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# A COMPREHENSIVE ANALYSIS OF VIRTUAL LOCAL AREA NETWORK (VLAN) AND INTER-VLAN ROUTING STRATEGIES

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**ABSTRACT**

*VLANs divide broadcast domains in a LAN environment. Whenever hosts in one VLAN need to communicate with hosts in another VLAN, the traffic must be routed between them. This is known as inter-VLAN routing. On Catalyst switches it is accomplished by the creation of Layer 3 interfaces (switch virtual interfaces (SVIs). In this paper, we have taken a configuration with 4 L2 switches and 2 L3 switches along with a router to explain the concept of Virtual Local Area Networks and Inter VLAN routing. We have also explained the technology associated with creating VLAN and maintaining VLAN. Static routing is done to provide routing of traffic among different VLAN's.*

**KEYWORDS:** Band Width Ratio (BWR), Electronic Warfare, Impedance, Matching networks, Traveling Wave Tubes (T.W.T), Ultra Wide Band (U.W.B).

## 1. INTRODUCTION

One of the biggest problem of a switch is Switch creates a one large broadcast domain. Let's consider a typical 48 port switch, A single broadcast generated from one single user in a LAN supported by L2 switch, will be broadcasted in the whole LAN and all other users in the same LAN has to Listen to the same broadcast even though it's not addressed to them. This will consume the Bandwidth of the network and also the CPU cycle. To solve this problem, we can virtually break this one large broadcast domain into multiple domains. Which means one switch can act as multiple switches. VLAN's also allows us to provide security by denying access to members of one VLAN to another unless it was authorized. In this paper we will demonstrate how to setup virtual LAN and communicate among one another broadcast domains.

## SWITCH PORTS

A Switch has two types of ports in VLAN.

1. Access Ports
2. Trunk Ports

## ACCESS PORTS:

Ports which Connects end Users are called Access ports. Access ports belong to one single VLAN and it carries only traffic of one single VLAN. No control information (TAGS) will beadded in the packets flowing through access ports [1]. Any device connected to any switch doesn't know anything about VLANS. It only knows that it belongs to some VLAN. If a switch receives any Packet with TAGS attached, Switch will remove the TAGS before forwarding the packet to the respective device connected on the Access lines. Any physical port can either be an Access port or trunk port.

## TRUNK PORTS

Trunk ports are used to carry multiple VLAN traffic on a single Link. It's like multiplexing multiple source traffic onto a single line, and how the traffic can be distinguished at the other end. For this we use TAGS. Each VLAN [2] has its own tags which are added to the traffic when the packet leaves the switch trunk port.

## TRUNK ENCAPSULATION

Trunk Encapsulation is of two types. 1. ISL-Inter-Switch Link 2. DOT1Q Encapsulation. ISL is a proprietary of CISCO Inc. ISL works at layer 2 of OSI model and it encapsulated Layer 2 frame and performs a new CRC-Cyclic Redundancy Check [3].

## DOT 1Q ENCAPSULATION

IEEE 802.1q is a standard Ethernet protocol for encapsulating traffic belonging to multiple switch and routers defining multiple VLAN's. Figure 2 Shows the Ethernet and 802.1Q frames.

This 802.1Q encapsulation is usually applied in the Trunk port to encapsulate the traffic flowing out of it. Figure 4 shows the command lines of an L3 switch. From this we can understand that interface FastEthernet0/1 and interface FastEthernet0/2 are made as Trunk ports and Dot1Q encapsulation is enabled to tag [4] the packets running out of the interfaces. Fa0/1 and Fa0/2 are used to connect two different L2 switches which contain separate VLAN's in our configuration.

## 2. INTER VLAN ROUTING

When we learnt about VLANs, we said that each VLAN is usually on its own subnet, switches mainly operate at layer 2 of the OSI model and therefore they do not examine the logical addresses. Therefore, user nodes located on different VLANs cannot communicate by default. In many cases, we may need connectivity between users located on different VLANs. The way this can be accomplished is through 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. As we learnt previously, VLANs logically segment the switch into different subnets, when a router is connected to the switch, an administrator can configure the router to forward the traffic between the various VLANs configured on the switch. 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. In this type of inter-VLAN routing, a router is usually connected to the switch using multiple interfaces. One for each VLAN. The interfaces on the router are configured as the default gateways for the VLANs configured on the switch.

The ports that connect to the router from the switch are configured in access mode in their corresponding VLANs. When a user node sends a message to a user connected to a different VLAN, the message moves from their node to the access port that connects to the router on their VLAN. When the router receives the packet, it examines the packet's destination IP address and forwards it to the correct network using the access port for the destination VLAN. The switch now can forward the frame to the destination node since the router changed the VLAN information from the source VLAN to the destination VLAN.

In this form of inter-VLAN routing, the router has to have as many LAN interfaces as the number of VLANs configured on the switch. Therefore, if a switch has 10 VLANs, the router should have the same number of LAN interfaces. Take the scenario shown below.

