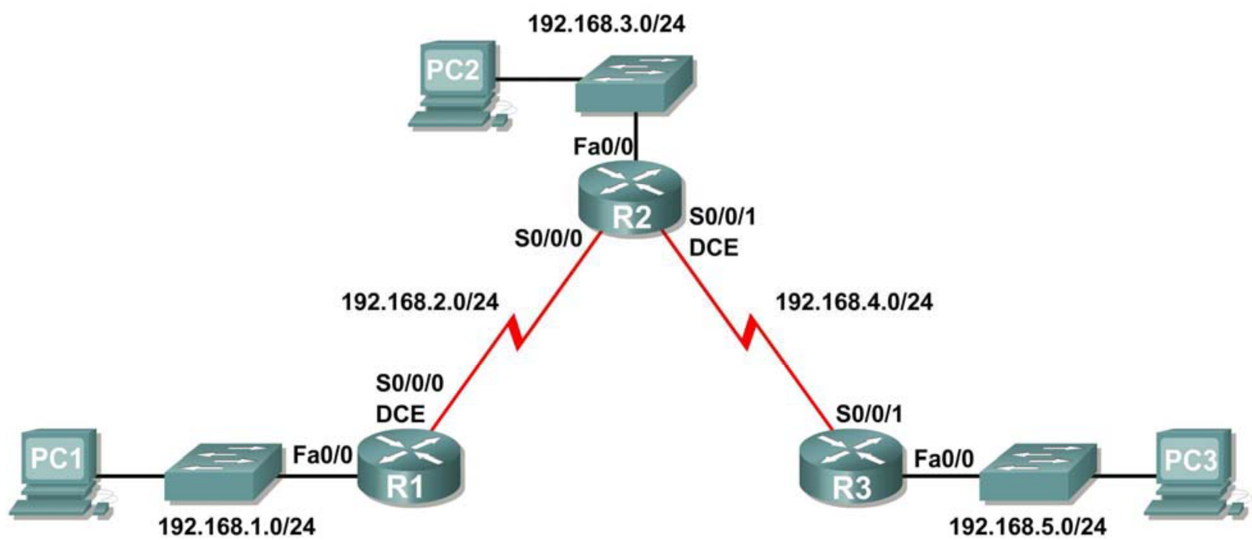
Lab 5.6.1: Basic RIP Configuration

Topology Diagram



Learning Objectives

Upon completion of this lab, you will be able to:

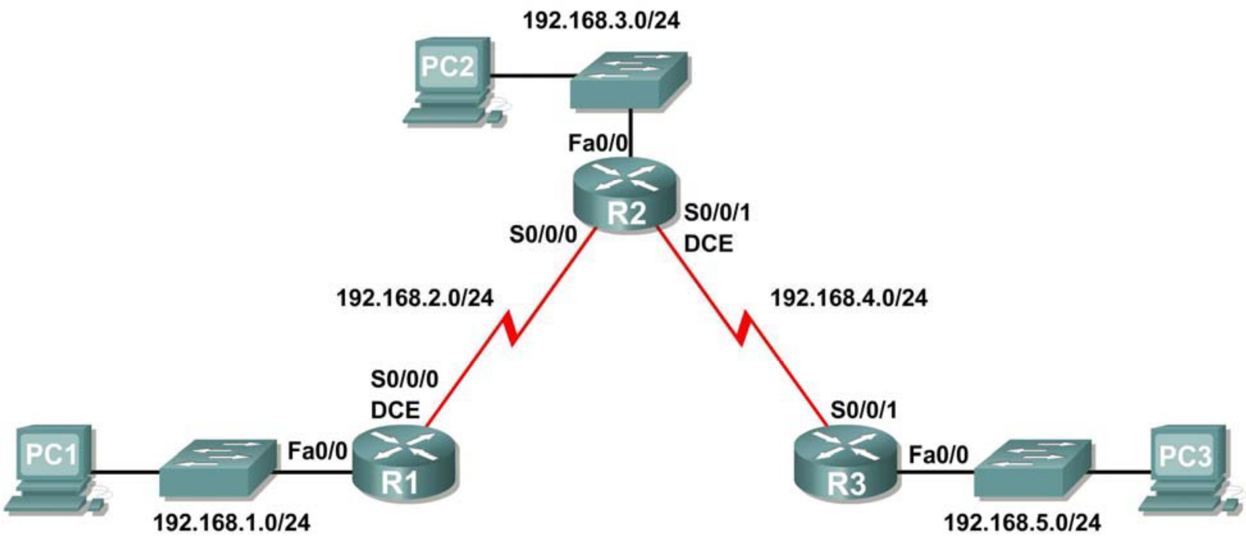
- Cable a network according to the Topology Diagram.
- Erase the startup configuration and reload a router to the default state.
- Perform basic configuration tasks on a router.
- Configure and activate interfaces.
- Configure RIP routing on all routers.
- Verify RIP routing using **`show`** and **`debug`** commands.
- Reconfigure the network to make it contiguous.
- Observe automatic summarization at boundary router.
- Gather information about RIP processing using the **`debug ip rip`** command.
- Configure a static default route.
- Propagate default routes to RIP neighbors.
- Document the RIP configuration.

Scenarios

- Scenario A: Running RIPv1 on Classful Networks
- Scenario B: Running RIPv1 with Subnets and Between Classful Networks
- Scenario C: Running RIPv1 on a Stub Network.

Scenario A: Running RIPv1 on Classful Networks

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0	192.168.2.1	255.255.255.0	N/A
R2	Fa0/0	192.168.3.1	255.255.255.0	N/A
	S0/0/0	192.168.2.2	255.255.255.0	N/A
	S0/0/1	192.168.4.2	255.255.255.0	N/A
R3	Fa0/0	192.168.5.1	255.255.255.0	N/A
	S0/0/1	192.168.4.1	255.255.255.0	N/A
PC1	NIC	192.168.1.10	255.255.255.0	192.168.1.1
PC2	NIC	192.168.3.10	255.255.255.0	192.168.3.1
PC3	NIC	192.168.5.10	255.255.255.0	192.168.5.1

Task 1: Prepare the Network.

Step 1: Cable a network that is similar to the one in the Topology Diagram.

You can use any current router in your lab as long as it has the required interfaces shown in the topology.

Note: If you use 1700, 2500, or 2600 routers, the router outputs and interface descriptions will appear different.

Step 2: Clear any existing configurations on the routers.

Task 2: Perform Basic Router Configurations.

Perform basic configuration of the R1, R2, and R3 routers according to the following guidelines:

1. Configure the router hostname.
2. Disable DNS lookup.
3. Configure an EXEC mode password.
4. Configure a message-of-the-day banner.
5. Configure a password for console connections.
6. Configure a password for VTY connections.

Task 3: Configure and Activate Serial and Ethernet Addresses.

Step 1: Configure interfaces on R1, R2, and R3.

Configure the interfaces on the R1, R2, and R3 routers with the IP addresses from the table under the Topology Diagram.

Step 2: Verify IP addressing and interfaces.

Use the **`show ip interface brief`** command to verify that the IP addressing is correct and that the interfaces are active.

