NetSim®
NETWORK SIMULATOR®

Lab ID: 9.9K714E046.SUP1.3

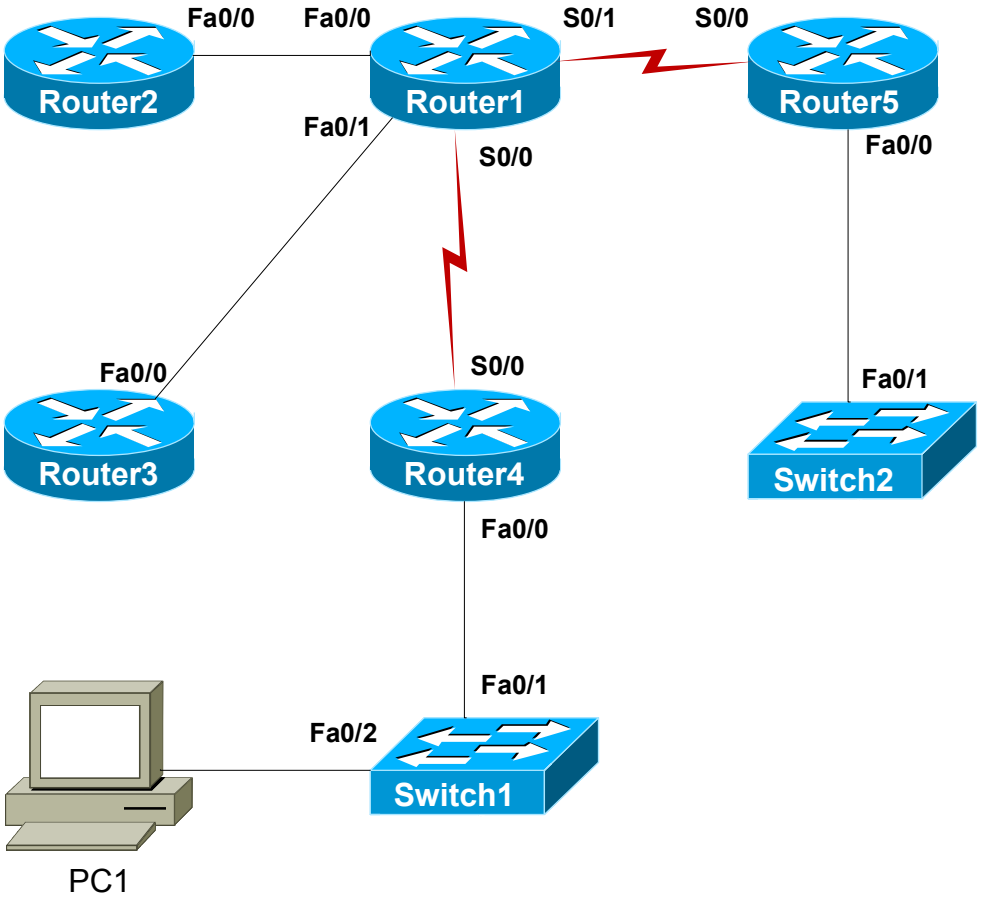
Supplemental Lab: RIPv2

Objective

Learn to configure Routing Information Protocol version 2 (RIPv2), and observe the limitations of RIPv1. Configure the appropriate settings on Router1, Router2, Router4, and Router5.

Lab Topology

The topology diagram below represents the NetMap in the Simulator.



Command Summary

Command	Description
clock rate *clock-rate*	sets the clock rate for a Data Communications Equipment (DCE) interface
configure terminal	enters global configuration mode from privileged EXEC mode
enable	enters privileged EXEC mode
end	ends and exits configuration mode
exit	exits one level in the menu structure
hostname *host-name*	sets the device name

Command	Description
interface *type number*	changes from global configuration mode to interface configuration mode
ip address *ip-address subnet-mask*	assigns an IP address to an interface
network *network-address*	activates the specified routing protocol on the specified network
no auto-summary	disables automatic route summary for a routing protocol
no shutdown	enables an interface
ping *ip-address*	sends an Internet Control Message Protocol (ICMP) echo request to the specified address
router rip	enables Routing Information Protocol (RIP) routing
show ip interface brief	displays a brief summary of interface status and configuration
show ip protocols	displays information about active routing protocols
show ip route	displays the IP routing table
show running-config	displays the active configuration file
version 2	enables RIPv2

