LAB 2

Routing Information Protocol
Student Lab Manual

NOTE: Make sure you have gone through Lab 1(Router Basics) and that you are familiar with the basic router commands before attempting this lab.

RIP-Routing Information Protocol

1. Objective

In this lab you will learn how to configure Routing Information Protocol (RIP) on a network. You will use relevant IOS commands to monitor RIP routing updates between routes and to control RIP updates messages. After completing this lab you know how to:

- Configure RIP on Routers with different network connections and interfaces
- Interpret the RIP routing update messages traveling between the routers with debug commands.
- Modify the default timers for routing updates on Cisco router
- Test connectivity between RIP routers and routing updates are exchanged between routers
- Understand how Split-Horizon works and when you may need to disable it.

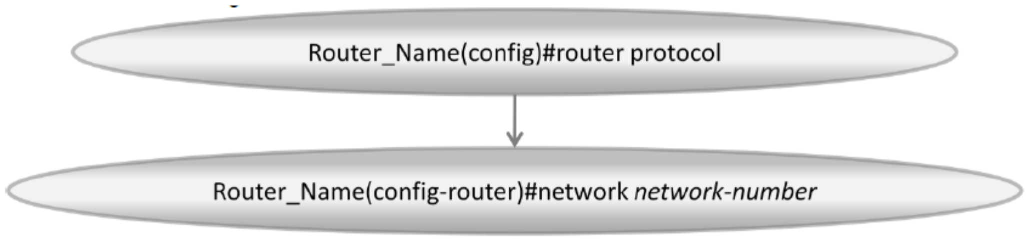
2. Background

RIP is one of the first distance vector routing protocols. It was designed for ease of use and for small networks. RIP is implemented by many host computers as well as networking devices, and it is the choice of many network administrators for small networks or for confined areas of larger networks. RIP uses a **metric** called **'hops'**, which is simply a count of the **number of links traversed on a path**.
This is an adequate metric in networks composed of homogeneous media, for example, an all Ethernet network. However, the simple metric does not account for different types of media or for the congestion of traffic in the network. Also, the original specification of RIP was incapable of measuring hops greater than 16, limiting the maximum network diameter.
This limitation was originally included to mitigate convergence delays and handle count to infinity problems. RIP was available for almost every protocol suite; DecNet, Novell, and so on. Integrated routing is the practice of maintaining a single routing table for all RIP-discovered paths, which permitted network administrators to configure only one RIP (usually TCP/IP) to cut down on update traffic.

Configuring RIP

To configure RIP, the following steps must be taken:

- Select a routing protocol.
- Assign IP network numbers without specifying subnet values. This is because RIP is a classful protocol. It is only concerned with major network boundaries. To configure RIP type the following commands in configuration mode.



- Where ***protocol*** is RIP
- The ***network-number*** specifies a directly connected network address.

Based on your test topology below determine the major network addresses. *Hint: We are using classful addressing schemes for all interfaces.*