When you have finished, be sure to save the running configuration to the NVRAM of the router.

Step 3: Configure Ethernet interfaces of PC1, PC2, and PC3.

Configure the Ethernet interfaces of PC1, PC2, and PC3 with the IP addresses and default gateways from the table under the Topology Diagram.

Step 4: Test the PC configuration by pinging the default gateway from the PC.

Task 4: Configure RIP.

Step 1: Enable dynamic routing.

To enable a dynamic routing protocol, enter global configuration mode and use the **`router`** command.

Enter **`router ?`** at the global configuration prompt to a see a list of available routing protocols on your router.

To enable RIP, enter the command **`router rip`** in global configuration mode.

```
R1(config)#router rip
R1(config-router)#
```

Step 2: Enter classful network addresses.

Once you are in routing configuration mode, enter the classful network address for each directly connected network, using the **`network`** command.

```
R1(config-router)#network 192.168.1.0
R1(config-router)#network 192.168.2.0
R1(config-router)#
```


The **network** command:

- Enables RIP on all interfaces that belong to this network. These interfaces will now both send and receive RIP updates.
- Advertises this network in RIP routing updates sent to other routers every 30 seconds.

When you are finished with the RIP configuration, return to privileged EXEC mode and save the current configuration to NVRAM.

```
R1(config-router)#end
%SYS-5-CONFIG_I: Configured from console by console
R1#copy run start
```

Step 3: Configure RIP on the R2 router using the router rip and network commands.

```
R2(config)#router rip
R2(config-router)#network 192.168.2.0
R2(config-router)#network 192.168.3.0
R2(config-router)#network 192.168.4.0
R2(config-router)#end
%SYS-5-CONFIG_I: Configured from console by console
R2#copy run start
```

When you are finished with the RIP configuration, return to privileged EXEC mode and save the current configuration to NVRAM.

Step 4: Configure RIP on the R3 router using the router rip and network commands.

```
R3(config)#router rip
R3(config-router)#network 192.168.4.0
R3(config-router)#network 192.168.5.0
R3(config-router)#end
%SYS-5-CONFIG_I: Configured from console by console
R3# copy run start
```

When you are finished with the RIP configuration, return to privileged EXEC mode and save the current configuration to NVRAM.

Task 5: Verify RIP Routing.

Step 1: Use the show ip route command to verify that each router has all of the networks in the topology entered in the routing table.

Routes learned through RIP are coded with an **R** in the routing table. If the tables are not converged as shown here, troubleshoot your configuration. Did you verify that the configured interfaces are active? Did you configure RIP correctly? Return to Task 3 and Task 4 to review the steps necessary to achieve convergence.


```
R1#show 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    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, Serial0/0/0
R    192.168.3.0/24 [120/1] via 192.168.2.2, 00:00:04, Serial0/0/0
R    192.168.4.0/24 [120/1] via 192.168.2.2, 00:00:04, Serial0/0/0
R    192.168.5.0/24 [120/2] via 192.168.2.2, 00:00:04, Serial0/0/0
R1#
```

```
R2#show ip route

<Output omitted>

R    192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:22, Serial0/0/0
C    192.168.2.0/24 is directly connected, Serial0/0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
C    192.168.4.0/24 is directly connected, Serial0/0/1
R    192.168.5.0/24 [120/1] via 192.168.4.1, 00:00:23, Serial0/0/1
R2#
```

```
R3#show ip route

<Output omitted>

R    192.168.1.0/24 [120/2] via 192.168.4.2, 00:00:18, Serial0/0/1
R    192.168.2.0/24 [120/1] via 192.168.4.2, 00:00:18, Serial0/0/1
R    192.168.3.0/24 [120/1] via 192.168.4.2, 00:00:18, Serial0/0/1
C    192.168.4.0/24 is directly connected, Serial0/0/1
C    192.168.5.0/24 is directly connected, FastEthernet0/0
R3#
```

Step 2: Use the `show ip protocols` command to view information about the routing processes.

The **`show ip protocols`** command can be used to view information about the routing processes that are occurring on the router. This output can be used to verify most RIP parameters to confirm that:

- RIP routing is configured
- The correct interfaces send and receive RIP updates
- The router advertises the correct networks
- RIP neighbors are sending updates


```
R1#show ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 16 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 1, receive any version
  Interface             Send  Recv  Triggered RIP  Key-chain
  FastEthernet0/0       1     2 1
  Serial0/0/0           1     2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
      192.168.1.0
      192.168.2.0
Passive Interface(s):
Routing Information Sources:
      Gateway         Distance      Last Update
      192.168.2.2          120
Distance: (default is 120)
R1#
```

R1 is indeed configured with RIP. R1 is sending and receiving RIP updates on FastEthernet0/0 and Serial0/0/0. R1 is advertising networks 192.168.1.0 and 192.168.2.0. R1 has one routing information source. R2 is sending R1 updates.

Step 3: Use the `debug ip rip` command to view the RIP messages being sent and received.

Rip updates are sent every 30 seconds so you may have to wait for debug information to be displayed.

```
R1#debug ip rip
R1#RIP: received v1 update from 192.168.2.2 on Serial0/0/0
      192.168.3.0 in 1 hops
      192.168.4.0 in 1 hops
      192.168.5.0 in 2 hops
RIP: sending  v1 update to 255.255.255.255 via FastEthernet0/0 (192.168.1.1)
RIP: build update entries
      network 192.168.2.0 metric 1
      network 192.168.3.0 metric 2
      network 192.168.4.0 metric 2
      network 192.168.5.0 metric 3
RIP: sending  v1 update to 255.255.255.255 via Serial0/0/0 (192.168.2.1)
RIP: build update entries
      network 192.168.1.0 metric 1
```

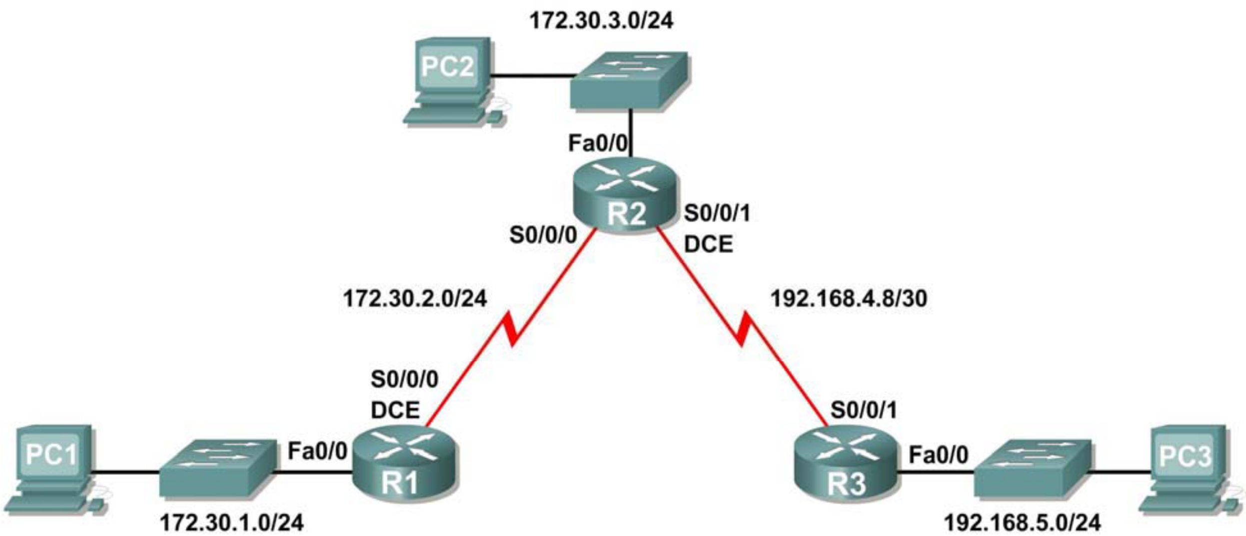
The debug output shows that R1 receives an update from R2. Notice how this update includes all the networks that R1 does not already have in its routing table. Because the FastEthernet0/0 interface belongs to the 192.168.1.0 network configured under RIP, R1 builds an update to send out that interface. The update includes all networks known to R1 except the network of the interface. Finally, R1 builds an update to send to R2. Because of split horizon, R1 only includes the 192.168.1.0 network in the update.

