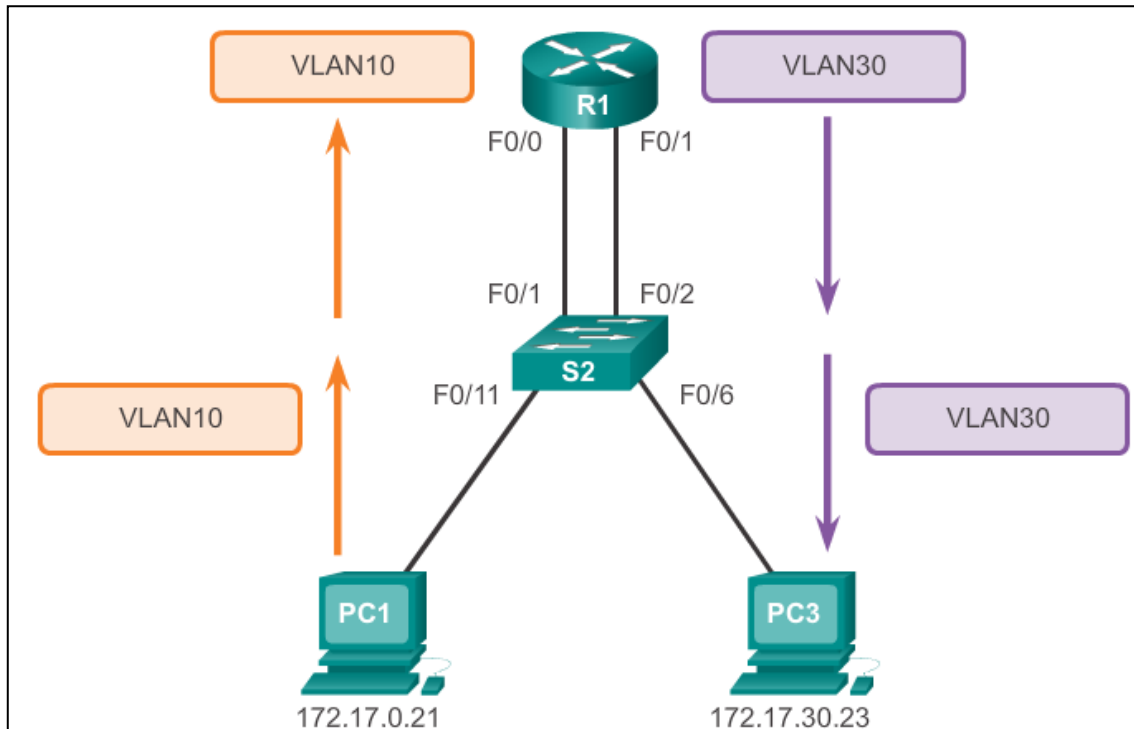# NET 363
Introduction to LANs

Inter-VLAN routing and L3 Switches

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Inter-VLAN Routing Operation
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, using a router.

Legacy Inter-VLAN Routing

In the past:

- Each VLAN was connected to a different physical router interface.

- Packets would arrive on the router through one through interface, be routed and leave through another.

- Because the router interfaces were connected to VLANs and had IP addresses from that specific VLAN, routing between VLANs was achieved.

- Large networks with large number of VLANs required many router interfaces.

Legacy Inter-VLAN Routing

Routing between VLANs:

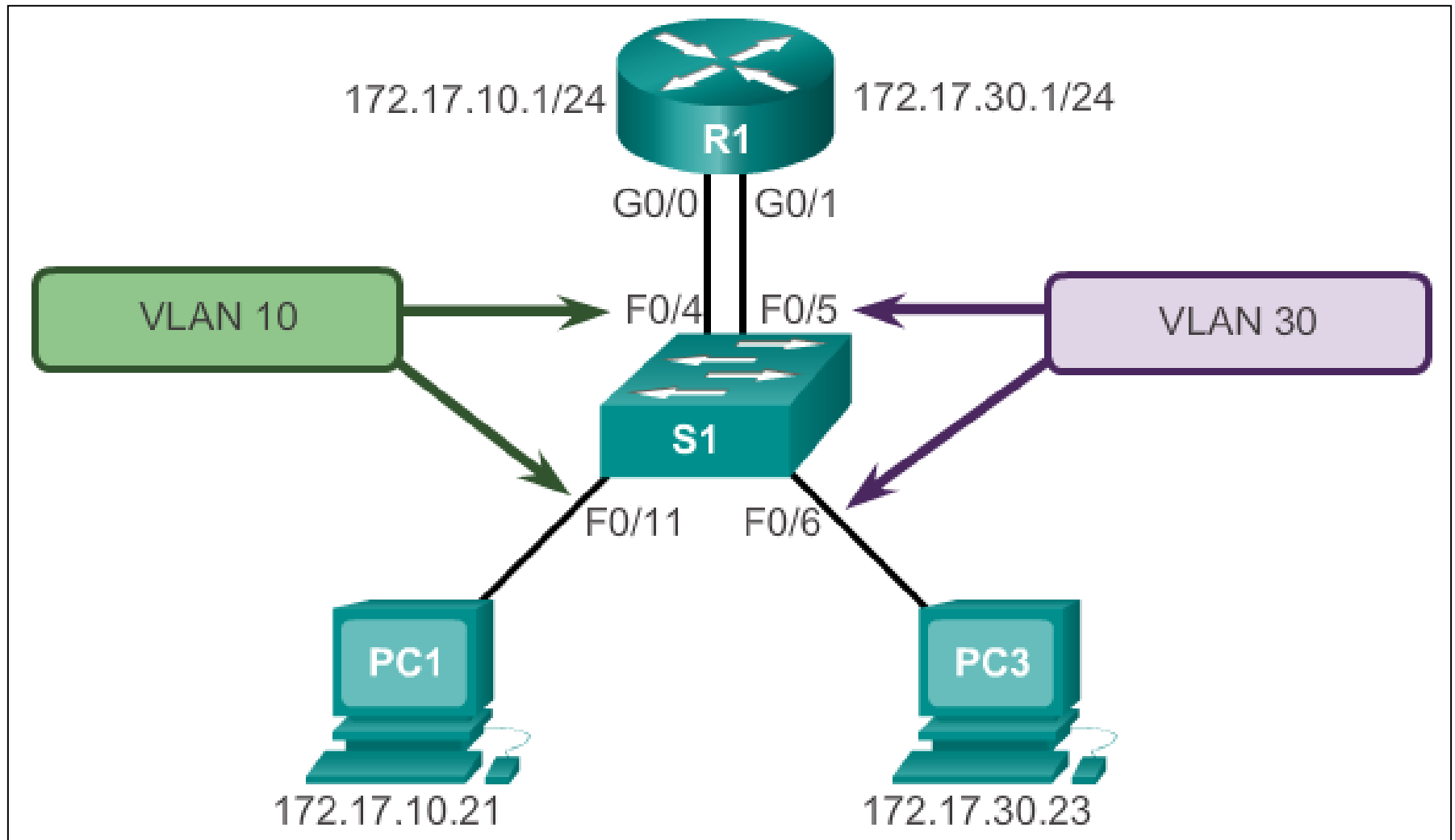**1st approach – One router interface for each VLAN as access port!**
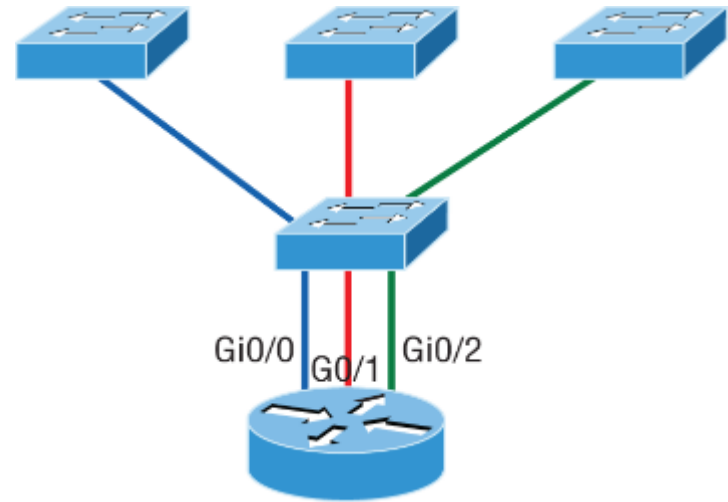
- As shown in the figure, if you had three VLANs, you would need a router equipped with three Ethernet interfaces.

