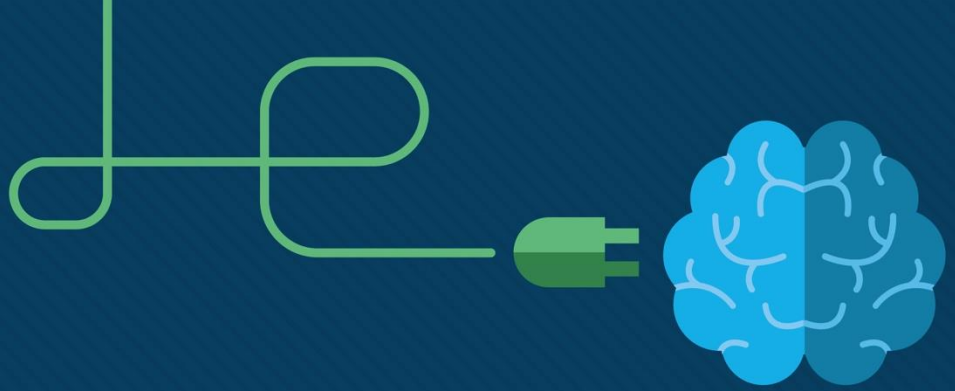


Chapter 6: VLANs

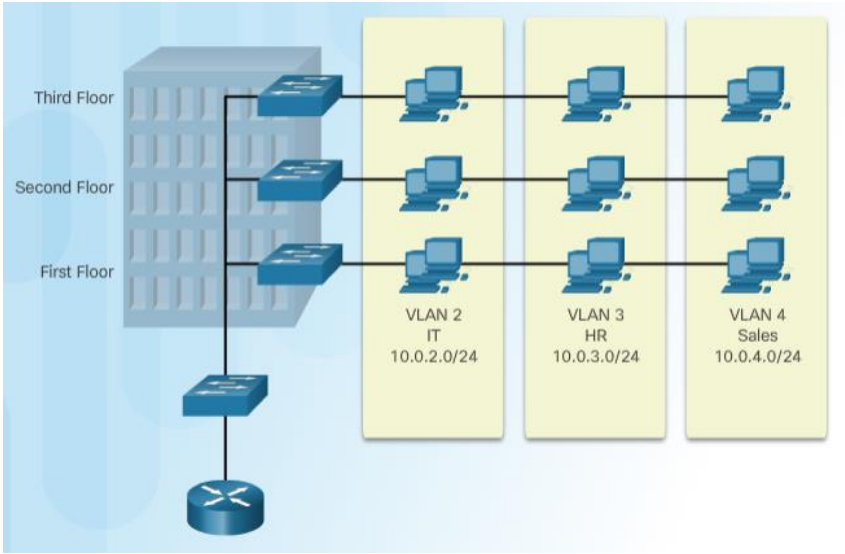
CCNA Routing and Switching

Routing and Switching Essentials v6.0

6.1 VLAN Segmentation

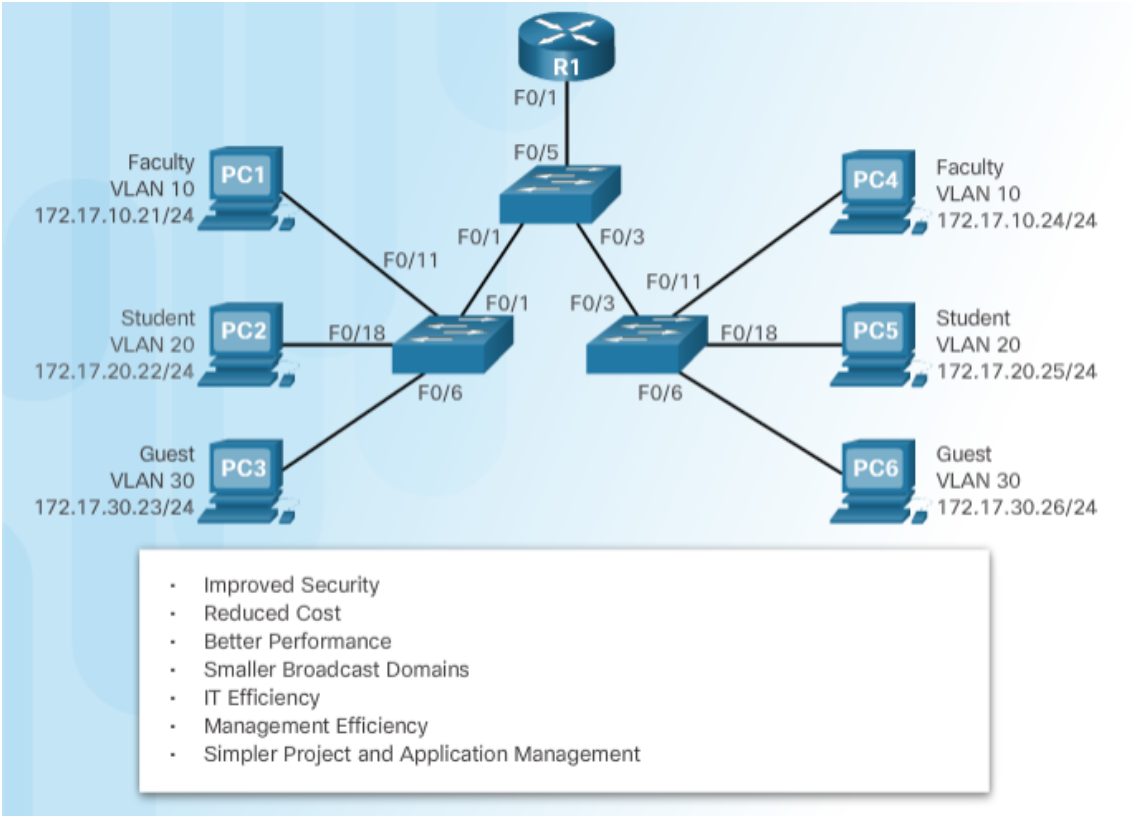
VLAN Definitions

- VLANs can segment LAN devices without regard for the physical location of the user or device.
  - In the figure, IT users on the first, second, and third floors are all on the same LAN segment. The same is true for HR and Sales users.
- A VLAN is a logical partition of a Layer 2 network.
  - Multiple partitions can be created and multiple VLANs can co-exist.
  - The partitioning of the Layer 2 network takes place inside a Layer 2 device, usually via a switch.
  - Each VLAN is a broadcast domain that can span multiple physical LAN segments.
  - Hosts on the same VLAN are unaware of the VLAN's existence.



