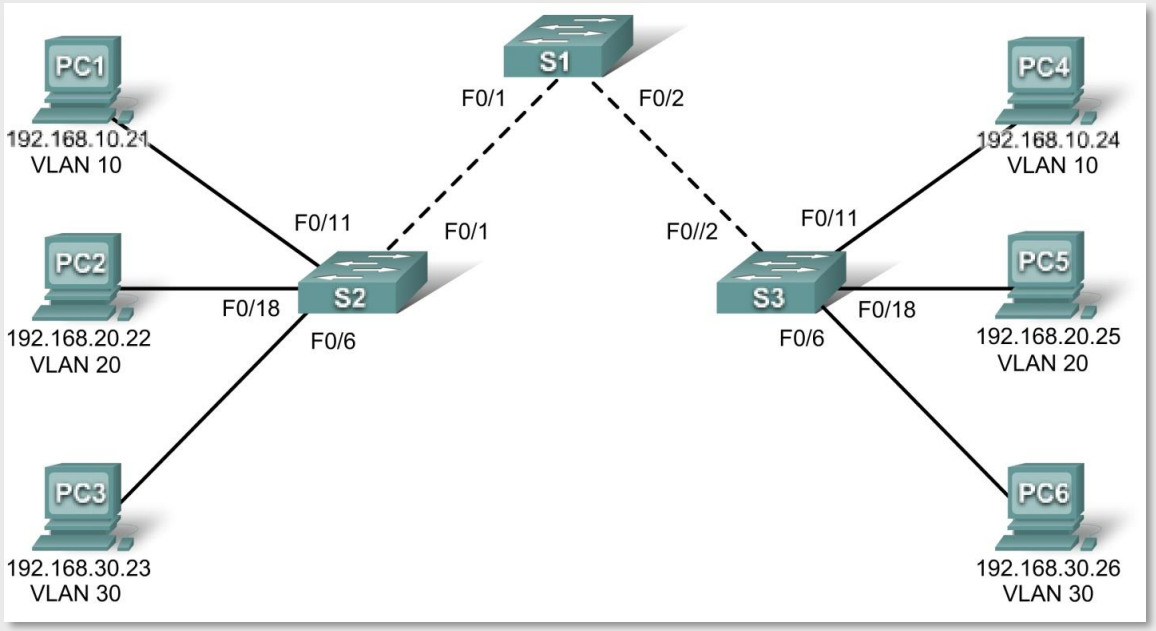
# Lab 11

Inter-VLAN networking

# Inter-VLAN routing

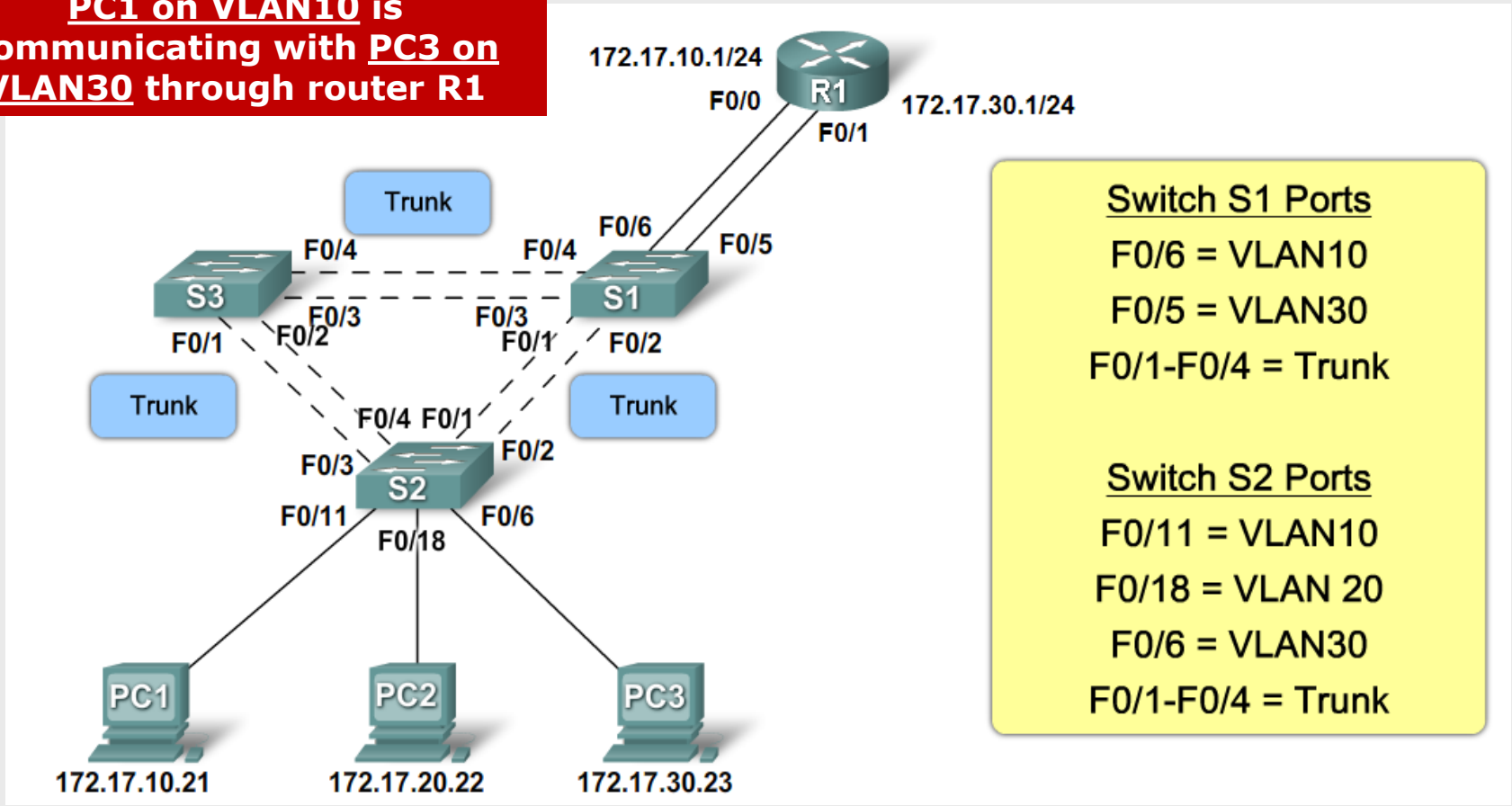
- Each VLAN is a unique broadcast domain
- Hosts on separate VLANs are not able to communicate
- **Inter-VLAN routing**: the process of forwarding network traffic from one VLAN to another VLAN using IP (L3) routing
  - Requires that VLANs are associated with unique IP subnets on the network



