



Chapter 4: EtherChannel & HSRP

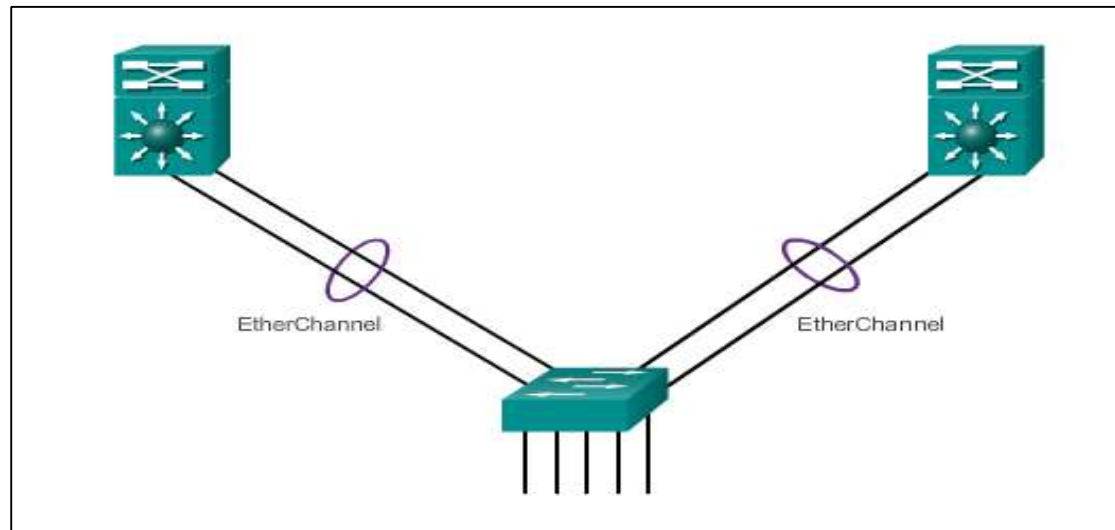


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Link Aggregation

Introduction to Link Aggregation

- Link aggregation allows the creation of logical links made up of several physical links.
- Without Link Aggregation, STP will block redundant links to prevent routing loops.
- EtherChannel technology is Cisco's switch-to-switch technique of grouping several Fast Ethernet or Gigabit Ethernet ports into one logical channel
 - Cisco: Ether Channel, PAgP (Port Aggregation Protocol)
 - IEEE: LACP Link Aggregation Control Protocol





Link Aggregation

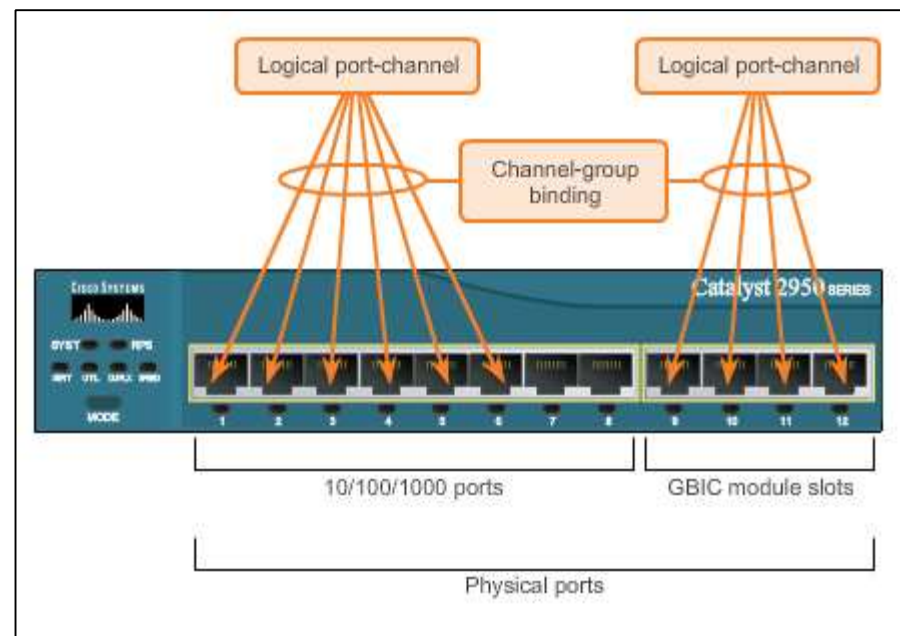
Advantages of EtherChannel

- Most configuration tasks can be done on the EtherChannel interface instead of on each individual port
- Using on existing switch ports – no need for upgrades, if needed more bandwidth.
- Load-balances between links on the same EtherChannel.
- Creates an aggregation viewed as one logical link by STP.
- Provides redundancy because the overall link is viewed as one logical connection. If one physical link within channel goes down, this does not cause a change in the topology and does not require STP recalculation.

