Interconexión de Redes

TC2022

Oportunidad de negocio.

Una compañía dedicada a la venta de soluciones de infraestructura computacional de servicios residenciales de Internet se ha acercado a las oficinas centrales de **IT^2 Networking Consulting**, y solicitado nuestros servicios para diseñar un nuevo producto que responda de manera efectiva a las necesidades actuales de conectividad.

Hasta hace unos días, la compañía ofrecía al cliente un único producto estandarizado al ofrecer los servicios de conectividad utilizando un solo equipo (router inalámbrico) con 4 conexiones físicas de FastEthernet y acceso inalámbrico.

Después de la primera entrevista con el **CEO** y con el departamento de mercadotecnia de dicha compañía, el departamento de **Desarrollo de Nuevos Productos** de IT² Networking Consulting nos hace las siguientes preguntas:

¿Cómo podríamos conseguir un tráfico más eficiente en la red de una infraestructura residencial?

¿Qué tendríamos que hacer para segmentar el tráfico?

Ve con atención el siguiente video:

https://www.youtube.com/watch?v=jC6MJTh9fRE

Chapter 6: VLANs

Routing and Switching Essentials v6.0

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Chapter 6 - Sections & Objectives

6.1 VLAN Segmentation

- Explain the purpose of VLANs in a switched network.
- Explain how a switch forwards frames based on VLAN configuration in a multi-switch environment.

6.2 VLAN Implementations

- Configure a switch port to be assigned to a VLAN based on requirements.
- Configure a trunk port on a LAN switch.
- Troubleshoot VLAN and trunk configurations in a switched network.

6.3 Inter-VLAN Routing Using Routers

- Describe the two options for configuring Inter-VLAN routing.
- Configure Legacy Inter-VLAN Routing.
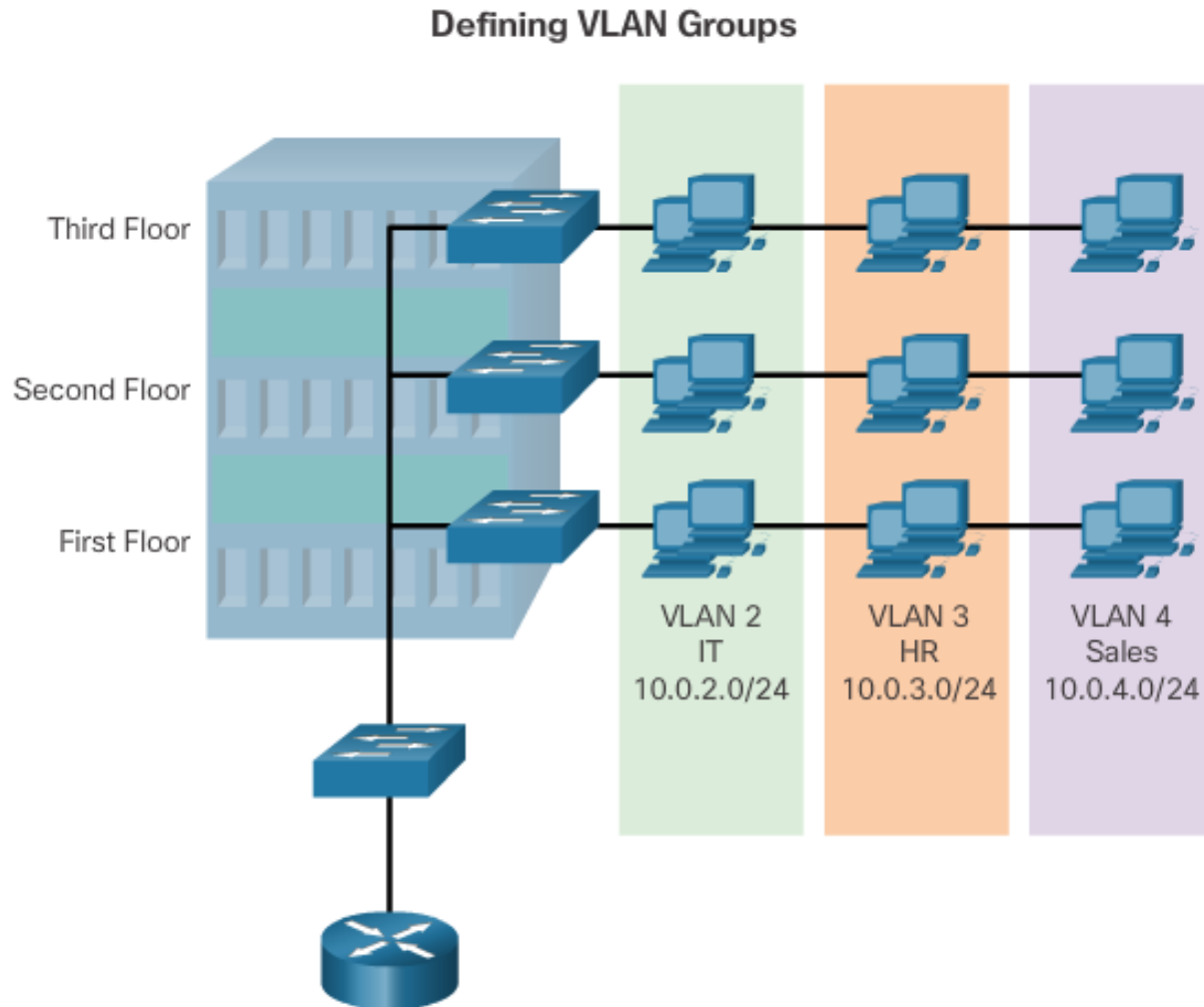- Configure Router-on-a-Stick Inter-VLAN Routing

