NATIONAL UNIVERSITY OF COMPUTER & EMERGING SCIENCE
Computer Network Lab (CL307)
Lab Session 12

Static Routing Vs Dynamic Routing

Routing tables can contain directly connected, manually configured static routes and routes learned dynamically using a routing protocol. Network professionals must understand when to use static or dynamic routing. This section compares static routing and dynamic routing.

Static Routing

Before identifying the benefits of dynamic routing protocols, consider the reasons why network professionals use static routing. Dynamic routing certainly has several advantages over static routing; however, static routing is still used in networks today. In fact, networks typically use a combination of both static and dynamic routing.

Static routing has several primary uses, including:

- **Providing ease of routing table maintenance in smaller networks that are not expected to grow significantly.**
- **Routing to and from a stub network, which is a network with only one default route out and no knowledge of any remote networks.**
- **Accessing a single default route (which is used to represent a path to any network that does not have a more specific match with another route in the routing table).**

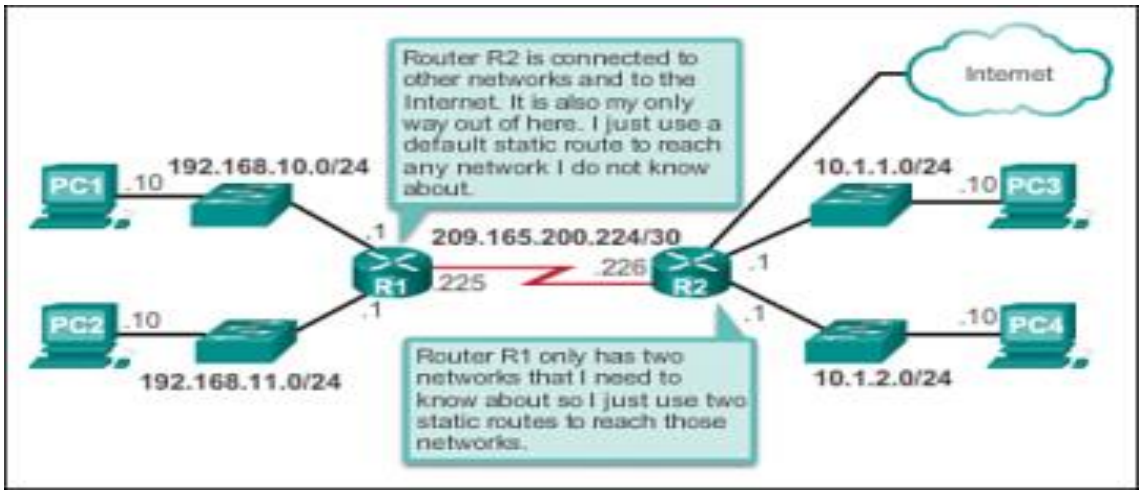


Figure 7.1: provides a sample static routing scenario.

Static routing is easy to implement in a small network. Static routes stay the same, which makes them fairly easy to troubleshoot. Static routes do not send update messages and, therefore, require very little overhead.

The disadvantages of static routing include:

- **They are not easy to implement in a large network.**
- **Managing the static configurations can become time consuming.**
- **If a link fails, a static route cannot reroute traffic.**

Advantages	Disadvantages
Easy to implement in a small network.	Suitable for simple topologies or for special purposes such as a default static route.
Very secure. No advertisements are sent, unlike with dynamic routing protocols.	Configuration complexity increases dramatically as the network grows. Managing the static configurations in large networks can become time consuming.
It is very predictable, as the route to the destination is always the same.	If a link fails, a static route cannot reroute traffic. Therefore, manual intervention is required to re-route traffic.
No routing algorithm or update mechanisms are required. Therefore, extra resources (CPU and memory) are not required.	

Table 7.2 highlights the advantages and disadvantages of static routing.

Dynamic Routing Protocols

Dynamic routing protocols help the network administrator manage the time-consuming and exacting process of configuring and maintaining static routes.

Imagine maintaining the static routing configurations for the seven routers in Figure 7.3.