The IP addresses and subnet masks used in this lab are shown in the table below:

IP Addresses

Device	Interface	IP Address	Subnet Mask
Router1	FastEthernet 0/0	10.1.1.1	255.255.255.0
	Serial 0/0	192.168.1.1	255.255.255.0
	Serial 0/1	172.16.1.1	255.255.255.0
Router2	FastEthernet 0/0	10.1.1.2	255.255.255.0
Router4	Serial 0/0	192.168.1.2	255.255.255.0
	Loopback 0	10.1.2.1	255.255.255.0
Router5	Serial 0/0	172.16.1.2	255.255.255.0
	Loopback 0	10.1.3.1	255.255.255.0

Lab Tasks

Task 1: Configure the Interfaces of Router1, Router2, Router4, and Router5

1. Configure Router1 with the appropriate host name, IP addresses, and subnet masks; refer to the IP Addresses table. Enable the interfaces. Configure a clock rate of 64 kilobits per second (Kbps) on the Serial interfaces. A clock rate must be configured on Router1 because it is the DCE end of both the link to Router4 and the link to Router5.

2. Configure Router2 with the appropriate host name, IP address, and subnet mask; refer to the IP Addresses table. Enable the interface.

3. Configure Router4 with the appropriate host name, IP addresses, and subnet masks; refer to the IP Addresses table. Enable the interfaces.

4. Configure Router5 with the appropriate host name, IP addresses, and subnet masks; refer to the IP Addresses table. Enable the interfaces.

5. On Router1, verify that you can ping Router2 (10.1.1.2), Router4 (192.168.1.2), and Router5 (172.16.1.2). The pings should be successful.

6. On Router1, Router2, Router4 and Router5, verify that the interfaces are correctly configured.

Task 2: Enable RIPv1 on Router1, Router2, Router4, and Router5

1. On Router1, configure RIP and advertise all directly connected networks.

2. On Router2, configure RIP and advertise all directly connected networks.

3. On Router4, configure RIP and advertise all directly connected networks.

4. On Router5, configure RIP and advertise all directly connected networks.

5. Wait at least 60 seconds for the network to converge.

Task 3: Review RIPv1 Limitations, and Configure RIPv2

1. By default, is RIPv1 a classful or classless routing protocol? What **show** command can you issue on Router1 to see whether RIPv1 is classful or classless? _____

2. Is RIPv2 a classful or classless routing protocol? _____

3. What improvements does RIPv2 offer over RIPv1? _____
   _____

4. What are the class boundaries for Internet Protocol version 4 (IPv4)?_____
   _____

5. On Router2, attempt to ping Router4's Loopback interface (10.1.2.1). Then attempt to ping Router5's Loopback interface (10.1.3.1). Do the pings fail or succeed? _____

6. On Router1, Router2, Router4, and Router5, configure RIPv2.

7. When you configured RIPv2 on the routers in the previous step, why was it unnecessary to issue the commands to advertise the networks? _____
_____

8. Why is it necessary to disable auto summarization when using RIPv2? _____
_____

9. Why is it necessary to wait a short period of time after enabling RIPv2 on the routers before you verify connectivity by issuing the **ping** command? _____
_____

Task 4: Verify RIPv2

1. On Router2, ping Router4's Loopback interface (10.1.2.1). Then attempt to ping Router5's Loopback interface (10.1.3.1). Both pings should now be successful.

2. On Router1, view the routing table.

Lab Solutions

Task 1: Configure the Router Interfaces

Task 1: Configure the Interfaces of Router1, Router2, Router4, and Router5

1. Issue the following commands to configure Router1 with the appropriate host name, IP addresses, and subnet masks and to enable the interfaces; you must also configure a clock rate on Router1's serial interfaces:

```
Router>enable
Router#configure terminal
Router(config)#hostname Router1
Router1(config)#interface fastethernet 0/0
Router1(config-if)#ip address 10.1.1.1 255.255.255.0
Router1(config-if)#no shutdown
Router1(config-if)#interface serial 0/0
Router1(config-if)#ip address 192.168.1.1 255.255.255.0
Router1(config-if)#clock rate 64000
Router1(config-if)#no shutdown
Router1(config-if)#interface serial 0/1
Router1(config-if)#ip address 172.16.1.1 255.255.255.0
Router1(config-if)#clock rate 64000
Router1(config-if)#no shutdown
```

