Lab – Troubleshooting Advanced EIGRP (Instructor Version)

**Instructor Note**: Red font color or Gray highlights indicate text that appears in the instructor copy only.

1. Topology

1. Addressing Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Device | Interface | IP Address | Subnet Mask | Default Gateway |
| R1 | G0/0 | 192.168.1.1 | 255.255.255.0 | N/A |
|  | Lo1 | 172.16.11.1 | 255.255.255.0 | N/A |
|  | Lo2 | 172.16.12.1 | 255.255.255.0 | N/A |
|  | Lo3 | 172.16.13.1 | 255.255.255.0 | N/A |
|  | Lo4 | 172.16.14.1 | 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 |
| R2 | G0/0 | 192.168.2.1 | 255.255.255.0 | N/A |
|  | Lo0 | 209.165.200.225 | 255.255.255.252 | 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 |
| R3 | G0/0 | 192.168.3.1 | 255.255.255.0 | N/A |
|  | Lo3 | 172.16.33.1 | 255.255.255.0 | N/A |
|  | Lo4 | 172.16.34.1 | 255.255.255.0 | N/A |
|  | Lo5 | 172.16.35.1 | 255.255.255.0 | N/A |
|  | Lo6 | 172.16.36.1 | 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 |
| 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 |

1. Objectives

Part 1: Build the Network and Load Device Configurations

Part 2: Troubleshoot EIGRP

1. Background / Scenario

The Enhanced Interior Gateway Routing Protocol (EIGRP) has advanced features to allow changes related to summarization, default route propagation, bandwidth utilization, metrics, and security.

In this lab, you will troubleshoot a network that is running EIGRP. Advanced EIGRP features have been implemented, but the network is now experiencing problems. You are tasked with finding and correcting the network issues.

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

**Instructor Note**: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

1. 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 cables as shown in the topology
1. Build the Network and Load Device Configurations
	1. Cable the network as shown in the topology.
	2. Configure PC hosts.
	3. Load router configurations.

Load the following configurations into the appropriate router. All routers have the same passwords. The privileged EXEC password is **class**, and **cisco** is the console and vty password.

Router R1 Configuration:

conf t

hostname R1

enable secret class

no ip domain lookup

key chain EIGRP-KEYS

 key 1

 key-string cisco123

! key-string Cisco123

line con 0

 password cisco

 login

 logging synchronous

line vty 0 4

 password cisco

 login

banner motd @

 Unauthorized Access is Prohibited! @

interface lo1

 description Connection to Branch 11

 ip add 172.16.11.1 255.255.255.0

interface lo2

 description Connection to Branch 12

 ip add 172.16.12.1 255.255.255.0

interface lo3

 description Connection to Branch 13

 ip add 172.16.13.1 255.255.255.0

interface lo4

 description Connection to Branch 14

 ip add 172.16.14.1 255.255.255.0

interface g0/0

 description R1 LAN Connection

 ip add 192.168.1.1 255.255.255.0

 no shutdown

interface s0/0/0

 description Serial Link to R2

 clock rate 128000

! bandwidth 128

 ip add 192.168.12.1 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 ip bandwidth-percent eigrp 1 40

! ip summary-address eigrp 1 172.16.8.0 255.255.248.0

 no shutdown

interface s0/0/1

 description Serial Link to R3

 bandwidth 128

 ip add 192.168.13.1 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

! ip hello-interval eigrp 1 30

! ip hold-time eigrp 1 90

! ip summary-address eigrp 1 172.16.8.0 255.255.248.0

 no shutdown

router eigrp 1

 router-id 1.1.1.1

 network 192.168.1.0 0.0.0.255

 network 192.168.12.0 0.0.0.3

 network 192.168.13.0 0.0.0.3

 network 172.16.0.0 0.0.255.255

 passive-interface g0/0

 auto-summary

! no auto-summary

end

Router R2 Configuration:

conf t

hostname R2

enable secret class

no ip domain lookup

key chain EIGRP-KEYS

 key 1

 key-string Cisco123

line con 0

 password cisco

 login

 logging synchronous

line vty 0 4

 password cisco

 login

banner motd @

 Unauthorized Access is Prohibited! @

interface g0/0

 description R2 LAN Connection

 ip add 192.168.2.1 255.255.255.0

 no shutdown

interface s0/0/0

 description Serial Link to R1

 bandwidth 128

 ip add 192.168.12.2 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 no shutdown

