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VLAN Theory and Implementation

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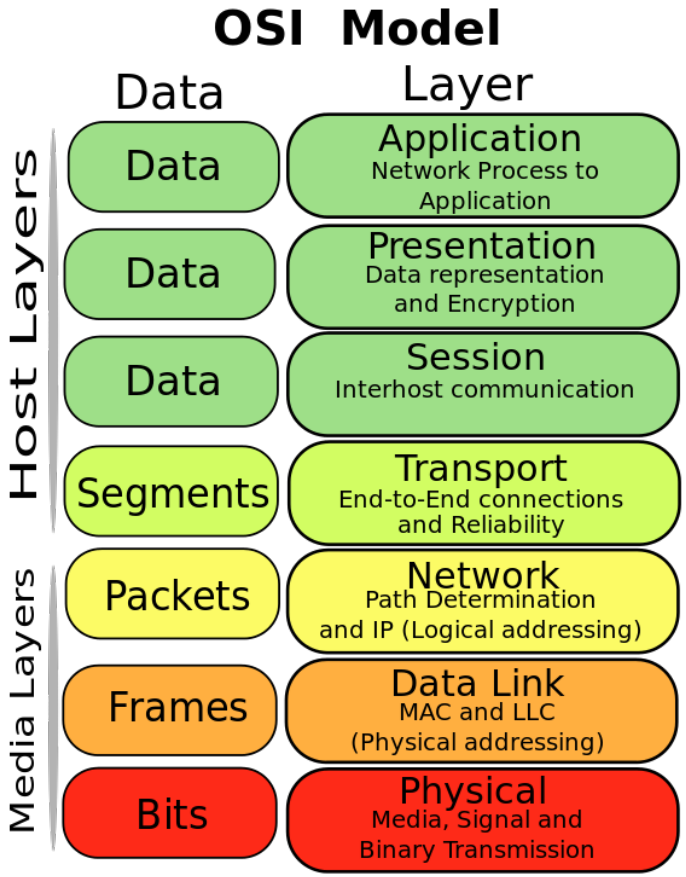
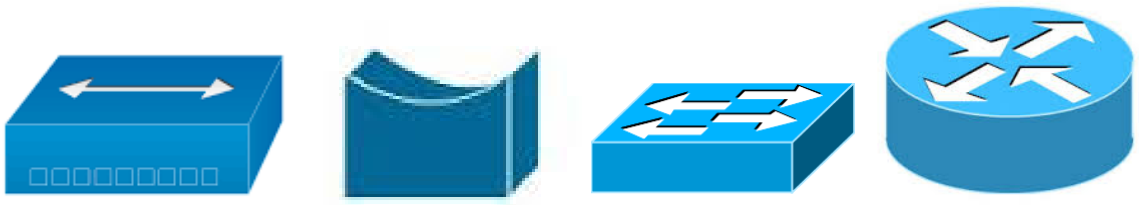


7-Layer Model

- 7
- 6
- 5
- 4 (TCP, UDP)
- 3 (IP, Routers)
- 2 (Ethernet, Switches, Bridges)
- 1 (100BaseT, Hubs, Repeaters)

Routers, Switches, and Hubs, Oh My!

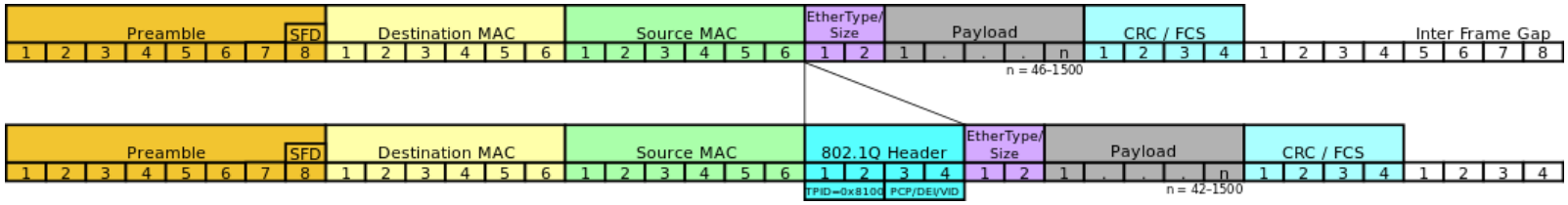


Device:	Hub	Bridge	Switch	Router
OSI Layer	1	2	2	3
Collision Domains	1	2	1/port	1/port
Broadcast Domains	1	1	1	1/port

What is a VLAN?

