Lab 7: VIRTUAL LOCAL AREA NETWORK (VLAN)

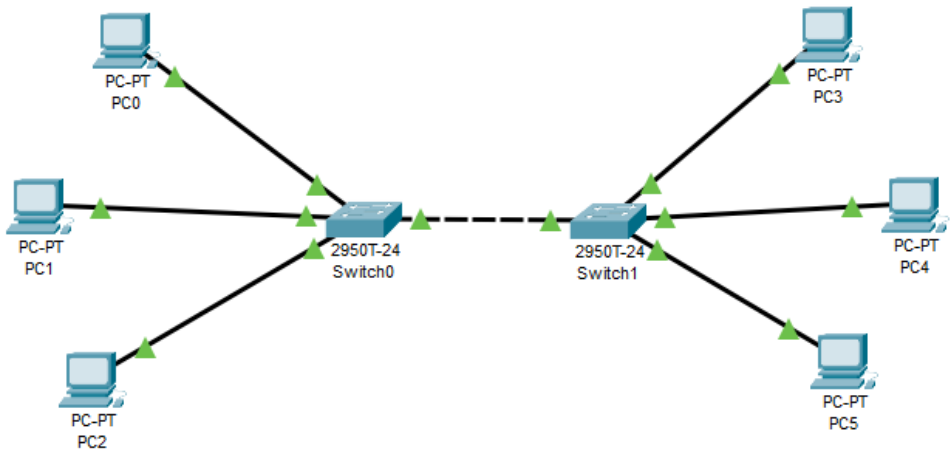
Experiment 1: VLAN Configuration

VLAN Configurations are very common in a companies' switched network. Different teams, different departments are divided with different VLANs to create small sub networks. So, this configuration is very critical for a network engineer. In this exercise, we will learn how to configure VLANs on Cisco switches. For this lesson, we will use the VLAN topology below. In this topology, 2 Cisco Catalyst 2950-24 switches and 6 PCs are used.

1.1 PC Configurations

For our VLAN configuration here, we will set our PC IP addresses as below. These ip addresses will be required at the end of this configuration example to test our configuration.

PC 1 –> 192.168.1.2 VLAN 2
PC 2 –> 192.168.1.3 VLAN 2
PC 3 –> 192.168.1.4 VLAN 3
PC 4 –> 192.168.1.6 VLAN 3
PC 5 –> 192.168.1.7 VLAN 3
PC 6 –> 192.168.1.8 VLAN 2



Start by identifying the default VLAN.

```
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, Fa0/24
                                                 Gig0/1, Gig0/2
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

1.2 VLAN Configuration on Switch0

After PC IP configurations, now, we can start our VLAN Packet Tracer Configuration steps. Here, we will follow the below steps:

- We will set access ports that will access specific VLANs. We will do this with "**switchport mode access**" command under these interfaces.
- We will also set the VLAN, that this port will access.
- After that, we will set the trunk port that will carry multiple VLANs with "**switchport mode trunk**" command.
- Then we will also set this port with "**no negotiate**" command to prevent negotiation about the port role.
- Lastly, we will set the allowed VLANs with "**switchport trunk allowed vlan**" command on this trunk and save our configuration.

```
Switch 1(config)# interface fastEthernet 0/2
Switch 1(config-if)# switchport mode access
Switch 1(config-if)# switchport access vlan 2

Switch 1(config)# interface fastEthernet 0/3
Switch 1(config-if)# switchport mode access
Switch 1(config-if)# switchport access vlan 2

Switch 1(config)# interface fastEthernet 0/4
Switch 1(config-if)# switchport mode access
Switch 1(config-if)# switchport access vlan 3

Switch 1(config)# interface fastEthernet 0/1
Switch 1(config-if)# switchport mode trunk
Switch 1(config-if)# switchport nonegotiate

Switch 1(config-if)# switchport trunk allowed vlan 2-4

Switch 1# copy running-config startup-config
```

1.3 Checking VLAN Configuration

Our last step of VLAN is configuration verification. To verify our VLAN Packet Tracer Configuration, we will use verification commands like "**show vlan brief**", "**show interfaces**", "**show interfaces trunk**" etc.