- VLANs are mutually isolated and packets can only pass between VLANs via a router.

Benefits of VLANs



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

Types of VLANs

- Common types of VLANs:
  - **Default VLAN** – Also known as VLAN 1. All switch ports are members of VLAN 1 by default.
  - **Data VLAN** – Data VLANs are commonly created for specific groups of users or devices. They carry user generated traffic.
  - **Native VLAN** – This is the VLAN that carries all untagged traffic. This is traffic that does not originate from a VLAN port (e.g., STP BPDU traffic exchanged between STP enabled switches). The native VLAN is VLAN 1 by default.
  - **Management VLAN** – This is a VLAN that is created to carry network management traffic including SSH, SNMP, Syslog, and more. VLAN 1 is the default VLAN used for network management.

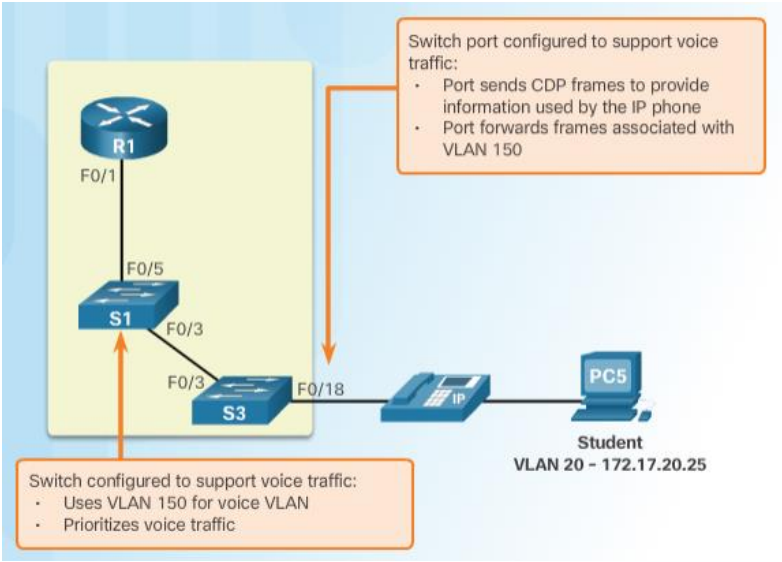
Default VLAN Assignment

```
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
```

Initially, all switch ports are members of VLAN 1.

Voice VLANs

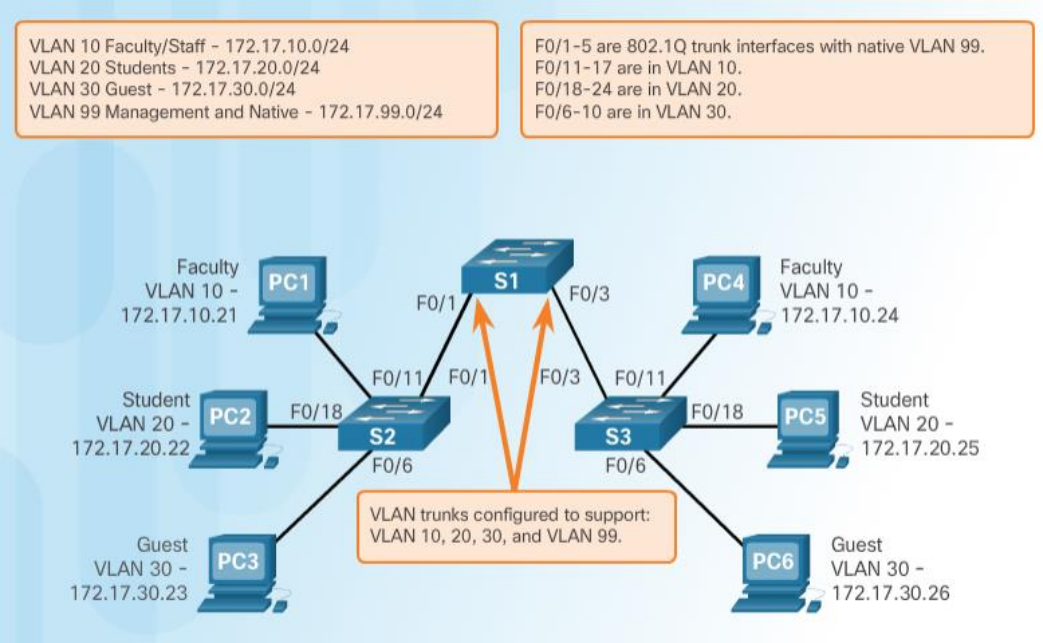
- To support time-sensitive voice traffic, Cisco switches support a voice VLAN that requires:
  - Assured bandwidth
  - Delay of less than 150 ms across the network to ensure voice quality
  - Transmission priority over other types of network traffic
  - Ability to be routed around congested areas on the network.



- The voice VLAN feature enables access ports to carry user and IP voice traffic.
  - In the figure, the S3 F0/18 interface has been configured to tag student traffic on VLAN 20 and voice traffic on VLAN 150.