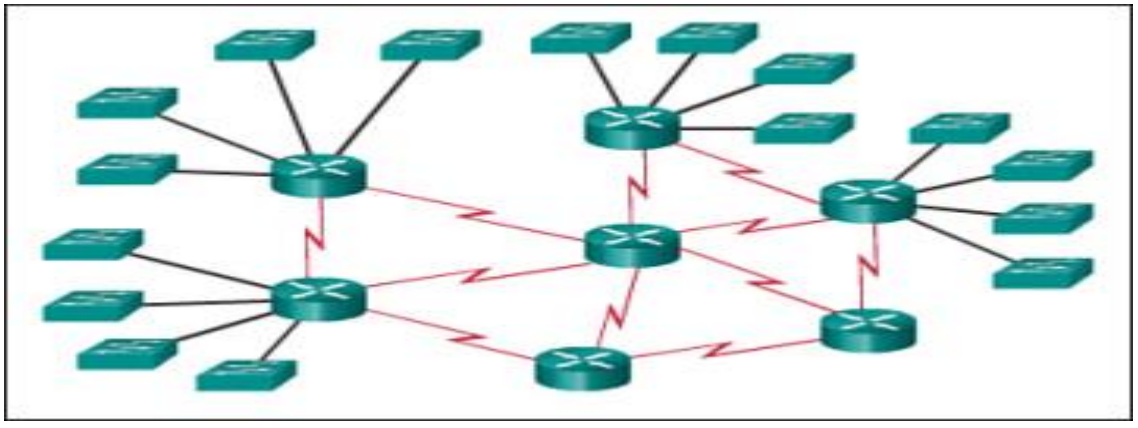


Figure 7.3 Small Dynamic Routing Scenario

What if the company grew and now has four regions and 28 routers to manage, as shown in Figure 7.4? What happens when a link goes down? How do you ensure that redundant paths are available?

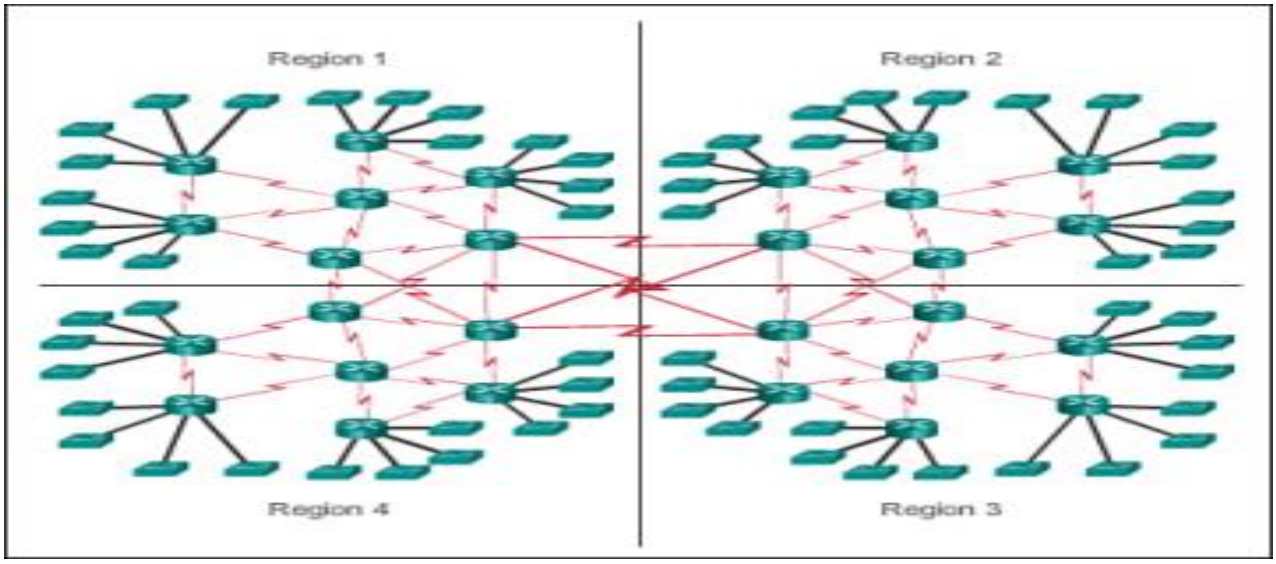


Figure 7.4 Large Dynamic Routing Scenario

Dynamic routing is the best choice for large networks like the one shown in Figure 7.4.