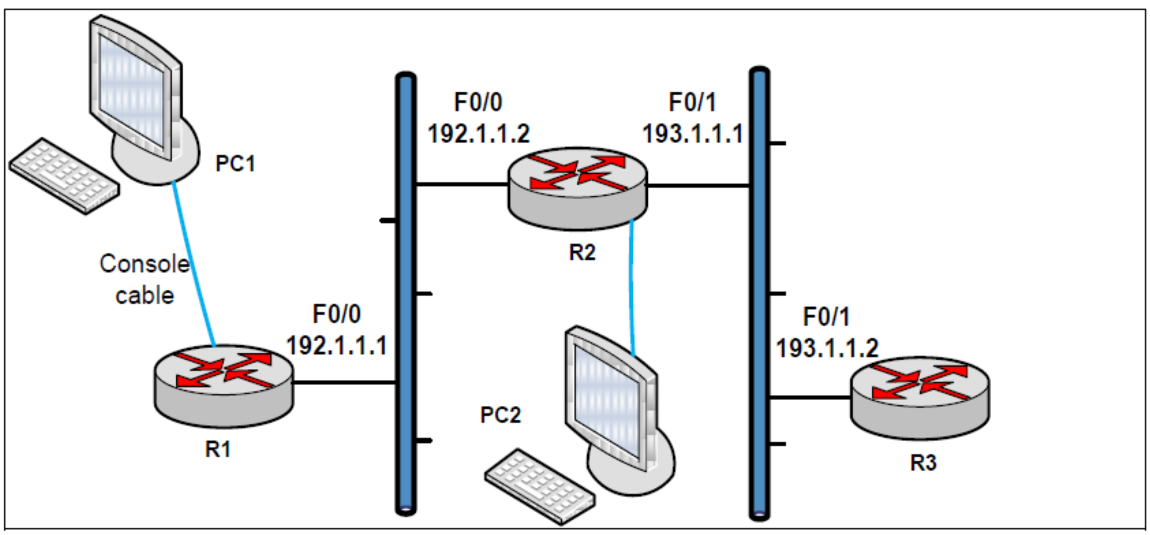


Figure 1:Test topology for configuring RIP

EXERCISE 1: Configuring Routers to use RIP

Step 0:
First, configure hostnames and IP addresses for each router and interface using the topology diagram in Figure 1. Use class C subnet masks (255.255.255.0) when configuring interfaces.
Record your steps below:
(Remember the **no shutdown** command after setting the IP address**)**
Router r1: _r1>____

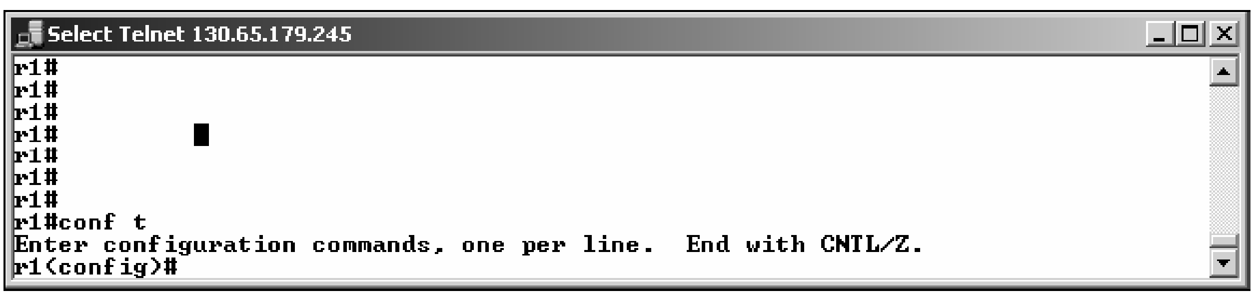
Router r2: _r2>

Router r3: _r3>

Objective 1. Configure router r1 and r2 to use RIP

PC 1 AND PC 2 ACTIVITY

STEP 1: Enter configuration mode on router r1 and r2, and do same for r3
First enter configuration mode by using the **configure terminal** command.



STEP 2: Manage access into the routers
Ensure that the console and vty passwords are not set (remember this from Lab 1).

___rX#

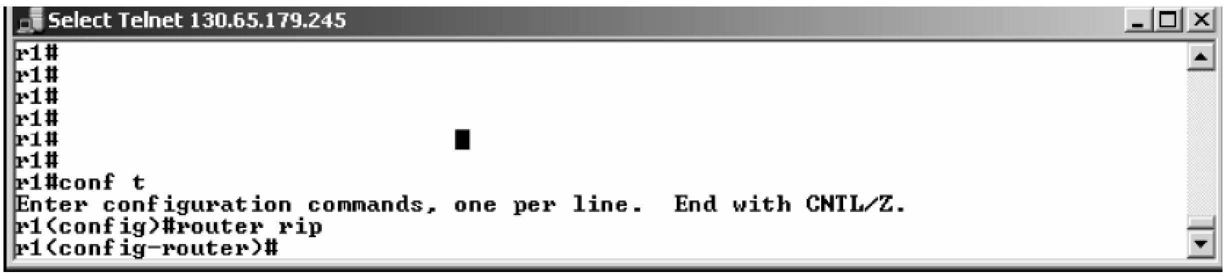
STEP 3: Set the secret password to "cisco" on all the routers

