

FIRST HOP REDUNDANCY

FHRP (First Hop Redundancy Protocol)—A generic term covering all the protocols that handle the complexity of multiple routers providing redundant default gateways for hosts. The goal is that a backup router can take over gateway duties during a failure without users needing to reconfigure their hosts. In general,

- Each of the first hop routers share a virtual IP address that is used by the hosts as their default gateway
- There is some communication between the first hop routers to decide which will provide gateway services to which hosts when, including a plan for graceful failover

Protocols—CCNA only deals with HSRP

PROTOCOL	PROPRIETARY?	REDUNDANCY	LOAD BALANCING
HSRP (Hot Standby Router Protocol)	Cisco	Active / Standby	Per Subnet
VRRP (Virtual Router Redundancy Protocol)	RFC 5798	Active / Standby	Per Subnet
GLBP (Gateway Load Balancing Protocol)	Cisco	Active / Active	Per Host

HSRP

HSRP (Hot Standby Router Protocol)

- Usually used to provide "first hop" redundancy—the default gateway for hosts
- Can be used on routers and on L3 switches, where it would be configured on the svi
- Active/Standby—Only one of the routers is actively answering to the shared IP address at a time while all others stand by—also called "active/passive." This means that each of them must be sized to carry the full load
- Real IP Address—Since the participating routers need to communicate amongst themselves, each has a unique IP address on the same LAN that they serve
- VIP (Virtual IP address)—All participating routers share a virtual IP address that is used by the hosts as a default gateway (but only the active router answers to it)
- VMAC (Virtual MAC address)—this goes with the virtual IP address so that recovery from the loss of the primary router is instantaneous—no need for the hosts to sense a problem and re-ARP. The last digits of a VMAC will always be the HSRP group number in hex.

Operation

- Startup—participating routers negotiate which will become active
- Periodic Hellos allow the standby routers to notice if the active one dies
- Gratuitous ARP—During a changeover (failure of the active), the newly active router broadcasts an ARP reply with the VMAC as the L2 source address in the Ethernet header. The switches naturally learn that the VMAC has moved to a different switchport and adjust

Optimization / Load Balancing—different routers can take the active role in different subnets.

C O N F I G U R A T I O N

R1	R2
<pre> 1 interface GigabitEthernet0/0 2 ip address 10.0.0.1 255.0.0.0 3 standby version 2 4 standby 1 ip 10.0.0.254 5 standby 1 priority 150 6 standby 1 name MyGroup 7 standby 1 preempt </pre>	<pre> interface GigabitEthernet0/0 ip address 10.0.0.2 255.0.0.0 standby version 2 standby 1 ip 10.0.0.254 <i>Default priority is 100; higher wins</i> standby 1 name MyGroup </pre>

In the above example, only line 4 is necessary in addition to line 2, which you would have had, even without HSRP. The HSRP version [Line 3] will default to 1. The priority [Line 5] will default to 100, with higher values winning. The group name [Line 6] is really only helpful in "show" commands, and even then only if you have more than one group.

Within line 4, the "1" is the standby group number, which must match on all routers in the standby group. 10.0.0.254 is the shared virtual IP.

Preemption [Line 7]—normally, there is no preemption. The active router will stay active, even if another router with a higher priority later joins the group. If your routers are unequal and you want the most capable one in the group to resume its role as the active router following a failure, you can configure it to preempt (and give it the highest priority in the group). The preemption setting only matters on the router doing the preempting.

V E R I F I C A T I O N

R1	
<pre> 1 R1# show standby brief 2 3 4 Interface Grp Pri P State Active Standby Virtual IP 5 Gi0/0 1 150 Active local 10.0.0.3 10.0.0.254 </pre>	<p>P indicates configured to preempt.</p>

On line 5, the first 5 columns, including the tiny "P" column (column 4) refer to local settings. The rest of the line refers to the overall picture shared by all routers in the standby group.

- Interface [Column 1] —This is the local interface that we configured HSRP on
- Group [Column 2]—This is the HSRP group number. Since these output lines are organized by interface, you'll use the group column to find the correct line of output to troubleshoot a single HSRP group
- Priority [Column 3]—This is the priority of this router in this HSRP group
- P (Preempt) [Column 4]—
- State [Column 5]—Our state in this group (Active / Standby / Listen)
- Active [Column 6]—The IP address of the active router in this group ("local" if we're it)
- Standby [Column 7]—The IP address of the standby router in this group ("local" if we're it)
- Virtual IP [Column 8]—The virtual IP address that all routers in this group are cooperating to keep available as a default gateway for hosts.

```

R1
1 R1# show standby
2 GigabitEthernet0/0 - Group 1 (version 2)
3   State is Active
4     2 state changes, last state change 00:04:43
5   Virtual IP address is 10.0.0.254
6   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 1.760 secs
   Preemption disabled
   Active router is local
   Standby router is 10.0.0.3, priority 100 (expires in 9.536 sec)
     Our group actually has three routers. Notice that R2 isn't mentioned because it's not the
     active or the standby for the group
   Priority 150 (configured 150)
   Group name is "MyGroup" (cfgd)

```

This command expands the "brief" version for readability, using full sentences in some cases. It also adds the virtual MAC address and the current values for the timers that allow the members of the HSRP group to coordinate.

A C T I V E R O U T E R E L E C T I O N

When an HSRP router interface comes up, it sends out an HSRP message on the subnet

- If no one answers, it becomes the active router
- If it discovers another negotiating router (perhaps they both came up at the same time), the router with the highest priority becomes active
- If it discovers that the subnet already has an active router:
 - If it is not set to preempt (default) it becomes the standby or listening router, depending on whether there's already a standby
 - If preemption *is* set and its priority is higher than the current active router, it becomes active

V E R S I O N S 1 A N D 2

The biggest difference is that version 2 supports IPv6. It also allows millisecond hello timers for very high availability. All routers in the same group must run the same version. If not, they'll ignore each other, both become active, and create a duplicate address problem.

Scope—The version command affects the entire interface and has no group number

```

interface GigabitEthernet0/0
ip address 10.0.0.1 255.0.0.0
standby version 2
...

```

Differences Between Versions 1 & 2

	v1	v2
IPv6 Support		•
Hello Timer Units	Seconds	Milliseconds
Group Number Range	0-255 (8 bits)	0-4095 (12 bits)
Virtual Mac Address (Add group number in hex to this)	0000 . 0C07 . AC00	0000 . 0C9F . F000
IPv4 Multicast Address	224.0.0.2	224.0.0.102
Hello Protocol / Port	UDP 1985	UDP 1985
Unique ID for Each Router		•

T R O U B L E S H O O T I N G

Ways to mess it up:

- **Version Mismatch**—Discussed above. The routers will ignore each other and both become active. Both will claim to own the VIP address, but with different VMACs (table above), causing one or more devices on the LAN to complain about detecting a duplicate address
- **Group Number Mismatch**—Same problem as above
- **ACL Blocking HSRP Hellos (UDP 1985)**—Same problem. The ACL might even prevent the routers from realizing that there's a duplicate address
- **Virtual IP Mismatch**—If the wrong router is active, your hosts won't have a gateway.