Dynamic routing protocols work well in any type of network consisting of several routers. They are scalable and automatically determine better routes if there is a change in the topology. Although there is more to the configuration of dynamic routing protocols, they are simpler to configure in a large network.

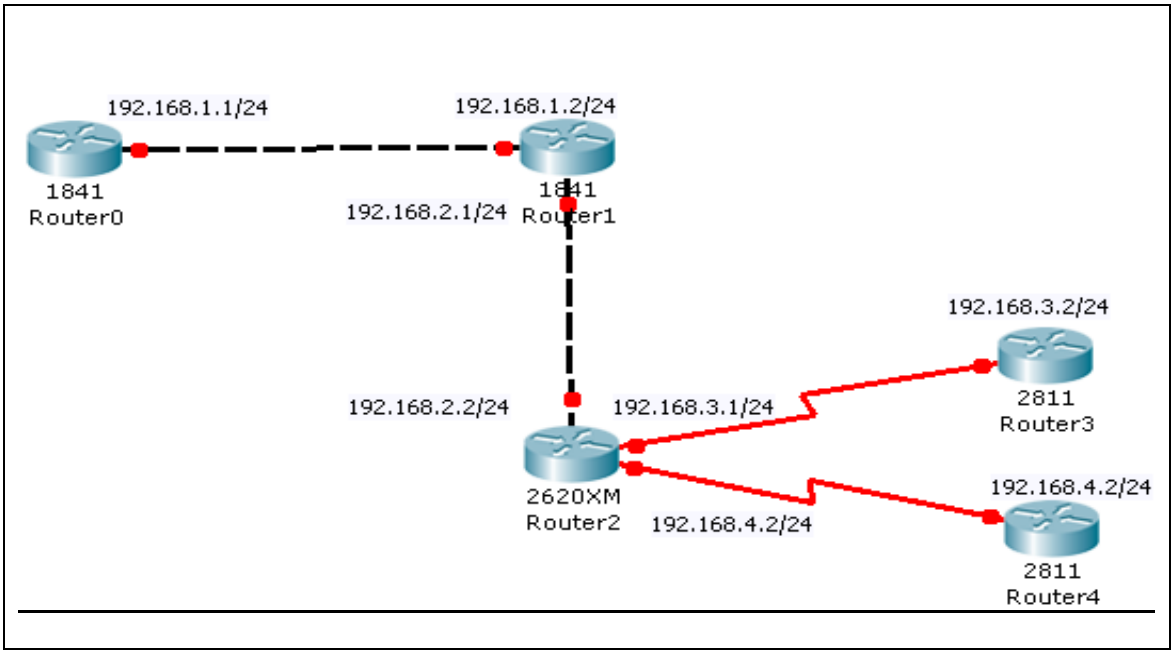
There are disadvantages to dynamic routing. Dynamic routing requires knowledge of additional commands. It is also less secure than static routing because the interfaces identified by the routing protocol send routing updates out. Routes taken may differ between packets. The routing algorithm uses additional CPU, RAM, and link bandwidth.

Advantages	Disadvantages
Suitable in all topologies where multiple routers are required.	Can be more complex to initially implement.
Generally independent of the network size.	Less secure due to the broadcast and multicast routing updates. Additional configuration settings such as passive interfaces and routing protocol authentication are required to increase security.
Automatically adapts topology to reroute traffic if possible.	Route depends on the current topology.
	Requires additional resources such as CPU, memory, and link bandwidth.

Table#7.5: highlights the advantages and disadvantages of dynamic routing.

