VLANs (Part-1)

VLANs, LANs, and Broadcast Domains (Basics)

- Topics covered:
  - What is a LAN
  - Broadcast domains
  - VLANs and their purpose
  - Basic VLAN configuration on Cisco switches
- This video covers only the basics

🔹 What is a LAN?

- A LAN is a group of devices (PCs, servers, routers, switches, etc.)
- In a single location, for example a home or office

` More specific definition:

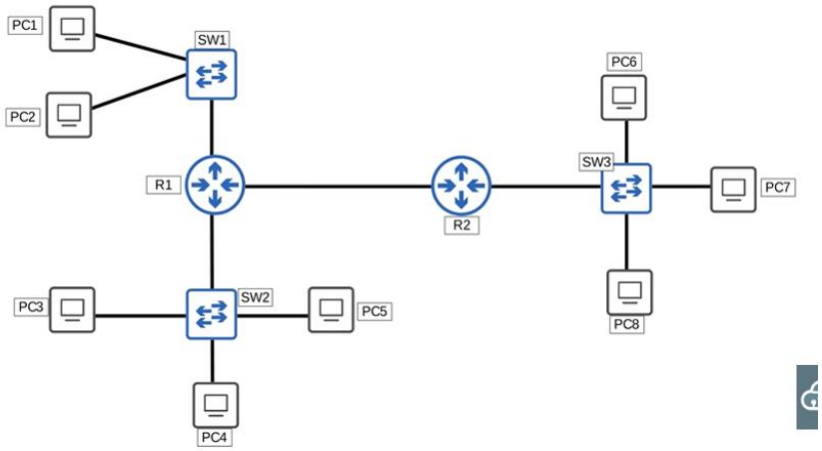
- A LAN is a single broadcast domain

🔹 What is a Broadcast Domain?

- A broadcast domain is the group of devices
- Which will receive a broadcast frame
- A broadcast frame has a destination MAC address of **all Fs**

FF:FF:FF:FF:FF:FF

🔹 **Network Diagram (Given Topology)**



🔸 **Case 1: PC1 Sends a Broadcast Frame**

PC1 --> SW1 --> PC2 |+--> R1 (stops here)

- Switch floods the broadcast frame
- Router does not forward the broadcast frame

Broadcast domain includes:

- PC1, PC2, SW1
- One interface of R1

➡️ One broadcast domain

🔸 **Case 2: PC3 Sends a Broadcast Frame**

PC3 --> SW2 --> PC4--> PC5--> R1 (stops here)

- Switch floods the broadcast frame
- Router does not forward the broadcast frame

Broadcast domain includes:

- PC3, PC4, PC5, SW2
- One interface of R1

➡️ Second broadcast domain

🔸 **Case 3: PC6 Sends a Broadcast Frame**

PC6 --> SW3 --> PC7--> PC8--> R2 (stops here)

- Switch floods the broadcast frame
- Router does not forward the broadcast frame

Broadcast domain includes:

- PC6, PC7, PC8, SW3
- One interface of R2

➡️ Third broadcast domain

🔸 **Case 4: R1 Sends a Broadcast Frame to R2**

R1 --> R2

- Frame is received only by R2
- This is still technically a broadcast domain

Broadcast domain includes:

- R1 interface
- R2 interface

➡️ Fourth broadcast domain

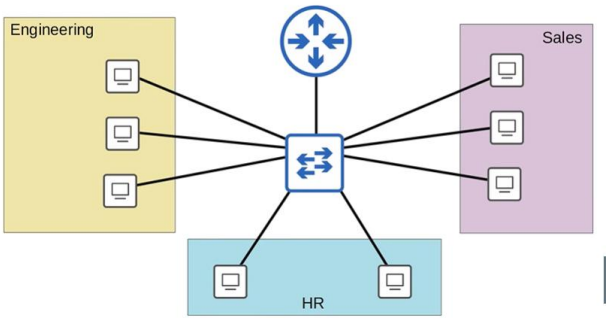
🔹 **Final Statement**

- A broadcast domain is the group of devices
- Which will receive a broadcast frame
- With a destination MAC address of all Fs
- Sent by any one of the members

In this network: There are four broadcast domains, and therefore four LANs.

