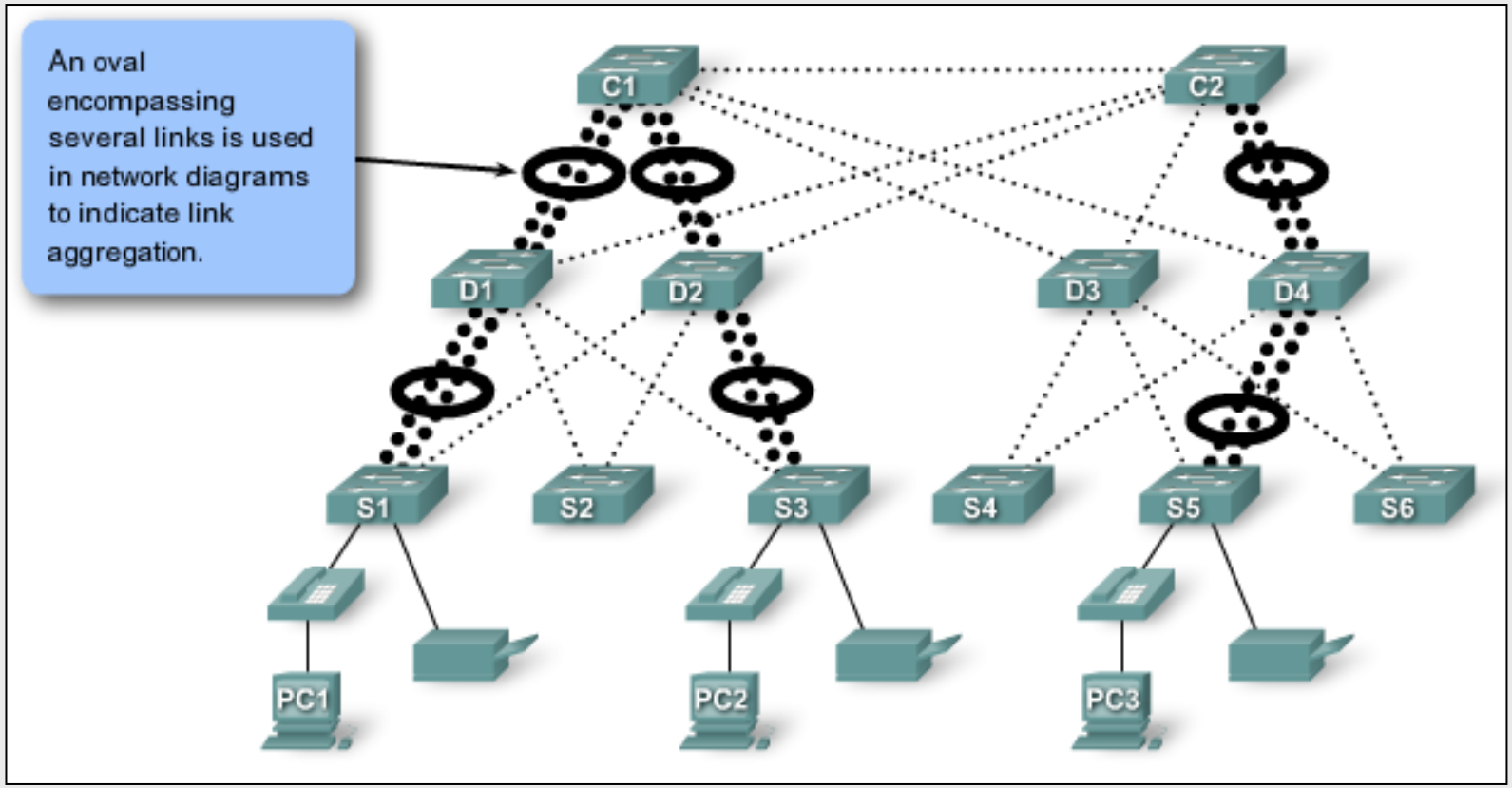
Lab 12.2

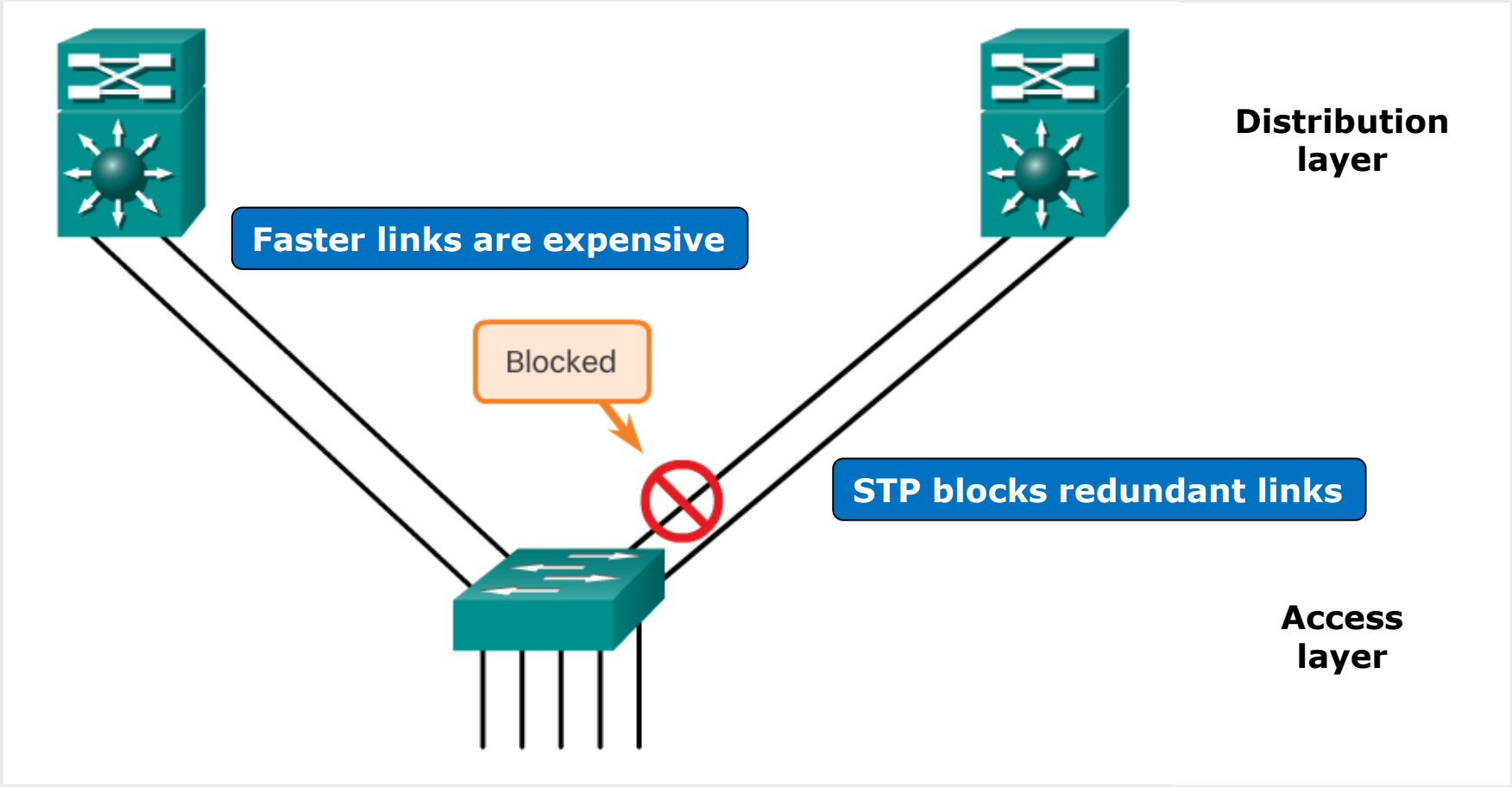
First hop redundancy

Hierarchical LAN design

- **Bandwidth aggregation**
  - Link aggregation allows multiple switch port links to be combined so as to achieve higher throughput between switches