# Inter-VLAN routing (1)

- Legacy inter-VLAN routing
  - IP router, multiple 'access' links

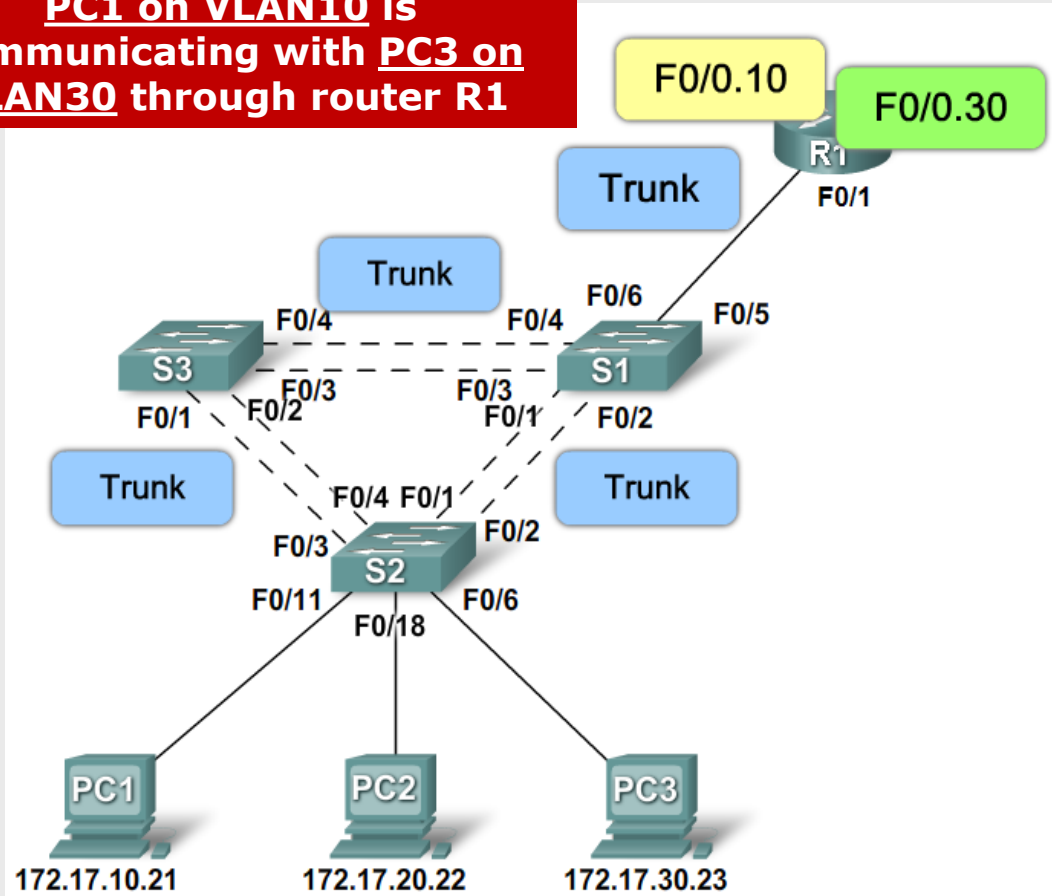
**PC1 on VLAN10 is communicating with PC3 on VLAN30 through router R1**



# Inter-VLAN routing (2)

- "Router-on-a-stick" inter-VLAN routing
  - IP router, single 'trunk' link

**PC1 on VLAN10 is communicating with PC3 on VLAN30 through router R1**




R1 Subinterfaces
F0/0.10: 172.17.10.1
F0/0.20: 172.17.20.1
F0/0.30: 172.17.30.1

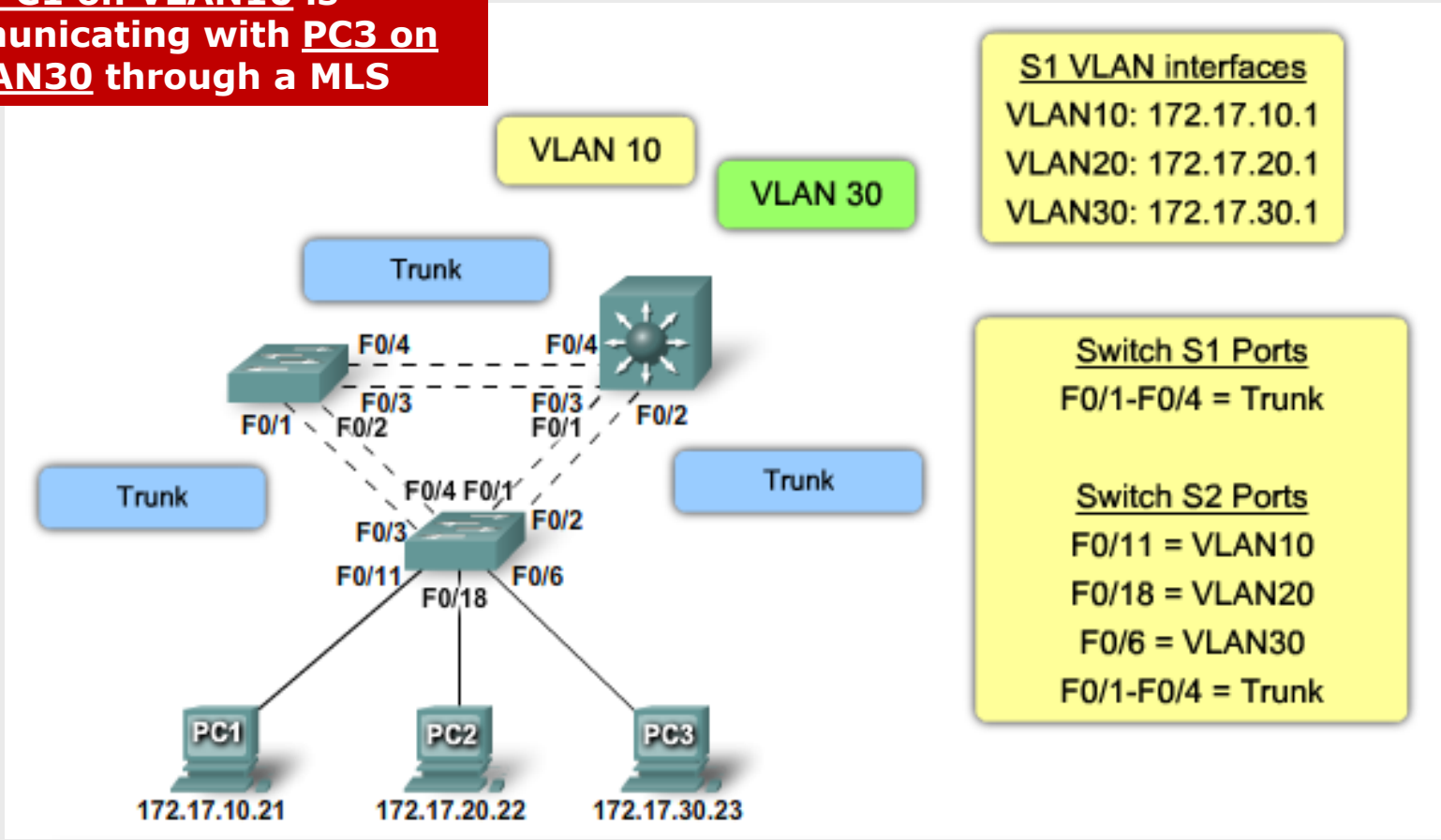
Switch S1 Ports
F0/1-F0/4 = Trunk
F0/5 = Trunk