Implementation of Default and Static route

Default Route



Lab Tasks

1. Create a default route on router 0 and 1 to reach network 192.168.3.0/24 and 192.168.4.0/24
2. Create a default route on router 3 and 4 to reach network 192.168.1.0/24 and 192.168.2.0/24
3. Test connectivity by ping router 2 from router 0

Lab Configuration

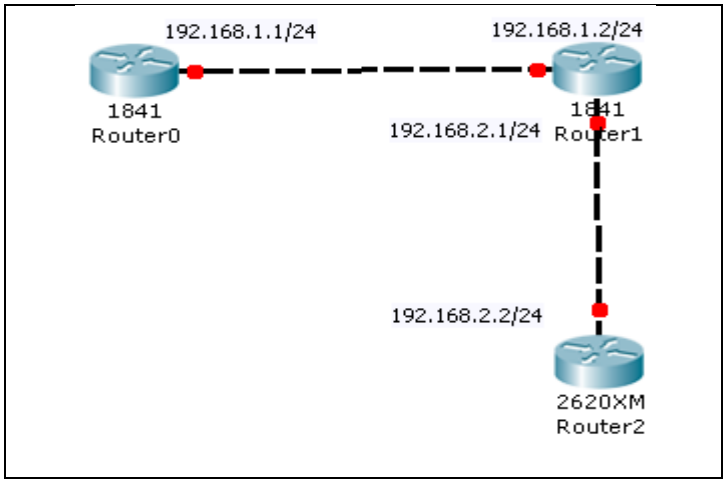
Task 1

Router 0
Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.1.2
Router 1
Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.2.2

Task 2

Router 3
Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.3.1
Router 4
Router(config)#ip route 0.0.0.0 0.0.0.0 192.168.3.1

Static route



Lab Tasks

1. **configure ip addresses on all routers and establish connectivity**
2. **create a static route on router 0 to reach 192.168.2.0/24 network**
3. **create a static route on router 2 to reach 192.168.1.0/24 network**
4. **Test connectivity by pinging router 2 from router 0**

Lab Configuration

Task 1

Router 0

```
Router(config)#interface fastethernet 0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
```

Router 1

```
Router(config)#interface fastethernet 0/0
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#no shutdown

Router(config)#interface fastethernet 0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
```

Router 2

```
Router(config)#interface fastethernet 0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
```

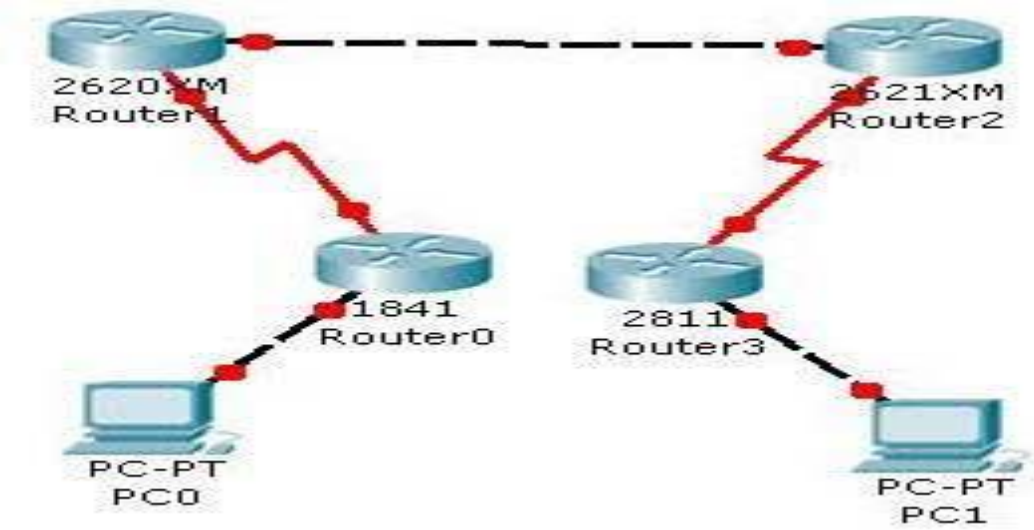
Task 2

```
Router(config)#ip route 192.168.2.0 255.255.255.0 192.168.1.2
```

Task 3

```
Router(config)#ip route 192.168.1.0 255.255.255.0 192.168.2.1
```

DYNAMIC ROUTING ALGORITHM



IP RIP comes in two different versions: 1 and 2. Version 1 is a distance vector protocol and is defined in RFC 1058. Version 2 is a hybrid protocol and is defined in RFCs 1721 and 1722. The CCNA exam now primarily focuses on version 2. There are no major differences between RIPv1 or RIPv2 so far configurations concern. To read more about differences between RIPv1 or RIPv2 or know about the characteristics read our pervious article about RIP.