VLAN Trunks

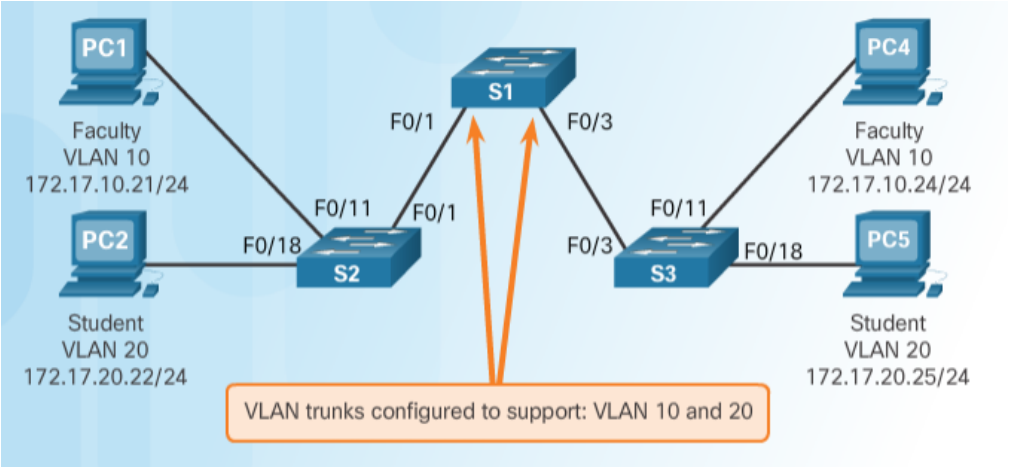
- A VLAN trunk is a point-to-point link that carries more than one VLAN.
  - Usually established between switches to support intra VLAN communication.
  - A VLAN trunk or trunk ports are not associated to any VLANs.
- Cisco IOS supports IEEE 802.1q, a popular VLAN trunk protocol.



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.

Controlling Broadcast Domains with VLANs

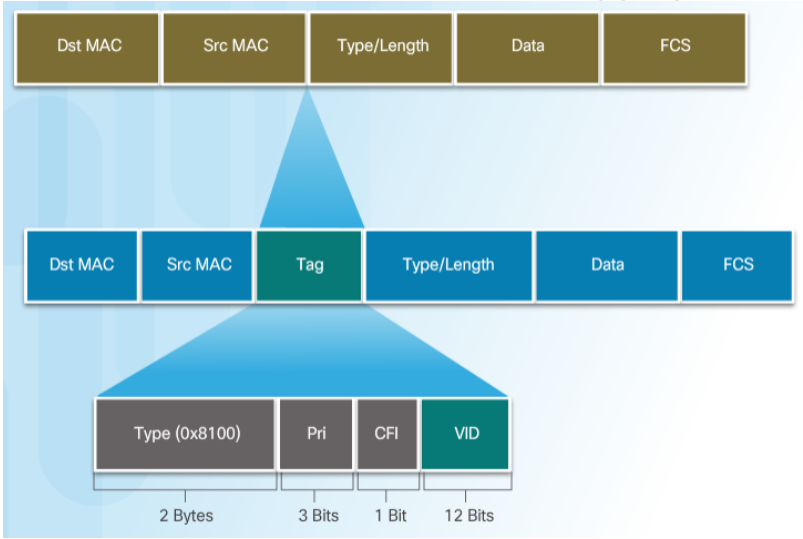
- If a switch port receives a broadcast frame, it forwards it out all ports except the originating port.
  - Eventually the entire network receives the broadcast because the network is one broadcast domain.
- VLANs can be used to limit the reach of broadcast frames because each VLAN is a broadcast domain.
  - VLANs help control the reach of broadcast frames and their impact in the network.
- In the figure, PC1 on VLAN 10 sends a broadcast frame.
  - Trunk links between S2 - S1 and S1 - S3 propagate the broadcast to other devices in VLAN 10.
  - Only devices in the same VLAN receive the broadcast therefore, PC4 would receive the broadcast.



Tagging Ethernet Frames for VLAN Identification

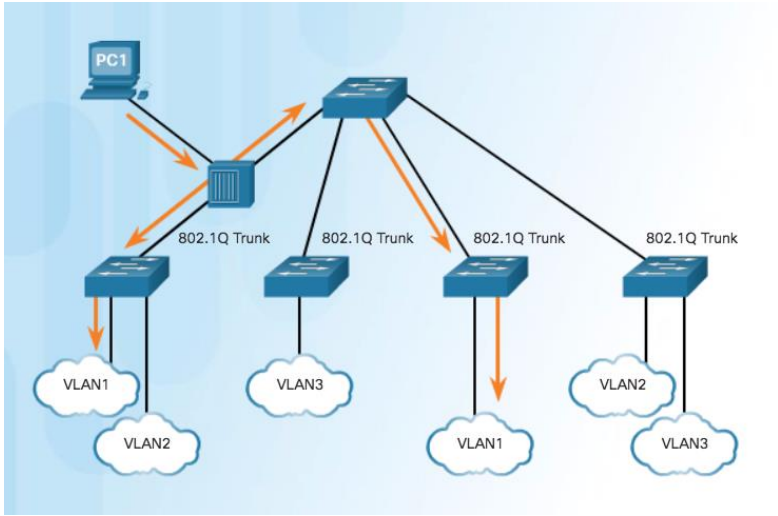
- Before a frame is forwarded across a trunk link, it must be tagged with its VLAN information.
  - Frame tagging is the process of adding a VLAN identification header to the frame.
  - It is used to properly transmit multiple VLAN frames through a trunk link.

- IEEE 802.1Q is a vey popular VLAN trunking protocol that defines the structure of the tagging header added to the frame.
  - Switches add VLAN tagging information after the Source MAC address field.
  - The fields in the 802.1Q VLAN tag includes VLAN ID (VID).
  - Trunk links add the tag information before sending the frame and then remove the tags before forwarding frames through non-trunk ports.



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.
- If there are no ports associated to the native VLAN and no other trunk links, an untagged frame is dropped.
- 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.



