CCNA Split Horizon Packet Tracer Lab

This CCNA Packet Tracer lab has been provided to help you gain a better understanding Split Horizon and how to configure it on a Cisco IOS router in a typical hub and spoke topology. Configuring and troubleshooting Split Horizon by default is a essential topic when preparing for the CCNA exam and as a Cisco network engineer, you will also be expected to know how to use Split Horizon when configuring Cisco networks or troubleshooting network issues.

Distance Vector routing protocol, such as RIP, IGRP and EIGRP uses Split Horizon to prevent routing loops. Split Horizon mandates that the routing protocol will not send updates back out the same interface on which they were received.

The split Horizon protocol permits a router to transmit routing updates in forward direction and propagates to all the attached routers, except that router which sent the new update. This method prevents routing loops and also sublimates those areas, where Route Poisoning cannot avoid routing loops to occur. This method is integrated in most of the distance vector routing protocols including RIP, IGRP, EIGRP and VPLS.

The latest versions of Cisco IOS software, Split Horizon is disabled by default for Frame Relay and SMDS. However, older Cisco IOS software may have Split Horizon enabled by default.

In the lab we will use Packet Tracer to model a simple hub and spoke Frame-Relay topology consisting 4 routers. We will use this topology to demonstrate how routing loop occur and how to use split horizon to prevent these routing loops. Although this lab has been created using Cisco’s Packet Tracer the lab can be completed using GNS3 or real hardware, but you should keep in mind that depending on the model of the Cisco device being used you may be required to modify the configuration to take in account changes in the interface names. Also if real hardware is used a wan switch will be required for the frame-relay, a router with three or more serial interface can be configured as a [frame-relay switch](http://freeciscolab.com/2010/10/23/cisco-router-emulates-frame-relay-switch/).

## Learning Objectives:

* Review basic router configuration.
* Review hub and spoke frame relay configuration.
* Review basic RIPv2 configuration.
* How to use split horizon to prevent routing loops.
* Review verifying configuration using Cisco show commands.

## Tasks:

### Basic Router Configuration:

1. Configure hostnames on all routers and switches as shown in the network diagram.
2. Configure no ip domain-lookup on all routers and switches as shown in the network diagram.
3. Assign ip address and subnet mask to the Gigabit interfaces on all routers as shown in the network diagram.
4. Assign ip address and subnet mask to the Serial interface S0/0/0 of R1, R2 and R3 as shown in the network diagram.
5. Insure all FastEthernet and Serial interface used in the lab topology are not administratively down.

### Frame-Relay Configuration:

1. Enable Frame Relay encapsulation on R1, R2, and R3. Use the default Frame Relay encapsulation of Cisco.
2. Create a static Frame Relay map on each router for the two other routers using the DLCI shown in the network diagram.
3. Display the static Frame Relay maps.

**R1#show frame-relay map**

Serial0/0/0 (up): ip 10.0.0.2 dlci 102, dynamic, broadcast, CISCO, status defined, active

Serial0/0/0 (up): ip 10.0.0.3 dlci 103, dynamic, broadcast, CISCO, status defined, active

**R2#show frame-relay map**

Serial0/0/0 (up): ip 10.0.0.1 dlci 201, dynamic, broadcast, CISCO, status defined, active

**R3#show frame-relay map**

Serial0/0/0 (up): ip 10.0.0.1 dlci 301, dynamic, broadcast, CISCO, status defined, active

From R1 use ping to verify connectivity to R2 and R3 routers.

**R1#ping 10.0.0.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 4/11/16 ms

**R1#ping 10.0.0.3**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.3, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 4/13/21 ms

### RIPv2 configuration:

1. Enable RIPv2 on all routers.
2. Configure all the subnets on all routers to part of the RIPv2 routing protocol.
3. Prevent RIPv2 from automatically summarizing at Classful network boundaries on all routers.
4. Make the Gigabit interface Gig0/0 passive on all routers.
5. Verify RIPv2 configuration.

**R1#show ip protocols**

Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 27 seconds

Invalid after 180 seconds, hold down 180, flushed after 240

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: rip

Default version control: send version 2, receive 2

 Interface Send Recv Triggered RIP Key-chain

 Serial0/0/0 2 2

Automatic network summarization is not in effect

Maximum path: 4

Routing for Networks:

 10.0.0.0

 192.168.1.0

Passive Interface(s):

 GigabitEthernet0/0

Routing Information Sources:

 Gateway Distance Last Update

 10.0.0.3 120 00:00:19

 10.0.0.2 120 00:00:02

Distance: (default is 120)

**R2#show ip protocols**

Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 12 seconds

Invalid after 180 seconds, hold down 180, flushed after 240

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: rip

Default version control: send version 2, receive 2

 Interface Send Recv Triggered RIP Key-chain

 Serial0/0/0 2 2

Automatic network summarization is not in effect

Maximum path: 4

Routing for Networks:

 10.0.0.0

 172.16.0.0

Passive Interface(s):

 GigabitEthernet0/0

Routing Information Sources:

 Gateway Distance Last Update

 10.0.0.1 120 00:00:14

Distance: (default is 120)

**R3#show ip protocols**

Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 1 seconds

Invalid after 180 seconds, hold down 180, flushed after 240

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: rip

Default version control: send version 2, receive 2

 Interface Send Recv Triggered RIP Key-chain

 GigabitEthernet0/1 2 2

 Serial0/0/0 2 2

Automatic network summarization is not in effect

Maximum path: 4

Routing for Networks:

 10.0.0.0

 192.168.3.0

Passive Interface(s):

 GigabitEthernet0/0

Routing Information Sources:

 Gateway Distance Last Update

 10.0.0.1 120 00:00:11

Distance: (default is 120)

**Note:** the router interface are sending and receiving RIP version 2 updates, Automatic network summarization is not in effect, the subnets that are part of RIPv2 and finally the passive interface. As you can see the show ip protocol command provides a lot of information it has just verified all the command we just added to the RIPv2 routing process.

### Split Horizon configuration:

1. From R2 ping 10.0.0.3.

**R2#ping 10.0.0.3**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.0.0.3, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

1. Display the routing table on R2.

**R1#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, E - EGP

 i - IS-IS, 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

Gateway of last resort is not set

 10.0.0.0/8 is variably subnetted, 3 subnets, 3 masks

C 10.0.0.0/27 is directly connected, Serial0/0/0

L 10.0.0.1/32 is directly connected, Serial0/0/0

R 10.1.1.0/24 [120/1] via 10.0.0.3, 00:00:11, Serial0/0/0

 172.16.0.0/25 is subnetted, 1 subnets

R 172.16.2.0/25 [120/1] via 10.0.0.2, 00:00:01, Serial0/0/0

 192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.1.0/26 is directly connected, GigabitEthernet0/0

L 192.168.1.1/32 is directly connected, GigabitEthernet0/0

R 192.168.3.0/24 [120/1] via 10.0.0.3, 00:00:11, Serial0/0/0

R 192.168.4.0/24 [120/2] via 10.0.0.3, 00:00:11, Serial0/0/0

**Note:** All routes are present on R1.

1. Use the show ip interface s0/0/0 command to check the status of the split horizon.

**R1#show ip interface s0/0/0**

Serial0/0/0 is up, line protocol is up (connected)

 Internet address is 10.0.0.1/27

 Broadcast address is 255.255.255.255

 Address determined by setup command

 MTU is 1500

 Helper address is not set

 Directed broadcast forwarding is disabled

 Outgoing access list is not set

 Inbound access list is not set

 Proxy ARP is enabled

 Security level is default

 Split horizon is enabled

 ICMP redirects are always sent

 ICMP unreachables are always sent

 ICMP mask replies are never sent

 IP fast switching is disabled

 IP fast switching on the same interface is disabled

 IP Flow switching is disabled

 IP Fast switching turbo vector

 IP multicast fast switching is disabled

 IP multicast distributed fast switching is disabled

 Router Discovery is disabled

 IP output packet accounting is disabled

 IP access violation accounting is disabled

 TCP/IP header compression is disabled

 RTP/IP header compression is disabled

 Probe proxy name replies are disabled

 Policy routing is disabled

 Network address translation is disabled

 WCCP Redirect outbound is disabled

 WCCP Redirect exclude is disabled

 BGP Policy Mapping is disabled

**Note:** the split horizon is enabled.

1. Disable the split horizon on the Serial interface S0/0/0 of R1.
2. Display the routing table on R2.

**R2#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, E - EGP

 i - IS-IS, 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

Gateway of last resort is not set

 10.0.0.0/8 is variably subnetted, 3 subnets, 3 masks

C 10.0.0.0/27 is directly connected, Serial0/0/0

L 10.0.0.2/32 is directly connected, Serial0/0/0

R 10.1.1.0/24 [120/2] via 10.0.0.1, 00:00:11, Serial0/0/0

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

C 172.16.2.0/25 is directly connected, GigabitEthernet0/0

L 172.16.2.1/32 is directly connected, GigabitEthernet0/0

 192.168.1.0/26 is subnetted, 1 subnets

R 192.168.1.0/26 [120/1] via 10.0.0.1, 00:00:11, Serial0/0/0

R 192.168.3.0/24 [120/2] via 10.0.0.1, 00:00:11, Serial0/0/0

R 192.168.4.0/24 [120/3] via 10.0.0.1, 00:00:11, Serial0/0/0

**Note:** the new routes in the table.

1. From R2 ping 192.168.4.1.

**R2#ping 192.168.4.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.4.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 6/13/20 ms

1. From R2 perform a traceroute to the 192.168.4.1 network.

**R2#traceroute 192.168.4.1**

Type escape sequence to abort.

Tracing the route to 192.168.4.1

 1 10.0.0.1 3 msec 2 msec 3 msec

 2 10.0.0.3 10 msec 5 msec 5 msec

 3 10.1.1.1 3 msec 3 msec 2 msec

This completes this CCNA Packet Tracer lab I hope you have found it helpful.