Switch S2 Ports
F0/11 = VLAN10
F0/18 = VLAN20
F0/6 = VLAN30
F0/1-F0/4 = Trunk

# Inter-VLAN routing (3)

- Multiple Switch Virtual Interfaces on Multi-Layer Switches

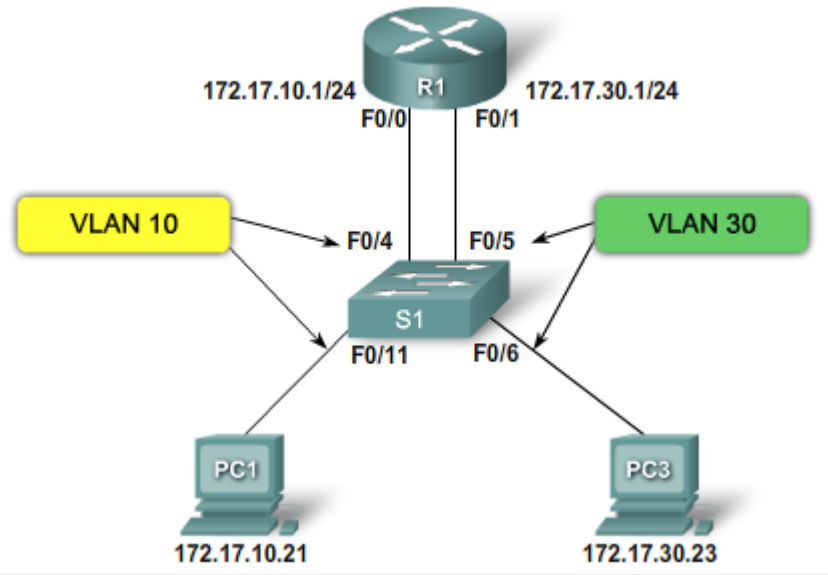
**PC1 on VLAN10 is communicating with PC3 on VLAN30 through a MLS**



# Legacy inter-VLAN routing

```
S1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#vlan 10
S1(config-vlan)#vlan 30
S1(config-vlan)#exit
S1(config)#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
%SYS-5-CONFIG_I: Configured from console by console
```

```
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface f0/0
R1(config-if)#ip address 172.17.10.1 255.255.255.0
R1(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R1(config-if)#interface f0/1
R1(config-if)#ip address 172.17.30.1 255.255.255.0
R1(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up
R1(config-if)#end
```

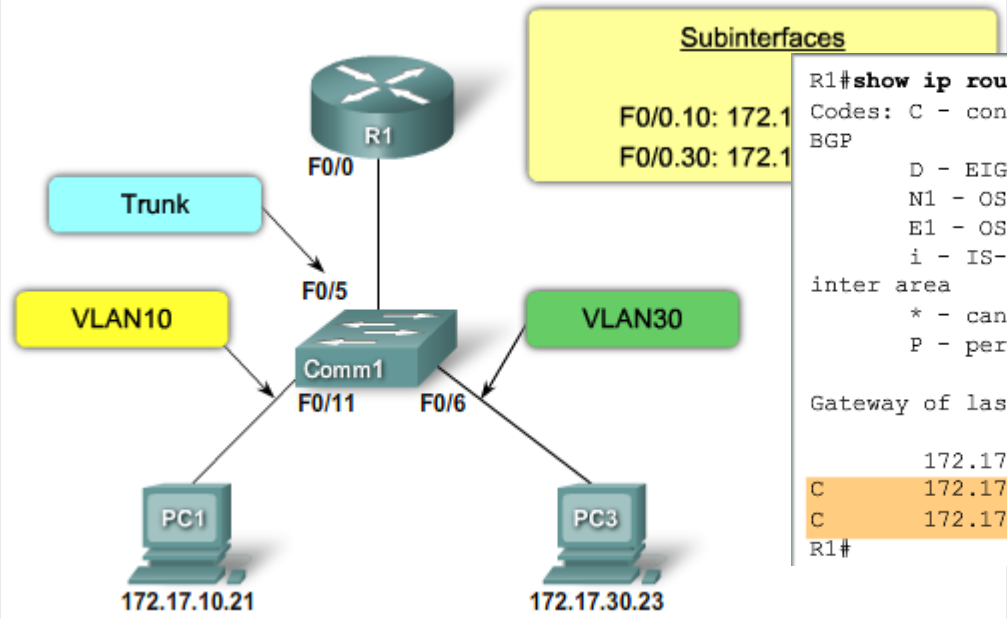



```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

        172.17.0.0/24 is subnetted, 2 subnets
C       172.17.10.0 is directly connected, FastEthernet0/0
C       172.17.30.0 is directly connected, FastEthernet0/1
R1#
```