1841 Series Router0 (R1)		
	FastEthernet0/0	Serial0/0/0
IP address	10.0.0.1	20.0.0.1
Connected With	Pc0	R2 on Serial 0/0
2811 Series Router0 (R4)		
	FastEthernet0/0	Serial0/0/0
IP address	50.0.0.1	40.0.0.2
Connected With	Pc1	R3 on Serial 0/0
2621XM Series Router0 (R3)		

	FastEthernet0/0	Serial0/0/0
IP address	30.0.0.2	40.0.0.1
Connected With	FastEthernet0/0	R4 on Serial 0/0/0
2620XM Series Router1 (R2)		
	FastEthernet0/0	Serial0/0
IP address	30.0.0.1	20.0.0.2
Connected With	R3 on FastEthernet0/0	R1 on Serial 0/0/0
PC-PT PC0		
	FastEthernet0	Default Gateway
IP address	10.0.0.2	10.0.0.1
Connected With	R1 on FastEthernet0/0	
PC-PT PC1		
	FastEthernet0	Default Gateway
IP address	50.0.0.2	50.0.0.1
Connected With	R4 on FastEthernet0/0	

To configure any router double click on it and select CLI. To configure this topology use this step by step guide.

(1841Router0) Hostname R1

To configure and enable rip routing on R1 follow these commands exactly.

```
Router>enable
Router#configure terminal
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fastethernet 0/0
R1(config-if)#ip address 10.0.0.1 255.0.0.0
R1(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config-if)#exit
R1(config)#interface serial 0/0/0
R1(config-if)#ip address 20.0.0.1 255.0.0.0
R1(config-if)#clock rate 64000
R1(config-if)#bandwidth 64
R1(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to down
R1(config-if)#exit
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up
R1(config)#router rip
R1(config-router)#network 10.0.0.0
R1(config-router)#network 20.0.0.0
R1(config-router)#exit
R1(config)#
```

(2620XM-Router1) Hostname R2

To configure and enable rip routing on R2 follow these commands exactly.

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface serial 0/0
```

```
R2(config-if)#ip address 20.0.0.2 255.0.0.0

R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up

R2(config-if)#exit

R2(config)#interface fastethernet 0/0

R2(config-if)#ip address 30.0.0.1 255.0.0.0

R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

R2(config-if)#exit

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

R2(config)#router rip

R2(config-router)#network 20.0.0.0

R2(config-router)#network 30.0.0.0

R2(config-router)#exit

R2(config)#
```

(2620XM-Router2)Hostname R3

To configure and enable rip routing on R3 follow these commands exactly.

```
Router>enable

Router#configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.

Router(config)#hostname R3

R3(config)#interface fastethernet 0/0

R3(config-if)#ip address 30.0.0.2 255.0.0.0

R3(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

R3(config-if)#interface serial 0/0
```

```
R3(config-if)#ip address 40.0.0.1 255.0.0.0

R3(config-if)#clock rate 64000

R3(config-if)#bandwidth 64

R3(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down

R3(config-if)#exit

%LINK-5-CHANGED: Interface Serial0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up

R3(config)#router rip

R3(config-router)#network 30.0.0.0

R3(config-router)#network 40.0.0.0

R3(config-router)#exit

R3(config)#
```

(2811Router3) Hostname R4

To configure and enable rip routing on R4 follow these commands exactly.

```
Router>enable

Router#configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.

