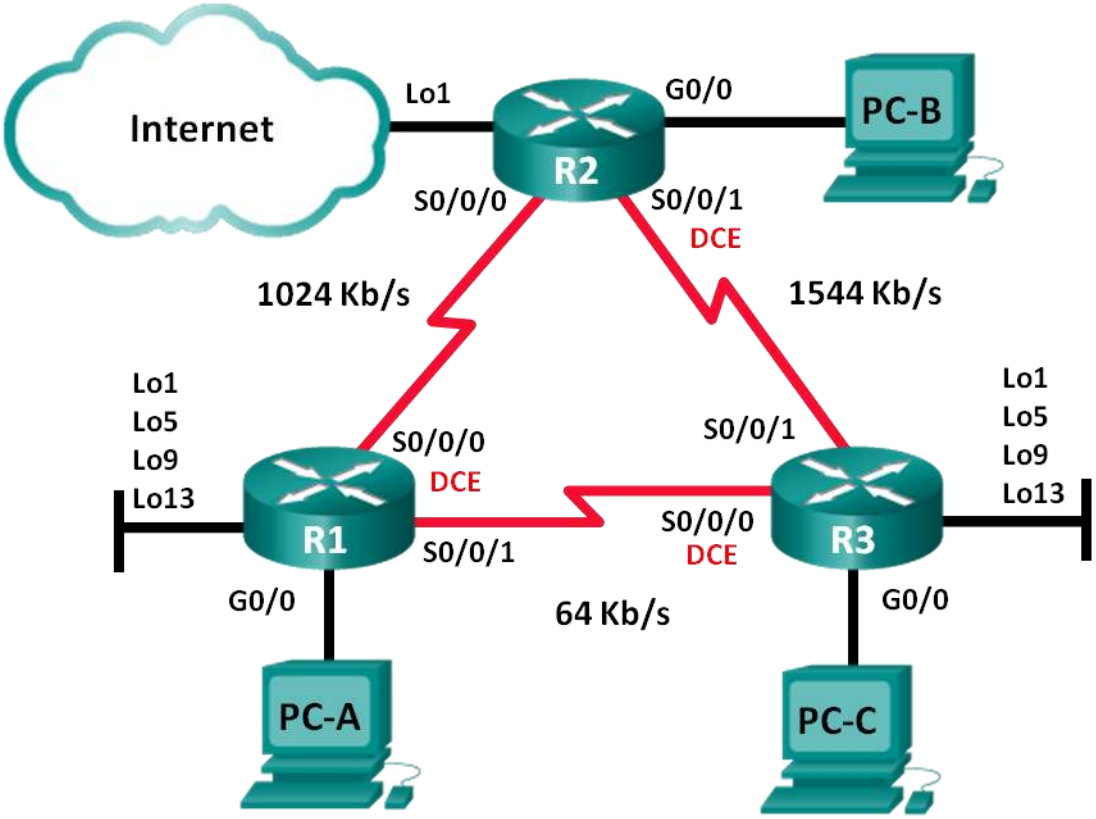
Lab – Configuring Advanced EIGRP for IPv4 Features

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)	192.168.12.1	255.255.255.252	N/A
	S0/0/1	192.168.13.1	255.255.255.252	N/A
	Lo1	192.168.11.1	255.255.255.252	N/A
	Lo5	192.168.11.5	255.255.255.252	N/A
	Lo9	192.168.11.9	255.255.255.252	N/A
	Lo13	192.168.11.13	255.255.255.252	N/A
R2	G0/0	192.168.2.1	255.255.255.0	N/A
	S0/0/0	192.168.12.2	255.255.255.252	N/A
	S0/0/1 (DCE)	192.168.23.1	255.255.255.252	N/A
	Lo1	192.168.22.1	255.255.255.252	N/A
R3	G0/0	192.168.3.1	255.255.255.0	N/A
	S0/0/0 (DCE)	192.168.13.2	255.255.255.252	N/A
	S0/0/1	192.168.23.2	255.255.255.252	N/A
	Lo1	192.168.33.1	255.255.255.252	N/A
	Lo5	192.168.33.5	255.255.255.252	N/A
	Lo9	192.168.33.9	255.255.255.252	N/A
	Lo13	192.168.33.13	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 Configure Basic Device Settings

Part 2: Configure EIGRP and Verify Connectivity

Part 3: Configure Summarization for EIGRP

- Configure EIGRP for automatic summarization.
- Configure manual summarization for EIGRP.

Part 4: Configure and Propagate a Default Static Route

Part 5: Fine-Tune EIGRP

- Configure bandwidth utilization for EIGRP.
- Configure the hello interval and hold timer for EIGRP.