_rx(config)#

PC 1 ACTIVITY

STEP 4: Create a RIP routing process

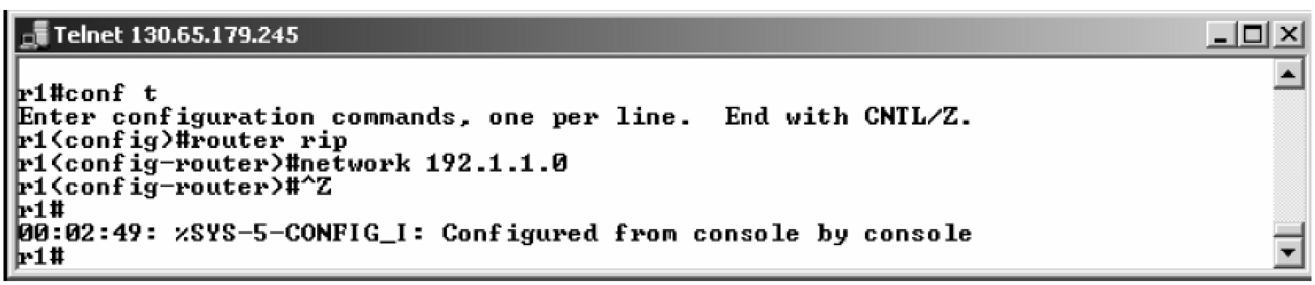
When you are in configuration mode, create a RIP routing process with the **router rip** command.



```
Select Telnet 130.65.179.245
r1#
r1#
r1#
r1#
r1#
r1#
r1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
r1(config)#router rip
r1(config-router)#
```

STEP 5: **Add the network(s) to participate in RIP**

Next, the network(s) participating in the RIP routing process must be specified using the **network** subcommand. For router **r1**, the only network to add is **192.1.1.0.**

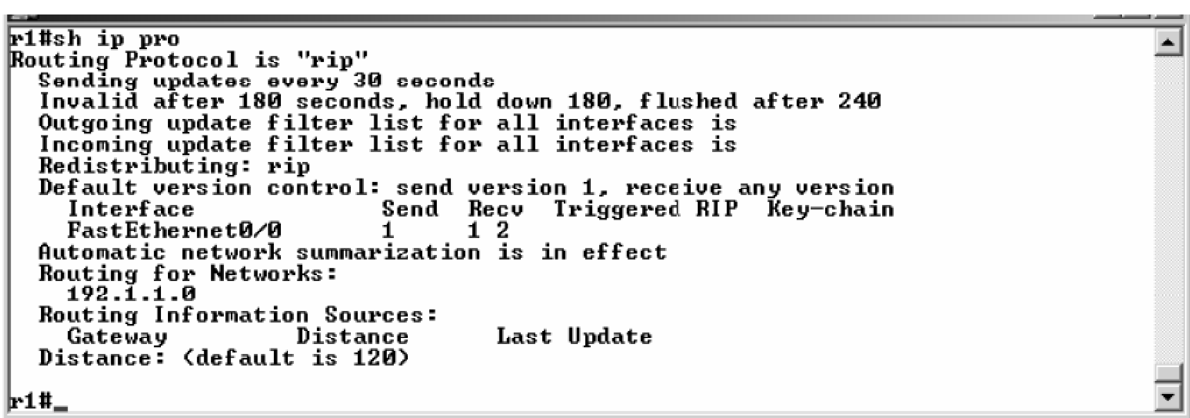


```
Telnet 130.65.179.245

r1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
r1(config)#router rip
r1(config-router)#network 192.1.1.0
r1(config-router)#^Z
r1#
00:02:49: %SYS-5-CONFIG_I: Configured from console by console
r1#
```

STEP 6: **Verify that RIP is configured on r1**

Now, use the **show ip protocols** command to verify that RIP is configured. The output shows that the routing protocol RIP has been configured and is routing for the network **192.1.1.0**.



```
r1#sh ip pro
Routing Protocol is "rip"
  Sending updates every 30 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       1     1 2
  Automatic network summarization is in effect
  Routing for Networks:
    192.1.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 120)

r1#_
```