6.2 VLAN Implementation

VLAN Ranges on Catalyst Switches

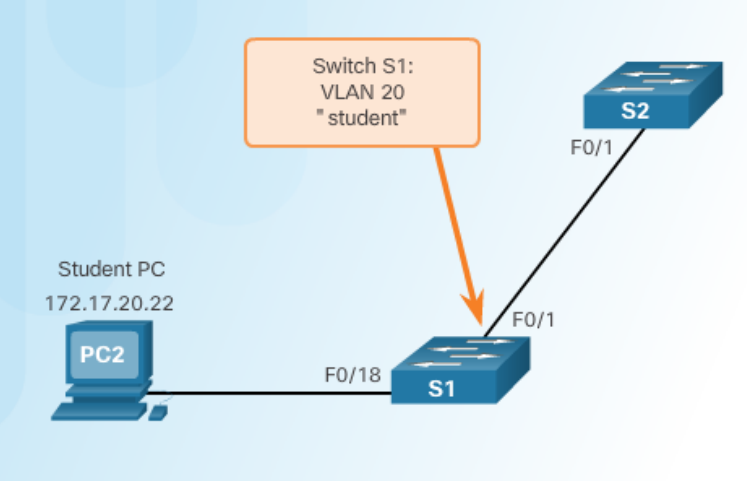
- VLANs are split into two categories:
  - **Normal range VLANs**
    - VLAN numbers from 1 to 1,005
    - Configurations stored in the vlan.dat (in the flash memory)
    - IDs 1002 through 1005 are reserved for legacy Token Ring and Fiber Distributed Data Interface (FDDI) VLANs, automatically created 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

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

```
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
```

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`

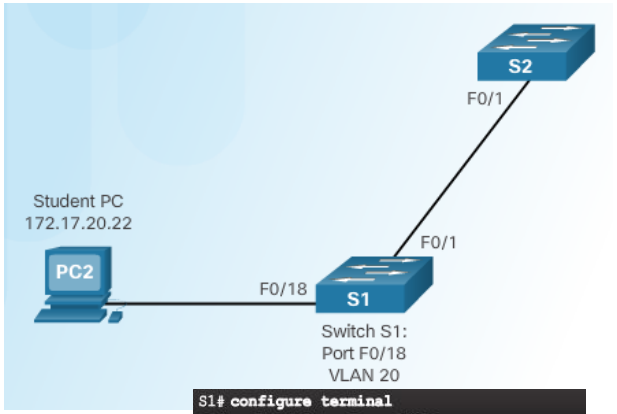



```
S1# configure terminal
S1(config)# vlan 20
S1(config-vlan)# name student
S1(config-vlan)# end
```

Assigning Ports to VLANs

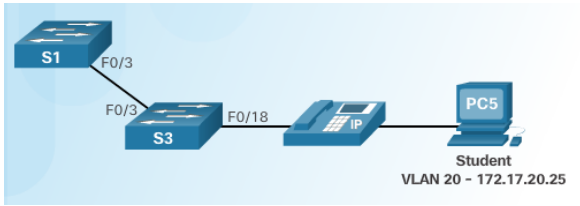
Cisco Switch IOS Commands	
Enter global configuration mode.	`S1# configure terminal`
Enter interface configuration mode.	`S1(config)# interface interface_id`
Set the port to access mode.	`S1(config-if)# switchport mode access`
Assign the port to a VLAN.	`S1(config-if)# switchport access vlan vlan_id`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

Example 1




```
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
```

Example 2




```
S3(config)# vlan 20
S3(config-vlan)# name student
S3(config-vlan)# vlan 150
S3(config-vlan)# name VOICE
S3(config-vlan)# exit
S3(config)#
S3(config)# interface fa0/18
S3(config-if)# switchport mode access
S3(config-if)# switchport access vlan 20
S3(config-if)#
S3(config-if)# mls qos trust cos
S3(config-if)# switchport voice vlan 150
S3(config-if)# end
S3#
```

Changing VLAN Port Membership

- Remove VLAN Assignment

Cisco Switch IOS Commands	
Enter global configuration mode.	`S1# configure terminal`
Enter interface configuration mode	`S1(config)# interface F0/18`
Remove the VLAN assignment from the port.	`S1(config-if)# no switchport access vlan`
Return to the privileged EXEC mode.	`S1(config-if)# end`

Even though interface F0/18 was previously assigned to VLAN 20, it reset to the default VLAN1.

```
S1(config)# int F0/18
S1(config-if)# no switchport access vlan
S1(config-if)# end
S1# 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
20   student           active
1002 fddi-default      act/unsup
1003 token-ring-default act/unsup
1004 fddinet-default   act/unsup
1005 trnet-default     act/unsup
S1#
```

Deleting VLANs

- Use the **no vlan** *vlan-id* global configuration mode command to remove VLAN.

```
S1# conf t
S1(config)# no vlan 20
S1(config)# end
S1#
S1# sh 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, Fa0/12, 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
S1#
```

- To delete the entire vlan.dat file, use the **delete flash:vlan.dat** privileged EXEC mode command.
  - **delete vlan.dat** can be used if the vlan.dat file has not been moved from its default location.

Verifying VLAN Information

- VLAN configurations can be validated using the Cisco IOS **show vlan** and **show interfaces** command options.

