Cisco Proprietary: HSRP - Hot Standby Redundancy Protocol

interface vlan10	Make VLAN an interface - activate switch virtual interface (SVI)
ip address 172.16.0.10 255.255.255.0	Assigns IP address and netmask.
standby 1 ip 172.16.0.1 [**secondary**]	Activates HSRP group 1 and creates virtual IP address of 172.16.0.1 If interface has secondary IP addresses, you can add **secondary** so HSRP has a redundant secondary gateway address.
standby 1 priority 120	Assigns a priority value of 120 to standby group 1.

- Group number can be from 0 to 255. The default is 0.
- Some Catalyst switches limit to 16 unique group numbers- just make the group number the same (that is, 1) for every VLAN interface. HSRP groups are locally significant only on an interface: HSRP Group 1 on interface VLAN 10 is unique and independent from HSRP Group 1 on interface VLAN 11.
- The actual interface address and the virtual (standby) address must be configured to be in the same subnet.
- Priority value 1-255, default is 100. A higher priority will result in that switch being elected the active switch.
- If priorities of all switches in the group are equal, switch with highest IP address becomes active switch.
- HSRP hello messages - multicast 224.0.0.2 (“all routers”) - UDP port 1985.
- Only the standby router (with the second-highest priority) monitors hello messages from the active router.
- Decreasing hello time allows a router failure to be detected more quickly, yet increases traffic on the interface.

Router interface states before becoming active:

Disabled **=>** Init **=>** Listen **=>** Speak **=>** Standby **=>** Active

- HSRP defines a virtual MAC address in the form 0000.0c07.acxx, where xx represents the group number as a two-digit hex value. (Group 1 appears as 0000.0c07.ac01, Group 16 appears as 0000.0c07.ac1, etc.)

show standby	Displays HSRP information
show standby brief	Displays single-line output summary of each standby group
show standby vlan 1	Displays HSRP information on the VLAN 1 group

Defaults for HSRP

HSRP version	Version 1 (v1 and v2 have different packet structure)
HSRP groups	None configured.
Standby group number	0
Standby MAC address	System assigned as 0000.0c07.ac*XX*, where *XX* is the HSRP group number. For HSRPv2, the MAC address will be 0000.0C9F.FXXX.
Standby priority	100
Standby delay	0 (no delay)
Standby track interface priority	10
Standby hello time	3 seconds
Standby holdtime	10 seconds

Preempt - switch will take control of the active switch if local priority is higher than priority of active switch

interface vlan10	
standby 1 preempt	Designate this switch to preempt
standby 1 preempt delay minimum 180 reload 140	Set to preempt 180 sec since that switch was last restarted or 140 sec since switch was last reloaded.
standby delay minimum 30 reload 60	Delay for HSRP group initialization 30 sec when interface comes up and 60 sec after switch reloads.
no standby 1 preempt delay	Disables the preemption delay
no standby 1 preempt	Disable the preempt option completely

If a router is not already active, it cannot become active again until the current active router fails- even if its priority is higher than that of the active router. When routers are just being powered up or added to a network, the first router to bring up its interface becomes the HSRP active router, even if it has the lowest priority of all. This is where setting up preempt comes to the rescue.

- Use **reload** to force router to wait after it has been reloaded or restarted before preempt (you should consider and allow time for routing protocols (e.g.) that need time to converge). Use of **minimum** only refers to time after interface is ready for HSRP

Timers - Hello timer 1-254, default is 3; Hold timer 1-255, default is 10. The default unit of time is seconds.

interface vlan10	
standby 1 timers 5 15	Sets the hello to 5 sec and hold to 15 sec
	Hold normally set to be ≧ 3X hello
standby 1 timers msec 200 msec 600	Sets hello to 200 milliseconds, hold to 600 msec.

If the **msec** argument is used, the timers can be an integer from 15 to 999

Track - assigns a value that the priority will be decreased if the tracked interface goes down

Switch(config)#**interface vlan10**	
Switch(config-if)#**standby 1 track f0/0 25**	HSRP will track the availability of interface FastEthernet0/0. If it goes down, the priority of the switch in group 1 will be decremented by 25.

Default value of the **track** is 10. In the example, assuming default priority of 100, the new priority will be 75.
Using track facilitates in election eligibility when failures occur and replacement candidates must be considered.

Authentication

Switch(config)#**key chain HSRP**	Creates authentication key chain called **HSRP**.
Switch(config-keychain)#**key 1**	Adds a first key to the key chain.
Switch(config-keychain-key)#**key-string australia**	Configures a key string of **australia**.
Switch(config)#**interface vlan10**	
Switch(config-if)#**standby 1 authentication text canada**	Configures **canada** as plain-text authentication string used by group 1.
Switch(config-if)#**standby 2 authentication md5 key-string england**	Configures **england** as MD5 key string for group 2.
Switch(config-if)#**standby 3 authentication md5 key-chain HSRP**	Configures MD5 using key chain **HSRP**. Queries key chain for current live key and key ID.