Step 4: Discontinue the debug output with the `undebug all` command.

```
R1#undebug all
All possible debugging has been turned off
```


Scenario B: Running RIPv1 with Subnets and Between Classful Networks

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	172.30.1.1	255.255.255.0	N/A
	S0/0/0	172.30.2.1	255.255.255.0	N/A
R2	Fa0/0	172.30.3.1	255.255.255.0	N/A
	S0/0/0	172.30.2.2	255.255.255.0	N/A
	S0/0/1	192.168.4.9	255.255.255.252	N/A
R3	Fa0/0	192.168.5.1	255.255.255.0	N/A
	S0/0/1	192.168.4.10	255.255.255.252	N/A
PC1	NIC	172.30.1.10	255.255.255.0	172.30.1.1
PC2	NIC	172.30.3.10	255.255.255.0	172.30.3.1
PC3	NIC	192.168.5.10	255.255.255.0	192.168.5.1

Task 1: Make Changes between Scenario A and Scenario B

Step 1: Change the IP addressing on the interfaces as shown in the Topology Diagram and the Addressing Table.

Sometimes when changing the IP address on a serial interface, you may need to reset that interface by using the **`shutdown`** command, waiting for the `LINK-5-CHANGED` message, and then using the **`no shutdown`** command. This process will force the IOS to starting using the new IP address.


```
R1(config)#int s0/0/0
R1(config-if)#ip add 172.30.2.1 255.255.255.0
R1(config-if)#shutdown

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to administratively
down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to
down
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up
R1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to
up
```

Step 2: Verify that routers are active.

After reconfiguring all the interfaces on all three routers, verify that all necessary interfaces are active with the **`show ip interface brief`** command.

Step 3: Remove the RIP configurations from each router.

Although you can remove the old **`network`** commands with the **`no`** version of the command, it is more efficient to simply remove RIP and start over. Remove the RIP configurations from each router with the **`no router rip`** global configuration command. This will remove all the RIP configuration commands including the **`network`** commands.

```
R1(config)#no router rip

R2(config)#no router rip

R3(config)#no router rip
```

Task 2: Configure RIP

Step 1: Configure RIP routing on R1 as shown below.

```
R1(config)#router rip
R1(config-router)#network 172.30.0.0
```

Notice that only a single network statement is needed for R1. This statement includes both interfaces on different subnets of the 172.30.0.0 major network.

Step 2: Configure R1 to stop sending updates out the FastEthernet0/0 interface.

Sending updates out this interface wastes the bandwidth and processing resources of all devices on the LAN. In addition, advertising updates on a broadcast network is a security risk. RIP updates can be intercepted with packet sniffing software. Routing updates can be modified and sent back to the router, corrupting the router table with false metrics that misdirects traffic.

The **`passive-interface fastethernet 0/0`** command is used to disable sending RIPv1 updates out that interface. When you are finished with the RIP configuration, return to privileged EXEC mode and save the current configuration to NVRAM.

```
R1(config-router)#passive-interface fastethernet 0/0
R1(config-router)#end
%SYS-5-CONFIG_I: Configured from console by console
R1#copy run start
```


Step 3: Configure RIP routing on R2 as shown below.

```
R2(config)#router rip
R2(config-router)#network 172.30.0.0
R2(config-router)#network 192.168.4.0
R2(config-router)#passive-interface fastethernet 0/0
R2(config-router)#end
%SYS-5-CONFIG_I: Configured from console by console
R2#copy run start
```

Again notice that only a single network statement is needed for the two subnets of 172.30.0.0. This statement includes both interfaces, on different subnets, of the 172.30.0.0 major network. The network for the WAN link between R2 and R3 is also configured.

When you are finished with the RIP configuration, return to privileged EXEC mode and save the current configuration to NVRAM.

Step 4: Configure RIP routing on R3 as shown below.

```
R3(config)#router rip
R3(config-router)#network 192.168.4.0
R3(config-router)#network 192.168.5.0
R3(config-router)#passive-interface fastethernet 0/0
R3(config-router)#end
%SYS-5-CONFIG_I: Configured from console by console
R3#copy run start
```

When you are finished with the RIP configuration, return to privileged EXEC mode and save the current configuration to NVRAM.

Task 3: Verify RIP Routing

Step 1: Use the `show ip route` command to verify that each router has all of the networks in the topology in the routing table.

```
R1#show ip route

<Output omitted>

     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.1.0 is directly connected, FastEthernet0/0
C       172.30.2.0 is directly connected, Serial0/0/0
R       172.30.3.0 [120/1] via 172.30.2.2, 00:00:22, Serial0/0/0
R    192.168.4.0/24 [120/1] via 172.30.2.2, 00:00:22, Serial0/0/0
R    192.168.5.0/24 [120/2] via 172.30.2.2, 00:00:22, Serial0/0/0
R1#
```

Note: RIPv1 is a classful routing protocol. Classful routing protocols do not send the subnet mask with network in routing updates. For example, 172.30.1.0 is sent by R2 to R1 without any subnet mask information.


```
R2#show ip route

<Output omitted>

     172.30.0.0/24 is subnetted, 3 subnets
R       172.30.1.0 [120/1] via 172.30.2.1, 00:00:04, Serial0/0/0
C       172.30.2.0 is directly connected, Serial0/0/0
C       172.30.3.0 is directly connected, FastEthernet0/0
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
R    192.168.5.0/24 [120/1] via 192.168.4.10, 00:00:19, Serial0/0/1
R2#
```

```
R3#show ip route

<Output omitted>

R    172.30.0.0/16 [120/1] via 192.168.4.9, 00:00:22, Serial0/0/1
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
C    192.168.5.0/24 is directly connected, FastEthernet0/0
```

Step 2: Verify that all necessary interfaces are active.

If one or more routing tables does not have a converged routing table, first make sure that all necessary interfaces are active with **`show ip interface brief`**.

