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Lab 8: First Hop Redundancy - VRRP, HSRP, and GLBP

Purpose

The purpose of this lab is to set up three first hop redundancy protocols that assign addresses to virtual routers in case the physical router fails. These protocols are essentially "backup protocols" in case the network loses connectivity with the default gateway.

Background Information on lab concepts

Virtual Router Redundancy Protocol (VRRP): A protocol that automatically assigns IP addresses to virtual routers as backups for failures of the physical router. Unlike HSRP and GLBP, this protocol increases the availability and reliability of various router paths. In addition, this protocol creates virtual routers that represent different routers on a network. When this protocol is implemented the default gateway is assigned to a virtual router IP address instead of a physical one; therefore, if this virtual interface fails, another physical or virtual router is selected to replace the one that failed. To summarize, VRRP is simply a protocol that creates backups for the physical router.

Hot Standby Router Protocol (HSRP): A Cisco proprietary redundancy protocol that not only converges quickly with other routing protocols like EIGRP and OSPF but also serves to overcome default gateway failures. Unlike VRRP and GLBP, HSRP is not a routing protocol, for it does not impact the routing table. It also uses multicast packets to set priorities and allows the router with the highest priority to act as the primary virtual router that can respond to ARP requests. If the virtual router with the highest priority fails, the virtual router with the second highest priority takes over the function of its precedent. The default local multicast address for HSRP version 1 is 224.0.0.2, 224.0.0.102 for version 2.

Gateway Load Balancing Protocol (GLBP): A Cisco proprietary protocol that adds a loading balancing feature in order to overcome the difficulties of previous redundant router protocol. This protocol establishes a weighting parameter that organizes how ARP requests will be answered. It also elects an Active Virtual Gateway (AVG) per GLBP group. Typically, there are three types of virtual states that a group can be in: the Standby state for the second best AVG and the Listening state for the rest of the groups. A virtual MAC address is assigned to each member of the GLBP group. The default local multicast address for GLBP routers is 224.0.0.102.

NOTE: The default priority for all three protocols is 100. This is one of the reasons why I chose to put priority numbers higher than 100 in my configurations section.

Lab Summary

VRRP

1. Connect the host and the two routers to the switch. One router will act as the primary default gateway, and the other as backup.
2. Issue the command *vrrp [group-number] ip [virtual ip address]* on both routers. Make sure that the group number and the virtual IP address are the same for both routers.
3. Set a priority on the interface by issuing the command *vrrp [group-number] preempt* and then *vrrp [group-number] priority.* This former will allow preemption, and the latter will set a priority. Remember that if preemption has been enabled while the main default gateway (primary router) fails, the router with the highest priority will become the main primary default gateway. For testing priority, I configured priorities higher than 100 (default) on both routers.
4. Make sure that the end devices have established connectivity by opening command prompt and request a continuous ping. Pull one of the straight-through cables that connect a router to a switch. The ping request will fail for a couple packets but will soon be established.
5. When connectivity is fully established, it is safe to assume that VRRP is working properly.

HSRP

Repeat steps 1-5 of VRRP, but instead of typing *vrrp* in front of *[group-number] ip [virtual ip address],* type *standby.*

GLBP

Repeat steps 1-5 of VRRP, but instead of typing *vrrp* in front of *[group-number] ip [virtual ip address],* type *glbp.*

Lab Commands

Command for VRRP

Router (config-if)# *vrrp [group-number] ip [virtual ip address]*	Enables VRRP by assigning a secondary IP address to the virtual router.
Router (config-if)# *vrrp [group-number] preempt*	Enables preemption on the router.
Router (config-if)# *vrrp [group-number] priority*	Sets a priority on the interface.

Command for HSRP

Router (config-if)# *standby [group-number] ip [virtual ip address]*	Enables HSRP by assigning a secondary IP address to the virtual router.
Router (config-if)# *standby [group-number] preempt*	Enables preemption on the router.
Router (config-if)# *standby [group-number] priority*	Sets a priority on the interface.

