CCNPv7 SWITCH

Chapter 6 Lab 6-1, First Hop Redundancy Protocols – HSRP and VRRP

Topology

Objectives

* Configure inter-VLAN routing with HSRP with load balancing
* Configure HSRP authentication
* Configure HSRP Interface Tracking
* Configure VRRP
* Configure VRRP object tracking

Hot Standby Router Protocol (HSRP) is a Cisco-proprietary redundancy protocol for establishing a fault-tolerant default gateway. It is described in RFC 2281. HSRP provides a transparent failover mechanism to the end stations on the network. This provides users at the access layer with uninterrupted service to the network if the primary gateway becomes inaccessible.

The Virtual Router Redundancy Protocol (VRRP) is a standards-based alternative to HSRP and is defined in RFC 3768. The two technologies are similar but not compatible.

This lab will offer configuration experience with both of the protocols in a phased approach.

Some of the configurations in this lab will be used in subsequent labs. Please read carefully before clearing your devices.

**Note:** This lab uses the Cisco WS-C2960-24TT-L switch with the Cisco IOS image c2960-lanbasek9-mz.150-2.SE6.bin and the Catalyst 3560V2-24PS switch with the Cisco IOS image c3560-ipservicesk9-mz.150-2.SE6.bin. Other switches and Cisco IOS Software versions can be used if they have comparable capabilities and features. Depending on the switch model and Cisco IOS Software version, the commands available and output produced might vary from what is shown in this lab.

Required Resources

* 2 switches (Cisco 2960 with the Cisco IOS Release 15.0(2)SE6 C2960-LANBASEK9-M image or comparable)
* 2 switches (Cisco 3560 with the Cisco IOS Release 15.0(2)SE6 C3560-ipservicesK9-M image or comparable)
* Ethernet and console cables
* 4 PC’s with Windows OS

1. Prepare for the Lab
   1. Prepare the switches for the lab

Use the **reset.tcl** script you created in Lab 1 “Preparing the Switch” to set your switches up for this lab. Then load the file BASE.CFG into the running-config with the command **copy flash:BASE.CFG running-config**. An example from DLS1:

DLS1# **tclsh reset.tcl**

Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]

[OK]

Erase of nvram: complete

Reloading the switch in 1 minute, type reload cancel to halt

Proceed with reload? [confirm]

\*Mar 7 18:41:40.403: %SYS-7-NV\_BLOCK\_INIT: Initialized the geometry of nvram

\*Mar 7 18:41:41.141: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload command.

*<switch reloads - output omitted>*

**Would you like to enter the initial configuration dialog? [yes/no]: n**

**Switch> en**

\*Mar 1 00:01:30.915: %LINK-5-CHANGED: Interface Vlan1, changed state to administratively down

**Switch# copy BASE.CFG running-config**

Destination filename [running-config]?

184 bytes copied in 0.310 secs (594 bytes/sec)

* 1. Configure basic switch parameters.

Configure an IP address on the management VLAN according to the diagram. VLAN 1 is the default management VLAN, but following best practice, we will use a different VLAN. In this case, VLAN 99.

Enter basic configuration commands on each switch according to the diagram.

DLS1 example:

DLS1# **configure terminal**

Enter configuration commands, one per line. End with CNTL/Z.

DLS1(config)# **interface vlan 99**

DLS1(config-if)# **ip address 172.16.99.1 255.255.255.0**

DLS1(config-if)# **no shutdown**

The interface VLAN 99 will not come up immediately, because the Layer 2 instance of the VLAN does not yet exist. This issue will be remedied in subsequent steps

(Optional) On each switch, create an enable secret password and configure the VTY lines to allow remote access from other network devices.

DLS1 example:

DLS1(config)# **enable secret class**

DLS1(config)# **line vty 0 15**

DLS1(config-line)# **password cisco**

DLS1(config-line)# **login**

**Note**: The passwords configured here are required for NETLAB compatibility only and are NOT recommended for use in a live environment.

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| **Note(2)**: For purely lab environment purposes, it is possible to configure the VTY lines so that they accept any Telnet connection immediately, without asking for a password, and place the user into the privileged EXEC mode directly. The configuration would be similar to the following example for DLS1:  DLS1(config)# **enable secret class**  DLS1(config)# **line vty 0 15**  DLS1(config-line)# **no login**  DLS1(config-line)# **privilege level 15** |

1. Configure default gateways on the access layer switches ALS1 and ALS2. The distribution layer switches will not use a default gateway because they are Layer 3 devices. The access layer switches are Layer 2 devices and need a default gateway to send management VLAN traffic off of the local subnet for the management VLAN. \*\*The HSRP virtual IP address 172.16.99.5 will be configured in subsequent steps.

ALS1(config)# **ip default-gateway 172.16.99.5**

**\*See note above**

Step 4: Configure trunks and EtherChannels between switches.

