

Layer 2 Engineering – VLANs

Network Infrastructure Workshop



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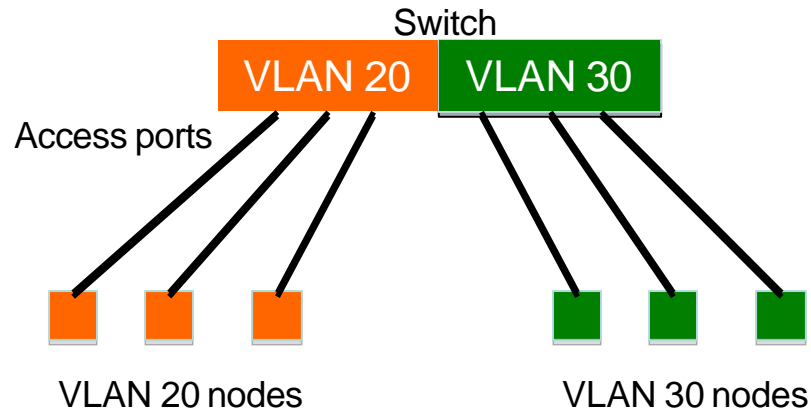
Virtual LANs (VLANs)

- Allow us to split switches into separate (virtual) switches
- Only members of a VLAN can see that VLAN's traffic
 - Inter-vlan traffic must go through a router
- Allow us to reuse router interfaces to carry traffic for separate subnets
 - E.g. sub-interfaces in Cisco routers

Local VLANs

- Two or more VLANs within a single switch
- The switch behaves as several virtual switches, sending traffic only within VLAN members
- **Access ports**, where end nodes are connected, are configured as members of a VLAN
- By default, all ports of a switch are members of VLAN 1 or default VLAN (**VLAN ID** = 1)
- Newly created VLANs must have a VLAN ID other than 1
 - Then add ports by moving them out of VLAN 1 into our new VLAN

Local VLANs



VLANs across switches

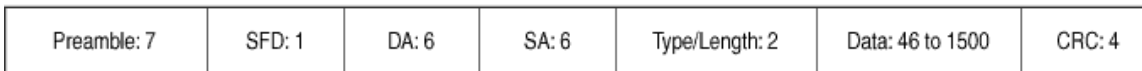
- Two switches can exchange traffic from one or more VLANs
- Inter-switch links are configured as **trunks**, carrying frames from all or a subset of a switch's VLANs
- Each frame carries a **tag** that identifies which VLAN it belongs to

802.1Q

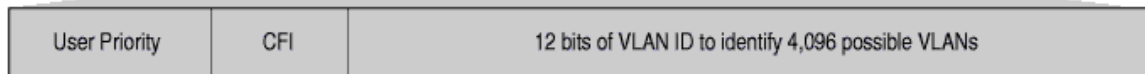
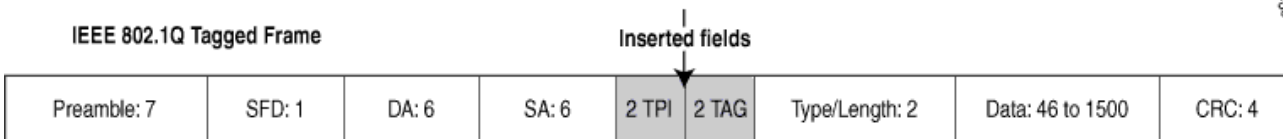
- The IEEE standard that defines how ethernet frames should be ***tagged*** when moving across switch trunks
- This means that switches from *different vendors* are able to exchange VLAN traffic.

