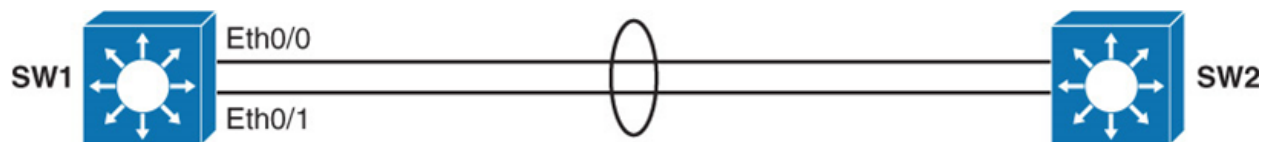
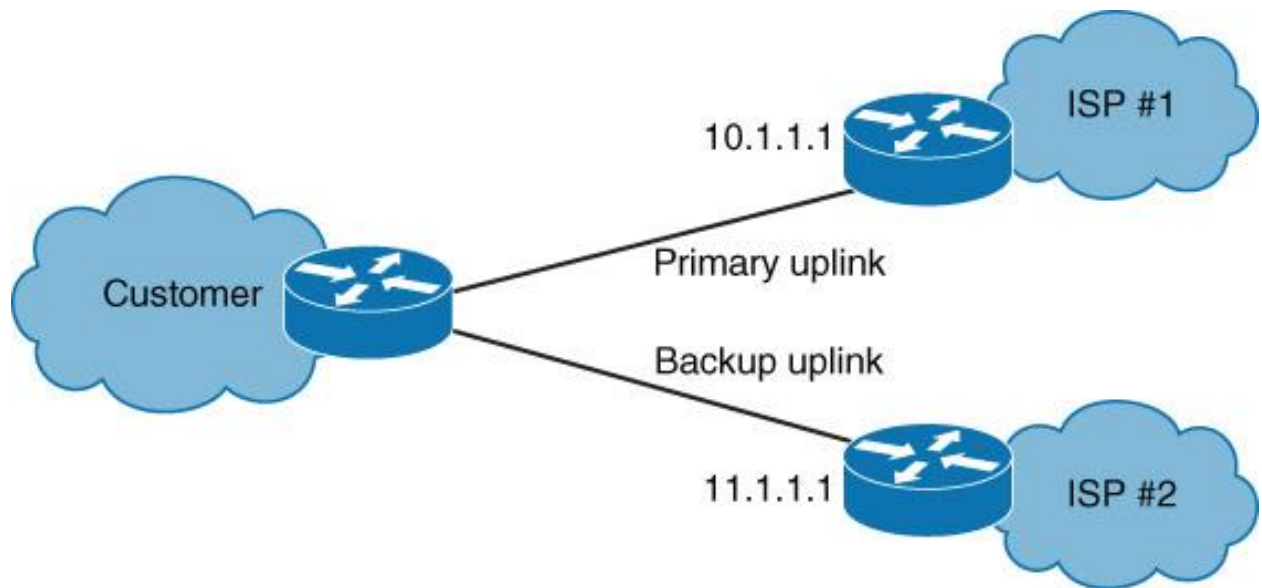


Redundancy:

- o Redundancy, Failover, High Availability, Clustering, RAID and Fault-tolerance.
- o A good network design provides the redundancy in devices and network links.
- o Redundancy is basically extra hardware or software that can be used as backup.
- o If the main hardware or software fails or link fail or unavailable in case of emergency.
- o It is method for ensuring network availability in case of network device or path failure.
- o It is method for ensuring network availability in case of network device unavailability.
- o Network redundancy is process through which additional or alternate instances of network devices, equipment & communication mediums are installed within network infrastructure.
- o Redundancy can be achieved via failover, load balancing & high availability in automatically.
- o High availability is a feature which provides redundancy and fault tolerance automatically.
- o High Availability is a number of connected devices processing and providing a services.
- o The goal is to ensure this service is always available even in the event of a failure or down.
- o Clustering is similar to redundant servers & provides fault tolerance in case of emergency.
- o A group of servers are logically combined into a cluster and seen as one device to work.
- o If a device fails within cluster services continue because other devices continue services.
- o One link processing traffic & second link would only become active if primary link fails.
- o Set up to allow company to connect their device to more than one Internet connection.
- o If one connection goes down, all traffic would failover to the other Internet connection.
- o This would eliminate single point of failure and would re-assure availability and reliability.
- o RAID is a fault tolerance solution for hard drives usually implemented in the servers.
- o Redundant Array of Independent Disks providing redundancy and fault tolerance.
- o Automatic failover is process of moving active services from primary device to backup.
- o Usually backup device continues these services until primary device has come back up.
- o When a device fails another device takes over this process which is referred to as a failover.
- o Services failover to backup device which will continue from where primary device left off.
- o Failover feature allows for hardware firewalls to have some redundancy and backup.
- o Have two or more hardware device configured if primary fails, the backup take over.
- o It is implemented on the high-end hardware devices for networks require redundancy.
- o HSRP is a Cisco proprietary protocol for establishing a fault-tolerant default gateway.
- o Redundancy, Fault-tolerance, & High-availability, all refer to some sort of failover of backup.



