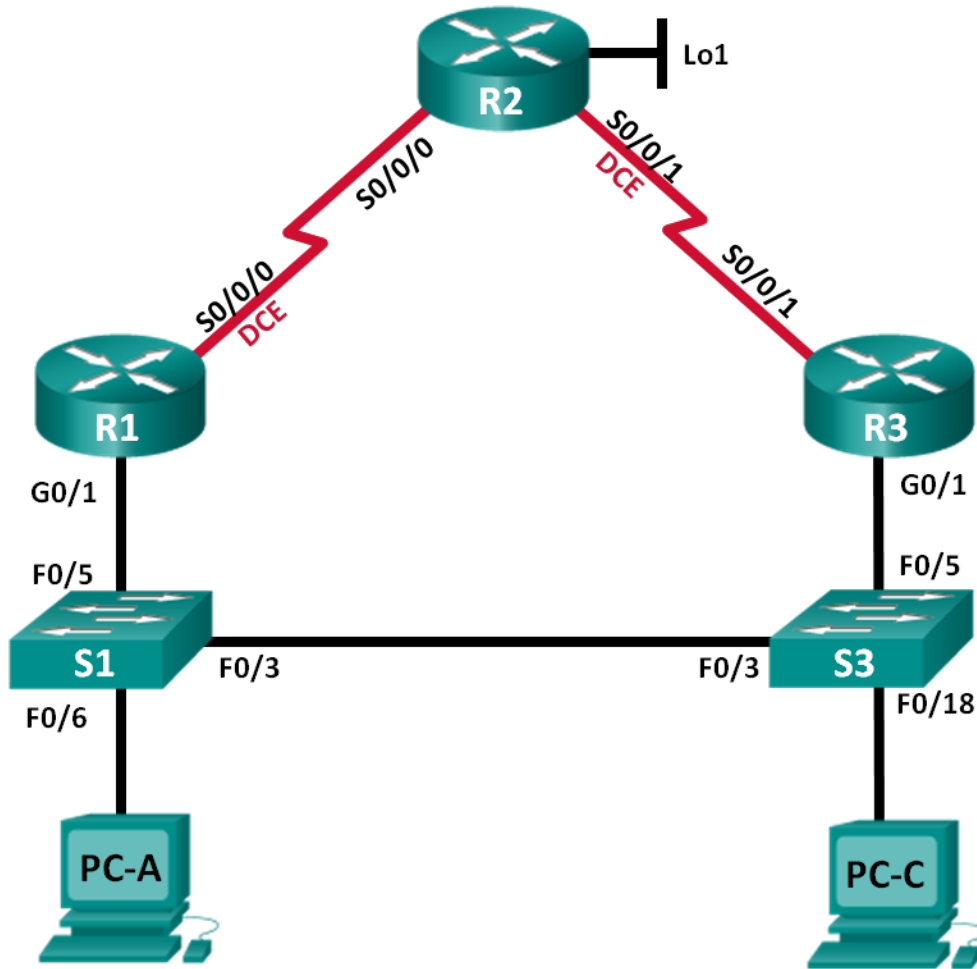


## Configuring HSRP Topology



## Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/1	192.168.1.1	255.255.255.0	N/A
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A
R2	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A
	Lo1	209.165.200.225	255.255.255.224	N/A
R3	G0/1	192.168.1.3	255.255.255.0	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
S1	VLAN 1	192.168.1.11	255.255.255.0	192.168.1.1
S3	VLAN 1	192.168.1.13	255.255.255.0	192.168.1.3
PC-A	NIC	192.168.1.31	255.255.255.0	192.168.1.1
PC-C	NIC	192.168.1.33	255.255.255.0	192.168.1.3

## Objectives

**Part 1: Build the Network and Verify Connectivity**

**Part 2: Configure First Hop Redundancy using HSRP**

## Background / Scenario

Spanning tree provides loop-free redundancy between switches within a LAN. However, it does not provide redundant default gateways for end-user devices within the network if one of the routers fails. First Hop Redundancy Protocols (FHRPs) provide redundant default gateways for end devices with no end-user configuration necessary. In this lab, you will configure Cisco's Hot Standby Routing Protocol (HSRP), a First Hop Redundancy Protocol (FHRP).

