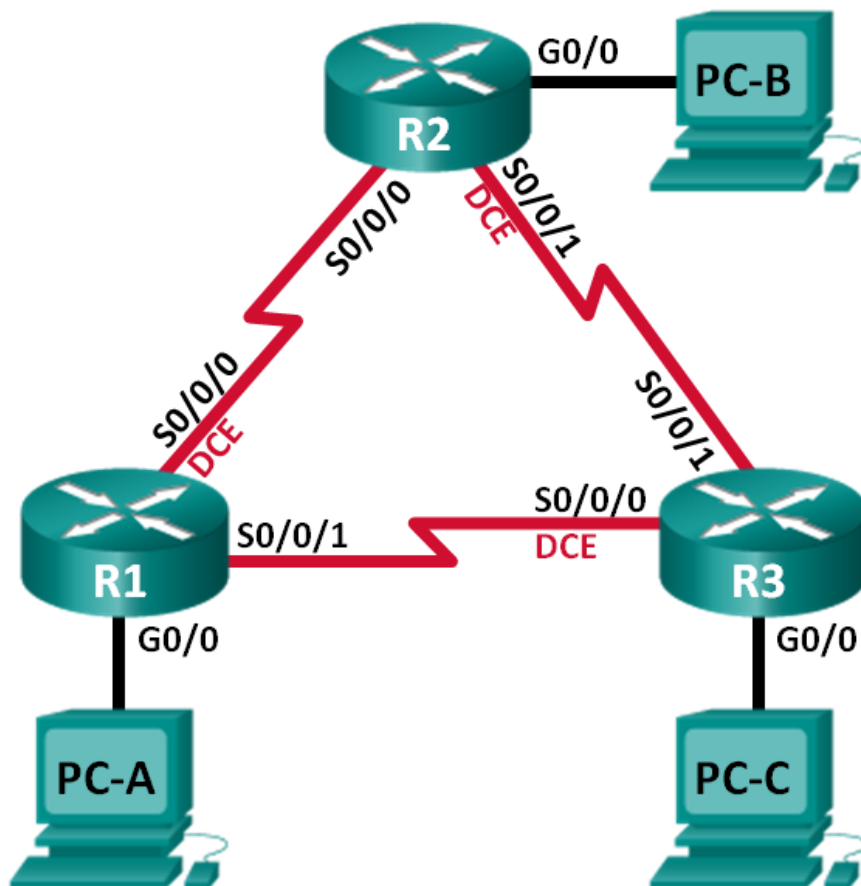


## Lab – Configuring Basic EIGRP for IPv4

### Topology



## Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A
	S0/0/1	10.3.3.1	255.255.255.252	N/A
R2	G0/0	192.168.2.1	255.255.255.0	N/A
	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A
R3	G0/0	192.168.3.1	255.255.255.0	N/A
	S0/0/0 (DCE)	10.3.3.2	255.255.255.252	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1
PC-B	NIC	192.168.2.3	255.255.255.0	192.168.2.1
PC-C	NIC	192.168.3.3	255.255.255.0	192.168.3.1

## Objectives

**Part 1: Build the Network and Verify Connectivity**

**Part 2: Configure EIGRP Routing**

**Part 3: Verify EIGRP Routing**

**Part 4: Configure Bandwidth and Passive Interfaces**

## Background / Scenario

Enhanced Interior Gateway Routing Protocol (EIGRP) is a powerful distance vector routing protocol and is relatively easy to configure for basic networks.

In this lab, you will configure EIGRP for the topology and networks shown above. You will modify bandwidth and configure passive interfaces to allow EIGRP to function more efficiently.

**Note:** The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). Other routers and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

**Note:** Make sure that the routers have been erased and have no startup configurations. If you are unsure, contact your instructor.

## Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 3 PCs (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology

## Part 1: Build the Network and Verify Connectivity

In Part 1, you will set up the network topology and configure basic settings, such as the interface IP addresses, device access, and passwords.