PC 2 ACTIVITY

Step 7: **Enter configuration mode on Router r2**

Now exit the router using the keys Ctrl-Shift-6 then x. Telnet into router **r2** and enter configuration mode using the **config t** command.

```
Select Telnet 130.65.179.246
2511-2#r2
Trying r2 (130.65.179.246, 2002)... Open

r2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
r2(config)#
```

Step 8: Create a RIP routing process.
When you are in configuration mode, create a RIP routing process with the **router rip** command.

```
Select Telnet 130.65.179.246
Trying r2 (130.65.179.246, 2002)... Open

r2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
r2(config)#router rip
r2(config-router)#
```

Step 9: Add the network(s) to participate in RIP.
Next, specify the network(s) participating in the RIP routing process by using the **network** subcommand. For router **r2**, there are two networks to add, **192.1.1.0** and **193.1.1.0**.

```
Select Telnet 130.65.179.246
Enter configuration commands, one per line.  End with CNTL/Z.
r2(config)#router rip
r2(config-router)#network 192.1.1.0
r2(config-router)#network 193.1.1.0
r2(config-router)#^Z
r2#
00:03:11: %SYS-5-CONFIG_I: Configured from console by console
r2#_
```

Step 10: Verify the RIP configuration on r2.
Check to see that you have configured RIP correctly; use **show ip protocols** command. In the **show ip protocols** output, you should notice that router r2 has already received RIP updates on both interface FastEthernet0/0 and FastEthernet 0/1, an indication that there is another source of RIP routing updates on the **193.1.1.0** network.

```
Telnet 130.65.179.246

r2#sh ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 6 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       1     1 2
    FastEthernet0/1       1     1 2
  Automatic network summarization is in effect
  Routing for Networks:
    192.1.1.0
    193.1.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 120)

r2#_
```

Step 11: View the routing table on r2.
Use the **show ip route** command to view the routing table of router r2.

You should now be able to see the networks learned via RIP in the routing table.

Telnet 130.65.179.246

```
r2#sh ip route
Codes: C - connected, S - static, I - IGRP, 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

C    193.1.1.0/24 is directly connected, FastEthernet0/1
C    192.1.1.0/24 is directly connected, FastEthernet0/0
r2#
```

PC 1 ACTIVITY

Step 12: Check to see if router r1 has received any routing updates.
Use **show ip protocols** on router **r1**. You can see that **r1** has received a RIP update from the address **192.1.1.2 (Router r2).**

Telnet 130.65.179.246

```
r1#sh ip pro
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 0 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is
  Incoming update filter list for all interfaces is
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       1     1 2
  Automatic network summarization is in effect
  Routing for Networks:
    192.1.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.1.1.2            120      00:00:22
  Distance: (default is 120)

r1#
```

Step 13: View the routing table on Router r1.
You can see that **r1** has learned about the **193.1.1.0** network from **192.1.1.2** (Router **r2**).

Telnet 130.65.179.246

```
r1#sh ip route
Codes: C - connected, S - static, I - IGRP, 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

R    193.1.1.0/24 [120/1] via 192.1.1.2, 00:00:26, FastEthernet0/0
C    192.1.1.0/24 is directly connected, FastEthernet0/0
r1#
```

Objective 2. Configure RIP on Router r3.

Step 14: Configure RIP on r3 for network 193.1.1.0.

Configure RIP on router **r3** for the network **193.1.1.0**. Record your steps below:

Step 15: Verify that RIP is running on router r3.

Use **the show ip protocols** and **show ip route** commands to verify that RIP is running. You can see that router **r3** is now getting updates from **193.1.1.1** and that **r3** now knows about the subnet **192.1.1.0** from router **r2.**