**Note:** The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

**Note:** Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

## Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 2 Switches (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- 2 PCs (Windows 8, 7, or Vista with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology

## Part 1: Build the Network and Verify Connectivity

In Part 1, you will set up the network topology and configure basic settings, such as the interface IP addresses, static routing, device access, and passwords.

### Step 1: Cable the network as shown in the topology.

Attach the devices as shown in the topology diagram, and cable as necessary.

### Step 2: Configure PC hosts.

### Step 3: Configure basic settings for each router.

### Step 4: Configure basic settings for each switch.

### Step 5: Verify connectivity between PC-A and PC-C.

Ping from PC-A to PC-C. Were the ping results successful? \_\_\_\_\_ **Yes**

If the pings are not successful, troubleshoot the basic device configurations before continuing.

### Step 6: Configure routing.

- Configure RIP version 2 on all routers. Add all the networks, except 209.165.200.224/27 into the RIP process.
- Configure a default route on R2 using Lo1 as the exit interface to 209.165.200.224/27 network.
- On R2, use the following commands to redistribute the default route into the RIP process.

```
R2(config)# router rip
R2(config-router)# default-information originate
```

### Step 7: Verify connectivity.

- From PC-A, you should be able to ping every interface on R1, R2, R3, and PC-C. Were all pings successful? \_\_\_\_\_ **Yes**

If the pings are not successful, troubleshoot the basic device configurations before continuing.

- From PC-C, you should be able to ping every interface on R1, R2, R3, and PC-A. Were all pings successful? \_\_\_\_\_ **Yes**

If the pings are not successful, troubleshoot the basic device configurations before continuing.

## Part 2: Configure First Hop Redundancy Using HSRP

Even though the topology has been designed with some redundancy (two routers and two switches on the same LAN network), both PC-A and PC-C are configured with only one gateway address. PC-A is using R1 and PC-C is using R3. If either of these routers or the interfaces on the routers went down, the PC could lose its connection to the Internet.

In Part 2, you will test how the network behaves both before and after configuring HSRP. To do this, you will determine the path that packets take to the loopback address on R2.

**Note: Loopback interfaces are logical interfaces, which means they're virtual, software-only interfaces, not actual, physical router interfaces. Loopback interfaces come in very handy for diagnostic purposes.**

**Step 1: Determine the path for Internet traffic for PC-A and PC-C.**

- a. From a command prompt on PC-A, issue a **tracert** command to the 209.165.200.225 loopback address of R2.

```
C:\ tracert 209.165.200.225
Tracing route to 209.165.200.225 over a maximum of 30 hops

  1     1 ms     1 ms     1 ms    192.168.1.1
  2    13 ms    13 ms    13 ms    209.165.200.225
```

Trace complete.

What path did the packets take from PC-A to 209.165.200.225?  
\_\_\_\_\_ PC-A to R1 to R2

- b. From a command prompt on PC-C, issue a **tracert** command to the 209.165.200.225 loopback address of R2.

What path did the packets take from PC-C to 209.165.200.225?  
\_\_\_\_\_ PC-C to R3 to R2

**Step 2: Start a ping session on PC-A, and break the connection between S1 and R1.**

- a. From a command prompt on PC-A, issue a **ping -t** command to the **209.165.200.225** address on R2. Make sure you leave the command prompt window open.

**Note:** The pings continue until you press **Ctrl+C**, or until you close the command prompt window.

```
C:\ ping -t 209.165.200.225
Pinging 209.165.200.225 with 32 bytes of data:
Reply from 209.165.200.225: bytes=32 time=9ms TTL=254
Reply from 209.165.200.225: bytes=32 time=9ms TTL=254
Reply from 209.165.200.225: bytes=32 time=9ms TTL=254
<output omitted>
```

- b. As the ping continues, disconnect the Ethernet cable from F0/5 on S1. You can also shut down the S1 F0/5 interface, which creates the same result.

What happened to the ping traffic?

\_\_\_\_\_ After the cable was disconnected from F0/5 on S1 (or the interface was shut down), pings failed. Sample output is below.