HSRPv2 for IPv6
HSRPv2 must be enabled on an interface before HSRP for IPv6 can be configured.
When configuring the IPv6 virtual address, if an IPv6 global address is used, it must include an IPv6 prefix length. If a link-local address is used, it does not have a prefix

standby version 2	Enables HSRPv2 on an interface
standby 1 ipv6 autoconfig	Use a virtual link-local address that will be generated automatically from the link-local prefix and a modified EUI-64 format interface identifier, where the EUI-64 interface identifier is created from the relevant HSRP virtual MAC address
standby 1 ipv6 FE80::1:1	Use an explicitly configured link-local address to be used as the virtual IPv6 address for group 1
standby 1 ipv6 2001::0DB8:2/64	Use a global IPv6 address as the virtual address for group 1

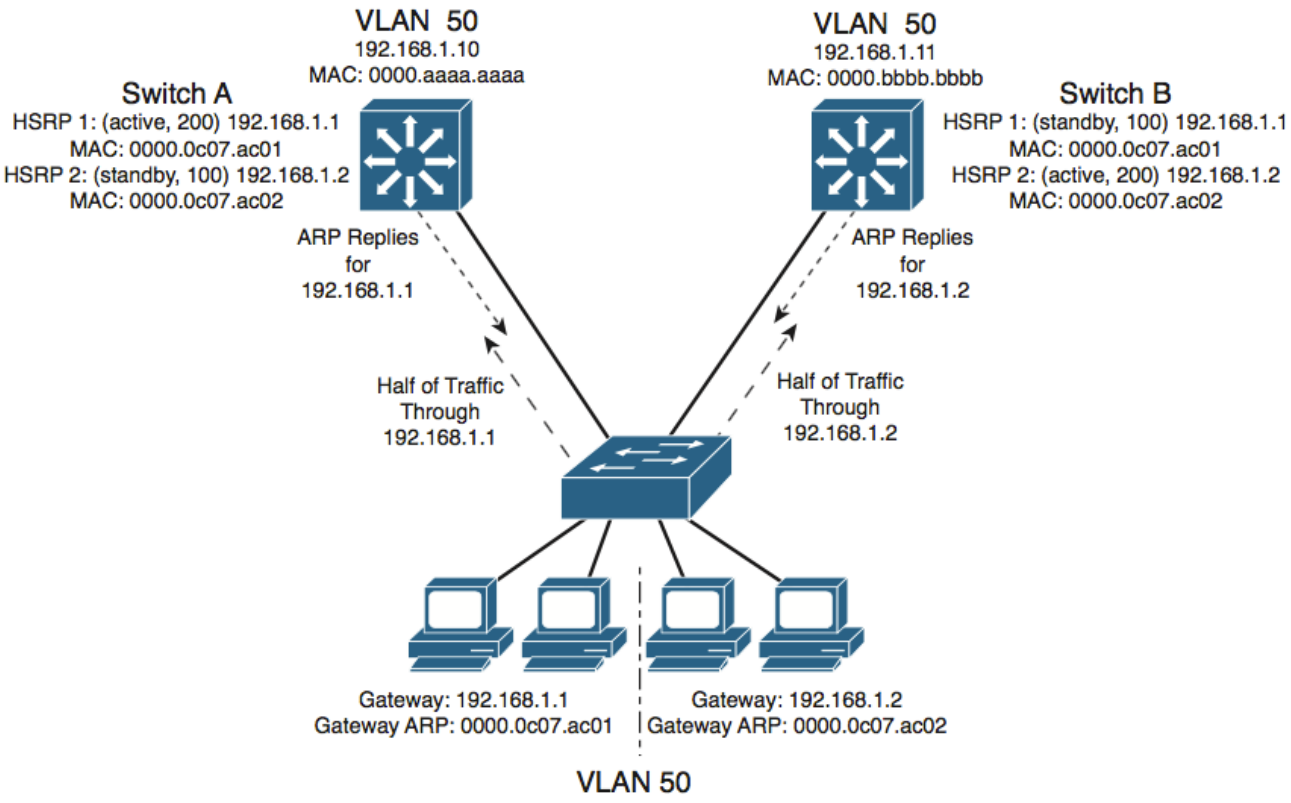
All other relevant HSRP commands (preempt, priority, authentication, tracking, and so on) are identical in HSRPv1 and HSRPv2.

Debugging HSRP

debug standby	All HSRP debugging information, including state changes and transmission/ reception of HSRP packets
debug standby terse	All HSRP errors, events, and packets, except for hellos and advertisements
debug standby errors	Displays HSRP error messages
debug standby events	Displays HSRP event messages
debug standby events terse	Displays all HSRP events except for hellos and advertisements
debug standby events track	Displays all HSRP tracking events
debug standby packets	Displays HSRP packet messages

HSRP and VRRP Load Balancing Example
[two HSRP groups, one VLAN]

Load balancing traffic across two uplinks to two HSRP routers with a single HSRP group is not possible.
We must use two HSRP groups where each group assigns an active router to one of the switches
- Make each switch function as the standby router for its partner's HSRP group.
- (Each router is active for one group and standby for the other group)
- Switch A is active router for Group 1 (192.168.1.1), and standby for Group 2 (192.168.1.2).
- Switch B is configured similarly, but with its roles reversed.
- Configure half of the PCs with the Group 1 virtual router address and the other half with the Group 2 address.
- Each half of the hosts uses one switch as its default gateway over one uplink

