

## FHRP(First Hop Redundancy Protocol) / Gateway Redundancy:

Creates a Virtual Gateway (i.e. Virtual MAC and Virtual IP).

1. There are methods on your OS (Windows/Linux/MacOS) to configure multiple gateways and gateway failover)

Types:

### Protocols

#### Hot Standby Router Protocol (HSRP)

Provides default gateway redundancy using one active and one standby router; standardized but licensed by Cisco Systems

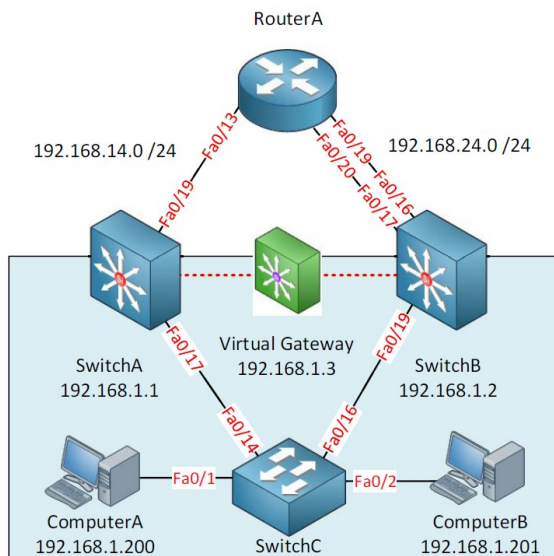
#### Virtual Router Redundancy Protocol (VRRP)

An open-standard alternative to Cisco's HSRP, providing the same functionality

#### Gateway Load Balancing Protocol (GLBP)

Supports arbitrary load balancing in addition to redundancy across gateways; Cisco proprietary

### HSRP (Hot Standby Routing Protocol) (Cisco Proprietary):



```
SwitchA(config)#interface fa0/17
SwitchA(config-if)#no switchport
SwitchA(config-if)#ip address 192.168.1.1 255.255.255.0
SwitchA(config)#interface fa0/19
SwitchA(config-if)#no switchport
SwitchA(config-if)#ip address 192.168.14.1 255.255.255.0
SwitchA(config)#ip routing
SwitchA(config)#ip route 0.0.0.0 0.0.0.0 192.168.14.4
SwitchA(config)#interface fa0/17
SwitchA(config-if)#standby 1 ip 192.168.1.3  ! (create a standby group and assign an IP)
```

!(Same and opposite config on SwitchB)

!(PC is configured with a default gateway of 192.168.1.3 i.e. Virtual Gateway's IP)

!(HSRPv1 uses the **0000.0c07.acXX** MAC address where XX is the HSRP group number e.g. 0000.0c07.ac01 for group 1)(HSRPv2 uses **0000.0c9f.fxxx** MAC)

!(By default the switch with the highest priority will become the active HSRP device. If the priority is the same then the highest IP address)

```
SwitchA(config)#interface fa0/17
SwitchA(config-if)#standby 1 priority 150
```

```
SwitchA(config-if)#standby 1 preempt
SwitchA(config-if)#standby 1 preempt delay minimum 60
!(If a router or reboots it might need some time to “converge”)
SwitchA(config-if)#standby 1 version 2
!(version must be same on both devices)
SwitchA(config-if)#standby 1 authentication md5 key-string md5pass
SwitchA(config-if)#standby 1 timers msec 100 msec 300
!(default 3 secs hello time and 10 secs hold time)
```

	HSRPv1	HSRPv2
<b>Group numbers</b>	0 – 255	0 – 4095
<b>Virtual MAC Address</b>	0000.0c07.acXX (XX = group number)	0000.0c9f.fxxx (XXX = group number)
<b>Multicast address</b>	224.0.0.2	224.0.0.102