802.1Q tagged frame

Normal Ethernet frame



IEEE 802.1Q Tagged Frame



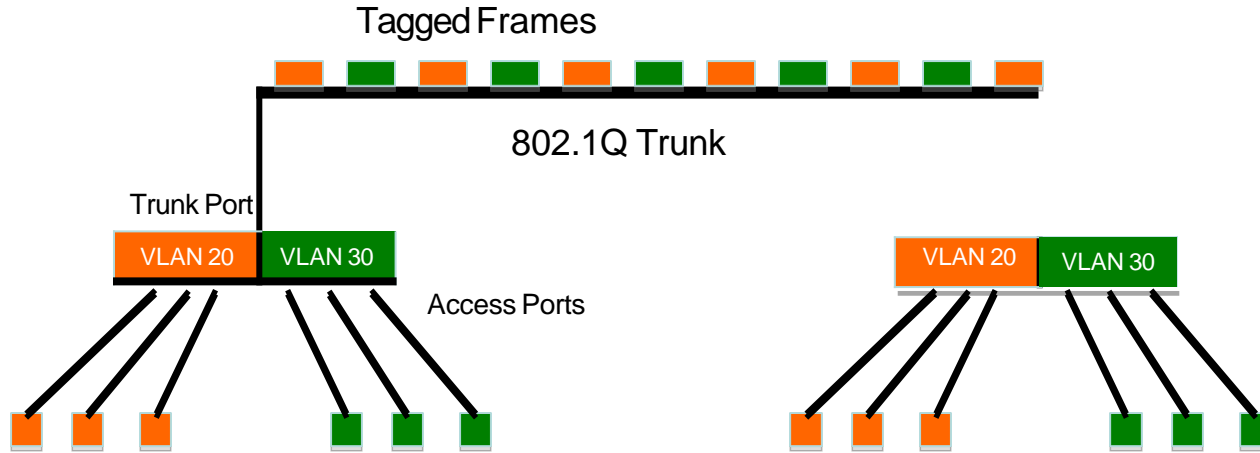
3 bits

1 bit

12 bits

g0716819

VLANs across switches



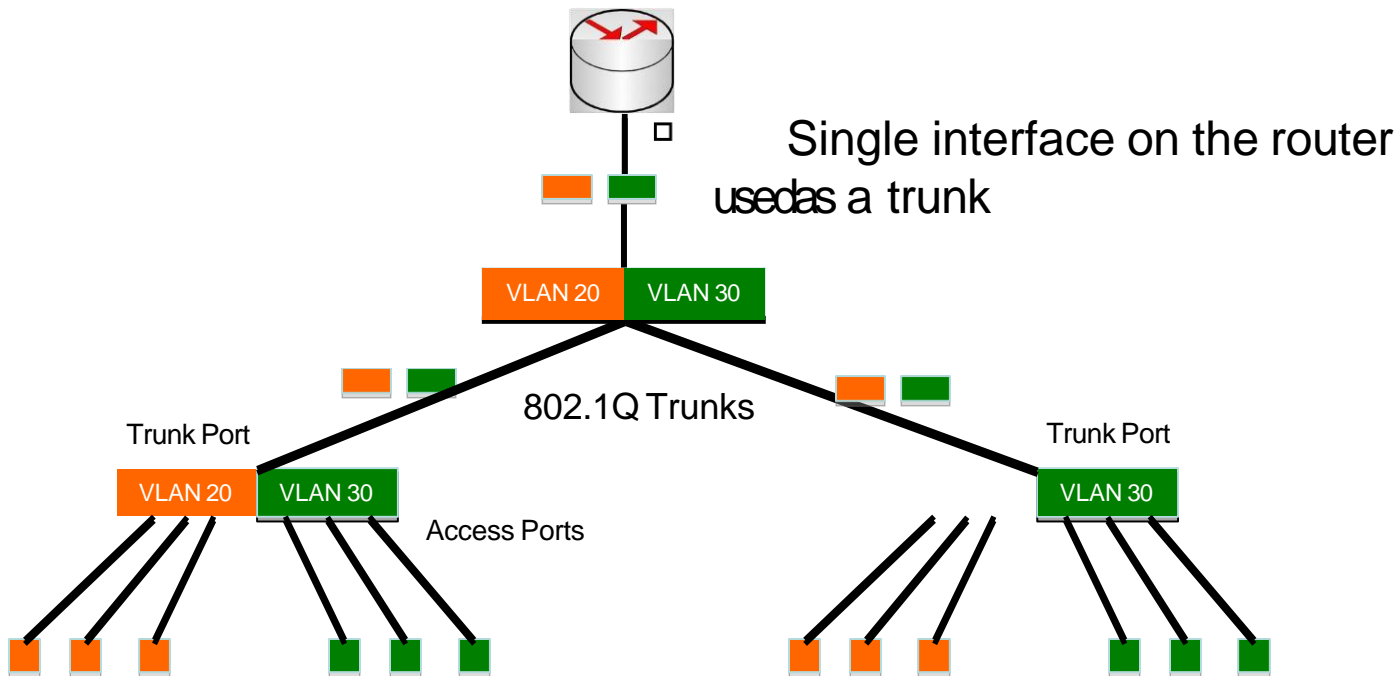
This is called “VLAN Trunking”