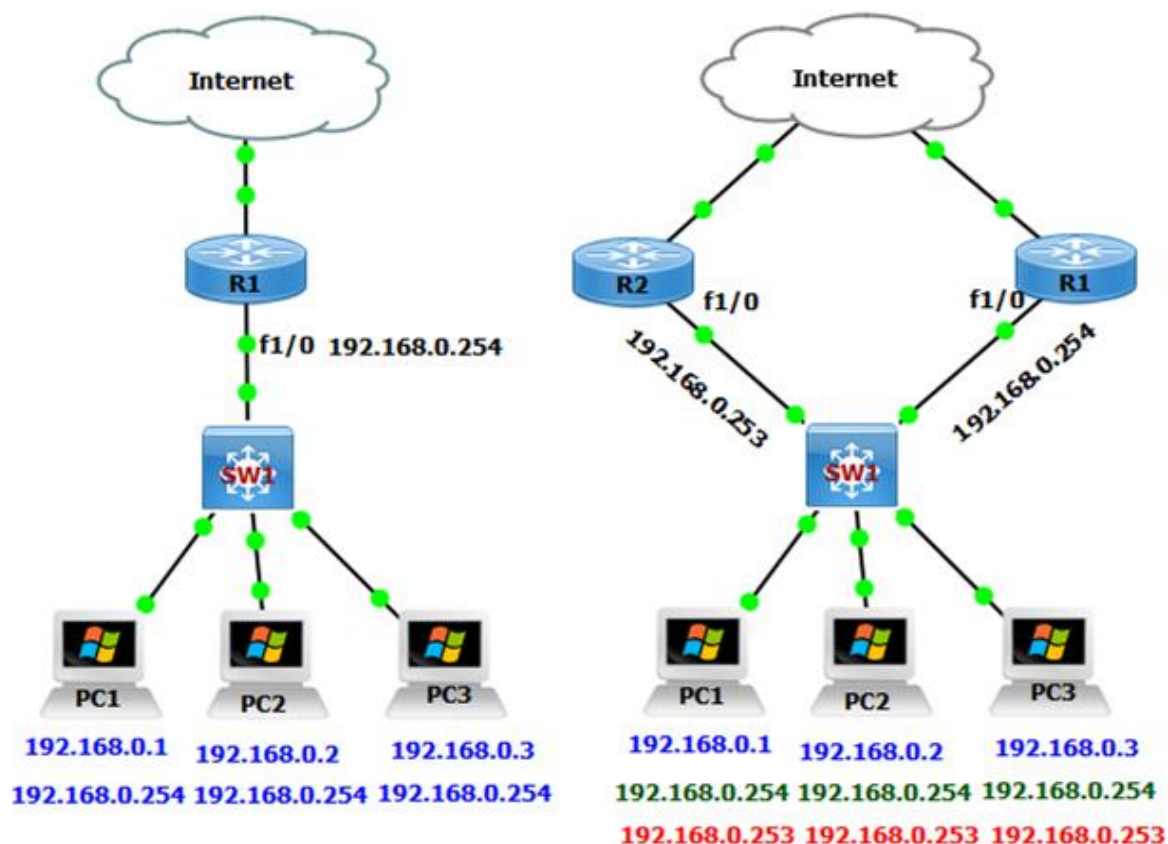


First-Hop Redundancy Protocols:

- o FHRP is a term which stands for First Hop Redundancy Protocol.
- o FHRP provide redundancy & load balancing of default gateway (First Hop).
- o FHRP connecting multiple physical router & treat as one or more logical router.
- o FHRP connecting multiple physical switch, which work as gateway for LAN devices.
- o FHRP allow for transparent fail-over at the first-hop Cisco IP Router or Cisco Switch.
- o FHRP protocols protect against a single point of failure for the default gateway.
- o FHRP provide load balancing if multiple uplinks are available at first-hop routers.
- o FHRP two or more routers sharing a single MAC and IP (Internet Protocol) address.
- o There are three types of FHRP protocol which are Cisco HSRP, VRRP and Cisco GLBP.

FHRP Working:

- o Creating group of Physical gateway using Layer 3 device Router or Switches.
- o Agree to assign one virtual IP address, which same to all first hop devices.
- o Virtual IP (Internet Protocol) going to use as gateway address to all LAN device.
- o The FHRP creating one or more Virtual MAC (Media Access Control) address.
- o One first hop is respond Address Resolution Protocol request (Active/AVG/Master).
- o It is using the keepalives messages in order to get Virtual gateway status.
- o LAN devices use Virtual IP & MAC (Media Access Control) address as default gateway.