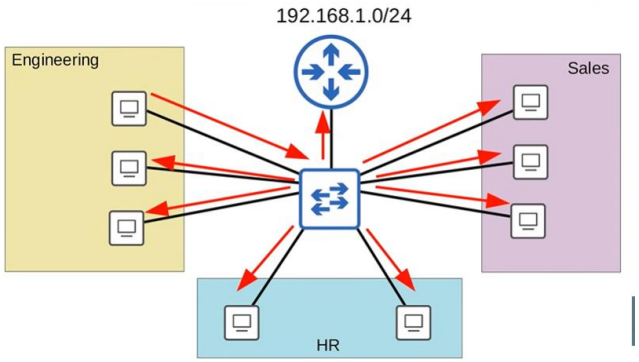
VLANs – Problem, Subnetting, and VLAN Solution

🔹 Small LAN of a Company (Single LAN)



- Three main departments:
  - Engineering
  - Sales
  - Human Resources
- Network used: **192.168.1.0/24**

🔹 Broadcast Problem in Single LAN

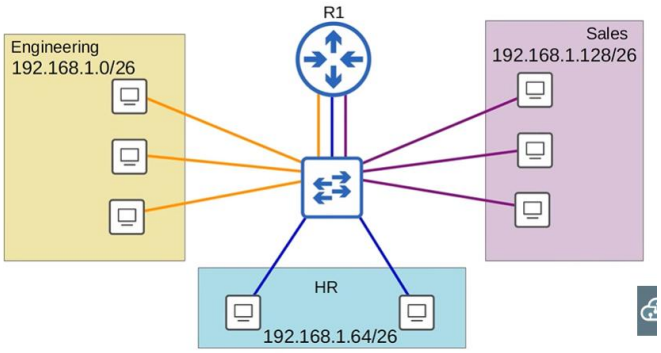


- Engineering PC sends a broadcast message
- Switch floods it out of all interfaces
- ALL PCs and the router receive the broadcast

Why This Is a Problem

- Lots of unnecessary broadcast traffic reduces network performance
- Switch floods frames when:
    - It receives a broadcast
    - It doesn't know the destination MAC address
- PCs can reach each other directly
- Traffic does not pass through the router
- Router security policies have no effect

Splitting into Separate Subnets



ENGINEERING	HR	SALES
192.168.1.0/26	192.168.1.64/26	192.168.1.128/26

Router Interface Requirement

ENGINEERING ----\

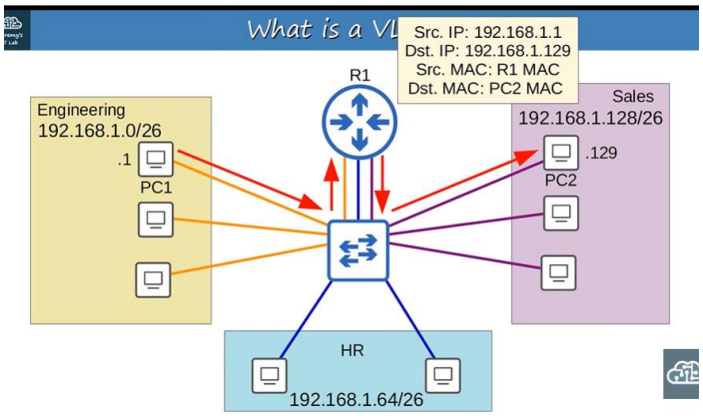
HR ----------> SWITCH ---- R1

SALES ----------/

- Router needs an IP address in each subnet
- Router needs one interface in each subnet
- Three separate connections are used
- A more efficient way exists (covered later)