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.
<output omitted>
```

- c. Would be the results if you repeat Steps 2a and 2b on PC-C and S3?

\_\_\_\_\_ The results were the same as on PC-A. After the Ethernet cable was disconnected from F0/5 on S3, the pings failed.

- d. Reconnect the Ethernet cables to F0/5 or enable the F0/5 interface on both S1 and S3, respectively. Re-issue pings to 209.165.200.225 from both PC-A and PC-C to make sure connectivity is re-established.

### Step 3: Configure HSRP on R1 and R3.

In this step, you will configure HSRP and change the default gateway address on PC-A, PC-C, S1, and S2 to the virtual IP address for HSRP. R1 becomes the active router via configuration of the HSRP priority command.

a. Configure HSRP on R1.

```
R1(config)# interface g0/1
R1(config-if)# standby version 2
R1(config-if)# standby 1 ip 192.168.1.254
R1(config-if)# standby 1 priority 150
R1(config-if)# standby 1 preempt
```

b. Configure HSRP on R3.

```
R3(config)# interface g0/1
R3(config-if)# standby version 2
R3(config-if)# standby 1 ip 192.168.1.254
```

c. Verify HSRP by issuing the **show standby** command on R1 and R3.

```
R1# show standby
GigabitEthernet0/1 - Group 1 (version 2)
  State is Active
    4 state changes, last state change 00:00:30
  Virtual IP address is 192.168.1.254
  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 1.696 secs
  Preemption enabled
  Active router is local
  Standby router is 192.168.1.3, priority 100 (expires in 11.120 sec)
  Priority 150 (configured 150)
  Group name is "hsrp-Gi0/1-1" (default)
```

```
R3# show standby
GigabitEthernet0/1 - Group 1 (version 2)
  State is Standby
    4 state changes, last state change 00:02:29
  Virtual IP address is 192.168.1.254
  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 0.720 secs
  Preemption disabled
  Active router is 192.168.1.1, priority 150 (expires in 10.128 sec)
    MAC address is d48c.b5ce.a0c1
  Standby router is local
  Priority 100 (default 100)
  Group name is "hsrp-Gi0/1-1" (default)
```

Using the output shown above, answer the following questions:

## Lab – Configuring HSRP

---

Which router is the active router? \_\_\_\_\_ R1

What is the MAC address for the virtual IP address? \_\_\_\_\_ 0000.0c9f.f001

What is the IP address and priority of the standby router?

---

IP address is 192.168.1.3 and the priority is 100 (the default which is less than that of R1, the active router, with a priority of 150).

- d. Use the **show standby brief** command on R1 and R3 to view an HSRP status summary. Sample output is shown below.

R1# **show standby brief**

```
                P indicates configured to preempt.
                |
Interface      Grp  Pri P State   Active           Standby           Virtual IP
Gi0/1          1   150 P Active  local            192.168.1.3      192.168.1.254
```

R3# **show standby brief**

```
                P indicates configured to preempt.
                |
Interface      Grp  Pri P State   Active           Standby           Virtual IP
Gi0/1          1   100 Standby 192.168.1.1     local            192.168.1.254
```

- e. Change the default gateway address for PC-A, PC-C, S1, and S3. Which address should you use?

---

192.168.1.254

- f. Verify the new settings. Issue a ping from both PC-A and PC-C to the loopback address of R2. Are the pings successful? \_\_\_\_\_ Yes

### Step 4: Start a ping session on PC-A and break the connection between the switch that is connected to the Active HSRP router (R1).

- a. From a command prompt on PC-A, issue a **ping -t** command to the 209.165.200.225 address on R2. Ensure that you leave the command prompt window open.
- b. As the ping continues, disconnect the Ethernet cable from F0/5 on S1 or shut down the F0/5 interface. What happened to the ping traffic?

---

A few packets may be dropped while the Standby router takes over. Sample output is shown below:

```
Reply from 209.165.200.225: bytes=32 time=9ms TTL=254
Request timed out.
Request timed out.
Reply from 209.165.200.225: bytes=32 time=9ms TTL=254
<output Omitted>
```

### Step 5: Verify HSRP settings on R1 and R3.

- a. Issue the **show standby brief** command on R1 and R3.

Which router is the active router? \_\_\_\_\_ R3 is now the active router.

- b. Reconnect the cable between the switch and the router or enable interface F0/5. Now which router is the active router? Explain.

\_\_\_\_\_ R1 became the active router because preemption is enabled and has a higher priority.

### Step 6: Change HSRP priorities.

- a. Change the HSRP priority to 200 on R3. Which is the active router? \_\_\_\_\_ R1

- b. Issue the command to change the active router to R3 without changing the priority. What command did you use?

\_\_\_\_\_ R3(config)# **interface g0/1**  
R3(config-if)# **standby 1 preempt**

- c. Use a **show** command to verify that R3 is the active router.

### Reflection

Why would there be a need for redundancy in a LAN?

\_\_\_\_\_ In today's networks, down time can be a critical issue affecting sales, productivity, and general connectivity (IP Telephony phones for example).

### Device Configs

#### Router R1

```
R1# show run
```

```
Building configuration...
```

```
Current configuration : 1375 bytes
```

```
!  
version 15.2  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname R1  
!  
boot-start-marker  
boot-end-marker  
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2  
!  
no aaa new-model
```

## Lab – Configuring HSRP

---

```
!  
no ip domain lookup  
ip cef  
no ipv6 cef  
multilink bundle-name authenticated  
!  
interface Embedded-Service-Engine0/0  
no ip address  
shutdown  
!  
interface GigabitEthernet0/0  
no ip address  
shutdown  
duplex auto  
speed auto  
!  
interface GigabitEthernet0/1  
ip address 192.168.1.1 255.255.255.0  
standby version 2  
standby 1 ip 192.168.1.254  
standby 1 priority 150  
standby 1 preempt  
duplex auto  
speed auto  
!  
interface Serial0/0/0  
ip address 10.1.1.1 255.255.255.252  
clock rate 128000  
!  
interface Serial0/0/1  
no ip address  
shutdown  
!  
!  
router rip  
network 10.1.1.0  
network 192.168.1.0  
!  
ip forward-protocol nd  
!  
no ip http server  
no ip http secure-server  
!  
!  
!  
control-plane  
!  
line con 0  
password cisco
```



## Lab – Configuring HSRP

---

```
logging synchronous
login
line aux 0
line 2
no activation-character
no exec
transport preferred none
transport input all
transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
stopbits 1
line vty 0 4
password cisco
login
transport input all
!
scheduler allocate 20000 1000
!
end
```

### Router R2

```
R2# show run
Building configuration...

Current configuration : 1412 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
interface Loopback1
ip address 209.165.200.225 255.255.255.224
!
interface Embedded-Service-Engine0/0
```

## Lab – Configuring HSRP

---

```
no ip address
shutdown
!
interface GigabitEthernet0/0
no ip address
shutdown
duplex auto
speed auto
!
interface GigabitEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!
interface Serial0/0/0
ip address 10.1.1.2 255.255.255.252
!
interface Serial0/0/1
ip address 10.2.2.2 255.255.255.252
clock rate 128000
!
!
router rip
network 10.1.1.0
network 10.2.2.0
default-information originate
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Loopback1
!
!
control-plane
!
!
line con 0
password cisco
logging synchronous
login
line aux 0
line 2
no activation-character
no exec
transport preferred none
transport input all
```

## Lab – Configuring HSRP

---

```
transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
stopbits 1
line vty 0 4
password cisco
login
transport input all
!
scheduler allocate 20000 1000
!
end
```

### Router R3

R3# **show run**

Building configuration...

Current configuration : 1319 bytes

```
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
no ip address
shutdown
duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address 192.168.1.3 255.255.255.0
```

## Lab – Configuring HSRP

---

```
standby version 2
standby 1 ip 192.168.1.254
standby 1 priority 200
standby 1 preempt
duplex auto
speed auto
!
interface Serial0/0/0
no ip address
shutdown
clock rate 2000000
!
interface Serial0/0/1
ip address 10.2.2.1 255.255.255.252
!
!
router rip
network 10.2.2.0
network 192.168.1.0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
control-plane
!
line con 0
password cisco
logging synchronous
login
line aux 0
line 2
no activation-character
no exec
transport preferred none
transport input all
transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
stopbits 1
line vty 0 4
password cisco
login
transport input all
!
scheduler allocate 20000 1000
!
end
```

### Switch S1

```
S1# show run
Building configuration...

