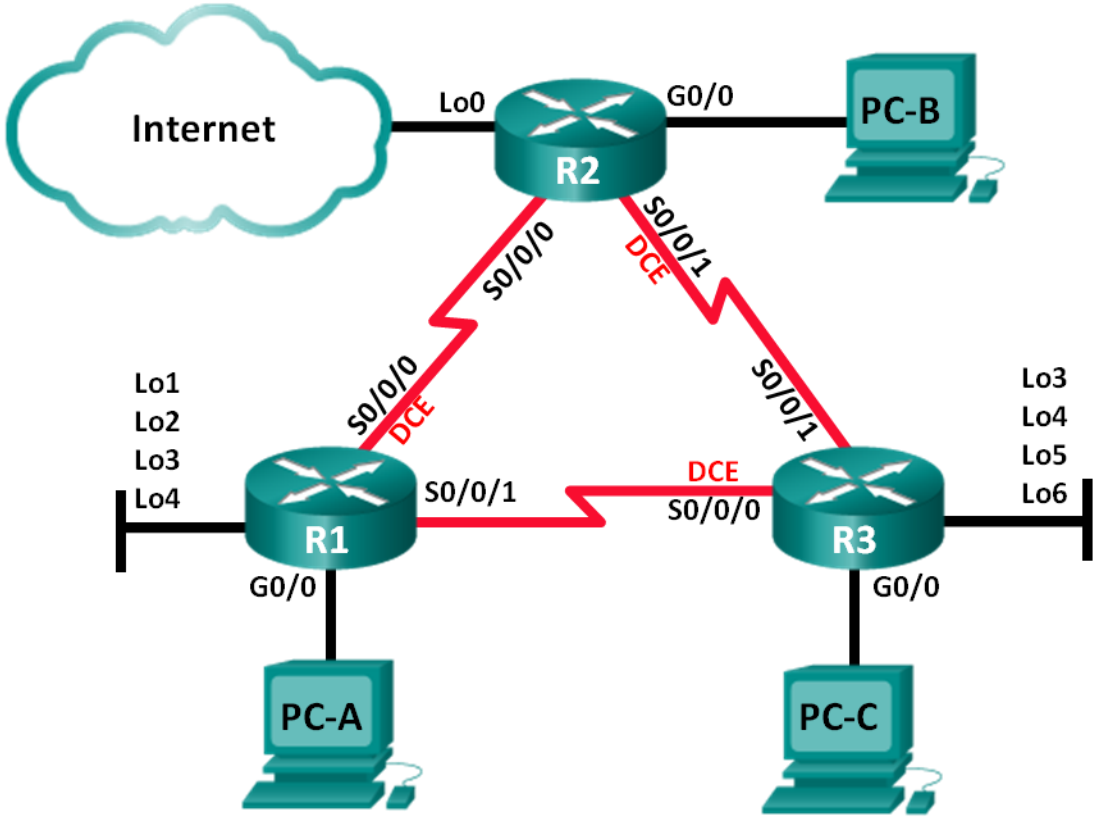
Lab – Troubleshooting Advanced EIGRP (Instructor Version)

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

Topology



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

Objectives

Part 1: Build the Network and Load Device Configurations

Part 2: Troubleshoot EIGRP

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.

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

Part 1: Build the Network and Load Device Configurations

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

Step 2: Configure PC hosts.

Step 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
```

Step 4: Verify end-to-end connectivity.

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

Step 5: Save the configuration on all routers.

Part 2: 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:

_____

_____

_____

_____

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:

_____

_____

_____

_____

```
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:

```
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:

```
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
```

Reflection

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

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**.

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

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.

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

_____

_____

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.

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.

Device Configs

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
```

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
```

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
```