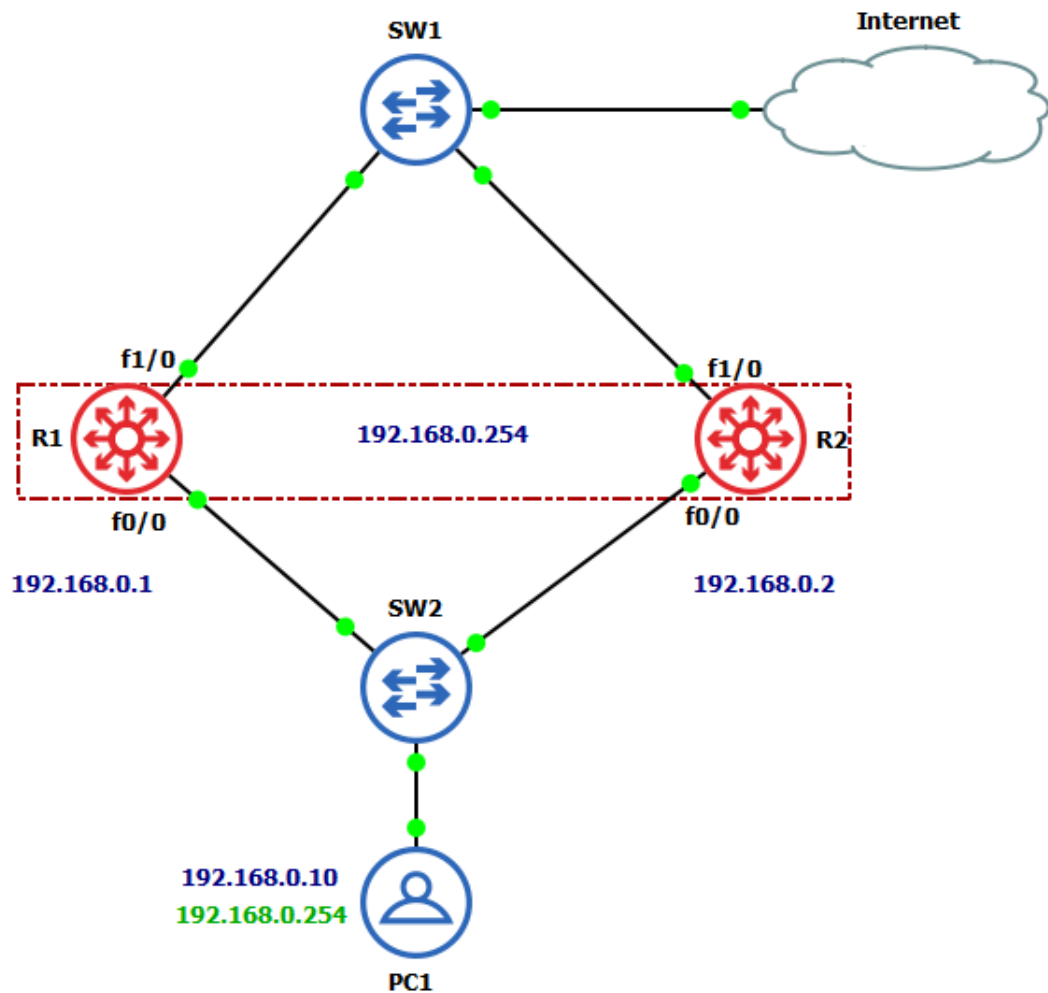


HSRP (Hot Standby Router Protocol):

- o HSRP stands for Hot Standby Router Protocol & Cisco proprietary protocol.
- o There are two versions of Hot Standby Router Protocol (HSRPv1 & HSRPv2).
- o Two or more Cisco Routers or Switches on LAN segment form an HSRP group.
- o In HSRP, one Cisco Router or Switch assumes the function of “Active” Device.
- o In HSRP, other Routers or Switches is known as “Standby” Router or Switch.
- o In HSRP, the highest priority gateway is elected as active gateway of group.
- o In HSRP the active gateway is the owner of Virtual MAC & Virtual IP address.
- o In HSRP, the default priority is set to 100 but it can be easily modify (0-255).
- o Highest interface IP as the tiebreaker and preempt option is disabled by default.
- o HSRP Version 1 uses Multicast Address 224.0.0.2 for sending the Hello traffic.
- o HSRP Version 2 uses Multicast Address 224.0.0.102 for sending the Hello traffic.
- o In HSRP, the messages can be authenticated using the clear text or the MD5.
- o HSRP Version 1 allows for group numbers ranging from 0 – 255 not more then.
- o HSRP Version 2 allows for group numbers ranging from 0 – 4095 which is more.
- o HSRP Version 1 virtual MAC 0000. 0c07.acXX. (XX is group no. {0-255}).
- o HSRP Version 2 virtual MAC 0000. 0c9f.fXXX. (XXX is group no. {0-4095}).
- o HSRP Version 2 support IPv6 address but HSRP version 1 doesn't support IPV6.
- o HSRP Version 1 and HSRP Version 2 are not compatible with each other.
- o Load sharing using multiple groups and virtual IP with priority modification.
- o In HSRP Version 1 & 2 Default Hello time is 3 seconds, Hold time is 10 seconds.
- o On Cisco Router or Switches By default, version 1 is enable until version 2 enabled.
- o By default, in all Cisco Routers or Cisco Switches have priority 100.

State	Explanation
Initial	This is the first state when HSRP starts. You'll see this just after you configured HSRP or when the interface just got enabled.
Listen	The router knows the virtual IP address and will listen for hello messages from other HSRP routers.
Speak	The router will send hello messages and will join the election to see which router will become active or standby.
Standby	The router didn't become the active router but will keep sending hello messages. If the active router fails it will take over.
Active	The router will actively forward packets from clients and sends hello messages.

Lab Time:



R1 Configuration:

```
R1(config)#interface FastEthernet0/0
R1(config-if)# ip address 192.168.0.1 255.255.255.0
R1(config-if)# no shutdown
```

```
R1(config)#interface FastEthernet1/0
R1(config-if)# ip address dhcp
R1(config-if)# no shutdown
```

R2 Configuration:

```
R2(config)#interface FastEthernet0/0
R2(config-if)# ip address 192.168.0.2 255.255.255.0
R2(config-if)# no shutdown
```

```
R1(config)#interface FastEthernet1/0
R1(config-if)# ip address dhcp
R1(config-if)# no shutdown
```

```
#
# This is a sample network config uncomment lines to configure the network
#

# Static config for eth0
auto eth0
iface eth0 inet static
    address 192.168.0.10
    netmask 255.255.255.0
    gateway 192.168.0.254
    up echo nameserver 8.8.8.8 > /etc/resolv.conf

# DHCP config for eth0
# auto eth0
# iface eth0 inet dhcp
```

R1 HSRP Configuration

```
R1(config)#interface FastEthernet 0/0
R1(config-if)#standby 1 ip 192.168.0.254
R1(config-if)#standby 1 name Group1
R1(config-if)#standby 1 authentication text abc
R1(config-if)#standby 1 authentication md5 key-string abc
R1(config-if)#standby 1 timers 2 3
R1(config-if)#standby 1 priority 110
R1(config-if)#standby 1 preempt
R1(config-if)#standby 1 preempt delay minimum 60
R1(config-if)#standby 1 track fastEthernet 1/0
```

```
R1#show standby
```

```
R1#show standby brief
```

```
R1#debug standby packets
```

```
R1#debug standby events
```

