CSE 4512 [Computer Networks Lab]

Lab # 06

1. Objectives:

- Describe the concept of dynamic routing
- Explain disadvantages of RIPv1 and improvement in RIPv2
- Configure Routing Information Protocol (RIP) in a network topology following given specifications

2. Theory:

As with other labs, this lab will also build up on the concepts and techniques of previous labs. So, make sure you've properly understood the previous lab contents.

Dynamic Routing:

In the previous lab you learnt the concept of static routing and how to configure static routing in a network. You also saw that static routing has some serious disadvantages when it comes to configure large-scale networks. Network administrator needs to know about the whole topology and the network changes have to be reflected manually in the configuration. In this lab, you'll learn about dynamic routing which overcomes all these issues but at the cost of bandwidth overhead. Still, its better to use extra bandwidth than to configure everything manually.

Basically, dynamic routing lets routers to select routes based on the real-time network condition. Always there will be packets travelling around the networks to keep the routers up-to-date about the present network condition. Then the routers will select an optimal route to a given destination based on some set of metrics. The dynamic routing protocols perform this basic function. As you know by now, there are different types of dynamic routing protocols following different algorithms. Two most common ones are **Routing Information Protocol** (RIP) following distance-vector algorithm and **Open Shortest Path First** (OSPF) protocol following link state routing algorithm. We'll not look at how these algorithms work. This is covered in your theory class. In this lab, we'll look at RIP only. OSPF will be covered in next lab.

Routing Information Protocol (RIP)

Before starting, know that RIP is somewhat an obsolete protocol due to its limitations and the advent of more modern and sophisticated protocols like OSPF, EIGRP etc. Still, as this was one of the pioneering dynamic routing protocols and dominated the networking world for quite some time, you need to understand this. This will help you in turn to understand the improvements made in newer protocols.

There are two versions of RIP namely RIPv1 and RIPv2. **RIPv2** is the dominant one and is used almost in all cases where RIP is used. So, we'll focus on RIPv2 only for our lab. Major problem of RIPv1 was that it used to broadcast routing table updates every 30 seconds. You can imagine the flood of packets every 30 seconds that would take place where millions of networks are now interconnected, even if they are configured to send updates at random times. RIPv2 was designed to overcome this issue along with other improvements. You can learn more on these two versions here.

RIP uses hop count as the metric for routes. Paths with lower metric are selected always for a given destination. The max hop count is 15 for both versions of RIP to prevent loops. Any route further than 15 hops away are considered unreachable. To configure RIP, three steps are followed:

I. Enable RIP by using the *router rip* global configuration command.

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

II. Tell router to use the RIPv2 by the *version 2* command.

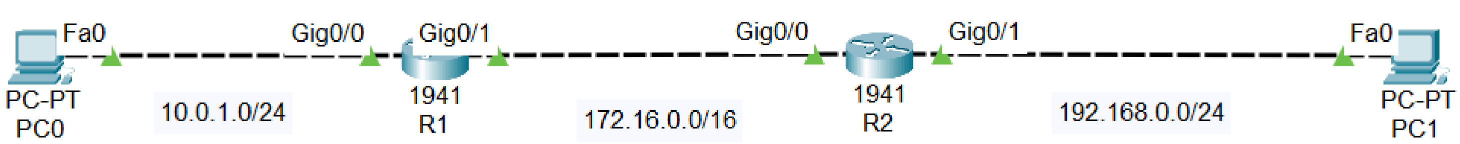
```
R1(config-router)#version 2
```

III. Tell RIP which networks to advertise by using one or more *network* commands.

```
R1(config-router)#network 10.0.0.0
```

In the 3rd step, you don't need to specify any subnet mask when using the network command. The network command takes a classful address as the parameter. As any address beginning with `10` belongs to class A, RIP will be enabled on *all the interfaces* that has IP address that begins with `10`.