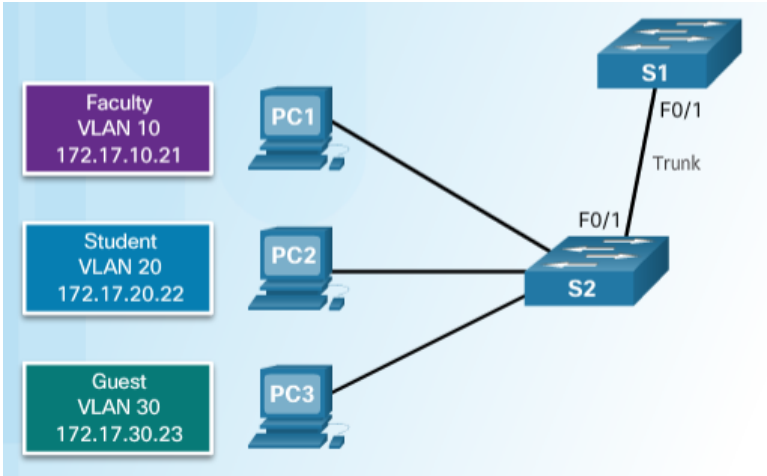
```
S1# show vlan name student

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------
20   student                           active    Fa0/11, Fa0/18

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
20   enet  100020     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------

S1# show vlan summary
Number of existing VLANs              : 7
Number of existing VTP VLANs          : 7
Number of existing extended VLANS     : 0

S1#
```

```
S1# show interfaces vlan 20
Vlan20 is up, line protocol is down
  Hardware is EtherSVI, address is 001c.57ec.0641 (bia 001c.57ec.0641)
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Configuring IEEE 802.1q Trunk Links

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`

Native VLAN
VLAN 99
172.17.99.0/24




```
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
```

Resetting the Trunk to Default State

Cisco Switch IOS Commands	
Enter global configuration mode.	S1# **configure terminal**
Enter interface configuration mode.	S1(config)# **interface** *interface_id*
Set trunk to allow all VLANs.	S1(config-if)# **no switchport trunk allowed vlan**
Reset native VLAN to default.	S1(config-if)# **no switchport trunk native vlan**
Return to the privileged EXEC mode.	S1(config-if)# **end**

```
S1(config)# interface f0/1
S1(config-if)# no switchport trunk allowed vlan
S1(config-if)# no switchport trunk native vlan
S1(config-if)# end
S1# show interfaces f0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
<output omitted>
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
<output omitted>
```

F0/1 is configured as an access port which removes the trunk feature.

```
S1(config)# interface f0/1
S1(config-if)# switchport mode access
S1(config-if)# end
S1# show interfaces f0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
<output omitted>
```

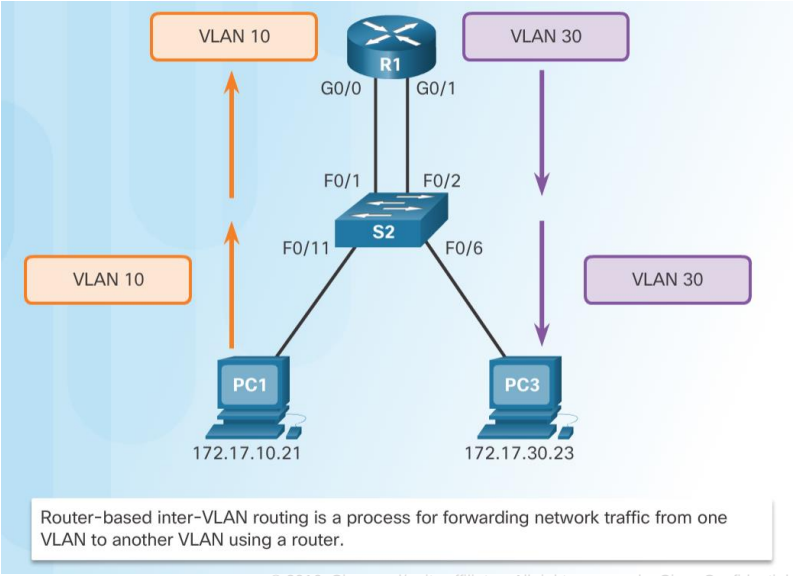
Verifying Trunk Configuration