Current configuration : 3114 bytes
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname S1
!
boot-start-marker
boot-end-marker
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
system mtu routing 1500
!
!
no ip domain-lookup
!
crypto pki trustpoint TP-self-signed-2530377856
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-2530377856
  revocation-check none
  rsakeypair TP-self-signed-2530377856
!
!
!spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
```

## Lab – Configuring HSRP

---

```
!  
interface FastEthernet0/7  
!  
interface FastEthernet0/8  
!  
interface FastEthernet0/9  
!  
interface FastEthernet0/10  
!  
interface FastEthernet0/11  
!  
interface FastEthernet0/12  
!  
interface FastEthernet0/13  
!  
interface FastEthernet0/14  
!  
interface FastEthernet0/15  
!  
interface FastEthernet0/16  
!  
interface FastEthernet0/17  
!  
interface FastEthernet0/18  
!  
interface FastEthernet0/19  
!  
interface FastEthernet0/20  
!  
interface FastEthernet0/21  
!  
interface FastEthernet0/22  
!  
interface FastEthernet0/23  
!  
interface FastEthernet0/24  
!  
interface GigabitEthernet0/1  
!  
interface GigabitEthernet0/2  
!  
interface Vlan1  
 ip address 192.168.1.11 255.255.255.0  
!  
 ip default-gateway 192.168.1.254  
 ip http server  
 ip http secure-server  
!  
line con 0
```

## Lab – Configuring HSRP

---

```
password cisco
logging synchronous
login
line vty 0 4
password cisco
login
line vty 5 15
password cisco
login
!
end
```

### Switch S3

```
S3# show run
Building configuration...

Current configuration : 2974 bytes
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname S3
!
boot-start-marker
boot-end-marker
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGholQM5EnRtoyr8cHAUg.2
!
no aaa new-model
system mtu routing 1500
!
!
no ip domain-lookup
!
!
crypto pki trustpoint TP-self-signed-2530358400
  enrollment selfsigned
  subject-name cn=IOS-Self-Signed-Certificate-2530358400
  revocation-check none
  rsakeypair TP-self-signed-2530358400
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
```

## Lab – Configuring HSRP

---

```
vlan internal allocation policy ascending
!  
interface FastEthernet0/1  
!  
interface FastEthernet0/2  
!  
interface FastEthernet0/3  
!  
interface FastEthernet0/4  
!  
interface FastEthernet0/5  
!  
interface FastEthernet0/6  
!  
interface FastEthernet0/7  
!  
interface FastEthernet0/8  
!  
interface FastEthernet0/9  
!  
interface FastEthernet0/10  
!  
interface FastEthernet0/11  
!  
interface FastEthernet0/12  
!  
interface FastEthernet0/13  
!  
interface FastEthernet0/14  
!  
interface FastEthernet0/15  
!  
interface FastEthernet0/16  
!  
interface FastEthernet0/17  
!  
interface FastEthernet0/18  
!  
interface FastEthernet0/19  
!  
interface FastEthernet0/20  
!  
interface FastEthernet0/21  
!  
interface FastEthernet0/22  
!  
interface FastEthernet0/23  
!  
interface FastEthernet0/24
```



## Lab – Configuring HSRP

---

```
!  
interface GigabitEthernet0/1  
!  
interface GigabitEthernet0/2  
!  
interface Vlan1  
 ip address 192.168.1.13 255.255.255.0  
!  
ip default-gateway 192.168.1.254  
ip http server  
ip http secure-server  
!  
!  
line con 0  
 password cisco  
 logging synchronous  
 login  
line vty 0 4  
 password cisco  
 login  
line vty 5 15  
 password cisco  
 login  
!  
end
```