Then use **`show ip protocols`** to verify the RIP configuration. Notice in the output from this command that the FastEthernet0/0 interface is no longer listed under **Interface** but is now listed under a new section of the output: **Passive Interface(s)**.

```
R1#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 20 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 version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Serial0/1/0           2     2
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    172.30.0.0
    209.165.200.0
Passive Interface(s):
      FastEthernet0/0
  Routing Information Sources:
    Gateway         Distance      Last Update
    209.165.200.229      120      00:00:15
  Distance: (default is 120)
```


Step 3: View the RIP messages being sent and received.

To view the RIP messages being sent and received use the **debug ip rip** command. Notice that RIP updates are not sent out of the fa0/0 interface because of the **passive-interface fastethernet 0/0** command.

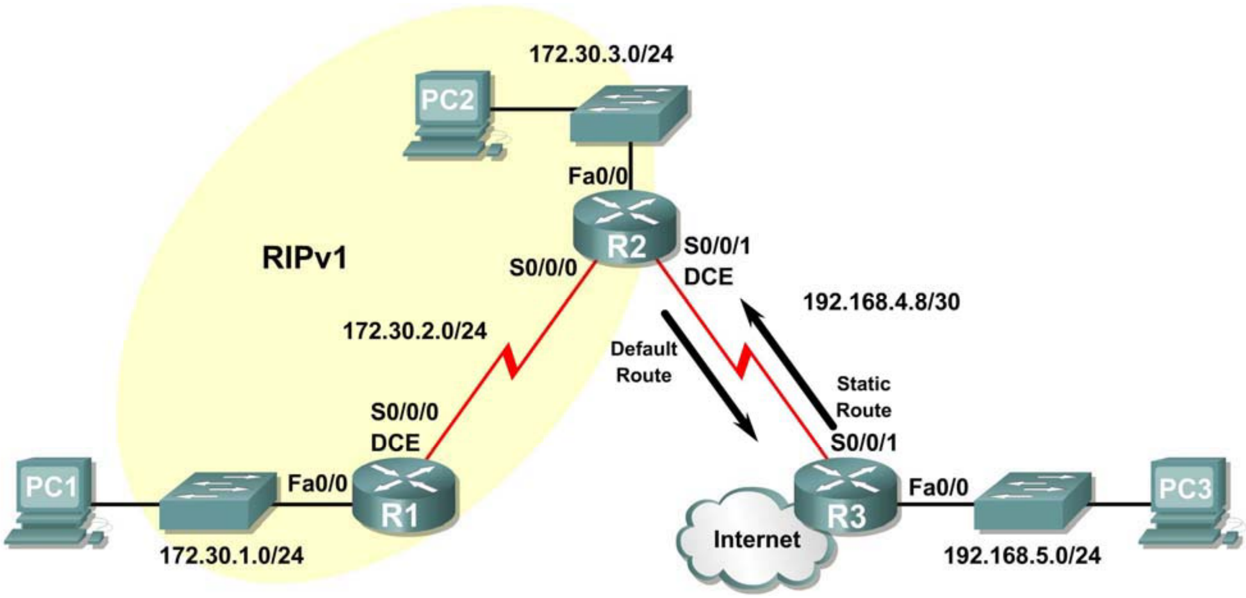
```
R1#debug ip rip
R1#RIP: sending  v1 update to 255.255.255.255 via Serial0/0/0 (172.30.2.1)
RIP: build update entries
      network 172.30.1.0 metric 1
RIP: received v1 update from 172.30.2.2 on Serial0/0/0
      172.30.3.0 in 1 hops
```

Step 4: Discontinue the debug output with the undebug all command.

```
R1#undebug all
All possible debugging has been turned off
```


Scenario C: Running RIPv1 on a Stub Network

Topology Diagram



Background

In this scenario we will modify Scenario B to only run RIP between R1 and R2. Scenario C is a typical configuration for most companies connecting a stub network to a central headquarters router or an ISP. Typically, a company runs a dynamic routing protocol (RIPv1 in our case) within the local network but finds it unnecessary to run a dynamic routing protocol between the company's gateway router and the ISP. For example, colleges with multiple campuses often run a dynamic routing protocol between campuses but use default routing to the ISP for access to the Internet. In some cases, remote campuses may even use default routing to the main campus, choosing to use dynamic routing only locally.

To keep our example simple, for Scenario C, we left the addressing intact from Scenario B. Let's assume that R3 is the ISP for our Company XYZ, which consists of the R1 and R2 routers using the 172.30.0.0/16 major network, subnetted with a /24 mask. Company XYZ is a stub network, meaning that there is only one way in and one way out of the 172.30.0.0/16 network—in via R2 (the gateway router) and out via R3 (the ISP). It doesn't make sense for R2 to send R3 RIP updates for the 172.30.0.0 network every 30 seconds, because R3 has no other way to get to 172.30.0.0 except through R2. It makes more sense for R3 to have a static route configured for the 172.30.0.0/16 network pointing to R2.

How about traffic from Company XYZ toward the Internet? It makes no sense for R3 to send over 120,000 summarized Internet routes to R2. All R2 needs to know is that if a packet is not destined for a host on the 172.30.0.0 network, then it should send the packet to the ISP, R3. This is the same for all other Company XYZ routers (only R1 in our case). They should send all traffic not destined for the 172.30.0.0 network to R2. R2 would then forward the traffic to R3.

Task 1: Make Changes between Scenario B and Scenario C.

Step 1: Remove network 192.168.4.0 from the RIP configuration for R2.

Remove network 192.168.4.0 from the RIP configuration for R2, because no updates will be sent between R2 and R3 and we don't want to advertise the 192.168.4.0 network to R1.

```
R2(config)#router rip
R2(config-router)#no network 192.168.4.0
```


Step 2: Completely remove RIP routing from R3.

```
R3(config)#no router rip
```

Task 2: Configure the Static Route on R3 for the 172.30.0.0/16 network.

Because R3 and R2 are not exchanging RIP updates, we need to configure a static route on R3 for the 172.30.0.0/16 network. This will send all 172.30.0.0/16 traffic to R2.

```
R3(config)#ip route 172.30.0.0 255.255.252.0 serial0/0/1
```

Task 3: Configure a Default Static Route on R2.

Step 1: Configure R2 to send default traffic to R3.

Configure a default static route on R2 that will send all default traffic—packets with destination IP addresses that do not match a specific route in the routing table—to R3.

```
R2(config)# ip route 0.0.0.0 0.0.0.0 serial 0/0/1
```

Step 2: Configure R2 to send default static route information to R1.

The **`default-information originate`** command is used to configure R2 to include the default static route with its RIP updates. Configure this command on R2 so that the default static route information is sent to R1.

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

Note: Sometimes it is necessary to clear the RIP routing process before the **`default-information originate`** command will work. First, try the command **`clear ip route *`** on both R1 and R2. This command will cause the routers to immediately flush routes in the routing table and request updates from each other. Sometimes this does not work with RIP. If the default route information is still not sent to R1, save the configuration on R1 and R2 and then reload both routers. Doing this will reset the hardware and both routers will restart the RIP routing process.

Task 4: Verify RIP Routing.