Part 6: Configure EIGRP Authentication

Background / Scenario

EIGRP has advanced features to allow changes related to summarization, default route propagation, bandwidth utilization, metrics, and security.

In this lab, you will configure automatic and manual summarization for EIGRP, configure EIGRP route propagation, fine-tune EIGRP metrics, and use MD5 authentication to secure EIGRP routing information.

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 this end of the lab for the correct interface identifiers.

Note: Ensure 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 Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on the PC hosts and routers.

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 device name as shown in the topology.

c. Assign **cisco** as the console and vty passwords.

d. Assign **class** as the privileged EXEC password.

e. Configure **logging synchronous** to prevent console messages from interrupting command entry.

f. Configure the IP address listed in the Addressing Table for all interfaces.

Note: Do **NOT** configure the loopback interfaces at this time.

g. Copy the running configuration to the startup configuration.

Part 2: Configure EIGRP and Verify Connectivity

In Part 2, you will configure basic EIGRP for the topology and set bandwidths for the serial interfaces.

Note: This lab provides minimal assistance with the actual commands necessary to configure EIGRP. However, the required commands are provided in Appendix A. Test your knowledge by trying to configure the devices without referring to the appendix.

Step 1: Configure EIGRP.

a. On R1, configure EIGRP routing with an autonomous system (AS) ID of 1 for all directly connected networks. Write the commands used in the space below.

b. For the LAN interface on R1, disable the transmission of EIGRP hello packets. Write the command used in the space below.

c. On R1, configure the bandwidth for S0/0/0 to 1024 Kb/s and the bandwidth for S0/0/1 to 64 Kb/s. Write the commands used in the space below. **Note**: The **bandwidth** command only affects the EIGRP metric calculation, not the actual bandwidth of the serial link.

d. On R2, configure EIGRP routing with an AS ID of 1 for all networks, disable the transmission of EIGRP hello packets for the LAN interface, and configure the bandwidth for S0/0/0 to 1024 Kb/s.

e. On R3, configure EIGRP routing with an AS ID of 1 for all networks, disable the transmission of EIGRP hello packets for the LAN interface, and configure the bandwidth for S0/0/0 to 64 Kb/s.

Step 2: Test connectivity.

All PCs should be able to ping one another. Verify and troubleshoot if necessary.

Note: It may be necessary to disable the PC firewall to ping between PCs.

Part 3: Configure Summarization for EIGRP

In Part 3, you will add loopback interfaces to R1, enable EIGRP automatic summarization on R1, and observe the effects on the routing table for R2. You will also add loopback interfaces on R3.

Step 1: Configure EIGRP for automatic summarization.

a. Issue the **show ip protocols** command on R1. What is the default status of automatic summarization in EIGRP?

b. Configure the loopback addresses on R1.

c. Add the appropriate network statements to the EIGRP process on R1. Record the commands used in the space below.

d. On R2, issue the **show ip route eigrp** command. How are the loopback networks represented in the output?

e. On R1, issue the **auto-summary** command inside the EIGRP process.

```
R1(config)# router eigrp 1
R1(config-router)# auto-summary
R1(config-router)#
*Apr 14 01:14:55.463: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.13.2
(Serial0/0/1) is resync: summary configured
*Apr 14 01:14:55.463: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.12.2
(Serial0/0/0) is resync: summary configured
*Apr 14 01:14:55.463: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.13.2
(Serial0/0/1) is resync: summary up, remove components
R1(config-router)#67: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.12.2
(Serial0/0/0) is resync: summary up, remove components
*Apr 14 01:14:55.467: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.12.2
(Serial0/0/0) is resync: summary up, remove components
*Apr 14 01:14:55.467: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.13.2
(Serial0/0/1) is resync: summary up, remove components
```

How does the routing table on R2 change?

Step 2: Configure manual summarization for EIGRP.

a. Configure the loopback addresses on R3.

b. Add the appropriate network statements to the EIGRP process on R3.

c. On R2, issue the **show ip route eigrp** command. How are the loopback networks from R3 represented in the output?

d. Determine the summary EIGRP route for the loopback addresses on R3. Write the summary route in the space below.

e. For the serial interfaces on R3, issue the **ip summary-address eigrp 1** *network address subnet mask* command to manually summarize the networks.

```
R3(config)# interface s0/0/0
R3(config-if)# ip summary-address eigrp 1 192.168.33.0 255.255.255.240
R3(config-if)# exit
R3(config)# interface s0/0/1
R3(config-if)# ip summary-address eigrp 1 192.168.33.0 255.255.255.240
```

```
*Apr 14 01:33:46.433: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.13.1
(Serial0/0/0) is resync: summary configured
*Apr 14 01:33:46.433: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 192.168.23.1
(Serial0/0/1) is resync: summary configured
```

How does the routing table on R2 change?