🔹 Inter-Subnet Communication Example

PC1 (192.168.1.1) ---> SWITCH ---> R1 ---> SWITCH ---> PC2 (192.168.1.129)



Frame details:

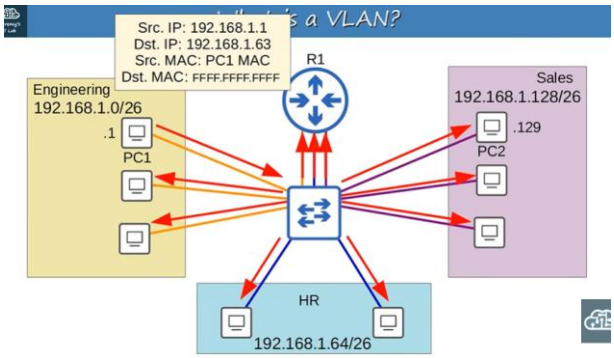
- Source IP: PC1
- Destination IP: PC2
- Source MAC: PC1
- Destination MAC: R1

Router changes:

- Source MAC → R1
- Destination MAC → PC2

🔹 Remaining Problem (Broadcast Still Flooded)

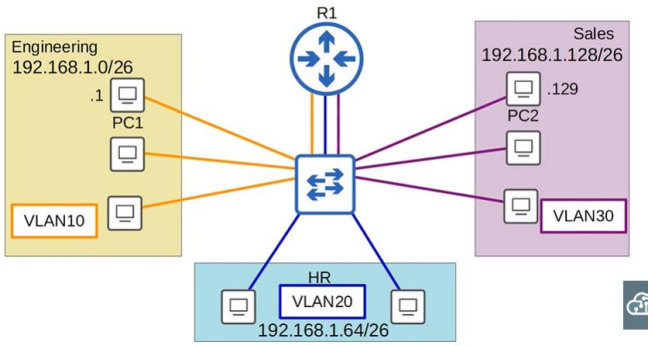
PC1 (Broadcast)------→ SWITCH ---> ALL PORTS (All subnets)



- Broadcast frame destination MAC = **FFFF.FFFF.FFFF**
- Switch looks only at Layer 2 (MAC addresses)

- Switch does not know about subnets
- Still one broadcast domain
- Still one LAN
- This is bad for performance and security

🔹 VLAN Solution (Layer 2 Separation)



- Engineering → **VLAN10**
- HR → **VLAN20**
- Sales → **VLAN30**

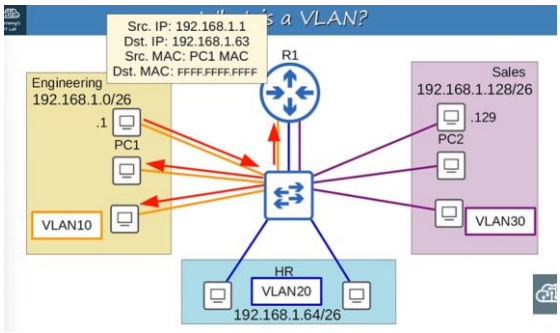
🔹 VLAN Configuration Concept

SWITCH PORT ---> VLAN ---> HOST

- VLANs are configured on the switch
- Configured per switch interface
- Host connected to interface becomes part of that VLAN

🔹 Broadcast with VLANs

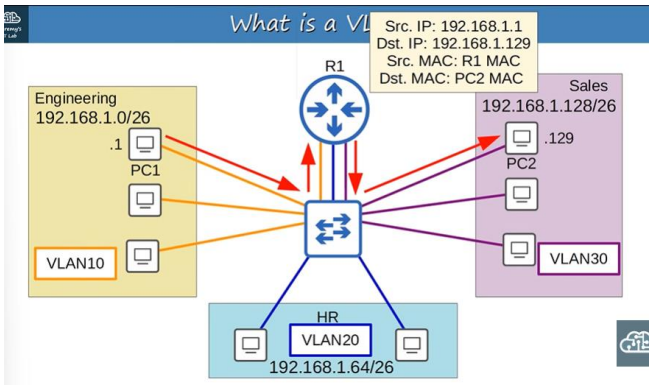
PC1 (VLAN10 Broadcast)→SWITCH→Only VLAN10 ports



