Virtual LAN

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Objectives

- VLAN concepts
- VLAN configuration
- Troubleshooting VLANs
VLAN concepts
Introduction to VLANs

- A group of ports or users in same broadcast domain
- Can be based on port ID, MAC address, protocol, or application
- LAN switches and network management software provide a mechanism to create VLANs
- Frame tagged with VLAN ID
VLANs logically segment switched networks based on an organization's functions, project teams, or applications as opposed to a physical or geographical basis.
Broadcast Domains

- In this scenario 3 switches & 1 router could be used. No VLANs are used.
- Switch for Engineering.
- Switch for Sales.
- Switch for Marketing.
- Each switch treats all ports as members of one broadcast domain.
- Router is used to route packets among the three broadcast domains.
Example with 3 Broadcast Domains, 3 VLANs
Static VLANs

- Assign ports (port-centric)
- Static VLANs are secure, easy to configure and monitor
Dynamic VLANs

- VLANs assigned using centralized VLAN management application
- VLANs based on MAC address, logical address, or protocol type
- Less administration in wiring closet
- Notification when unrecognized user is added to network
Port-Centric VLANs

Routing function interconnects VLANs

192.168.1.0  192.168.2.0  192.168.3.0

Network layer

Data link layer
broadcast domains

Physical layer
switch ports

Attached nodes

Floor 1

Floor 2

Floor 3
## VLAN Configuration

<table>
<thead>
<tr>
<th>Configuring VLANs</th>
<th>Description</th>
</tr>
</thead>
</table>
| Statically        | Network administrators configure port-by-port.  
                    | Each Port is associated with a specific VLAN.  
                    | The network administrator is responsible for keying in the mappings between the ports and VLANs. |
| Dynamically       | The ports are able to dynamically work out their VLAN configuration.  
                    | Uses a software database of MAC address to VLAN mappings (which the network administrator must set up first). |
Benefits of VLANs

- Easily move workstations on the LAN
- Easily add workstations to the LAN
- Easily change the LAN configuration
- Easily control network traffic
- Improve security
Using Layer 3 routers to link VLANs provides the following benefits:
- Additional security and management is added.
- Logical links conserve physical ports.
- Depending on the protocol, multimode configurations can be implemented.
- Routers control access to VLANs.
- Up to 255 VLANs or more can be supported per router.
## VLAN Types

<table>
<thead>
<tr>
<th>VLAN Types</th>
<th>Description</th>
</tr>
</thead>
</table>
| Port-based       | • Most common configuration method.  
                    • Ports assigned individually, in groups, in rows, or across 2 or more switches.  
                    • Simple to use.  
                    • Often implemented where Dynamic Host Control Protocol (DHCP) is used to assign IP addresses to network hosts. |
| MAC address      | • Rarely implemented today.  
                    • Each address must be entered into the switch and configured individually.  
                    • Users find it useful.  
                    • Difficult to administer, troubleshoot and manage. |
| Protocol Based   | • Configured like MAC addresses, but instead uses a logical or IP address.  
                    • No longer common because of DHCP. |
## Inter-Switch Link

<table>
<thead>
<tr>
<th>Tagging</th>
<th>Method</th>
<th>Media</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-Switch Link (ISL)</td>
<td>Fast Ethernet</td>
<td>ISL header encapsulates the LAN frame and there is a VLAN ID field in the ISL header</td>
<td>Frame is lengthened</td>
</tr>
<tr>
<td>802.1Q</td>
<td>Fast Ethernet</td>
<td>IEEE defined Ethernet VLAN protocol</td>
<td>Header is modified</td>
</tr>
<tr>
<td>802.1Q</td>
<td>FDDI</td>
<td>IEEE defined standard: The 802.10 protocol incorporates a mechanism whereby LAN traffic can carry a VLAN identifier</td>
<td>VLAN ID is the essential piece of required header information.</td>
</tr>
<tr>
<td>LAN Emulation (LANE)</td>
<td>ATM</td>
<td>No tagging</td>
<td>Virtual connection implies a VLAN id.</td>
</tr>
</tbody>
</table>
VLAN configuration
Concurrent Transmissions in a Switch
End-to-End VLANs
Static VLANs