Step 1: Use the `show ip route` command to view the routing table on R2 and R1.

```
R2#show 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 0.0.0.0 to network 0.0.0.0

     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.2.0 is directly connected, Serial0/0/0
C       172.30.3.0 is directly connected, FastEthernet0/0
R       172.30.1.0 [120/1] via 172.30.2.1, 00:00:16, Serial0/0/0
```

```
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
S*   0.0.0.0/0 is directly connected, Serial0/0/1
```

Notice that R2 now has a static route tagged as a **candidate default**.

```
R1#show 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 172.30.2.2 to network 0.0.0.0

     172.30.0.0/24 is subnetted, 3 subnets
C       172.30.2.0 is directly connected, Serial0/0/0
R       172.30.3.0 [120/1] via 172.30.2.2, 00:00:05, Serial0/0/0
C       172.30.1.0 is directly connected, FastEthernet0/0
R*   0.0.0.0/0 [120/1] via 172.30.2.2, 00:00:19, Serial0/0/0
```

Notice that R1 now has a RIP route tagged as a **candidate default** route. The route is the “quad-zero” default route sent by R2. R1 will now send default traffic to the **Gateway of last resort** at 172.30.2.2, which is the IP address of R2.

Step 2: View the RIP updates that are sent and received on R1 with the `debug ip rip` command.

```
R1#debug ip rip
RIP protocol debugging is on
R1#RIP: sending  v1 update to 255.255.255.255 via Serial0/0/0 (172.30.2.1)
RIP: build update entries
      network 172.30.1.0 metric 1
RIP: received v1 update from 172.30.2.2 on Serial0/0/0
      0.0.0.0 in 1 hops
      172.30.3.0 in 1 hops
```

Notice that R1 is receiving the default route from R2.

Step 3: Discontinue the debug output with the `undebug all` command.

```
R1#undebug all
All possible debugging has been turned off
```

Step 4: Use the `show ip route` command to view the routing table on R3.

```
R3#show ip route

<Output omitted>

S    172.30.0.0/16 is directly connected, Serial0/0/1
     192.168.4.0/30 is subnetted, 1 subnets
C       192.168.4.8 is directly connected, Serial0/0/1
C    192.168.5.0/24 is directly connected, FastEthernet0/0
```

Notice that RIP is not being used on R3. The only route that is not directly connected is the static route.

Task 5: Document the Router Configurations

On each router, capture the following command output to a text file and save for future reference:

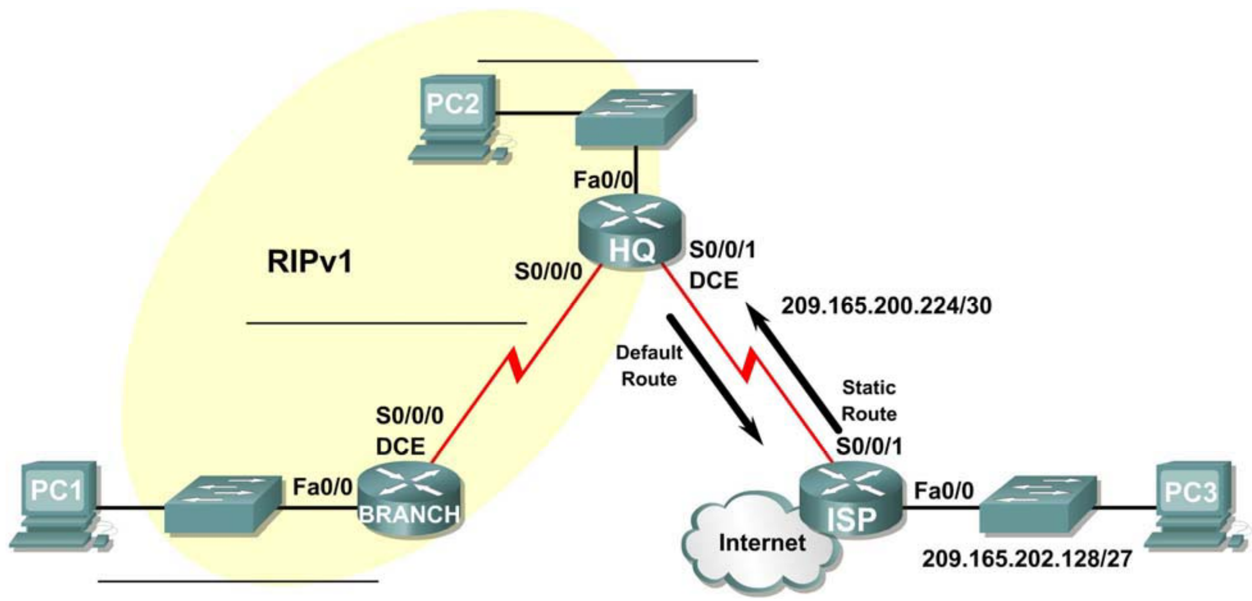
- Running configuration
- Routing table
- Interface summarization
- Output from **`show ip protocols`**

Task 6: Clean Up

Erase the configurations and reload the routers. Disconnect and store the cabling. For PC hosts that are normally connected to other networks (such as the school LAN or to the Internet), reconnect the appropriate cabling and restore the TCP/IP settings.

Lab 5.6.2: Challenge RIP Configuration

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
BRANCH	Fa0/0	10.10.2.1	255.255.254.0	N/A
	S0/0/0	192.168.1.65	255.255.255.192	N/A
HQ	Fa0/0	192.168.1.1	255.255.255.192	N/A
	S0/0/0	192.168.1.66	255.255.255.192	N/A
	S0/0/1	209.165.200.225	255.255.255.252	N/A
ISP	Fa0/0	209.165.202.129	255.255.255.224	N/A
	S0/0/1	209.165.200.226	255.255.255.252	N/A
PC1	NIC	10.10.2.2	255.255.254.0	10.10.2.1
PC2	NIC	192.168.1.2	255.255.255.192	192.168.1.1
PC3	NIC	209.165.202.130	255.255.254.224	209.165.202.129

Learning Objectives

Upon completion of this lab, you will be able to:

- Subnet an address space given requirements.
- Assign appropriate addresses to interfaces and document them in the Addressing Table.
- Cable a network according to the Topology Diagram.

- Erase the startup configuration and reload a router to the default state.
- Configure RIPv1 routing on all routers.
- Configure and propagate a static default route.
- Verify RIPv1 operation.
- Test and verify full connectivity.
- Reflect upon and document the network implementation.

Scenario

In this lab activity, you will be given a network address that must be subnetted to complete the addressing of the network shown in the Topology Diagram. A combination of RIPv1 and static routing will be required so that hosts on networks that are not directly connected will be able to communicate with each other.

Task 1: Subnet the Address Space.

Step 1: Examine the network requirements.

The addressing for the network has the following requirements:

- The ISP LAN will use the 209.165.202.128/27 network.
- The link between the ISP router and the HQ router will use the 209.165.200.224/30 network.
- The 192.168.1.0/24 network must be subnetted for use in the HQ LAN and the link between the HQ and BRANCH routers. The HQ LAN will require 50 host IP addresses.
- The BRANCH LAN will use the 10.10.2.0/23 network.