**Step 1: Cable the network as shown in the topology.**

**Step 2: Configure PC hosts.**

**Step 3: Initialize and reload the routers as necessary.**

**Step 4: Configure basic settings for each router.**

- a. Disable DNS lookup.
- b. Configure IP addresses for the routers, as listed in the Addressing Table.
- c. Configure device name as shown in the topology.
- d. Assign **cisco** as the console and vty passwords.
- e. Assign **class** as the privileged EXEC password.
- f. Configure **logging synchronous** to prevent console and vty messages from interrupting command entry.
- g. Configure a message of the day.
- h. Copy the running configuration to the startup configuration.

**Step 5: Verify connectivity.**

The routers should be able to ping one another, and each PC should be able to ping its default gateway. The PCs will not be able to ping other PCs until EIGRP routing is configured. Verify and troubleshoot if necessary.

## Part 2: Configure EIGRP Routing

**Step 1: Enable EIGRP routing on R1. Use AS number 10.**

```
R1(config)# router eigrp 10
```

**Step 2: Advertise the directly connected networks on R1 using the wildcard mask.**

```
R1(config-router)# network 10.1.1.0 0.0.0.3
R1(config-router)# network 192.168.1.0 0.0.0.255
R1(config-router)# network 10.3.3.0 0.0.0.3
```

Why is it a good practice to use wildcard masks when advertising networks? Could the mask have been omitted from any of the network statements above? If so, which one(s)?

**We should only advertise networks that we can control. In earlier versions of EIGRP, classful boundaries were assumed meaning that the whole network space was advertised. When advertising the 10.1.1.0 network, the 10.0.0.0/8 could be assumed. The wildcard mask could have been omitted from the 192.168.1.0 network statement because EIGRP would automatically assume the 0.0.0.255 classful mask.**

**Step 3: Enable EIGRP routing and advertise the directly connected networks on R2 and R3.**

You will see neighbor adjacency messages as interfaces are added to the EIGRP routing process. The messages on R2 are displayed as an example.

```
*Apr 14 15:24:59.543: %DUAL-5-NBRCHANGE: EIGRP-IPv4 10: Neighbor 10.1.1.1 (Serial0/0/0) is up: new adjacency
```

### Step 4: Verify end-to-end connectivity.

All devices should be able to ping each other if EIGRP is configured correctly.

**Note:** Depending on the operating system, it may be necessary to disable the firewall for the pings to the host PCs to be successful.

## Part 3: Verify EIGRP Routing

### Step 1: Examine the EIGRP neighbor table.

On R1, issue the **show ip eigrp neighbors** command to verify that the adjacency has been established with its neighboring routers.

```
R1# show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(10)
H   Address                Interface      Hold Uptime    SRTT   RTO   Q   Seq
                               (sec)          (ms)        Cnt  Num
1   10.3.3.2                 Se0/0/1        13 00:24:58     8   100   0   17
0   10.1.1.2                 Se0/0/0        13 00:29:23     7   100   0   23
```

### Step 2: Examine the IP EIGRP routing table.

```
R1# show ip route eigrp
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP
       + - replicated route, % - next hop override
```

Gateway of last resort is not set

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
D       10.2.2.0/30 [90/2681856] via 10.3.3.2, 00:29:01, Serial0/0/1
        [90/2681856] via 10.1.1.2, 00:29:01, Serial0/0/0
D       192.168.2.0/24 [90/2172416] via 10.1.1.2, 00:29:01, Serial0/0/0
D       192.168.3.0/24 [90/2172416] via 10.3.3.2, 00:27:56, Serial0/0/1
```

Why does R1 have two paths to the 10.2.2.0/30 network?

**Because EIGRP automatically does equal-cost load balancing**

### Step 3: Examine the EIGRP topology table.