### HSRP States:

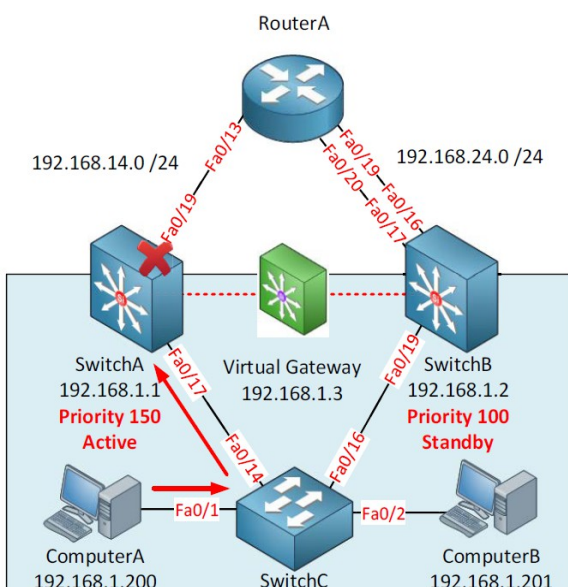
State	Explanation
<b>Initial</b>	This is the first state when HSRP starts. You’ll see this just after you configured HSRP or when the interface just got enabled.
<b>Listen</b>	The router knows the virtual IP address and will listen for hello messages from other HSRP routers.
<b>Speak</b>	The router will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

HSRP/GLBP Interface States	
<b>Speak</b>	· Gateway election in progress
<b>Active</b>	· Active router/VG
<b>Standby</b>	· Backup router/VG
<b>Listen</b>	· Not the active router/VG

!(Can use MSEC with HSRP v2)

### Interface tracking:

1. Select an interface to track and if it fails decrease the priority so that another device can become the active router.



```

SwitchA(config)#interface fa0/17
SwitchA(config-if)#standby 1 preempt
SwitchB(config)#interface fa0/19
SwitchB(config-if)#standby 1 preempt
SwitchA(config-if)#standby 1 track fastEthernet 0/19
!(Test)
SwitchA(config)#interface fa0/19
SwitchA(config-if)#shutdown
!(Verify)
SwitchA#show standby | include Priority
    Priority 140 (configured 150)
SwitchA(config)#interface fa0/17
SwitchA(config-if)#standby 1 track fastEthernet 0/19 60
!(If the links goes down again the priority will become 90 reducing it by 60 so the other device with
default priority 100 will then become active)

```

!(Interface tracking will only check the state of the interface not if anything fails upstream)

### **IP SLA with object tracking:**

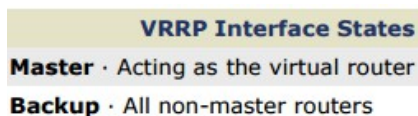
!(IP SLA can be used for many things. One of them is to generate a ping to a destination every X seconds and we can combine this with object tracking)

```

SwitchA(config)#interface fa0/17
SwitchA(config-if)#no standby 1 track fastEthernet 0/19 60
SwitchA(config)#ip sla 1
SwitchA(config-ip-sla)#icmp-echo 192.168.14.4
SwitchA(config)#ip sla schedule 1 start-time now life forever
SwitchA(config)#track 1 rtr 1 reachability
SwitchA(config)#interface fa0/19
SwitchA(config-if)#standby 1 track 1 decrement 60
!(Test)
RouterA(config)#interface fa0/13
RouterA(config-if)#shutdown

```

### **VRRP:**



#### **1. Exactly same config as HSRP except we use vrrp instead of standby**

2. VRRP uses the **0000.5e00.01XX** MAC address where XX is the VRRP group number.
3. VRRP can have the same IP as that of the real interface as opposed to HSRP.

