Data Communication and Computer Networks

EEE314

Lab # 05

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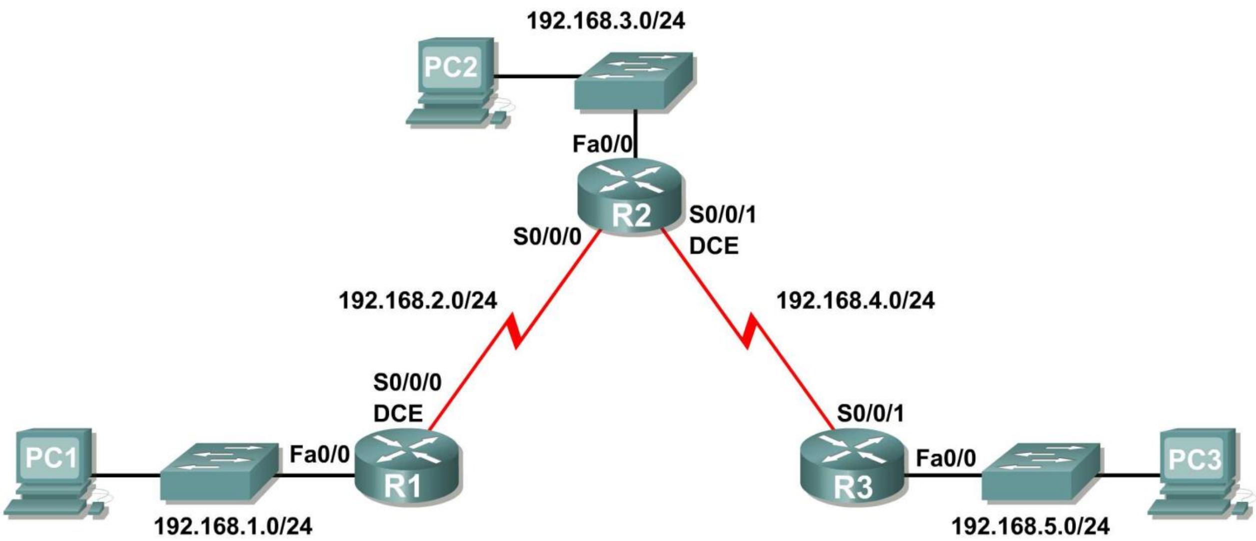
LAB #05 RIP Configuration

Topology Diagram



Learning Objectives

- 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.

Pre Lab

Perspective and Background of Dynamic Routing:

Dynamic routing protocols have evolved over several years to meet the demands of changing network requirements. Although many organizations have migrated to more recent routing protocols such as Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First (OSPF), many of the earlier routing protocols, such as Routing Information Protocol (RIP), are still in use today.

One of the earliest routing protocols was RIP. RIP has evolved into a newer version: RIPv2. However, the newer version of RIP still does not ***scale*** to larger network implementations. To address the needs of larger networks, two advanced routing protocols were developed: OSPF and Intermediate System–to–Intermediate System (IS-IS). Cisco developed Interior Gateway Routing Protocol (IGRP) and Enhanced IGRP (EIGRP). EIGRP also scales well in larger network implementations. Additionally, there was the need to interconnect different internetworks and provide routing among them. Border Gateway Protocol (BGP) is now used between Internet service providers (ISP) as well as between ISPs and their larger private clients to exchange routing information.

Role of Dynamic Routing Protocol

What exactly are dynamic routing protocols? Routing protocols are used to facilitate the exchange of routing information between routers. Routing protocols allow routers to dynamically learn information about remote networks and automatically add this information to their own routing tables.

Routing protocols determine the best path to each network, which is then added to the routing table. One of the primary benefits of using a dynamic routing protocol is that routers exchange routing information whenever there is a topology change. This exchange allows routers to automatically learn about new networks and also to find alternate paths if there is a link failure to a current network.

Compared to static routing, dynamic routing protocols require less administrative overhead. However, the expense of using dynamic routing protocols is dedicating part of a router’s resources for protocol operation, including CPU time and network link bandwidth. Despite the benefits of dynamic routing, static routing still has its place. There are times when static routing is more appropriate and other times when dynamic routing is the better choice. More often than not, you will find a combination of both types of routing in any network that has a moderate level of complexity.

Purpose of Dynamic Routing Protocols

A routing protocol is a set of processes, algorithms, and messages that are used to exchange routing information and populate the routing table with the routing protocol’s choice of best paths. The purpose of a routing protocol includes

- Discovering remote networks
- Maintaining up-to-date routing information

■ Choosing the best path to destination networks
■ Having the ability to find a new best path if the current path is no longer available

The components of a routing protocol are as follows:
■ **Data structures:** Some routing protocols use tables or databases for their operations. This information is kept in RAM.

■ **Algorithm:** An ***algorithm*** is a finite list of steps used in accomplishing a task. Routing protocols use algorithms for processing routing information and for best-path determination.
■ **Routing protocol messages:** Routing protocols use various types of messages to discover neighboring routers, exchange routing information, and do other tasks to learn and maintain accurate information about the network

Dynamic Routing Protocol Operation
All routing protocols have the same purpose: to learn about remote networks and to quickly adapt whenever there is a change in the topology. The method that a routing protocol uses to accomplish this depends on the algorithm it uses and the operational characteristics of that protocol. The operations of a dynamic routing protocol vary depending on the type of routing protocol and the specific operations of that routing protocol. The specific operations of RIP, EIGRP, and OSPF are examined in later chapters. In general, the operations of a dynamic routing protocol can be described as follows:

a) The router sends and receives routing messages on its interfaces.
b) The router shares routing messages and routing information with other routers that are
c) using the same routing protocol.
d) Routers exchange routing information to learn about remote networks.
e) When a router detects a topology change, the routing protocol can advertise this change
f) to other routers.

Classifying Dynamic Routing Protocols
Routing protocols can be classified into different groups according to their characteristics:
■ IGP or EGP
■ Distance vector or link-state
■ Classful or classless
The sections that follow discuss these classification schemes in more detail.

IGP and EGP

An ***autonomous system*** (AS)—otherwise known as a ***routing domain***—is a collection of routers under a common administration. Typical examples are a company's internal network and an ISP's network. Because the Internet is based on the autonomous system concept, two types of routing protocols are required: interior and exterior routing protocols. These protocols are

■ ***Interior gateway protocols (IGP)*****:** Used for intra-autonomous system routing, that is, routing inside an autonomous system

■ ***Exterior gateway protocols (EGP)*****:** Used for inter-autonomous system routing, that is, routing between autonomous systems.