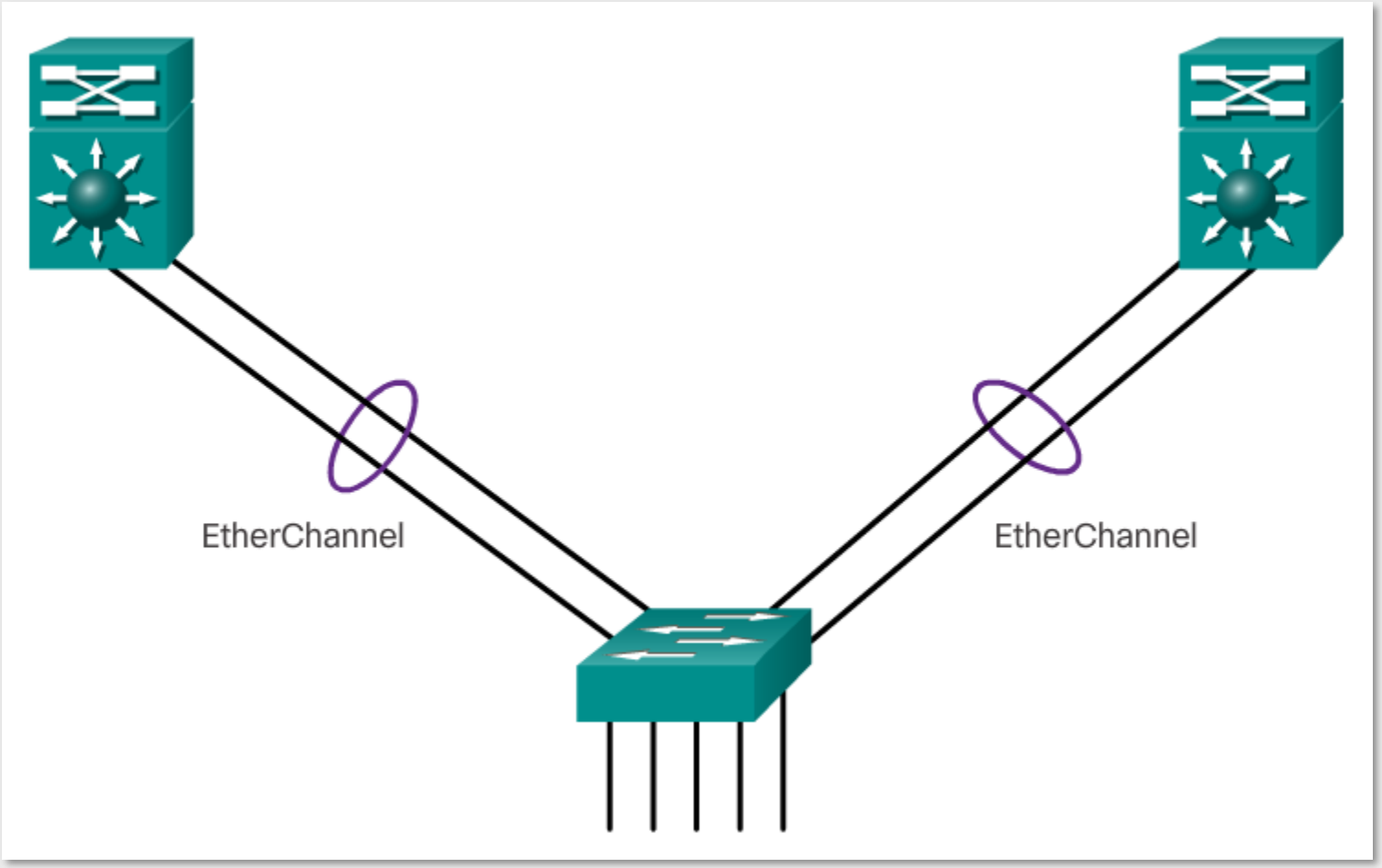


Higher bandwidth links are needed



Link aggregation

- **Link aggregation** is the ability to create one ***logical*** link using multiple physical links between two devices



