



Implementing HSRP

- [Implementing HSRP, on page 1](#)
- [Enabling Multiple Group Optimization \(MGO\) for HSRP, on page 7](#)
- [Understanding HSRP, on page 8](#)

Implementing HSRP

The Hot Standby Router Protocol (HSRP) is an IP routing redundancy protocol designed to allow for transparent failover at the first-hop IP router. HSRP provides high network availability, because it routes IP traffic from hosts on networks without relying on the availability of any single router. HSRP is used in a group of routers for selecting an active router and a standby router. An active router is the router of choice for routing packets; a standby router is a router that takes over the routing duties when an active router fails, or when preset conditions are met.

For more information on HSRP and related concepts, see [Understanding HSRP, on page 8](#)

Implementing HSRP involves:

- **Enabling HSRP for IPv4 or IPv6**
Activates HSRP on the configured interface.
- **Configuring HSRP group attributes**
Configures other Hot Standby group attributes that affect how the local router participates in HSRP.
- **Configuring the HSRP activation delay**
Delays the startup of the state machine when an interface comes up, giving the network time to settle and avoiding unnecessary state changes early after the link comes up.
- **Enabling HSRP support for ICMP redirect messages**
By default, HSRP filtering of ICMP redirect messages is enabled on routers running HSRP. This procedure reenables this feature on your router if it is disabled.
- **Enabling Multiple Group Optimization (MGO) for HSRP**
(Optional) Provides a solution for reducing control traffic in a deployment consisting of many subinterfaces. Some customizations include:
 - **Configuring an HSRP session name**

- Configuring a slave follow
Instructs the slave group to inherit its state from a specified group.
- Configuring primary and secondary virtual IPv4 addresses
- Configuring primary and secondary virtual IPv4 addresses for the slave group
- Configuring a slave virtual mac address for the slave group

Restrictions

- Upto 64 HSRP sessions are permitted on Cisco NCS 5001 and NCS 5002 routers (including Virtual Router Redundancy Protocol [VRRP] sessions, if any).
- Upto 16 HSRP sessions are permitted on Cisco NCS 5011 routers (including Virtual Router Redundancy Protocol [VRRP] sessions, if any).
- HSRP version 2 authentication is not supported.

For more information on HSRP and related concepts, see [Understanding HSRP, on page 8](#)

Enabling HSRP

Configuration Example

The `hsrp ipv4` command activates HSRP on the configured interface. If an IP address is specified, that address is used as the designated address for the Hot Standby group. If no IP address is specified, the virtual address is learned from the active router. For HSRP to elect a designated router, at least one router in the Hot Standby group must have been configured with, or learned, the designated address. Configuring the designated address on the active router always overrides a designated address that is currently in use.

```
Router#configure
Router(config)#router hsrp
router(config-hsrp)#interface TenGigE 0/0/0/2
router(config-hsrp-if)#address-family ipv4
router(config-hsrp-if-ipv4)#hsrp 1 version 1
/* The version keyword is available only if IPv4 address-family is selected. By default,
version is set to 2 for IPv6 address families. */

router(config-hsrp-gp)#address learn
router(config-hsrp-gp)#commit
```

Running Configuration

```
Router#show running-config router hsrp
router hsrp
interface TenGigE 0/0/0/2
address-family ipv4
hsrp 1 version 1
address learn
!
```

Verification

```
Router#show hsrp detail

TenGigE0/0/0/2 - IPv4 Group 1 (version 1)
  Local state is Active, priority 100
  Hello time 3000 msec holdtime 10000 msec
  Minimum delay 1 sec, reload delay 5 sec
  Hot standby IP address is 10.0.0.10 configured
  Active router is local
  Standby router is unknown expired
  Standby virtual mac address is 0000.0c07.ac01, state is active
  4 state changes, last state change 1w1d
  State change history:
  May 10 12:34:35.461 UTC  Init      -> Listen  Virtual IP configured
  May 10 12:34:45.461 UTC  Listen   -> Speak   Active timer expired
  May 10 12:34:55.461 UTC  Speak    -> Standby Standby timer expired
  May 10 12:34:55.462 UTC  Standby  -> Active  Active timer expired
  Last coup sent:         Never
  Last coup received:     Never
  Last resign sent:       Never
  Last resign received:   Never
```