Distance Vector and Link State Routing

Distance vector means that routes are advertised as ***vectors*** of distance and direction. Distance is defined in terms of a metric such as hop count, and direction is simply the nexthop router or exit interface. Distance vector protocols typically use the Bellman-Ford algorithm for the best-path route determination. In contrast to distance vector routing protocol operation, a router configured with a ***linkstate*** routing protocol can create a "complete view," or topology, of the network by gathering information from all the other routers. Think of using a link-state routing protocol as having a complete map of the network topology. The signposts along the way from source to destination are not necessary, because all link-state routers are using an identical "map" of the network. A ***link-state router*** uses the link-state information to create a topology map and to select the best path to all destination networks in the topology. With some distance vector routing protocols, routers send periodic updates of their routing information to their neighbors. Link-state routing protocols do not use periodic updates. After the network has ***converged***, a link-state update is only sent when there is a change in the topology.

Classful and Classless Routing Protocols

Classful routing protocols do not send subnet mask information in routing updates. The first routing protocols, such as RIP, were classful. This was at a time when network addresses were allocated based on classes: Class A, B, or C. A routing protocol did not need to include the subnet mask in the routing update because the network mask could be determined based on the first octet of the network address. Classless routing protocols include the subnet mask with the network address in routing updates. Today's networks are no longer allocated based on classes, and the subnet mask cannot be determined by the value of the first octet. Classless routing protocols are required in most networks today because of their support for VLSM, discontiguous networks, and other features.

Convergence, Metric and Administrative distance

The process of bringing all routing tables to a state of consistency is called convergence. Convergence is when all the routers in the same routing domain or area have complete and accurate information about the network.

Metrics are used by routing protocols to determine the best path or shortest path to reach a destination network. Different routing protocols can use different metrics. Typically, a lower metric means a better path. Five hops to reach a network is better than ten hops. Routers sometimes learn about multiple routes to the same network from both static routes and dynamic routing protocols. When a Cisco router learns about a destination network from more than one routing source, it uses the administrative distance value to determine which source to use. Each dynamic routing protocol has a unique administrative value, along with static routes and directly connected networks. The lower the administrative value, the more preferred the route source. A directly connected network is always the preferred source, followed by static routes and then various dynamic routing protocols.

Routing Information Protocol (RIP)

RIP is a standardized Distance Vector protocol, designed for use on smaller networks. RIP was one of the first true Distance Vector routing protocols, and is supported on a wide variety of systems. RIP adheres to the following Distance Vector characteristics:

i. RIP sends out periodic routing updates (every **30 seconds**)
ii. RIP sends out the full routing table every periodic update
iii. 3.RIP uses a form of distance as its metric (in this case, **hopcount**)
iv. RIP uses the Bellman-Ford Distance Vector algorithm to determine the best "path" to a particular destination

PRE LAB Questions

Q.1: What are the differences between a distance vector and a link-state routing protocol? What kind of routing protocol is RIP?

Q.2: What is metric and its parameters?

Q.3: What is the purpose of administrative distance?

Q.2: How do RIP routers to exchange routing information?

Q.3: What is the maximum number of routes that can be sent in a RIP update?

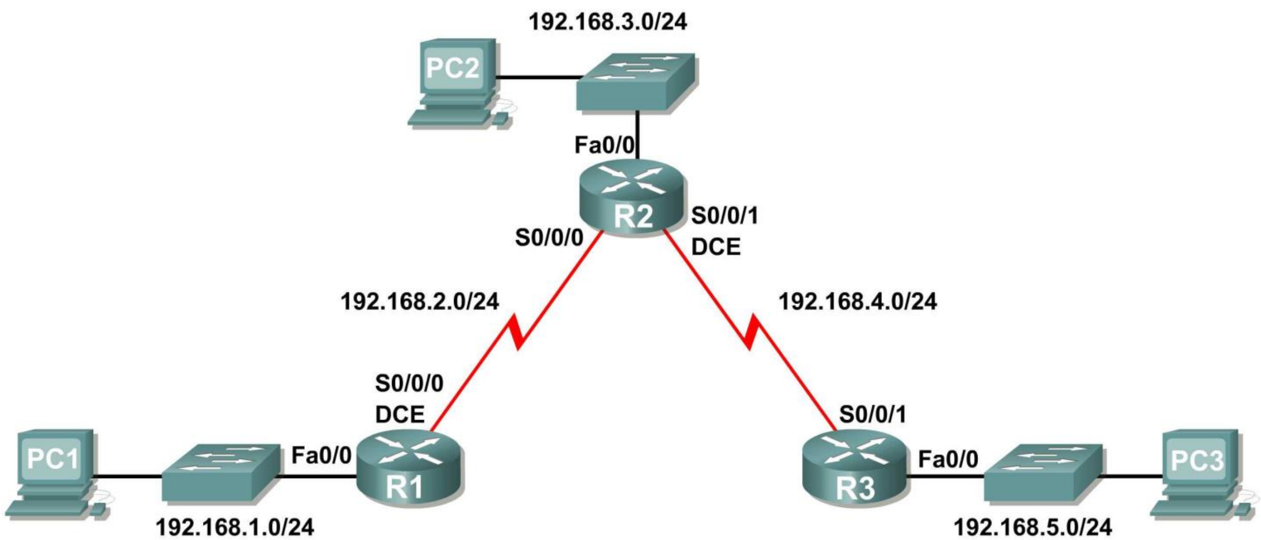
Q.4: What is VLSM? Does RIP support it? Justify your answer.

Q.5: What metric does RIP use?

Q.6: What is difference between RIPv1 and RIPv2?

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

Pre Lab 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.

Pre Lab Task

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 ripand networkcommands.

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 ripand networkcommands.

