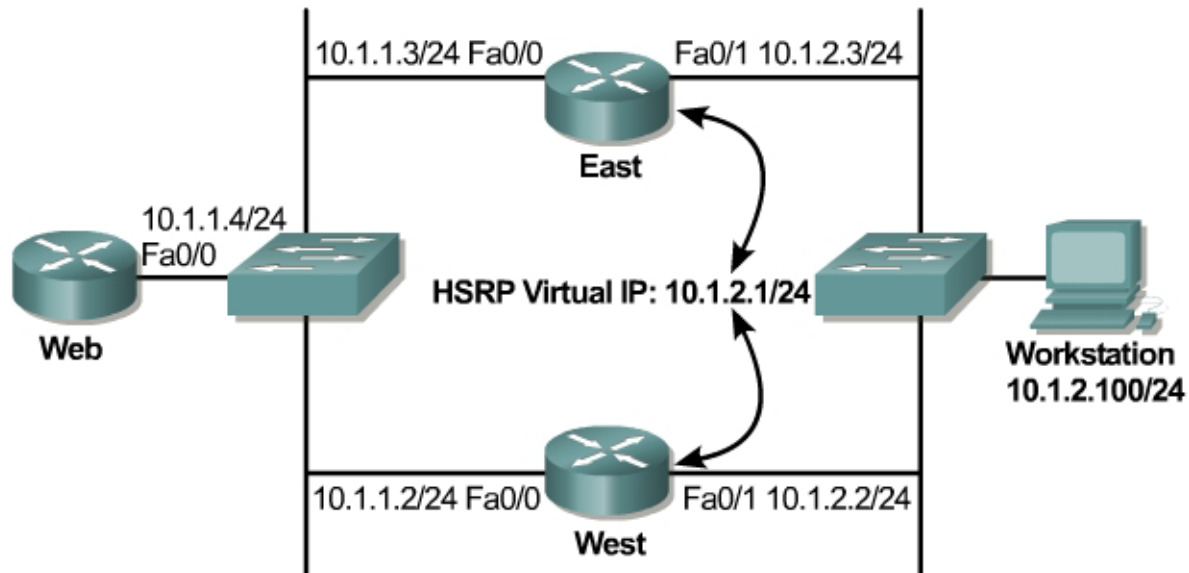


## Lab 6.2.2.1 Hot Standby Router Protocol



### Objective

Configure Hot Standby Router Protocol (HSRP) on a pair of routers to provide redundant fault tolerant router services to a network.

### Scenario

Two routers are connected to the network and the two default gateways do not provide a completely reliable path in the event of an outage.

Although the ITA has some newer IP hosts that support dynamic router discovery with the ICMP Router Discovery Protocol (IRDP), it mostly has a large class of legacy host implementations that do not. These hosts are unable to find a new router when their default gateway becomes unavailable. The ITA is also concerned with IRDP's administrative and processing overhead, security issues, and lack of support on the legacy platforms.

Configuring HSRP on the two routers provides a fast fail-over mechanism that is transparent to the users. This allows hosts on the LAN segment to maintain access to the Web router if a single point of failure occurs.

### Step 1

Cable the lab as shown in the diagram. Before beginning a lab, the configurations on all the routers should be cleared and then reloaded or power cycled to reset their default configurations. Delete the **vlan.dat** and startup configuration files on the switches before reloading them.

---

<b>Note</b>	The routers require two Ethernet interfaces therefore Cisco 2621 routers or equivalent with dual Ethernet interfaces are required to complete this lab. However, this lab could be written to use the Cisco 2620, single Ethernet interface routers by substituting the Ethernet connection to the Web, with serial links and additional subnet (e.g., 10.1.3.0/24).
-------------	--