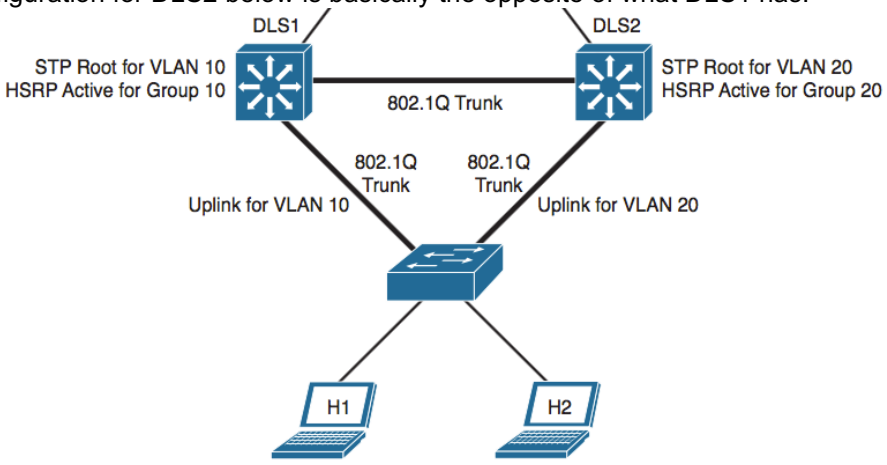


HSRP Version	**VRRP Version (minus authentication)**
Switch-A(config)# **interface vlan 50** Switch-A(config-if)# **ip address 192.168.1.10 255.255.255.0** Switch-A(config-if)# **standby 1 priority 200** Switch-A(config-if)# **standby 1 preempt** Switch-A(config-if)# **standby 1 ip 192.168.1.1** Switch-A(config-if)# **standby 2 priority 100** Switch-A(config-if)# **standby 2 ip 192.168.1.2** Switch-B(config)# **interface vlan 50** Switch-B(config-if)# **ip address 192.168.1.11 255.255.255.0** Switch-B(config-if)# **standby 1 priority 100** Switch-B(config-if)# **standby 1 ip 192.168.1.1** Switch-B(config-if)# **standby 2 priority 200** Switch-B(config-if)# **standby 2 preempt** Switch-B(config-if)# **standby 2 ip 192.168.1.2**	Switch-A(config)# **interface vlan 50** Switch-A(config-if)# **ip address 192.168.1.10 255.255.255.0** Switch-A(config-if)# **vrrp 1 priority 200** Switch-A(config-if)# **vrrp 1 ip 192.168.1.1** Switch-A(config-if)# **vrrp 2 priority 100** Switch-A(config-if)# **no vrrp 2 preempt** Switch-A(config-if)# **vrrp 2 ip 192.168.1.2** Switch-B(config)# **interface vlan 50** Switch-B(config-if)# **ip address 192.168.1.11 255.255.255.0** Switch-B(config-if)# **vrrp 1 priority 100** Switch-B(config-if)# **no vrrp 1 preempt** Switch-B(config-if)# **vrrp 1 ip 192.168.1.1** Switch-B(config-if)# **vrrp 2 priority 200** Switch-B(config-if)# **vrrp 2 ip 192.168.1.2**

HSRP Load Balancing Example 2

[two HSRP groups, two VLANs, Spanning Tree roots (primary and secondary]

- configure DLS1 as STP root, HSRP active for VLAN 10 - also backup root and HSRP standby for VLAN 20
- configure DLS2 as STP root, HSRP active for VLAN 20 - also backup root and HSRP standby for VLAN 10.
  - The configuration for DLS2 below is basically the opposite of what DLS1 has.



STP forwarding to the correct VLANs ensured by setting spanning-tree primary root for those VLANs.

DLS1(config)#**spanning-tree vlan 10 root primary**	Configures STP root primary for VLAN 10.
DLS1(config)#**spanning-tree vlan 20 root secondary**	Configures STP root secondary for VLAN 20.
DLS1(config)#**interface vlan10**	Moves to interface configuration mode.
DLS1(config-if)#**ip address 10.1.10.2 255.255.255.0**	Assigns IP address and netmask.
DLS1(config-if)#**standby 10 ip 10.1.10.1**	Activates HSRP group 10, virtual IP of 10.1.10.1
DLS1(config-if)#**standby 10 priority 110**	Assigns a priority value of 110 to standby group 10. This will be the active forwarder for VLAN 10.
DLS1(config-if)#**standby 10 preempt**	Switch will take control of VLAN 10 forwarding if local priority is higher than active switch VLAN 10 priority.
DLS1(config-if)#**interface vlan20**	Moves to interface configuration mode.
DLS1(config-if)#**ip address 10.1.20.2 255.255.255.0**	Assigns IP address and netmask.
DLS1(config-if)#**standby 20 ip 10.1.20.1**	Activate HSRP group 20, virtual IP address 10.1.20.1.
DLS1(config-if)#**standby 20 priority 90**	Assigns a priority value of 90 to standby group 20. This switch will be the standby device for VLAN 20.
DLS1(config-if)#**standby 20 preempt**	This switch will take control of VLAN 20 forwarding if local priority is higher than active switch for VLAN 20

DLS2(config)#**spanning-tree vlan 20 root primary**	Configures STP root primary for VLAN 20.
DLS2(config)#**spanning-tree vlan 10 root secondary**	Configures STP root secondary for VLAN 10.
DLS2(config)#**interface vlan20**	Moves to interface configuration mode.
DLS2(config-if)#**ip address 10.1.20.3 255.255.255.0**	Assigns IP address and netmask.
DLS2(config-if)#**standby 20 ip 10.1.20.1**	Activates HSRP group 10, virtual IP of 10.1.20.1
DLS2(config-if)#**standby 20 priority 110**	Assigns a priority value of 110 to standby group 20. This will be the active forwarder for VLAN 10.
DLS2(config-if)#**standby 20 preempt**	Switch will take control of VLAN 20 forwarding if local priority is higher than active switch VLAN 20 priority.
DLS2(config-if)#**interface vlan10**	Moves to interface configuration mode.
DLS2(config-if)#**ip address 10.1.10.3 255.255.255.0**	Assigns IP address and netmask.
DLS2(config-if)#**standby 10 ip 10.1.10.1**	Activate HSRP group 10, virtual IP address 10.1.10.1.
DLS2(config-if)#**standby 10 priority 90**	Assigns a priority value of 90 to standby group 10. This switch will be the standby device for VLAN 10.
DLS2(config-if)#**standby 10 preempt**	This switch will take control of VLAN 20 forwarding if local priority is higher than active switch for VLAN 10