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 protocolscommand 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 ripcommand 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

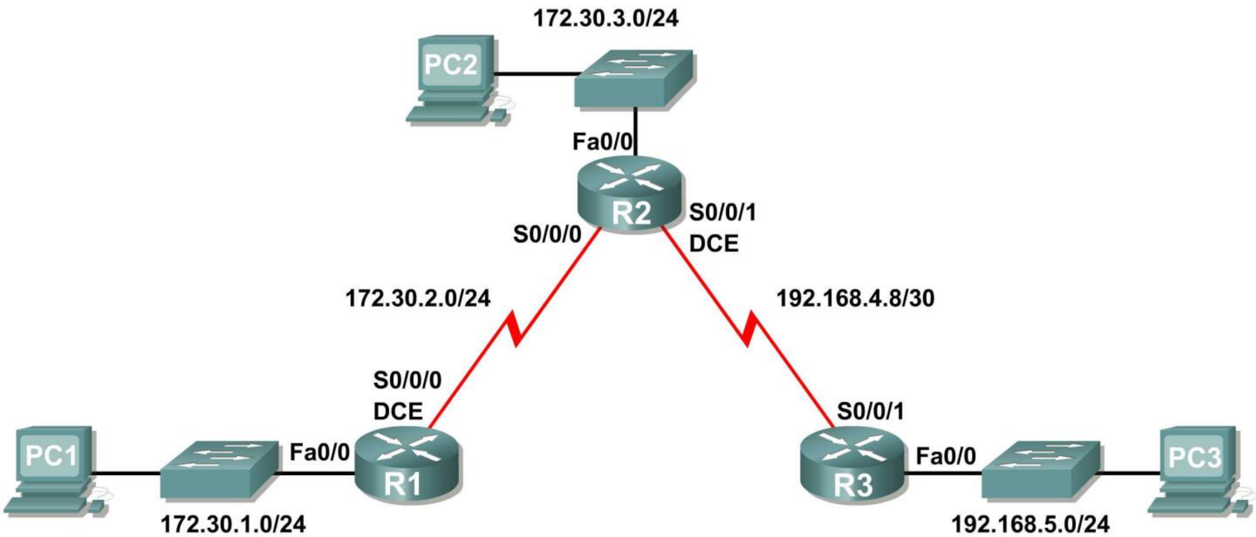
The debug output shows that R1 receives an update from R2. Notice how this update includes all the networks that R1 does not already have in its routing table. Because the FastEthernet0/0 interface belongs to the 192.168.1.0 network configured under RIP, R1 builds an update to send out that interface.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

Step 1: Use the show ip routecommand 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.

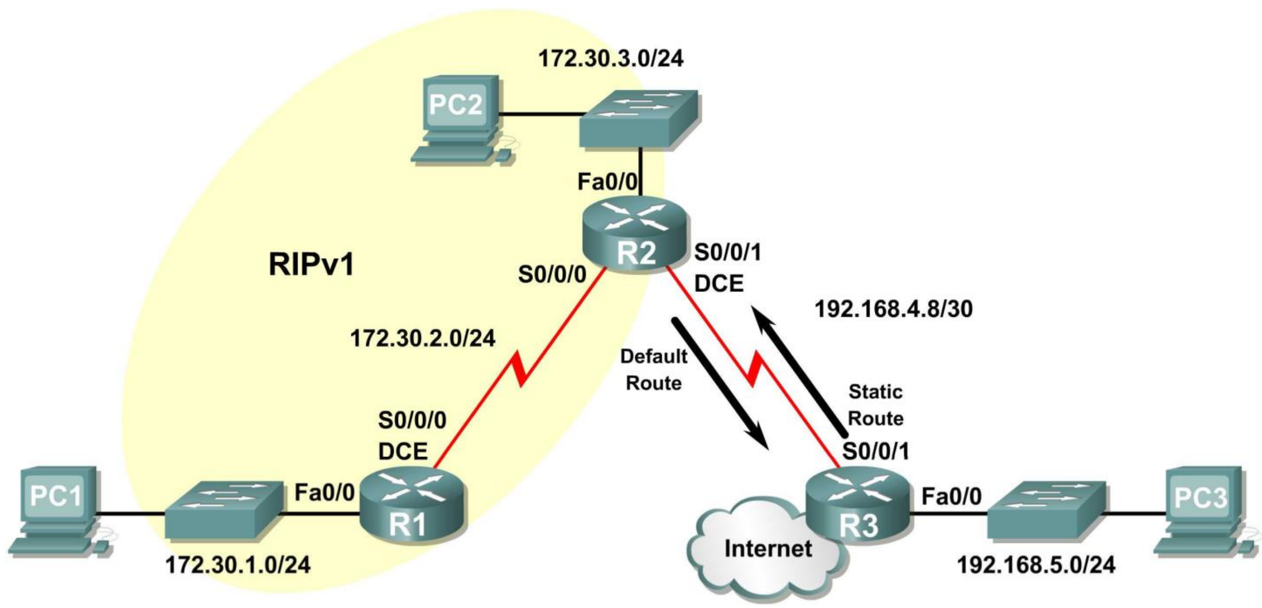
R1#**debug ip rip**
R1#RIP: sending v1 update to 255.255.255.255 via Serial0/0/0 (172.30.2.1) RIP: build update entries
network 172.30.1.0 metric 1
RIP: received v1 update from 172.30.2.2 on Serial0/0/0
172.30.3.0 in 1 hops

Step 4: Discontinue the debug output with the undebug allcommand.

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-informationoriginate**
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 routecommand 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 ripcommand.

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 allcommand.

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

Step 4: Use the show ip routecommand 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:

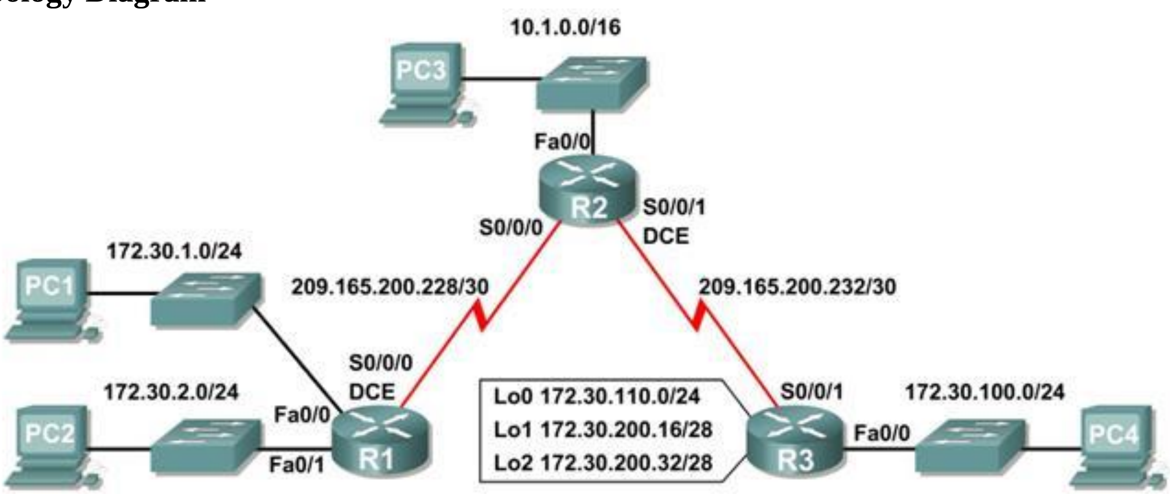
- Running configuration
- Routing table
- Interface summarization
- Output from **show ip protocols**

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.