Enabling HSRP for IPv6

Configuration Example

```
Router#configure
Router(config)#router hsrp
router(config-hsrp)#interface TenGigE 0/0/0/2
router(config-hsrp-if)#address-family ipv6
router(config-hsrp-if-ipv4)#hsrp 1
/* The version keyword is available only if IPv4 address-family is selected. By default,
version is set to 2 for IPv6 address families. */

router(config-hsrp-gp)#address linklocal autoconfig
/* The virtual linklocal address must not match any other virtual linklocal address that
is already configured for a different group.
The virtual linklocal address must not match the interface linklocal IPv6 address.
If you use the autoconfig keyword, the linklocal address is calculated using the EUI-64
format. */

router(config-hsrp-gp)#address global 2001:DB8:A:B::1
router(config-hsrp-gp)#commit
```

Running Configuration

```
Router#show running-config router hsrp
router hsrp
interface TenGigE 0/0/0/2
address-family ipv6
hsrp 1
address linklocal autoconfig
address global 2001:DB8:A:B::1
!
```

Verification

```
Router#show hsrp detail

TenGigE0/0/0/2 - IPv6 Group 1 (version 2)
  Local state is Active, priority 100
  Hellotime 3000 msec holdtime 10000 msec
  Minimum delay 1 sec, reload delay 5 sec
Hot standby IP address is fe80::205:73ff:fea0:1 configured
  Active router is local
  Standby router is unknown expired
  Standby virtual mac address is 0005.73a0.0001, state is active
  4 state changes, last state change 1w1d
  State change history:
  May 10 12:34:16.360 UTC  Init      -> Listen   Delay timer expired
  May 10 12:34:26.360 UTC  Listen   -> Speak    Active timer expired
  May 10 12:34:36.360 UTC  Speak    -> Standby  Standby timer expired
  May 10 12:34:36.360 UTC  Standby  -> Active   Active timer expired
  Last coup sent:         Never
  Last coup received:    Never
  Last resign sent:      Never
  Last resign received:  Never
```

Configuring HSRP Group Attributes

Configuration Example

Configures Hot Standby group attributes that affect how the local router participates in HSRP.

```
Router#configure
Router(config)#router hsrp
router(config-hsrp)#interface TenGigE 0/0/0/2
router(config-hsrp-if)#hsrp use-bia
/* (Optional) Configures the HSRP to use the burned-in address of the interface as its
virtual MAC address,
instead of the preassigned MAC address or the functional address. */

router(config-hsrp-if)#address-family ipv4
router(config-hsrp-if-ipv4)#hsrp 1 version 1
router(config-hsrp-gp)#priority 100
router(config-hsrp-gp)#track TenGigE 0/0/0/3
/* (Optional) Configures an interface so that the Hot Standby priority changes on the basis
of the availability of other interfaces. */

router(config-hsrp-gp)#preempt
/* (Optional) Configures HSRP preemption and preemption delay. */

router(config-hsrp-gp)#authentication company1
/* company1 is the authentication string for HSRP */

router(config-hsrp-gp)#mac-address 4000.1000.1060
/* (Optional) Specifies a virtual MAC address for the HSRP. */

router(config-hsrp-gp)#commit
```

Running Configuration

```
Router#show running-config router hsrp
router hsrp
```

```

interface TenGigE 0/0/0/2
 hsrp use-bia
 address-family ipv4
 hsrp 1 version 1
 priority 100
 track TenGigE 0/0/0/3
 preempt
 authentication company1
 mac-address 4000.1000.1060
 !