Tagged vs. Untagged

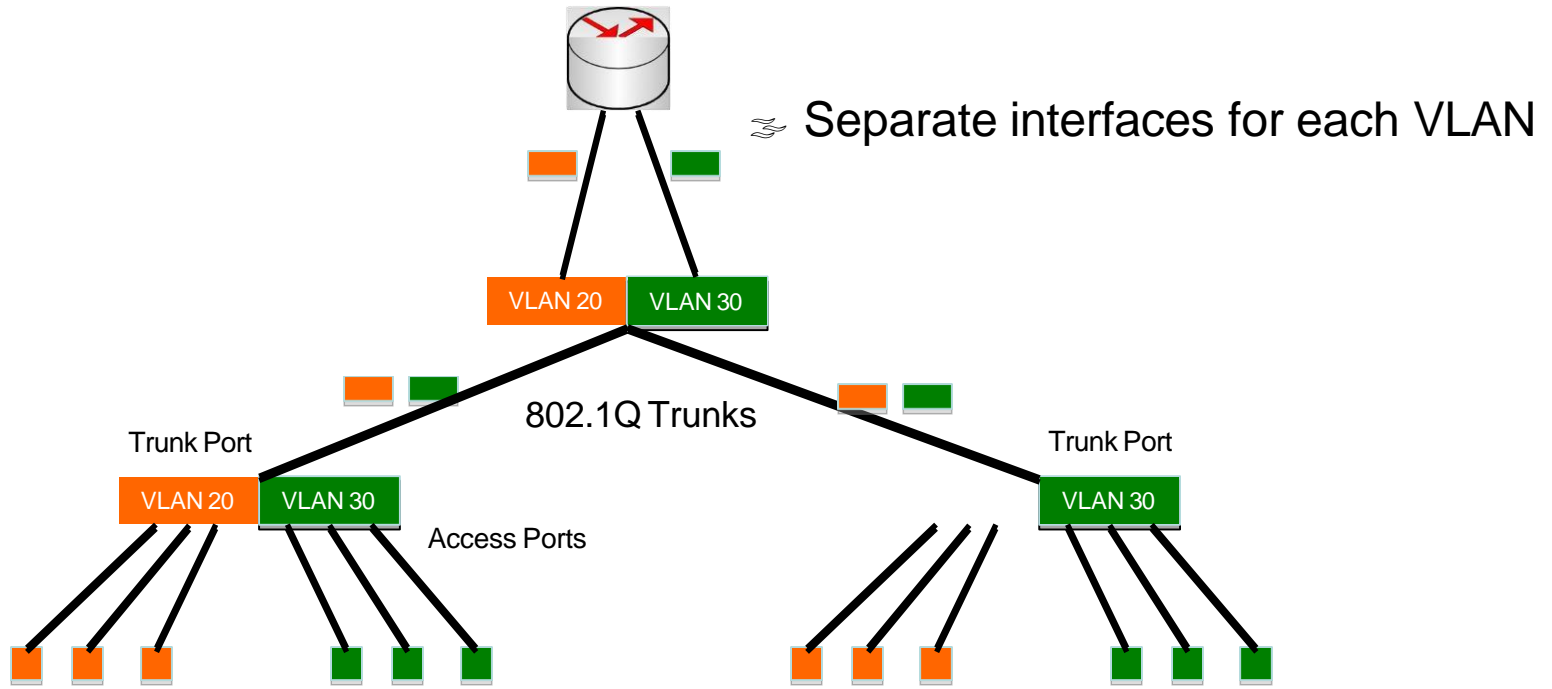
- Frames sent out on access ports are not tagged
 - frames received on access ports are not expected to be tagged either
- You only need to tag frames in switch-to-switch links (trunks), when transporting multiple VLANs
- However, a trunk can transport both tagged and untagged frames
 - As long as the two switches agree on how to handle untagged frames

Routing Inter-VLAN traffic

Traffic between VLANs must now go through a router.