RIPv2 Configuration Lab

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
	Fa0/1	172.30.2.1	255.255.255.0	N/A
	S0/0/0	209.165.200.230	255.255.255.252	N/A
R2	**Fa0/0**	10.1.0.1	255.255.0.0	N/A
	S0/0/0	209.165.200.229	255.255.255.252	N/A
	S0/0/1	209.165.200.233	255.255.255.252	N/A
R3	**Fa0/0**	172.30.100.1	255.255.255.0	N/A
	S0/0/1	209.165.200.234	255.255.255.252	N/A
	Lo0	172.30.110.1	255.255.255.0	N/A
	Lo1	172.30.200.17	255.255.255.240	N/A

	Lo2	172.30.200.33	255.255.255.240	N/A
PC1	**NIC**	172.30.1.10	255.255.255.0	172.30.1.1
PC2	**NIC**	172.30.2.10	255.255.255.0	172.30.2.1
PC3	**NIC**	10.1.0.10	255.255.0.0	10.1.0.1
PC4	**NIC**	172.30.100.10	255.255.255.0	172.30.100.1

Learning Objectives

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

- Cable a network according to the Topology Diagram.
- Load provided scripts onto the routers.
- Examine the current status of the network.
- Configure RIPv2 on all routers.
- Examine the automatic summarization of routes.
- Examine routing updates with **debug ip rip**.
- Disable automatic summarization.
- Examine the routing tables. Verify
- network connectivity. Document the
- RIPv2 configuration.

Scenario

The network shown in the Topology Diagram contains a discontiguous network, 172.30.0.0. This network has been subnetted using VLSM. The 172.30.0.0 subnets are physically and logically divided by at least one other classful or major network, in this case the two serial networks 209.165.200.228/30 and 209.165.200.232/30. This can be an issue when the routing protocol used does not include enough information to distinguish the individual subnets. RIPv2 is a classless routing protocol that can be used to provide subnet mask information in the routing updates. This will allow VLSM subnet information to be propagated throughout the network.

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 R1.

```
!
hostname R1
!
!
!
interface FastEthernet0/0
 ip address 172.30.1.1 255.255.255.0 duplex auto
  speed auto
```

```
    no shutdown
   !
   interface FastEthernet0/1
    ip address 172.30.2.1 255.255.255.0
    duplex auto

speed auto no shutdown
 !
 interface Serial0/0/0
  ip address 209.165.200.230 255.255.255.252
  clock rate 64000
  no shutdown
 !
 router rip
  passive-interface FastEthernet0/0
  passive-interface FastEthernet0/1
  network 172.30.0.0 network
  209.165.200.0
 !
 line con 0
 line vty 0 4
  login
 !
 end
```

Step 2: Load the following script onto R2.

```
hostname R2
!
!
!
interface FastEthernet0/0
 ip address 10.1.0.1 255.255.0.0 duplex auto
 speed auto
 no shutdown
!
interface Serial0/0/0
 ip address 209.165.200.229 255.255.255.252
 no shutdown
!
interface Serial0/0/1
 ip address 209.165.200.233 255.255.255.252 clock rate 64000
 no shutdown
!
router rip
 passive-interface FastEthernet0/0 network
 10.0.0.0
 network 209.165.200.0
!
line con 0
line vty 0 4 login
!
end
```

Step 3: Load the following script onto R3.

```
hostname R3
!
!
!
interface FastEthernet0/0
  ip address 172.30.100.1 255.255.255.0
  duplex        auto
  speed   auto   no
  shutdown
!
interface Serial0/0/1
  ip address 209.165.200.234 255.255.255.252 no shutdown
!
interface Loopback0
  ip address 172.30.110.1 255.255.255.0
!
interface Loopback1
  ip address 172.30.200.17 255.255.255.240
!
interface Loopback2
  ip address 172.30.200.33 255.255.255.240
!
router rip
  passive-interface FastEthernet0/0
  network 172.30.0.0
  network 209.165.200.0
!
line con 0 line vty
0 4
  login
!
end
```

Task 3: Examine the Current Status of the Network.

Step 1: Verify that both serial links are up.

The two serial links can quickly be verified using the **show ip interface brief** command on R2.

```
R2#show ip interface brief
Interface            IP-Address          OK? Method Status                     Protocol
FastEthernet0/0      10.1.0.1            YES manual up                         up
FastEthernet0/1      unassigned          YES  manual  administratively  down  down  Serial0/0/0
                     209.165.200.229 YES manual up                             up
Serial0/0/1          209.165.200.233 YES manual up                             up
Vlan1                unassigned          YES manual administratively down down
```

Step 2: Check the connectivity from R2 to the hosts on the R1 and R3 LANs.

Note: For the 1841 router, you will need to disable IP CEF to obtain the correct output from the **ping** command. Although a discussion of IP CEF is beyond the scope of this course, you may disable IP CEF by using the following command in global configuration mode:

R2(config)#**no ip cef**

From the R2 router, how many ICMP messages are successful when pinging PC1?

____

From the R2 router, how many ICMP messages are successful when pinging PC4?

____

Step 3: Check the connectivity between the PCs. From the PC1, is it possible to ping PC2? _________ What is the success rate? ________________________

From the PC1, is it possible to ping PC3? _______________

What is the success rate? ______________

From the PC1, is it possible to ping PC4? _______________

What is the success rate? ______________

From the PC4, is it possible to ping PC2? _______________

What is the success rate? ______________

From the PC4, is it possible to ping PC3? _______________

What is the success rate? ______________

Step 4: View the routing table on R2.

Both the R1 and R3 are advertising routes to the 172.30.0.0/16 network; therefore, there are two entries for this network in the R2 routing table. The R2 routing table only shows the major classful network address of 172.30.0.0—it does not show any of the subnets for this network that are used on the LANs attached to R1 and R3. Because the routing metric is the same for both entries, the router alternates the routes that are used when forwarding packets that are destined for the 172.30.0.0/16 network.

R2#**show ip route**

Output omitted

```
     10.0.0.0/16 is subnetted, 1 subnets
C       10.1.0.0 is directly connected, FastEthernet0/0
R    172.30.0.0/16 [120/1] via 209.165.200.230, 00:00:24, Serial0/0/0
                   [120/1] via 209.165.200.234, 00:00:15, Serial0/0/1
     209.165.200.0/30 is subnetted, 2 subnets
C       209.165.200.228 is directly connected, Serial0/0/0
C       209.165.200.232 is directly connected, Serial0/0/1
```

Step 5: Examine the routing table on the R1 router.