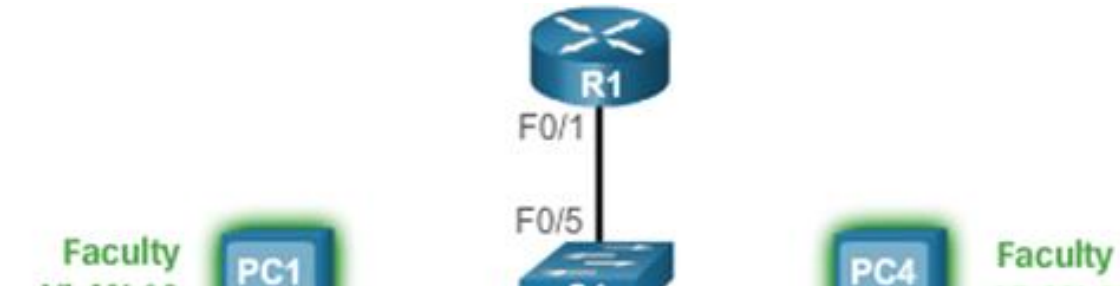# 6.1 VLAN Segmentation

VLAN Definitions

Defining VLAN Groups

Benefits of VLANs

- Improved Security
- Reduced Cost
- Better Performance
- Smaller Broadcast Domains
- IT Efficiency
- Management Efficiency
- Simpler Project and Application Management