- Each router interface link connects to an **access port** on the switch for a single VLAN. This means that each of the routers' interface IP addresses would then become the **default gateway address** for each host on each respective VLAN.

Example – Legacy Inter-VLAN Routing

     5

Switch Configuration

```
S1(config)# vlan 10
S1(config-vlan)# vlan 30
S1(config-vlan)# interface f0/11
S1(config-if)# switchport access vlan 10
S1(config-if)# interface f0/4
S1(config-if)# switchport access vlan 10
S1(config-if)# interface f0/6
S1(config-if)# switchport access vlan 30
S1(config-if)# interface f0/5
S1(config-if)# switchport access vlan 30
S1(config-if)# end
*Mar 20 01:22:56.751: %SYS-5-CONFIG_I: Configured from console by
console
S1# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Router Interface Configuration

```
R1(config)# interface g0/0
R1(config-if)# ip address 172.17.10.1 255.255.255.0
R1(config-if)# no shutdown
*Mar 20 01:42:12.951: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
changed state to up
*Mar 20 01:42:13.951: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/0, changed state to up
R1(config-if)# interface g0/1
R1(config-if)# ip address 172.17.30.1 255.255.255.0
R1(config-if)# no shutdown
*Mar 20 01:42:54.951: %LINK-3-UPDOWN: Interface GigabitEthernet0/1,
changed state to up
*Mar 20 01:42:55.951: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/1, changed state to up
R1(config-if)# end
R1# copy running-config startup-config
```

Router-on-a-Stick Inter-VLAN Routing

- The router-on-a-stick approach uses a different path to route between VLANs.

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

- Router's 802.1Q interface is connected through a data cable to one Trunk Port on switch.

- One physical 802.1Q interface can handle multiple VLANs, based on VLAN Tag in each incoming packet.

  Logical subinterfaces are created; one subinterface per VLAN.
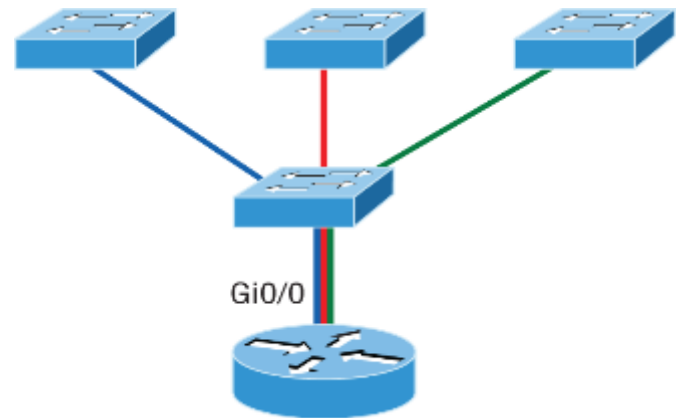
  Each subinterface is configured with an IP address from the VLAN it represents.

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

Inter-VLAN Routing

Routing between VLANs:
2nd approach – Router On A Stick (ROAS)

Gi0/0

Single router interface connecting all three VLANs together for inter-VLAN communication.

Instead of using a router interface for each VLAN, you can use one FastEthernet interface and configure ISL or 802.1q trunking.

The figure shows how a FastEthernet interface on a router will look when configured with ISL or 802.1q trunking. This allows all VLANs to communicate through one interface. Cisco calls this a "router on a stick (ROAS)".

Configure Router-on-a-Stick
Switch Configuration
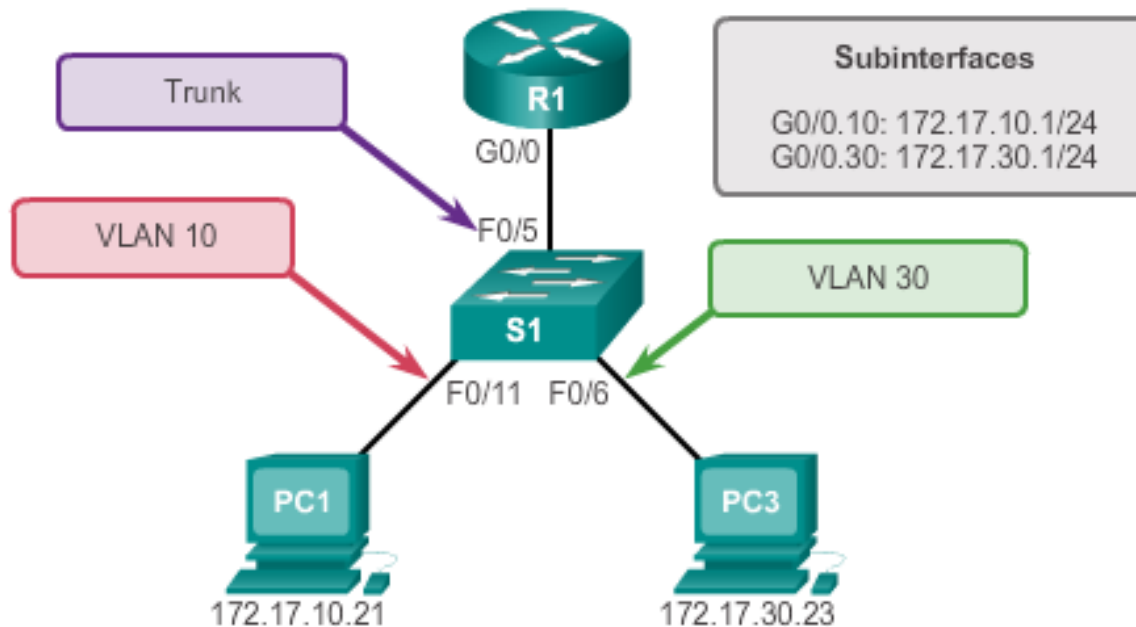