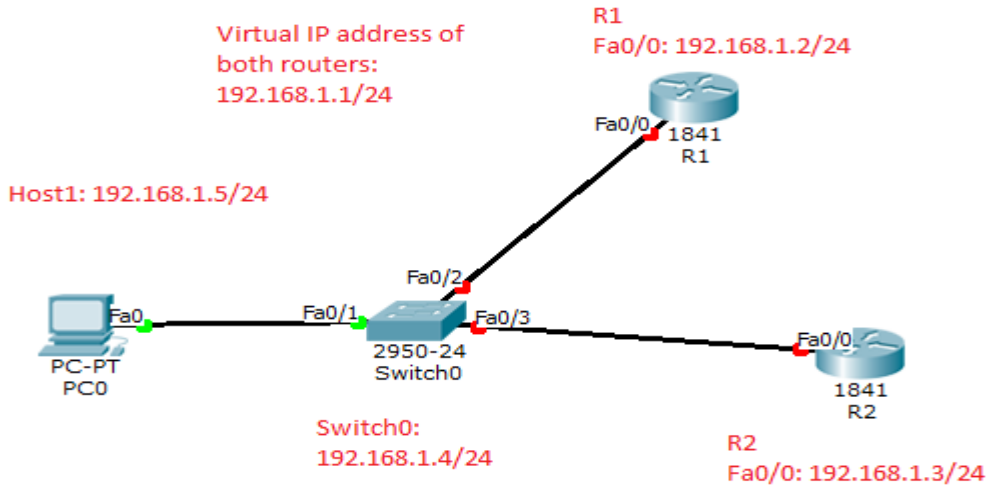
Command for GLBP

Router (config-if)# *glbp [group-number] ip*	Enables GLBP by assigning a secondary IP

[virtual ip address]	address to the virtual router.
Router (config-if)# *glbp [group-number] preempt*	Enables preemption on the router.
Router (config-if)# *glbp [group-number] priority*	Sets a priority on the interface.

Network Diagram with IP's

For all three routing protocols, the following diagram was used:



Configurations

VRRP

Show run on R1

```
R1#sh run
Building configuration...

Current configuration : 1472 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 10
!
no ipv6 cef
ip source-route
ip cef
!
!
!
!
no ip domain lookup
multilink bundle-name authenticated
!
!
crypto pki token default removal
timeout 0
!
interface GigabitEthernet0/0
 ip address 192.168.1.2 255.255.255.0
 duplex auto
 speed auto
 vrrp 1 ip 192.168.1.1
 vrrp 1 priority 102
!
line con 0
 password cisco
 login
line aux 0
line vty 0 4
 password cisco
 login
 transport input all
```

```
!
scheduler allocate 20000 1000
end
```

Show run on R2

```
R2#sh run
Building configuration...

Current configuration : 941 bytes
!
! Last configuration change at 16:16:28
UTC Thu Feb 27 2014
!
version 15.0
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
memory-size iomem 10
!
ip source-route
!
!
ip cef
!
!
no ip domain lookup
multilink bundle-name authenticated
!
!
!
license udi pid CISCO2811 sn
FTX1508AJ0X
!
!
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.1.3 255.255.255.0
 duplex auto
 speed auto
 vrrp 1 ip 192.168.1.1
 vrrp 1 priority 101
!
!
line con 0
line aux 0
line vty 0 4
 no login
!
scheduler allocate 20000 1000
end
```

HSRP

Show run on R1

```
R1#sh run
Building configuration...

Current configuration : 1205 bytes
!
! Last configuration change at 16:24:07
UTC Thu Feb 27 2014
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
!
!
!
!
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 ip address 192.168.1.2 255.255.255.0
 standby 1 ip 192.168.1.1
 standby 1 priority 102
 standby 1 preempt
 duplex auto
 speed auto
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
!
!
control-plane
!
!
!
line con 0
line aux 0
line vty 0 4
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Show run on R2

```
R2#sh run
Building configuration...

Current configuration : 1343 bytes
!
```

```
! Last configuration change at 16:33:41
UTC Thu Feb 27 2014
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 ip address 192.168.1.3 255.255.255.0
 standby 1 ip 192.168.1.1
 standby 1 priority 101
 standby 1 preempt
 duplex auto
 speed auto
!

line con 0
line aux 0
line vty 0 4
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

GLBP

Show run on R1

```
R1#sh run
Current configuration : 1183 bytes
!
version 12.4
service timestamps debug datetime msec
```

```
R2#sh run
Current configuration : 1564 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
logging message-counter syslog
!
no aaa new-model
memory-size iomem 10
no network-clock-participate slot 1
!
!
!
!
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.1.2 255.255.255.0
 duplex auto
 speed auto
 glbp 1 ip 192.168.1.1
 glbp 1 priority 102
 glbp 1 preempt
!
!
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
!
!
!
line con 0
line aux 0
line vty 0 4
 login
!
scheduler allocate 20000 1000
end
```