interface s0/0/1

 description Serial Link to R3

 bandwidth 128

! clock rate 128000

 ip add 192.168.23.1 255.255.255.252

 ip authentication mode eigrp 1 md5

! ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 no shutdown

interface lo0

 ip add 209.165.200.225 255.255.255.252

 description Connection to ISP

router eigrp 1

 router-id 2.2.2.2

 network 192.168.2.0 0.0.0.255

 network 192.168.12.0 0.0.0.3

 network 192.168.23.0 0.0.0.3

 passive-interface g0/0

! redistribute static

ip route 0.0.0.0 0.0.0.0 lo0

end

Router R3 Configuration:

conf t

hostname R3

enable secret class

no ip domain lookup

key chain EIGRP-KEYS

 key 1

 key-string Cisco123

line con 0

 password cisco

 login

 logging synchronous

line vty 0 4

 password cisco

 login

banner motd @

 Unauthorized Access is Prohibited! @

interface lo3

 description Connection to Branch 33

 ip add 172.16.33.1 255.255.255.0

interface lo4

 description Connection to Branch 34

 ip add 172.16.34.1 255.255.255.0

interface lo5

 description Connection to Branch 35

 ip add 172.16.35.1 255.255.255.0

interface lo6

 description Connection to Branch 36

 ip add 172.16.36.1 255.255.255.0

interface g0/0

 description R3 LAN Connection

 ip add 192.168.3.1 255.255.255.0

 no shutdown

interface s0/0/0

 description Serial Link to R1

 ip add 192.168.13.2 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

! ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

! ip summary-address eigrp 1 172.16.32.0 255.255.248.0

 clock rate 128000

 bandwidth 128

 no shutdown

interface s0/0/1

 description Serial Link to R2

 bandwidth 128

 ip add 192.168.23.2 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 eigrp-keys

! ip authentication key-chain eigrp 1 EIGRP-KEYS

! ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

! ip summary-address eigrp 1 172.16.32.0 255.255.248.0

 no shutdown

router eigrp 1

 router-id 3.3.3.3

 network 192.168.3.0 0.0.0.255

 network 192.168.13.0 0.0.0.3

 network 192.168.23.0 0.0.0.3

 network 172.16.0.0 0.0.255.255

 passive-interface g0/0

 auto-summary

! no auto-summary

end

* 1. Verify end-to-end connectivity.

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

* 1. Save the configuration on all routers.
1. Troubleshoot EIGRP

In Part 2, verify that all routers have established neighbor adjacencies, and that all network routes are available.

Additional EIGRP Requirements:

* All serial interface clock rates should be set at 128 Kb/s and a matching bandwidth setting should be available to allow EIGRP cost metrics to be calculated correctly.
* Manual route summarization of the branch networks, simulated by using Loopback interfaces on R1 and R3, should be utilized. The automatic summarization feature of EIGRP should not be used.
* EIGRP should redistribute the static default route to the Internet. This is simulated by using Loopback interface 0 on R2.
* EIGRP should be configured to use no more than **40** percent of the available bandwidth on the serial interfaces.
* EIGRP Hello/Hold timer intervals should be set to **30/90** on all serial interfaces.
* All serial interfaces should be configured with MD5 authentication, using key chain **EIGRP-KEYS**, with a key-string of **Cisco123**.

List the commands used during your EIGRP troubleshooting process:

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Answers may vary, but the list of commands can include:

* **show controllers,**
* **show ip eigrp neighbor**
* **show ip eigrp interfaces**
* **show ip eigrp interface detail**
* **show ip route**
* **show ip route eigrp**
* **show ip protocols**
* **show run**
* **show run | section router eigrp**

List the changes made to resolve the EIGRP issues. If no problems were found on the device, then respond with “no problems were found”.