---

If the routers are connected to Ethernet switches, it could take a few seconds for the switch to reach Spanning-Tree Protocol (STP) forwarding state. To maximize the benefits of HSRP, change the connected switch ports to spanning-tree PortFast (Fa0/2 - Fa0/3). If the router is connected to a hub or switch with PortFast configured, the interface should come up almost immediately.

```
Switch#configure terminal
Switch(config)#hostname PCSwitch
PCSwitch(config)#interface range fastethernet 0/2 -3
PCSwitch(config-if-range)#spanning-tree portfast
PCSwitch(config-if-range)#^Z
PCSwitch#
```

```
Switch#configure terminal
Switch(config)#hostname WebSwitch
WebSwitch(config)#interface range fastethernet 0/2 -3
WebSwitch(config-if-range)#spanning-tree portfast
WebSwitch(config-if-range)#^Z
WebSwitch#
```

```
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname PCSwitch
PCSwitch(config)#interface range fastethernet 0/2 -3
PCSwitch(config-if-range)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast will be configured in 2 interfaces due to the range command
but will only have effect when the interfaces are in a non-trunking mode.
PCSwitch(config-if-range)#^Z
PCSwitch#
```

```
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname WebSwitch
WebSwitch(config)#interface range fastethernet 0/2 -3
WebSwitch(config-if-range)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast will be configured in 2 interfaces due to the range command
but will only have effect when the interfaces are in a non-trunking mode.
WebSwitch(config-if-range)#^Z
WebSwitch#
```

## Step 2

Configure the router with a username, VTY and secret passwords, IP address, and enable HTTP management services as shown below.

```

Router(config)#hostname Web
Web(config)#interface fastethernet 0/0
Web(config-if)#ip address 10.1.1.4 255.255.255.0
Web(config-if)#no shutdown
Web(config-if)#line vty 0 4
Web(config-line)#password cisco
Web(config-line)#login
Web(config-line)#enable password class
Web(config-line)#ip http server

```

### Step 3

Configure the East and West routers for connectivity.

```

Router(config)#hostname West
West(config)#interface fastethernet 0/0
West(config-if)#ip address 10.1.1.2 255.255.255.0
West(config-if)#no shutdown
West(config-if)#interface fastethernet 0/1
West(config-if)#ip address 10.1.2.2 255.255.255.0
West(config-if)#no shutdown
West(config-if)#line vty 0 4
West(config-line)#password cisco
West(config-line)#login
West(config-line)#enable password class
West(config-line)#exit

Router(config)#hostname East
East(config)#interface fastethernet 0/0
East(config-if)#ip address 10.1.1.3 255.255.255.0
East(config-if)#no shutdown
East(config-if)#interface fastethernet 0/1
East(config-if)#ip address 10.1.2.3 255.255.255.0
East(config-if)#no shutdown
East(config-if)#line vty 0 4
East(config-line)#password cisco
East(config-line)#login
East(config-line)#enable password class
East(config-line)#exit

```

### Step 4

Configure Enhanced Interior Gateway Routing Protocol (EIGRP) on all routers.

```

Web(config)#router eigrp 10
Web(config-router)#network 10.0.0.0

West(config)#router eigrp 10
West(config-router)#network 10.0.0.0

East(config)#router eigrp 10
East(config-router)#network 10.0.0.0

```

Specify the default gateway for the workstation. Both routers will be specified as candidate default routers because there are two routers present on each network.

Configure the workstation with the IP address 10.1.2.100/24 and the two default gateways 10.1.2.2 and 10.1.2.3.

### Step 5

**Ping** the Web server at address 10.1.1.4 from the workstation.

1. Is the **ping** command successful?

## Step 6

After the **ping** to the Web server or router is successful, unplug the cable connected to interface FastEthernet 0/1 on the West router.

2. Now try to **ping** again. What happens?

3. Why is this happening?

Plug the cable back into the West router.

4. Try the **ping** again. Does it work?

## Step 7

The Hot Standby Router Protocol (HSRP) will remove the single point of failure, and provide a virtual gateway.

Currently there are two IP addresses on each network used by the routers, one for each router. HSRP allows the user to create a third virtual IP address that floats between the routers, in the event that one of the routers fails. The 10.1.2.1 address will be used for the HSRP address on the 10.1.2.0/24.

HSRP is enabled on an interface with the interface configuration **standby ip** command.

Turn on HSRP on the 10.1.2.0 network.

```
East(config)#interface fastethernet 0/1
East(config-if)#standby ip 10.1.2.1
East(config-if)#standby preempt

West(config)#interface fastethernet 0/1
West(config-if)#standby ip 10.1.2.1
West(config-if)#standby preempt
```

## Step 8

Reconfigure the workstation. Remove the current default gateways and install just a single default gateway pointing to the HSRP virtual IP address of 10.1.2.1/24.

## Step 9

Now try to **ping** the Web router at 10.1.1.4.