```

Verification

```
Router#show hsrp detail
```

```

TenGigE0/0/0/2 - IPv4 Group 1 (version 1)
  Local state is Active, priority 90, may preempt, use bia
  Hello time 3000 msec hold time 10000 msec
  Minimum delay 2 sec, reload delay 10 sec
  Hot standby IP address is 10.0.0.10 configured
  Active router is local
  Standby router is unknown expired
  Standby virtual mac address is c472.95a6.4eb6 configured, state is stored
  Authentication text, string "company1"
  4 state changes, last state change 1w1d
  State change history:
  May 10 12:34:35.461 UTC  Init    -> Listen  Virtual IP configured
  May 10 12:34:45.461 UTC  Listen -> Speak   Active timer expired
  May 10 12:34:55.461 UTC  Speak  -> Standby Standby timer expired
  May 10 12:34:55.462 UTC  Standby -> Active  Active timer expired
  Last coup sent:         Never
  Last coup received:     Never
  Last resign sent:      Never
  Last resign received:  Never
  Tracking states for 1 object, 0 up:
  Up TenGigE0/0/0/3 Priority decrement: 10

```

Configuring the HSRP Activation Delay

Configuration Example

Delays the startup of the state machine when an interface comes up. This gives the network time to settle and avoids unnecessary state changes early after the link comes up.

```

Router#configure
Router(config)#router hsrp
router(config-ksrp)#interface TenGigE 0/0/0/2
router(config-ksrp-if)#hsrp delay minimum 2 reload 10
/* The reload delay is the delay applied after the first interface up event.
The minimum delay is the delay that is applied after any subsequent interface up event (if
the interface flaps). */

router(config-ksrp-if)#address-family ipv4
router(config-ksrp-if-ipv4)#hsrp 1 version 1
/* The version keyword is available only if IPv4 address-family is selected. By default,
version is set to 2 for IPv6 address families. */

```

```
router(config-hsrp-gp)#address learn
router(config-hsrp-gp)#commit
```

Running Configuration

```
Router#show running-config router hsrp
router hsrp
interface TenGigE 0/0/0/2
hsrp delay minimum 2 reload 10
address-family ipv4
hsrp 1 version 1
address learn
!
```

Verification

```
Router#show hsrp detail
```

```
TenGigE0/0/0/0 - IPv4 Group 1 (version 1)
  Local state is Active, priority 90, may preempt, use bia
  Hellotime 3000 msec holdtime 10000 msec
  Minimum delay 2 sec, reload delay 10 sec
  Hot standby IP address is 10.0.0.10 configured
  Active router is local
  Standby router is unknown expired
  Standby virtual mac address is c472.95a6.4eb6 configured, state is stored
  4 state changes, last state change 1w1d
  State change history:
  May 10 12:34:35.461 UTC  Init      -> Listen   Virtual IP configured
  May 10 12:34:45.461 UTC  Listen   -> Speak    Active timer expired
  May 10 12:34:55.461 UTC  Speak    -> Standby  Standby timer expired
  May 10 12:34:55.462 UTC  Standby  -> Active   Active timer expired
  Last coup sent:          Never
  Last coup received:     Never
  Last resign sent:       Never
  Last resign received:   Never
```

Disabling HSRP Support for ICMP Redirect Messages

Configuration Example

By default, HSRP filtering of Internet Control Message Protocol (ICMP) redirect messages is enabled on routers running HSRP. Use the **hsrp redirects disable** command in interface configuration mode to disable this feature on your router.

```
Router#configure
Router(config)#router hsrp
router(config-hsrp)#interface TenGigE 0/0/0/2
router(config-hsrp-if)#hsrp redirects disable
/* To enable ICMP redirect messages, use the 'no hsrp redirects disable' command. */

router(config-hsrp-if)#address-family ipv4
router(config-hsrp-if-ipv4)#hsrp 1 version 1
/* The version keyword is available only if IPv4 address-family is selected. By default,
version is set to 2 for IPv6 address families. */
```

```
router(config-hsrp-gp)#address learn
router(config-hsrp-gp)#commit
```