Part 4: Configure and Propagate a Default Static Route

In Part 4, you will configure a default static route on R2 and propagate the route to all other routers.

a. Configure the loopback address on R2.

b. Configure a default static route with an exit interface of Lo1.

```
R2(config)# ip route 0.0.0.0 0.0.0.0 Lo1
```

c. Use the **redistribute static** command within the EIGRP process to propagate the default static route to other participating routers.

```
R2(config)# router eigrp 1
R2(config-router)# redistribute static
```

d. Use the **show ip protocols** command on R2 to verify the static route is being distributed.

```
R2# show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "eigrp 1"
  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
  Redistributing: static
  EIGRP-IPv4 Protocol for AS(1)
    Metric weight K1=1, K2=0, K3=1, K4=0, K5=0
    NSF-aware route hold timer is 240
    Router-ID: 192.168.23.1
    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:
    192.168.2.0
    192.168.12.0/30
    192.168.23.0/30
  Passive Interface(s):
    GigabitEthernet0/0
  Routing Information Sources:
```

```
    Gateway         Distance      Last Update
    192.168.12.1           90      00:13:20
    192.168.23.2           90      00:13:20
  Distance: internal 90 external 170
```

e. On R1, issue the **show ip route eigrp | include 0.0.0.0** command to view statements specific to the default route. How is the static default route represented in the output? What is the administrative distance (AD) for the propagated route?

Part 5: Fine-Tune EIGRP

In Part 5, you will configure the percentage of bandwidth that can be used by an EIGRP interface and change the hello interval and hold timers for EIGRP interfaces.

Step 1: Configure bandwidth utilization for EIGRP.

a. Configure the serial link between R1 and R2 to allow only 75 percent of the link bandwidth for EIGRP traffic.

```
R1(config)# interface s0/0/0
R1(config-if)# ip bandwidth-percent eigrp 1 75
R2(config)# interface s0/0/0
R2(config-if)# ip bandwidth-percent eigrp 1 75
```

b. Configure the serial link between R1 and R3 to allow 40 percent of the links bandwidth for EIGRP traffic.

Step 2: Configure the hello interval and hold timer for EIGRP.

a. On R2, use the **show ip eigrp interfaces detail** command to view the hello interval and hold timer for EIGRP.

```
R2# show ip eigrp interfaces detail
EIGRP-IPv4 Interfaces for AS(1)
                            Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Se0/0/0                  1        0/0       0/0           1       0/15          50           0
  Hello-interval is 5, Hold-time is 15
  Split-horizon is enabled
  Next xmit serial <none>
  Packetized sent/expedited: 29/1
  Hello's sent/expedited: 390/2
  Un/reliable mcasts: 0/0  Un/reliable ucasts: 35/39
  Mcast exceptions: 0  CR packets: 0  ACKs suppressed: 0
  Retransmissions sent: 0  Out-of-sequence rcvd: 0
  Topology-ids on interface - 0
  Interface BW percentage is 75
  Authentication mode is not set
Se0/0/1                  1        0/0       0/0           1       0/16          50           0
  Hello-interval is 5, Hold-time is 15
  Split-horizon is enabled
  Next xmit serial <none>
```

```
  Packetized sent/expedited: 34/5
  Hello's sent/expedited: 382/2
  Un/reliable mcasts: 0/0  Un/reliable ucasts: 31/42
  Mcast exceptions: 0  CR packets: 0  ACKs suppressed: 2
  Retransmissions sent: 0  Out-of-sequence rcvd: 0
  Topology-ids on interface - 0
  Authentication mode is not set
```

What is the default value for hello time?

What is the default value for hold time?

b. Configure S0/0/0 and S0/0/1 interfaces on R1 to use a hello interval of 60 seconds and a hold time of 180 seconds in that specific order.

```
R1(config)# interface s0/0/0
R1(config-if)# ip hello-interval eigrp 1 60
R1(config-if)# ip hold-time eigrp 1 180
R1(config)# interface s0/0/1
R1(config-if)# ip hello-interval eigrp 1 60
R1(config-if)# ip hold-time eigrp 1 180
```

c. Configure the serial interfaces on R2 and R3 to use a hello interval of 60 seconds and a hold time of 180 seconds.

d. Use the **show ip eigrp interfaces detail** command on R2 to verify configuration.