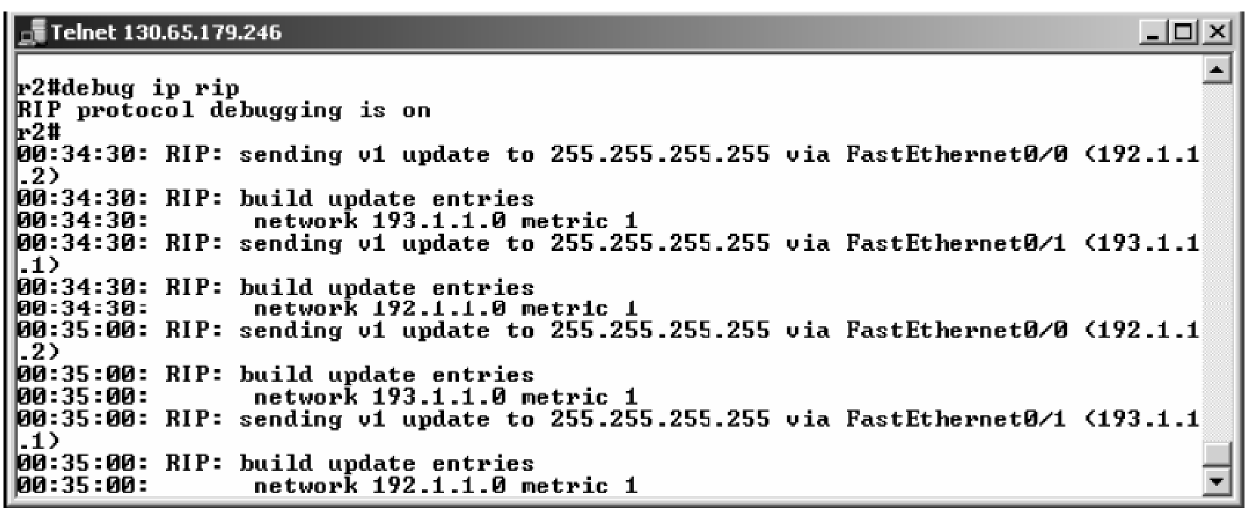
EXERCISE 2: View and interpret RIP messages between routers

Now let's look at how RIP communicates between the routers. To view the routing messages between the routers use the **debug ip rip** command.

PC 2 ACTIVITY

Step 16: Turn on debug ip rip on Router r2.

Return to router **r2** and turn on **debug ip rip** to view the routing messages between the routers. In the output, you see the addresses from which r1 is receiving updates. This data should correspond to the Routing Information Sources field in the **show ip protocols** output. You can also see the network that r1 is advertising and receiving.



Step 17: Turn off debug ip rip on Router r2.
To turn off **debug ip rip**; enter the command **no debug ip rip**.

Step 18: View condensed debug output.
If you wish to view only when a RIP routing event occurs and you are not concerned with the contents of the update (the network and subnet portion), use **debug ip rip events**.

Step 19: Turn on debug ip rip events.
Enter the **debug ip rip events** command. The output shows only the events that are happening and suppresses the network in the update messages.

Step 20: Turn off debug ip rip events on Router r2.
To turn off **debug ip rip events**, enter the command sequence **no debug ip rip events**.

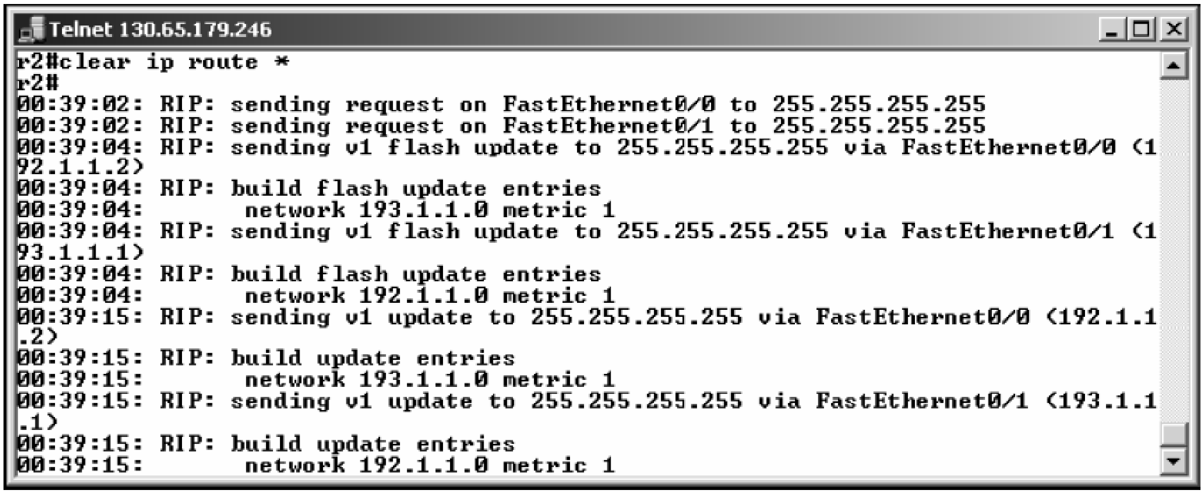
Step 21: Perform general request updates.
So far the RIP messages have been sent between the routers at a predetermined time interval (the **update time**). Another type of update is **the triggered update**. A triggered update is an update sent asynchronously in response to a change in the network topology.