2. Issue the following commands to configure Router2 with the appropriate host name, IP address, and subnet mask and to enable the interface:

```
Router>enable
Router#configure terminal
Router(config)#hostname Router2
Router2(config)#interface fastethernet 0/0
Router2(config-if)#ip address 10.1.1.2 255.255.255.0
Router2(config-if)#no shutdown
```

3. Issue the following commands to configure Router4 with the appropriate host name, IP addresses, and subnet masks and to enable the interfaces:

```
Router>enable
Router#configure terminal
Router(config)#hostname Router4
Router4(config)#interface serial 0/0
Router4(config-if)#ip address 192.168.1.2 255.255.255.0
Router4(config-if)#no shutdown
Router4(config-if)#interface loopback 0
Router4(config-if)#ip address 10.1.2.1 255.255.255.0
```

4. Issue the following commands to configure Router5 with the appropriate host name, IP addresses, and subnet masks and to enable the interfaces:

```
Router>enable
Router#configure terminal
Router(config)#hostname Router5
Router5(config)#interface serial 0/0
Router5(config-if)#ip address 172.16.1.2 255.255.255.0
Router5(config-if)#no shutdown
Router5(config-if)#interface loopback 0
Router5(config-if)#ip address 10.1.3.1 255.255.255.0
```

5. On Router1, verify that you can ping Router2, Router4, and Router5. The pings should be successful.

```
Router1(config-if)#end
Router1#ping 10.1.1.2
Router1#ping 192.168.1.2
Router1#ping 172.16.1.2
```

6. On Router1, Router2, Router4 and Router5, issue the **show ip interface brief** command to verify that the interfaces are correctly configured. Below is sample output for Router4:

```
Router4(config-if)#end
Router4#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
Serial0/0              192.168.1.2     YES unset  up                    up
Serial0/1              unassigned      YES unset  administratively down down
FastEthernet0/0        unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
Loopback0              10.1.2.1        YES unset  up                    up
```

Task 2: Enable RIPv1 on Router1, Router2, Router4, and Router5

1. On Router1, issue the following commands to configure RIP to advertise the 10.1.1.0, 192.168.1.0, and 172.16.1.0 networks:

```
Router1#configure terminal
Router1(config)#router rip
Router1(config-router)#network 10.1.1.0
Router1(config-router)#network 192.168.1.0
Router1(config-router)#network 172.16.1.0
```

2. On Router2, issue the following commands to configure RIP to advertise the 10.1.1.0 network:

```
Router2(config-if)#exit
Router2(config)#router rip
Router2(config-router)#network 10.1.1.0
```

3. On Router4, issue the following commands to configure RIP to advertise the 10.1.2.0 and 192.168.1.0 networks:

```
Router4#configure terminal
Router4(config)#router rip
Router4(config-router)#network 10.1.2.0
Router4(config-router)#network 192.168.1.0
```

4. On Router5, issue the following commands to configure RIP to advertise the 10.1.3.0 and 172.16.1.0 networks:

```
Router5(config-if)#exit
Router5(config)#router rip
Router5(config-router)#network 10.1.3.0
Router5(config-router)#network 172.16.1.0
```

5. Wait at least 60 seconds for the network to converge.

Task 3: Review RIPv1 Limitations, and Configure RIPv2

1. By default, RIPv1 is a classful routing protocol. It strictly follows the Class A, Class B, and Class C hierarchy. By issuing the **show ip protocols** command on Router1, you can see that RIP is advertising networks using classful boundaries.

```
Router1(config-router)#end
Router1#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
  Incoming update filter list for all interfaces is
  Redistributing:   rip
  Default version control: send version 1, receive any version
    Interface         Send  Recv   Key-chain
    Serial0/0           1     1 2
    Serial0/1           1     1 2
    FastEthernet0/0     1     1 2
  Routing for Networks:
    10.0.0.0
    172.16.0.0
    192.168.1.0
  Routing Information Sources:
    192.168.1.2           120      00:00:09
    172.16.1.2            120      00:00:09
  Distance: (default is 120)
```

2. RIPv2 is a classless routing protocol; classless routing protocols send subnet mask information in routing updates.

3. RIPv2 includes several improvements over RIPv1, including support for variable-length subnet masks (VLSMs), Classless Inter-Domain Routing (CIDR), authentication, route summarization, and key management.