Running Configuration

```
Router#show running-config router hsrp
router hsrp
interface TenGigE 0/0/0/2
hsrp redirects
address-family ipv4
hsrp 1 version 1
address learn
!
```

Verification

```
Router#show hsrp detail
```

```
TenGigE0/0/0/2 - IPv4 Group 1 (version 1)
  Local state is Active, priority 100
  Hello time 3000 msec holdtime 10000 msec
  Minimum delay 1 sec, reload delay 5 sec
  Hot standby IP address is 10.0.0.10 configured
  Active router is local
  Standby router is unknown expired
  Standby virtual mac address is 0000.0c07.ac01, state is active
  4 state changes, last state change 1w1d
  State change history:
  May 10 12:34:35.461 UTC  Init    -> Listen  Virtual IP configured
  May 10 12:34:45.461 UTC  Listen -> Speak   Active timer expired
  May 10 12:34:55.461 UTC  Speak  -> Standby Standby timer expired
  May 10 12:34:55.462 UTC  Standby -> Active  Active timer expired
Standby ICMP redirects disabled
  Last coup sent:      Never
  Last coup received:  Never
  Last resign sent:   Never
  Last resign received: Never
```

Enabling Multiple Group Optimization (MGO) for HSRP

Configuration Example

Multiple Group Optimization (MGO) provides a solution for reducing control traffic in a deployment consisting of many subinterfaces. By running the HSRP control traffic for just one of the sessions, the control traffic is reduced for the subinterfaces with identical redundancy requirements. All other sessions are slaves of this primary session, and inherit their states from it. Customizing the behavior of HSRP is optional. Be aware that as soon as you enable a HSRP group, that group is in operation.

```
Router#configure
Router(config)#router hsrp
router(config-hsrp)#interface TenGigE 0/0/0/2
router(config-hsrp-if)#address-family ipv4
router(config-hsrp-if-ipv4)#hsrp 1 version 1
/* Enables HSRP group configuration mode on a specific interface.
The version keyword is available only if IPv4 address-family is selected. By default, version
is set to 2 for IPv6 address families. */
```

```

router(config-hsrp-if-gp)#name s1
/* Specifies the HSRP session name. */

router(config-hsrp-gp)#address 10.20.30.1
/* Specifies the primary virtual IPv4 address for a router.
Use the address learn command for the virtual address to be learned from the active router.
*/

router(config-hsrp-if-gp)#address 10.20.30.2 secondary
/* Specifies the secondary virtual IPv4 address for a router. */

router(config-hsrp-if-gp)#authentication company1
/* company1 is the authentication string for HSRP. */

router(config-hsrp-if-gp)#mac-address 4000.1000.1060
/* Specifies a virtual MAC address for HSRP. */

router(config-hsrp-if-gp)#hsrp 2 slave
/* Enables HSRP slave configuration mode on a specific interface. */

router(config-hsrp-if-gp-slave)#follow m1
/* Configures a slave follow. Instructs the slave group to inherit its state from the
specified group, m1 (MGO session name). */

router(config-hsrp-if-gp-slave)#address 10.2.3.2
/* Specifies the primary virtual IPv4 address for slave group. */

router(config-hsrp-if-gp-slave)#address 10.2.3.3 secondary
/* Specifies the secondary virtual IPv4 address for slave group. */

router(config-hsrp-if-gp-slave)#mac-address 10.20.30
/* Specifies the virtual MAC address for the slave group. */

router(config-hsrp-gp)#commit

```

Running Configuration

```

Router#show running-config router hsrp
router hsrp
interface TenGigE 0/0/0/2
address-family ipv4
hsrp 1 version 1
name s1
address 10.20.30.1
address 10.20.30.2 secondary
authentication company1
mac-address 4000.1000.1060
hsrp 2 slave
follow m1
address 10.2.3.2
address 10.2.3.3 secondary
mac-address 10.20.30
!