Type~~s of VLAN~~

VLAN 1

- **Data**

- **Defa**
until

- **Nati**

- **Man**
capa

```
Switch# show vlan brief

VLAN Name                    Status      Ports
---- -------------------- ---------   -------------------------
1    default              active      Fa0/1,  Fa0/2,  Fa0/3,  Fa0/4
                                      Fa0/5,  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
                                      Gi0/1,  Gi0/2
1002 fddi-default         act/unsup
1003 token-ring-default   act/unsup
1004 fddinet-default      act/unsup
1005 trnet-default        act/unsup
```
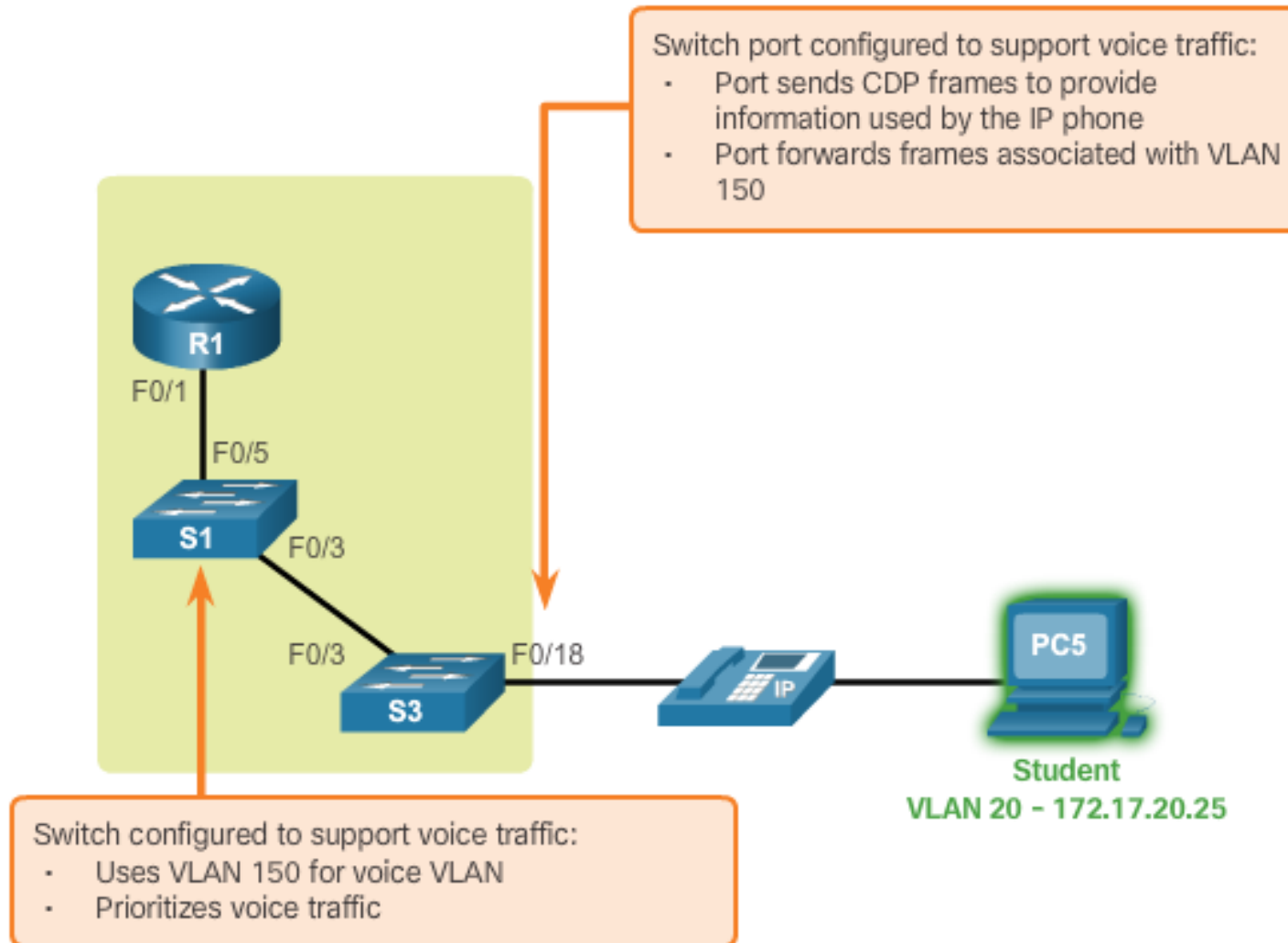
M

- All ports assigned to VLAN 1 by default.
- Native VLAN is VLAN 1 by default.
- Management VLAN is VLAN 1 by default.

Voice VLANs

Switch port configured to support voice traffic:
- Port sends CDP frames to provide information used by the IP phone
- Port forwards frames associated with VLAN 150

R1

F0/1

F0/5

S1   F0/3

F0/3   S3   F0/18

PC5

IP

Student
VLAN 20 – 172.17.20.25

Switch configured to support voice traffic:
- Uses VLAN 150 for voice VLAN
- Prioritizes voice traffic

Voice VLANs (cont.)

- VoIP traffic is **time-sensitive** and requires:

  - Assured **bandwidth** to ensure voice quality.

  - **Transmission priority** over other types of network traffic.

  - **Ability** to be routed around **congested** areas on the network.

  - **Delay of less than 150 ms** across the network.