4. The class boundaries for IPv4 are where the Class A, Class B, and Class C networks start and end. For private IP addresses, Class A ranges from 10.0.0.0 through 10.255.255.255, Class B ranges from 172.16.0.0 through 172.31.255.255, and Class C ranges from 192.168.0.0 through 192.168.255.255.

5. Pings from Router2 to Router4's Loopback interface, 10.1.2.1, and to Router5's Loopback interface, 10.1.3.1 should fail because, when the packet destined for 10.1.2.1 leaves Router2 and arrives at Router1, Router1 sends the packet back out the only route that it has for the 10.0.0.0 network, FastEthernet 0/0. When Router1 receives RIP updates from Router4 and Router5, it is using RIPv1, which is classful, so Router1 looks only at the 10.0.0.0 network.

   If you were to issue the **show ip route** command, you would see that Router1 already has a route for the 10.0.0.0 network, which is a route to the FastEthernet 0/0 interface on the directly connected neighbor, Router2 (10.1.1.1). A directly connected neighbor will have the least cost; therefore, Router1 ignores the RIPv1 updates from Router4 and Router5.

```
Router2(config-router)#end
Router2#ping 10.1.2.1
Router2#ping 10.1.3.1
```

   ERRATA NOTE: One of the two pings in this step may succeed. This is a known bug in NetSim that will be resolved as soon as possible.

```
Router1#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
       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, * - candidate default
       U - per-user static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
C    192.168.1.0 is directly connected, Serial0/0
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial0/1
```

6. On Router1, Router2, Router4, and Router5, issue the following commands to configure RIPv2:

```
Router1#configure terminal
Router1(config)#router rip
Router1(config-router)#version 2
Router1(config-router)#no auto-summary

Router2#configure terminal
Router2(config)#router rip
Router2(config-router)#version 2
Router2(config-router)#no auto-summary

Router4(config-router)#version 2
Router4(config-router)#no auto-summary

Router5(config-router)#version 2
Router5(config-router)#no auto-summary
```

7. When you configured RIPv2 on the routers in the previous step, it was unnecessary to issue the commands to advertise the networks because those commands had already been issued when RIPv1 was enabled.

8. By default, auto summarization is enabled for RIPv2. This feature will summarize a subnetted classful network at a network boundary before advertising the route. This feature should be disabled in order to advertise the subnetted routes of discontiguous classful networks.

9. You should allow a short period of time to elapse after enabling RIP in order to allow the network to converge. Network convergence occurs when the routes advertised on the routers are learned by other devices on the network.

Task 4: Verify RIPv2

1. On Router2, ping Router4's Loopback interface (10.1.2.1). Then attempt to ping Router5's Loopback interface (10.1.3.1). Both pings should now be successful.

```
Router2(config-router)#end
Router2#ping 10.1.2.1
Router2#ping 10.1.3.1
```

2. On Router1, issue the **show ip route** command to view the routing table. The show ip route command output displayed on Router1 should display a route to the 10.1.3.0 network through its Serial 0/1 interface and a route to the 10.1.2.0 network through its Serial 0/0 network. Below is sample output:

```
Router1(config-router)#end
Router1#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
       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, * - candidate default
       U - per-user static route

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 3 subnets
C       10.1.1.0 is directly connected, FastEthernet0/0
R       10.1.2.0 [120/1] via 192.168.1.2, 00:07:13, Serial0/0
R       10.1.3.0 [120/1] via 172.16.1.2, 00:08:37, Serial0/1
C    192.168.1.0 is directly connected, Serial0/0
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial0/1
```

Sample Configuration Script

Router1	Router1 (continued)
Router1#show running-config Building configuration... Current configuration : 806 bytes ! Version 12.3 service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname Router1 ! ip subnet-zero ! ip cef no ip domain-lookup ! interface Serial0/0 ip address 192.168.1.1 255.255.255.0 no ip directed-broadcast clock rate 64000 ! interface Serial0/1 ip address 172.16.1.1 255.255.255.0 no ip directed-broadcast clock rate 64000 !	interface FastEthernet0/0 ip address 10.1.1.1 255.255.255.0 no ip directed-broadcast ! interface FastEthernet0/1 no ip address no ip directed-broadcast shutdown ! router rip version 2 network 10.0.0.0 network 172.16.0.0 network 192.168.1.0 no auto-summary ! ip classless no ip http server ! line con 0 line aux 0 line vty 0 4 ! no scheduler allocate end