```
S1(config)# interface f0/1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk native vlan 99
S1(config-if)# end
S1# show interfaces f0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 99 (VLAN0099)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk associations: none
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
<output omitted>
```

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, using a router.
- There are three options for inter-VLAN routing:
  - Legacy inter-VLAN routing
  - Router-on-a-Stick
  - Layer 3 switching using SVIs

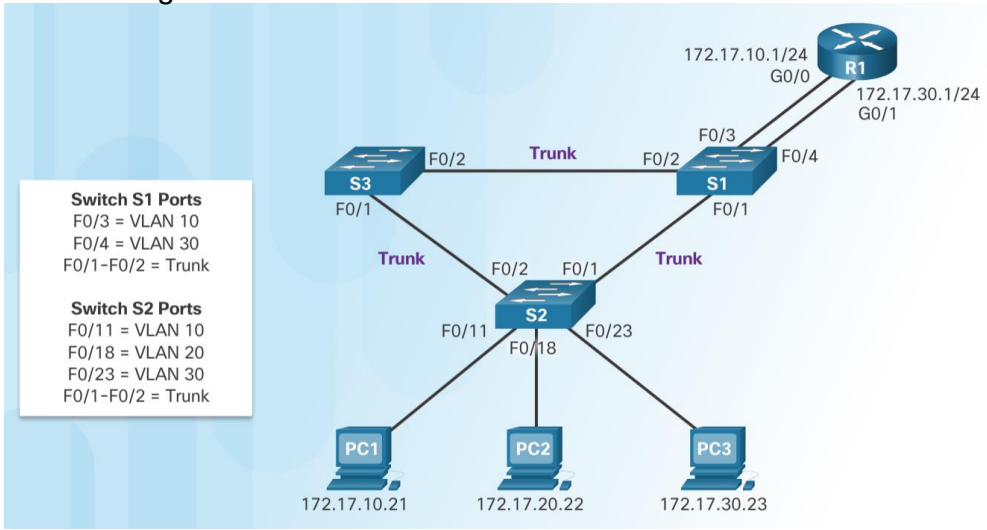


Router-based inter-VLAN routing is a process for forwarding network traffic from one VLAN to another VLAN using a router.

Legacy Inter-VLAN Routing

- In the past:
  - Router interfaces were used to route between VLANs.
  - Each VLAN was connected to a different physical router interface.
  - Packets would arrive on the router through one 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.

In this example, the router was configured with two separate physical interfaces to interact with the different VLANs and perform the routing.

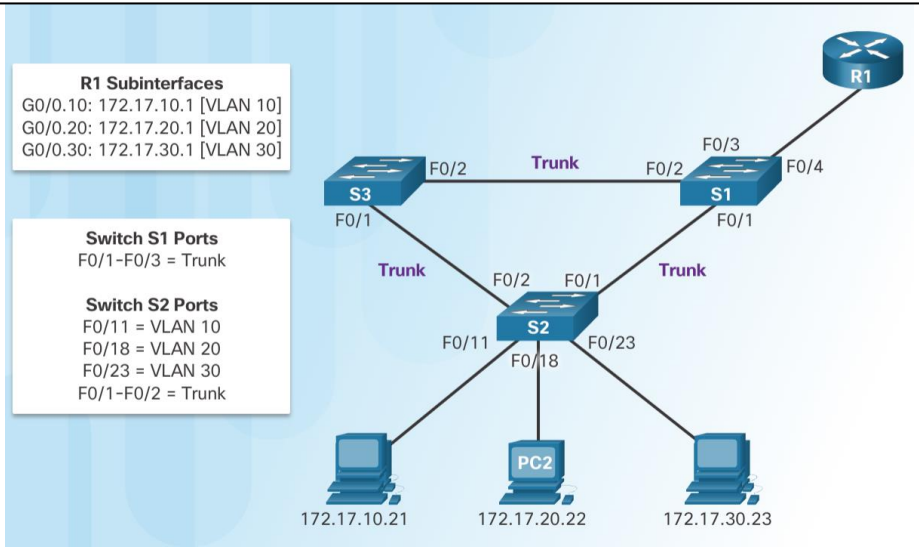


Router-on-a-Stick Inter-VLAN Routing

- 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.

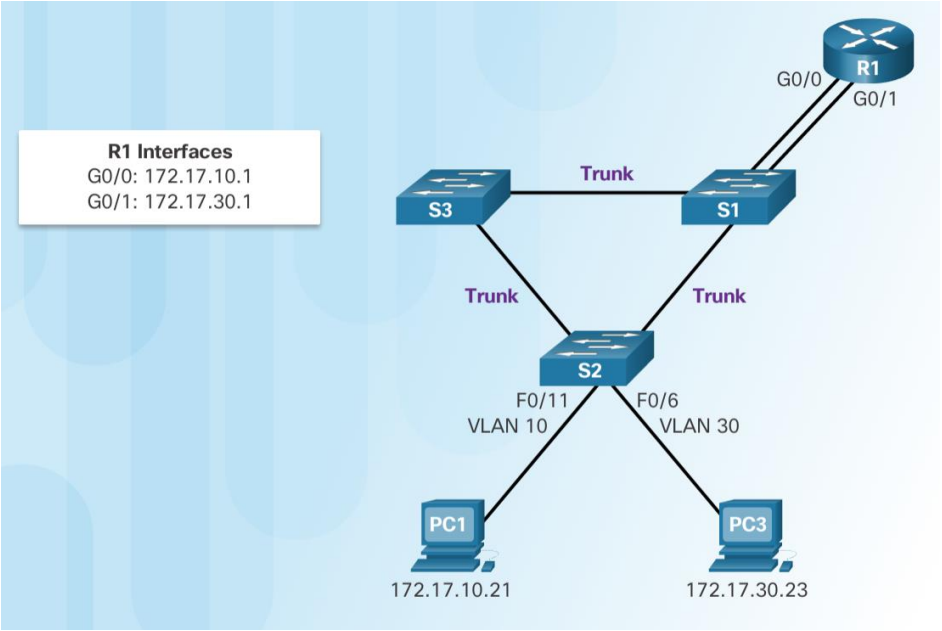
In this example, the R1 interface is configured as a trunk link and connects to the trunk F0/4 port on S1.

- Router accepts VLAN-tagged traffic on the trunk interface
- Router internally routes between the VLANs using subinterfaces.
- Router then forwards the routed traffic as VLAN-tagged for the destination VLAN out the trunk link.

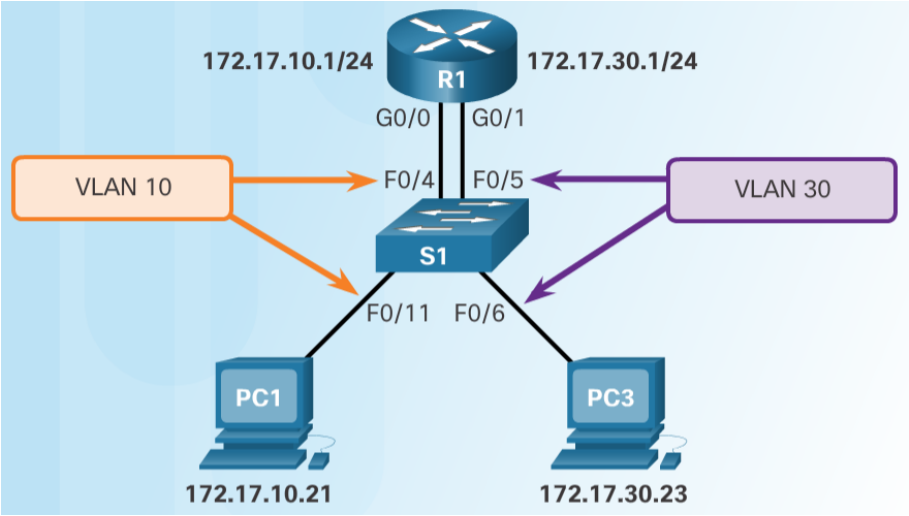


Configure Legacy Inter-VLAN Routing: Preparation

- Legacy inter-VLAN routing requires routers to have multiple physical interfaces.
- Each one of the router's physical interfaces is connected to a unique VLAN.
- Each interface is also configured with an IP address for the subnet associated with the particular VLAN.
- Network devices use the router as a gateway to access the devices connected to the other VLANs.



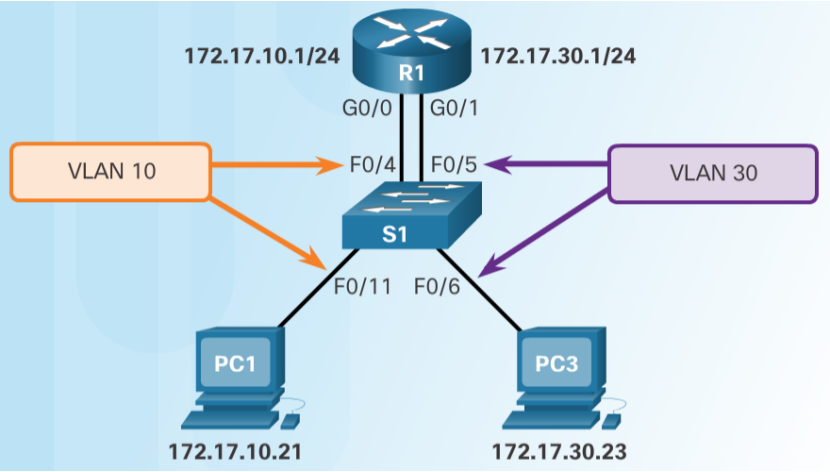
Configure Legacy Inter-VLAN Routing: Switch Configuration



- Configure the VLANs on the switch and then assign the ports to their respective VLANs.
- In this example, the S1 ports are configured as follows:
  - Ports F0/4 and F0/11 of S1 are on VLAN 10
  - Ports F0/5 and F0/16 ports are on VLAN 30.