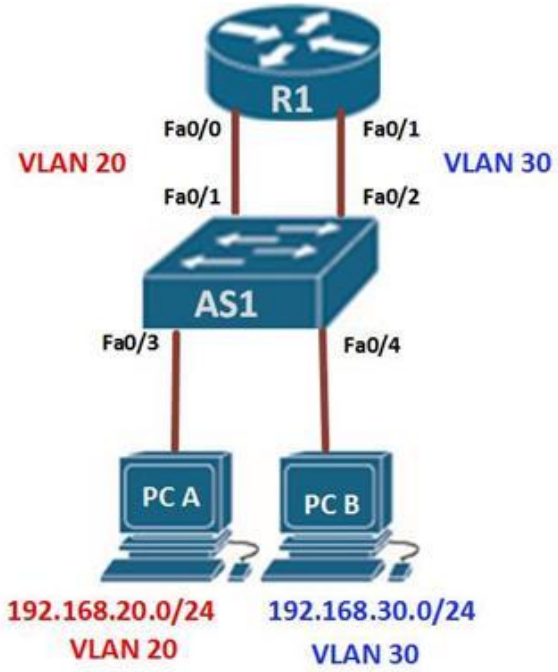


**FIGURE 1**
**SAMPLE VLAN SCENARIO**

PC A would check whether the destination IPv4 address is in its VLAN if it is not, it would need to forward the traffic to its default gateway which is the ip address on Fa0/0 on R1.

PC A then sends an ARP request to AS1 so as to determine the physical address of Fa0/0 on R1. Once the router replies, PC A can send the frame to the router as a unicast message, since AS1 has Fa0/0's MAC address, it can forward the frame directly to R1.When the router receives the frame, it compares the destination IP address by referring to its routing table so as to know to which interface it should send the data towards the destination node.The router then sends an ARP request out the interface connected to the destination VLAN in this case out Fa0/1, when the switch receives the message, it would flood it to its ports and in this case, PC B would reply with its MAC address.R1 would then use this information to frame the packet and finally send it to PC B as a unicast frame.

```
AS1(config)#interface fastEthernet 0/1
AS1(config-if)#switchport mode access
AS1(config-if)#switchport access vlan 20
AS1(config-if)#exit
AS1(config)#interface fastEthernet 0/2
AS1(config-if)#switchport mode access
AS1(config-if)#switchport access vlan 30
AS1(config-if)#exit
```

## 3. CONFIGURATION

Figure 3 shows our configuration which we use to explain the concept of VLAN, and to demonstrate Inter VLAN routing.In Our configuration, we used 4 L2 switches and 2 VLAN's are created on each L2 switches. Sub netting is done on a given Network ID 10.0.0.0/24. Each VLAN contains 30 users. On a total 8 VLAN's are taken for our configuration. Figure shows the VLAN created on a switch and the interfaces assigned to them.

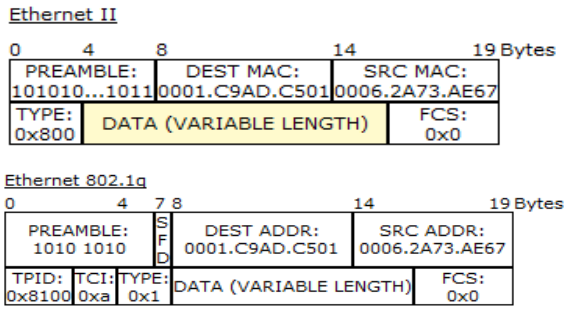


**FIGURE 2**
**FRAME FORMAT**

Static routing is performed between the routers. One router is used to simulate ISP router. Routers are used to provide routing among different VLAN's. Figure 3 shows the routing tables of our L3 switch.

```
VLAN Name                              Status    Ports
---- --------------------------------- --------
-------------------------------
1    default                           active    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
10   VLAN0010                          active    Fa0/1, Fa0/2
20   VLAN0020                          active    Fa0/3, Fa0/4
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
sw1#
```

**FIGURE 3**
**ROUTING TABLES OF OUR L3 SWITCH**

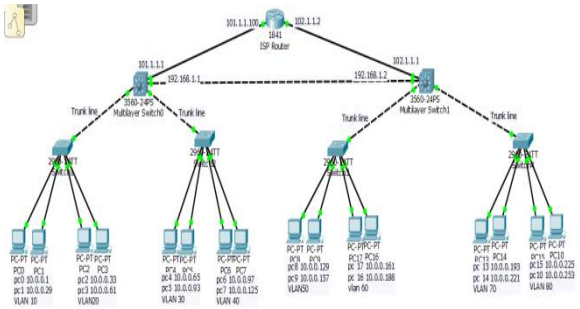

**FIGURE 4**
**PROPOSED VLAN ROUTING**

Default routing is done to route the unknown destination traffic to ISP router. ISP routers usually are high capacity nexus series routers which has info about a large number of networks which the local router doesn't know.

## 4. CONCLUSION

Whenever hosts in one VLAN need to communicate with hosts in another VLAN, the traffic must be routed between them. This is known as inter-VLAN routing. On Catalyst switches it is accomplished by the creation of Layer 3 interfaces (switch virtual interfaces (SVIs). In this paper, we have taken a configuration with 4 L2 switches and 2 L3 switches along with a router to explain the concept of Virtual Local Area Networks and Inter VLAN routing. We have also explained the technology associated with creating VLAN and maintaining VLAN. Static routing is done to provide routing of traffic among different VLAN's.

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