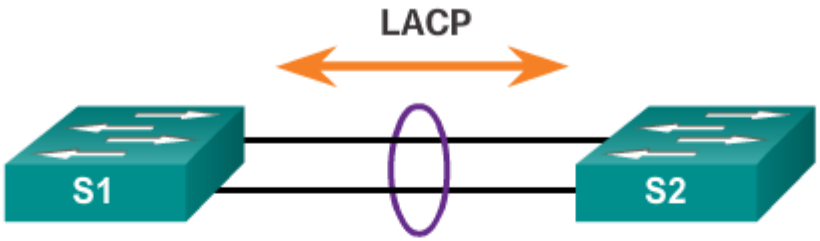
Link Aggregation Control Protocol

- **IEEE 802.1AX-2008** – standard specification
  - Allows several physical ports (up to 8) to be bundled to form a single logical channel
  - LACP packets are used to **dynamically** negotiate an automatic bundling of links
  - Keep-alive mechanism for link membership
  - Load-balancing
  - Two modes
    - ***Active***: actively asking if the other side will participate
    - ***Passive***: passively waiting for the other side

- Dynamic vs. static link aggregation
  - Failover is managed automatically
  - Safe configuration

Link Aggregation Control Protocol

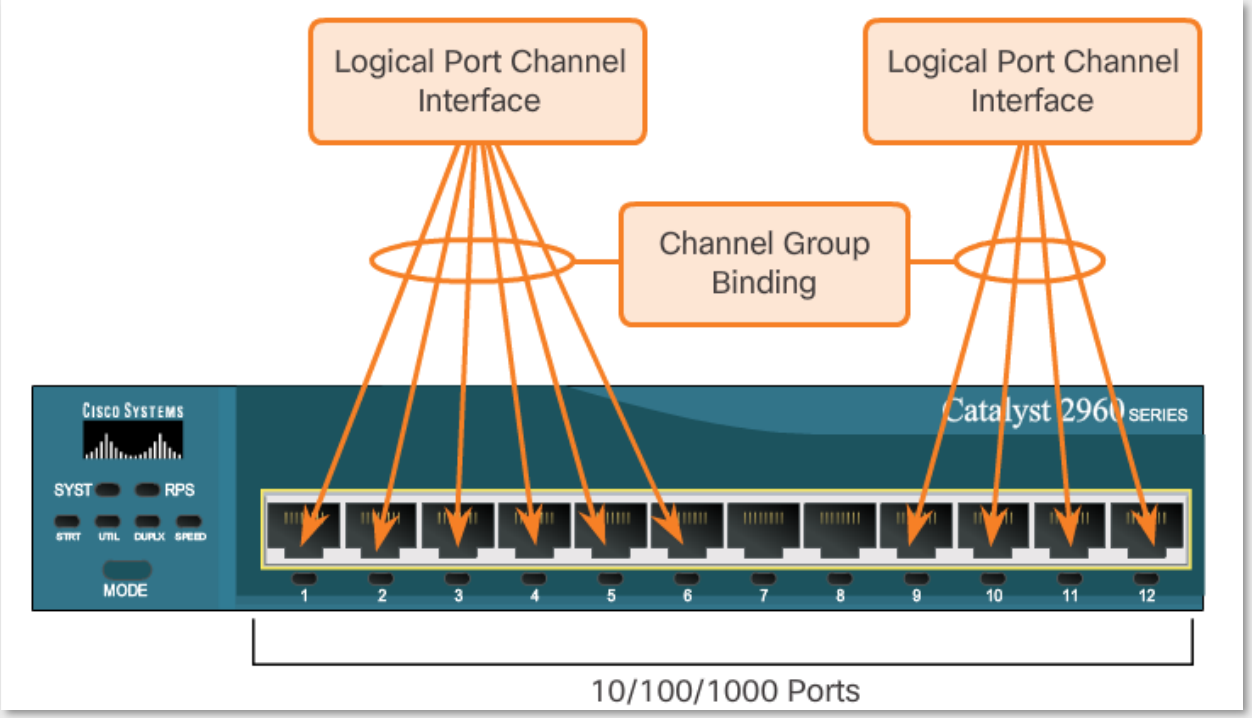
- Modes
  - On (static link aggregation, no LACP)
  - Active (dynamic, LACP)
  - Passive (dynamic, LACP)



S1	S2	Channel Establishment
On	On	Yes
Active/Passive	Active	Yes
On/Active/Passive	Not Configured	No
On	Active	No
Passive/On	Passive	No