- Broadcast forwarded only within the same VLAN
- Broadcast does not reach other VLANs

🔹 Inter-VLAN Communication

PC1 (VLAN10)→SWITCH→R1→SWITCH→PC2(VLAN30)



- Router is used to route between VLANs
- Switch does not perform inter-VLAN routing
- Traffic must pass through the router

🔹 VLAN Traffic Rules (Review)

VLAN10 ---> VLAN10 ✓

VLAN30 ---> VLAN30 ✓

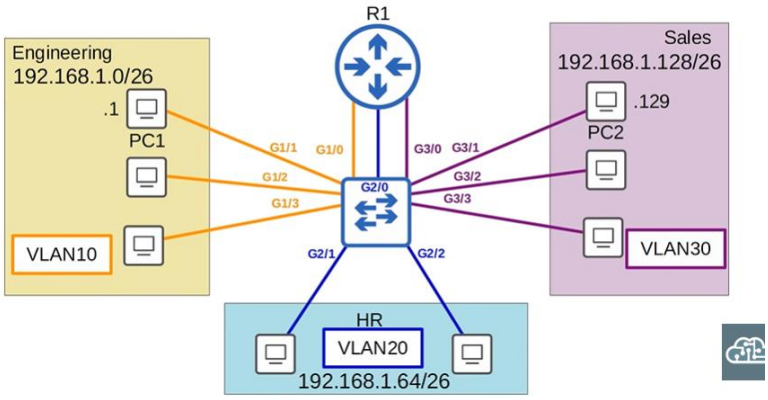
VLAN10 ---> VLAN30 ✗

- Traffic arriving on a VLAN10 interface is forwarded out VLAN10 interfaces

- Traffic arriving on a VLAN30 interface is forwarded out VLAN30 interfaces
- Switch never forwards traffic directly between VLANs
- VLANs are configured on switches per interface
- VLANs logically separate end hosts at Layer 2
- Hosts were physically connected to the same switch
- VLANs logically separated them
- VLANs created separate broadcast domains
- Switches do not forward traffic between different VLANs

Basic VLAN Configuration

🔹 Network Topology (Before Configuration)



- VLAN10 → G1/0 through G1/3
- VLAN20 → G2/0 through G2/2
- VLAN30 → G3/0 through G3/3

🔹 Check Default VLANs on Switch

Command used: show vlan brief

```
SW1#show vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Gi0/0, Gi0/1, Gi0/2, Gi0/3
                                                 Gi1/0, Gi1/1, Gi1/2, Gi1/3
                                                 Gi2/0, Gi2/1, Gi2/2, Gi2/3
                                                 Gi3/0, Gi3/1, Gi3/2, Gi3/3
1002 fddi-default                      act/unsup
1003 token-ring-default                act/unsup
1004 fddinet-default                   act/unsup
1005 trnet-default                     act/unsup
SW1#
```

- VLAN1 is the **default VLAN**
- All interfaces are in VLAN1 by default
- VLANs **1 and 1002–1005 exist by default**
- These VLANs **cannot be deleted**

🔹 Assign Interfaces to VLAN10/20/30

Command Used: interface range _____

```
SW1(config)#interface range g1/0 - 3
SW1(config-if-range)#switchport mode access
SW1(config-if-range)#switchport access vlan 10
% Access VLAN does not exist. Creating vlan 10
SW1(config-if-range)#interface range g2/0 - 2
SW1(config-if-range)#switchport mode access
SW1(config-if-range)#switchport access vlan 20
% Access VLAN does not exist. Creating vlan 20
SW1(config-if-range)#interface range g3/0 - 3
SW1(config-if-range)#switchport mode access
SW1(config-if-range)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
SW1(config-if-range)#
```