R2 HSRP Configuration

```
R2(config)#interface FastEthernet 0/0
R2(config-if)#standby 1 ip 192.168.0.254
R2(config-if)#standby 1 name Group1
R1(config-if)#standby 1 timers 2 3
R2(config-if)#standby 1 authentication text abc
R2(config-if)#standby 1 authentication md5 key-string abc
```

```
R2#show standby
```

```
R2#show standby brief
```

```
R2#show standby neighbors
```

```
R2#debug standby packets
```

```
R2#debug standby events
```



```

R1#show standby
FastEthernet0/0 - Group 1
  State is Active
    2 state changes, last state change 00:01:00
  Virtual IP address is 192.168.0.254
  Active virtual MAC address is 0000.0c07.ac01 (MAC In Use)
  Local virtual MAC address is 0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
  Next hello sent in 1.632 secs
  Preemption disabled
  Active router is local
  Standby router is 192.168.0.2, priority 100 (expires in 9.504 sec)
  Priority 100 (default 100)
  Group name is "hsrp-Fa0/0-1" (default)

```

```

R1#show standby
FastEthernet0/0 - Group 1
  State is Standby
    7 state changes, last state change 00:01:45
  Virtual IP address is 192.168.0.254
  Active virtual MAC address is 0000.0c07.ac01 (MAC Not In Use)
  Local virtual MAC address is 0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
  Next hello sent in 0.752 secs
  Authentication MD5, key-string
  Preemption disabled
  Active router is 192.168.0.2, priority 100 (expires in 8.432 sec)
  Standby router is local
  Priority 100 (default 100)
  Group name is "hsrp-Fa0/0-1" (default)