EtherChannel is used for the trunks because it allows you to utilize both Fast Ethernet interfaces that are available between each device, thereby doubling the bandwidth.

**Note**: It is good practice to shut down the interfaces on both sides of the link before a port channel is created and then re-enable them after the port channel is configured.

1. Configure trunks and EtherChannels from DLS1 and DLS2 to the other three switches according to the diagram. The switchport trunk encapsulation {isl | dot1q} command is used because these switches also support ISL encapsulation. A sample configuration is provided. Not all of the commands listed below will be used on all devices. Repeat and reference chapter 2 labs if you still are having difficulty with implementing trunking between devices.

DLS1(config)# **interface range fastEthernet 0/x - x**

DLS1(config-if-range)# **switchport trunk encapsulation dot1q**

DLS1(config-if-range)# **switchport mode trunk**

DLS1(config-if-range)# **channel-group x mode desirable**

DLS1(config-if-range)# **no shut**

Creating a port-channel interface Port-channel x

Note: Repeat configurations on the other three switches.

1. Verify trunking between DLS1, ALS1, and ALS2 using the show interface trunk command on all switches.
2. Verify the EtherChannel configuration
3. Which EtherChannel negotiation protocol is in use here?

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Step 5: Configure VTP on DLS2, ALS1 and ALS2.

1. Change the VTP mode of ALS1 and ALS2 to client and VTP modes of DLS2 to *server*. A sample configuration is provided.

**ALS1(config)# vtp mode client**

Setting device to VTP CLIENT mode for VLANS.

1. Verify the VTP changes.

Step 6: Configure VTP on DLS1 and create VLANs.

1. Create the VTP domain on VTP server DLS1 and create VLANs 10, 20, 30, 40 and 99 for the domain.

NOTE: Switches default to vtp mode server. However, remember the base configuration modifies this setting to vtp mode transparent.

**DLS1(config)# vtp domain SWLAB**

**DLS1(config)# vtp version 2**

**DLS1(config)#vtp mode server**

**Setting device to VTP Server mode for VLANS**

DLS1(config)# **vlan 10**

DLS1(config-vlan)# **name Finance**

DLS1(config-vlan)# **vlan 20**

DLS1(config-vlan)# **name Engineering**

DLS1(config-vlan)# **vlan 30**

DLS1(config-vlan)# **name Server-Farm1**

DLS1(config-vlan)# **vlan 40**

DLS1(config-vlan)# **name Server-Farm2**

DLS1(config-vlan)# **vlan 99**

DLS1(config-vlan)# **name Management**

Verify VLAN propagation across the SWLAB domain**.**

Step 7: Configure access ports.

1. Configure the host ports of all four switches. The following commands configure the switch port mode as access, place the port in the proper VLANs, and turn on spanning-tree PortFast for the ports. A sample configuration is provided for you.
2. Configure PC’s with the IP addresses shown in the topology diagram. Use the address ending in .5 as the gateway address for the respective VLANs.

DLS2(config)# **interface fastEthernet 0/6**

DLS2(config-if)# **switchport mode access**

DLS2(config-if)# **switchport access vlan 40**

DLS2(config-if)# **spanning-tree portfast**

DLS2(config-if)# **no shutdown**

1. Ping from the host on VLAN 10 to the host on VLAN 40. The ping should fail.

Are these results expected at this point? Why?

**Note**: The **switchport host** command can be used to configure individual access ports. This command automatically activates access mode, PortFast, and removes all associations of the physical switch port with the port-channel interfaces (if there are any).

Step 8: Configure HSRP interfaces and enable routing.

HSRP provides redundancy in the network. The VLANs can be load-balanced by using the standby group priority priority command. The ip routing command is used on DLS1 and DLS2 to activate routing capabilities on these Layer 3 switches.

Each route processor can route between the various SVIs configured on its switch. In addition to the real IP address assigned to each distribution switch SVI, assign a third IP address in each subnet to be used as a virtual gateway address. HSRP negotiates and determines which switch accepts information forwarded to the virtual gateway IP address.

The standby command configures the IP address of the virtual gateway, sets the priority for each VLAN, and configures the router for preempt. Preemption allows the router with the higher priority to become the active router after a network failure has been resolved. Notice that hsrp is not used in the command syntax to implement HSRP.

In the following configurations, the priority for VLANs 10, 20, and 99 is 150 on DLS1, making it the active router for those VLANs. VLANs 30 and 40 have a default priority of 100 on DLS1, making DLS1 the standby router for these VLANs. DLS2 is configured to be the active router for VLANs 30 and 40 with a priority of 150, and the standby router for VLANs 10, 20, and 99 with a default priority of 100.

Note: It is recommended that the HSRP group number be mapped to VLAN number.