EtherChannel Operation

Implementation Restrictions

- EtherChannel implemented by grouping multiple physical ports into one or more logical EtherChannel links.
- Interface types cannot be mixed.
- EtherChannel provides full-duplex bandwidth up to 800 Mb/s (Fast EtherChannel) or 8 Gb/s (Gigabit EtherChannel).
- EtherChannel can consist of up to 16 compatibly-configured Ethernet ports. (Some IOS version only 6)





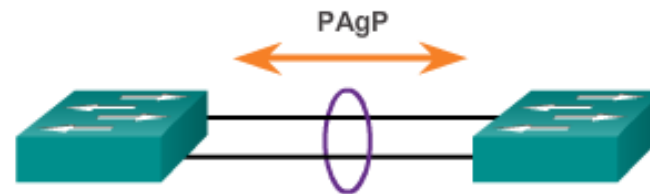
EtherChannel Operation

Port Aggregation Protocol (PAgP)

- Cisco-proprietary protocol
- PAgP packets are sent every 30 seconds
- All ports have the same speed, duplex setting, and VLAN information
- Any port modification after the creation of the channel also changes all other channel ports.

PAgP modes:

- **On:** Channel member without negotiation (no protocol).
- **Desirable:** Actively asking if the other side can or will participate.
- **Auto:** Passively waiting for the other side.



Switch 1	Switch 2	Channel Establishment
On	On	Yes
Auto/Desirable	Desirable	Yes
On/Auto/Desirable	Not Configured	No
On	Desirable	No
Auto/On	Auto	No



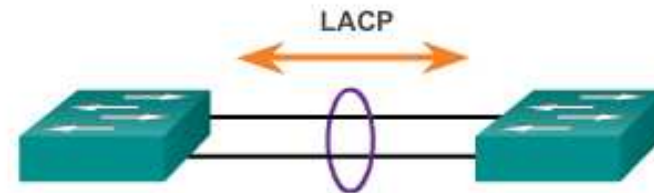
EtherChannel Operation

Link Aggregation Control Protocol (LACP)

- LACP is part of an IEEE specification
- Just as with PAgP, modes must be compatible on both sides

LACP modes:

- **On:** Channel member without negotiation (no protocol).
- **Active:** Actively asking if the other side can or will participate.
- **Passive:** Passively waiting for the other side.