Router(config)#interface serial 0/0/0

Router(config-if)#ip address 40.0.0.2 255.0.0.0

Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

Router(config-if)#exit

Router(config)#interface fastethernet 0/0

Router(config-if)#ip address 50.0.0.1 255.0.0.0

Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
```

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit

R4(config)#router rip

R4(config-router)#network 40.0.0.0

R4(config-router)#network 50.0.0.0

R4(config-router)#exit

R4(config)#

PC-1

```
PC>ipconfig


IP Address.....: 10.0.0.2

Subnet Mask.....: 255.0.0.0

Default Gateway.....: 10.0.0.1


PC>ping 50.0.0.2


Pinging 50.0.0.2 with 32 bytes of data:


Reply from 50.0.0.2: bytes=32 time=156ms TTL=124

Reply from 50.0.0.2: bytes=32 time=127ms TTL=124

Reply from 50.0.0.2: bytes=32 time=156ms TTL=124

Reply from 50.0.0.2: bytes=32 time=140ms TTL=124


Ping statistics for 50.0.0.2:

    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

    Minimum = 127ms, Maximum = 156ms, Average = 144ms

PC>
```

PC-2

```
PC>ipconfig

IP Address.....: 50.0.0.2

Subnet Mask.....: 255.0.0.0

Default Gateway.....: 50.0.0.1


PC>ping 10.0.0.2


Pinging 10.0.0.2 with 32 bytes of data:


Reply from 10.0.0.2: bytes=32 time=140ms TTL=124

Reply from 10.0.0.2: bytes=32 time=141ms TTL=124

Reply from 10.0.0.2: bytes=32 time=157ms TTL=124

Reply from 10.0.0.2: bytes=32 time=156ms TTL=124


Ping statistics for 10.0.0.2:

    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

    Minimum = 140ms, Maximum = 157ms, Average = 148ms
```

You can verify that RIP is running successfully via show ip protocols command in privilege mode.

```
R1#show ip protocols

Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 2 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
```

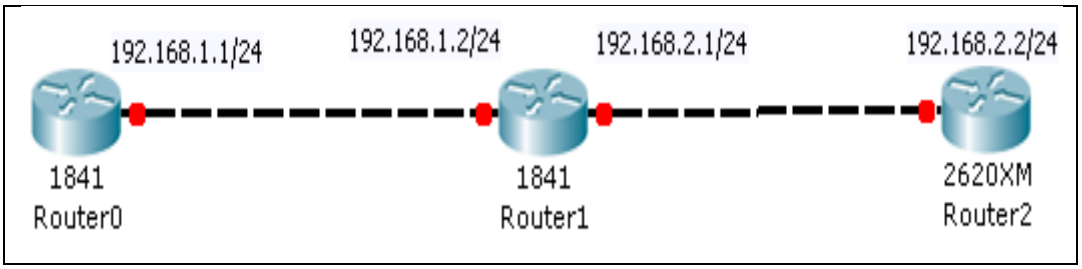
```
  Interface              Send  Recv  Triggered RIP  Key-chain
  FastEthernet0/0        1     2 1
  Serial0/0/0            1     2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
    10.0.0.0
    20.0.0.0
Passive Interface(s):
Routing Information Sources:
    Gateway         Distance      Last Update
    20.0.0.2              120      00:00:20
Distance: (default is 120)
R1#
```

You can use show ip route command to troubleshoot rip network. If you did not see information about any route checks the router attached with that network.

```
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    10.0.0.0/8 is directly connected, FastEthernet0/0
```

```
C    20.0.0.0/8 is directly connected, Serial0/0/0

R    30.0.0.0/8 [120/1] via 20.0.0.2, 00:00:01, Serial0/0/0

R    40.0.0.0/8 [120/2] via 20.0.0.2, 00:00:01, Serial0/0/0

R    50.0.0.0/8 [120/3] via 20.0.0.2, 00:00:01, Serial0/0/0

R1#
```

Rip version 2 Configuration



Configure Rip ver 2 protocol on all routers and disable auto summarisation

Lab Configuration

Task 1

Router 0

Router(config)#router rip

Router(config-router)#version 2

Router(config-router)#network 192.168.1.0

Router(config-router)#no auto-summary

Router 1

Router(config)#router rip

Router(config-router)#version 2

Router(config-router)#network 192.168.1.0

Router(config-router)#network 192.168.2.0

Router(config-router)#no auto-summary

Router 2

Router(config)#router rip

Router(config-router)#version 2

Router(config-router)#network 192.168.2.0

Router(config-router)#no auto-summary