Show run on R2

```
!
!
interface FastEthernet0/0
 ip address 192.168.1.3 255.255.255.0
 duplex auto
 speed auto
 glbp 1 ip 192.168.1.1
 glbp 1 priority 101
 glbp 1 preempt
!
!
interface Vlan1
 no ip address
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
line con 0
line aux 0
line vty 0 4
 login
```

```
!
scheduler allocate 20000 1000
```

Show vrrp

```
R1#sh vrrp
GigabitEthernet0/0 - Group 1
  State is Master
  Virtual IP address is 192.168.1.1
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 102
  Master Router is 192.168.1.2 (local),
priority is 102
  Master Advertisement interval is
1.000 sec
  Master Down interval is 3.601 sec

R2#show vrrp
GigabitEthernet0/0 - Group 1
  State is Master
  Virtual IP address is 192.168.1.1
  Virtual MAC address is 0000.5e00.0101
  Advertisement interval is 1.000 sec
  Preemption enabled
  Priority is 101
  Master Router is 192.168.1.3 (local),
priority is 101
  Master Advertisement interval is
1.000 sec
  Master Down interval is 3.605 sec
```

Show standby

```
R1#show standby
GigabitEthernet0/0 - Group 1
  State is Speak
```

Show glbp

```
R1#sh glbp
FastEthernet0/0 - Group 1
  State is Active
    1 state change, last state change
00:01:57
  Virtual IP address is 192.168.1.1
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.416 secs
  Redirect time 600 sec, forwarder
timeout 14400 sec
  Preemption enabled, min delay 0 sec
  Active is local
  Standby is 192.168.1.3, priority 101
(expires in 9.504 sec)
  Priority 102 (configured)
  Weighting 100 (default 100),
thresholds: lower 1, upper 100
  Load balancing: round-robin
  Group members:
    0012.d974.b568 (192.168.1.3)
end

    3 state changes, last state change
00:01:37
  Virtual IP address is 192.168.1.1
  Active virtual MAC address is unknown
    Local virtual MAC address is
0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.904 secs
  Preemption enabled
  Active router is unknown
  Standby router is unknown
  Priority 102 (configured 102)
  Group name is "hsrp-Gi0/0-1"
(default)



R2#show standby
FastEthernet0/0 - Group 1
  State is Active
    5 state changes, last state change
00:00:18
  Virtual IP address is 192.168.1.1
  Active virtual MAC address is
0000.0c07.ac01
    Local virtual MAC address is
0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.768 secs
  Preemption enabled
  Active router is local
  Standby router is unknown
  Priority 101 (configured 101)
  Group name is "hsrp-Fa0/0-1"
(default)



    0022.900c.dd08 (192.168.1.2) local
  There are 2 forwarders (1 active)
  Forwarder 1
    State is Active
      1 state change, last state change
00:01:46
    MAC address is 0007.b400.0101
(default)
    Owner ID is 0022.900c.dd08
    Redirection enabled
    Preemption enabled, min delay 30
sec
    Active is local, weighting 100
    Client selection count: 4
  Forwarder 2
    State is Listen
    MAC address is 0007.b400.0102
(learnt)
    Owner ID is 0012.d974.b568
    Redirection enabled, 597.408 sec
remaining (maximum 600 sec)
    Time to live: 14397.408 sec
(maximum 14400 sec)
```