3. Configure RIP:



I. **Configure R1 Interfaces**

```
R1(config)# int g0/0
R1(config-if)# ip address 10.0.1.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# exit

R1(config)# int g0/1
R1(config-if)# ip address 172.16.0.1 255.255.0.0
R1(config-if)# no shutdown
R1(config-if)# exit

R1# copy running-config startup-config
```

II. Configure R2 Interfaces

```
R2(config)# int g0/1
R2(config-if)# ip address 192.168.0.1 255.255.255.0
R2(config-if)# no shutdown
R2(config-if)# exit

R2(config)# int g0/0
R2(config-if)# ip address 172.16.0.2 255.255.0.0
R2(config-if)# no shutdown
R2(config-if)# exit

R2# copy running-config startup-config
```

III. Configure PC0

```
IP: 10.0.1.10
Mask: 255.255.255.0
Gateway: 10.0.1.1
```

IV. Configure PC1

```
IP: 192.168.0.10
Mask: 255.255.255.0
Gateway: 192.168.0.1
```

V. Configure RIP in R1

```
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#network 10.0.0.0
R1(config-router)#network 172.16.0.0
```

VI. Configure RIP in R2

```
R2(config)#router rip
R2(config-router)#version 2
R2(config-router)#network 192.168.0.0
R2(config-router)#network 172.16.0.0
```

VII. Verify

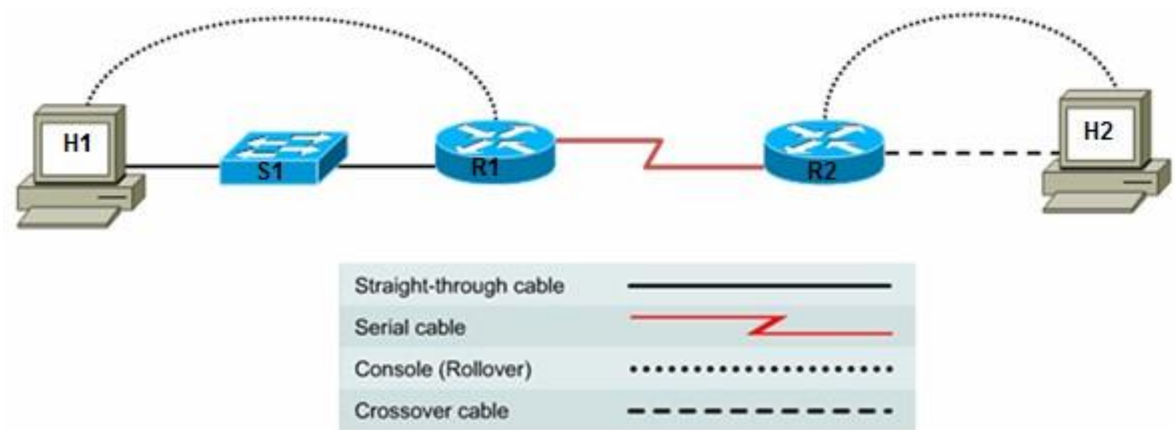
```
R1# show ip route rip

Ping PC1 from PC0
```

4. Tasks:

I. You will implement **RIP** following the address configurations and answer the given questions in this task. The task description for this task is provided in the pdf ***Task-1_RIP***. You're ***not*** provided a .pka file for this task. You need to create the topology on your own.

Lab 6.1.5 Configuring and Verifying RIP



Device	Host Name	Interface	IP Address	Subnet Mask
R1	R1	Serial 0/0/0 (DCE)	172.17.0.1	255.255.255.224
		Fast Ethernet 0/0	172.16.0.1	255.255.255.0
R2	R2	Serial 0/0/0 (DTE)	172.17.0.2	255.255.255.224
		Fast Ethernet 0/0	172.18.0.1	255.255.255.0

Objectives

- Implement RIP routing and verify that network routes are being exchanged dynamically.

Background / Preparation

RIP is one of the most commonly used and widely supported routing protocols in the networking industry. Knowledge of RIP and how to configure it using the Cisco IOS CLI is essential to success as a network technician. In this lab, you build a multi-router network and use RIP to automatically propagate routes, so hosts on remote networks can communicate.

Set up a network similar to the one in the diagram above. You can use any router or combination of routers that meets the interface requirements in the diagram, such as 800, 1600, 1700, 1800, 2500, or 2600 routers.