5. Does the **ping** work?

## Step 10

Enter the **show standby** command on the East router before testing HSRP.

```
East#show standby
FastEthernet0/1 - Group 0
  Local state is Active, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 1.552
  Virtual IP address is 10.1.2.1 configured
  Active router is local
  Standby router is 10.1.2.2 expires in 9.900
  Virtual mac address is 0000.0c07.ac00
  5 state changes, last state change 00:04:41
```

6. Which router becomes the active HSRP router?
7. How is the active HSRP router selected?

Remove the cable from interface FastEthernet 0/1 on the East router.

8. Try to **ping** again. Does it work?

## Step 11

Enter the **show standby** command on the West router:

```
West#show standby
FastEthernet0/1 - Group 0
  Local state is Active, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 1.306
  Virtual IP address is 10.1.2.1 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac00
  2 state changes, last state change 00:01:40
```

9. Why does HSRP create a standby virtual MAC address?

Enter the **show standby** command on the East router.

```
East#show standby
FastEthernet0/1 - Group 0
  Local state is Init (interface down), priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
```

```
Virtual IP address is 10.1.2.1 configured
Active router is unknown
Standby router is unknown
3 state changes, last state change 00:00:17
```

Plug the cable back into interface FastEthernet 0/1 on the East router. Try the **ping** again and enter the **show standby** command on both the East and West routers. Notice that the West router is still the Active router while the East router is now the Standby router.

```
West#show standby
FastEthernet0/1 - Group 0
  Local state is Active, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 1.312
  Virtual IP address is 10.1.2.1 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac00
  2 state changes, last state change 00:12:28
  IP redundancy name is "hsrp-Fa0/1-0" (default)

East#show standby
FastEthernet0/1 - Group 0
  Local state is Standby, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 0.658
  Virtual IP address is 10.1.2.1 configured
  Active router is 10.1.2.2, priority 100 expires in 8.436
  Standby router is local
  4 state changes, last state change 00:00:31
  IP redundancy name is "hsrp-Fa0/1-0" (default)
```

## Step 12

Make the East router the active HSRP router by setting the standby priority to 150. The East router has the higher priority and will win the election because the default standby priority is 100.

The preempt keyword is used to force the router with the highest priority, which is the East router, to resume the role of the active HSRP router. The change will occur even if West is currently the active HSRP router. For example, when the East router standby interface FastEthernet 0/1 goes down and then comes back up, East will resume the role of the active router.

```
East(config-if)#interface fastethernet 0/1
East(config-if)#standby priority 150
East(config-if)#standby preempt

22:01:51: %STANDBY-6-STATECHANGE: FastEthernet0/7 Group 0 state Standby ->
Active
```

Now issue the **show standby** command.

```
East#show standby
FastEthernet0/1 - Group 0
  Local state is Active, priority 150, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 0.164
  Virtual IP address is 10.1.2.1 configured
  Active router is local
  Standby router is 10.1.2.3 expires in 8.896
  Virtual mac address is 0000.0c07.ac00
  5 state changes, last state change 00:02:31
```

Notice that the East router has become the active HSRP router again.

Test the priority configuration by unplugging the cable from interface FastEthernet 0/1 on the East router and then issuing the **show standby** command on both routers. The East router will show that the interface is down and the West router should assume the role of the Active router.

Plug the cable back into interface FastEthernet 0/1 on the East router, and then issue the **show standby** command on both routers again. The East router should have resumed the Active router role and the West router should have become the Standby router again.

---

<b>Note</b>	After changing the standby priority and unplugging the cable from interface FastEthernet 0/1 on the East Router.
-------------	--

---

```
East#show standby
FastEthernet0/1 - Group 0
  Local state is Init (interface down), priority 150, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Virtual IP address is 10.1.2.1 configured
  Active router is unknown
  Standby router is unknown
  6 state changes, last state change 00:00:05
  IP redundancy name is "hsrp-Fa0/1-0" (default)
```

```
West#show standby
FastEthernet0/1 - Group 0
  Local state is Active, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 0.024
  Virtual IP address is 10.1.2.1 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac00
  5 state changes, last state change 00:00:17
  IP redundancy name is "hsrp-Fa0/1-0" (default)
```