- An access port:
    - Belongs to a **single VLAN**
    - Usually connects to **end hosts like PCs**
- Switchports that carry multiple VLANs are called **trunk ports**
- This video focuses **only on access ports**

🔹 Verify VLAN Creation

Command Used: show vlan brief

```
SW1(config)#do show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi0/0, Gi0/1, Gi0/2, Gi0/3
                                                Gi2/3
10   VLAN0010                         active    Gi1/0, Gi1/1, Gi1/2, Gi1/3
20   VLAN0020                         active    Gi2/0, Gi2/1, Gi2/2
30   VLAN0030                         active    Gi3/0, Gi3/1, Gi3/2, Gi3/3
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

🔹 Rename VLANs

```
SW1(config)#vlan 10
SW1(config-vlan)#name ENGINEERING
SW1(config-vlan)#vlan 20
SW1(config-vlan)#name HR
SW1(config-vlan)#vlan 30
SW1(config-vlan)#name SALES
```

- **Verify VLAN Names**

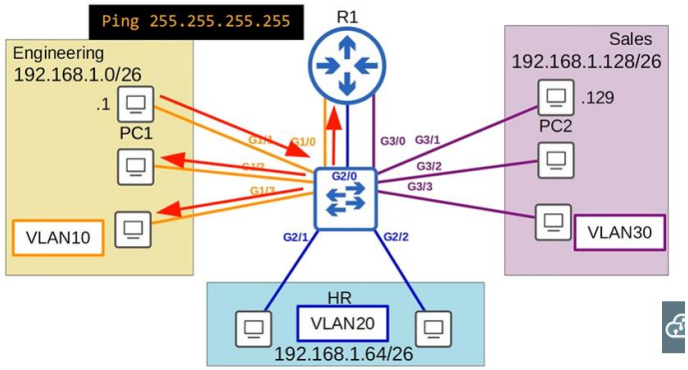
```
SW1(config)#do show vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Gi0/0, Gi0/1, Gi0/2, Gi0/3
                                                 Gi2/3
10   ENGINEERING                       active    Gi1/0, Gi1/1, Gi1/2, Gi1/3
20   HR                                active    Gi2/0, Gi2/1, Gi2/2
30   SALES                             active    Gi3/0, Gi3/1, Gi3/2, Gi3/3
1002 fddi-default                      act/unsup
1003 token-ring-default                act/unsup
1004 fddinet-default                   act/unsup
1005 trnet-default                     act/unsup
SW1(config)#
```

- **Broadcast Test (After VLAN Configuration)**

PC1 (VLAN10)

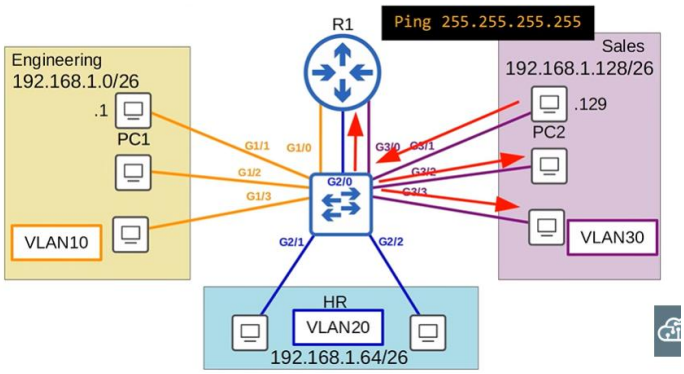
PING 255.255.255.255



- Broadcast reaches **only VLAN10 hosts**

PC2 (VLAN30)

PING 255.255.255.255



- Broadcast reaches **only VLAN30 hosts**

🔹 Final Result

- Interfaces are assigned to correct VLANs
- VLANs are named properly
- Broadcast traffic stays inside the same VLAN
- VLANs are separated at **Layer 2**