R1 Router:

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R1(config)# **key chain EIGRP-KEYS**

R1(config-keychain)# **key 1**

R1(config-keychain-key)# **key-string Cisco123**

R1(config-keychain-key)# **interface s0/0/0**

R1(config-if)# **bandwidth 128**

R1(config-if)# **ip summary-address eigrp 1 172.16.8.0 255.255.248.0**

R1(config-if)# **interface s0/0/1**

R1(config-if)# **ip hello-interval eigrp 1 30**

R1(config-if)# **ip hold-time eigrp 1 90**

R1(config-if)# **ip summary-address eigrp 1 172.16.8.0 255.255.248.0**

R1(config-if)# **router eigrp 1**

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

R2 Router:

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R2(config)# **interface s0/0/1**

R2(config-if)# **clock rate 128000**

R2(config-if)# **ip authentication key-chain eigrp 1 EIGRP-KEYS**

R2(config-if)# **router eigrp 1**

R2(config-router)# **redistribute static**

R3 Router:

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R3(config)# **interface s0/0/0**

R3(config-if)# **ip summary-address eigrp 1 172.16.32.0 255.255.248.0**

R3(config-if)# **ip bandwidth-percent eigrp 1 40**

R3(config-if)# **interface s0/0/1**

R3(config-if)# **ip authentication key-chain eigrp 1 EIGRP-KEYS**

R3(config-if)# **ip summary-address eigrp 1 172.16.32.0 255.255.248.0**

R3(config-if)# **ip bandwidth-percent eigrp 1 40**

R3(config-if)# **router eigrp 1**

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

1. Reflection
	1. How can the **auto-summary** command create routing issues in EIGRP?

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Answers may vary, but auto summary may create routing issues by summarizing subnets in a network as a classful route. This may cause traffic to be incorrectly routed. When working with the EIGRP routing protocol, it is often preferable to manually summarize routes in EIGRP instead of allowing them to be automatically summarized. This is why Cisco changed the default setting in IOS 15 to **no auto-summary**.

* 1. What advantages are provided by manually summarizing the branch routes (loopback interfaces on R1 and R3) in this network?

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Answers may vary, but manual summarization of these networks reduces the number of routes contained in the routing tables and reduces EIGRP traffic by eliminating unnecessary updates of each branch route.

* 1. Why would you want to change the EIGRP Hello and Hold time intervals on an interface?

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You may want to extend the time between EIGRP hellos on an interface with a low bandwidth clocking speed. This reduces the amount of EIGRP traffic over that interface, providing more availability for data traffic.

1. 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. |

1. Device Configs
2. Router R1 (Final)

R1#sh run

Building configuration...

Current configuration : 2626 bytes

!

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname R1

!

boot-start-marker

boot-end-marker

!

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

memory-size iomem 15

!

ip cef

!

no ip domain lookup

no ipv6 cef

multilink bundle-name authenticated

!

!

key chain EIGRP-KEYS

 key 1

 key-string Cisco123

!

interface Loopback1

 description Connection to Branch 11

 ip address 172.16.11.1 255.255.255.0

!

interface Loopback2

 description Connection to Branch 12

 ip address 172.16.12.1 255.255.255.0

!

interface Loopback3

 description Connection to Branch 13

 ip address 172.16.13.1 255.255.255.0

!

interface Loopback4

 description Connection to Branch 14

 ip address 172.16.14.1 255.255.255.0

!

interface Embedded-Service-Engine0/0

 no ip address

 shutdown

!

interface GigabitEthernet0/0

 description R1 LAN Connection

 ip address 192.168.1.1 255.255.255.0

 duplex auto

 speed auto

!

interface GigabitEthernet0/1

 no ip address

 shutdown

 duplex auto

 speed auto

!

interface Serial0/0/0

 description Serial Link to R2

 bandwidth 128

 ip address 192.168.12.1 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 ip summary-address eigrp 1 172.16.8.0 255.255.248.0

 clock rate 128000

!

interface Serial0/0/1

 description Serial Link to R3

 bandwidth 128

 ip address 192.168.13.1 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 ip summary-address eigrp 1 172.16.8.0 255.255.248.0

!

!

router eigrp 1

 network 172.16.0.0

 network 192.168.1.0

 network 192.168.12.0 0.0.0.3

 network 192.168.13.0 0.0.0.3

 passive-interface GigabitEthernet0/0

 eigrp router-id 1.1.1.1

!

ip forward-protocol nd

!

no ip http server

no ip http secure-server

!

control-plane

!

banner motd ^C

 Unauthorized Access is Prohibited! ^C

!

line con 0

 password cisco

 login

 logging synchronous

line aux 0

line 2

 no activation-character

 no exec

 transport preferred none

 transport input all

 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh

 stopbits 1

line vty 0 4

 password cisco

 login

 transport input all

!

scheduler allocate 20000 1000

!

end

1. Router R2 (Final)

R2#sh run

Building configuration...

