

CIS 83 LAB 3 - EIGRP

Rich Simms

September 23, 2006

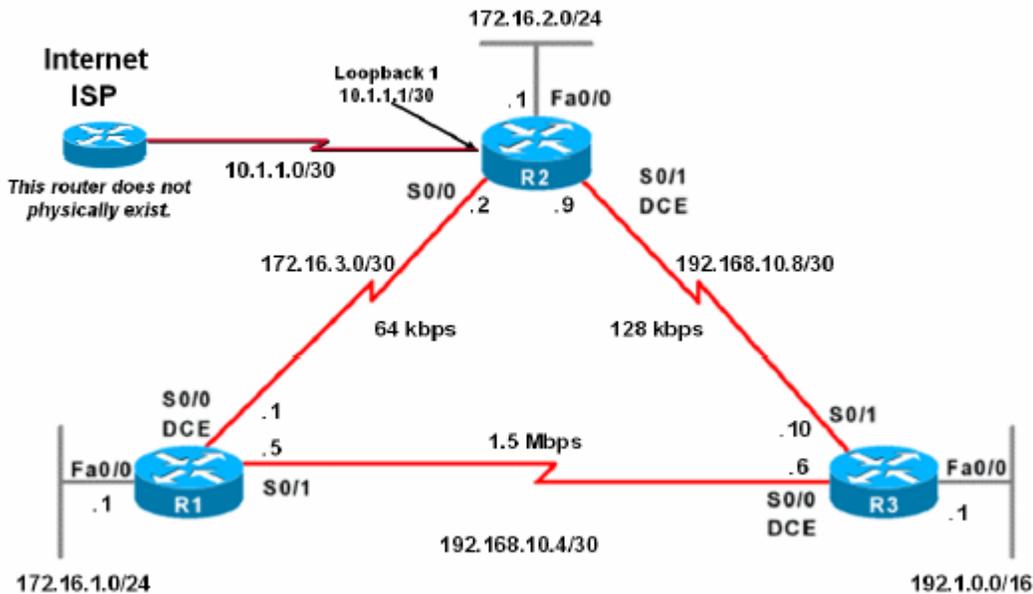
Objective

The objective of this lab is to become familiar setting up and configuring EIGRP on three routers. EIGRP is a Cisco proprietary distance-vector protocol that addresses many of the limitation of RIP.

Scenario

This lab was done using the basic router pod on NETLAB. NETLAB lets you remotely access a pod of Cisco routers. The three Cisco routers were configured as shown below.

Topology



Final Running Configurations

R1	R2	R3
<pre> R1#show run Building configuration... Current configuration : 974 bytes ! ! Last configuration change at 06:00:38 UTC Sat Jul 15 2006 ! NVRAM config last updated at 05:51:10 UTC Sat Jul 15 2006 ! version 12.2 service timestamps debug datetime msec service timestamps log datetime msec no service password-encryption ! hostname R1 ! logging queue-limit 100 ! memory-size iomem 10 ip subnet-zero ! ip audit notify log ip audit po max-events 100 ! interface BRI0 no ip address shutdown ! interface FastEthernet0 ip address 172.16.1.1 255.255.255.0 speed auto ! interface Serial0 bandwidth 64 ip address 172.16.3.1 255.255.255.252 clockrate 64000 no fair-queue ! interface Serial1 bandwidth 1500 ip address 192.168.10.5 255.255.255.252 ip summary-address eigrp 1 172.16.0.0 255.255.252.0 5 ! router eigrp 1 network 172.16.0.0 network 192.168.10.0 no auto-summary ! ! ip classless no ip http server no ip http secure-server ! ! line con 0 exec-timeout 0 0 logging synchronous </pre>	<pre> R2#show run Building configuration... Current configuration : 1009 bytes ! ! Last configuration change at 00:24:46 UTC Mon May 22 2006 ! NVRAM config last updated at 00:18:31 UTC Mon May 22 2006 ! version 12.2 service timestamps debug datetime msec service timestamps log datetime msec no service password-encryption ! hostname R2 ! logging queue-limit 100 ! memory-size iomem 10 ip subnet-zero ! ip audit notify log ip audit po max-events 100 ! interface Loopback1 ip address 10.1.1.1 255.255.255.252 ! interface FastEthernet0 ip address 172.16.2.1 255.255.255.0 speed auto ! interface Serial0 bandwidth 64 ip address 172.16.3.2 255.255.255.252 no fair-queue ! ! interface Serial1 bandwidth 128 ip address 192.168.10.9 255.255.255.252 shutdown clockrate 64000 ! router eigrp 1 redistribute static network 172.16.0.0 network 192.168.10.8 0.0.0.3 no auto-summary ! ! ip classless ip route 0.0.0.0 0.0.0.0 Loopback1 no ip http server no ip http secure-server ! ! line con 0 exec-timeout 0 0 logging synchronous </pre>	<pre> R3#show run Building configuration... Current configuration : 765 bytes ! ! Last configuration change at ! ! NVRAM config last updated at ! ! version 12.2 service timestamps debug datetime msec service timestamps log datetime msec no service password-encryption ! hostname R3 ! logging queue-limit 100 ! memory-size iomem 10 ip subnet-zero ! ip audit notify log ip audit po max-events 100 ! ! interface FastEthernet0 ip address 192.1.0.1 255.255.0.0 speed auto ! interface Serial0 bandwidth 1500 ip address 192.168.10.6 255.255.255.252 clockrate 64000 no fair-queue ! interface Serial1 bandwidth 128 ip address 192.168.10.10 255.255.255.252 shutdown ! ! router eigrp 1 network 192.1.0.0 network 192.168.10.0 no auto-summary ! ! !ip classless no ip http server no ip http secure-server ! ! line con 0 exec-timeout 0 0 logging synchronous </pre>