Link aggregation – Etherchannel

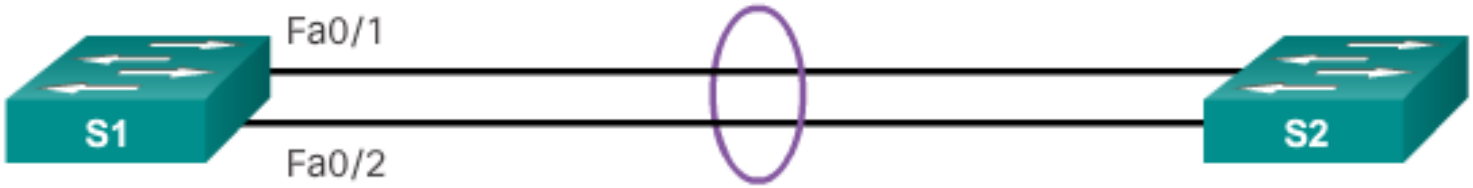
- Interface types cannot be mixed (i.e., no Fast and Giga Ethernet ports in the same group)
- Groups can consist of up to eight Ethernet ports
- Port configuration must be consistent on both devices (e.g., trunk with same native VLAN)



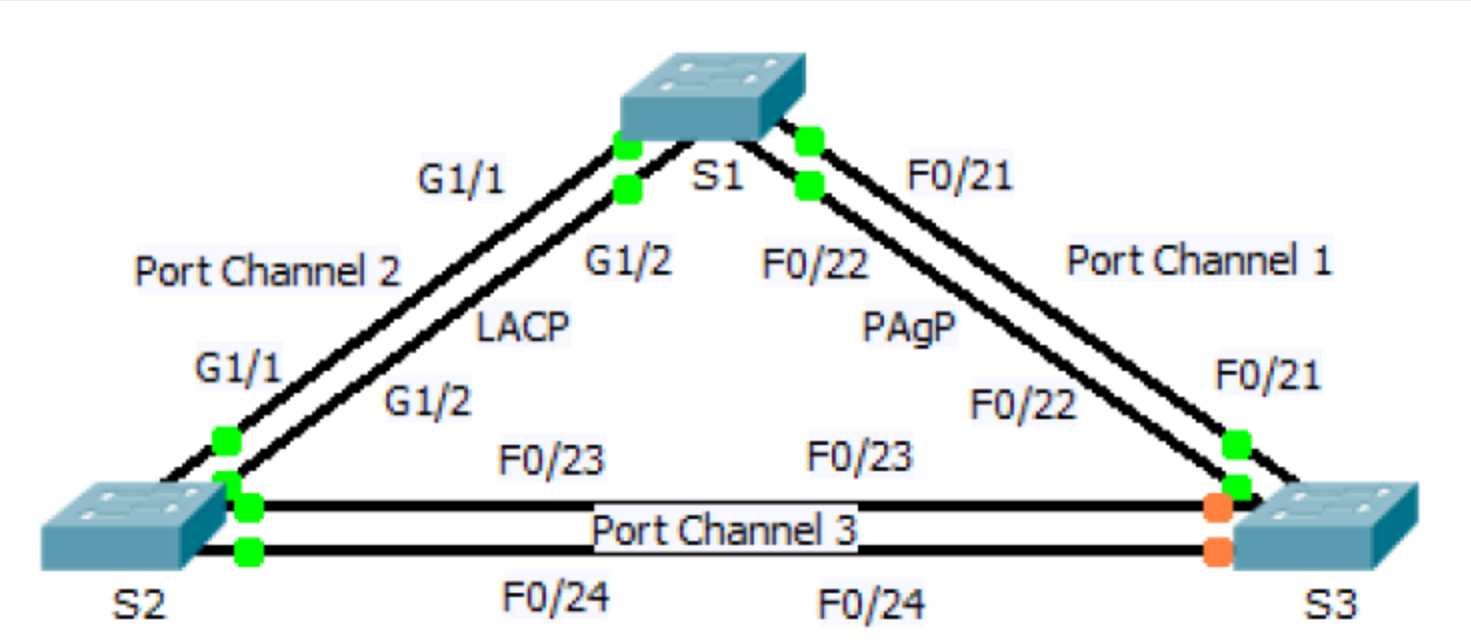
Etherchannel configuration

```
S1(config)# interface range FastEthernet0/1 - 2
S1(config-if-range)# channel-group 1 mode active
Creating a port-channel interface Port-channel 1
S1(config-if-range)# interface port-channel 1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport trunk allowed vlan 1,2,20
```