```

Understanding HSRP

To implement HSRP on Cisco IOS XR software, you need to understand the following concepts:

HSRP Overview

HSRP is useful for hosts that do not support a router discovery protocol (such as Internet Control Message Protocol [ICMP] Router Discovery Protocol [IRDP]) and cannot switch to a new router when their selected router reloads or loses power. Because existing TCP sessions can survive the failover, this protocol also provides a more transparent recovery for hosts that dynamically choose a next hop for routing IP traffic.

When HSRP is configured on a network segment, it provides a virtual MAC address and an IP address that is shared among a group of routers running HSRP. The address of this HSRP group is referred to as the *virtual IP address*. One of these devices is selected by the protocol to be the *active router*. The active router receives and routes packets destined for the MAC address of the group. For n routers running HSRP, $n + 1$ IP and MAC addresses are assigned.

HSRP detects when the designated active router fails, at which point a selected standby router assumes control of the MAC and IP addresses of the HSRP group. A new *standby router* is also selected at that time.

Devices that are running HSRP send and receive multicast User Datagram Protocol (UDP) based hello packets to detect router failure and to designate active and standby routers.

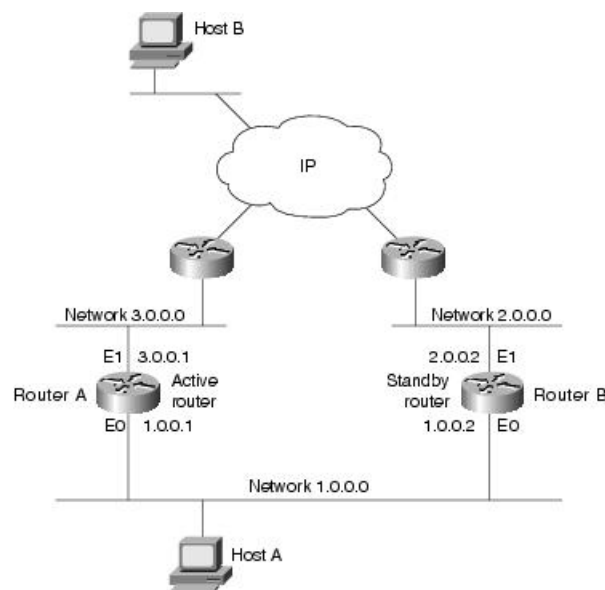
HSRP Groups

An HSRP group consists of two or more routers running HSRP that are configured to provide hot standby services for one another. HSRP uses a priority scheme to determine which HSRP-configured router is to be the default active router. To configure a router as the active router, you assign it a priority that is higher than the priority of all the other HSRP-configured routers. The default priority is 100, so if you configure just one router to have a higher priority, that router will be the default active router.

HSRP works by the exchange of multicast messages that advertise priority among the HSRP group. When the active router fails to send a hello message within a configurable period of time, the standby router with the highest priority becomes the active router. The transition of packet-forwarding functions between routers is completely transparent to all hosts on the network.

[Figure 1: Routers Configured as an HSRP Group, on page 9](#) shows routers configured as members of a single HSRP group.

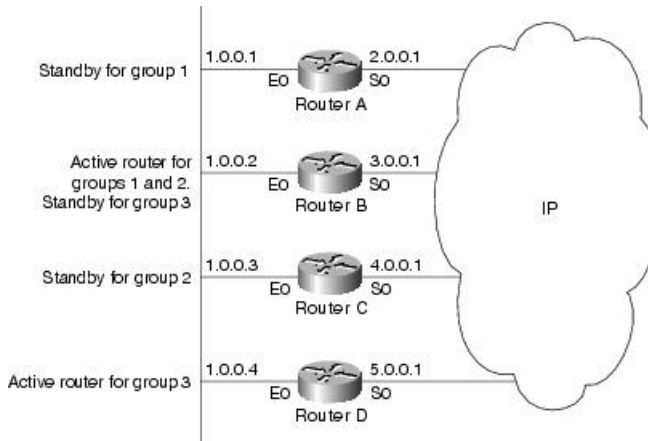
Figure 1: Routers Configured as an HSRP Group



All hosts on the network are configured to use the IP address of the virtual router (in this case, 1.0.0.3) as the default gateway.