Triggered updates are also called **Flash updates**. New routes in the routing table or existing route metric changes can cause triggered updates to be sent. In the following steps, you cause a triggered update known as a **general request** to be sent.

Step 22: Turn on debug ip rip on Router r2.
On Router **r2** turn on **debug ip rip**.

Step 23: Trigger a routing update by clearing the routing table with the command clear ip route *.
When you enter the command **clear ip route ***, the router will automatically send a broadcast request out all interfaces participating in RIP for adjoining routers to send it a routing update. When routers **r1** and **r3** receive the request, they send an immediate response instead of waiting for their update timer to expire.

You can see that, as soon as you enter the **clear ip route *** command, the router sends messages out of its interfaces participating in RIP to request a routing table update. The routers receiving the messages immediately reply with an update.



```
Telnet 130.65.179.246
r2#clear ip route *
r2#
00:39:02: RIP: sending request on FastEthernet0/0 to 255.255.255.255
00:39:02: RIP: sending request on FastEthernet0/1 to 255.255.255.255
00:39:04: RIP: sending v1 flash update to 255.255.255.255 via FastEthernet0/0 (1
92.1.1.2)
00:39:04: RIP: build flash update entries
00:39:04:        network 193.1.1.0 metric 1
00:39:04: RIP: sending v1 flash update to 255.255.255.255 via FastEthernet0/1 (1
93.1.1.1)
00:39:04: RIP: build flash update entries
00:39:04:        network 192.1.1.0 metric 1
00:39:15: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/0 (192.1.1
.2)
00:39:15: RIP: build update entries
00:39:15:        network 193.1.1.0 metric 1
00:39:15: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.1)
00:39:15: RIP: build update entries
00:39:15:        network 192.1.1.0 metric 1
```

Step24: Turn off the debug on Router r2.
On Router **r2**, turn off the debug using the **no debug ip rip** command.

PC 1 ACTIVITY

Step xx: Telnet into router r2 (complete the following)
__r1>____
__r___>____
____
____
____

Step 25: Perform poison-reverse updates.
A poison-reverse update is a routing update with an infinite metric. A poison-reverse update is sent for a specific route when a router experienced that a connection associated with the route has disappeared. Poison-reverse updates are normally triggered updates, meaning that they are sent immediately upon discovery of the routing change. Poison-reverse updates are also called unreachables. Rather than just leaving the specific route out of the update, sending an unreachable for a number of update periods helps prevent routing loops and brings down convergence time. In the following steps, you will trigger the sending of a poison-reverse update by shutting down an interface, thus making the routes learned via that interface unreachable.

Step 26: Turn on debug ip rip on Router r2.
On **r2**, turn on **debug ip rip**.

Step 27: Trigger a poison-reverse update by shutting down interface Fast Ethernet 0/0 on router r2.
Now shut down interface **Fast Ethernet 0/0** of **r2** using the **shutdown** command. When an interface is shut down, the router immediately sends out an update advertising any routers learned over that interface as unreachable; this process is know as poison reverse.

