LAB No: 8
VLAN Configuration and InterVLAN Routing

Objectives:

- To be familiar with VLAN and its uses
- To create VLANs and extend it using multiple switches
- To route packets between computers at different VLANs (InterVLAN Routing)

Environmental Setup:

- Network simulation tool: Packet Tracer

Theory:

VLAN (Virtual Local Area Network)

- When computers are plugged into a switch and give them all IP addresses in the same network, a LAN (Local Area Network) is created
- A VLAN (Virtual Local Area Network) is a logical collection of devices that are grouped together to create separate networks, using layer 2 devices, such as an Ethernet switch
- With VLANs, we connect all the PCs to a single switch but we can make the switch behave as if having multiple independent switches
- Each VLAN is its own broadcast domain and IP subnet
- VLANs can be local within a single layer 2 device or be trunked over multiple layer 2 devices
- Router is used to route the packets between multiple VLANs
- Because VLANs are based on logical instead of physical connections, they are extremely flexible

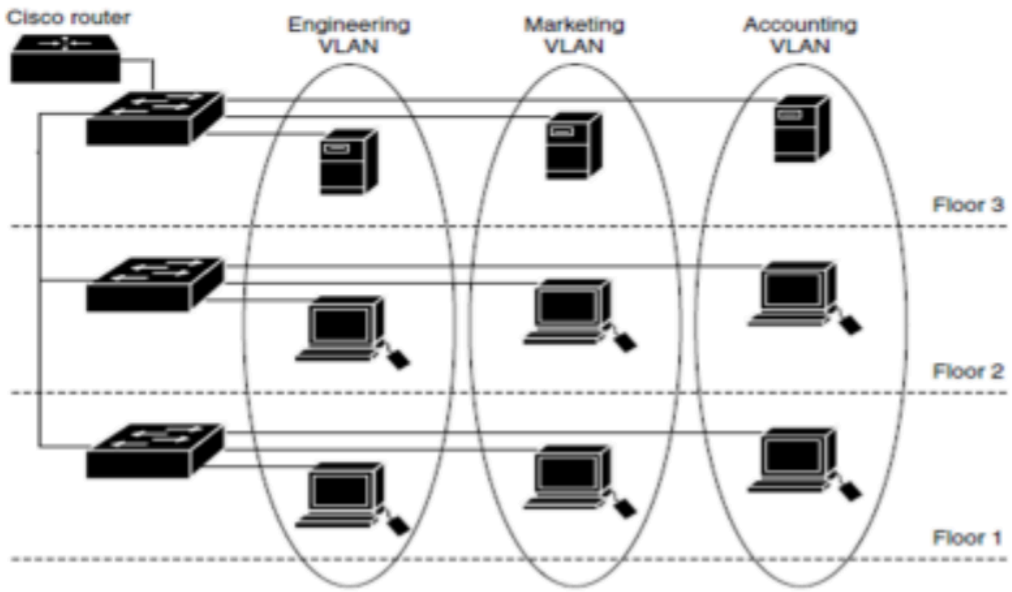

Figure: Different VLANs interconnected by a Router

[Activity A]

1. Connected each of the PCs with given interfaces of corresponding switches and each of the switches with another switch with interfaces as specified in the given figure.
   Used the subnet mask of **255.255.255.0** for each of the PCs.
   A Specified model of Switch was selected to avoid any problem while creating the given topology.

2. The connectivity between each computer was tested using the ping command and all the computers were connected properly.

3. Created the VLAN 2 and VLAN 10 in all switches i.e. Switch0, Switch1 and Switch 2.

4. Assigned interfaces FastEthernet 0/8, 0/9, 0/10, 0/11, 0/12 of all three switches to VLAN 2. And interfaces FastEthernet 0/16, 0/17, 0/18, 0/19, 0/20, 0/21, 0/22 of all three switches to VLAN 10.

5. The ping from PC0 to PC3 & PC6 was successful. The ping from PC1 to PC4 & PC7 had a **request time out**, similar case for PC0, PC1 & PC2 to all other PCs.

6. Connected interface FastEthernet 0/12 of Switch0 with FastEthernet 0/12 of Switch1 and connected interface FastEthernet 0/11 of Switch1 with FastEthernet 0/11 of Switch2. Connectivity from {PC0 & PC3 & PC6} {PC1 & PC4 & PC7] was successful

but PC0 & PC2 had a request time out. The ping was successful from PC1 to PC4 and PC7.

7. Now, again connected the interface FastEthernet 0/20 of Switch0 with FastEthernet 0/20 of Switch1. No connectivity from PC0, PC1 & PC2. Now the ping from PC2 to PC5 was successful after a connection in vlan 10 of switch 0 and switch 1.

8. Now, removed the additional links between switches that was added in **step 6** & **step 7**, and:
    - Configured interfaces GigabitEthernet0/1 and GigabitEthernet0/2 of all three switches as a Trunk port
    - The ping from PC0 to PC3 & PC6 was successful
    - The ping from PC1 to PC4 & PC7 was successful
    - The ping from PC2 to PC5 was successful because a trunk port is a member of all VLANs by default.
    - A single trunk port connection worked successfully while we had to allocate the port members to each vlans previously through the access port.