```
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, Fa0/24

2 VLAN0002 active Fa0/2, Fa0/3

3 VLAN0003 active Fa0/4

1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
```

Checking individual interface

```
Switch# show interfaces fasthernet 0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: Off Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default) 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 encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed:
ALL Protected: false
```

Repeat for each interface.

Show interface trunk

```
Switch# show interfaces trunk
Port        Mode         Encapsulation    Status        Native vlan
Fa0/1       on           802.1q           trunking      1
Port        Vlans allowed on trunk
Fa0/1       2-4
Port        Vlans allowed and active in management domain
Fa0/1       2,3
Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       2,3
```

Repeat for Switch1

1.4 Verifying VLAN Configuration

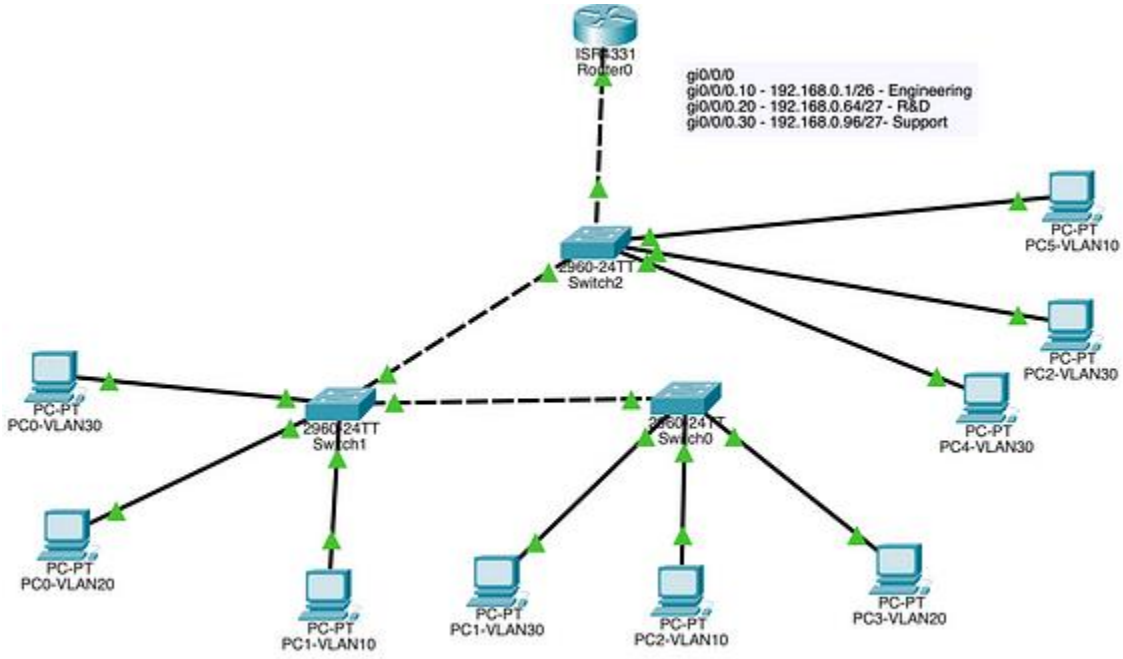
To verify the communication between same VLANs now we will use ping command to check the communication between two PCs in the same VLAN. Here, if the PCs are in the same VLAN, the ping will successfull. If they are in different VLANs, ping will not be successful. As you can see above, the PC 1 can ping the PCs in the same VLAN, even if it is connected to a different switch.

Experiment 2: VLAN and inter-VLAN Routing

A Virtual LAN (VLAN) is simply a logical LAN, just as its name suggests. VLANs have similar characteristics to those of physical LANs, only that with VLANs, you can logically group hosts even if they are physically located on separate LAN segments.

We treat each VLAN as a separate subnet or broadcast domain. For this reason, to move packets from one VLAN to another, we have to use a router or a layer 3 switch.

VLANs are configured on switches by placing some interfaces into one broadcast domain and some interfaces into another. For this tutorial, we'll configure 2 VLANs on a switch. We will then proceed and configure a router to enable communication between the two VLANs.



2.1 Creating VLANs

Create 3 VLANs on the switch: VLAN 10, VLAN 20, and VLAN 30. You can give them names Engineering, R&D, and Support respectively.

This is a sample configuration of the floor2 switch, Similarly, we will create the same VLAN in each floor switch (floor1-a,floor1-b).

Creating VLAN in floor2,floor1-a, floor1-b switches