# Router-on-a-stick

```
S1#configure terminal
Enter configuration commands, one per line.
S1(config)#vlan 10
S1(config-vlan)#vlan 30
S1(config-vlan)#exit
S1(config)#interface f0/5
S1(config-if)#switchport mode trunk
S1(config-if)#end
S1#
```

```
R1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface f0/0.10
R1(config-subif)#encapsulation dot1q 10
R1(config-subif)#ip address 172.17.10.1 255.255.255.0
R1(config-subif)#interface f0/0.30
R1(config-subif)#encapsulation dot1q 30
R1(config-subif)#ip address 172.17.30.1 255.255.255.0
R1(config-subif)#interface f0/0
R1(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/0.10, changed state to up
```




```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B -
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       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, E - EGP
       i - IS-IS, 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

Gateway of last resort is not set

        172.17.0.0/24 is subnetted, 2 subnets
C       172.17.10.0 is directly connected, FastEthernet0/0.10
C       172.17.30.0 is directly connected, FastEthernet0/0.30
R1#
```
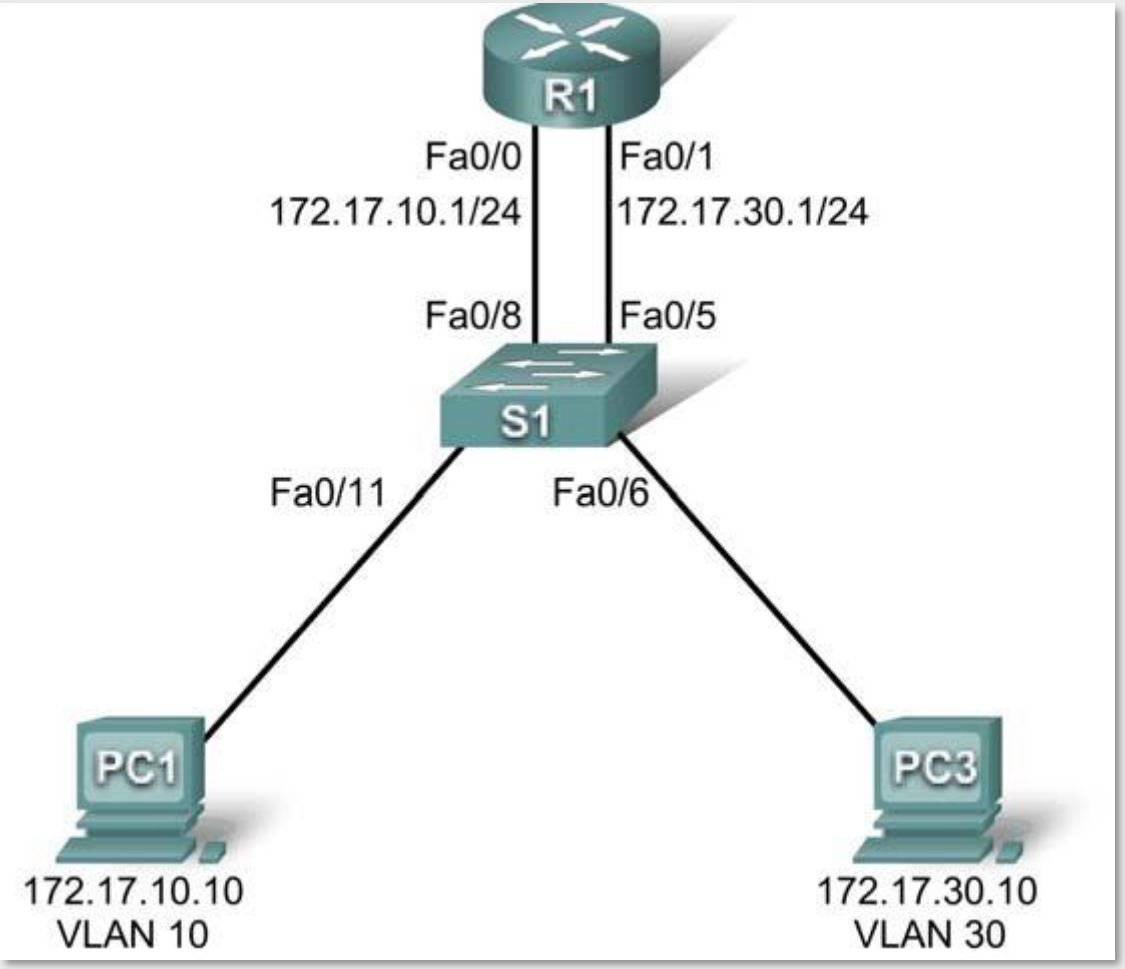
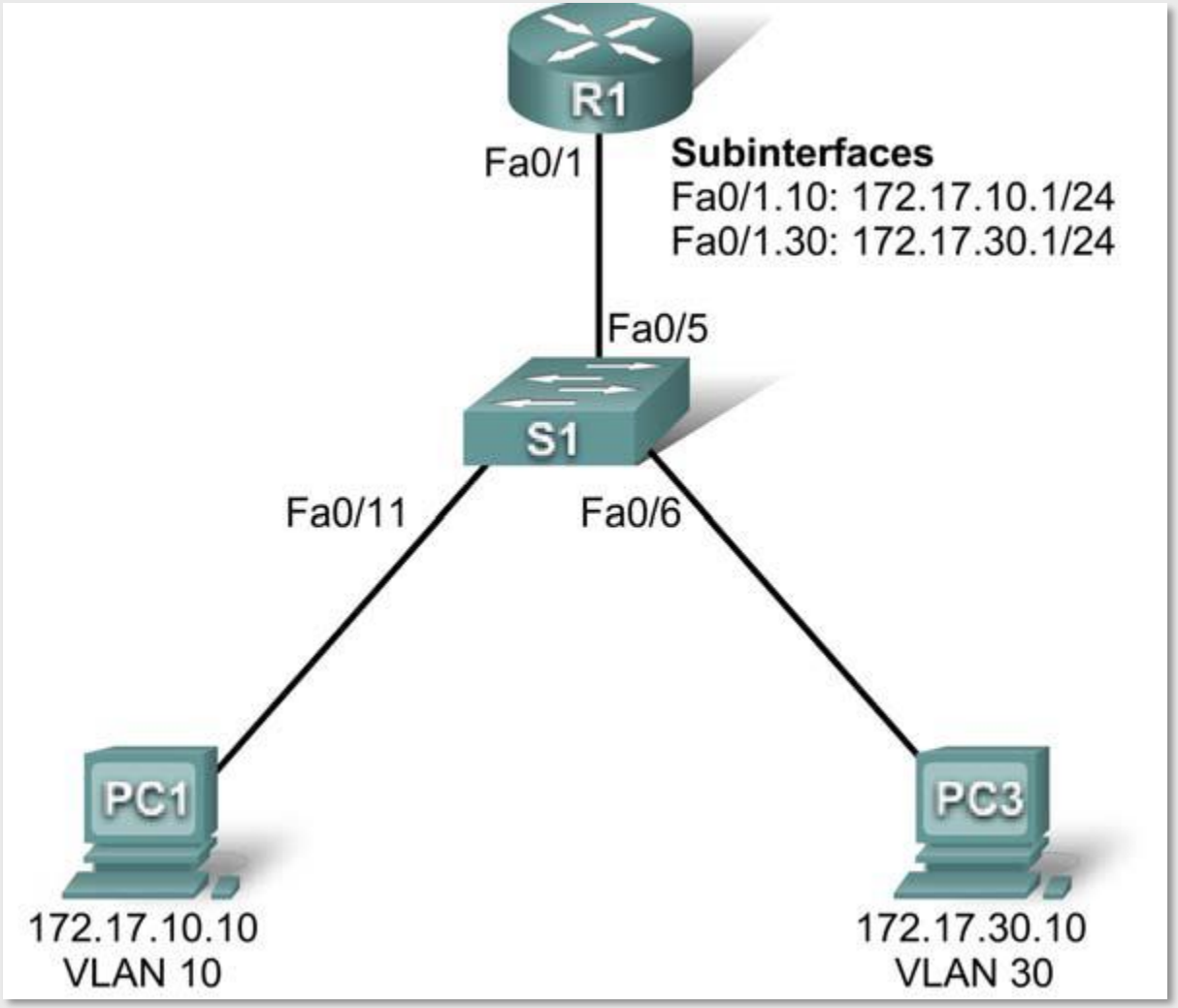