```
S1(config)# vlan 10
S1(config-vlan)# vlan 30
S1(config-vlan)# interface f0/5
S1(config-if)# switchport mode trunk
S1(config-if)# end
S1#
```

Router-on-a-Stick Configuration

- <u>Subinterfaces</u> specify how router handles each VLAN for 802.1Q interface.

  - Subinterface name = <Interface Name> "." <Number>

  - Example: **Fa0/0.10** is the name of a subinterface of Fa0/0 that sends/receives packets one particular VLAN.

  - The "**encapsulation dot1q <VLAN Number>**" command on subinterface specifies the VLAN number for this subinterface.

Configure Router-on-a-Stick
Router Subinterface Configuration

```
R1(config)# interface g0/0.10
R1(config-subif)# encapsulation dot1q 10
R1(config-subif)# ip address 172.17.10.1 255.255.255.0
R1(config-subif)# interface g0/0.30
R1(config-subif)# encapsulation dot1q 30
R1(config-subif)# ip address 172.17.30.1 255.255.255.0
R1(config)# interface g0/0
R1(config-if)# no shutdown
*Mar 20 00:20:59.299: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
 changed state to down
*Mar 20 00:21:02.919: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
 changed state to up
*Mar 20 00:21:03.919: %LINEPROTO-5-UPDOWN: Line protocol on
 changed state to down
*Mar 20 00:21:02.919: %LINK-3-UPDOWN: Interface GigabitEthernet0/0,
 changed state to up
*Mar 20 00:21:03.919: %LINEPROTO-5-UPDOWN: Line protocol on
 Interface GigabitEthernet0/0, changed state to up