DLS1(config)# **ip routing**

DLS1(config)# **interface loopback 200**

DLS1(config-if)#ip address 209.165.200.254 255.255.255.0

**\*NOTE: This loopback is used only for the purpose of testing HSRP state changes. Both DLS1 and DLS2 will have this loopback configured**.

DLS1(config)# **interface vlan 99**

DLS1(config-if)# **standby 99 ip 172.16 99.5**

DLS1(config-if)# **standby 99 preempt**

DLS1(config-if)# **standby 99 priority 110**

DLS1(config-if)# **exit**

DLS1(config)# **interface vlan 10**

DLS1(config-if)# **ip address 172.16.10.1 255.255.255.0**

DLS1(config-if)# **standby 10 ip 172.16.10.5**

DLS1(config-if)# **standby 10 preempt**

DLS1(config-if)# **standby 10 priority 110**

DLS1(config-if)# **exit**

DLS1(config)# **interface vlan 20**

DLS1(config-if)# **ip address 172.16.20.1 255.255.255.0**

DLS1(config-if)# **standby 20 ip 172.16.20.5**

DLS1(config-if)# **standby 20 preempt**

DLS1(config-if)# **standby 20 priority 110**

DLS1(config-if)# **exit**

DLS1(config)# **interface vlan 30**

DLS1(config-if)# **ip address 172.16.30.1 255.255.255.0**

DLS1(config-if)# **standby 30 ip 172.16.30.5**

DLS1(config-if)# **standby 30 preempt**

DLS1(config-if)# **exit**

**\*NOTE: When the priority command is not present on the L3 interface, the HSRP priority value defaults to 100.**

DLS1(config)# **interface vlan 40**

DLS1(config-if)# **ip address 172.16.40.1 255.255.255.0**

DLS1(config-if)# **standby 40 ip 172.16.40.5**

DLS1(config-if)# **standby 40 preempt**

DLS2(config)# **ip routing**

**DLS1(config)# interface loopback 200**

**DLS1(config-if)#ip address 209.165.200.254 255.255.255.0**

**\*NOTE: This loopback is used only for the purpose of testing HSRP state changes. Both DLS1 and DLS2 will have this loopback configured**.

DLS2(config)# **interface vlan 99**

DLS2(config-if)# **standby 99 ip 172.16.99.5**

DLS2(config-if)# **standby 99 preempt**

DLS2(config-if)# **exit**

DLS2(config)# **interface vlan 10**

DLS2(config-if)# **ip address 172.16.10.2 255.255.255.0**

DLS2(config-if)# **standby 10 ip 172.16.10.5**

DLS2(config-if)# **standby 10 preempt**

DLS2(config-if)# **exit**

DLS2(config)# **interface vlan 20**

DLS2(config-if)# **ip address 172.16.20.2 255.255.255.0**

DLS2(config-if)# **standby 20 ip 172.16.20.5**

DLS2(config-if)# **standby 20 preempt**

DLS2(config-if)# **exit**

DLS2(config)# **interface vlan 30**

DLS2(config-if)# **ip address 172.16.30.2 255.255.255.0**

DLS2(config-if)# **standby 30 ip 172.16.30.5**

DLS2(config-if)# **standby 30 preempt**

DLS2(config-if)# **standby 30 priority 110**

DLS2(config-if)# **exit**

DLS2(config)# **interface vlan 40**

DLS2(config-if)# **ip address 172.16.40.2 255.255.255.0**

DLS2(config-if)# **standby 40 ip 172.16.40.5**

DLS2(config-if)# **standby 40 preempt**

DLS2(config-if)# **standby 40 priority 110**

From PC-A (VLAN 10) ping the HSRP virtual gateway address of 172.16.10.5.

C:\>ping 172.16.10.5

Pinging 172.16.10.5 with 32 bytes of data:

Reply from 172.16.10.5: bytes=32 time=1ms TTL=127

Reply from 172.16.10.5: bytes=32 time<1ms TTL=127

Reply from 172.16.10.5: bytes=32 time=1ms TTL=127

Reply from 172.16.10.5: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.10.5:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 1ms, Average = 0ms

Now, issue a continuous ping using the –t option to the loopback interface 209.165.200.254. The following is from the Payroll host (VLAN 10) to the 209.165.200.254 destination. This continuous ping will be used to analyze the loss of connectivity experienced as result HSRP failover demonstration in coming in future steps.

C:\>ping 209.165.200.254 -t

Pinging 209.165.200.254 with 32 bytes of data:

Reply from 209.165.200.254: bytes=32 time=1ms TTL=127

Reply from 209.165.200.254: bytes=32 time<1ms TTL=127

Reply from 209.165.200.254: bytes=32 time=1ms TTL=127

Reply from 209.165.200.254: bytes=32 time<1ms TTL=127

Ping statistics for 209.165.200.254:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 1ms, Average = 0ms

Step 9: Verify the HSRP configuration.