• Static VLANs work well in networks where the following is true:
  ○ Moves are controlled and managed.
  ○ There is robust VLAN management software to configure the ports.
  ○ It is not desirable to assume the additional overhead required when maintaining end-station MAC addresses and custom filtering tables.
Verifying VLAN Configuration
Deleting VLANs

Switch(config)#interface fastethernet 0/9
Switch(config-if)#no switchport access vlan 300
Catalyst IOS `show vlan` Command

```
Cat4000 (enable) `show vlan`
VLAN Name                      Status   IfIndex   Mod/Ports,
Vlans
1    default                    active   45     1/1-2
     100   VLAN0100               active   53     2/9-29, 2/31-34
     200   VLAN0200               active   54     2/4-5
     300   VLAN0300               active   56     2/6-7
     1002  fddi-default           active   46
     1003  token-ring-default     active   49
     1004  fddinet-default        active   47
     1005  trnet-default          active   48

VLAN Type   SAID    MTU   Parent   RingNo   BrdgNo   Stp   BrdgMode
Trans1  Trans2
-----    -------  ----  ------    ------   -----  -----    -------
1      enet     100001  1500  -       -       -       -       0
0
```
<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>trunk</td>
<td>(Optional) Keyword that specifies to force the display to show information only on trunk ports.</td>
</tr>
<tr>
<td>vlan</td>
<td>Number of the VLAN. If the VLAN number is not specified, all VLANs are displayed.</td>
</tr>
<tr>
<td>notrunk</td>
<td>(Optional) Keyword that specifies to force the display to show information only on nontrunk ports.</td>
</tr>
<tr>
<td>mapping</td>
<td>Keyword to display VLAN mapping table information.</td>
</tr>
<tr>
<td>type</td>
<td>Type of VLAN; valid values are Ethernet, FDDI, FDDI-net, TrBRF, and TrCRF.</td>
</tr>
</tbody>
</table>
Trunking
The telephone industry used multiplexers to carry multiple voice signals on a single trunk between COs.
Trunking Concepts
VLANs and Trunking

Trunking provides effective communication between switches in a network.
Frame Tagging
# Frame Tagging and Encapsulation Methods

<table>
<thead>
<tr>
<th>Identification Method</th>
<th>Encapsulation</th>
<th>Tagging (insertion into frame)</th>
<th>Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.1Q</td>
<td>No</td>
<td>Yes</td>
<td>Ethernet</td>
</tr>
<tr>
<td>ISL</td>
<td>Yes</td>
<td>No</td>
<td>Ethernet</td>
</tr>
<tr>
<td>802.10</td>
<td>No</td>
<td>No</td>
<td>FDDI</td>
</tr>
<tr>
<td>LANE</td>
<td>No</td>
<td>No</td>
<td>ATM</td>
</tr>
</tbody>
</table>
Inter-VLAN routing
To route traffic between VLAN 1 and VLAN 200 in a non-VLAN-trunk environment, a router must be connected to a port in VLAN1 and a port in VLAN 200.
In order for traffic to move from one VLAN to another, it must go through the router.
Physical and Logical Interfaces

The router supports one VLAN per interface.

A single ISL link can support multiple VLANs.
Dividing Physical Interfaces into Subinterfaces

Each VLAN is its own IP network or subnet.
Configuring Inter-VLAN Routing

Sydney(config)#interface FastEthernet 0/0.1
Sydney(config-subif)#description Management VLAN1
Sydney(config-subif)#encapsulation 802.1q 1
Sydney(config-subif)#ip address 192.168.1.1 255.255.255.0
Sydney(config)#interface FastEthernet 0/0.2
Sydney(config-subif)#description Accounting VLAN 20
Sydney(config-subif)#encapsulation 802.1q 20
Sydney(config-subif)#ip address 192.168.2.1 255.255.255.0
Sydney(config)#interface FastEthernet 0/0.3
Sydney(config-subif)#description Sales VLAN 30
Sydney(config-subif)#encapsulation 802.1q 30
Sydney(config-subif)#ip address 192.168.3.1 255.255.255.0