- The voice VLAN feature enables access ports to carry IP voice traffic from an IP phone.
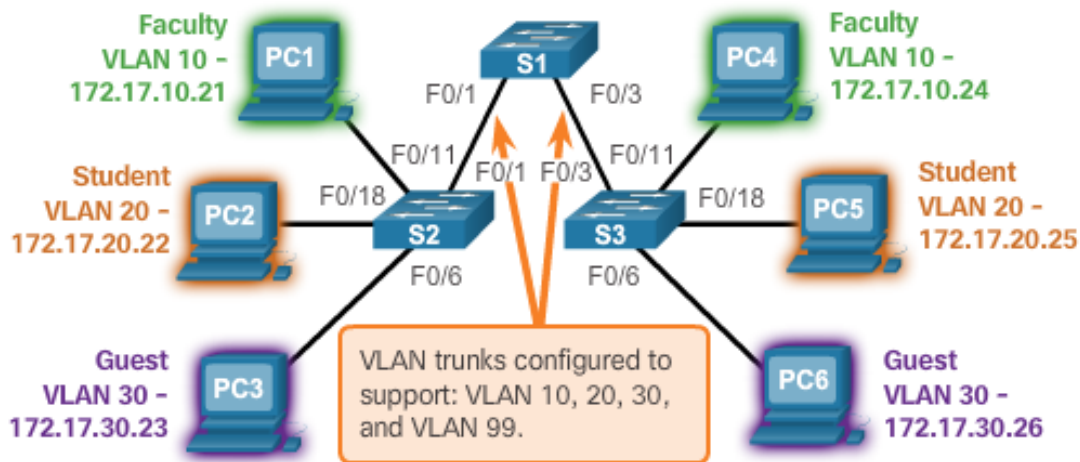
VLAN Trunks

VLAN 10 Faculty/Staff - 172.17.10.0/24
VLAN 20 Students - 172.17.20.0/24
VLAN 30 Guest - 172.17.30.0/24
VLAN 99 Management and Native -
172.17.99.0/24

F0/1-5 are 802.1Q trunk interfaces with native
VLAN 99.
F0/11-17 are in VLAN 10.
F0/18-24 are in VLAN 20.
F0/6-10 are in VLAN 30.

Faculty
VLAN 10 –
172.17.10.21
PC1

S1
F0/1   F0/3
F0/11   F0/11
F0/1 F0/3

Student
VLAN 20 –
172.17.20.22
PC2
F0/18   F0/18

S2   S3
F0/6   F0/6

Guest
VLAN 30 –
172.17.30.23
PC3

VLAN trunks configured to
support: VLAN 10, 20, 30,
and VLAN 99.

Faculty
VLAN 10 –
172.17.10.24
PC4

Student
VLAN 20 –
172.17.20.25
PC5

Guest
VLAN 30 –
172.17.30.26
PC6

The links between switches S1 and S2, and S1 and S3 are configured to
transmit traffic coming from VLANs 10, 20, 30, and 99 across the network.
This network could not function without VLAN trunks.

VLAN Trunks (cont.)

- A VLAN **trunk** is a point-to-point link that **carries more than one VLAN**.

- A VLAN **trunk** is usually **established** between **switches** so same-VLAN devices can communicate, even if physically connected to different switches.

- A VLAN **trunk** is **not associated to any VLANs**; neither is the trunk ports used to establish the trunk link.

- **Cisco IOS supports IEEE802.1q, a popular VLAN trunk protocol.**

Controlling Broadcast Domains with VLANs

- **VLANs** can be used to **limit** the reach of **broadcast** frames.

- A **VLAN** is a **broadcast domain** of its own.

- A **broadcast frame** sent by a device **in a specific VLAN** is forwarded within that VLAN only.

- **VLANs** help **control the reach of broadcast frames** and their impact in the network.

- **Unicast** and **multicast** frames are **forwarded** within the **originating VLAN**.

Each VLAN is associated to one subnet (broadcast domain)

# Tagging Ethernet Frames for VLAN Identification

- Frame tagging is the process **of adding a VLAN identification** header to the frame.

- It is used to properly **transmit multiple VLAN** frames through a **trunk link**.

- Different tagging **protocols** exist; **IEEE 802.1Q** is a vey popular example.

- The **protocol defines** the **structure** of the **tagging** header added to the frame.

- **Switches add VLAN tags** to the frames **before placing** them into **trunk** links and **remove** the **tags** before **forwarding** frames through **non-trunk ports**.

- When **properly tagged**, the frames can **transverse** any number of switches **via trunk links** and still be forwarded within the correct VLAN at the destination.