A **virtual LAN** (**VLAN**) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2) … creating the appearance and functionality of network traffic that is physically on a single network but acts as if it is split between separate networks. In this way, VLANs can keep network applications separate despite being connected to the same physical network, and without requiring multiple sets of cabling and networking devices to be deployed.

VLAN Tagging (IEEE 802.1Q)



- adds a 32-bit field between the source MAC address and the EtherType fields
- *Tag protocol identifier (TPID)*: a 16-bit field set to a value of 0x8100
- *Priority code point (PCP)*: a 3-bit field which refers to the IEEE 802.1p class of service
- *Drop eligible indicator (DEI)*: a 1-bit field (congestion management)
- *VLAN identifier (VID)*: a 12-bit field

  0x000 and 0xFFF are reserved

  other values may be used as VLAN identifiers, allowing up to 4,094 VLANs

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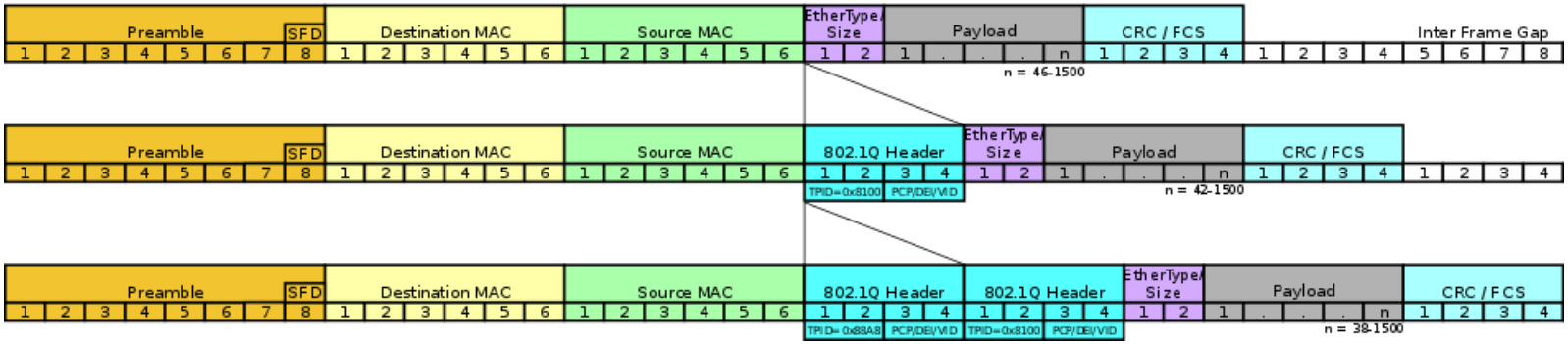
Source: https://en.wikipedia.org/wiki/IEEE_802.1Q

Double Tagging (802.1ad)



- useful for Internet service providers
- allow use of VLANs internally while mixing traffic from clients that are already VLAN-tagged
- outer (representing ISP VLAN) S-TAG (service tag) comes first
- inner C-TAG (customer tag) next
- TPID of 0x88a8 for service-provider outer S-TAG

IOS Access Mode vs Trunk Mode

- ! Port 1 in access mode:

- interface GigabitEthernet1/0/1
- switchport access vlan 10
- switchport mode access

- ! Port 24 (uplink) in trunk mode:

- interface GigabitEthernet1/0/24
- switchport trunk encapsulation dot1q
- switchport mode trunk

Trunk Mode with VLAN Filtering

- ! Define our VLAN's:
- **vlan 10,20,30**

…

- ! Restricted Trunk Port:
- interface GigabitEthernet1/0/24
- switchport trunk encapsulation dot1q
- **switchport trunk allowed vlan 10,20**
- switchport mode trunk

Trunk Mode with Native VLAN

- ! Define our VLAN's:
- **vlan 10,20,30**

…

- ! Transitional Trunk Port:
- interface GigabitEthernet1/0/24
- switchport trunk encapsulation dot1q
- **switchport trunk native vlan 10**
- switchport mode trunk

VLAN Support – Linux

- Similar mechanism to virtual interfaces (e.g. *eth0**:1***)
- Parent interface (e.g. *eth0*) will send/receive *untagged* frames on *native* VLAN
- Define a separate child interface (e.g. *eth0**.10***) per VLAN
- These interfaces will send/receive *tagged* frames for those specific VLANs
- Tagging done at kernel level; no direct user-level manipulation