(**Note:** Remember that the interfaces of network devices are also host IP addresses and are included in the above addressing requirements.)

Step 2: Consider the following questions when creating your network design:

How many subnets need to be created from the 192.168.1.0/24 network? 4

What is the subnet mask for this network in dotted decimal format? 255.255.255.192

What is the subnet mask for the network in slash format? /26

What are the network addresses of the subnets?

Subnet 0: 192.168.1.0

Subnet 1: 192.168.1.64

Subnet 2: 192.168.1.128

Subnet 3: 192.168.1.192

How many usable host IP addresses are there per subnet? 62

How many usable hosts IP addresses are available in the BRANCH LAN? 512

Step 3: Assign subnetwork addresses to the Topology Diagram.

1. Assign subnet 1 in the 192.168.1.0 network to the WAN link between the HQ and BRANCH routers.
2. Assign subnet 2 in the 192.168.1.0 network to the LAN attached to the HQ router.

Task 2: Determine Interface Addresses.

Step 1: Assign appropriate addresses to the device interfaces.

1. Assign the first valid host address in the 209.165.202.128/27 network to the LAN interface on the ISP router.
2. Assign the last valid host address in the 209.165.202.128/27 network to PC3.
3. Assign the first valid host address in the 209.165.200.224/30 network to the WAN interface of the ISP router.
4. Assign the last valid host address in the 209.165.200.224/30 network to the Serial 0/0/1 interface of the HQ router.
5. Assign the first valid host address in the HQ LAN network to the LAN interface of the HQ router.
6. Assign the last valid host address in the HQ LAN network to PC 2.
7. Assign the first valid host address in the HQ/BRANCH WAN link to the Serial 0/0/0 interface of the HQ router.
8. Assign the last valid host address in the HQ/BRANCH WAN link to the Serial 0/0/0 interface of the BRANCH router.
9. Assign the first valid host address in the 10.10.2.0/23 network to the LAN interface on the BRANCH router.
10. Assign the last valid host address in the 10.10.2.0/23 network to PC1.

Step 2: Document the addresses to be used in the table provided under the Topology Diagram.

Task 3: Prepare the Network.

Step 1: Cable a network that is similar to the one in the Topology Diagram.

You can use any current router in your lab as long as it has the required interfaces shown in the topology.

Note: If you use 1700, 2500, or 2600 routers, the router outputs and interface descriptions will appear different.

Step 2: Clear any existing configurations on the routers.

Task 4: Perform Basic Router Configurations.

Perform basic configuration in the BRANCH, HQ, and ISP routers according to the following guidelines:

1. Configure the router hostname.
2. Disable DNS lookup.
3. Configure an EXEC mode password.
4. Configure a message-of-the-day banner.
5. Configure a password for console connections.
6. Configure a password for VTY connections.
7. Synchronize unsolicited messages and debug output with solicited output and prompts for the console and virtual terminal lines.
8. Configure an EXEC timeout of 15 minutes.

Task 5: Configure and Activate Serial and Ethernet Addresses.

Step 1: Configure the BRANCH, HQ, and ISP routers.

Configure the interfaces on the BRANCH, HQ, and ISP routers with the IP addresses from the Addressing Table provided under the Topology Diagram.

When you have finished, be sure to save the running configuration to the NVRAM of the router.

Step 2: Configure the Ethernet interfaces of PC1, PC2, and PC3.

Configure the Ethernet interfaces of PC1, PC2, and PC3 with the IP addresses from the Addressing Table provided under the Topology Diagram.

Task 6: Verify Connectivity to Next-Hop Device.

You should *not* have connectivity between end devices yet. However, you can test connectivity between two routers and between an end device and its default gateway.

Step 1: Verify BRANCH connectivity.

Verify that BRANCH can ping across the WAN link to HQ and that HQ can ping across the WAN link it shares with ISP.

Step 2: Verify Ethernet interface connectivity.

Verify that PC1, PC2, and PC3 can ping their respective default gateways.

Task 7: Configure RIP Routing on the BRANCH Router.

Consider the networks that need to be included in the RIP updates that are sent out by the BRANCH router.

What networks are currently present in the BRANCH routing table before RIP is configured? List the networks with slash notation.

10.0.0.0/23
____

192.168.1.0/26
____

____

What commands are required to enable RIP version 1 and include these networks in the routing updates?

router rip
____

10.0.0.0
____

192.168.1.0
____

Are there any router interfaces that do not need to have RIP updates sent out? yes

What command is used to disable RIP updates on this interface?

passive-interface fa0/0
____

Task 8: Configure RIP and Static Routing on the HQ Router

Consider the type of static routing that is needed on HQ.

What networks are present in the HQ routing table? List the networks with slash notation.

192.168.1.0/26

209.165.200.0/27

A static default route will need to be configured to send all packets with destination addresses that are not in the routing table to the ISP router. What command is needed to accomplish this? Use the appropriate exit interface on the HQ router in the command.

ip route 0.0.0.0 0.0.0.0 s0/1

What commands are required to enable RIPv1 and include the LAN network in the routing updates?

router rip

192.168.1.0

Are there any router interfaces that do not need to have RIP updates sent out? yes

What command is used to disable RIP updates on this interface?

passive-interface fa0/0

The HQ router needs to send the default route information to the BRANCH router in the RIP updates. What command is used to configure this?

default-information originate

Task 9: Configure Static Routing on the ISP Router

Static routes will need to be configured on the ISP router for all traffic that is destined for the RFC 1918 addresses that are used on the BRANCH LAN, HQ LAN, and the link between the BRANCH and HQ routers.

What are the commands that will need to be configured on the ISP router to accomplish this?

`ISP(config)#` ip route 10.10.2.0 255.255.254.0 s0/0/1

`ISP(config)#` ip route 192.168.1.0 255.255.255.0 s0/0/1

Task 10: Verify the Configurations

Answer the following questions to verify that the network is operating as expected.

From PC2, is it possible to ping PC1? yes

From PC2, is it possible to ping PC3? yes

From PC1, is it possible to ping PC3? yes

The answer to the above questions should be **yes**. If any of the above pings failed, check your physical connections and configurations. Refer to the basic troubleshooting techniques used in the Chapter 1 labs.

What routes are present in the routing table of the BRANCH router?

10.0.0.0/23

192.168.1.0/26

0.0.0.0/0

What is the gateway of last resort in the routing table of the BRANCH router?

192.168.1.65

What routes are present in the routing table of the HQ router?

10.0.0.0/8

192.168.1.0/26

209.165.200.0/27

0.0.0.0/0

What networks are present in the routing table of the ISP router?

10.0.0.0/23

192.168.1.0/24

209.165.200.0/27

209.165.202.0/27

What networks, including the metric, are present in the RIP updates sent from the HQ router?

0.0.0.0 metric 1

192.168.1.128 metric 1

What networks, including the metric, are present in the RIP updates sent from the BRANCH router?