Refer to the chart at the end of the lab to correctly identify the interface identifiers to be used based on the equipment in the lab. Depending on the model of router, your output may vary from the output shown in this lab. The lab steps are intended to be executed on each router, unless you are specifically instructed otherwise.

From hosts H1 and H2, start a HyperTerminal session with each router.

Required Resources

The following resources are required:

- Two routers, each with an Ethernet and serial interface. These should be non-SDM routers, if possible, because the required SDM startup configuration is deleted when the startup-config is erased.
- Two Windows XP computers
- Two straight-through Category 5 Ethernet cables (H1 to switch and switch to R1)
- Crossover Category 5 Ethernet cable (H2 to router R2)
- Null serial cable
- Console cables (from H1 and H2 to routers R1 and R2)
- Access to the H1 and H2 command prompt
- Access to the H1 and H2 network TCP/IP configuration

Step 1: Build the network and configure the routers.

a. Build a network as shown in the topology diagram

b. In global configuration mode, configure the host names and interfaces according to the chart.

Note: See Lab 5.3.5 if you have difficulty with the basic router configuration. That lab provides instructions for using the Cisco IOS CLI.

Step 2: Configure the hosts.

a. Configure host H1 attached to R1 with an IP address, subnet mask, and default gateway that is compatible with the IP address of the R1 Fast Ethernet interface (172.16.0.1/24).

Host H1 IP configuration:

IP address: 172.16.0.2
Subnet mask: 255.255.0.0
Default gateway: 172.16.0.1

b. Configure host H2 attached to R2 with an IP address, subnet mask, and default gateway that is compatible with the IP address of the R2 Fast Ethernet interface (172.18.0.1/24).

Host H2 IP configuration:

IP address: 172.18.0.2
Subnet mask: 255.255.0.0
Default gateway: 172.18.0.1

Step 3: Check the R1 routing table.

a. View the IP routing table for R1 using the **show ip route** command.

```
R1>show ip route
<output omitted>
Gateway of last resort is not set
```

```
C 172.16.0.0/16 is directly connected,
FastEthernet0/0
C  172.17.0.0/16  is  directly  connected,
Serial0/0/0
```

b. What is the significance of the "C" to the left of the 172.16.0.0 and 172.17.0.0 network entries in the routing table?

____

c. Is there a route in the R1 routing table to the R2 Ethernet network 172.18.0.0? ______ Why?

____

Step 4: Test end-to-end connectivity.

a. From R1, ping the R2 router Fast Ethernet interface.

```
R1#ping 172.18.0.1
```

Are the pings successful? ____

b. From host H1, ping host H2 (from network 172.16.0.2 to network 172.18.0.2).

```
C:\>ping 172.18.0.2
```

Are the pings successful? _____

c. Why are the pings not successful? ____

____

____

Step 5: Configure the routing protocol of the routers.

There are two versions of RIP: version 1 and version 2. It is important to specify RIP version 2 (RIPv2) in this configuration, because RIPv2 is the most current version. Some routers default to RIPv2, but it is best to not assume that is the case.

a. In global configuration mode, enter the following on R1.

```
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#network 172.16.0.0
R1(config-router)#network 172.17.0.0
R1(config-router)#exit
R1(config)#exit
```

b. Save the R1 router configuration.

```
R1#copy running-config startup-config
```

c. In global configuration mode, enter the following on R2.

```
R2(config)#router rip
R2(config-router)#version 2
R2(config-router)#network 172.17.0.0
R2(config-router)#network 172.18.0.0
R2(config-router)#exit
R2(config)#exit
```

d. Save the R2 router configuration.

```
R2#copy running-config startup-config
```

Step 6: View the routing tables for each router.

a. In enable or privileged EXEC mode, examine the routing table entries using the **show ip route** command on router R1.

```
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    172.17.0.0/16 is directly connected, Serial0/0/0
C    172.16.0.0/16 is directly connected, FastEthernet0/0
R    172.18.0.0/16 [120/1] via 172.17.0.2, 00:00:17, Serial0/0/0
```

b. Which networks are shown in the R1 routing table?