Tagging Ethernet Frames for VLAN Identification (cont.)
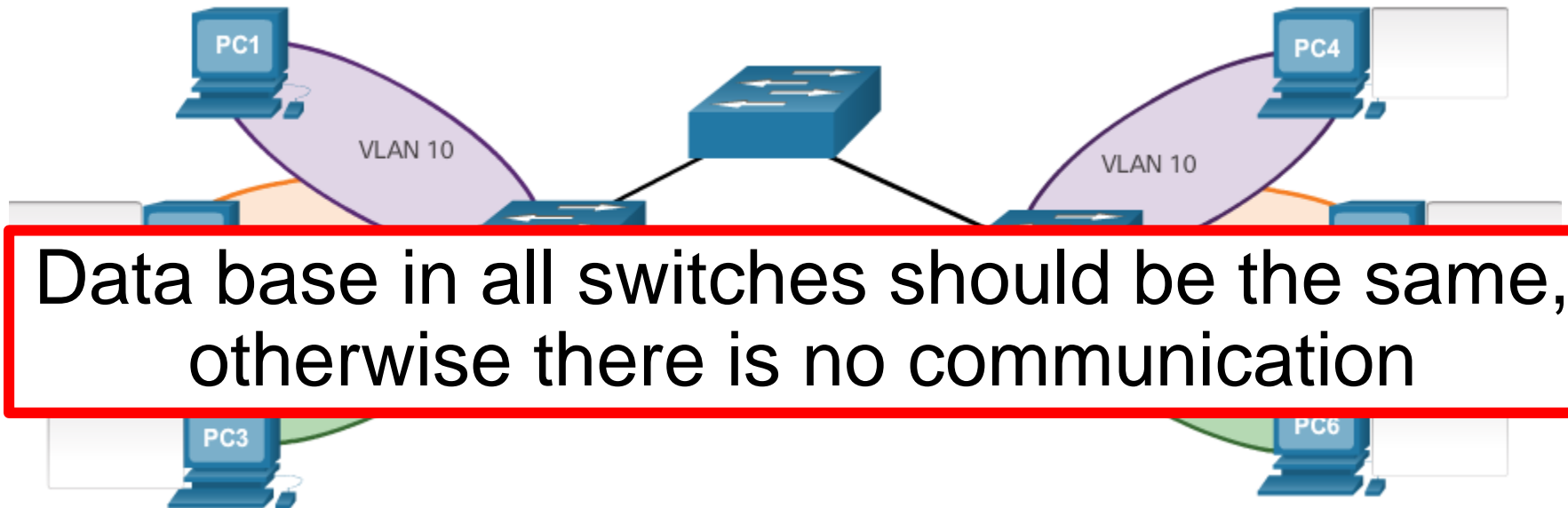
Fields in an Ethernet 802.1Q Frame
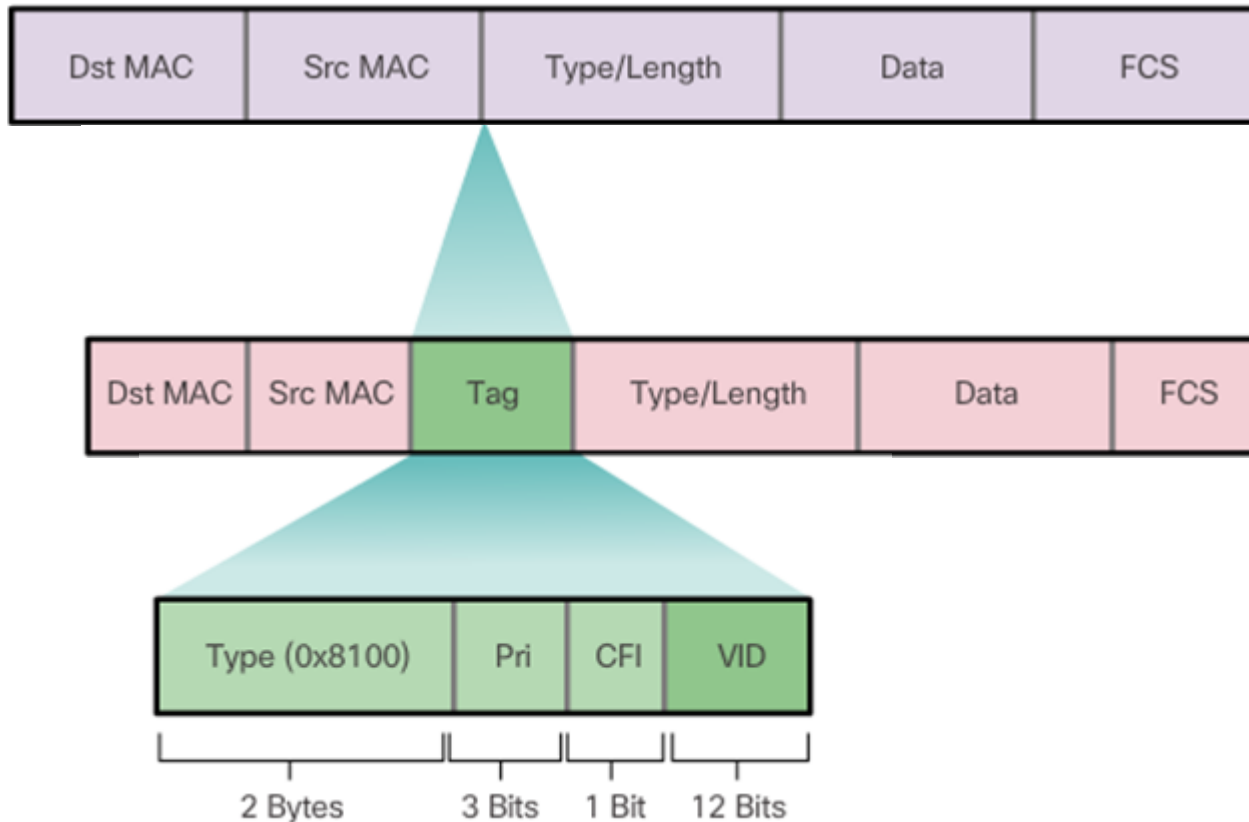
Native VLANs and 802.1Q Tagging