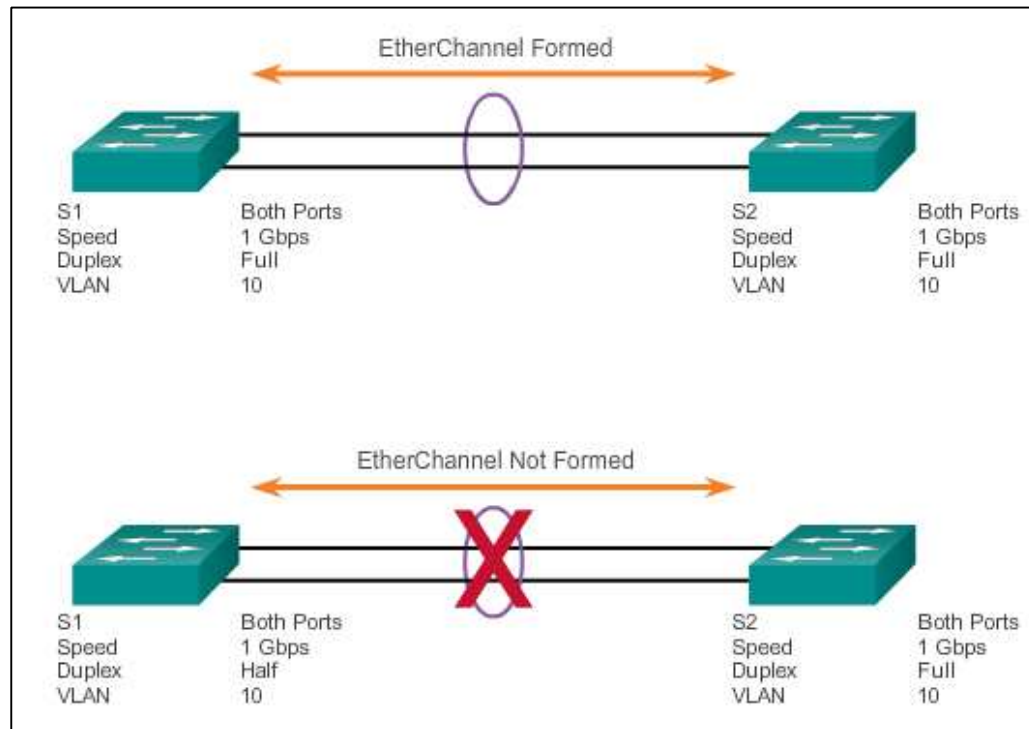


Switch 1	Switch 2	Channel Establishment
On	On	Yes
Active/Passive	Active	Yes
On/Active/Passive	Not Configured	No
On	Active	No
Passive/On	Passive	No

Configuring EtherChannel

Configuration Guidelines

- EtherChannel must be supported.
- Speed and duplex must match.
- VLAN match – All interfaces are in the same VLAN.
- Range of VLAN – Same range on all interfaces.





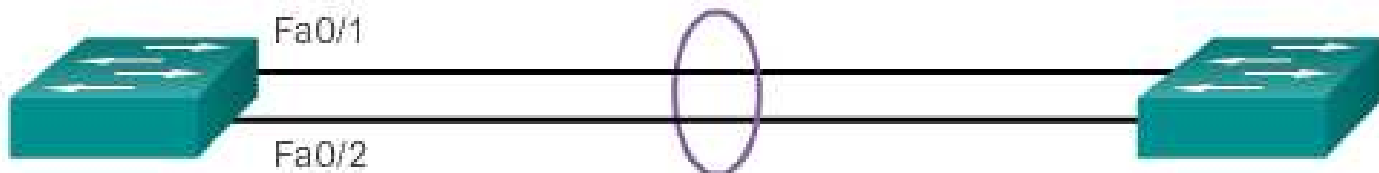
Configuring EtherChannel

Configuring Interfaces

Configuring EtherChannel with LACP

```
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.





Verifying and Troubleshooting EtherChannel

Verifying EtherChannel

- **show interface Port-channel** – Displays the general status of the EtherChannel interface.
- **show etherchannel summary** – Displays one line of information per port channel.
- **show etherchannel port-channel** – Displays information about a specific port channel interface.
- **show interfaces etherchannel** – Provides information about the role of the interface in the EtherChannel.