```
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
```

Configure Legacy Inter-VLAN Routing: Router Interface Configuration

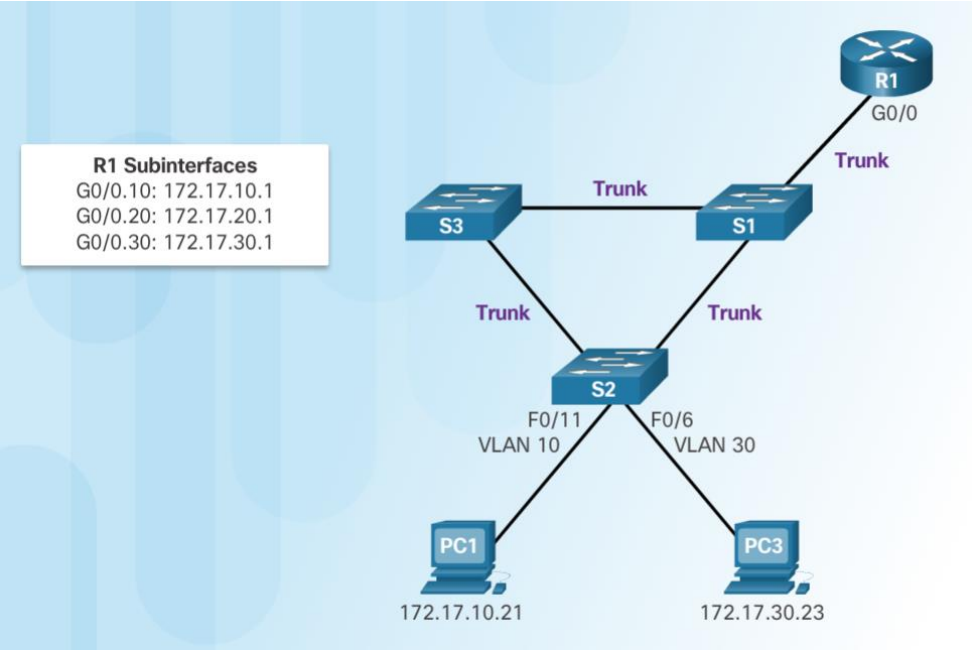


- Next configure the router interfaces.

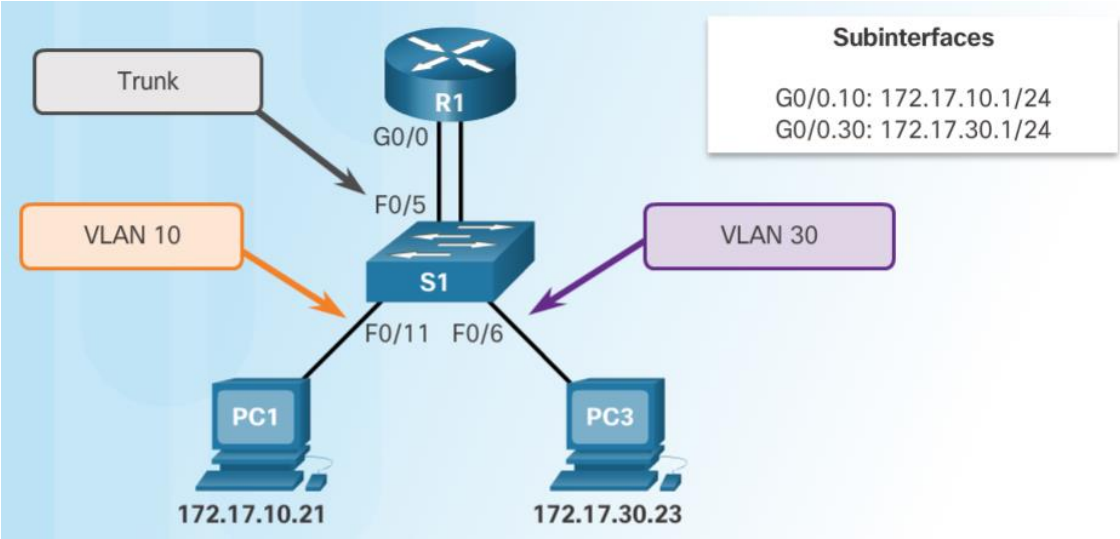
```
R1(config)# interface g0/0
R1(config-if)# ip address 172.17.10.1 255.255.255.0
R1(config-if)# no shutdown
*Mar 20 01:42:12.951: %LINK-3-UPDOWN: Interface GigabitEthernet0/0, changed state to up
*Mar 20 01:42:13.951: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0,
changed state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

Configure Router-on-a Stick: Preparation

- An alternative to legacy inter-VLAN routing is to use VLAN trunking and subinterfaces.
- VLAN trunking allows a single physical router interface to route traffic for multiple VLANs.
- The physical interface of the router must be connected to a trunk link on the adjacent switch.
- On the router, subinterfaces are created for each unique VLAN.
- Each subinterface is assigned an IP address specific to its subnet or VLAN and is also configured to tag frames for that VLAN.