- **Control traffic** sent on the **native VLAN** should not be tagged.

- **Frames** received untagged, remain untagged and **are placed** in the **native VLAN** when forwarded.

- When **configuring** a switch **port** on a Cisco switch, **configure** devices so **that they do not send tagged frames on the native VLAN**.

- **In Cisco switches, the native VLAN is VLAN 1, by default**.

Activity – Predict Switch Behavior

Data base in all switches should be the same, otherwise there is no communication

Scenario 1: PC 1 sends a broadcast.
Scenario 2: PC 2 sends a broadcast.
Scenario 3: PC 3 sends a broadcast.

6.2 VLAN Implementations

VLAN Ranges on Catalyst Switches

- Cisco Catalyst **2960** and **3560** Series switches support over **4,000 VLANs**.

- VLANs are split into two categories:

  - **Normal** range **VLANs**

    - **VLAN** numbers from **1 to 1,005**

    - Configurations stored in the **vlan.dat** (in the flash memory)

    - IDs **1002 through 1005** are reserved for **Token Ring and Fiber Distributed Data Interface (FDDI)** VLANs, automatically created and cannot be removed

  - **Extended** Range **VLANs**

    - VLAN numbers from **1,006 to 4,096**

    - **Configurations** stored in the **running configuration** (NVRAM)

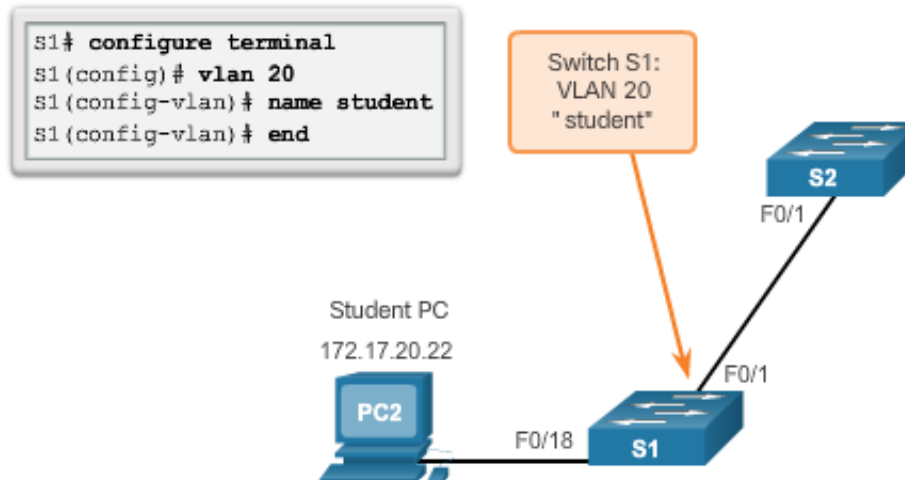   - VLAN Trunking Protocol (**VTP**) does **not learn extended** VLANs