Both R1 and R3 are configured with interfaces on a discontiguous network, 172.30.0.0. The 172.30.0.0 subnets are physically and logically divided by at least one other classful or major network—in this case, the two serial networks 209.165.200.228/30 and 209.165.200.232/30. Classful routing protocols like RIPv1 summarize networks at major network boundaries. Both R1 and R3 will be summarizing 172.30.0.0/24 subnets to 172.30.0.0/16. Because the route to 172.30.0.0/16 is directly connected, and because R1 does not have any specific routes for the 172.30.0.0 subnets on R3, packets destined for the R3 LANs will not be forwarded properly.

R1#**show ip route**

Output omitted

```
R       10.0.0.0/8 [120/1] via 209.165.200.229, 00:00:02, Serial0/0/0
        172.30.0.0/24 is subnetted, 2 subnets
C           172.30.1.0 is directly connected, FastEthernet0/0
C           172.30.2.0 is directly connected, FastEthernet0/1
        209.165.200.0/30 is subnetted, 2 subnets
C           209.165.200.228 is directly connected, Serial0/0/0
R           209.165.200.232 [120/1] via 209.165.200.229, 00:00:02, Serial0/0/0
```

Step 6: Examine the routing table on the R3 router.

R3 only shows its own subnets for 172.30.0.0 network: 172.30.100/24, 172.30.110/24, 172.30.200.16/28, and 172.30.200.32/28. R3 does not have any routes for the 172.30.0.0 subnets on R1.

R3#**show ip route**

Output omitted

```
R       10.0.0.0/8 [120/1] via 209.165.200.233, 00:00:19, Serial0/0/1
        172.30.0.0/16 is variably subnetted, 4 subnets, 2 masks
C           172.30.100.0/24 is directly connected, FastEthernet0/0
C           172.30.110.0/24 is directly connected, Loopback0
C           172.30.200.16/28 is directly connected, Loopback1
C           172.30.200.32/28 is directly connected, Loopback2
        209.165.200.0/30 is subnetted, 2 subnets
R           209.165.200.228 [120/1] via 209.165.200.233, 00:00:19, Serial0/0/1
C           209.165.200.232 is directly connected, Serial0/0/1
```

Step 7: Examine the RIPv1 packets that are being received by R2.

Use the **debug ip rip**command to display RIP routing updates.

R2 is receiving the route 172.30.0.0, with 1 hop, from both R1 and R3. Because these are equal cost metrics, both routes are added to the R2 routing table. Because RIPv1 is a classful routing protocol, no subnet mask information is sent in the update.

R2#**debug ip rip**

```
RIP protocol debugging is on
RIP: received v1 update from 209.165.200.234 on Serial0/0/1
        172.30.0.0 in 1 hops
RIP: received v1 update from 209.165.200.230 on Serial0/0/0
        172.30.0.0 in 1 hops
```

R2 is sending only the routes for the 10.0.0.0 LAN and the two serial connections to R1 and R3. R1 and R3 are not receiving any information about the 172.30.0.0 subnet routes.

```
RIP: sending     v1 update to 255.255.255.255 via Serial0/0/1 (209.165.200.233)
RIP:  build  update  entries  network  10.0.0.0
        metric 1
        network 209.165.200.228 metric 1
RIP: sending     v1 update to 255.255.255.255 via Serial0/0/0
(209.165.200.229)
```

RIP: build update entries network 10.0.0.0
metric 1
network 209.165.200.232 metric 1

When you are finished, turn off the debugging.

R2#**undebug all**

Task 4: Configure RIP Version 2.

Step 1: Use the version 2command to enable RIP version 2 on each of the routers.

R2(config)#**router rip**
R2(config-router)#**version 2**

R1(config)#**router rip**
R1(config-router)#**version 2**

R3(config)#**router rip**
R3(config-router)#**version 2**

RIPv2 messages include the subnet mask in a field in the routing updates. This allows subnets and their masks to be included in the routing updates. However, by default RIPv2 summarizes networks at major network boundaries, just like RIPv1, except that the subnet mask is included in the update.

Step 2: Verify that RIPv2 is running on the routers.

The **debug ip rip**, **show ip protocols**, and **show run**commands can all be used to confirm that RIPv2 is running. The output of the **show ip protocols**command for R1 is shown below.

```
R1# show ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 7 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 2
   Interface             Send  Recv   Triggered RIP    Key-chain
   FastEthernet0/0       2     2
   FastEthernet0/1       2     2
   Serial0/0/0           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
        FastEthernet0/1
Routing Information Sources:
    Gateway           Distance         Last Update
    209.165.200.229        120
Distance: (default is 120)
```

Task 5: Examine the Automatic Summarization of Routes.

The LANs connected to R1 and R3 are still composed of discontiguous networks. R2 still shows two equal cost paths to the 172.30.0.0/16 network in the routing table. R2 still shows only the major classful network address of 172.30.0.0 and does not show any of the subnets for this network.

```
R2#show ip route

Output omitted

        10.0.0.0/16 is subnetted, 1 subnets
C           10.1.0.0 is directly connected, FastEthernet0/0
R       172.30.0.0/16 [120/1] via 209.165.200.230, 00:00:07, Serial0/0/0
                      [120/1] via 209.165.200.234, 00:00:08, Serial0/0/1
        209.165.200.0/30 is subnetted, 2 subnets
C           209.165.200.228 is directly connected, Serial0/0/0
C           209.165.200.232 is directly connected, Serial0/0/1
```

R1 still shows only its own subnets for the 172.30.0.0 network. R1 still does not have any routes for the 172.30.0.0 subnets on R3.

```
R1#show ip route

Output omitted

R       10.0.0.0/8 [120/1] via 209.165.200.229, 00:00:09, Serial0/0/0
        172.30.0.0/24 is subnetted, 2 subnets
C           172.30.1.0 is directly connected, FastEthernet0/0
C           172.30.2.0 is directly connected, FastEthernet0/1
        209.165.200.0/30 is subnetted, 2 subnets
C           209.165.200.228 is directly connected, Serial0/0/0
R           209.165.200.232 [120/1] via 209.165.200.229, 00:00:09, Serial0/0/0
```

R3 still only shows its own subnets for the 172.30.0.0 network. R3 still does not have any routes for the 172.30.0.0 subnets on R1.

```
R3#show ip route

Output omitted

R       10.0.0.0/8 [120/1] via 209.165.200.233, 00:00:16, Serial0/0/1
        172.30.0.0/16 is variably subnetted, 4 subnets, 2 masks
C           172.30.100.0/24 is directly connected, FastEthernet0/0
C           172.30.110.0/24 is directly connected, Loopback0
C           172.30.200.16/28 is directly connected, Loopback1
C           172.30.200.32/28 is directly connected, Loopback2
        209.165.200.0/30 is subnetted, 2 subnets
R           209.165.200.228 [120/1] via 209.165.200.233, 00:00:16, Serial0/0/1
C           209.165.200.232 is directly connected, Serial0/0/1
```

Use the output of the **debug ip rip** command to answer the following questions:

What entries are included in the RIP updates sent out from R3?