```

```

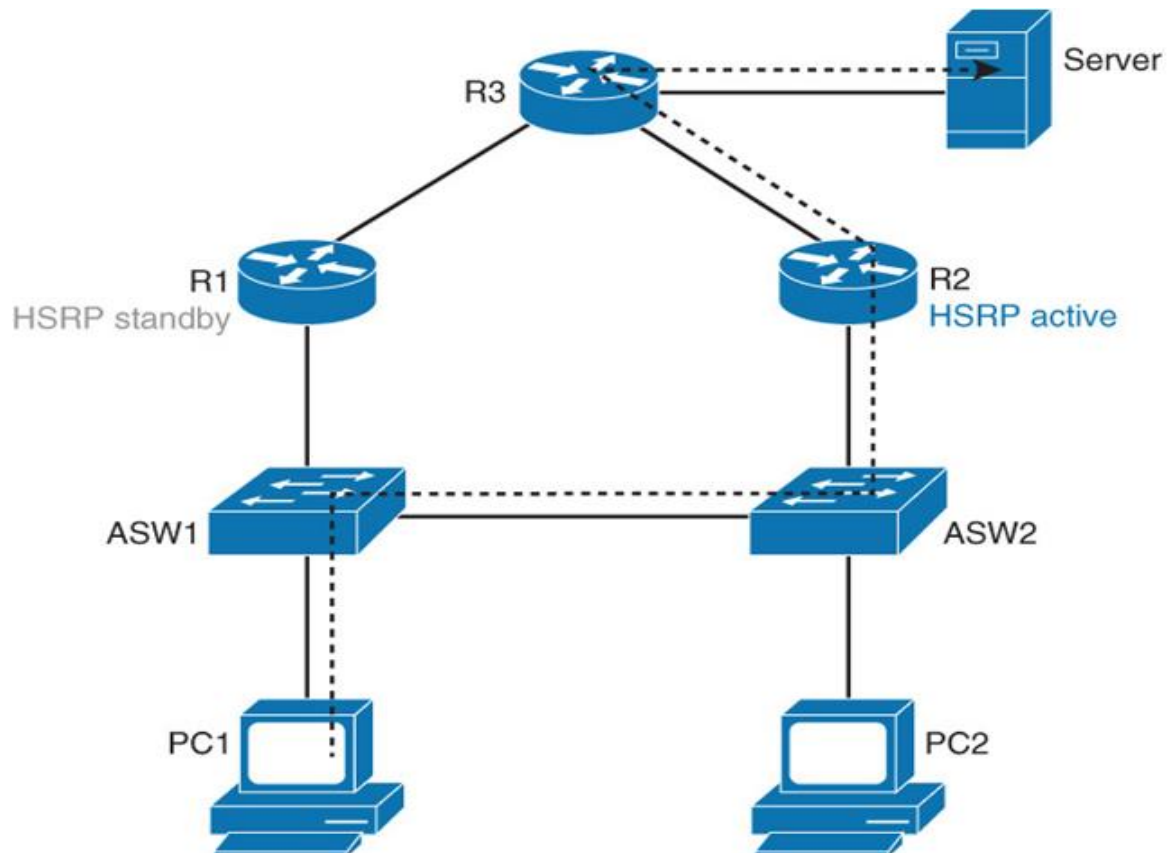
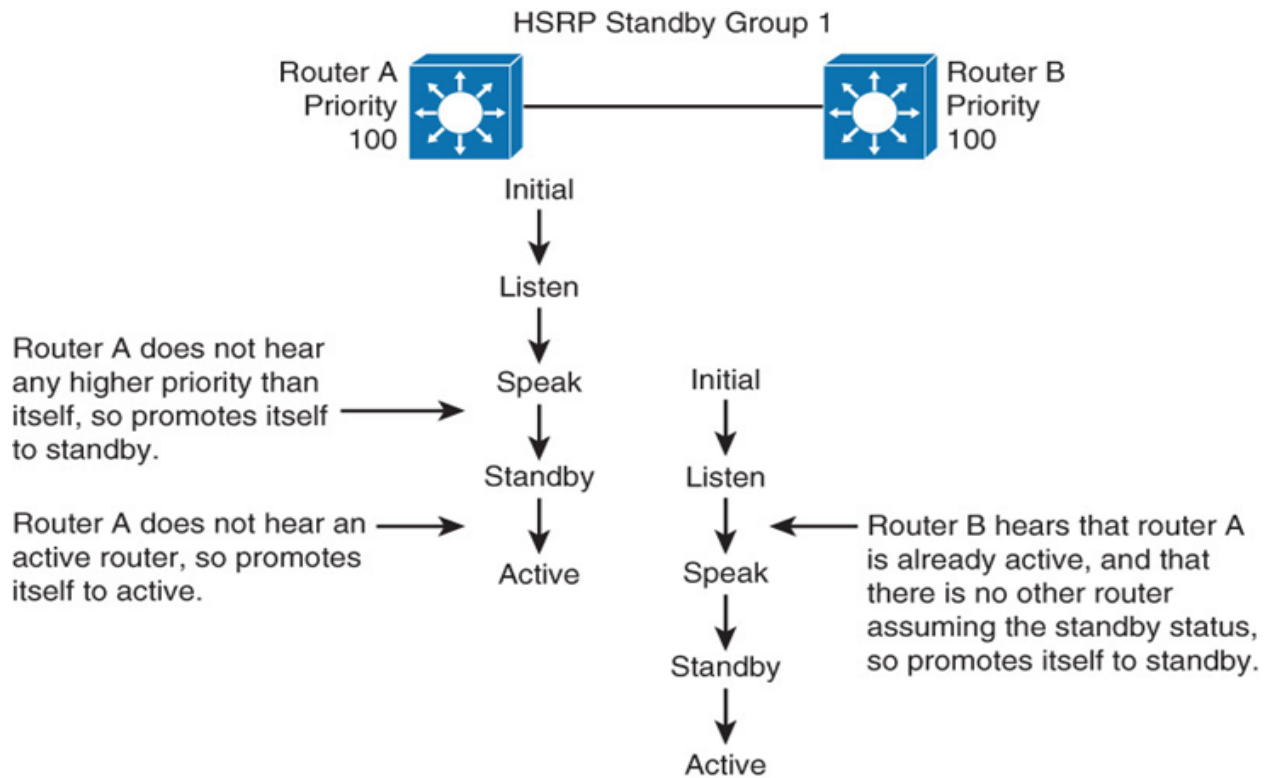
R1#show standby
FastEthernet0/0 - Group 1
  State is Standby
    7 state changes, last state change 00:04:24
  Virtual IP address is 192.168.0.254
  Active virtual MAC address is 0000.0c07.ac01 (MAC Not In Use)
  Local virtual MAC address is 0000.0c07.ac01 (v1 default)
  Hello time 3 sec (cfgd 1 sec), hold time 10 sec (cfgd 3 sec)