Also notice that **r3** advertises the route back to **r2**, in violation of the split horizon rule, but it is an effective method to ensure that routing tables are properly updated when routes become unreachable.

```
Telnet 130.65.179.246
r2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
r2(config)#int fast0/0
r2(config-if)#shutdown
r2(config-if)#^Z
r2#
00:41:24: %SYS-5-CONFIG_I: Configured from console by console
00:41:25: %LINK-5-CHANGED: Interface FastEthernet0/0, changed state to administr
atively down
00:41:25: RIP: sending v1 flash update to 255.255.255.255 via FastEthernet0/1 (1
93.1.1.1)
00:41:25: RIP: build flash update entries
00:41:25:       network 192.1.1.0 metric 16
00:41:26: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, chang
ed state to down
00:41:27: RIP: received v1 update from 193.1.1.2 on FastEthernet0/1
00:41:27:      192.1.1.0 in 16 hops (inaccessible)
00:41:31: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.1)
00:41:31: RIP: build update entries - suppressing null update
00:41:59: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.1)
00:41:59: RIP: build update entries - suppressing null update_
```

Step 28: Turn off debug ip rip and open up interface Fastethernet0/0 again.
On router **r2**, in privileged mode turn off debug ip rip with the **no debug ip rip** command. Also, go into interface **Fastethernet0/0** and perform a **no shutdown** command.

____

Split horizon states that a router will not advertise a route out of the same interface it learned the route on. We need to disable split horizon on **r3** in order for routing updates to flow from **r1** to **r3** and back.

Step 29: Exit router r2, and telnet into router r3
__r2>____
__r?>____
____
____
____

```
Telnet 130.65.179.246
r3#debug ip rip
RIP protocol debugging is on
r3#
03:19:38: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.2)
03:19:38: RIP: build update entries - suppressing null update
03:19:39: RIP: received v1 update from 193.1.1.1 on FastEthernet0/1
03:19:39:      192.1.1.0 in 1 hops
03:20:05: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.2)
03:20:05: RIP: build update entries - suppressing null update
03:20:06: RIP: received v1 update from 193.1.1.1 on FastEthernet0/1
03:20:06:      192.1.1.0 in 1 hops
03:20:32: RIP: received v1 update from 193.1.1.1 on FastEthernet0/1
03:20:32:      192.1.1.0 in 1 hops
03:20:32: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.2)
03:20:32: RIP: build update entries - suppressing null update
```

Step 30: Turn off debug ip rip on Router r3.
Now, turn off **debug ip rip** on Router **r3**.

Step 31: Disable split horizon on FastEthernet 0/1 of Router r3.
To disable split horizon on **r3**, enter **no ip split-horizon** subcommand on the interface you want to disable it on (in this case **FastEthernet 0/1**).
* Note the **(no) ip split-horizon** command is not specific to the RIP routing protocol.

```
Telnet 130.65.179.246
r3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
r3(config)#int fast0/1
r3(config-if)#no ip split-horizon
r3(config-if)#^Z
r3#
00:27:25: %SYS-5-CONFIG_I: Configured from console by console
r3#_
```

Step 32: Turn on debug ip rip on Router r3.
When you turn on **debug ip rip** on **r3**, you will see that it is receiving updates from router **r1** (**192.1.1.0**) and **r2** (**193.1.1.0**).

```
Telnet 130.65.179.246
r3#debug ip rip
RIP protocol debugging is on
r3#
00:31:10: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.2)
00:31:10: RIP: build update entries
00:31:10:        network 192.1.1.0 metric 2
00:31:10:        subnet 193.1.1.0 metric 1
00:31:24: RIP: received v1 update from 193.1.1.1 on FastEthernet0/1
00:31:24:      192.1.1.0 in 1 hops
00:31:37: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.2)
00:31:37: RIP: build update entries
00:31:37:        network 192.1.1.0 metric 2
00:31:37:        subnet 193.1.1.0 metric 1
00:31:53: RIP: received v1 update from 193.1.1.1 on FastEthernet0/1
00:31:53:      192.1.1.0 in 1 hops
00:32:06: RIP: sending v1 update to 255.255.255.255 via FastEthernet0/1 (193.1.1
.2)
00:32:06: RIP: build update entries
00:32:06:        network 192.1.1.0 metric 2
00:32:06:        subnet 193.1.1.0 metric 1_
```