HSRP Load Balancing Example 1 (cont.)
(output of "show standby" command)

```
Switch-A# show standby vlan 50 brief
                     P indicates configured to preempt.
                     |
Interface   Grp Prio P State    Active addr     Standby addr    Group addr
Vl50        1   200  P Active   local           192.168.1.11    192.168.1.1
Vl50        2   100    Standby  192.168.1.11    local           192.168.1.2
Switch-A#
Switch-A# show standby vlan 50
Vlan50 - Group 1

  Local state is Active, priority 200, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 2.248
  Virtual IP address is 192.168.1.1 configured
  Active router is local
  Standby router is 192.168.1.11 expires in 9.860
  Virtual mac address is 0000.0c07.ac01
  Authentication text "MyKey"
  2 state changes, last state change 00:11:58
  IP redundancy name is "hsrp-Vl50-1" (default)
Vlan50 - Group 2
  Local state is Standby, priority 100
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 1.302
  Virtual IP address is 192.168.1.2 configured
  Active router is 192.168.1.11, priority 200 expires in 7.812
  Standby router is local
  Authentication text "MyKey"
  4 state changes, last state change 00:10:04
  IP redundancy name is "hsrp-Vl50-2" (default)
```

Switch B is the same, just flipped.

VRRP Load Balancing example - output of "show" commands

Table 18-3 *Verifying VRRP Status for multiple VRRP Groups*

Switch A

```
Switch-A# show vrrp
Vlan50 - Group 1
  State is Master
  Virtual IP address is 192.168.1.1
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption is enabled
    min delay is 0.000 sec
  Priority is 200
  Authentication is enabled
  Master Router is 192.168.1.10 (local),
    priority is 200
  Master Advertisement interval is 1.000
    sec
  Master Down interval is 3.218 sec

Vlan50 - Group 2
  State is Backup
  Virtual IP address is 192.168.1.2
  Virtual MAC address is 0000.5e00.0102
  Advertisement interval is 1.000 sec
  Preemption is disabled
  Priority is 100
  Authentication is enabled
  Master Router is 192.168.1.11, priority
    is 200
  Master Advertisement interval is 1.000
    sec
  Master Down interval is 3.609 sec
(expires in 2.977 sec)
Switch-A#
```

Switch B

```
Switch-B# show vrrp
Vlan50 - Group 1
State is Backup
Virtual IP address is 192.168.1.1
Virtual MAC address is 0000.5e00.0101
Advertisement interval is 1.000 sec
Preemption is disabled
Priority is 100
Authentication is enabled
Master Router is 192.168.1.10, priority
is 200
Master Advertisement interval is 1.000
sec
Master Down interval is 3.609 sec
(expires in 2.833 sec)

Vlan50 - Group 2
State is Master
Virtual IP address is 192.168.1.2
Virtual MAC address is 0000.5e00.0102
Advertisement interval is 1.000 sec
Preemption is enabled
min delay is 0.000 sec
Priority is 200
Authentication is enabled
Master Router is 192.168.1.11 (local),
priority is 200
Master Advertisement interval is 1.000
sec
Master Down interval is 3.218 sec
Switch-B#
```

```
Switch-A# show vrrp brief
Interface          Grp Pri Time  Own Pre State   Master addr     Group addr
Vlan50             1   200 3218        Y  Master  192.168.1.10    192.168.1.1
Vlan50             2   100 3609           Backup  192.168.1.11    192.168.1.2
Switch-A#

Switch-B# show vrrp brief
Interface          Grp Pri Time  Own Pre State   Master addr     Group addr
Vlan50              1   100 3609           Backup  192.168.1.10    192.168.1.1
Vlan50              2   200 3218        Y  Master  192.168.1.11    192.168.1.2
Switch-B#
```

IEEE Standard: VRRP - Virtual Router Redundancy Protocol (RFC 2338)

Almost the same as HSRP. Here, "master" takes the place of "active" in HSRP terms, and the rest are termed "backup." The VRRP preempt option is enabled by default (the switch that is the IP address owner will preempt, regardless of this explicit setting). Default preempt delay is 0 sec (easily extended)
- Group number can be from 1- 255; Priority range 1-254. The default is 100.
- The virtual router MAC is of the form 0000.5e00.01xx, where xx is a two-digit hex group number.
- Sends advertisements to multicast 224.0.0.18 (VRRP), using IP protocol 112
- Uses a timer for advertisements by the virtual switch master.
- All switches in a group must use the same timer values, or the group will not communicate.
- Default interval value is 1 sec, range is 1-255 sec. If you use the msec argument, you change the timer globally to measure in milliseconds. The range then is 50 to 999ms.

Switch(config)#**interface vlan10**	(all of these are interface config mode)
ip address 172.16.100.5 255.255.255.0	Assigns IP address and netmask to VLAN interface.
vrrp 10 ip 172.16.100.1	Enables VRRP group 10 virtual IP of 172.16.100.1 (using a real interface IP here will make the router with that address become the master)
vrrp 10 description Sales Group	Assigns a text description to the group.
vrrp 10 priority 110	Sets the priority level for this VLAN.
vrrp 10 preempt	This switch will take over as virtual switch master for group 10 if it has a higher priority than the current one
vrrp 10 preempt delay minimum 60	This switch will preempt, only after a delay of 60 sec
vrrp 10 timers advertise 15	Configures the interval between successful advertisements by the virtual switch master.
vrrp 10 timers learn	Configures a virtual switch backup, to learn the advertisement interval from the virtual switch master.
(**no**) **vrrp 10 shutdown**	Disables/ re-enables VRRP on the interface, in a way that the configuration is still retained.
no vrrp 10 shutdown	Reenables the VRRP group using the previous configuration.
vrrp 10 authentication text ottawa	Plain-text auth for group 10 using the key **ottawa**.
vrrp 10 authentication md5 key-string winnipeg	MD5 auth for group 10 using the key **winnipeg**.

