       1,5,10
L2-S1#
*Nov 12 08:26:05.817: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on Ethernet0/0 (not full duple
x), with R1 FastEthernet0/0 (full duplex).
L2-S1#
```

Now we see the interfaces that have been set to the trunk mode in Layer 2 Switch – 2a.

```
L2-S2#sh int trunk

Port        Mode             Encapsulation  Status        Native vlan
Et0/0       on               802.1q         trunking      1

Port        Vlans allowed on trunk
Et0/0       1-4094

Port        Vlans allowed and active in management domain
Et0/0       1,5

Port        Vlans in spanning tree forwarding state and not pruned
Et0/0       1,5
L2-S2#
```

Now we see the overall running configuration of Router 1 (R1).

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

Current configuration : 1514 bytes
!
! Last configuration change at 13:32:53 UTC Tue Nov 12 2024
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
!
no aaa new-model
no ip icmp rate-limit unreachable
ip cef
!
!
!
!
!
!
no ip domain lookup
no ipv6 cef
!
!
multilink bundle-name authenticated
!
!
!
!
!
!
!
!
!
ip tcp synwait-time 5
!
!
!
 --More--
```

```
 --More--
*Nov 12 13:58:06.739: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on FastEthernet0/0
uplex), with L2-S1 Ethernet0/0 (half duplex).
!
!
!
!
!
!
!
!
!
interface FastEthernet0/0
 no ip address
 duplex full
!
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 Serial1/0
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial1/1
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial1/2
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial1/3
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial2/0
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial2/1
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial2/2
 no ip address
 shutdown
 serial restart-delay 0
!
interface Serial2/3
 no ip address
 shutdown
 serial restart-delay 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
!
!
!
control-plane
!
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
 stopbits 1
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
 stopbits 1
line vty 0 4
 login
!
!
end
```