10.0.0.0 metric 1

____

Task 11: Reflection

If static routing were used instead of RIP on the BRANCH router, how many individual static routes would be needed for hosts on the BRANCH LAN to communicate with all of the networks in the Topology Diagram? ____3____

Task 12: Document the Router Configurations

On each router, capture the following command output to a text file and save for future reference:

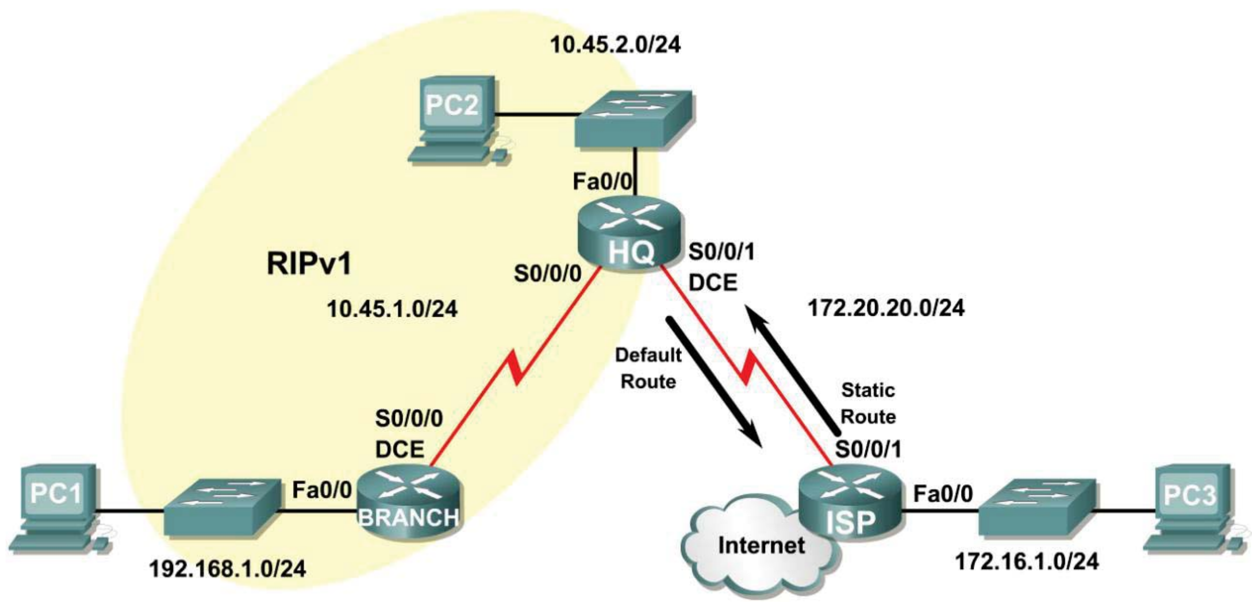
- Running configuration
- Routing table
- Interface summarization

Task 13: Clean Up

Erase the configurations and reload the routers. Disconnect and store the cabling. For PC hosts that are normally connected to other networks (such as the school LAN or to the Internet), reconnect the appropriate cabling and restore the TCP/IP settings.

Lab 5.6.3: RIP Troubleshooting

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
BRANCH	Fa0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0	10.45.1.254	255.255.255.0	N/A
HQ	Fa0/0	10.45.2.1	255.255.255.0	N/A
	S0/0/0	10.45.1.1	255.255.255.0	N/A
	S0/0/1	172.20.20.254	255.255.255.0	N/A
ISP	FA0/0	172.16.1.1	255.255.255.0	N/A
	S0/0/1	172.20.20.1	255.255.255.0	N/A
PC1	NIC	192.168.1.254	255.255.255.0	192.168.1.1
PC2	NIC	10.45.2.254	255.255.255.0	10.45.2.1
PC3	NIC	172.16.1.254	255.255.255.0	172.16.1.1

Learning Objectives

Upon completion of this lab, you will be able to:

- Cable a network according to the Topology Diagram.
- Erase the startup configuration and reload a router to the default state.
- Load the routers with supplied scripts.

- Discover where convergence is not complete.
- Gather information about the non-converged portion of the network along with any other errors.
- Analyze information to determine why convergence is not complete.
- Propose solutions to network errors.
- Implement solutions to network errors.
- Document the corrected network.

Scenario

In this lab, you will begin by loading configuration scripts on each of the routers. These scripts contain errors that will prevent end-to-end communication across the network. You will need to troubleshoot each router to determine the configuration errors and then use the appropriate commands to correct the configurations. When you have corrected all of the configuration errors, all of the hosts on the network should be able to communicate with each other.

The network should also have the following requirements met:

- RIPv1 routing is configured on the BRANCH router.
- RIPv1 routing is configured on the HQ router.
- RIP updates must be disabled on the BRANCH and HQ LAN interfaces.
- Static default route is configured on the HQ router and shared with the BRANCH router via RIP updates.
- Static routes for all HQ and BRANCH networks are to be configured on the ISP router. The routes must be summarized wherever possible.

Task 1: Cable, Erase, and Reload the Routers.

Step 1: Cable a network.

Cable a network that is similar to the one in the Topology Diagram.

Step 2: Clear the configuration on each router.

Clear the configuration on each of routers using the **`erase startup-config`** command and then **`reload`** the routers. Answer **no** if asked to save changes.

Task 2: Load Routers with the Supplied Scripts.

Step 1: Load the following script onto the BRANCH router.

```
hostname BRANCH
!
no ip domain-lookup
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
 no shutdown
!
interface Serial0/0/0
 ip address 10.45.1.254 255.255.255.0
 clock rate 64000
 no shutdown
!
```



```
router rip
 passive-interface FastEthernet0/0
 network 10.0.0.0
 network 192.168.1.0
!
line con 0
line vty 0 4
 password cisco
 login
!
end
```

Step 2: Load the following script onto the HQ router.

```
hostname HQ
!
no ip domain-lookup
!
interface FastEthernet0/0
 ip address 10.45.2.1 255.255.255.0
 duplex auto
 speed auto
 no shutdown
!
interface Serial0/0/0
 ip address 10.45.1.1 255.255.255.0
 no shutdown
!
interface Serial0/0/1
 ip address 172.20.20.254 255.255.255.0
 clock rate 64000
 no shutdown
!
router rip
 passive-interface FastEthernet0/0
network 10.0.0.0
default-information originate
!
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
!
line con 0
line vty 0 4
 password cisco
 login
!
end
```

Step 3: Load the following script onto the ISP router.

```
hostname ISP
!
no ip domain-lookup
!
interface FastEthernet0/0
```



```
 ip address 172.16.1.1 255.255.255.0
 duplex auto
 speed auto
 no shutdown
!
interface Serial0/0/1
 ip address 172.20.20.1 255.255.255.0
 no shutdown
!
ip route 10.45.0.0 255.255.252.0 Serial0/0/1
ip route 192.168.1.0 255.255.255.0 Serial0/0/1
!
line con 0
line vty 0 4
 password cisco
 login
!
end
```

Task 3: Troubleshoot the BRANCH Router

Step 1: Begin troubleshooting at the Host connected to the BRANCH router.

From the host PC1, is it possible to ping PC2? no

From the host PC1, is it possible to ping PC3? no

From the host PC1, is it possible to ping the default gateway? no

Step 2: Examine the BRANCH router to find possible configuration errors.