~~Interface~~ Object Tracking
VRRP does not have a native interface tracking mechanism, but even better, has the ability to track objects. This allows the VRRP master to lose its status if a tracked object (interface, IP SLA, and so on) fails.

Switch(config)#**track 10 interface fastethernet0/0 line-protocol**	Creates a tracked object, where the status of the uplink interface is tracked
Switch(config)#**interface fastethernet0/1**	
Switch(config-if)#**vrrp 1 track 10 decrement 30**	Track previously created object and decrease the VRRP priority by 30 should the uplink interface fail

Verifying VRRP (same for IPv6 and IPv4)

Switch#**show vrrp**	Displays VRRP information
Switch#**show vrrp brief**	Displays a brief status of all VRRP groups
Switch#**show vrrp 10**	Displays detailed information about VRRP group 10
Switch#**show vrrp interface vlan10**	Displays info about VRRP enabled on int Vlan10
Switch#**show vrrp interface vlan10 brief**	Displays a brief summary about VRRP on int Vlan10

Debugging VRRP

Switch#**debug vrrp all**	Displays all VRRP messages
Switch#**debug vrrp error**	Displays all VRRP error messages
Switch#**debug vrrp events**	Displays all VRRP event messages
Switch#**debug vrrp packets**	Displays messages about packets sent and received
Switch#**debug vrrp state**	Displays messages about state transitions

VRRP is only partially supported on some Cisco hardware. Verify VRRP capabilities by platform datasheets and appropriate Cisco IOS command and configuration guides.

Cisco Proprietary: GLBP - Gateway Load Balancing Protocol

Introduced in Cisco IOS 12.2(14)S for routers, but is not consistently supported across all switching platforms.
- Group members elect one gateway to be the **active virtual gateway (AVG)**.
- Members are **active virtual forwarders (AVF)**, backup for AVG in the event it becomes unavailable.
- The AVG assigns a different virtual MAC address to each AVF (which becomes their identifier).
- Each AVF assumes responsibility for forwarding packets sent to the virtual MAC address assigned
- If an AVF fails, one of others assumes responsibility for the virtual MAC address.
- Precedence is highest priority value, or the highest IP address in the group
- Automatic selection and simultaneous use of multiple available gateways; automatic failover
- No configuring multiple groups or multiple default gateway configurations like HSRP/VRRP
- Maximum of four routers in each forwarding group. Technically the AVG is also an AVF (it is just "special")
- Up to 1024 virtual routers as GLBP groups on each router's physical interface (number range 0-1023)
- Up to four AVFs per group at a time, secondaries can be backups if one fails

- Priority is 1- 255, default 100. A higher number is preferred.
- Preemption is disabled by default for AVG; AVF preempt has default delay of 30 seconds.
- Hello timer default 3 sec; range 1-60 sec. If msec argument is used, the timer will switch to msec, range of 50-60,000 msec.
- Hold timer default 10 sec; range 19-180 sec. If msec argument is used, the timer will switch to msec, range of 18,020-180,000 msec.
- Hello messages - multicast 224.0.0.102 - UDP 3222.
- Virtual MAC have the form 0007.b4xx.xxyy. The 16-bit value denoted by xx.xx represents six 0 bits followed by a 10-bit GLBP group number. The 8-bit yy value is the virtual forwarder number.

Three different types of load balancing

Host-dependent uses MAC address of a host to determine which AVF MAC address to use.
- The option if using stateful NAT (needs each host to be returned to the same virtual MAC address each time it sends an ARP request for the virtual IP address)
- Not recommended for where there are fewer than 20 end hosts.

Weighted - place a weight on each device when calculating the amount of load sharing.
- If router A has twice the forwarding capacity of router B, weighting value should be configured accordingly
- Use the **glbp x weighting y** where **x** is the GLBP group number, and **y** is the weighting value (1-254)

Round-robin (default) each AVF MAC is used sequentially in ARP replies for virtual IP address.
- If no load balancing is used, GLBP will operate like HSRP, where the AVG will only respond to ARP requests with its own AVF MAC address, and all traffic will be directed to the AVG. Use **no glbp load-balancing**.

It is recommended that unless you are extremely familiar with your network design and mechanisms of GLBP that you don't change the timers. Reset timers back to default **no glbp x timers**, where x is group number.

Router(config)#**interface fastethernet0/0**	(all of these are interface config mode)
ip address 172.16.100.5 255.255.255.0	Assigns IP address and netmask.
glbp 10 ip 172.16.100.1	Put group 10 on this int w/ virtual IP of 172.16.100.1.
glbp 10 preempt	Take over as AVG for group 10 if this router has higher priority than current AVG
glbp 10 preempt delay minimum 60	Wait before preempt AVG- delay of 60 seconds
glbp 10 forwarder preempt	Take over as AVF for group 10 if this router has higher priority than current AVF.
glbp 10 forwarder preempt delay minimum 60	Wait before preempt AVF- delay of 60 seconds
glbp 10 priority 150	Sets the priority level of the router.
glbp 10 timers 5 15	Configures the hello timer 5 sec and the hold 15 sec
glbp 10 timers msec 20200 msec 60600	Hello timer 20,200 msec hold timer to 60,600 millisec
glbp 10 authentication text edmonton	Configures GLBP for plain text authentication
glbp 10 authentication md5 key-chain vancouver	Configures GLBP for MD5 authentication
glbp 10 load- balancing host-dependent	Load balance using the host-dependent method.
glbp 10 load- balancing weighted	Load balance using the weighted method.
glbp 10 weighting 80	Set maximum weighting value for this interface
glbp 10 load balancing round robin	Load balance using the round-robin method.