```
S1# show interface port-channel1
Port-channel1 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is 0cd9.96e8.8a02 (bia
0cd9.96e8.8a02)
  MTU 1500 bytes, BW 200000 Kbit/sec, DLY 100 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
<Output omitted>
```

Verifies the interface status.



First-Hop Redundancy Protocols



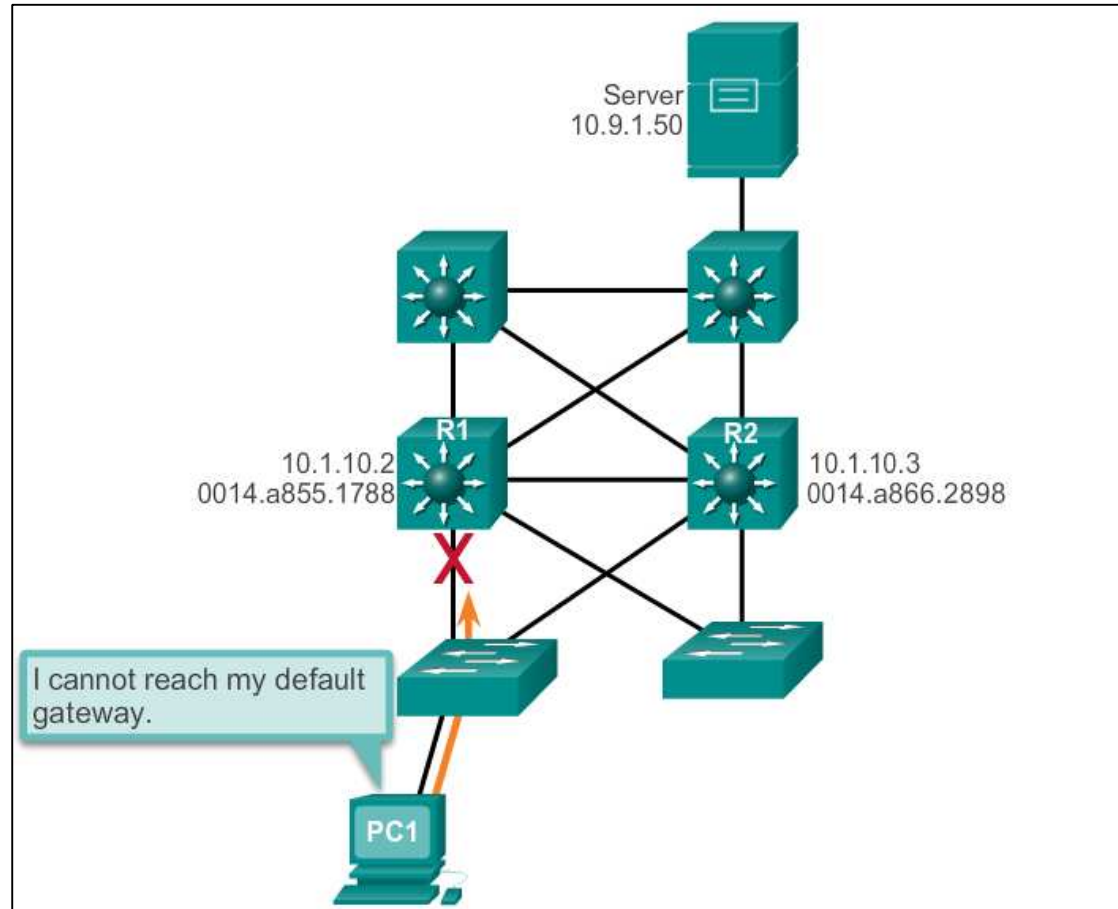
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Concept of First-Hop Redundancy Protocols

Default Gateway Limitations

- If the default gateway cannot be reached, the local device is unable to send packets off the local network segment.
- Even if a redundant router exists that could serve as a default gateway for that segment, there is no dynamic method by which these devices can determine the address of a new default gateway.

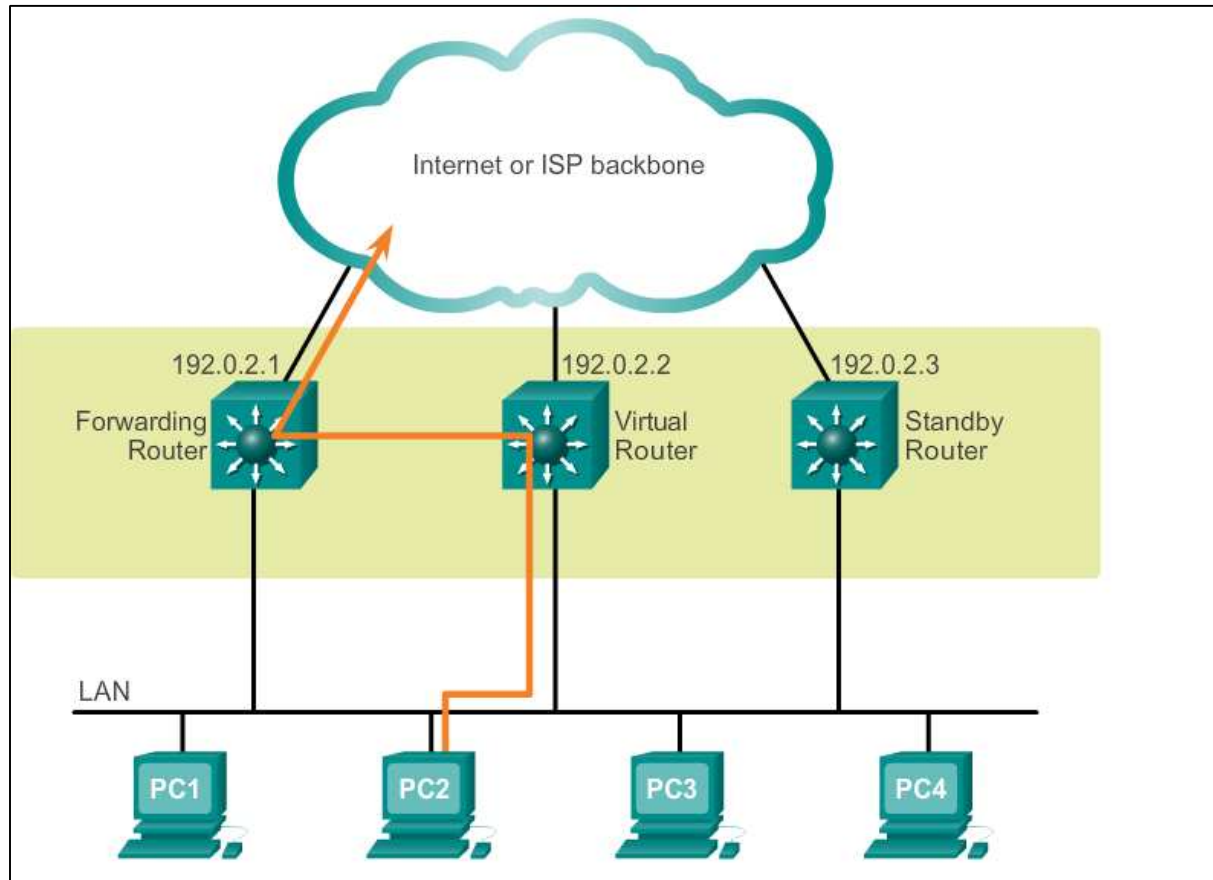




Concept of First-Hop Redundancy Protocols

Router Redundancy

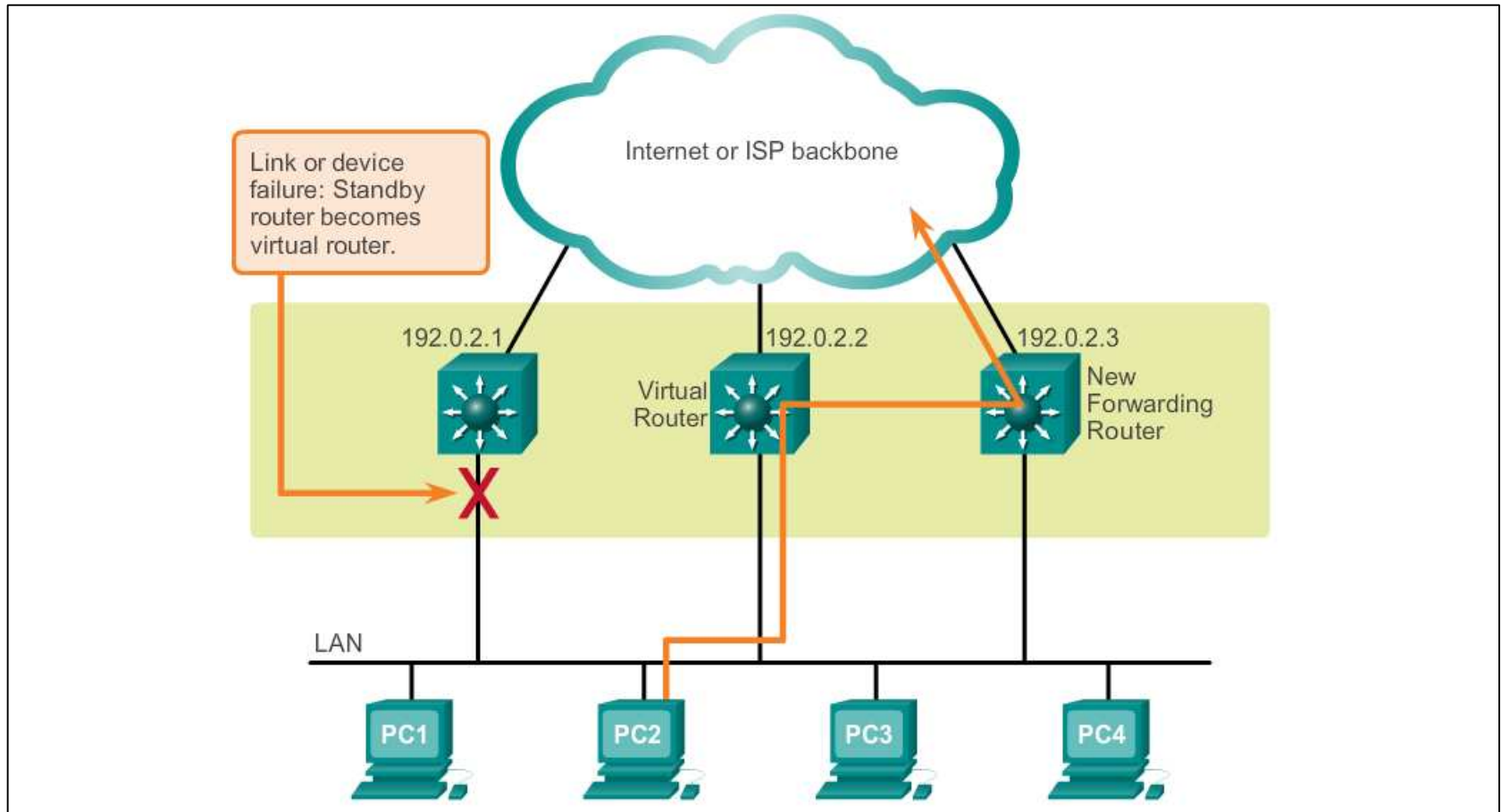
- Multiple routers are configured to work together to present the illusion of a single router to the hosts on the LAN.
- The ability of a network to dynamically recover from the failure of a device acting as a default gateway is known as first-hop redundancy.





Concept of First-Hop Redundancy Protocols

Steps for Router Failover





Varieties of First-Hop Redundancy Protocols

First-Hop Redundancy Protocols

- Hot Standby Router Protocol (HSRP)
- HSRP for IPv6
- Virtual Router Redundancy Protocol version 2 (VRRPv2)
- VRRPv3
- Gateway Load Balancing Protocol (GLBP)
- GLBP for IPv6
- ICMP Router Discovery Protocol (IRDP)



FHRP Verification

HSRP Verification