Part 6: Configure EIGRP Authentication

In Part 6, you will create an authentication key on all routers and configure router interfaces to use MD5 authentication for EIGRP message authentication.

Step 1: Configure authentication keys.

a. On R1, use the **key chain** *name* command in global configuration mode to create a key chain with the label EIGRP-KEYS.

```
R1(config)# key chain EIGRP-KEYS
R1(config-keychain)# key 1
R1(config-keychain-key)# key-string cisco
```

b. Complete the configuration on R2 and R3.

c. Issue the **show key chain** command. You should have the same output on every router.

Step 2: Configure EIGRP link authentication.

a. Apply the following commands to active EIGRP authentication on the serial interfaces on R1.

```
R1# conf t
R1(config)# interface s0/0/0
R1(config-if)# ip authentication key-chain eigrp 1 EIGRP-KEYS
R1(config-if)# ip authentication mode eigrp 1 md5
R1(config-if)# interface s0/0/1
R1(config-if)# ip authentication key-chain eigrp 1 EIGRP-KEYS
R1(config-if)# ip authentication mode eigrp 1 md5
```

b. Activate EIGRP authentication on the serial interfaces on R2 and R3.

c. On R2, use the **show ip eigrp interfaces detail** command to verify authentication.

```
R2# show ip eigrp interfaces detail
EIGRP-IPv4 Interfaces for AS(1)
                              Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Se0/0/0                  1        0/0       0/0           1       0/23          50           0
  Hello-interval is 60, Hold-time is 180
  Split-horizon is enabled
  Next xmit serial <none>
  Packetized sent/expedited: 30/5
  Hello's sent/expedited: 1163/5
  Un/reliable mcasts: 0/0  Un/reliable ucasts: 25/34
  Mcast exceptions: 0  CR packets: 0  ACKs suppressed: 0
  Retransmissions sent: 0  Out-of-sequence rcvd: 0
  Topology-ids on interface - 0
  Authentication mode is md5,  key-chain is "EIGRP-KEYS"
Se0/0/1                  1        0/0       0/0           2       0/15          50           0
  Hello-interval is 60, Hold-time is 180
  Split-horizon is enabled
  Next xmit serial <none>
  Packetized sent/expedited: 31/1
  Hello's sent/expedited: 1354/3
  Un/reliable mcasts: 0/0  Un/reliable ucasts: 28/34
  Mcast exceptions: 0  CR packets: 0  ACKs suppressed: 4
  Retransmissions sent: 0  Out-of-sequence rcvd: 0
  Topology-ids on interface - 0
  Authentication mode is md5,  key-chain is "EIGRP-KEYS"
```

Reflection

1. What are the benefits of summarizing routes?

2. When setting EIGRP timers, why is it important to make the hold time value equal to or greater than the hello interval?

3. Why is it important to configure authentication for EIGRP?

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)

Note: 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.

Appendix A: Configuration Commands

Router R1

```
R1(config)# router eigrp 1
R1(config-router)# network 192.168.1.0
R1(config-router)# network 192.168.12.0 0.0.0.3
R1(config-router)# network 192.168.13.0 0.0.0.3
R1(config-router)# network 192.168.11.0 0.0.0.3
R1(config-router)# network 192.168.11.4 0.0.0.3
R1(config-router)# network 192.168.11.8 0.0.0.3
R1(config-router)# network 192.168.11.12 0.0.0.3
R1(config-router)# passive-interface g0/0
R1(config)# int s0/0/0
R1(config-if)# bandwidth 1024
R1(config-if)# int s0/0/1
R1(config-if)# bandwidth 64
```

Router R2

```
R2(config)# router eigrp 1
R2(config-router)# network 192.168.2.0
R2(config-router)# network 192.168.12.0 0.0.0.3
R2(config-router)# network 192.168.23.0 0.0.0.3
R2(config-router)# passive-interface g0/0
```

```
R2(config)# int s0/0/0
R2(config-if)# bandwidth 1024
```

Router R3

```
R3(config)# router eigrp 1
R3(config-router)# network 192.168.3.0
R3(config-router)# network 192.168.13.0 0.0.0.3
R3(config-router)# network 192.168.23.0 0.0.0.3
R3(config-router)# network 192.168.33.0 0.0.0.3
R3(config-router)# network 192.168.33.4 0.0.0.3
R3(config-router)# network 192.168.33.8 0.0.0.3
R3(config-router)# network 192.168.33.12 0.0.0.3
R3(config-router)# passive-interface g0/0
R3(config)# int s0/0/0
R3(config-if)# bandwidth 64
```