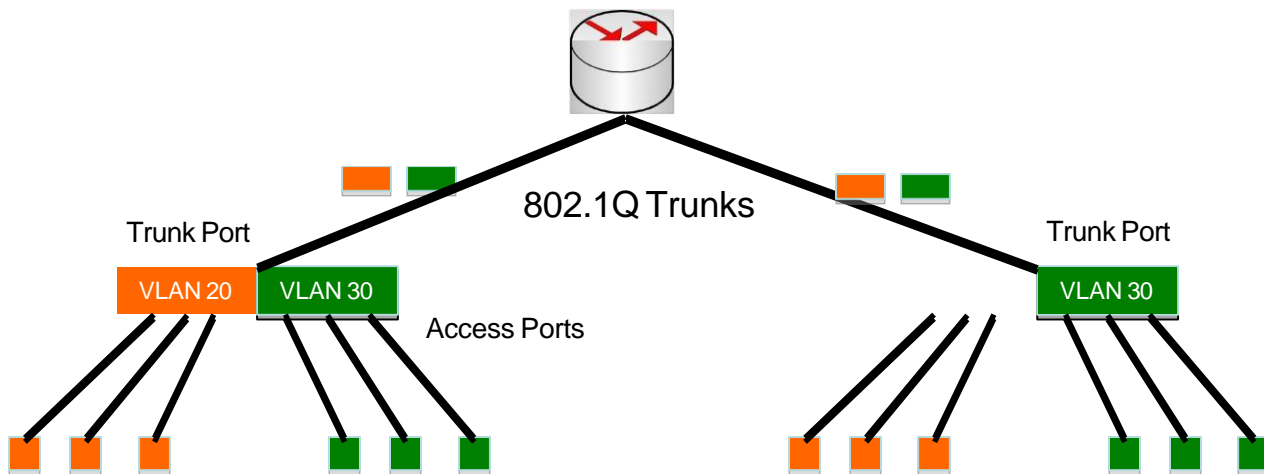


Routing Inter-VLAN traffic (2)



Routing Inter-VLAN traffic (3)

Can use a 802.1Q compliant Layer-3 switch to do switching as well routing



VLANs increase complexity

- You can no longer “just replace” a switch
 - Now you have VLAN configuration to maintain
 - Field technicians need more skills
- You have to make sure that all the switch-to-switch trunks are configured to carry frames of all the necessary VLANs
 - Need to keep in mind when adding/removing VLANs

Good reasons to use VLANs

- You want multiple subnets in a building, and carry them over a single fibre to your core router
- You want to segment your network into multiple subnets, without buying more switches
 - Separate broadcast domains for wired, wireless, phones, device management etc.
- Separate control traffic from user traffic
 - Restrict who can access your switch management address

Bad reasons to use VLANs

- Because you can, and you feel cool ☐
- Because they will completely secure your hosts (or so you think)
- Because they allow you to extend the same IP network over multiple separate buildings
 - This is actually very common, but a bad idea

Do not build “VLAN spaghetti”

- Extending a VLAN to multiple buildings across trunk ports
- Bad idea because:
 - Broadcast traffic is carried across all trunks from one end of the network to another
 - Broadcast storm can spread across the extent of the VLAN, and affect all VLANS!
 - Maintenance and troubleshooting nightmare

Cisco configuration

- **Configure access port**

- interface
GigabitEthernet1/0/3
switchport mode access
switchport access vlan 10

- **Configure trunk port**

- interface
GigabitEthernet1/0/1
switchport mode trunk
switchport trunk allowed vlan 10,20,30

Cisco mis-features

- **Disable VLAN Trunking Protocol (VTP)**
 - vtp mode off
or
vtp mode transparent
- **Disable Dynamic Trunking Protocol (DTP)**
 - interface range Gi 1 - 8
switchport mode [trunk|access]
switchport nonegotiate

Questions?