<pre> line aux 0 line vty 0 4 login ! end R1# </pre>	<pre> line aux 0 line vty 0 4 login ! end R2# </pre>	<pre> line aux 0 line vty 0 4 login ! end R3# </pre>
--	--	--

Final Routing Tables

<p>R1</p>	<pre> R1#show ip route Codes: 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, 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 172.16.3.2 to network 0.0.0.0 192.168.10.0/30 is subnetted, 1 subnets C 192.168.10.4 is directly connected, Serial1 172.16.0.0/16 is variably subnetted, 4 subnets, 3 masks D 172.16.0.0/22 is a summary, 00:00:25, Null0 C 172.16.1.0/24 is directly connected, FastEthernet0 D 172.16.2.0/24 [90/40514560] via 172.16.3.2, 00:03:53, Serial0 C 172.16.3.0/30 is directly connected, Serial0 D*EX 0.0.0.0/0 [170/40640000] via 172.16.3.2, 00:03:53, Serial0 D 192.1.0.0/16 [90/2221056] via 192.168.10.6, 00:00:21, Serial1 R1# </pre>
<p>R2</p>	<pre> R2#show ip route Codes: 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, 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 0.0.0.0 192.168.10.0/30 is subnetted, 2 subnets D 192.168.10.4 [90/21024000] via 192.168.10.10, 00:03:34, Serial1 C 192.168.10.8 is directly connected, Serial1 172.16.0.0/16 is variably subnetted, 3 subnets, 2 masks D 172.16.1.0/24 [90/21026560] via 192.168.10.10, 00:03:32, Serial1 C 172.16.2.0/24 is directly connected, FastEthernet0 C 172.16.3.0/30 is directly connected, Serial0 10.0.0.0/30 is subnetted, 1 subnets C 10.1.1.0 is directly connected, Loopback1 S* 0.0.0.0/0 is directly connected, Loopback1 D 192.1.0.0/16 [90/20514560] via 192.168.10.10, 00:03:35, Serial1 R2# </pre>
<p>R3</p>	<pre> R3#show ip route Codes: 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, 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 192.168.10.5 to network 0.0.0.0 192.168.10.0/30 is subnetted, 1 subnets C 192.168.10.4 is directly connected, Serial0 172.16.0.0/22 is subnetted, 1 subnets D 172.16.0.0 [90/2221056] via 192.168.10.5, 00:00:26, Serial0 D*EX 0.0.0.0/0 [170/41152000] via 192.168.10.5, 00:00:26, Serial0 </pre>

C	192.1.0.0/16 is directly connected, FastEthernet0
R3#	

Summary

The lab explores how to setup and configure EIGRP (Enhanced Interior Gateway Routing Protocol). EIGRP is a Cisco proprietary protocol and it replaces the earlier IGRP. While Cisco calls EIGRP a hybrid protocol it is really only a distance-vector protocol. That's because each router does not have a complete topology map of the network. Routing information is exchanged using RTP (Reliable Transport Protocol) which is independent of IP. This is so EIGRP can be used for multiple network protocols (IP, AppleTalk, IPX)

EIGRP has its own lingo which must be understood to use it. A "feasible" route means there are no routing loops detected by the DUAL (Diffusing Update Algorithm). The "feasible distance" is the minimum cost path to the destination via the "successor". A "successor" is the next hop which represents the lowest cost path. A "feasible successor" is a backup route which can be used if the successor goes down. To be feasible, the feasible condition must be met which is that the reported distance (RD) of the neighbor under consideration is less than the current feasible distance to insure there are no routing loops.