  Next hello sent in 1.424 secs
  Authentication MD5, key-string
  Preemption disabled
  Active router is 192.168.0.2, priority 100 (expires in 10.512 sec)
  Standby router is local
  Priority 100 (default 100)
  Group name is "hsrp-Fa0/0-1" (default)

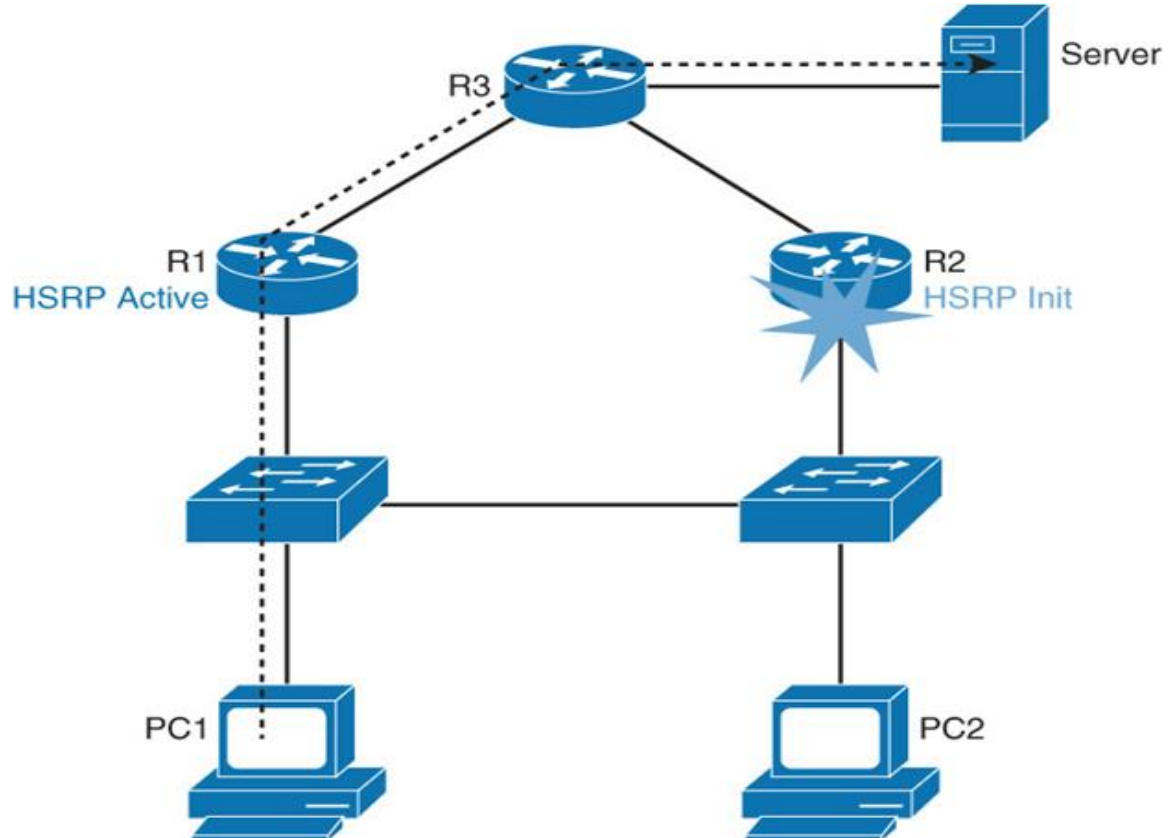
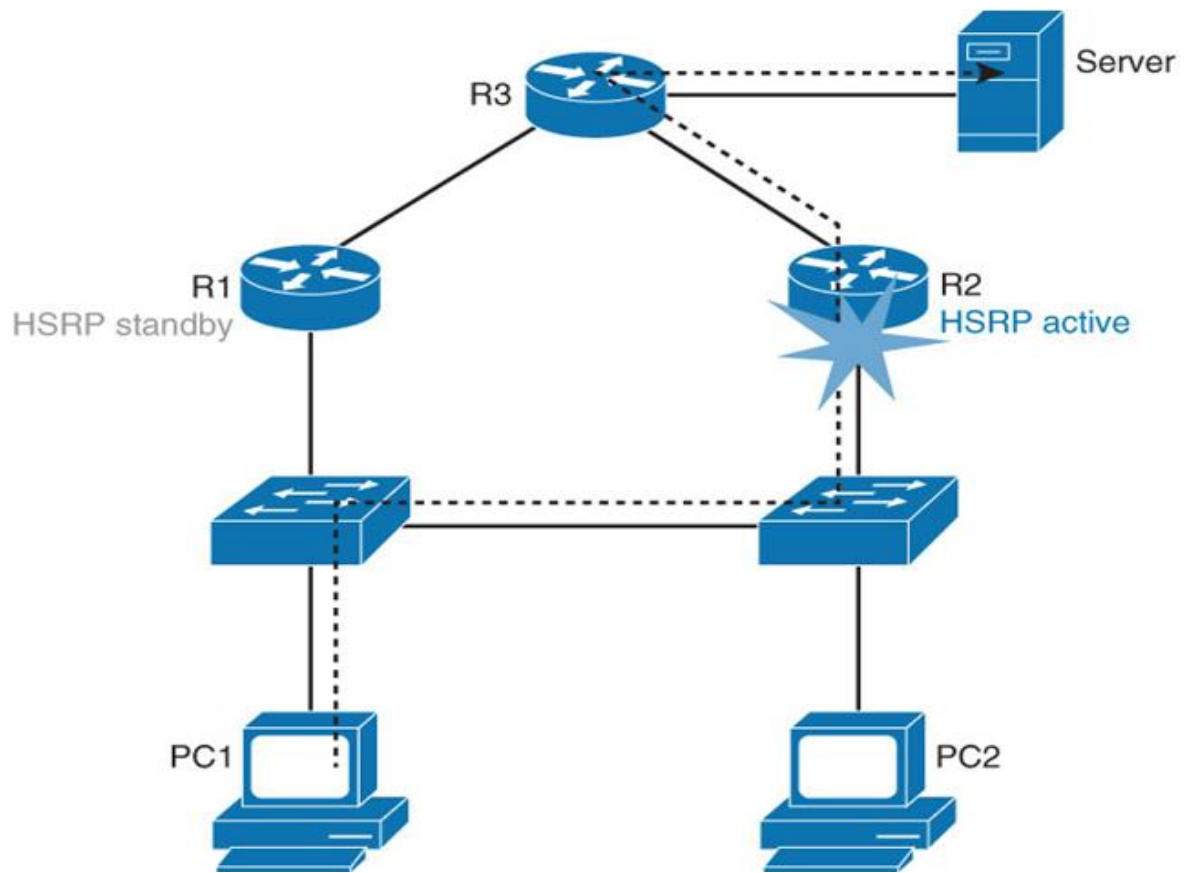
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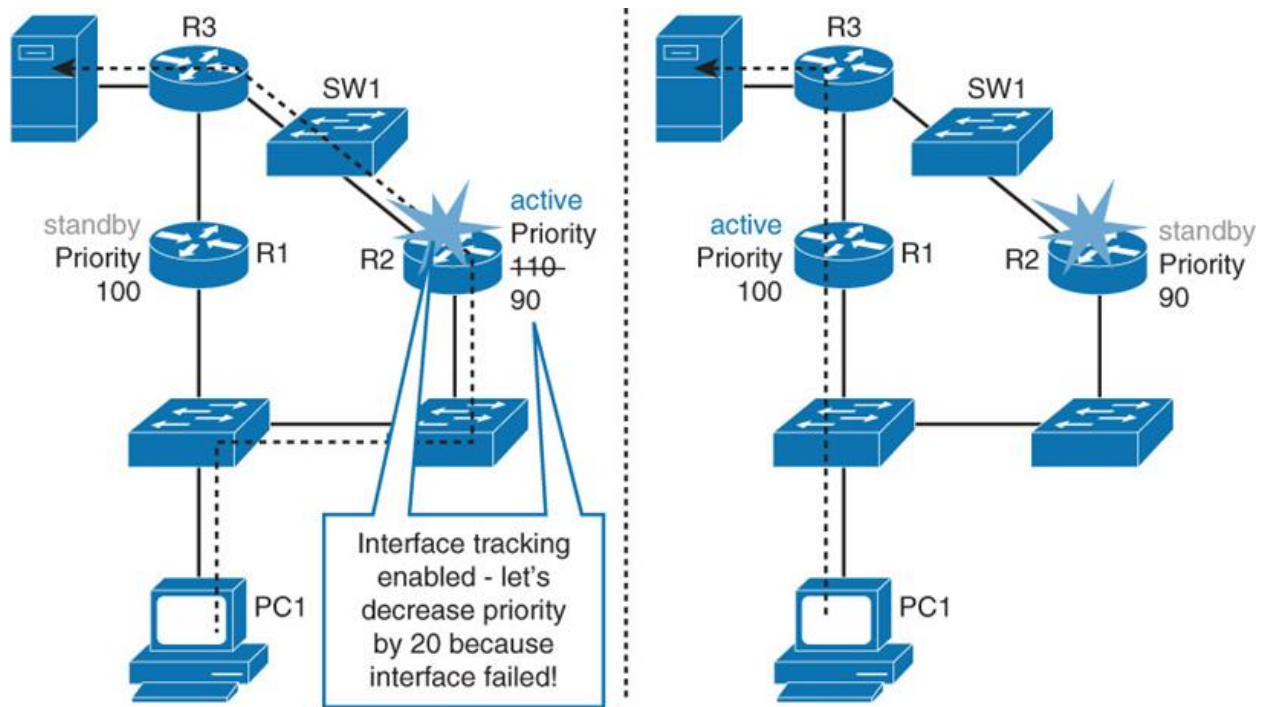
```