```
Switch(config)#hostname floor2
floor2(config)#vlan
floor2(config)#vlan 10
floor2(config-vlan)#name
floor2(config-vlan)#name Engineering
floor2(config-vlan)#exit
floor2(config)#vlan
floor2(config)#vlan 20
```

```
floor2(config-vlan)#name R&D
floor2(config-vlan)#exit
floor2(config)#vlan
floor2(config)#vlan 30
floor2(config-vlan)#name
floor2(config-vlan)#name Support
floor2(config-vlan)#do show vlan br
```

```
Switch(config)#hostname floor1-a
floor1-a(config)#vlan 10
floor1-a(config-vlan)#name
floor1-a(config-vlan)#name Engineering
floor1-a(config-vlan)#exit
floor1-a(config)#vlan
floor1-a(config)#vlan 20
floor1-a(config-vlan)#name
floor1-a(config-vlan)#name R&D
floor1-a(config-vlan)#exit
floor1-a(config)#vlan
floor1-a(config)#vlan 30
floor1-a(config-vlan)#name
floor1-a(config-vlan)#name Support
```

```
Switch(config)#hostname floor1-b
floor1-b(config)#vl
floor1-b(config)#vlan 10
floor1-b(config-vlan)#name
floor1-b(config-vlan)#name Engineering
floor1-b(config-vlan)#exit
floor1-b(config)#vlan 20
floor1-b(config-vlan)#name
floor1-b(config-vlan)#name R&D
floor1-b(config-vlan)#exit
floor1-b(config)#vlan 30
floor1-b(config-vlan)#name
floor1-b(config-vlan)#name  Support
```

2.2 Ports Assignments

Assign switch ports to the VLANs. Remember each VLAN is viewed as a separate broadcast domain.

And just before you configure, keep in mind that switch ports could be either access or trunk.

- An access port is assigned to a single VLAN. These ports are configured for switch ports that connect to devices with a normal network card, for example, a PC in a network.
- A trunk port on the other hand is a port that can be connected to another switch or router. This port can carry traffic of multiple VLANs.

In our topology, we will configure switch interfaces fa0/1 to VLAN20, fa 0/2 to VLAN10, and fa0/3 to VLAN30 of floor1-a. In floor1-b switch fa0/1 to VLAN20, fa 0/2 — VLAN10 and fa 0/3 to VLAN30. Similarly, for switch floor2 fa0/1 to VLAN10, fa 0/2 to VLAN20, and fa 0/3 to VLAN30. These are all access ports.

Gi0/1, Gi 0/2 — floor1-a, Gi0/2-floor1-b, Gi0/1, Gi 0/2 — floor2 will be configured as trunk port. Switch port Gi0/2 will be configured as a trunk which will carry traffic between VLANs (10,20,30) via the router port Gi0/0/0.10, Gi0/0/0.20, Gi0/0/0.30 subinterfaces of the main interface Gi0/0/0.

Configuring access and trunk ports in floor2,floor1-a, floor1-b switches