VLAN Setup – Linux Commands

- vconfig add *eth0* 10

… or …

- ip link add link *eth0* name *eth0.10* type vlan id 10

… or …

- nmcli con add type vlan ifname *VLAN10* dev *eth0* id 10

VLAN Setup – Red Hat ifcfg File

- # /etc/sysconfig/network-scripts/ifcfg-*eth0***.10**
- DEVICE=*eth0***.10**
- **VLAN=yes**
- BOOTPROTO=none
- ONBOOT=yes
- IPADDR=192.168.1.1
- PREFIX=24
- NETWORK=192.168.1.0

…

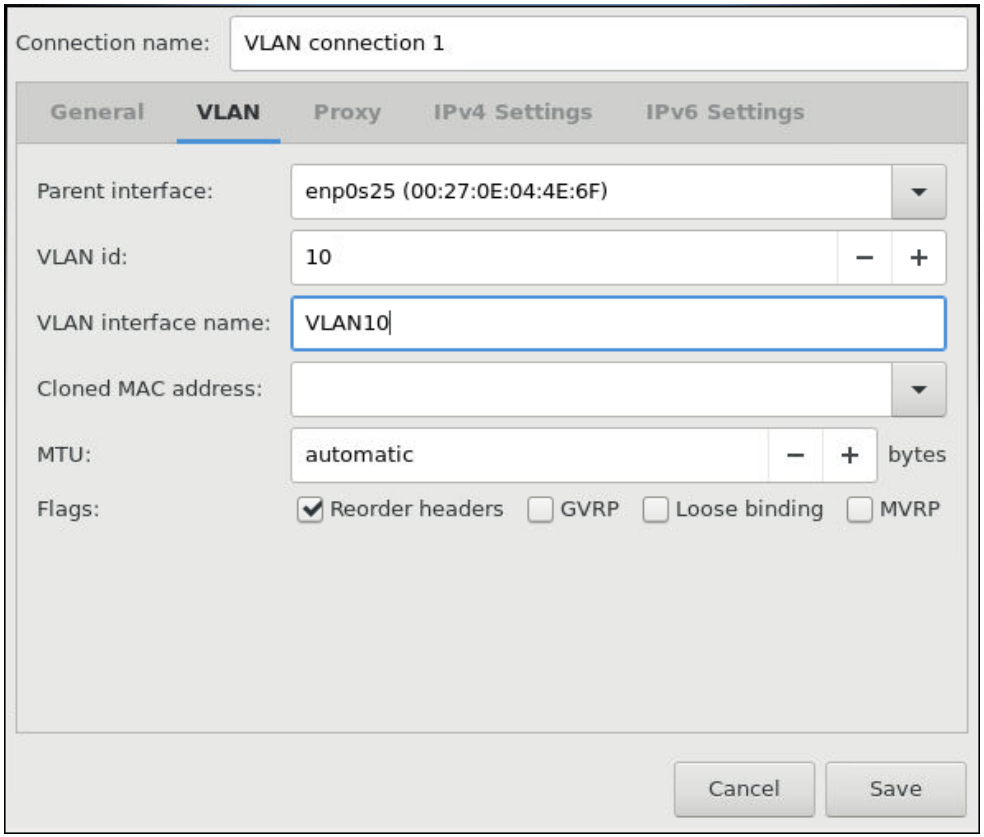
VLAN Setup – Debian interfaces

- # /etc/network/interfaces
- auto *eth0***.10**
- iface *eth0***.10** inet static
- address 10.10.10.1
- netmask 255.255.255.0
- **vlan-raw-device *eth0***

…

VLAN Setup – Linux / Gnome3

- open the **Network** window, click the plus symbol, and select **VLAN** from the list
- select the parent interface from the drop-down list
- enter the VLAN ID
- enter a VLAN interface name
- Save…



Sample Gnome NetworkManager Dialogue for VLAN Configuration

Further Reading

- https://www.thomas-krenn.com/en/wiki/VLAN_Basics
- https://en.wikipedia.org/wiki/IEEE_802.1Q
- https://en.wikipedia.org/wiki/Multiple_Registration_Protocol
- https://www.cisco.com/c/en/us/tech/lan-switching/virtual-lans-vlan-trunking-protocol-vlans-vtp/tech-configuration-examples-list.html
- https://www.cyberciti.biz/tips/howto-configure-linux-virtual-local-area-network-vlan.html
- https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/networking_guide/ch-configure_802_1q_vlan_tagging
- https://wiki.debian.org/NetworkConfiguration#Howto_use_vlan_.28dot1q.2C_802.1q.2C_trunk.29_.28Etch.2C_Lenny.29

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