In the output below, the last two digits (XX) in the MAC address (0000.0c07.acXX) correspond with the HSRP group number. The MAC address is 0000.0c07.ac0a. The last two hexadecimal digits are 0a. These equate to decimal # 10. Our HSRP configuration is group 10.

1. Issue the show standby command on both DLS1 and DLS2.

DLS1#sh standby

Vlan10 - Group 10

State is Active

2 state changes, last state change 00:10:11

Virtual IP address is 172.16.10.5

Active virtual MAC address is 0000.0c07.ac0a <-

Local virtual MAC address is 0000.0c07.ac0a (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 1.872 secs

Preemption enabled

Active router is local

Standby router is 172.16.10.2, priority 100 (expires in 10.864 sec)

Priority 150 (configured 150) 🡨

Here is the priority value we used in the configuration.

Group name is "hsrp-Vl10-10" (default)

Vlan20 - Group 20

State is Active

2 state changes, last state change 00:07:28

Virtual IP address is 172.16.20.5

Active virtual MAC address is 0000.0c07.ac14

Local virtual MAC address is 0000.0c07.ac14 (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.432 secs

Preemption enabled

Active router is local

Standby router is 172.16.20.2, priority 100 (expires in 8.304 sec)

Priority 150 (configured 150)

Group name is "hsrp-Vl20-20" (default)

Vlan30 - Group 30

State is Standby

4 state changes, last state change 00:02:22

Virtual IP address is 172.16.30.5

Active virtual MAC address is 0000.0c07.ac1e

Local virtual MAC address is 0000.0c07.ac1e (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 2.320 secs

Preemption enabled

Active router is 172.16.30.2, priority 150 (expires in 9.104 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-Vl30-30" (default)

Vlan40 - Group 40

State is Standby

4 state changes, last state change 00:01:35

Virtual IP address is 172.16.40.5

Active virtual MAC address is 0000.0c07.ac28

Local virtual MAC address is 0000.0c07.ac28 (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.016 secs

Preemption disabled

Active router is 172.16.40.2, priority 150 (expires in 8.400 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-Vl40-40" (default)

Vlan99 - Group 99

State is Active

2 state changes, last state change 00:10:49

Virtual IP address is 172.16.99.5

Active virtual MAC address is 0000.0c07.ac63

Local virtual MAC address is 0000.0c07.ac63 (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 1.648 secs

Preemption enabled

Active router is local

Standby router is 172.16.99.2, priority 100 (expires in 9.008 sec)

Priority 150 (configured 150)

Group name is "hsrp-Vl99-99" (default)

DLS2#sh stand

Vlan10 - Group 10

State is Standby

1 state change, last state change 00:04:26

Virtual IP address is 172.16.10.5

Active virtual MAC address is 0000.0c07.ac0a

Local virtual MAC address is 0000.0c07.ac0a (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 2.528 secs

Preemption enabled

Active router is 172.16.10.1, priority 150 (expires in 10.624 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-Vl10-10" (default)

Vlan20 - Group 20

State is Standby

1 state change, last state change 00:03:57

Virtual IP address is 172.16.20.5

Active virtual MAC address is 0000.0c07.ac14

Local virtual MAC address is 0000.0c07.ac14 (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 1.280 secs

Preemption enabled

Active router is 172.16.20.1, priority 150 (expires in 8.256 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-Vl20-20" (default)

Vlan30 - Group 30

State is Active

1 state change, last state change 00:03:32

Virtual IP address is 172.16.30.5

Active virtual MAC address is 0000.0c07.ac1e

Local virtual MAC address is 0000.0c07.ac1e (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.352 secs

Preemption enabled

Active router is local

Standby router is 172.16.30.1, priority 100 (expires in 8.448 sec)

Priority 150 (configured 150)

Group name is "hsrp-Vl30-30" (default)

Vlan40 - Group 40

State is Active

1 state change, last state change 00:02:44

Virtual IP address is 172.16.40.5

Active virtual MAC address is 0000.0c07.ac28

Local virtual MAC address is 0000.0c07.ac28 (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.752 secs

Preemption enabled

Active router is local

Standby router is 172.16.40.1, priority 100 (expires in 10.064 sec)

Priority 150 (configured 150)

Group name is "hsrp-Vl40-40" (default)

Vlan99 - Group 99

State is Standby

1 state change, last state change 00:04:58

Virtual IP address is 172.16.99.5

Active virtual MAC address is 0000.0c07.ac63

Local virtual MAC address is 0000.0c07.ac63 (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.128 secs

Preemption enabled

Active router is 172.16.99.1, priority 150 (expires in 9.120 sec)

Standby router is local

Priority 100 (default 100)

Group name is "hsrp-Vl99-99" (default)

1. Issue the show standby brief command on both DLS1 and DLS2.

DLS1#sh stand bri

P indicates configured to preempt.