```
R1# show ip eigrp topology
EIGRP-IPv4 Topology Table for AS(10)/ID(192.168.1.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
```

r - reply Status, s - sia Status

```
P 192.168.3.0/24, 1 successors, FD is 2172416
    via 10.3.3.2 (2172416/28160), Serial0/0/1
P 192.168.2.0/24, 1 successors, FD is 2172416
    via 10.1.1.2 (2172416/28160), Serial0/0/0
P 10.2.2.0/30, 2 successors, FD is 2681856
    via 10.1.1.2 (2681856/2169856), Serial0/0/0
    via 10.3.3.2 (2681856/2169856), Serial0/0/1
P 10.3.3.0/30, 1 successors, FD is 2169856
    via Connected, Serial0/0/1
P 192.168.1.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet0/0
P 10.1.1.0/30, 1 successors, FD is 2169856
    via Connected, Serial0/0/0
```

Why are there no feasible successors listed in the R1 topology table?

**The feasibility condition has not met.**

### Step 4: Verify the EIGRP routing parameters and networks advertised.

Issue the **show ip protocols** command to verify the EIGRP routing parameters used.

```
R1# show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "eigrp 10"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(10)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.1.1
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1

  Automatic Summarization: disabled
  Maximum path: 4
  Routing for Networks:
    10.1.1.0/30
    10.3.3.0/30
    192.168.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.3.3.2         90           02:38:34
```

```
10.1.1.2          90      02:38:34
Distance: internal 90 external 170
```

Based on the output of issuing the **show ip protocols** command, answer the following questions.

What AS number is used? **10**

What networks are advertised? **10.1.1.0/30, 10.3.3.0/30, 192.168.1.0**

What is the administrative distance for EIGRP? **90**

How many equal cost paths does EIGRP use by default? **4**

## Part 4: Configure Bandwidth and Passive Interfaces

EIGRP uses a default bandwidth based on the type of interface in the router. In Part 4, you will modify the bandwidth so that the link between R1 and R3 has a lower bandwidth than the link between R1/R2 and R2/R3. In addition, you will set passive interfaces on each router.

### Step 1: Observe the current routing settings.

- a. Issue the **show interface s0/0/0** command on R1.

```
R1# show interface s0/0/0
Serial0/0/0 is up, line protocol is up
  Hardware is WIC MBRD Serial
  Internet address is 10.1.1.1/30
  MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:01, output 00:00:02, output hang never
  Last clearing of "show interface" counters 03:43:45
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    4050 packets input, 270294 bytes, 0 no buffer
    Received 1554 broadcasts (0 IP multicasts)
    0 runs, 0 giants, 0 throttles
    1 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 1 abort
    4044 packets output, 271278 bytes, 0 underruns
    0 output errors, 0 collisions, 5 interface resets
    4 unknown protocol drops
    0 output buffer failures, 0 output buffers swapped out
    12 carrier transitions
  DCD=up DSR=up DTR=up RTS=up CTS=up
```

What is the default bandwidth for this serial interface? **1544 Kbits**

- b. How many routes are listed in the routing table to reach the 10.2.2.0/30 network? **2**

### Step 2: Modify the bandwidth on the routers.

- a. Modify the bandwidth on R1 for the serial interfaces.

```
R1(config)# interface s0/0/0
R1(config-if)# bandwidth 2000
R1(config-if)# interface s0/0/1
R1(config-if)# bandwidth 64
```

Issue **show ip route** command on R1. Is there a difference in the routing table? If so, what is it?

Codes: L - local, C - connected, S - static, 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  
i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C       10.1.1.0/30 is directly connected, Serial0/0/0
L       10.1.1.1/32 is directly connected, Serial0/0/0
D       10.2.2.0/30 [90/2681856] via 10.1.1.2, 00:03:09, Serial0/0/0
C       10.3.3.0/30 is directly connected, Serial0/0/1
L       10.3.3.1/32 is directly connected, Serial0/0/1
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, GigabitEthernet0/0
L       192.168.1.1/32 is directly connected, GigabitEthernet0/0
D       192.168.2.0/24 [90/1794560] via 10.1.1.2, 00:03:09, Serial0/0/0
D       192.168.3.0/24 [90/2684416] via 10.1.1.2, 00:03:08, Serial0/0/0
```