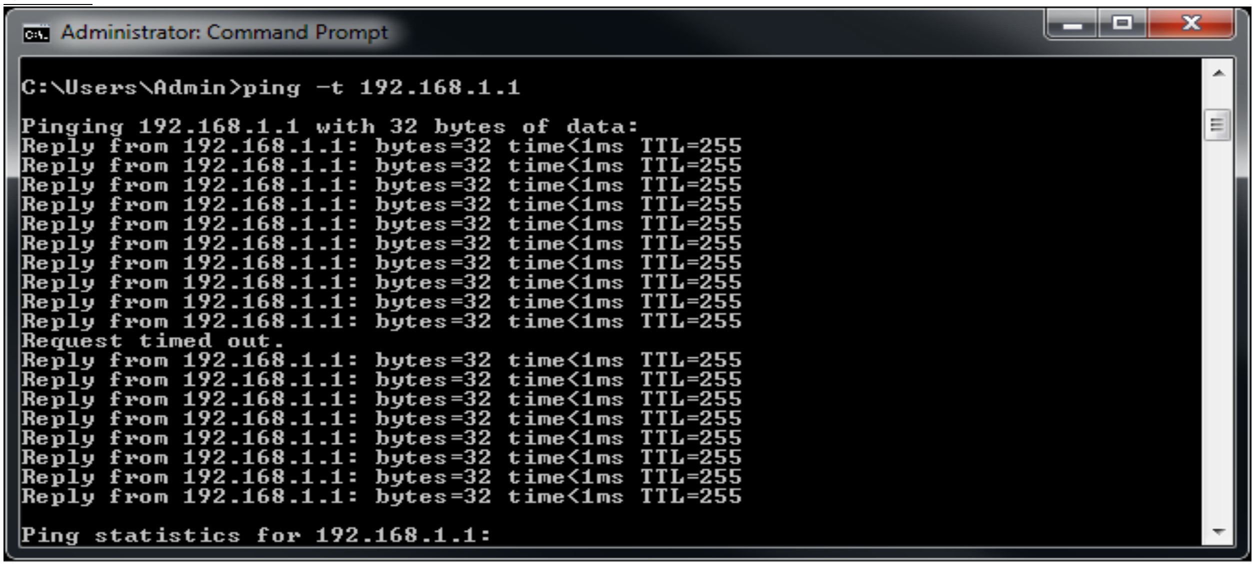
```
    Preemption enabled, min delay 30
sec
    Active is 192.168.1.3 (primary),
weighting 100 (expires in 8.672 sec)

R2#sh glbp
FastEthernet0/0 - Group 1
  State is Speak
  Virtual IP address is 192.168.1.1
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.688 secs
```

```
  Redirect time 600 sec, forwarder
timeout 14400 sec
  Preemption enabled, min delay 0 sec
  Active is unknown
  Standby is unknown
  Priority 101 (configured)
  Weighting 100 (default 100),
thresholds: lower 1, upper 100
  Load balancing: round-robin
  Group members:
    0012.d974.b568 (192.168.1.3) local
  There are no forwarders
```

Pings

<u>VRRP</u>



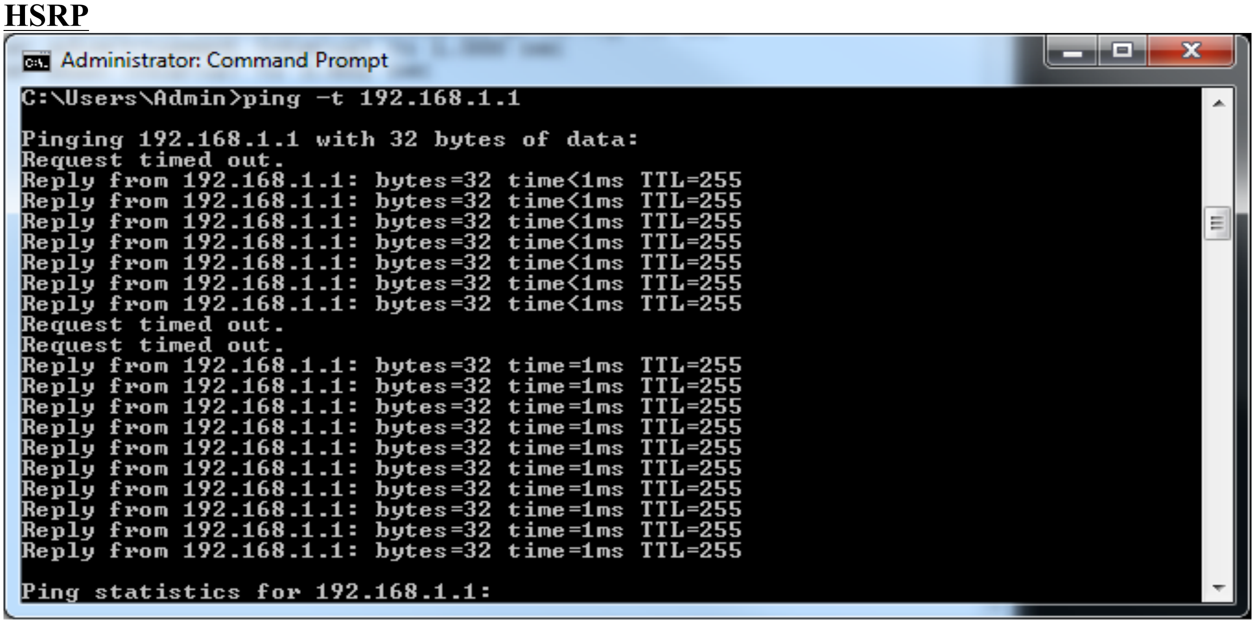
```
Administrator: Command Prompt
C:\Users\Admin>ping -t 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Request timed out.
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.1.1:
```

The *Request timed out* that shows that connection is quickly restored after the cable is unplugged.