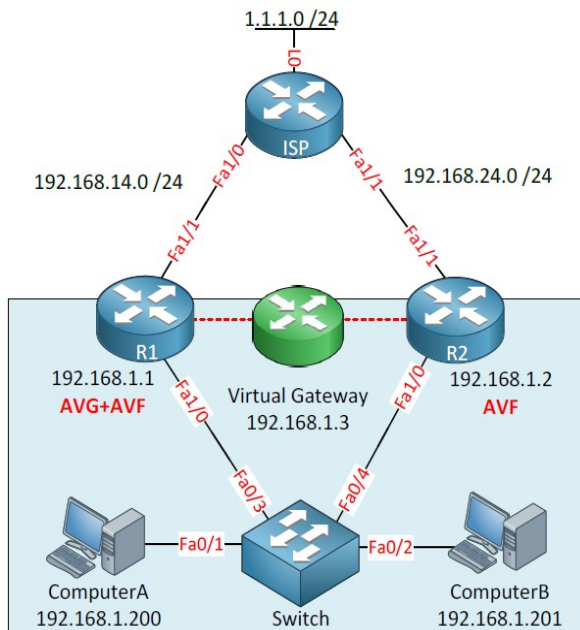
#### **50/50 load share config with HSRP or VRRP (Multiple HSRP/VRRP) Groups:**

```

R1(config)#interface fa1/0
R1(config-if)#standby 1 ip 192.168.1.3
R1(config-if)#standby 1 priority 150
R1(config-if)#standby 2 ip 192.168.1.4
R2(config)#interface fa1/0
R2(config-if)#standby 1 ip 192.168.1.3
R2(config-if)#standby 2 ip 192.168.1.4
R2(config-if)#standby 2 priority 150

```

!(ComputerA can use 192.168.1.3 as its default gateway. ComputerB can use 192.168.1.4 as its default gateway. We now have load sharing and R1 and R2 will be redundant for each other)



**GLBP Roles**

**Active Virtual Gateway (AVG)**  
Answers for the virtual router and assigns virtual MAC addresses to group members

**Active Virtual Forwarder (AVF)**  
All routers which forward traffic for the group

**GLBP Load Balancing**

**Round-Robin (default)**  
The AVG answers host ARP requests for the virtual router with the next router in the cycle

**Host-Dependent**  
Round-robin cycling is used while a consistent AVF is maintained for each host

**Weighted**  
Determines the proportionate share of hosts handled by each AVF

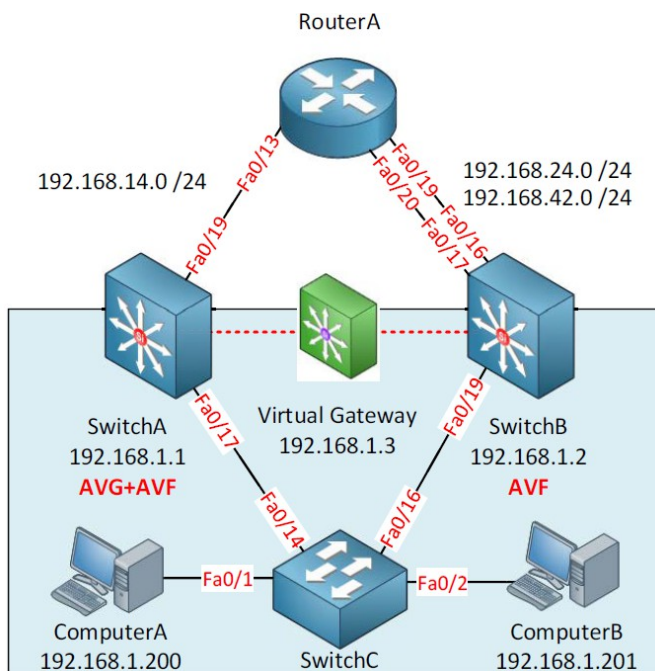
**GLBP:**

```
R1(config)#interface fa1/0
R1(config-if)#glbp 1 ip 192.168.1.3
R1(config-if)#glbp 1 preempt
R1(config-if)#glbp 1 authentication md5 key-string mypass
!(Same and opposite config on SwitchB)
R1(config-if)#glbp 1 priority 150
```

!(The virtual MAC address that GLBP uses is 0007.b400.XXYY (where X = GLBP group number and Y = AVF number))