[Activity B]

From the above activity A, changed the subnet mask to **255.255.255.192** for all PCs, and:

1. The connectivity stayed the same as before after the subnet mask was updated.

2. Now the computers are on different networks, so routing is essential to forward packets from one network to another network. For this default gateway of PC0, PC3 & PC6 was set as 200.1.1.1. Similarly the default gateway of PC1, PC4 & PC7 as 200.1.1.65. Also the default gateway of PC2 & PC5 as 200.1.1.129.

3. Connected interface FastEthernet0/2 of Switch0 to GigabitEthernet0/0 of Router0 with IP Address of 200.1.1.1/26, similarly connected interface FastEthernet0/9 of Switch1 to GigabitEthernet0/1 of Router0 with IP Address of 200.1.1.65/26. And connected interface FastEthernet 0/20 of Router0 with IP Address of 200.1.1.129/26.

4. Now each and every computers despite the differences in their vlans were able to communicate with each other because of the addition of the router.

[Activity C]

There are still more than one connection from switch to router. There is only one connection between switches using the trunk port to forward frames between computers of the same VLAN connected via different switches. Similarly we can use a single connection between switch and router to route packets between multiple VLANS.

Removed all the links between Switch1 and Router0. Also removed the IP address & subnet mask of all interfaces of router and performed the followings:

1. Configured interface GigabitEthernet 0/1 of Switch0 as Trunk port and established connection to the GigabitEthernet0/0 interface of Router0

2. Then configured subinterfaces in Router 0 as GigabitEthernet0/0.1 with IP address of 200.1.1.1/26. Similarly configured another sub-interface as GigabitEthernet0/0.2 on the same physical interface for another VLAN with IP address of 200.1.1.65/26. Again configured another sub-interface as GigabitEthernet0/0.3 on the same physical interface for another VLAN with IP address of 200.1.1.129/26. And finally activated this physical interface by using no shutdown command.

3. The ping command displayed connectivity in all the combinations of the PCs.

4. This configuration didn't have multiple port uses, instead trunked single port to address all the vlans.

5. Removed the VLAN 1 from both trunk ports of Switch 1 and [no connection to PC0, PC3 and PC6] the PCs in Vlan 1 were disconnected from the network and similar case when removing other VLANs.

Exercise:

I. What is VLAN? Explain its importance with basic configuration steps.

VLAN (Virtual Local Area Network):

A VLAN is a method of segmenting a physical network into multiple logical networks. This segmentation enhances network security, performance, and management.

Importance:

Segmentation: Divides a large network into smaller, manageable segments, improving security and reducing broadcast traffic.

Flexibility: Allows logical grouping of devices regardless of their physical location.

Efficiency: Minimizes unnecessary traffic and potential congestion.

Basic Configuration Steps:

Access the Switch: Connect to the switch through a console, SSH, or web interface.

Create VLAN:

switch(config)# vlan 10

switch(config-vlan)# name Sales

Assign Ports to VLAN:

switch(config)# interface fastethernet 0/1

switch(config-if)# switchport mode access

switch(config-if)# switchport access vlan 10

Save Configuration:

switch(config)# end

switch# write memory

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

Packets Forwarding Within Same VLAN Across Different Switches:

Packets can be forwarded between computers in the same VLAN, even if they are connected to different switches, using a trunk link. A trunk link carries traffic for multiple VLANs between switches.

Steps:

Configure Trunk Port on Switch 1:

switch1(config)# interface gigabitethernet 0/1

switch1(config-if)# switchport mode trunk

switch1(config-if)# switchport trunk allowed vlan 10

Configure Trunk Port on Switch 2:

switch2(config)# interface gigabitethernet 0/1

switch2(config-if)# switchport mode trunk

switch2(config-if)# switchport trunk allowed vlan 10

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

To route packets between different VLANs, a Layer 3 device such as a router or a Layer 3 switch is required. This process is known as Inter-VLAN Routing.

Steps:

Create VLAN Interfaces on the Router/Switch:

router(config)# interface vlan 1

router(config-if)# ip address 200.1.1.1 255.255.255.192

router(config-if)# no shutdown

router(config)# interface vlan 2

router(config-if)# ip address 200.1.1.65 255.255.255.192

router(config-if)# no shutdown

Ensure VLANs are Configured on Switches:

Configure VLANs 1 and 2 on the switches as previously described.

Configure Trunking Between Switch and Router:

switch(config)# interface gigabitethernet 0/1

switch(config-if)# switchport mode trunk

This setup enables the router to route packets between VLAN 1 and VLAN 2, allowing communication between devices in different VLANs.

Conclusion:

This Lab Exercise was really helpful for understanding the operation of VLAN with multiple users and configuring it with the routers. VLANs seems to be an amazing concept as it helped separate the computers with in a LAN creating Logical sub LANs within it.