Interface Tracking

Router(config)#**track 2 interface fa0/1 line-protocol**	Config FastEthernet0/1 interface to be tracked. The **line-protocol** tracks whether the interface is up
Router(config-track)#**exit**	Notice prompt "(config-track)" Use ? for more options
Router(config)#**interface fastethernet0/0**	
Router(config-if)#**glbp 10 weighting 110 lower 20 upper 50**	Initial weighting value; upper/lower thresholds, for GW
Router(config-if)#**glbp 10 weighting track 2 decrement 50**	Track the object and decrement the weight by 50 when the Fast Ethernet 0/1 interface fails

Verifying GLBP

Router#**show glbp**	Displays GLBP information
Router#**show glbp brief**	Displays a brief status of all GLBP groups
Router#**show glbp 10**	Displays information about GLBP group 10
Router#**show glbp vlan10**	Displays GLBP information on interface Vlan10
Router#**show glbp vlan20 10**	Displays GLBP group 10 info on interface Vlan20

Debugging GLBP

Router#**debug condition glbp**	Displays GLBP condition messages
Router#**debug glbp errors**	Displays all GLBP error messages
Router#**debug glbp events**	Displays all GLBP event messages
Router#**debug glbp packets**	Displays messages about packets sent and received
Router#**debug glbp terse**	Displays a limited range of debugging messages

A redirect timer is used to determine when the AVG will stop using a stale virtual MAC address in ARP replies. The AVF corresponding to the old address continues to act as a stand-in gateway for any clients that try to use it.

When the timeout timer expires, the old MAC address and the virtual forwarder using it are flushed from all the GLBP peers.
The AVG assumes that the previously failed AVF will not return to service, so the resources assigned to it must be reclaimed.
At this point, clients still using the old MAC address in their ARP caches must refresh the entry to obtain the new virtual MAC address.

The redirect timer defaults to 600 seconds (10 minutes) and can range from 0 to 3600 seconds (1 hour). The timeout timer defaults to 14,400 seconds (4 hours) and can range from 700 to 64,800 seconds (18 hours). You can adjust these timers with the following interface configuration command:
Switch(config-if)# **glbp** *group* **timers redirect** *redirect timeout*

Switch(config)# **track** *object-number* **interface** *type member/module/number* {**line- protocol** | **ip routing**}
The object-number is an arbitrary index (1 to 500) that is used for weight adjustment. The condition that triggers an adjustment can be **line-protocol** (the interface line protocol is up) or **ip routing**. (IP routing is enabled, the interface has an IP address, and the interface is up.)

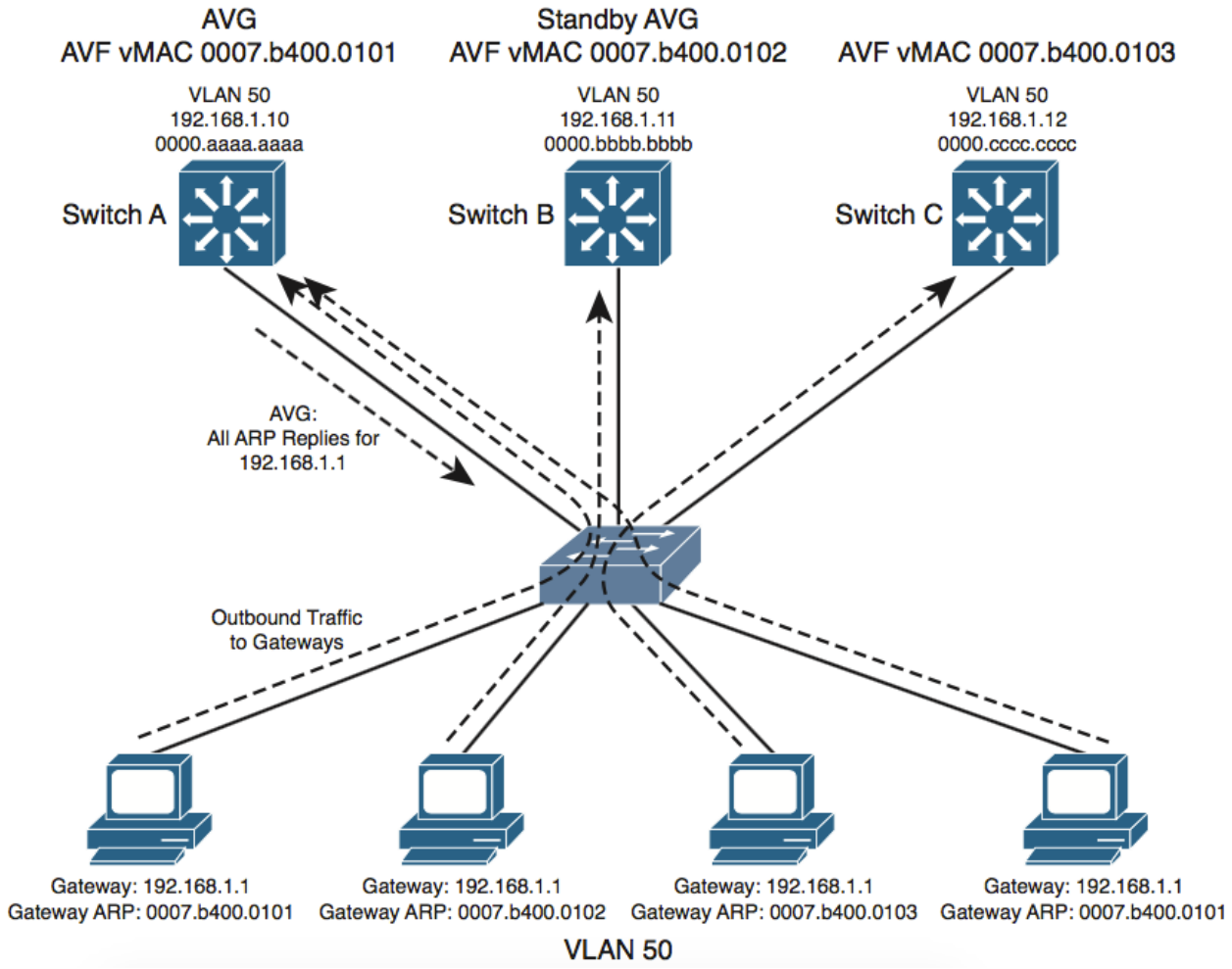
GLBP can also be used with IPv6. Rather than specifying an IPv6 address, use the following command to autoconfigure the address:
Switch(config-if)# **glbp** *group* **ipv6 autoconfigure**