# Lab activity



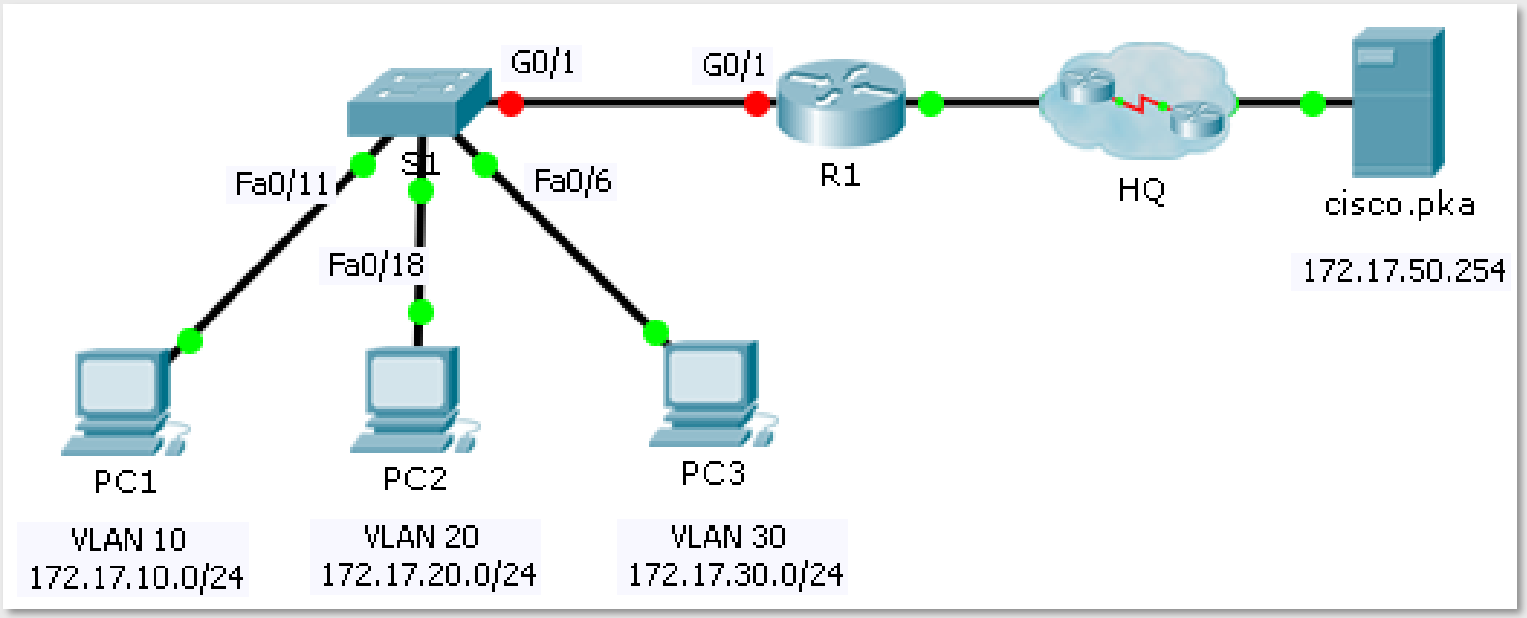
# Lab activity



# Comparison

| Physical Interface | Subinterface |
|---|---|
| One physical interface per VLAN | One physical interface for many VLANs |
| No bandwidth contention | Bandwidth contention |
| Connected to access mode switch port | Connected to trunk mode switch port |
| More expensive | Less expensive |
| Less complex connection configuration | More complex connection configuration |