Note: After plugging the cable back into interface FastEthernet 0/1 on the East Router.

```
East#show standby
FastEthernet0/1 - Group 0
  Local state is Active, priority 150, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 2.078
  Virtual IP address is 10.1.2.1 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac00
  7 state changes, last state change 00:00:03
  IP redundancy name is "hsrp-Fa0/1-0" (default)
```

```
West#show standby
FastEthernet0/1 - Group 0
  Local state is Standby, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 2.296
  Virtual IP address is 10.1.2.1 configured
  Active router is 10.1.2.3, priority 150 expires in 7.988
  Standby router is local
```

```
7 state changes, last state change 00:00:03
IP redundancy name is "hsrp-Fa0/1-0" (default)
```

### Step 13

From the workstation, perform a **tracert** to the Web router. The **tracert** command will trace the path of a packet, similar to the Cisco IOS **traceroute** command. The results should be similar to the following output.

```
C:\>tracert 10.1.1.4

Tracing route to 10.1.1.4 over a maximum of 30 hops

  1  <10 ms    10 ms    <10 ms    10.1.2.1
  2  <10 ms    <10 ms    <10 ms    10.1.1.4

Trace complete.
```

From the workstation, **ping** the Web router with a **-t** option. The **-t** option provides continuous pings. Disconnect the cable from interface FastEthernet 0/0 on the West router. Observe the output.

10. What was the result of removing the cable?

View the routing table on the West router.

```
West#show ip route
<Output omitted>

Gateway of last resort is not set

  10.0.0.0/24 is subnetted, 2 subnets
C       10.1.2.0 is directly connected, fastethernet 0/1
D       10.1.1.0 [90/284160] via 10.1.2.3, 00:00:15, fastethernet 0/1
```

When the direct connection to the Web router is broken, West must use the FastEthernet 0/1 interface through East to pass packets to the Web.

There is another way to view the problem. Even if a ping is successful, there could still be issues with a connection. For example, the hops that the packet must traverse are hidden from the ping output. With the cable still disconnected from interface FastEthernet 0/0 on the West router, issue the **tracert** command to the Web router.

```
C:\>tracert 10.1.1.4

Tracing route to 10.1.1.4 over a maximum of 30 hops

  1  <10 ms    <10 ms    10 ms    10.1.2.1
  2  <10 ms    <10 ms    <10 ms    10.1.2.3
  3  <10 ms    <10 ms    <10 ms    10.1.1.4

Trace complete.
```



West could not pass the packet to the Web router on the FastEthernet 0/1 interface. Therefore, the packet had to be sent to East on 10.1.2.3. The packet was successfully delivered from East interface FastEthernet 0/0 to the Web router.

The solution to this problem is to use the **standby track** command, which ties the router standby priority to the availability of tracked interfaces. This command is important for providing redundancy for routers with interfaces that are not configured for HSRP. When a tracked interface fails, the hot standby priority on the device on which tracking has been configured is decreased by the specified value. If an interface is not tracked, state changes do not affect the hot standby priority on the configured interface.

Reconnect the cable between the Web router and the West router.

Now track the FastEthernet 0/0 interface on the West router. If the interface state changes then the standby priority should be decreased by at least 51.

```
West(config)#interface fastethernet 0/1
West(config-if)#standby track fastethernet 0/0 51
```

Verify standby track configuration.

```
West#show standby fastethernet 0/1
FastEthernet0/1 - Group 0
  Local state is Standby, priority 100, may preempt
  Hellotime 3 sec, holdtime 10 sec
  Next hello sent in 0.022
  Virtual IP address is 10.1.2.1 configured
  Active router is 10.1.2.3, priority 150 expires in 8.476
  Standby router is local
  7 state changes, last state change 00:39:34
  IP redundancy name is "hsrp-Fa0/1-0" (default)
  Priority tracking 1 interface, 1 up:
    Interface          Decrement  State
    FastEthernet0/0    51         Up
```

From the workstation, **ping** the Web router with the **-t** option. Disconnect the cable from interface FastEthernet 0/0 on the West router.

11. Did the network recover from the interface change?

From the workstation, perform a **tracert** to the Web router. The results should be similar to the following output.

```
C:\>tracert 10.1.1.4

Tracing route to 10.1.1.4 over a maximum of 30 hops

  1  <10 ms    10 ms    <10 ms    10.1.2.1
  2  <10 ms    <10 ms    <10 ms    10.1.1.4

Trace complete.
```

The output of the **tracert** command now shows that the optimal path from the workstation to the Web router was used.

This lab has demonstrated the basic configuration of HSRP. The HSRP provides fast failover for devices on a LAN segment containing two or more Cisco routers.