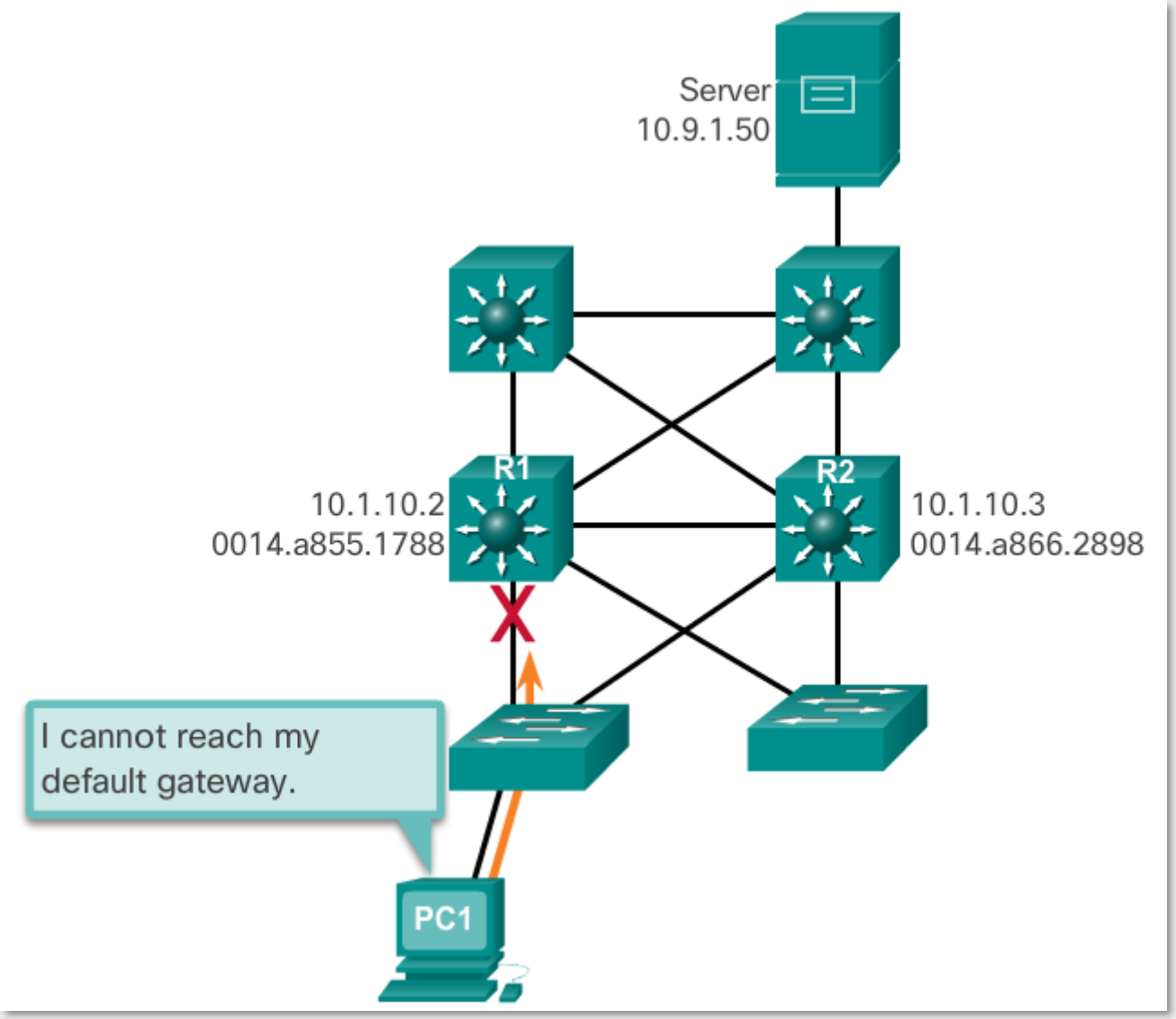
Creates EtherChannel and configures trunk.