```
Router# show standby
Ethernet0/1 - Group 1
  State is Active
    2 state changes, last state change 00:30:59
  Virtual IP address is 10.1.0.20
    Secondary virtual IP address 10.1.0.21
  Active virtual MAC address is 0004.4d82.7981
    Local virtual MAC address is 0004.4d82.7981 (bia)
  Hello time 4 sec, hold time 12 sec
    Next hello sent in 1.412 secs
  Gratuitous ARP 14 sent, next in 7.412 secs
  Preemption enabled, min delay 50 sec, sync delay 40 sec
  Active router is local
  Standby router is 10.1.0.6, priority 75 (expires in 9.184 sec)
  Priority 95 (configured 120)
    Tracking 2 objects, 0 up
      Down Interface Ethernet0/2, pri 15
      Down Interface Ethernet0/3
  Group name is "HSRP1" (cfgd)
Follow by groups:
Et1/0.3 Grp 2 Active 10.0.0.254 0000.0c07.ac02 refresh 30 secs
(next 19.666)
Et1/0.4 Grp 2 Active 10.0.0.254 0000.0c07.ac02 refresh 30 secs
(next 19.491)
  Group name is "HSRP1", advertisement interval is 34 sec
```




FHRP Verification

GLBP Verification

- Gateway Load Balancing Protocol (GLBP) is a Cisco proprietary solution to allow automatic selection and simultaneous use of multiple available gateways in addition to automatic failover between those gateways.