Creating a VLAN

Cisco Switch IOS Commands

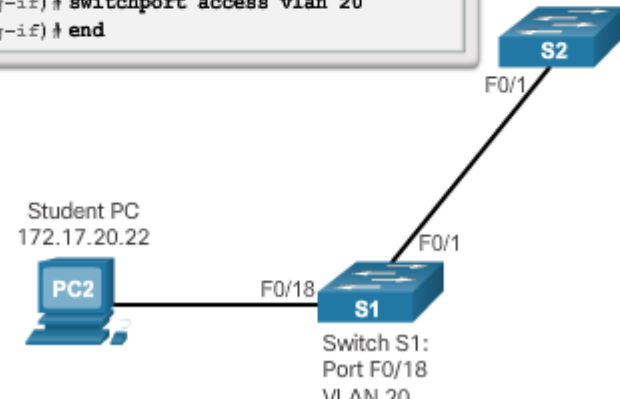|	
Enter global configuration mode.	S1# configure terminal
Create a VLAN with a valid id number.	S1(config)# vlan vlan-id
Specify a unique name to identify the VLAN.	S1(config-vlan)# name vlan-name
Return to the privileged EXEC mode.	S1(config-vlan)# end

Sample Configuration

```
S1# configure terminal
S1(config)# vlan 20
S1(config-vlan)# name student
S1(config-vlan)# end
```

Switch S1:
VLAN 20
"student"

S2

F0/1

Student PC
172.17.20.22

F0/1

PC2

F0/18   S1

Assigning Ports to VLANs

Cisco Switch IOS Commands

Enter global configuration mode.	`S1# configure terminal`
Enter interface configuration mode.	`S1(config)# interface interface_id`
Set the port to access mode.	`S1(config-if)# switchport mode access`
Assign the port to a VLAN.	`S1(config-if)# switchport access vlan vlan_id`
Return to the privileged EXEC mode.	`S1(config-if)# end`

```
s1# configure terminal
s1(config)# interface F0/18
s1(config-if)# switchport mode access
s1(config-if)# switchport access vlan 20
s1(config-if)# end
```

S2

F0/1

Student PC
172.17.20.22

F0/1

F0/18   S1

Switch S1:
Port F0/18
VLAN 20

PC2

Assigning Ports to VLANs

```
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3(con
S3#
```

vlan 10
name HomeOffice
exit

int range f0/1-15
switchport mode access
switchport access vlan 10

Student
VLAN 20 - 172.17.20.25

Verifying VLAN Information

show vlan Command

Cisco IOS CLI Command Syntax	
show vlan [brief | id vlan-id | name vlan-name | summary]	
Display one line for each VLAN with the VLAN name, status, and its ports.	brief
Display information about a single VLAN identified by VLAN ID number. For vlan-id, the range is 1 to 4094.	id vlan-id
Display information about a single VLAN identified by VLAN name. The VLAN name is an ASCII string from 1 to 32 characters.	name vlan-name
Display VLAN summary information.	summary

show interfaces Command

Cisco IOS CLI Command Syntax	
show interfaces [interface-id | vlan vlan-id] | switchport	
Valid interfaces include physical ports (including type, module, and port number) and port channels. The port-channel range is 1 to 6.	interface-id
VLAN identification. The range is 1 to 4094.	vlan vlan-id
Display the administrative and operational status of a switching port, including port blocking and port protection settings.	switchport

Configuring IEEE 802.1q Trunk Links

Trunk Configuration

Cisco Switch IOS Commands	
Enter global configuration mode.	`S1# configure terminal`
Enter interface configuration mode.	`S1(config)# interface interface_id`
Force the link to be a trunk link.	`S1(config-if)# switchport mode trunk`
Specify a native VLAN for untagged frames.	`S1(config-if)# switchport trunk native vlan vlan_id`
Specify the list of VLANs to be allowed on the trunk link.	`S1(config-if)# switchport trunk allowed vlan vlan-list`
Return to the privileged EXEC mode.	`S1(config-if)# end`

```
S1(config)# interface FastEthernet0/1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk native vlan 99
S1(config-if)# switchport trunk allowed vlan 10,20,30,99
S1(config-if)# end
```

Configuring IEEE 802.1q Trunk Links (cont.)