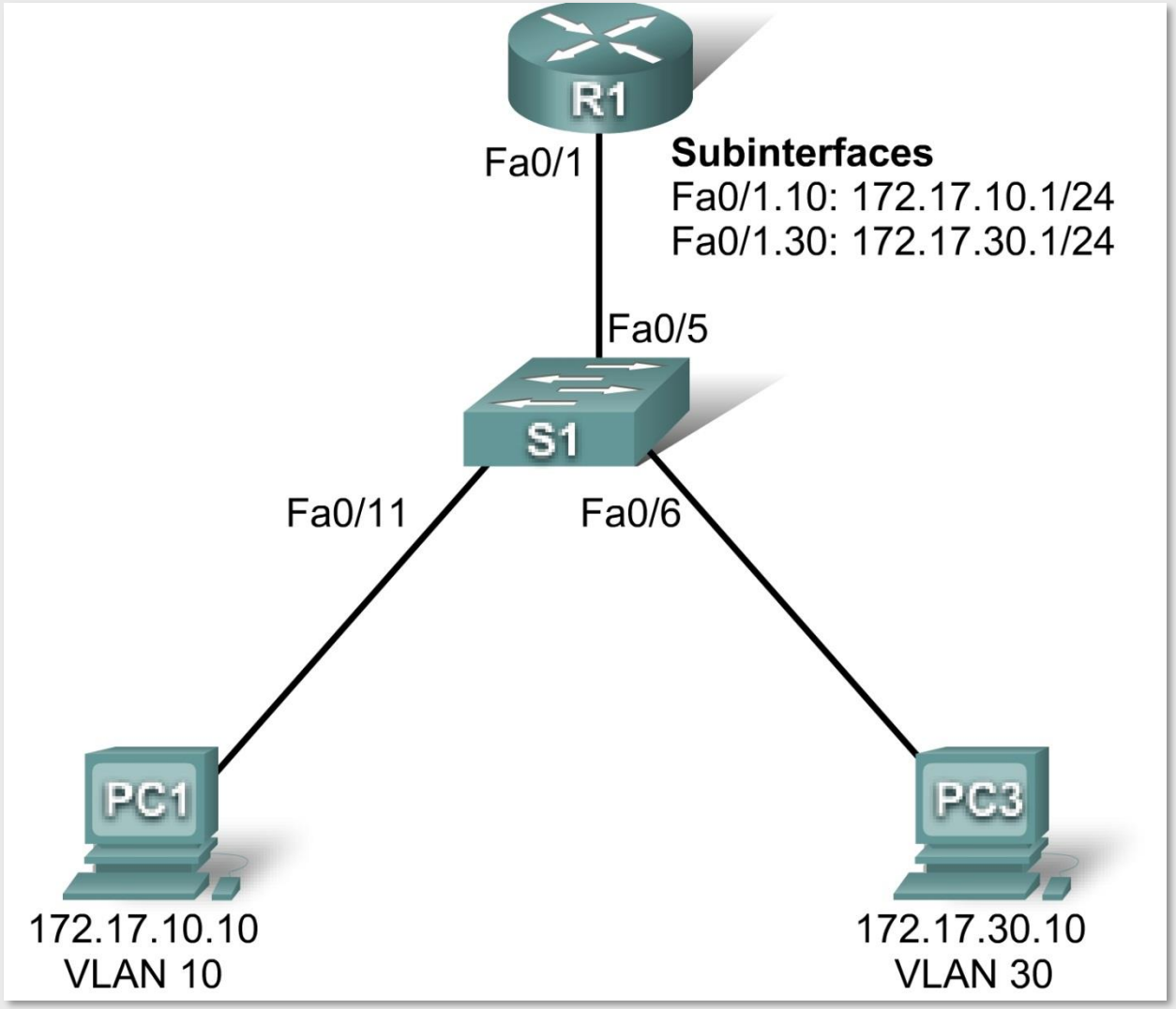
# Lab activity



# Troubleshooting

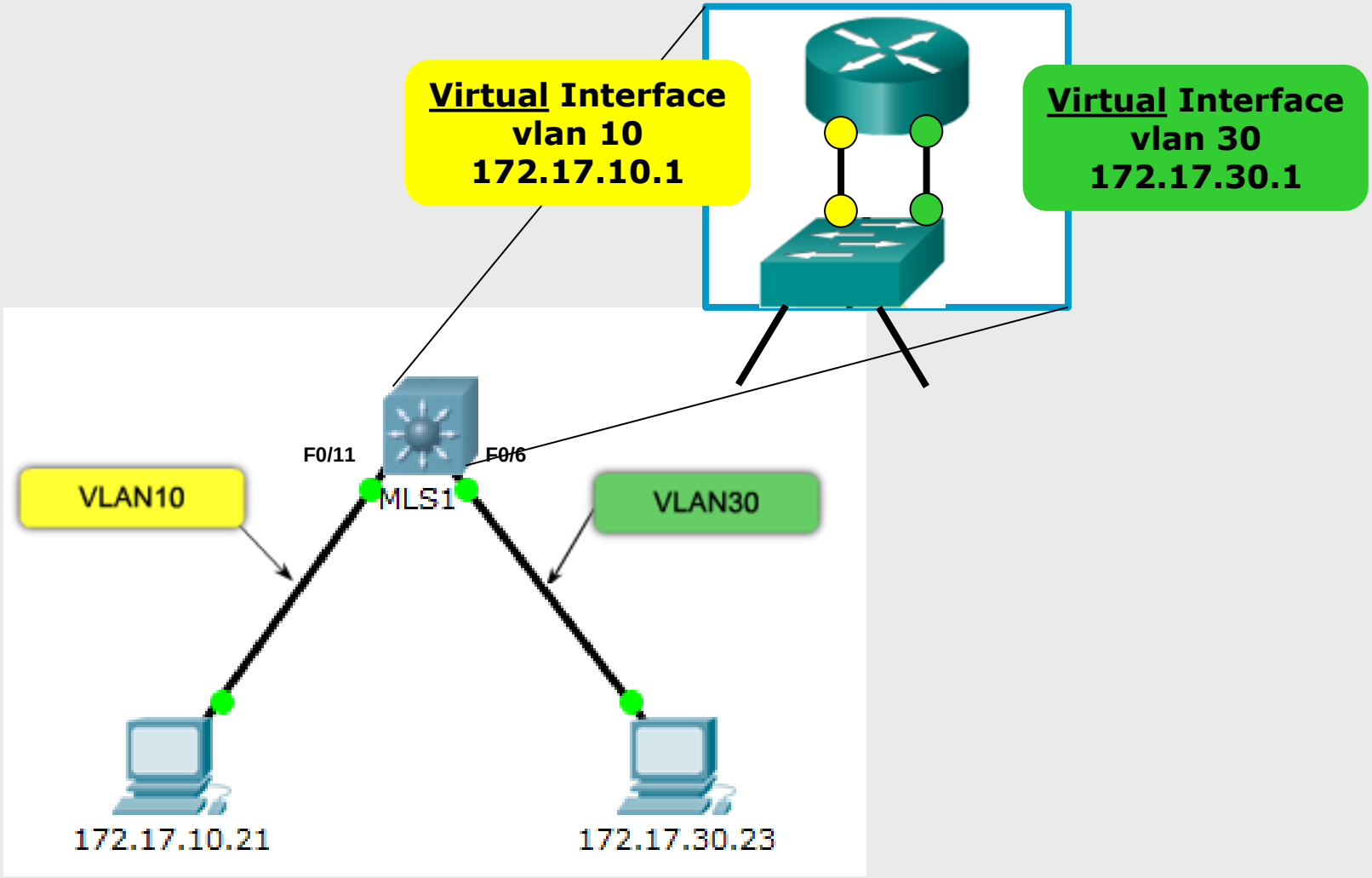
- Switch configuration issues
  - Failing to associate the switch port connected to the router to the right VLAN in traditional inter-VLAN routing
  - Failing to configure the switch port as a trunk in router-on-a-stick inter-VLAN routing
- Router configuration issues
  - Connecting the router physical interface to the wrong switch port
  - Failing to configure 802.1Q encapsulation on the router sub-interface
- IP addressing issues

# Lab activity



# Layer 3 switching

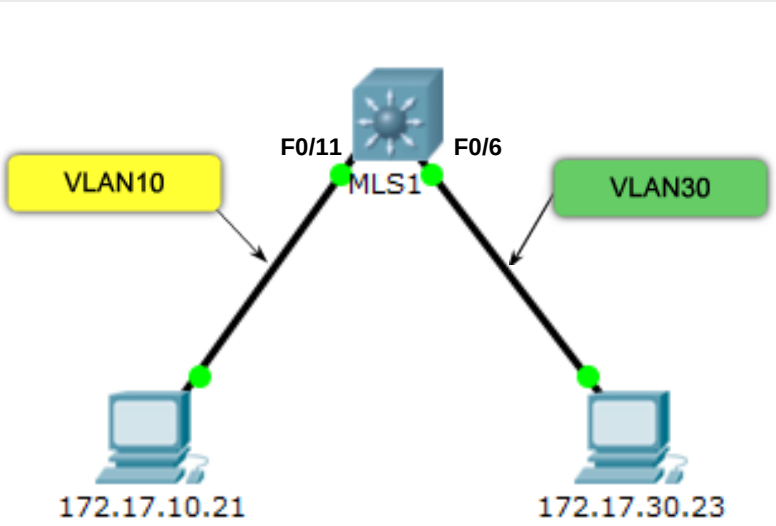
- Switch Virtual Interface (SVI): provides Layer 3 processing for packets to or from all switch ports associated with that VLAN