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Interface Grp Pri P State Active Standby Virtual IP

Vl10 10 150 P Active local 172.16.10.2 172.16.10.5

Vl20 20 150 P Active local 172.16.20.2 172.16.20.5

Vl30 30 100 P Standby 172.16.30.2 local 172.16.30.5

Vl40 40 100 Standby 172.16.40.2 local 172.16.40.5

Vl99 99 150 P Active local 172.16.99.2 172.16.99.5

DLS2#sh stand bri

P indicates configured to preempt.

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Interface Grp Pri P State Active Standby Virtual IP

Vl10 10 100 P Standby 172.16.10.1 local 172.16.10.5

Vl20 20 100 P Standby 172.16.20.1 local 172.16.20.5

Vl30 30 150 P Active local 172.16.30.1 172.16.30.5

Vl40 40 150 P Active local 172.16.40.1 172.16.40.5

Vl99 99 100 P Standby 172.16.99.1 local 172.16.99.5

Which router is the active router for VLANs 10, 20, and 99? Which is the active router for 30 and 40?

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What is the default hello time for each VLAN? What is the default hold time?

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How is the active HSRP router selected?

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1. Use the show ip route command to verify routing on both DLS1 and DLS2.

DLS1# **show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 10 subnets, 2 masks

C 172.16.1.0/24 is directly connected, Vlan1

L 172.16.1.3/32 is directly connected, Vlan1

C 172.16.10.0/24 is directly connected, Vlan10

L 172.16.10.3/32 is directly connected, Vlan10

C 172.16.20.0/24 is directly connected, Vlan20

L 172.16.20.3/32 is directly connected, Vlan20

C 172.16.30.0/24 is directly connected, Vlan30

L 172.16.30.3/32 is directly connected, Vlan30

C 172.16.40.0/24 is directly connected, Vlan40

L 172.16.40.3/32 is directly connected, Vlan40

Step 10: Verify connectivity between VLANs.

Verify connectivity between VLANs using the ping command with a –t option from the SQL Server (VLAN 40) to the other hosts and servers on the network. Keep the ping running to evaluate loss of connectivity that will occur in Step 11.

The following is from the SQL Server (VLAN 40) to the 209.165.200.254 address.

C:\>**ping 209.165.200.254 -t**

Pinging 209.165.200.254 with 32 bytes of data:

Reply from 209.165.200.254: bytes=32 time=1ms TTL=127

Reply from 209.165.200.254: bytes=32 time<1ms TTL=127

Reply from 209.165.200.254: bytes=32 time=1ms TTL=127

Reply from 209.165.200.254: bytes=32 time<1ms TTL=127

Ping statistics for 209.165.200.254:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 1ms, Average = 0ms

Step 11: Verify HSRP functionally.

1. Verify HSRP by disconnecting the trunks to DLS2. You can simulate this using the shutdown command on those interfaces.

DLS2(config)# **interface range fastEthernet 0/7 - 12**

DLS2(config-if-range)# **shutdown**

Output to the console at DLS1 should reflect DLS1 becoming the active router for VLANs 30 and 40.

1. Verify that DLS1 is acting as the backup default gateway for VLANs 30 and 40 using the **show standby brief** command. DLS1 is now the active HSRP router for all VLANs and the standby router is unknown.

DLS1#sh stand bri

P indicates configured to preempt.

|

Interface Grp Pri P State Active Standby Virtual IP

Vl10 10 150 P Active local unknown 172.16.10.5

Vl20 20 150 P Active local unknown 172.16.20.5

Vl30 30 100 P Active local unknown 172.16.30.5

Vl40 40 100 Active local unknown 172.16.40.5

Vl99 99 150 P Active local unknown 172.16.99.5

Repeat this process by bringing up the DLS2 trunks and shutting down the DLS1 interfaces. Use the show standby brief command to see the results.

**Note**: If both DLS1 and DLS2 have links to the Internet, failure of either switch will cause HSRP to redirect packets to the other switch. The functioning switch will take over as the default gateway to provide virtually uninterrupted connectivity for hosts at the access layer.

**Go back to the payroll and SQL clients that we issued the continuous pings on in earlier steps**. The ping should still be running to the 209.165.200.254 destination address. Evaluate the loss of connectivity the payroll client experienced during the HSRP state change. The users experience minimal service disruption as a result of the HSRP state change.

**Step 12: Apply HSRP authentication using MD5.**

Now that we have successfully implemented default gateway redundancy in our network, we should think about securing the HSRP communication between member devices. HSRP authentication prevents rogue routers on the network from joining the HSRP group. Without authentication a rogue router could join the group and claim the active role. The attacker would then be able to capture all the track forwarded to attacker’s device. HSRP authentication can be configured using plain text or MD5. MD5 is the preferred method. Using MD5 key, a hash is calculated on HSRP messages.