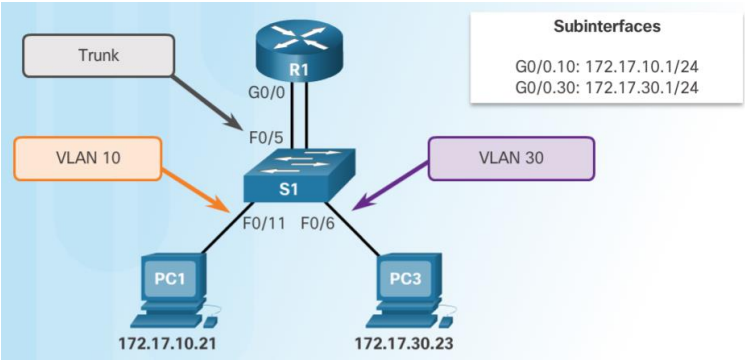
Configure Router-on-a Stick: Switch Configuration



- To enable inter-VLAN routing using router-on-a stick, start by enabling trunking on the switch port that is connected to the router.

```
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#
```

Configure Router-on-a Stick: Router Subinterface Configuration



- The router-on-a-stick method requires subinterfaces to be configured for each routable VLAN.
  - The subinterfaces must be configured to support VLANs using the **encapsulation dot1Q** *VLAN-ID* interface configuration command.

```
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 Interface GigabitEthernet0/0,
changed state to up
```

Configure Router-on-a Stick: Verifying Subinterfaces

- By default, Cisco routers are configured to route traffic between local subinterfaces.
  - As a result, routing does not specifically need to be enabled.
- Use the **show vlan** and **show ip route** commands to verify the subinterface configurations.

```
R1# show vlan
<output omitted>

Virtual LAN ID:  10 (IEEE 802.1Q Encapsulation)

  vLAN Trunk Interface:   GigabitEthernet0/0.10

  Protocols Configured:     Address:         Received:      Transmitted:
         IP                 172.17.10.1            11                18
<output omitted>

Virtual LAN ID:  30 (IEEE 802.1Q Encapsulation)

  vLAN Trunk Interface:   GigabitEthernet0/0.30

  Protocols Configured:     Address:         Received:      Transmitted:
         IP                 172.17.30.1            11                 8
<output omitted>
```

The **show vlan** command displays information about the Cisco IOS VLAN subinterfaces.

```
R1# show ip route
Codes: L - local, C - connected, S - static, R - RIP,M - mobile, B - BGP, D - EIGRP,
       EX - EIGRP external, O - OSPF, IA - OSPF inter area,
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, i - IS-IS,
       su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP,
       + - replicated route, % - next hop override

Gateway of last resort is not set

      172.17.0.0/16 is variably subnetted, 4 subnets, 2 masks
C     172.17.10.0/24 is directly connected, GigabitEthernet0/0.10
L     172.17.10.1/32 is directly connected, GigabitEthernet0/0.10
C     172.17.30.0/24 is directly connected, GigabitEthernet0/0.30
L     172.17.30.1/32 is directly connected, GigabitEthernet0/0.30
```

The **show ip route** command displays the routing table containing the networks associated with outgoing subinterfaces.

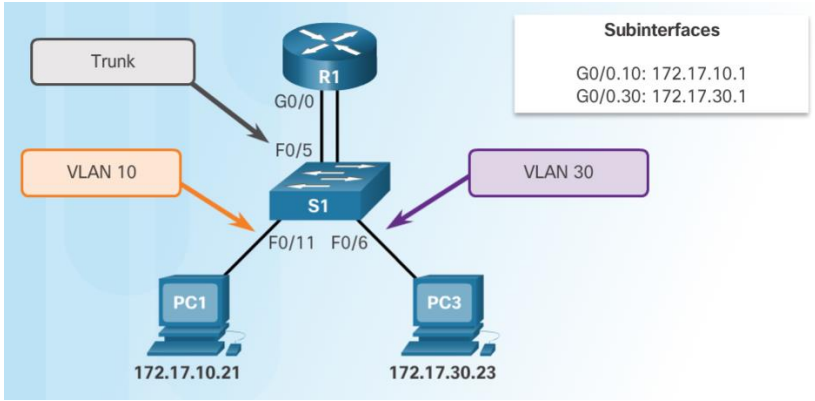
Configure Router-on-a Stick: Verifying Routing

- Remote VLAN device connectivity can be tested using the **ping** command.
  - The command sends an ICMP echo request and when a host receives an ICMP echo request, it responds with an ICMP echo reply.

```
PC1> ping 172.17.30.23

Pinging 172.17.30.23 with 32 bytes of data:

Reply from 172.17.30.23: bytes=32 time=17ms TTL=127
Reply from 172.17.30.23: bytes=32 time=15ms TTL=127
Reply from 172.17.30.23: bytes=32 time=18ms TTL=127
Reply from 172.17.30.23: bytes=32 time=19ms TTL=127

Ping statistics for 172.17.30.23:
   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

- **Tracert** is a useful utility for confirming the routed path taken between two devices.

```
Approximate round trip times in milli-seconds:
   Minimum = 15ms, Maximum = 19ms, Average = 17ms

PC1> tracert 172.17.30.23

Tracing route to 172.17.30.23 over a maximum of 30 hops:

 1    9 ms      7 ms      9 ms      172.17.10.1
 2    16 ms     15 ms     16 ms     172.17.30.23

Trace complete.
```

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