____

____

c. What is the significance of the "R" to the left of the 172.18.0.0 network entry in the routing table?

____

d. What does "via 172.17.0.2" mean for this network route?

____

e. What does "Serial0/0/0" mean for this network route?

____

f. Examine the routing table entries on router R2.

```
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 not set

C    172.17.0.0/16 is directly connected, Serial0/0/0
R    172.16.0.0/16 [120/1] via 172.17.0.1, 00:00:13,
Serial0/0/0 C    172.18.0.0/16 is directly connected,
FastEthernet0/0
```

g. Which networks are shown in the R2 routing table?

____

____

Step 7: Test end-to-end connectivity.

a. From R1, ping the R2 router Fast Ethernet interface.

```
R1#ping 172.18.0.1
```

Are the pings successful? ____

b. From the host H1 command prompt, ping H2 (from network 172.16.0.2 to network 172.18.0.2).

```
C:\>ping 172.18.0.2
```

c. Are the pings successful? ____

If the answer is no for either question, troubleshoot the router configurations to find the error. Then do the pings again until the answer to both questions is yes. Be sure to check physical cabling for problems and bad connections, and make sure that you are using the correct cable types.

d. Why are the pings successful this time? ____

____

Step 8: Use debug to observe RIP communications

Using the **debug ip rip** command, you can see real-time communication and updates passing between routers that are running RIP.

Note: Running debug commands puts a significant load on the CPU of the router. Do not use debug commands on a production network, if possible.

a. On router R1, enter the **debug ip rip** command from privileged EXEC mode. Examine the exchange of routes between the two routers. The output should look similar to that shown here.

```
R1#debug ip rip
RIP protocol debugging is on
R1#
00:51:28: RIP: sending v2 update to 224.0.0.9 via Serial0/0/0
(172.17.0.1)
00:51:28: RIP: build update entries
00:51:28:       172.16.0.0/16 via 0.0.0.0, metric 1, tag 0
```

```
00:51:49: RIP: received v2 update from 172.17.0.2 on Serial0/0/0
00:51:49:      172.18.0.0/16 via 0.0.0.0 in 1 hops
00:51:57: RIP: sending v2 update to 224.0.0.9 via FastEthernet0/0
(172.16.0.1)
00:51:57: RIP: build update entries
00:51:57:       172.17.0.0/16 via 0.0.0.0, metric 1, tag 0
00:51:57:       172.18.0.0/16 via 0.0.0.0, metric 2, tag 0
```

b. Enter the command **undebug all** to stop all debugging activity.

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

c. What interface does router R1 send and receive updates through? ________________

d. Why does the route to 172.17.0.0 have a metric of 1, and the route to 172.18.0.0 have a metric of 2?

____ e.

Log off by typing **exit** and turn off the router.

Step 9: Reflection

a. What would happen to the routing table on router R1 if the Ethernet network on router R2 went down?

____

____

b. What would happen if router R1 was configured to run RIPv1, and R2 was configured to run RIPv2?

____

____

Router Interface Summary Table

Router Interface Summary				
Router Model	**Ethernet Interface #1**	**Ethernet Interface #2**	**Serial Interface #1**	**Serial Interface #2**
800 (806)	Ethernet 0 (E0)	Ethernet 1 (E1)		
1600	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)
1700	Fast Ethernet 0 (FA0)	Fast Ethernet 1 (FA1)	Serial 0 (S0)	Serial 1 (S1)
1800	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2500	Ethernet 0 (E0)	Ethernet 1 (E1)	Serial 0 (S0)	Serial 1 (S1)
2600	Fast Ethernet 0/0 (FA0/0)	Fast Ethernet 0/1 (FA0/1)	Serial 0/0 (S0/0)	Serial 0/1 (S0/1)

Note: To find out exactly how the router is configured, look at the interfaces. The interface identifies the type of router and how many interfaces the router has. There is no way to effectively list all combinations of configurations for each router class. What is provided are the identifiers for the possible combinations of interfaces in the device. This interface chart does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The information in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.