Current configuration : 2220 bytes

!

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname R2

!

boot-start-marker

boot-end-marker

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

memory-size iomem 15

!

ip cef

!

no ip domain lookup

no ipv6 cef

multilink bundle-name authenticated

!

key chain EIGRP-KEYS

 key 1

 key-string Cisco123

!

interface Loopback0

 description Connection to ISP

 ip address 209.165.200.225 255.255.255.252

!

interface Embedded-Service-Engine0/0

 no ip address

 shutdown

!

interface GigabitEthernet0/0

 description R2 LAN Connection

 ip address 192.168.2.1 255.255.255.0

 duplex auto

 speed auto

!

interface GigabitEthernet0/1

 no ip address

 shutdown

 duplex auto

 speed auto

!

interface Serial0/0/0

 description Serial Link to R1

 bandwidth 128

 ip address 192.168.12.2 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

!

interface Serial0/0/1

 description Serial Link to R3

 bandwidth 128

 ip address 192.168.23.1 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 clock rate 128000

!

!

router eigrp 1

 network 192.168.2.0

 network 192.168.12.0 0.0.0.3

 network 192.168.23.0 0.0.0.3

 redistribute static

 passive-interface GigabitEthernet0/0

 eigrp router-id 2.2.2.2

!

ip forward-protocol nd

!

no ip http server

no ip http secure-server

!

ip route 0.0.0.0 0.0.0.0 Loopback0

!

control-plane

!

banner motd ^C

 Unauthorized Access is Prohibited! ^C

!

line con 0

 password cisco

 login

 logging synchronous

line aux 0

line 2

 no activation-character

 no exec

 transport preferred none

 transport input all

 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh

 stopbits 1

line vty 0 4

 password cisco

 login

 transport input all

!

scheduler allocate 20000 1000

!

end

1. Router R3 (Final)

R3#sh run

Building configuration...

Current configuration : 2551 bytes

!

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname R3

!

boot-start-marker

boot-end-marker

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

memory-size iomem 15

!

ip cef

!

no ip domain lookup

no ipv6 cef

multilink bundle-name authenticated

!

key chain EIGRP-KEYS

 key 1

 key-string Cisco123

!

interface Loopback3

 description Connection to Branch 33

 ip address 172.16.33.1 255.255.255.0

!

interface Loopback4

 description Connection to Branch 34

 ip address 172.16.34.1 255.255.255.0

!

interface Loopback5

 description Connection to Branch 35

 ip address 172.16.35.1 255.255.255.0

!

interface Loopback6

 description Connection to Branch 36

 ip address 172.16.36.1 255.255.255.0

!

interface Embedded-Service-Engine0/0

 no ip address

 shutdown

!

interface GigabitEthernet0/0

 description R3 LAN Connection

 ip address 192.168.3.1 255.255.255.0

 duplex auto

 speed auto

!

interface GigabitEthernet0/1

 no ip address

 shutdown

 duplex auto

 speed auto

!

interface Serial0/0/0

 description Serial Link to R1

 bandwidth 128

 ip address 192.168.13.2 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 ip summary-address eigrp 1 172.16.32.0 255.255.248.0

 clock rate 128000

!

interface Serial0/0/1

 description Serial Link to R2

 bandwidth 128

 ip address 192.168.23.2 255.255.255.252

 ip authentication mode eigrp 1 md5

 ip authentication key-chain eigrp 1 EIGRP-KEYS

 ip bandwidth-percent eigrp 1 40

 ip hello-interval eigrp 1 30

 ip hold-time eigrp 1 90

 ip summary-address eigrp 1 172.16.32.0 255.255.248.0

!

router eigrp 1

 network 172.16.0.0

 network 192.168.3.0

 network 192.168.13.0 0.0.0.3

 network 192.168.23.0 0.0.0.3

 passive-interface GigabitEthernet0/0

 eigrp router-id 3.3.3.3

!

ip forward-protocol nd

!

no ip http server

no ip http secure-server

!

control-plane

!

banner motd ^C

 Unauthorized Access is Prohibited! ^C

!

line con 0

 password cisco

 login

 logging synchronous

line aux 0

line 2

 no activation-character

 no exec

 transport preferred none

 transport input all

 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh

 stopbits 1

line vty 0 4

 password cisco

 login

 transport input all

!

scheduler allocate 20000 1000

!

end