<u>HSRP</u>



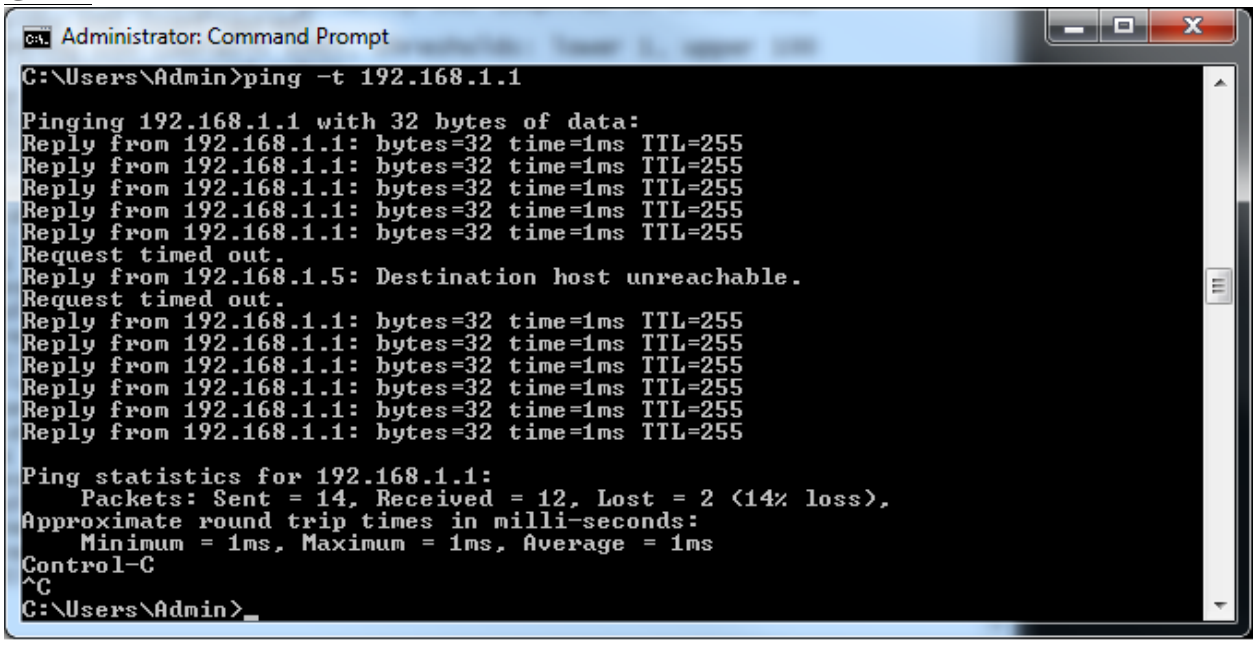
```
Administrator: Command Prompt
C:\Users\Admin>ping -t 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:
Request timed out.
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Reply from 192.168.1.1: bytes=32 time<1ms TTL=255
Request timed out.
Request timed out.
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255
Reply from 192.168.1.1: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.1.1:
```

The *Request timed out* that shows that connection is quickly restored after the cable is unplugged.

GLBP



The *Request timed out* and *Reply from 192.1268.1.5: Destination host unreachable* above shows that it takes some time to restore connection.

Problem

Since the process and the configurations were relatively simple, I had very few problems in this lab. The most dominant problem that I had, however, was initial insufficient research. I did not realize that the commands *vrrp [group-number] preempt* and *vrrp [group-number] priority* were necessary: I thought they were optional commands that were not a major part of this lab. However, as I discovered that connectivity was not restored when the primary router failed, I had to go back and issue these two commands.

Also, I did not put the same virtual IP address for both routers. This also prevented the protocol from working because the router recognized two separate default gateways. After I had undergone some trouble shooting, I discovered that the same virtual IP address was necessary.

Conclusion

Overall, I managed to implement three different router protocols in networks: HSRP, VRRP, and GLBP. Although my initial inadequate research impeded me, I eventually managed to successfully implement these three protocols. I learned how to set up backup routers in the network without having to lose complete connection between a host and a router.