DLS1(config)# **int vlan 10**

DLS1(config-if)# **standby 10 authentication ?**

**WORD Plain text authentication string (8 chars max)**

**md5 Use MD5 authentication**

**text Plain text authentication**

DLS1(config-if)# **standby 10 authentication md5 ?**

**key-chain Set key chain**

**key-string Set key string**

With MD5 authentication, you can choose between a configuration using the key string or a key chain. Key chains offer more options and security because you can have lifetime parameters associated with the different keys. In this lab, we will be configuring HSRP authentication using the key string option.

DLS1(config-if)# **standby 10 authentication md5 key-string ?**

**0 Specifies an UNENCRYPTED key string will follow**

**7 Specifies a HIDDEN key string will follow**

**WORD Key string (64 chars max)**

DLS1(config-if)# **standby 10 authentication md5 key-string cisco123**

**\*Mar 1 22:22:34.315: %HSRP-4-BADAUTH: Bad authentication from 172.16.10.2, group 10, remote state Active**

Notice as soon as this command was entered on DLS1 that we received a “bad authentication” message display to the console screen. HSRP authentication is not yet configured on DLS2 therefore we expect for the HSRP process to be disrupted. The output of the **show standby brief** command below confirms that DLS2 is no longer the standby router for group 10. The standby router shows *unknown*.

DLS1# **sh stand bri**

**P indicates configured to preempt.**

**|**

**Interface Grp Pri P State Active Standby Virtual IP**

**Vl10 10 110 P Active local unknown 172.16.10.5**

**Vl20 20 110 P Active local 172.16.20.2 172.16.20.5**

**Vl30 30 100 P Standby 172.16.30.2 local 172.16.30.5**

**Vl40 40 100 Standby 172.16.40.2 local 172.16.40.5**

**Vl99 99 110 P Active local 172.16.99.2 172.16.99.5**

Now configure HSRP authentication for interface VLAN 10 on DLS2.

DLS2(config-if)# **standby 10 authentication md5 key-string cisco123**

**\*Mar 1 22:24:04.165: %HSRP-5-STATECHANGE: Vlan10 Grp 10 state Active -> Speak**

**\*Mar 1 22:24:14.349: %HSRP-5-STATECHANGE: Vlan10 Grp 10 state Speak -> Standby**

Refer to the above output. Once the hsrp authentication with the correct key string were added to DLS2, the hsrp state changed.

Verify the HSRP status of VLAN 10 on DLS1 and DLS2. DLS1 should be the active router for VLAN 10 while DLS2 is the standby.

DLS1# **sh stand bri**

**P indicates configured to preempt.**

**|**

**Interface Grp Pri P State Active Standby Virtual IP**

**Vl10 10 110 P Active local 172.16.10.2 172.16.10.5**

**Vl20 20 110 P Active local 172.16.20.2 172.16.20.5**

**Vl30 30 100 P Standby 172.16.30.2 local 172.16.30.5**

**Vl40 40 100 Standby 172.16.40.2 local 172.16.40.5**

**Vl99 99 110 P Active local 172.16.99.2 172.16.99.5**

Continue configuring HSRP authentication on the remaining HSRP groups used in this lab scenario.

**CHALLENGE:**

On one of the groups, implement HSRP authentication using a key chain instead of a key string.

**Step 12: Configure HSRP interface tracking.**

Interface tracking enables the priority of a standby group router to be automatically adjusted, based on the availability of the router interfaces. When a tracked interface becomes unavailable, the HSRP priority of the router is decreased. When properly configured, the HSRP tracking features ensures that a router with an unavailable key interface will relinquish the active router role.

Refer to the network topology, we will track availability to the 209.165.200.254 destination. Loopback 200 is configured with this destination and is used for testing HSRP interface tracking concepts.

HSRP can perform object and interface tracking. Configure an IP SLA reachability test on DLS1. Also create an object that tracks this SLA test. HSRP will then be configured to track this object and decrease the priority by a value that will cause an HSRP state change.

DLS1# **conf t**

DLS1(config)# **ip sla 10**

DLS1(config-ip-sla)# **icmp-echo 209.165.200.254**

DLS1(config-ip-sla-echo)# **frequency 5**

DLS1(config-ip-sla-echo)# **ip sla schedule 10 life forever start-time now**

DLS1(config)# **track 100 ip sla 10**

DLS1(config)# **int vlan 10**

DLS1(config-if)# **standby 10 track 100 decrement 30**

DLS1(config-if)# **exit**

Verify SLA configuration using the **show ip sla configuration** and the **show ip sla statistics** command.

Verify HSRP tracking configuration using the **show standby** command.

To test the HSRP tracked object, shutdown the loopback 200 interface. Notice the messages displayed to console screen concerning the tracked object 10. More significantly, notice the HSRP state change that happened as a result of the failure of the SLA test.