**There is only 1 route for 10.2.2.0/30**

- b. Modify the bandwidth on the R2 and R3 serial interfaces.

```
R2(config)# interface s0/0/0
R2(config-if)# bandwidth 2000
R2(config-if)# interface s0/0/1
R2(config-if)# bandwidth 2000
```

```
R3(config)# interface s0/0/0
R3(config-if)# bandwidth 64
R3(config-if)# interface s0/0/1
R3(config-if)# bandwidth 2000
```

### Step 3: Verify the bandwidth modifications.

- a. Verify bandwidth modifications. Issue a **show interface serial 0/0/x** command, with x being the appropriate serial interface on all three routers to verify that bandwidth is set correctly. R1 is shown as an example.

```
R1# show interface s0/0/0
Serial0/0/0 is up, line protocol is up
Hardware is WIC MBRD Serial
```

```
Internet address is 10.1.1.1/30
MTU 1500 bytes, BW 2000 Kbit/sec, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set
Keepalive set (10 sec)
Last input 00:00:01, output 00:00:02, output hang never
Last clearing of "show interface" counters 04:06:06
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  4767 packets input, 317155 bytes, 0 no buffer
    Received 1713 broadcasts (0 IP multicasts)
    0 runs, 0 giants, 0 throttles
    1 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 1 abort
  4825 packets output, 316451 bytes, 0 underruns
    0 output errors, 0 collisions, 5 interface resets
    4 unknown protocol drops
    0 output buffer failures, 0 output buffers swapped out
    12 carrier transitions
DCD=up DSR=up DTR=up RTS=up CTS=up
```

Based on your bandwidth configuration, try and determine what the R2 and R3 routing tables will look like before you issue a **show ip route** command. Are their routing tables the same or different?

**R2 routing table will be same as before but in R3 routing table there is only 1 route to the 10.1.1.0/30 via network R2.**

### Step 4: Configure G0/0 interface as passive on R1, R2, and R3.

A passive interface does not allow outgoing and incoming routing updates over the configured interface. The **passive-interface** *interface* command causes the router to stop sending and receiving Hello packets over an interface; however, the network associated with the interface is still advertised to other routers through the non-passive interfaces. Router interfaces connected to LANs are typically configured as passive.

```
R1(config)# router eigrp 10
R1(config-router)# passive-interface g0/0

R2(config)# router eigrp 10
R2(config-router)# passive-interface g0/0

R3(config)# router eigrp 10
R3(config-router)# passive-interface g0/0
```

### Step 5: Verify the passive interface configuration.

Issue a **show ip protocols** command on R1, R2, and R3 and verify that G0/0 has been configured as passive.

```
R1# show ip protocols
*** IP Routing is NSF aware ***
```



```
Routing Protocol is "eigrp 10"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP-IPv4 Protocol for AS(10)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.1.1
    Topology : 0 (base)
      Active Timer: 3 min
      Distance: internal 90 external 170
      Maximum path: 4
      Maximum hopcount 100
      Maximum metric variance 1

  Automatic Summarization: disabled
  Maximum path: 4
  Routing for Networks:
    10.1.1.0/30
    10.3.3.0/30
    192.168.1.0
  Passive Interface(s):
    GigabitEthernet0/0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.3.3.2         90           00:48:09
    10.1.1.2         90           00:48:26
  Distance: internal 90 external 170
```

### Reflection

**You could have used only static routing for this lab. What is an advantage of using EIGRP?**

**EIGRP can automatically adjust network for topology changes. It automatically picks the best path when the bandwidth of a link is modified and it will automatically load balance across multiple equal cost paths.**

## Router Interface Summary Table

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
<p><b>Note:</b> To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table 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 string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.</p>				