Typical 3 Switch GLBP Setup Example

Three multilayer switches participating in a common GLBP group. with switch A elected AVG, to coordinate the GLBP process, answer all ARP requests for the virtual router 192.168.1.1.

It has identified itself, and other two switches as AVFs for the group, using default round-robin load balancing, so each of the client PCs sends an ARP request to look for the virtual router address (192.168.1.1) in turn, from left to right. Each time the AVG replies, the next sequential virtual MAC is sent back to a client. After the fourth PC sends a request, all three virtual MAC addresses (and AVF routers) have been used, so the AVG cycles back to the first virtual MAC address.

One GLBP group has been configured, clients know of only one gateway IP address: 192.168.1.1, all uplinks are being used, and all routers are proportionately forwarding traffic.



Switch-A(config)# **interface vlan 50**
Switch-A(config-if)# **ip address 192.168.1.10 255.255.255.0**
Switch-A(config-if)# **glbp 1 priority 200**
Switch-A(config-if)# **glbp 1 preempt**
Switch-A(config-if)# **glbp 1 ip 192.168.1.1**

Switch-B(config)# **interface vlan 50**
Switch-B(config-if)# **ip address 192.168.1.11 255.255.255.0**
Switch-B(config-if)# **glbp 1 priority 150**
Switch-B(config-if)# **glbp 1 preempt**
Switch-B(config-if)# **glbp 1 ip 192.168.1.1**

Switch-C(config)# **interface vlan 50**
Switch-C(config-if)# **ip address 192.168.1.12 255.255.255.0**
Switch-C(config-if)# **glbp 1 priority 100**
Switch-C(config-if)# **glbp 1 ip 192.168.1.1**

You can verify GLBP operation with the **show glbp** [**brief**] command. With the **brief** keyword, the GLBP roles are summarized showing the interface, GLBP group number (Grp), virtual forwarder number (Fwd), GLBP priority (Pri), state, and addresses.

```
Switch-A# show glbp brief
Interface   Grp  Fwd Pri State    Address         Active router   Standby router
Vl50        1    -   200 Active   192.168.1.1     local           192.168.1.11
Vl50        1    1   7   Active   0007.b400.0101  local           -
Vl50        1    2   7   Listen   0007.b400.0102  192.168.1.11    -
Vl50        1    3   7   Listen   0007.b400.0103  192.168.1.12    -
Switch-A#

Switch-B# show glbp brief
Interface   Grp  Fwd Pri State    Address         Active router   Standby router
Vl50        1    -   150 Standby  192.168.1.1     192.168.1.10    local
Vl50        1    1   7   Listen   0007.b400.0101  192.168.1.10    -
Vl50        1    2   7   Active   0007.b400.0102  local           -
Vl50        1    3   7   Listen   0007.b400.0103  192.168.1.12    -
Switch-B#

Switch-C# show glbp brief
Interface   Grp  Fwd Pri State    Address         Active router   Standby router
Vl50        1    -   100 Listen   192.168.1.1     192.168.1.10    192.168.1.11
Vl50        1    1   7   Listen   0007.b400.0101  192.168.1.10    -
Vl50        1    2   7   Listen   0007.b400.0102  192.168.1.11    -
Vl50        1    3   7   Active   0007.b400.0103  local          -
```

Notice that Switch A is shown to be the AVG because it has a dash in the Fwd column and is in the Active state. It also is acting as AVF for virtual forwarder number 1.

Because the GLBP group has three routers, there are three virtual forwarders and virtual MAC addresses.

Switch A is in the Listen state for forwarders number 2 and 3, waiting to be given an active role in case one of those AVFs fails.