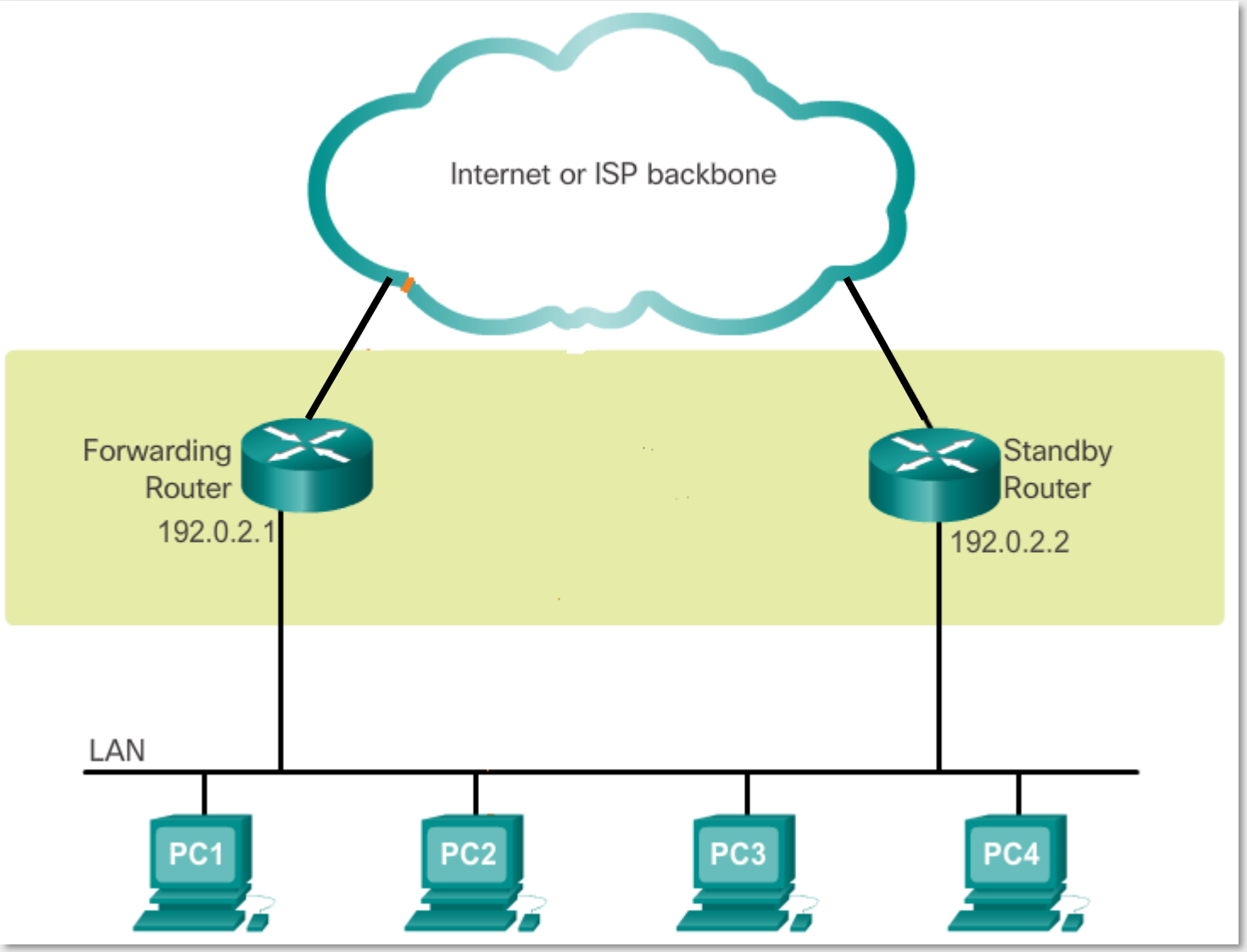
Etherchannel configuration



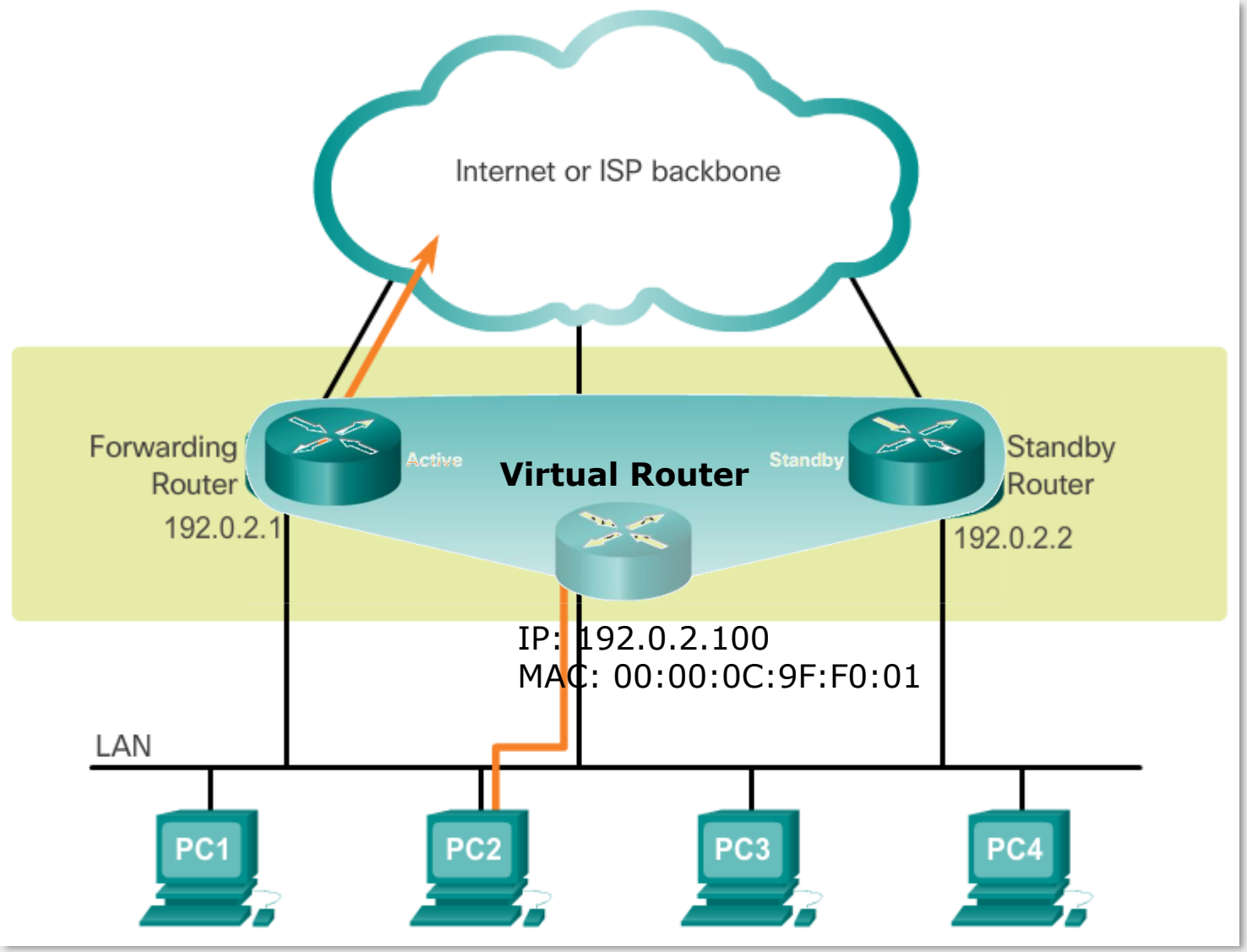
Default gateway – single point of failure