```
Router# show glbp
FastEthernet0/1 - Group 1
  State is Active
    1 state change, last state change 00:02:34
  Virtual IP address is 192.168.2.100
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.288 secs
  Redirect time 600 sec, forwarder timeout 14400 sec
  Preemption disabled
  Active is local
  Standby is 192.168.2.2, priority 100 (expires in 8.640 sec)
  Priority 100 (default)
  Weighting 100 (default 100), thresholds: lower 1, upper 100
  Load balancing: round-robin
  Group members:
    001e.7aa3.5e71 (192.168.2.1) local
    001e.7aa3.5f31 (192.168.2.2)
  There are 2 forwarders (1 active)
  Forwarder 1
    State is Active
      1 state change, last state change 00:02:23
      MAC address is 0007.b400.0101 (default)
      Owner ID is 001e.7aa3.5e71
      Redirection enabled
  Preemption enabled, min delay 30 sec
  Active is local, weighting 100
```

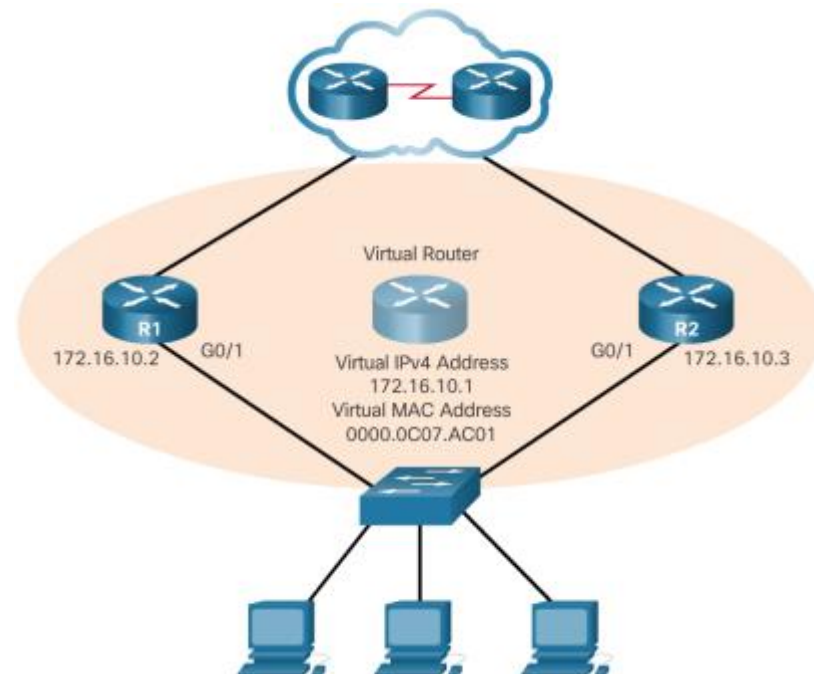

First Hop Redundancy Protocols

HSRP Configuration

- Sample Configuration