____

____

____

____

____

On R2, what routes are in the RIP updates that are received from R3?

____

____

____

R3 is not sending any of the 172.30.0.0 subnets—only the summarized route of 172.30.0.0/16, including the subnet mask. This is why R2 and R1 are not seeing the 172.30.0.0 subnets on R3.

Task 6: Disable Automatic Summarization.

The **no auto-summary** command is used to turn off automatic summarization in RIPv2. Disable auto summarization on all routers. The routers will no longer summarize routes at major network boundaries.

R2(config)#**router rip**
R2(config-router)#**no auto-summary**

R1(config)#**router rip**
R1(config-router)#**no auto-summary**

R3(config)#**router rip**
R3(config-router)#**no auto-summary**

The **show ip route** and **ping** commands can be used to verify that automatic summarization is off.

Task 7: Examine the Routing Tables.

The LANs connected to R1 and R3 should now be included in all three routing tables.

R2#**show ip route**

Output omitted

```
      10.0.0.0/16 is subnetted, 1 subnets
C        10.1.0.0 is directly connected, FastEthernet0/0
      172.30.0.0/16 is variably subnetted, 7 subnets, 3 masks
R        172.30.0.0/16 [120/1] via 209.165.200.230, 00:01:28, Serial0/0/0
                       [120/1] via 209.165.200.234, 00:01:56, Serial0/0/1
R        172.30.1.0/24 [120/1] via 209.165.200.230, 00:00:08, Serial0/0/0
```

```
R       172.30.2.0/24 [120/1] via 209.165.200.230, 00:00:08, Serial0/0/0
R       172.30.100.0/24 [120/1] via 209.165.200.234, 00:00:08, Serial0/0/1
R       172.30.110.0/24 [120/1] via 209.165.200.234, 00:00:08, Serial0/0/1
R       172.30.200.16/28 [120/1] via 209.165.200.234, 00:00:08, Serial0/0/1
R       172.30.200.32/28 [120/1] via 209.165.200.234, 00:00:08, Serial0/0/1
     209.165.200.0/30 is subnetted, 2 subnets
C       209.165.200.228 is directly connected, Serial0/0/0
C       209.165.200.232 is directly connected, Serial0/0/1
```

R1#**show ip route**

Output omitted

```
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R       10.0.0.0/8 [120/1] via 209.165.200.229, 00:02:13, Serial0/0/0
R       10.1.0.0/16 [120/1] via 209.165.200.229, 00:00:21, Serial0/0/0
     172.30.0.0/16 is variably subnetted, 6 subnets, 2 masks
C       172.30.1.0/24 is directly connected, FastEthernet0/0
C       172.30.2.0/24 is directly connected, FastEthernet0/1
R       172.30.100.0/24 [120/2] via 209.165.200.229, 00:00:21, Serial0/0/0
R       172.30.110.0/24 [120/2] via 209.165.200.229, 00:00:21, Serial0/0/0
R       172.30.200.16/28 [120/2] via 209.165.200.229, 00:00:21, Serial0/0/0
R       172.30.200.32/28 [120/2] via 209.165.200.229, 00:00:21, Serial0/0/0
     209.165.200.0/30 is subnetted, 2 subnets
C       209.165.200.228 is directly connected, Serial0/0/0
R       209.165.200.232 [120/1] via 209.165.200.229, 00:00:21, Serial0/0/0
```

R3#**show ip route**

Output omitted

```
     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R       10.0.0.0/8 [120/1] via 209.165.200.233, 00:02:28, Serial0/0/1
R       10.1.0.0/16 [120/1] via 209.165.200.233, 00:00:08, Serial0/0/1
     172.30.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       172.30.1.0/24 [120/2] via 209.165.200.233, 00:00:08, Serial0/0/1
R       172.30.2.0/24 [120/2] via 209.165.200.233, 00:00:08, Serial0/0/1
C       172.30.100.0/24 is directly connected, FastEthernet0/0
C       172.30.110.0/24 is directly connected, Loopback0
C       172.30.200.16/28 is directly connected, Loopback1
C       172.30.200.32/28 is directly connected, Loopback2
     209.165.200.0/30 is subnetted, 2 subnets
R       209.165.200.228 [120/1] via 209.165.200.233, 00:00:08, Serial0/0/1
C       209.165.200.232 is directly connected, Serial0/0/1
```

Use the output of the **debug ip rip**command to answer the following questions: What entries are included in the RIP updates sent out from R1?

____

____

____

On R2, what routes are in the RIP updates that are received from R1?

____

____

____

Are the subnet masks now included in the routing updates? _________________

Task 8: Verify Network Connectivity.

Step 1: Check connectivity between R2 router and PCs.

From R2, how many ICMP messages are successful when pinging PC1?

____

From R2, how many ICMP messages are successful when pinging PC4?

____

Step 2: Check the connectivity between the PCs.

From PC1, is it possible to ping PC2? _______________

What is the success rate? _______________

From PC1, is it possible to ping PC3? _______________

What is the success rate? _______________

From PC1, is it possible to ping PC4? _______________

What is the success rate? _______________

From PC4, is it possible to ping PC2? _______________

What is the success rate? _______________

From PC4, is it possible to ping PC3? _______________

What is the success rate? _______________

Task 9: Documentation

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

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

Task 10: 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.