```
floor1-a(config)#int fa 0/1
floor1-a(config-if)#description ### Connected-To-PC0-VLAN20 ###
floor1-a(config-if)#switchport mode access
floor1-a(config-if)#switchport access vlan 20

floor1-a(config)#interface fastEthernet 0/2
floor1-a(config-if)#description ### Connected-To-PC0-VLAN10 ###
floor1-a(config-if)#switchport mode access
floor1-a(config-if)#switchport access vlan 10

floor1-a(config)#interface fastEthernet 0/3
floor1-a(config-if)description ### Connected-To-PC0-VLAN20 ###
floor1-a(config-if)#switchport mode access
floor1-a(config-if)#switchport access vlan 30

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floor1-a(config)#interface gigabitEthernet 0/1
floor1-a(config-if)#description ### Connected-To-Switch-floor2-gi0/1 ###
floor1-a(config-if)#switchport mode trunk

floor1-a(config-if)#int gi 0/2
floor1-a(config-if)#description ### Connected To-Switch-floor1-b-gi0/2 ###
floor1-a(config-if)#switchport mode trunk
```

```
floor1-b(config)#interface fastEthernet 0/1
floor1-b(config-if)#description ### Connected-To-PC3-VLAN20###
floor1-b(config-if)#switchport mode access
floor1-b(config-if)#switchport access vlan 20

floor1-b(config)#interface fastEthernet 0/2
floor1-b(config-if)#description ###Connected-To-PC2-VLAN10###
floor1-b(config-if)#switchport mode access
floor1-b(config-if)#switchport access vlan 10

floor1-b(config-if)#int fa 0/3
floor1-b(config-if)#description ###Connected-To-PC3-VLAN30###
floor1-b(config-if)#switchport mode access
floor1-b(config-if)#switchport access vlan 30
```

```
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floor1-b(config)#interface GigabitEthernet0/2
floor1-b(config)#description ###Connected to floor1-a-gi0/2 ###
floor1-b(config)#switchport mode trunk
```

```
floor2(config)#interface fastEthernet 0/1
floor2(config-if)#description ###Connected-To-PC5-VLAN10###
floor2(config-if)#switchport mode access
floor2(config-if)#switchport access vlan 10

floor2(config)#interface fastEthernet 0/2
floor2(config-if)#description ###Connected-To-PC5-VLAN20###
floor2(config-if)#switchport mode access
floor2(config-if)#switchport access vlan 20

floor2(config-if)#int fa 0/3
floor2(config-if)#description ###Connected-To-PC5-VLAN30###
floor2(config-if)#switchport mode access
floor2(config-if)#switchport access vlan 30

================

floor2(config)#interface gigabitEthernet 0/1
floor2(config-if)#description ###Connected-To-Switch-floor1-a-Gi0/1###
floor2(config-if)#switchport mode trunk
floor2(config-if)#

floor2(config-if)#int gi 0/2
floor2(config-if)#description ###Connected-To-Router-R1-core-Gi0/0/0###
floor2(config-if)#switchport mode trunk
```

Show command for verification of VLAN database

```
floor2#show vlan brief
```

Show command trunk port configuration

```
floor2#show interfaces trunk
```

2.3 Router configuration (Router on stick)

Now we will configure the router so that it will enable communication between the two VLANs via a single physical interface. How is this made possible? We'll divide the single physical interface on the router into logical interfaces (sub-interfaces). Each sub-interface will then serve as a default gateway for each of the VLANs. This scenario is called a router on a stick (R.O.A.S) and will allow the VLANs to communicate through a single physical interface.

Worth noting: We can't assign an IP address to the router's physical interface that we have subdivided into logical sub-interfaces. We'll instead assign IP addresses to the sub-interfaces.

Configuring router interface

```
core-R1(config)#interface gigabitEthernet 0/0/0
core-R1(config-if)#description ###Connected-To-floor2-Gi0/2###
```

Configuring sub-interface in the router