# Multi-layer switching

```
MLS1#configure terminal
Enter configuration commands, one per line.  En
MLS1(config)#vlan 10
MLS1(config-vlan)#vlan 30
MLS1(config-vlan)#exit
MLS1(config)#interface fa0/11
MLS1(config-if)#switchport mode access
MLS1(config-if)#switchport access vlan 10
MLS1(config-if)#interface fa0/6
MLS1(config-if)#switchport mode access
MLS1(config-if)#switchport access vlan 30
MLS1(config-if)#end
MLS1#
```

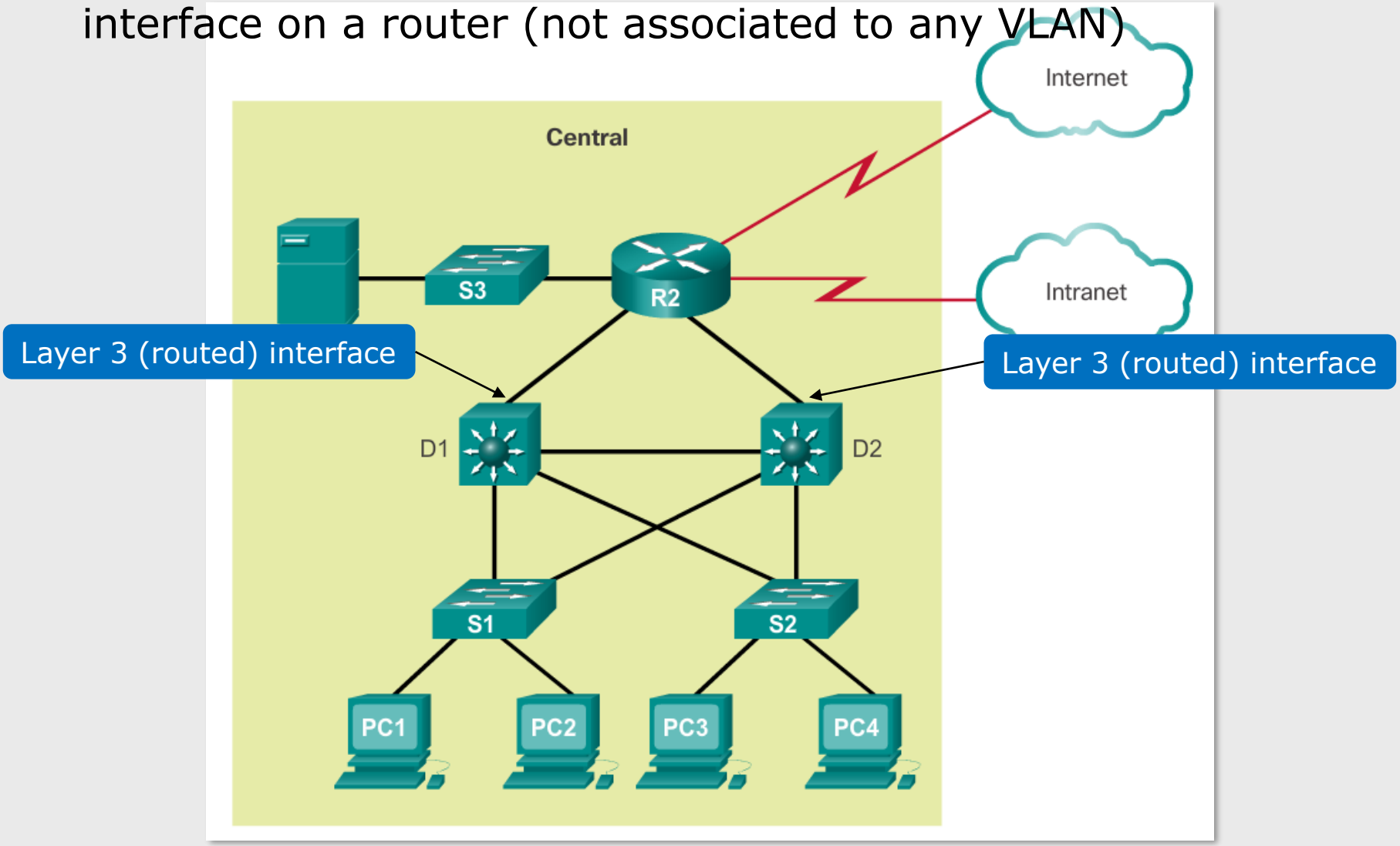
```
MLS1#configure terminal
MLS1(config)#ip routing
MLS1(config)#interface vlan 10
MLS1(config)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up

MLS1(config-if)#ip address 172.17.10.1 255.255.255.0
MLS1(config-if)#interface Vlan30
MLS1(config)#
%LINK-5-CHANGED: Interface Vlan30, changed state to up

MLS1(config-if)#ip address 172.17.30.1 255.255.255.0
MLS1(config-if)#end
MLS1#
```




```
MLS1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mob
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF i
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA extern
       E1 - OSPF external type 1, E2 - OSPF external type 2,
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia
       * - candidate default, U - per-user static route, o -
       P - periodic downloaded static route

Gateway of last resort is not set

     172.17.0.0/24 is subnetted, 2 subnets
C       172.17.10.0 is directly connected, Vlan10
C       172.17.30.0 is directly connected, Vlan30
MLS1#
```