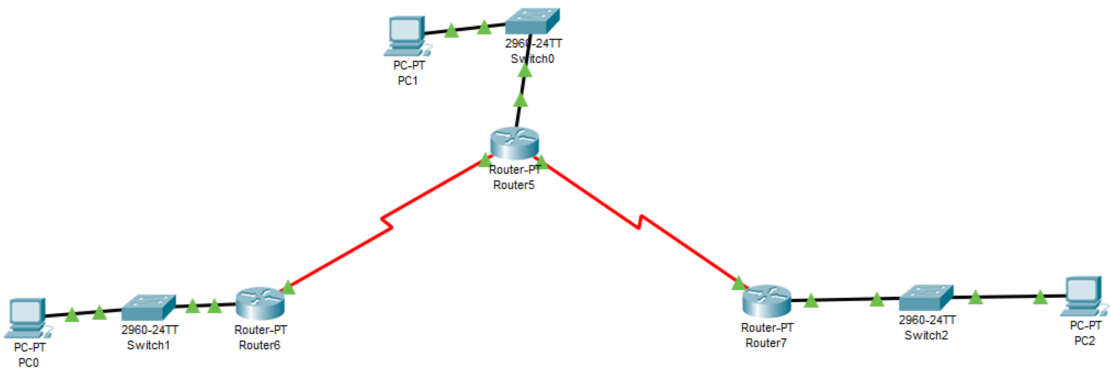
Critical Analysis / Conclusion

In this lab we learn tabout the Routing Information Protocol and its different versions like the one designed for classful networks. It is dynamic routing protocol and easier to route as compared to static routing. In this scenario we only use Network address to route.

<table>
<tr><th colspan="3">Lab Assessment</th></tr>
<tr><td>Pre Lab</td><td>/5</td><td rowspan="5">/25</td></tr>
<tr><td>Performance</td><td>/5</td></tr>
<tr><td>Results</td><td>/5</td></tr>
<tr><td>Viva</td><td>/5</td></tr>
<tr><td>Critical Analysis</td><td>/5</td></tr>
<tr><td colspan="3">Instructor Signature and Comments</td></tr>
</table>

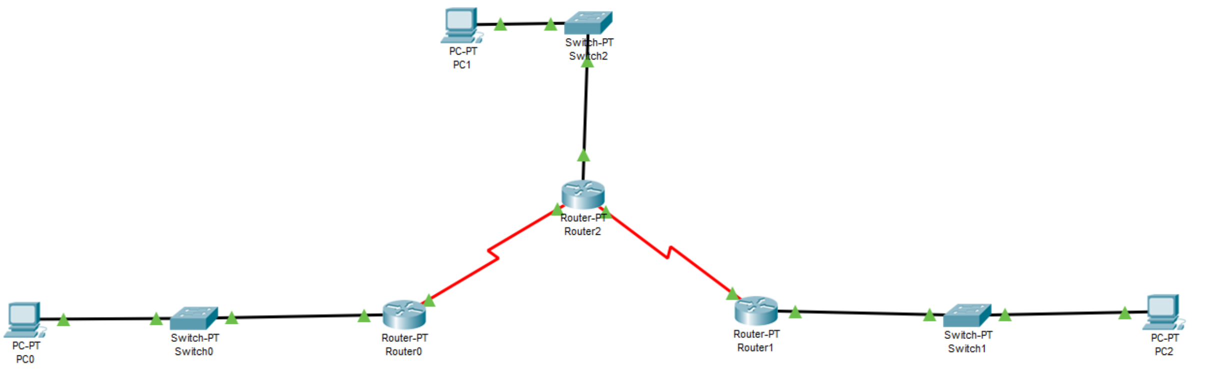
In-Lab Task

Task 1



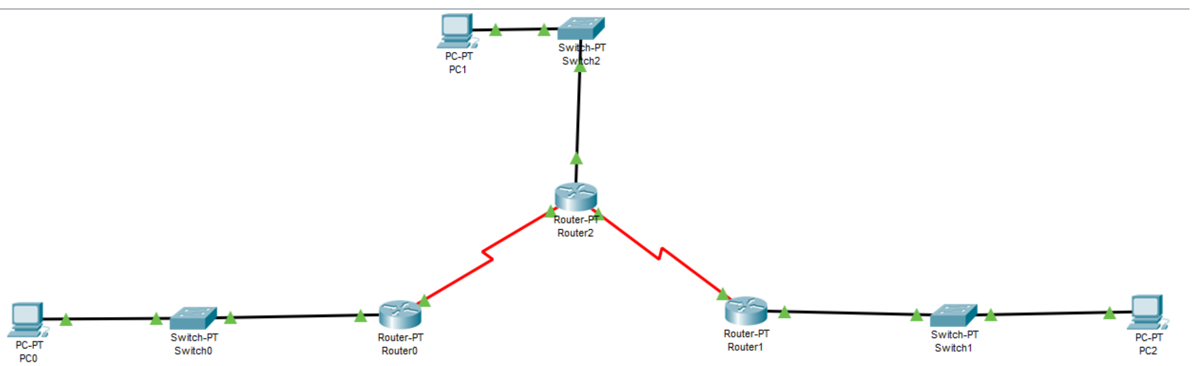
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	PC0	PC1	ICMP		0.000	N	0
	Successful	PC1	PC0	ICMP		0.000	N	1
	Successful	PC1	PC2	ICMP		0.000	N	2

Task 2



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Ed
	Successful	PC0	PC1	ICMP		0.000	N	0	(e
	Successful	PC2	PC1	ICMP		0.000	N	1	(e

Task 3



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Ed
	Successful	PC1	PC2	ICMP		0.000	N	0	(e

Home Task

TASK 1:

Router 1:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 192.168.1.1 YES NVRAM up up
FastEthernet1/0 unassigned YES NVRAM administratively down down
Serial2/0 192.168.2.1 YES NVRAM up up
Serial3/0 unassigned YES NVRAM administratively down down
FastEthernet4/0 unassigned YES NVRAM administratively down down
FastEthernet5/0 unassigned YES NVRAM administratively down down

Show ip protocols:

Router>show ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 9 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
Serial2/0 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 00:00:21

Distance: (default is 120)

Show ip route:

Router>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

172.16.0.0/24 is subnetted, 1 subnets
S 172.16.1.0 is directly connected, FastEthernet0/0
is directly connected, Serial2/0
C 192.168.1.0/24 is directly connected, FastEthernet0/0
C 192.168.2.0/24 is directly connected, Serial2/0
R 192.168.3.0/24 [120/1] via 192.168.2.2, 00:00:08, Serial2/0
R 192.168.4.0/24 [120/1] via 192.168.2.2, 00:00:08, Serial2/0
R 192.168.5.0/24 [120/2] via 192.168.2.2, 00:00:08, Serial2/0

Router 2:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 192.168.3.1 YES NVRAM up up
FastEthernet1/0 unassigned YES NVRAM administratively down down
Serial2/0 192.168.2.2 YES NVRAM up up
Serial3/0 192.168.4.2 YES NVRAM up up
FastEthernet4/0 unassigned YES NVRAM administratively down down
FastEthernet5/0 unassigned YES NVRAM administratively down down