Begin by viewing the summary of status information for each interface on the router.

Are there any problems with the status of the interfaces?

fa0/0 is down

If there are any problems with the status of the interfaces, record any commands that will be necessary to correct the configuration errors.

config t

int fa0/0

no shutdown

Step 3: If you have recorded any commands above, apply them to the router configuration now.

Step 4: View summary of the status information.

If any changes were made to the configuration in the previous step, view the summary of the status information for the router interfaces again.

Does the information in the interface status summary indicate any configuration errors? no

If the answer is **yes**, troubleshoot the interface status of the interfaces again.

Step 5: Troubleshoot the routing configuration on the BRANCH router.

What networks are shown in the routing table?

10.0.0.0/24

192.168.1.0/24

Are there any problems with the routing table?

cannot reach networks beyond router

If there are any problems with the routing table, record any commands that will be necessary to correct the configuration errors.

What networks are included in the RIP updates?

none

Are there any problems with the RIP updates that are being sent out from the router?

rip should update with 192.168.1.0/24

If there are any problems with the RIP configuration, record any commands that will be necessary to correct the configuration errors.

config t

router rip

network 192.168.1.0

Step 6: If you have recorded any commands above, apply them to the router configuration now.

Step 7: View the routing information.

If any changes were made to the configuration in the previous steps, view the routing information again.

Does the information in routing table indicate any configuration errors? no

Does the information included in the RIP updates that are sent out indicate any configuration errors?
no

If the answer to either of these questions is **yes**, troubleshoot the routing configuration again.

What networks are included in the RIP updates?

192.168.1.0

Step 8: Attempt to ping between the hosts again.

From the host PC1, is it possible to ping PC2? no

From the host PC1, is it possible to ping PC3? no

From the host PC1, is it possible to ping the Serial 0/0 interface of the HQ router? yes

Task 4: Troubleshoot the HQ Router

Step 1: Begin troubleshooting at the Host connected to the R2 router.

From the host PC2, is it possible to ping PC1? no

From the host PC2, is it possible to ping PC3? no

From the host PC2, is it possible to ping the default gateway? yes

Step 2: Examine the HQ router to find possible configuration errors.

Begin by viewing the summary of status information for each interface on the router.

Are there any problems with the status of the interfaces?

no

If there are any problems with the status of the interfaces, record any commands that will be necessary to correct the configuration errors.

Step 3: If you have recorded any commands above, apply them to the router configuration now.

Step 4: View the summary of the status information.

If any changes were made to the configuration in the previous step, view the summary of the status information for the router interfaces again.

Does the information in the interface status summary indicate any configuration errors? no

If the answer is **yes**, troubleshoot the interface status of the interfaces again.

Step 5: Troubleshoot the routing configuration on the BRANCH router.

What networks are shown in the routing table?

0.0.0.0/0 10.0.0.0/24

192.168.1.0/24

172.20.20.0/24

Are there any problems with the routing table?

no

If there are any problems with the routing table, record any commands that will be necessary to correct the configuration errors.

What networks are included in the RIP updates?

0.0.0.0

10.45.1.0

192.168.1.0

Are there any problems with the RIP updates that are being sent out from the router?

passive interface is on for s0/0 should be on fa0/0

If there are any problems with the RIP configuration, record any commands that will be necessary to correct the configuration errors.

configure terminal

router rip

no passive-interface Serial 0/0/0

passive-interface FastEthernet 0/0

Step 6: If you have recorded any commands above, apply them to the router configuration now.

Step 7: View the routing information.

If any changes were made to the configuration in the previous steps, view the routing information again.

Does the information in routing table indicate any configuration errors? no

Does the information included in the RIP updates that are sent out indicate any configuration errors? no

If the answer to either of these questions is **yes**, troubleshoot the routing configuration again.

What networks are included in the RIP updates?

0.0.0.0

10.45.2.0

Step 8: Verify that the HQ router is sending a default route to the BRANCH router.

Is there a default route in the BRANCH routing table? no

If not, what commands are needed to configure this on the HQ router?

configure terminal

router rip

default-information originate

Step 9: If you have recorded any commands above, apply them to the HQ router configuration now.

Step 10: View the BRANCH routing table.

If any changes were made to the configuration in the previous step, view the BRANCH routing table again.

Is there a default route in the BRANCH routing table? yes

If the answer is **no**, troubleshoot the RIP configuration again.

Step 11: Attempt to ping between the hosts again.

From the host PC2, is it possible to ping PC1? yes

From the host PC2, is it possible to ping the Serial 0/1 interface of the ISP router? no

From the host PC1, is it possible to ping PC3? yes

Task 5: Troubleshoot the ISP Router

Step 1: Begin troubleshooting at the Host connected to the ISP router.

From the host PC3, is it possible to ping PC1? yes

From the host PC3, is it possible to ping PC2? no

From the host PC3, is it possible to ping the default gateway? yes

Step 2: Examine the ISP router to find possible configuration errors.

Begin by viewing the summary of status information for each interface on the router.

Are there any problems with the status of the interfaces?

no

If there are any problems with the status of the interfaces, record any commands that will be necessary to correct the configuration errors.

Step 3: If you have recorded any commands above, apply them to the router configuration now.

Step 4: View the summary of the status information.

If any changes were made to the configuration in the previous step, view the summary of the status information for the router interfaces again.

Does the information in the interface status summary indicate any configuration errors? no

If the answer is **yes**, troubleshoot the interface status of the interfaces again.

Step 5: Troubleshoot the static routing configuration on the ISP router.

Begin by viewing the routing table.

What networks are shown in the routing table?

10.0.0.0/23

172.16.0.0/24

172.20.0.0/24

192.168.1.0/24

Are there any problems with the routing configuration?

change mask for 10.0.0.0 to 255.255.252.0

If there are any problems with the routing configuration, record any commands that will be necessary to correct the configuration errors.

configure terminal

no ip route 10.45.0.0 255.255.254.0 Serial0/1

ip route 10.45.0.0 255.255.252.0 Serial0/1

Step 6: If you have recorded any commands above, apply them to the router configuration now.

Step 7: View the routing table.

If any changes were made to the configuration in the previous step, view the routing table again.

Does the information in the routing table indicate any configuration errors? no

If the answer is **yes**, troubleshoot the routing configuration again.

Step 8: Attempt to ping between the hosts again.

From the host PC3, is it possible to ping PC1? yes

From the host PC3, is it possible to ping PC2? yes

From the host PC3, is it possible to ping the WAN interface of the BRANCH router? yes

Task 6: Reflection

There were a number of configuration errors in the scripts that were provided for this lab. Use the space below to write a brief description of the errors that you found.

Task 7: Documentation

On each router, capture output from the following commands to a text (.txt) file and save for future reference:

- **`show running-config`**
- **`show ip route`**
- **`show ip interface brief`**
- **`show ip protocols`**

If you need to review the procedures for capturing command output, refer to Lab 1.5.1.

Task 8: Clean Up

Erase the configurations and reload the routers. Disconnect and store the cabling. For PC hosts that are normally connected to other networks (such as the school LAN or to the Internet), reconnect the appropriate cabling and restore the TCP/IP settings.