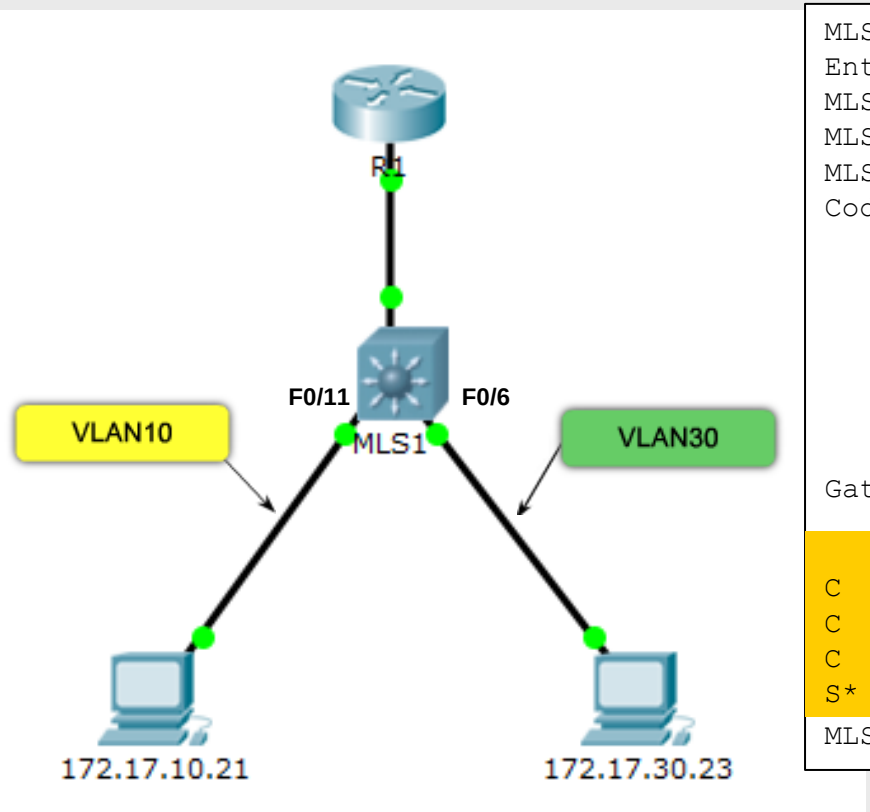
# Layer 3 switching

- **Routed port**: A pure Layer 3 interface similar to a physical interface on a router (not associated to any VLAN)



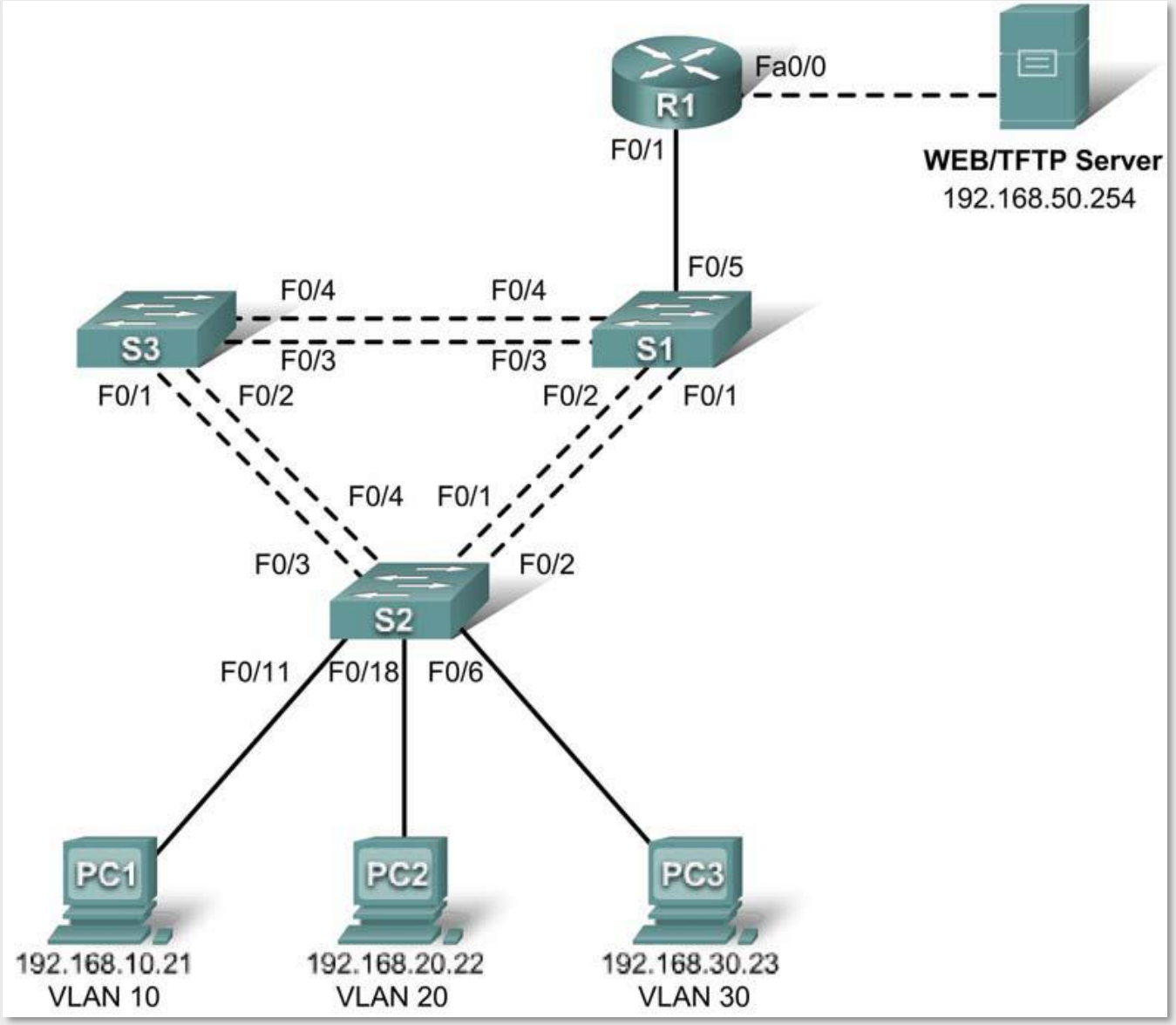
# Layer 3 switching

```
MLS1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
MLS1(config)#interface fa0/1
MLS1(config-if)#no switchport
MLS1(config-if)#ip address 192.168.1.2 255.255.255.0
MLS1(config-if)#no shutdown
MLS1(config-if)#end
MLS1#
```




```
MLS1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z
MLS1(config)#ip route 0.0.0.0 0.0.0.0 192.168.1.1
MLS1(config-if)#end
MLS1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mob
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF i
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA extern
       E1 - OSPF external type 1, E2 - OSPF external type 2,
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia
       * - candidate default, U - per-user static route, o -
       P - periodic downloaded static route

Gateway of last resort is 192.168.1.1 to network 0.0.0.0

     172.17.0.0/24 is subnetted, 2 subnets
C       172.17.10.0 is directly connected, Vlan10
C       172.17.30.0 is directly connected, Vlan30
C    192.168.1.0/24 is directly connected, FastEthernet0/1
S*   0.0.0.0/0 [1/0] via 192.168.1.1
MLS1#
```

# Lab activity



# Lab activity