DLS1(config)# **int lo 200**

DLS1(config-if)# **shut**

\*Mar 1 23:29:32.072: %TRACKING-5-STATE: 1 interface Lo200 line-protocol Up->Down

\*Mar 1 23:29:34.077: %LINK-5-CHANGED: Interface Loopback200, changed state to administratively down

\*Mar 1 23:29:35.084: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback200, changed state to down

\*Mar 1 23:29:43.707: %TRACKING-5-STATE: 100 ip sla 10 state Up->Down

\*Mar 1 23:29:46.207: %HSRP-5-STATECHANGE: Vlan10 Grp 10 state Active -> Speak

\*Mar 1 23:29:57.691: %HSRP-5-STATECHANGE: Vlan10 Grp 10 state Speak -> Standby

Issue the show standby vlan 10 on DLS1 command to view how the new priority value.

DLS1# **sh stand vlan 10**

Vlan10 - Group 10

State is Standby

4 state changes, last state change 01:33:49

Virtual IP address is 172.16.10.5

Active virtual MAC address is 0000.0c07.ac0a

Local virtual MAC address is 0000.0c07.ac0a (v1 default)

Hello time 3 sec, hold time 10 sec

Next hello sent in 0.752 secs

Authentication MD5, key-string

Preemption enabled

Active router is 172.16.10.2, priority 100 (expires in 9.488 sec)

Standby router is local

Priority 80 (configured 110)

Track object 100 state Down decrement 30

Group name is "hsrp-Vl10-10" (default)

**Phase 2: Remove HSRP configurations and Implement VRRP**.

Background: Your company is merging with another company that does not have all Cisco devices employed in their campus network. As a result, you need to change your choice in first hop redundancy protocols from a proprietary solution to an industry standard solution. In preparation for the next phase of this lab, remove all HSRP configurations. The commands can be removed by issuing the command **no standby x** command on the switched virtual interface (SVI).

In the next phase of this lab, we will use the Virtual Router Redundancy Protocol (VRRP). Virtual Router Redundancy Protocol (VRRP) is an industry standard protocol that has many similarities to HSRP. HSRP elects an active and standby router to participate in the HSRP process. VRRP elects a Master and Backup. Although referred to by different names, the operational concepts of the VRRP master and backup are likened unto the HSRP active and standby respectively. HSRP operation requires the use of a virtual router IP address. VRRP also requires the use of a virtual router IP address, but it can use an address in use on the device. If a device owns the configured IP address, then it automatically assumes the Master role and ignores the priority value in its role election process. Recall that is what necessary to configure HSRP routers with the preempt option. VRRP uses preempt by default. The next lab will demonstrate the commands necessary to run VRRP in a campus switched network.

**Step 12: Implement VRRP on DLS1 and DLS2**.

Assign the VRRP protocol to the switched virtual interfaces. **DLS1** should be the **master for VLANs 10, 20, and 99**. **DLS2** should be the **master** for **VLANs 30 and 40**. The priority values *default* to 100. A higher priority is preferred. One of the noteworthy differences in HSRP and VRRP operation is that VRRP virtual ip address can be set to an IP address that is actually configured and in use on your devices. If you set the virtual IP address to an IP that is in use, then VRRP ignores the priority values sent in VRRP messages and automatically chooses the router that owns the IP to be the master.

DLS2(config)# **interface Vlan10**

DLS2(config-if)# **ip address 172.16.10.1 255.255.255.0**

DLS2(config-if)# **vrrp 10 ip 172.16.10.5**

DLS2(config-if)# **vrrp 10 priority 150**

\*Only use the **vrrp x priority** command on the interfaces in which you desire this switch to be the master forwarder.

Repeat these commands as necessary to implement vrrp on all SVIs on DLS1 and DLS2 switches.

Verify VRRP operation using the following show commands: **show vrrp**. Ensure DLS1 is the master for VLANs 10, 20 and 99 and backup for VLANs 30 and 40. DLS2 should be the master for VLANs 30 and 40 and backup for VLANs 10, 20, and 99.

DLS1# **show vrrp**

Vlan10 - Group 10

State is Master

Virtual IP address is 172.16.10.5

Virtual MAC address is 0000.5e00.010a

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 150

Master Router is 172.16.10.1 (local), priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.414 sec

Vlan20 - Group 20

State is Master

Virtual IP address is 172.16.20.5

Virtual MAC address is 0000.5e00.0114

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 150

Master Router is 172.16.20.1 (local), priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.414 sec

Vlan30 - Group 30

State is Backup

Virtual IP address is 172.16.30.5

Virtual MAC address is 0000.5e00.011e

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 100

Master Router is 172.16.30.2, priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.609 sec (expires in 3.475 sec)

Vlan40 - Group 40

State is Backup

Virtual IP address is 172.16.40.5

Virtual MAC address is 0000.5e00.0128

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 100

Master Router is 172.16.40.2, priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.609 sec (expires in 2.930 sec)

Vlan99 - Group 99

State is Master

Virtual IP address is 172.16.99.5

Virtual MAC address is 0000.5e00.0163

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 150

Master Router is 172.16.99.1 (local), priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.414 sec

View the show vrrp output on DLS2.