Show ip protocols:

Router>show ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 24 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
Serial3/0 1 2 1
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
192.168.2.0
192.168.3.0
192.168.4.0
Passive Interface(s):
Routing Information Sources:
Gateway Distance Last Update
192.168.2.1 120 00:00:01
192.168.4.1 120 00:00:22
Distance: (default is 120)

Show ip route:

Router>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

172.16.0.0/24 is subnetted, 1 subnets
S 172.16.3.0 is directly connected, Serial2/0
R 192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:05, Serial2/0
C 192.168.2.0/24 is directly connected, Serial2/0
C 192.168.3.0/24 is directly connected, FastEthernet0/0

C 192.168.4.0/24 is directly connected, Serial3/0
S 192.168.5.0/24 is directly connected, Serial3/0

Router 3:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 192.168.5.1 YES NVRAM up up
FastEthernet1/0 unassigned YES NVRAM administratively down down
Serial2/0 192.168.4.1 YES NVRAM up up
Serial3/0 unassigned YES NVRAM administratively down down
FastEthernet4/0 unassigned YES NVRAM administratively down down
FastEthernet5/0 unassigned YES NVRAM administratively down down

Show ip protocols:

Router>show ip protocol
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 11 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
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
192.168.1.0
192.168.2.0
192.168.3.0
192.168.4.0
192.168.5.0
Passive Interface(s):
Routing Information Sources:
Gateway Distance Last Update
192.168.4.2 120 00:00:22
Distance: (default is 120)

Show ip route:

Router>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

172.16.0.0/24 is subnetted, 2 subnets
S 172.16.1.0 is directly connected, Serial2/0
S 172.16.3.0 is directly connected, Serial2/0
R 192.168.1.0/24 [120/2] via 192.168.4.2, 00:00:26, Serial2/0
R 192.168.2.0/24 [120/1] via 192.168.4.2, 00:00:26, Serial2/0
S 192.168.3.0/24 is directly connected, Serial2/0
C 192.168.4.0/24 is directly connected, Serial2/0
C 192.168.5.0/24 is directly connected, FastEthernet0/0

TASK 2:

Router 1:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 172.30.1.1 YES manual up up
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 172.30.2.1 YES manual up up
Serial3/0 unassigned YES unset administratively down down
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down

Show ip protocols:

Router>show ip protocol
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 13 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
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
172.30.0.0
Passive Interface(s):
Routing Information Sources:
Gateway Distance Last Update
172.30.2.2 120 00:00:13
Distance: (default is 120)

Show ip route:

Router>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

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, Serial2/0
R 172.30.3.0 [120/1] via 172.30.2.2, 00:00:04, Serial2/0
R 192.168.4.0/24 [120/1] via 172.30.2.2, 00:00:04, Serial2/0
R 192.168.5.0/24 [120/2] via 172.30.2.2, 00:00:04, Serial2/0

Router 2:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 172.30.3.1 YES manual up up
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 172.30.2.2 YES manual up up
Serial3/0 192.168.4.9 YES manual up up
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down

Show ip protocols:

Router>show ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 10 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
Serial3/0 1 2 1
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
172.30.0.0
192.168.4.0
Passive Interface(s):
FastEthernet0/0
Routing Information Sources:
Gateway Distance Last Update
172.30.2.1 120 00:00:23
192.168.4.10 120 00:00:20
Distance: (default is 120)

Show ip route:

Router>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

172.30.0.0/24 is subnetted, 3 subnets
R 172.30.1.0 [120/1] via 172.30.2.1, 00:00:14, Serial2/0
C 172.30.2.0 is directly connected, Serial2/0
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, Serial3/0
R 192.168.5.0/24 [120/1] via 192.168.4.10, 00:00:10, Serial3/0

Router 3:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 192.168.5.1 YES manual up up
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 192.168.4.10 YES manual up up
Serial3/0 unassigned YES unset administratively down down
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down

Show ip protocols:

Router>show ip protocol
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 1, receive any version
Interface Send Recv Triggered RIP Key-chain
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
192.168.4.0
192.168.5.0
Passive Interface(s):
FastEthernet0/0
Routing Information Sources:
Gateway Distance Last Update
192.168.4.9 120 00:00:28
Distance: (default is 120)

Show ip route:

Router>show ip protocol
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 1, receive any version
Interface Send Recv Triggered RIP Key-chain
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
192.168.4.0
192.168.5.0
Passive Interface(s):
FastEthernet0/0
Routing Information Sources:
Gateway Distance Last Update

192.168.4.9 120 00:00:28
Distance: (default is 120)

TASK 3:

Router 1:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 172.30.1.1 YES manual up up
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 172.30.2.1 YES manual up up
Serial3/0 unassigned YES unset administratively down down
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down

Show ip protocols:

Router>show ip protocol
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 28 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
Serial2/0 1 2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
172.30.0.0
Passive Interface(s):
Routing Information Sources:
Gateway Distance Last Update

Distance: (default is 120)

Show ip route:

Router>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

172.30.0.0/24 is subnetted, 2 subnets
C 172.30.1.0 is directly connected, FastEthernet0/0
C 172.30.2.0 is directly connected, Serial2/0

Router 2:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 172.30.3.1 YES manual up up
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 172.30.2.2 YES manual up up
Serial3/0 192.168.4.9 YES manual up up
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down

Show ip protocols:

Router>show ip protocol

Show ip route:

Router>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, 2 subnets
C 172.30.2.0 is directly connected, Serial2/0
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, Serial3/0
S* 0.0.0.0/0 is directly connected, Serial3/0

Router 3:

Show ip interface brief:

Router>show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0/0 192.168.5.1 YES manual up up
FastEthernet1/0 unassigned YES unset administratively down down
Serial2/0 192.168.4.10 YES manual up up
Serial3/0 unassigned YES unset administratively down down
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down

Show ip protocols:

Router>show ip protocol
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 21 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
Serial2/0 1 2 1

Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
192.168.4.0
192.168.5.0
Passive Interface(s):
FastEthernet0/0
Routing Information Sources:
Gateway Distance Last Update
Distance: (default is 120)

Show ip route:

Router>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

172.30.0.0/22 is subnetted, 1 subnets
S 172.30.0.0 is directly connected, Serial2/0
192.168.4.0/30 is subnetted, 1 subnets
C 192.168.4.8 is directly connected, Serial2/0
C 192.168.5.0/24 is directly connected, FastEthernet0/0