A single router interface can also be configured to belong to more than one HSRP group. [Figure 2: Routers Configured as Members of Multiple HSRP Groups, on page 10](#) shows routers configured as members of multiple HSRP groups.

Figure 2: Routers Configured as Members of Multiple HSRP Groups



In [Figure 2: Routers Configured as Members of Multiple HSRP Groups, on page 10](#), the Ethernet interface 0 of Router A belongs to group 1. Ethernet interface 0 of Router B belongs to groups 1, 2, and 3. The Ethernet interface 0 of Router C belongs to group 2, and the Ethernet interface 0 of Router D belongs to group 3. When you establish groups, you might want to align them along departmental organizations. In this case, group 1 might support the Engineering Department, group 2 might support the Manufacturing Department, and group 3 might support the Finance Department.

Router B is configured as the active router for groups 1 and 2 and as the standby router for group 3. Router D is configured as the active router for group 3. If Router D fails for any reason, Router B assumes the packet-transfer functions of Router D and maintains the ability of users in the Finance Department to access data on other subnets.



Note A different virtual MAC address (VMAC) is required for each sub interface. VMAC is determined from the group ID. Therefore, a unique group ID is required for each sub interface configured, unless the VMAC is configured explicitly.



Note We recommend that you disable Spanning Tree Protocol (STP) on switch ports to which the virtual routers are connected. Enable RSTP or rapid-PVST on the switch interfaces if the switch supports these protocols.

HSRP and ARP

When a router in an HSRP group goes active, it sends a number of ARP responses containing its virtual IP address and the virtual MAC address. These ARP responses help switches and learning bridges update their port-to-MAC maps. These ARP responses also provide routers configured to use the burned-in address of the interface as its virtual MAC address (instead of the preassigned MAC address or the functional address) with

a means to update the ARP entries for the virtual IP address. Unlike the gratuitous ARP responses sent to identify the interface IP address when an interface comes up, the HSRP router ARP response packet carries the virtual MAC address in the packet header. The ARP data fields for IP address and media address contain the virtual IP and virtual MAC addresses.

Preemption

The HSRP preemption feature enables the router with highest priority to immediately become the active router. Priority is determined first by the priority value that you configure, and then by the IP address. In each case, a higher value is of greater priority.

When a higher-priority router preempts a lower-priority router, it sends a coup message. When a lower-priority active router receives a coup message or hello message from a higher-priority active router, it changes to the speak state and sends a resign message.

ICMP Redirect Messages

Internet Control Message Protocol (ICMP) is a network layer Internet protocol that provides message packets to report errors and other information relevant to IP processing. ICMP provides many diagnostic functions and can send and redirect error packets to the host. When running HSRP, it is important to prevent hosts from discovering the interface (or real) MAC addresses of routers in the HSRP group. If a host is redirected by ICMP to the real MAC address of a router, and that router later fails, then packets from the host are lost.

ICMP redirect messages are automatically enabled on interfaces configured with HSRP. This functionality works by filtering outgoing ICMP redirect messages through HSRP, where the next-hop IP address may be changed to an HSRP virtual IP address.

To support ICMP redirects, redirect messages are filtered through HSRP, where the next-hop IP address is changed to an HSRP virtual address. When HSRP redirects are turned on, ICMP interfaces with HSRP do this filtering. HSRP keeps track of all HSRP routers by sending advertisements and maintaining a real IP address to virtual IP address mapping to perform the redirect filtering.

Hot Restartability for HSRP

In the event of failure of a HSRP process in one active group, forced failovers in peer HSRP active router groups should be prevented. Hot restartability supports warm RP failover without incurring forced failovers to peer HSRP routers for active groups.