```
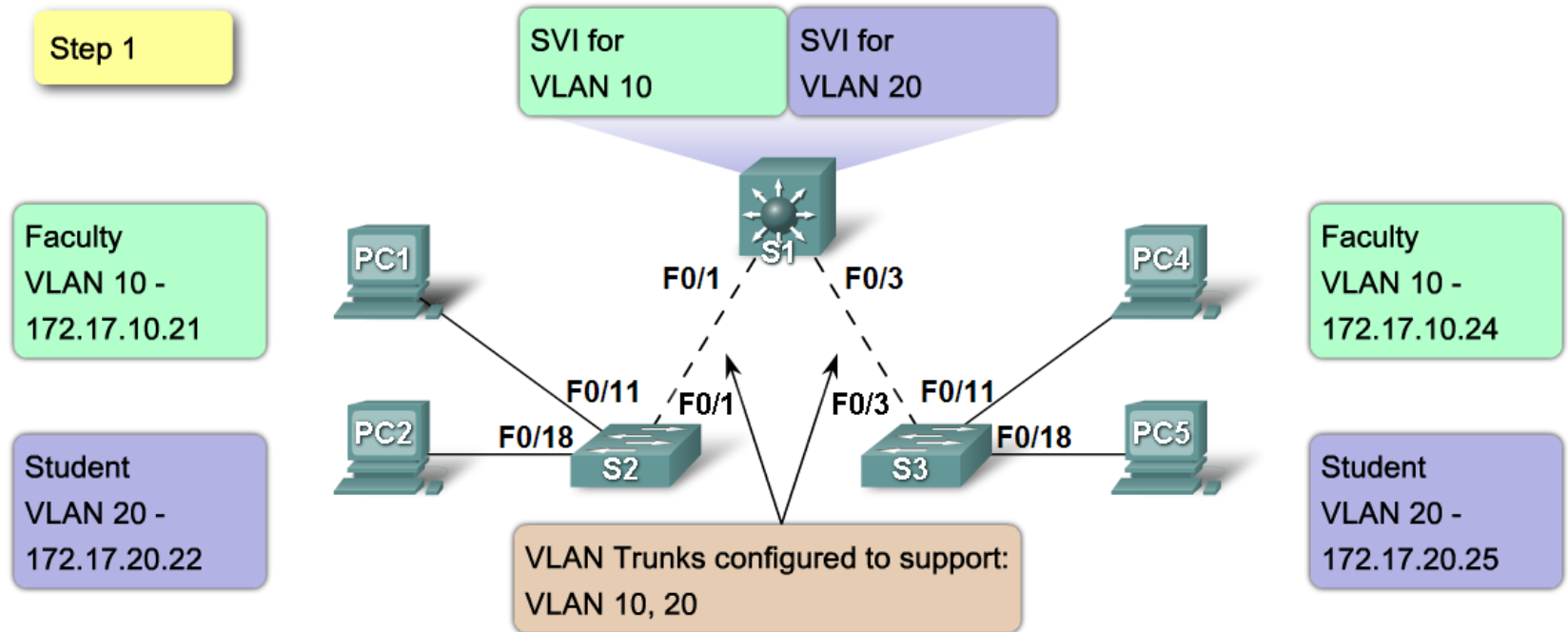
Layer 3 Switches

- A **<u>Layer 3 Switch</u>** or **<u>Multilayer Switch</u>** performs the same operations as a standard (layer 2) switch, but can also perform <u>IP routing</u> to move packets from one VLAN/subnet to other IP subnets.
    - The SVI IP for each VLAN is the Default Gateway IP
- Layer 3 switches improve VLAN performance since they provide a way to pass data between VLANs <u>without</u> going to an external router.
- Layer 3 switch interfaces can also be converted to <u>L3 interfaces</u> that have an IP address and work like a regular router interface (each L3 interface connects to a separate external IP subnet).

Layer 3 Switch

Layer 3 Forwarding

Layer 3 Switch Configuration

- On an L3 Switch, execute **ip routing** command in global config mode to activate <u>routing operations</u>:
  - L3 Switch creates its own routing table.
  - **Inter-VLAN Routing**: L3 Switch will route between all its active VLANs as directly-connected subnets, where the <u>VLAN SVI IP</u> is default gateway address for each VLAN.
  - To create a <u>L3 interface</u>, execute **no switchport** on that interface and assign it an IP address.
    - **Router Peering**: the L3 interface can be used to exchange RIP, OSPF, EIGRP or BGP packets with another router to keep routing table updated.   Not a part of NET 363.