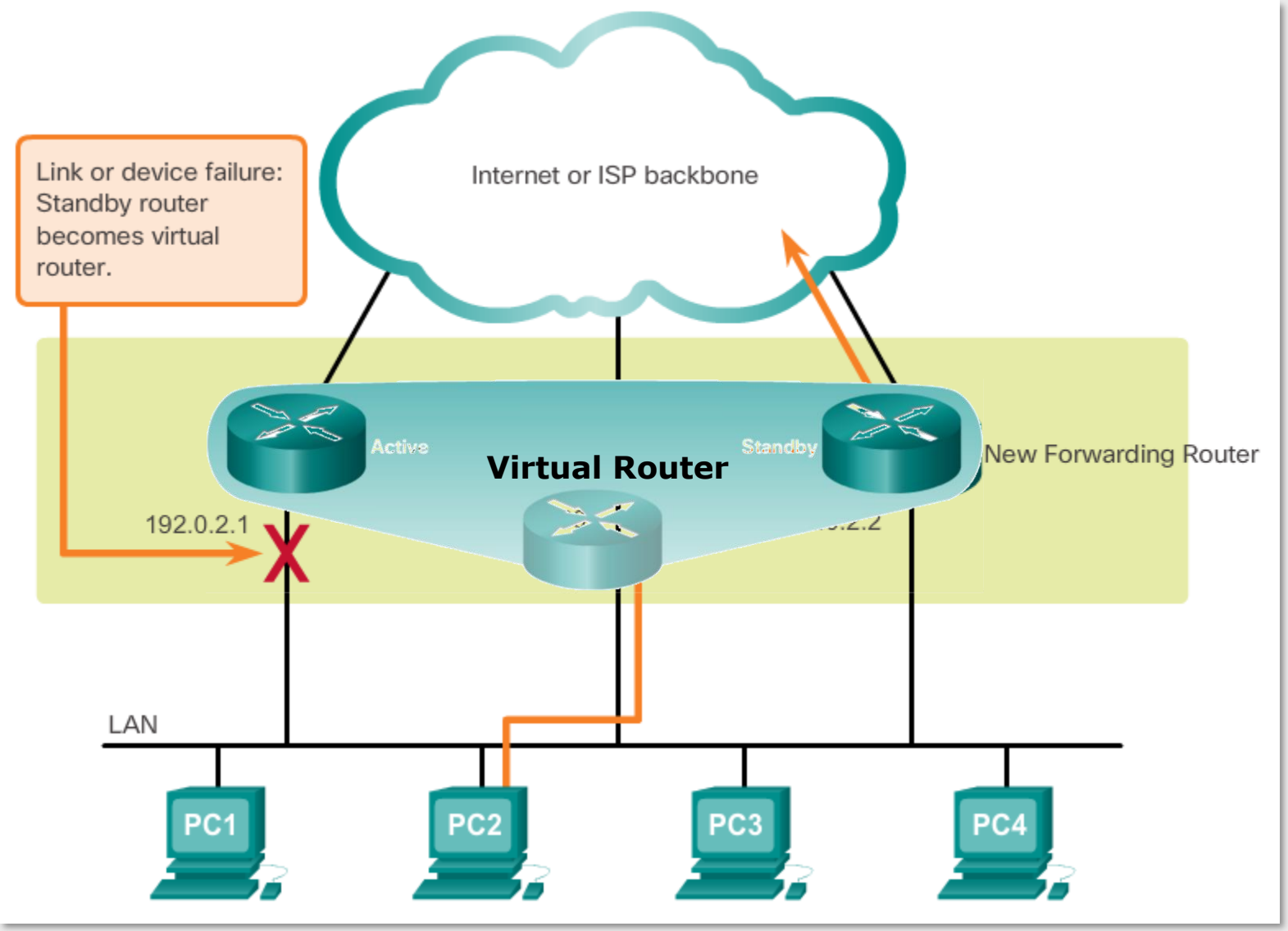
Router redundancy



First hop redundancy



First hop redundancy



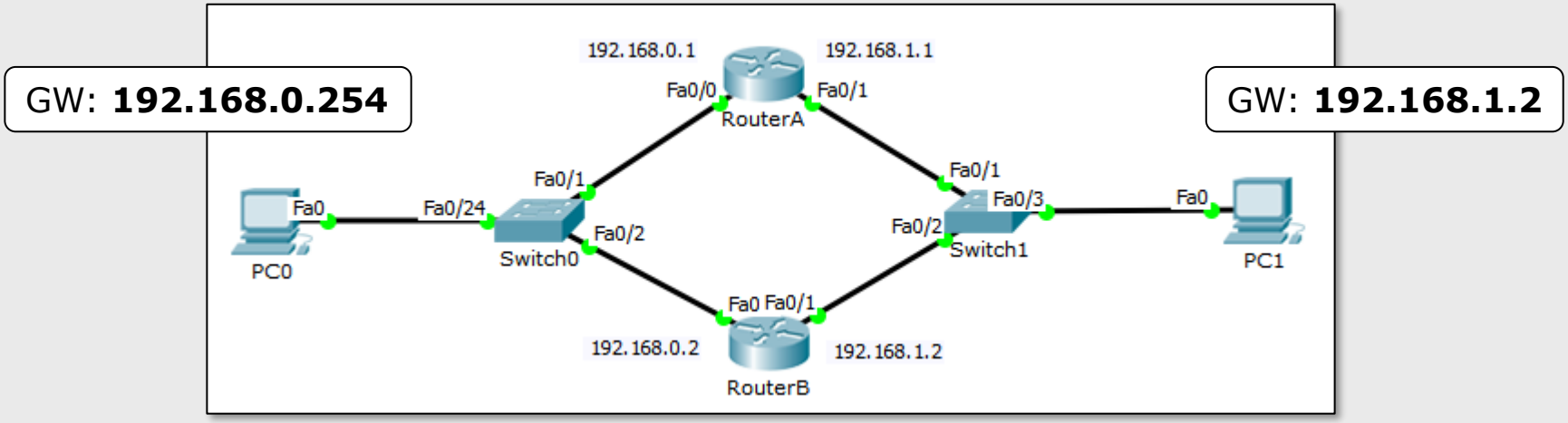
FHR protocols

- **Virtual Router Redundancy Protocol (VRRP)**
  - Open standard (RFC 5798), version 3, for both IPv4 and IPv6
  - Protocol messaging using IPv4 (or IPv6) multicast datagrams
  - Election protocol: one router is elected the virtual router master, the other routers act as backups
  - Load balancing is supported

- **Hot Standby Router Protocol (HSRP)**
  - Open Cisco-proprietary (RFC 2281), version 2, for both IPv4 and IPv6
  - Protocol messaging using IPv4 (or IPv6) multicast datagrams
  - A set of routers form an *HSRP group* (or standby group); a single router is elected as the *active* router (the only responsible for packet forwarding), another router is elected as the *standby* router

- **Gateway Load Balancing Protocol (GLBP)**
  - Cisco-proprietary, for both IPv4 and IPv6
  - Adds load balancing support