R1#show standby brief
P indicates configured to preempt.
|
Interface  Grp  Pri  P  State  Active        Standby        Virtual IP
Fa0/0      1    100      Standby 192.168.0.2    local          192.168.0.254

```



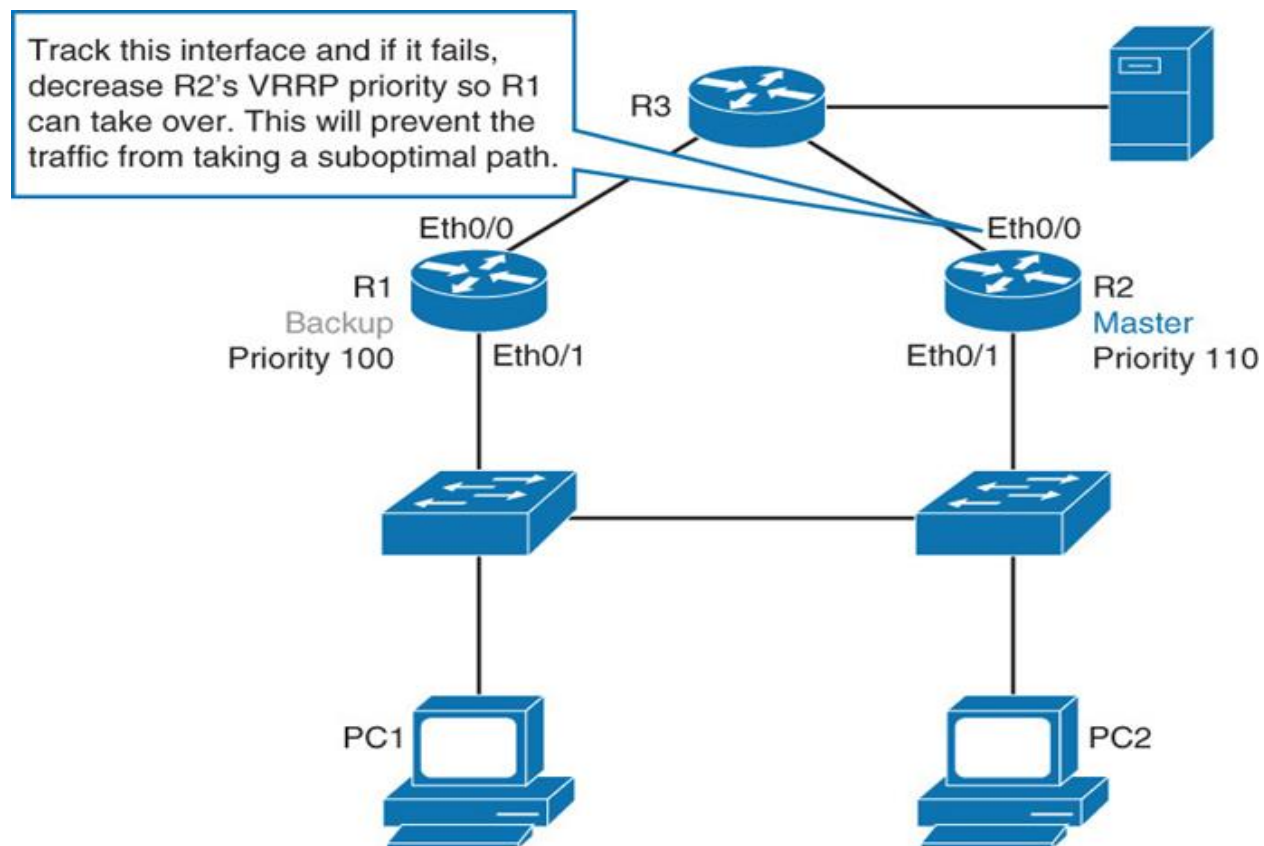
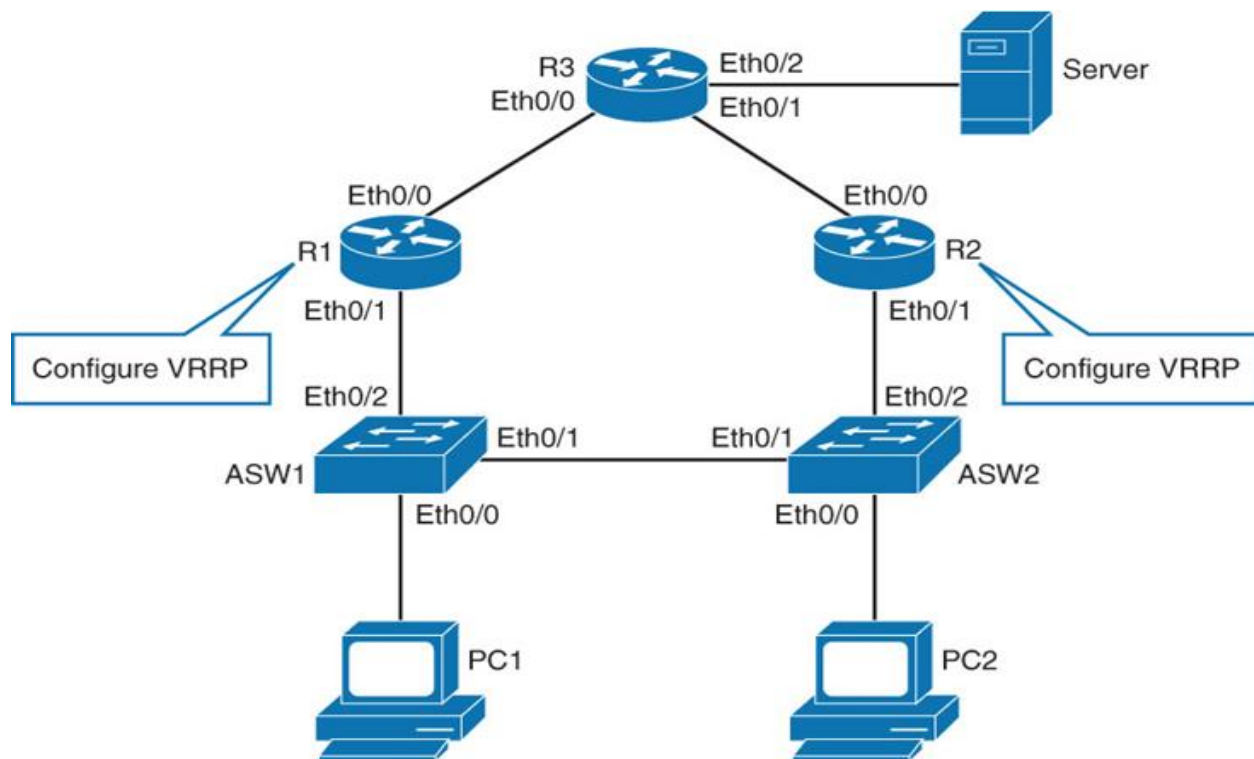




VRRP (Virtual Router Redundancy Protocol):

- o VRRP is term which is stands for **Virtual Router Redundancy Protocol**.
- o VRRP is open standard alternative to HSRP (Hot Standby Router Protocol).
- o Uses terms master/backup same as active/standby in HSRP Protocols.
- o In VRRP, one Router or Switch assumes the function of “Master” Device.
- o In VRRP, other Router or Switch is known as “Backup” Router or Switch.
- o Master sends VRRP advertisements to other routers in the same group.
- o VRRP, uses multicast IP 224.0.0.18 for hello mechanism and elections.
- o VRRP (Virtual Router Redundancy Protocol) uses own transport protocol 112.
- o VRRP use the Virtual MAC address which is 0000.5E00.01XX. (XX is group no.).
- o Unlike in HSRP protocol, in VRRP the preemption is enabled by default.
- o Preemption can be disabled using the no vrrp preempt command under interface.
- o In VRRP, the default Hello time is 1 seconds and the Hold time is set to 3 seconds.
- o Virtual IP Address can be the same as the real IP address on the interface.
- o In VRRP, the gateway become master using highest priority 255.
- o Load sharing can be using multiple group & virtual IP with changing the priority.
- o There are three versions of VRRP and VRRP version 3 support IPv6 as well.

R1 VRRP Configuration
R1(config)#interface FastEthernet 0/0
R1(config-if)# vrrp 1 ip 192.168.0.254
R1(config-if)# vrrp 1 name Group1
R1(config-if)# vrrp 1 priority 110
R1(config-if)# vrrp 1 preempt
R1#show vrrp
R1#show vrrp brief
R2#show vrrp neighbors
R2# show vrrp brief
R2# show vrrp all
R2 VRRP Configuration
R2(config)#interface FastEthernet 0/0
R2(config-if)# vrrp 1 ip 192.168.0.254
R2(config-if)# vrrp 1 name Group1
R2(config-if)# vrrp 1 priority 110
R2(config-if)# vrrp 1 preempt
R2#show vrrp
R2#show vrrp brief
R2#show vrrp neighbors
R2# show vrrp brief
R2# show vrrp all