Example Topology

```
VLAN 10 - Faculty/Staff - 172.17.10.0/24
VLAN 20 - Students - 172.17.20.0/24
VLAN 30 - Guest - 172.17.30.0/24
VLAN 99 - Native - 172.17.99.0/24
```

```
int F0/1
switchport mode trunk
no shut
```
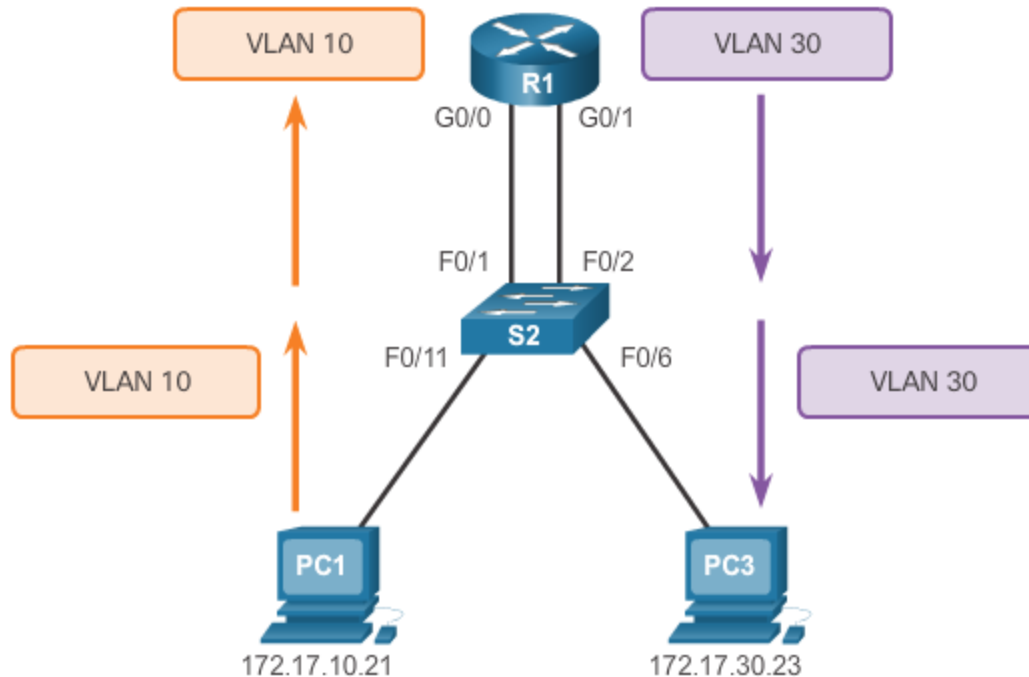
Guest
VLAN 30
172.17.30.23

PC3

6.3 Inter-VLAN Routing Using Routers

What is Inter-VLAN Routing?

- Layer 2 **switches cannot forward traffic between VLANs** without the assistance of a router.

- **Inter-VLAN routing** is a process for **forwarding** network **traffic** from one **VLAN** to **another**, <u>using a router</u>.

What is Inter-VLAN Routing?

Router-on-a-Stick Inter-VLAN Routing

- The **router-on-a-stick** approach uses **only one** of the router's **physical interface**.

- One of the router's physical interfaces **is configured as a 802.1Q trunk** port so it can understand VLAN tags.

- Logical **subinterfaces** are **created**; **one subinterface per VLAN**.

- Each **subinterface** is **configured** with an **IP address from the VLAN** it represents.

- **VLAN members** (hosts) are configured to **use the subinterface address** as a **default gateway**.

Configure Router-on-a Stick: Switch Configuration

```
! Subinterface for VLAN 10
int g0/1.10
description  HomeOffice
encapsulation  dot1q  10
ip add  192.168.10.126  255.255.255.128

! Subinterface for VLAN 20
int g0/1.20
description  Entretenimiento
encapsulation   dot1q   20
ip add 192.168.10.190  255.255.255.192

int g0/1
no shut
```

Ejemplo 06– Configuración **básica** de VLANs

El departamento de **TI** de **IT² Networking Consulting**, con base en la información recopilada nos solicita realizar una propuesta de solución.

Nuestra labor del día de hoy es realizar la programación necesaria de los equipos de interconexión para demostrar que el tráfico puede ser segmentado.

Ejemplo 06– Configuración **básica** de VLANs

Utiliza la propuesta inicial del diseño lógico de la red (segmentación de tráfico) de la siguiente tabla y el diagrama que ilustra el diseño físico de la red para realizar la programación de los equipos de interconexión.

Accede al Módulo 5 en CANVAS y descarga los archivos relacionados con el Ejemplo de VLANs.