HSRP configuration

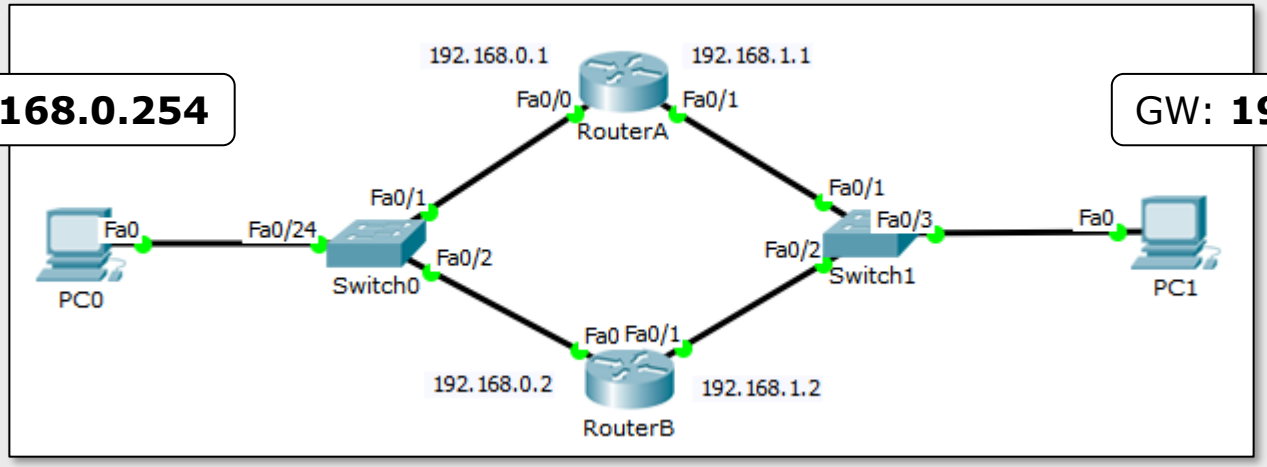


- In interface configuration mode

standby <0-4095> **ip** <addr>	Enable HSRP and set the virtual IP address
standby <0-4095> **priority**	Priority level (default 100)
standby <0-4095> **preempt**	Overthrow lower priority Active routers

HSRP configuration

GW: **192.168.0.254**

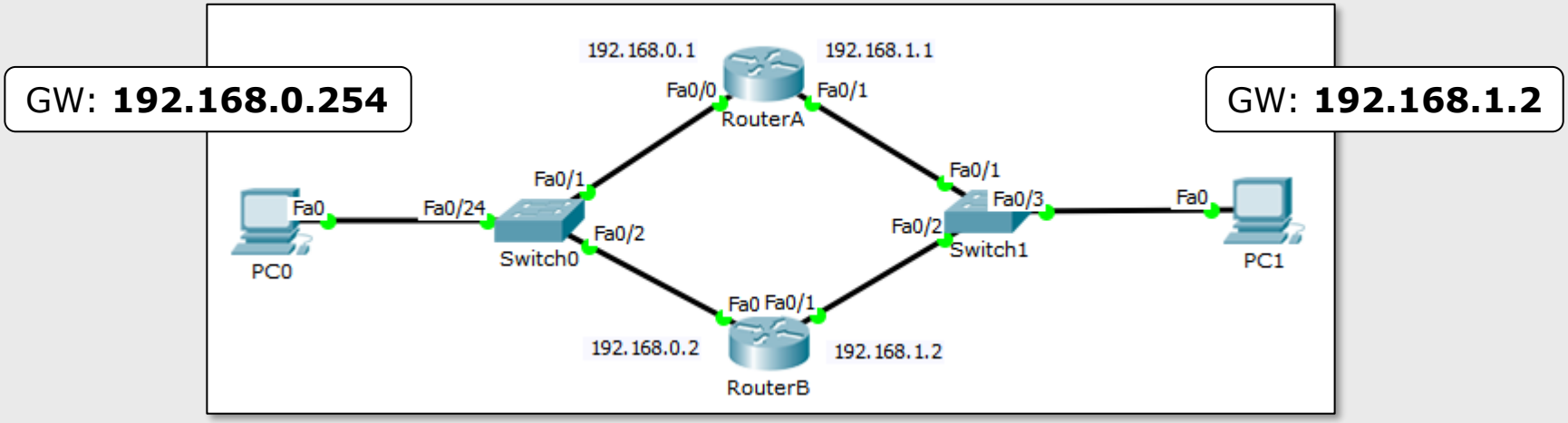


GW: **192.168.1.2**

```
RouterA#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
RouterA(config)#interface Fa0/0
RouterA(config-if)#ip address 192.168.0.1 255.255.255.0
RouterA(config-if)#standby 1 ip 192.168.0.254
RouterA(config-if)#standby 1 priority 120
RouterA(config-if)#standby 1 preempt
RouterA(config-if)#no shutdown
RouterA(config-if)#end
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
RouterA#
```

```
RouterB#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
RouterB(config)#interface Fa0/0
RouterB(config-if)#ip address 192.168.0.2 255.255.255.0
RouterB(config-if)#standby 1 ip 192.168.0.254
RouterB(config-if)#no shutdown
RouterB(config-if)#end
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
RouterB#
```

HSRP configuration




```
RouterB#show standby
FastEthernet0/0 - Group 1 (version 2)
  State is Standby
    9 state changes, last state change 00:13:01
  Virtual IP address is 192.168.0.254
  Active virtual MAC address is 0000.0C9F.F001
    Local virtual MAC address is 0000.0C9F.F001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.388 secs
  Preemption disabled
  Active router is 192.168.0.1, priority 120 (expires in 7 sec)
    MAC address is 0000.0C9F.F001
  Standby router is local
  Priority 100 (default 100)
  Group name is hsrp-Fa0/0-1 (default)
RouterB#
```

HSRP configuration