```

R1#show vrrp
FastEthernet0/0 - Group 1
  State is Master
  Virtual IP address is 192.168.0.254
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 100
  Master Router is 192.168.0.1 (local), priority is 100
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.609 sec

```

```

R1#show vrrp br
R1#show vrrp brief

```

Interface	Grp	Pri	Time	Own	Pre	State	Master_addr	Group_addr
Fa0/0	1	100	3609		Y	Master	192.168.0.1	192.168.0.254

```

R2#show vrrp
FastEthernet0/0 - Group 1
  State is Master
  Virtual IP address is 192.168.0.254
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 100
  Authentication text "abc"
  Master Router is 192.168.0.2 (local), priority is 100
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.609 sec

```

VRRP Track

```
R2(config)#track 2 interface f1/0 line-protocol
```

```
R2(config)#interface f0/0
```

```
R2(config-if)#vrrp 1 track 2 decrement 20
```

```
R2(config)#interface f1/0
```

```
R2(config-if)#shutdown
```

```

R2#show track
Track 2
  Interface FastEthernet1/0 line-protocol
  Line protocol is Down (hw admin-down)
  2 changes, last change 00:05:43
  Tracked by:
    VRRP FastEthernet0/0 1

```



```
R2#show vrrp
FastEthernet0/0 - Group 1
  State is Backup
  Virtual IP address is 192.168.0.254
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 80
  VRRS Group name abc
  Track object 2 state Down decrement 20
  Authentication text "abc"
```

```
R2#show vrrp all
FastEthernet0/0 - Group 1
  State is Backup
  Virtual IP address is 192.168.0.254
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 80
  VRRS Group name abc
  Track object 2 state Down decrement 20
  Authentication text "abc"
  Master Router is 192.168.0.1, priority is 100
  Master Advertisement interval is 1.000 sec
  Master Down interval is 3.609 sec (expires in 3.485 sec) Learning
```