```
R1(config)# int g0/1
R1(config-if)# ip add 172.16.10.2 255.255.255.0
R1(config-if)# standby version 2
R1(config-if)# standby 1 ip 172.16.10.1
R1(config-if)# standby 1 priority 150
R1(config-if)# standby 1 preempt
R1(config-if)# no shutdown
R1(config-if)#
```

```
R2(config)# int g0/1
R2(config-if)# ip add 172.16.10.3 255.255.255.0
R2(config-if)# standby version 2
R2(config-if)# standby 1 ip 172.16.10.1
R2(config-if)# no shut
R2(config-if)#
```



Assigning priority helps select the active and standby routers. If preemption is enabled, the router with the highest priority becomes the designated active router. If priorities are equal, the primary IP addresses are compared, and the higher IP address has priority.



Configure GLBP

Configure GLBP on Router

```
R1(config)# interface g0/1
R1(config-if)# glbp 1 ip 192.168.1.254
R1(config-if)# glbp 1 preempt
R1(config-if)# glbp 1 priority 150
R1(config-if)# glbp 1 load-balancing round-robin
```

Assigning priority helps select the active and standby routers. If preemption is enabled, the router with the highest priority becomes the designated active router. If priorities are equal, the primary IP addresses are compared, and the higher IP address has priority.

Round Robin term is generally used, time slices are assigned to each process in equal portions and in circular order, handling all processes without priority