DLS2# **sh vrrp**

Vlan10 - Group 10

State is Backup

Virtual IP address is 172.16.10.5

Virtual MAC address is 0000.5e00.010a

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 100

Master Router is 172.16.10.1, priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.609 sec (expires in 3.097 sec)

Vlan20 - Group 20

State is Backup

Virtual IP address is 172.16.20.5

Virtual MAC address is 0000.5e00.0114

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 100

Master Router is 172.16.20.1, priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.609 sec (expires in 2.736 sec)

Vlan30 - Group 30

State is Master

Virtual IP address is 172.16.30.5

Virtual MAC address is 0000.5e00.011e

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 150

Master Router is 172.16.30.2 (local), priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.414 sec

Vlan40 - Group 40

State is Master

Virtual IP address is 172.16.40.5

Virtual MAC address is 0000.5e00.0128

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 150

Master Router is 172.16.40.2 (local), priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.414 sec

Vlan99 - Group 99

State is Backup

Virtual IP address is 172.16.99.5

Virtual MAC address is 0000.5e00.0163

Advertisement interval is 1.000 sec

Preemption enabled

Priority is 100

Master Router is 172.16.99.1, priority is 150

Master Advertisement interval is 1.000 sec

Master Down interval is 3.609 sec (expires in 3.206 sec)

You can also use the **show vrrp brief** command to view a summary of the VRRP configuration.

DLS1# **show vrrp brief**

Interface Grp Pri Time Own Pre State Master addr Group addr

Vl10 10 150 3414 Y Master 172.16.10.1 172.16.10.5

Vl20 20 150 3414 Y Master 172.16.20.1 172.16.20.5

Vl30 30 100 3609 Y Backup 172.16.30.2 172.16.30.5

Vl40 40 100 3609 Y Backup 172.16.40.2 172.16.40.5

Vl99 99 150 3414 Y Master 172.16.99.1 172.16.99.5

DLS2# **show vrrp brief**

Interface Grp Pri Time Own Pre State Master addr Group addr

Vl10 10 100 3609 Y Backup 172.16.10.1 172.16.10.5

Vl20 20 100 3609 Y Backup 172.16.20.1 172.16.20.5

Vl30 30 150 3414 Y Master 172.16.30.2 172.16.30.5

Vl40 40 150 3414 Y Master 172.16.40.2 172.16.40.5

Vl99 99 100 3609 Y Backup 172.16.99.1 172.16.99.5

**Step 12: Configure VRRP tracking.**

As you may recall from earlier configurations with HSRP, the HSRP protocol can perform interface tracking and object tracking. VRRP can only perform object tracking. As with the HSRP scenario, we are using the simulating connectivity to the 209.165.200.254 address in the cloud. Create an object that tracks the line protocol status of the interface loopback 200 with this address. Once the object is created, configure VRRP to track the object and to decrease the priority to a value that would cause a state change between the Master and Backup devices. Recall that we configured the priority values to 150 on the Master devices. The Backup devices priority defaults to 100. To cause the state change, we would need to decrease the priority by at least 60. A sample configuration is provided for you below.

DLS1(config)# **track 1 interface Loopback 200 line-protocol**

DLS1(config-if)# **vrrp 99 track 1 decrement 60**

**CHALLENGE:**

**Step 13: Alternative option for VRRP configuration**

* Remove the VRRP commands from the interfaces and implement VRRP using the actual IP addresses configured on the SVIs.

On DLS1, configure VRRP using the actual IP addresses on interfaces VLAN, 10, 20, and 99 as the virtual router IP. A sample configuration is provided for you below.

* Do not configure the VRRP priority.

DLS1(config)# **interface Vlan10**

DLS1(config-if)# **ip address 172.16.10.1 255.255.255.0**

DLS1(config-if)# **vrrp 10 ip 172.16.10.1**

* On DLS2, use the IP address on interfaces VLAN 30 and 40.

DLS2(config)# **interface Vlan10**

DLS2(config-if)# **ip address 172.16.10.2 255.255.255.0**

DLS2(config-if)# **vrrp 10 ip 172.16.10.2**

* Observe VRRP results. DLS1 should automatically become the Master for VLANs 10, 20, and 99 and Backup for VLANs 30 and 40.
* DLS2 should become the Master for VLANs 30 and 40 and become the backup for VLANs 10, 20, and 99.