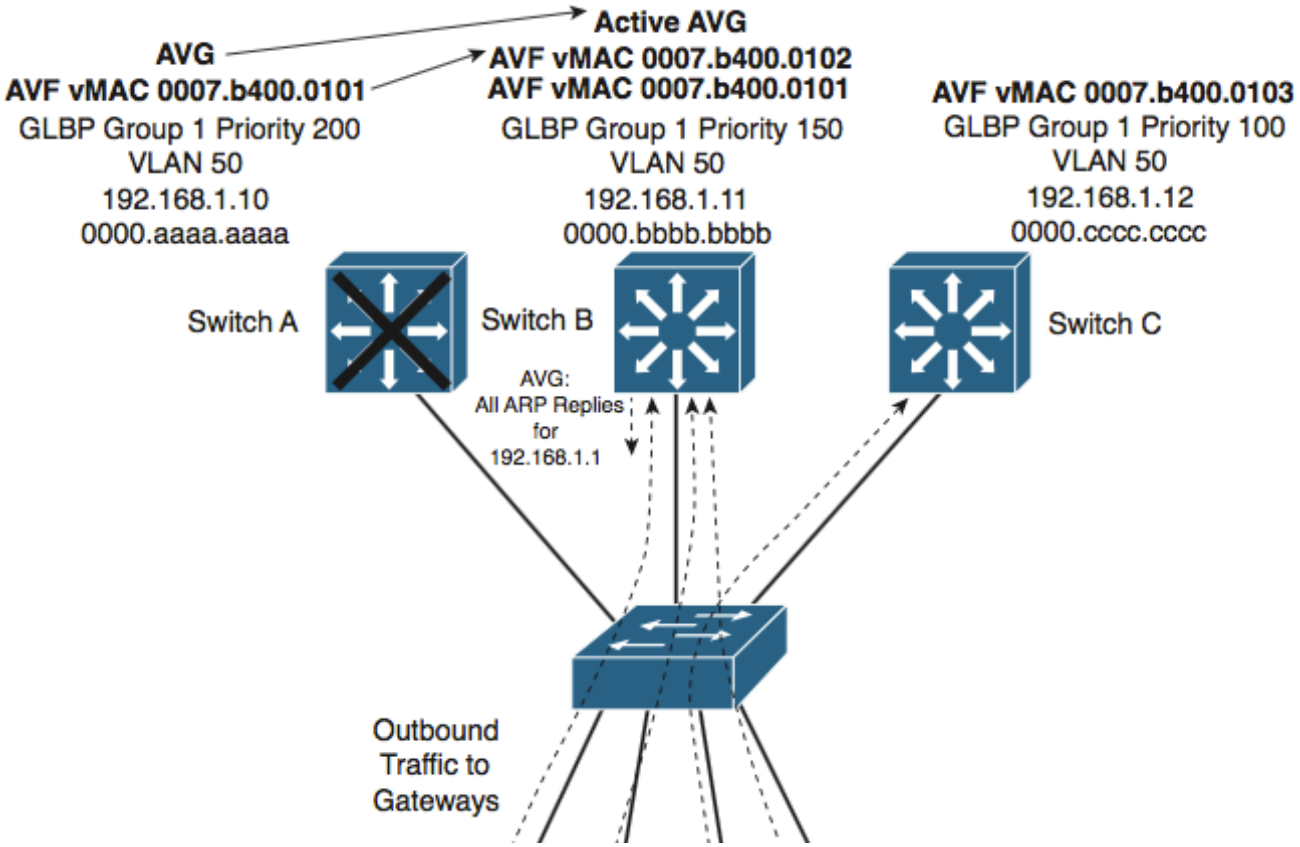
Switch B is shown to have the Standby role, waiting to take over in case the AVG fails. It is the AVF for virtual forwarder number 2.

Finally, Switch C has the lowest GLBP priority, so it stays in the Listen state, waiting for the active or standby AVG to fail. It is also the AVF for virtual forwarder number 3.

Taking off the **brief** keyword and just using **show glbp** displays more detailed info about config and status

The AVG here shows the virtual forwarder roles it has assigned to each of the routers in the GLBP group.

```
Switch-A# show glbp
Vlan50 - Group 1
  State is Active
    7 state changes, last state change 03:28:05
  Virtual IP address is 192.168.1.1
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.672 secs
  Redirect time 600 sec, forwarder time-out 14400 sec
  Preemption enabled, min delay 0 sec
  Active is local
  Standby is 192.168.1.11, priority 150 (expires in 9.632 sec)
  Priority 200 (configured)
  Weighting 100 (default 100), thresholds: lower 1, upper 100
  Load balancing: round-robin
  There are 3 forwarders (1 active)
  Forwarder 1
    State is Active
      3 state changes, last state change 03:27:37
    MAC address is 0007.b400.0101 (default)
    Owner ID is 00d0.0229.b80a
    Redirection enabled
    Preemption enabled, min delay 30 sec
    Active is local, weighting 100
  Forwarder 2
    State is Listen
    MAC address is 0007.b400.0102 (learnt)
    Owner ID is 0007.b372.dc4a
    Redirection enabled, 598.308 sec remaining (maximum 600 sec)
    Time to live: 14398.308 sec (maximum 14400 sec)
    Preemption enabled, min delay 30 sec
    Active is 192.168.1.11 (primary), weighting 100 (expires in 8.308 sec)
  Forwarder 3
    State is Listen
    MAC address is 0007.b400.0103 (learnt)
    Owner ID is 00d0.ff8a.2c0a
    Redirection enabled, 599.892 sec remaining (maximum 600 sec)
    Time to live: 14399.892 sec (maximum 14400 sec)
    Preemption enabled, min delay 30 sec
    Active is 192.168.1.12 (primary), weighting 100 (expires in 9.892 sec)
```



Redundancy is also inherent in the GLBP group: Switch A is the AVG, but the next-highest priority router can take over if the AVG fails.

All routers have been given an AVF role for a unique virtual MAC address in the group.

If one AVF fails, some clients remember the last-known virtual MAC address that was handed out. Therefore, another of the routers also takes over the AVF role for the failed router, causing the virtual MAC address to remain alive at all times.

Above is illustrated how these redundancy features react when the current active AVG fails. Before its failure, Switch A was the AVG because of its higher GLBP priority.

After it failed, Switch B became the AVG, answering ARP requests with the appropriate virtual MAC address for gateway 192.168.1.1.

Switch A also had been acting as an AVF, participating in the gateway load balancing.

Switch B also picks up this responsibility, using its virtual MAC address 0007.b400.0102 along with the one Switch A had been using, 0007.b400.0101.

Therefore, any hosts that know the gateway by any of its virtual MAC addresses still can reach a live gateway or AVF.