**GLBP interface tracking:**

!(Interface tracking works differently for GLBP compared to HSRP or VRRP. It has a weighting mechanism which is used to determine if a device can be AVF or not)



```

SwitchB#show glbp | include Weighting
    Weighting 100 (default 100)
SwitchB(config)#track 16 interface fastEthernet 0/16 line-protocol
SwitchB(config)#track 17 interface fastEthernet 0/17 line-protocol
SwitchB(config)#interface fa0/19
SwitchB(config-if)#glbp 1 weighting track 16 decrement 20
SwitchB(config-if)#glbp 1 weighting track 17 decrement 20
SwitchB(config-if)#glbp 1 weighting 100 lower 70 upper 90
!(Verify)
SwitchB#show glbp | include Weighting
    Weighting 100 (configured 100), thresholds: lower 70, upper 90
!(Test and verify)
!(Now shutdown int fa0/16)
    !(Weighting 80 (configured 100), thresholds: lower 70, upper 90)
!(Now shutdown int fa0/17)
    !(Weighting 60, low (configured 100), thresholds: lower 70, upper 90)
!(Now 'no shutdown' int fa0/16)
    !(Weighting 80, low (configured 100), thresholds: lower 70, upper 90)
!(Now 'no shutdown' int fa0/17)
    !(Weighting 100, low (configured 100), thresholds: lower 70, upper 90)

```

### **Verification and Troubleshooting:**

```

sh standby
sh standby | inc priority
sh standby | inc time
sh standby bri
sh standby vlan 1
debug standby events
debug standby errors
debug standby packets
debug standby events track
sh vrrp
sh vrrp | inc priority
sh vrrp | inc time
sh vrrp bri
sh vrrp vlan 1
debug vrrp events
debug vrrp errors
debug vrrp packets
debug vrrp events track
sh glbp
sh glbp | inc priority
sh glbp | inc time
sh glbp bri
sh glbp vlan 1
debug glbp events
debug glbp errors
debug glbp packets
debug glbp events track
sh ip arp    !(verification of mac on the switch)
c:\>ipconfig    !(to verify the gateway configured on the PC)
c:\>arp -a    !(to verify the mac learned on the PC)

```

**Comparison:**

	<b>HSRP</b>	<b>VRRP</b>	<b>GLBP</b>
<b>Protocol</b>	Cisco Proprietary/RFC 2281	IETF-RFC 3768	Cisco Proprietary
<b>Number of Groups</b>	16 groups max	255 max groups	
<b>Active/Standby</b>	1 active, 1 standby and multiple candidates	1 active and several backups	1 AVG 2 or more AVF
<b>Virtual IP address</b>	Different from real IP address on interfaces	Can be the same as the real IP of an interface	Different from real IP address on interfaces
<b>Multicast Address</b>	224.0.0.2 v1 224.0.0.102 v2	224.0.0.18	224.0.0.102
<b>Tracking</b>	Interfaces or Objects default decrement of 10	Objects	Interfaces or Objects object tracking is weighted
<b>Timers</b>	Hello 3 sec/Hold 10 sec	Hello 1 sec/Hold 3.609 sec	Hello 3 sec/Hold 10 sec
<b>Authentication</b>	Supported	Not Supported in RFC 3768	
<b>Load Balancing</b>	No (50/50 load share)	No (50/50 load share)	Yes
<b>Default priority</b>	100	100	100
<b>Transport Port number</b>	UDP/1985	UDP/112	UDP/3222
<b>OSI Layer</b>	Layer3	Layer3	Layer2
<b>Election</b>	Active Router: 1. Highest Priority 2. Highest IP (tie breaker)	Master Router: 1. Highest Priority 2. Highest IP (tie breaker)	AVG: 1. Highest Priority 2. Highest IP (tie breaker)
<b>Group Virtual MAC (X is the group number)</b>	v1 0000.0c07.acXX v2 0000.0C9F.FXXX	0000.5e00.01XX	0007.b4XX.XXXX
<b>IPv6 Support</b>	Yes	No	Yes
<b>Preempt</b>	If Active router (highest priority) is down and up again, preempt should be configured to become an active router again	By default preempt is ON in VRRP, If active router is down and up again, it will automatically become a Master router	If Active router (highest priority) is down and up again, preempt should be configured to become an active router again