```
core-R1(config)#interface gigabitEthernet 0/0/0.10
core-R1(config-subif)#encapsulation dot1Q 10
core-R1(config-subif)#ip address 192.168.0.1 255.255.255.192

core-R1(config-subif)#int gi 0/0/0.20
core-R1(config-subif)#encapsulation dot1Q 20
core-R1(config-subif)#ip address 192.168.0.65 255.255.255.224

core-R1(config-subif)#int gi 0/0/0.30
core-R1(config-subif)#encapsulation dot1Q 30
core-R1(config-subif)#ip address 192.168.0.97 255.255.255.224
```

Show command for verification of sub-interfaces

```
core-R1#show ip interface brief
Interface                  IP-Address      OK?  Method  Status                Protocol
GigabitEthernet0/0/0       unassigned      YES  unset   up                    up
GigabitEthernet0/0/0.10    192.168.0.1     YES  manual  up                    up
GigabitEthernet0/0/0.20    192.168.0.65    YES  manual  up                    up
GigabitEthernet0/0/0.30    192.168.0.97    YES  manual  up                    up
GigabitEthernet0/0/1       unassigned      YES  unset   administratively down down
GigabitEthernet0/0/2       unassigned      YES  unset   administratively down down
Vlan1                      unassigned      YES  unset   administratively down down
core-R1#
```

```
core-R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     192.168.0.0/24 is variably subnetted, 6 subnets, 3 masks
C       192.168.0.0/26 is directly connected, GigabitEthernet0/0/0.10
```

```
L       192.168.0.1/32 is directly connected, GigabitEthernet0/0/0.10
C       192.168.0.64/27 is directly connected, GigabitEthernet0/0/0.20
L       192.168.0.65/32 is directly connected, GigabitEthernet0/0/0.20
C       192.168.0.96/27 is directly connected, GigabitEthernet0/0/0.30
L       192.168.0.97/32 is directly connected, GigabitEthernet0/0/0.30

core-R1#
```

2.4 Test inter-VLAN Connectivity

VLAN10–192.168.0.0/26 — Gateway-92.168.0.1 — PC-92.168.0.2, PC-92.168.0.3,PC-92.168.0.4

VLAN20–192.168.0.64/27-Gateway-192.168.0.65, PC-92.168.0.66, PC-92.168.0.67,PC-92.168.0.68

VLAN30–192.168.0.96/27-Gateway-192.168.0.97,PC-92.168.0.98, PC-92.168.0.99,PC-92.168.0.100

```
C:\>ipconfig /all

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Physical Address.....: 0001.C707.D42A
   Link-local IPv6 Address.....: FE80::201:C7FF:FE07:D42A
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.0.98
   Subnet Mask.....: 255.255.255.224
   Default Gateway.....: ::
                              192.168.0.97
   DHCP Servers.....: 0.0.0.0
   DHCPv6 IAID.....:
   DHCPv6 Client DUID.....: 00-01-00-01-77-4B-E6-D5-00-01-C7-07-D4-2A
   DNS Servers.....: ::
                              0.0.0.0

======================
Testing for VLAN 10 Reachability from vlan 30
======================

C:\>ping 192.168.0.2

Pinging 192.168.0.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.0.2: bytes=32 time=1ms TTL=127
Reply from 192.168.0.2: bytes=32 time<1ms TTL=127
Reply from 192.168.0.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
```

```
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

======================
Testing for VLAN 20 Reachability from vlan 30
======================

C:\>ping 192.168.0.66

Pinging 192.168.0.66 with 32 bytes of data:

Reply from 192.168.0.66: bytes=32 time<1ms TTL=127
Reply from 192.168.0.66: bytes=32 time<1ms TTL=127
Reply from 192.168.0.66: bytes=32 time<1ms TTL=127
Reply from 192.168.0.66: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Here we'll test connectivity between computers in different VLANs. Don't forget that the router that enables inter-VLAN routing.

You should have successfully pinged the PC in VLAN20 and VLAN 10 from VLAN 30. If everything is well configured, then we will see a ping reply.

Reflection questions

1. What is the primary purpose of using VLANs in a network?

2. When do you need to configure a **trunk** mode?

3. What is the major advantage of the "**Router on a Stick**"?

Note: You do not need to submit this.

End of lab.