EIGRP maintains three tables. The neighbor table keeps a list of the directly connected adjacent routers learned using hello packets. The topology table (confusingly named as it does not contain the "big picture" network topology kept by link-state protocols) stores all routes learned from its neighbors. Routes in the Topology table are either "passive" (stable and ready to use) or "active" (being recomputed by DUAL). The routing table has the best routes in the topology table.

The cost of a route is based on bandwidth, delay reliability and cost. The default cost is based just on bandwidth and delay is calculated using the bandwidth of the slowest link plus the sum of all the delays along the full path to the destination. These are calculated using DLY (in usec) and BW (in kbits) in the output of the show interface command (e.g. show int s0/1) as follows:

- Bandwidth=10,000,000/BW*256 (on slowest link)
- Delay=DLY/10*256 (then sum all delays for entire path)

When propagating a default gateway, use the redistribute static command on Cisco routers.

Commands

```
! Configuring EIGRP
! router eigrp autonomous-system-number (ASN must be same on all routers)
R1(config)#router eigrp 1
R1(config-router)#network 172.16.0.0
R1(config-router)#network 192.168.10.0

!Verifying IGRP
```

```
R1#show ip eigrp neighbors
IP-EIGRP neighbors for process 1
H   Address                Interface    Hold  Uptime    SRTT   RTO   Q   Seq Type
      (sec)                (ms)                Cnt  Num
0   192.168.10.6           Se0/1       11   00:02:12   4     1140  0   37
1   172.16.3.2             Se0/0       12   00:02:40  324   2280  0   36
```

!Getting cost parameters

```
R1#show interface s 0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
  Internet address is 172.16.3.1/30
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
<Output omitted>
```

!change link speeds (BW) to impact cost calculations

```
R1(config)#inter s 0/0
R1(config-if)#bandwidth 64
```

```
R1(config)#inter s 0/1
R1(config-if)#bandwidth 1500
```

!show routing table to see best routes, administrative distances and costs

```
R1#show ip route
<Output omitted>
Gateway of last resort is not set
  192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
D   192.168.10.0/24 is a summary, 00:02:52, Null0
C   192.168.10.4/30 is directly connected, Serial0/1
  172.16.0.0/16 is variably subnetted, 4 subnets, 3 masks
D   172.16.0.0/16 is a summary, 00:02:52, Null0
C   172.16.1.0/24 is directly connected, FastEthernet0/0
D   172.16.2.0/24 [90/40537600] via 172.16.3.2, 00:02:24, Serial0/0
C   172.16.3.0/30 is directly connected, Serial0/0
D   192.1.0.0/16 [90/2244096] via 192.168.10.6, 00:02:17, Serial0/1
```

!Disabling auto-summary

```
R1(config)#router eigrp 1
R1(config-router)#no auto-summary
```

!show cost metrics and calculations

!We can use the show ip eigrp topology command to show us these metrics.

```
R3#show ip eigrp topology 172.16.3.0 255.255.255.252
IP-EIGRP (AS 1): Topology entry for 172.16.3.0/30
  State is Passive, Query origin flag is 1, 2 Successor(s), FD is 41024000
  Routing Descriptor Blocks:
  192.168.10.5 (Serial0/0), from 192.168.10.5, Send flag is 0x0
    Composite metric is (41024000/40512000), Route is Internal
  Vector metric:
    Minimum bandwidth is 64 Kbit
    Total delay is 40000 microseconds
    Reliability is 255/255
```

```

    Load is 1/255
    Minimum MTU is 1500
    Hop count is 1
192.168.10.9 (Serial0/1), from 192.168.10.9, Send flag is 0x0
  Composite metric is (41024000/40512000), Route is Internal
  Vector metric:
    Minimum bandwidth is 64 Kbit
    Total delay is 40000 microseconds
    Reliability is 255/255
    Load is 1/255
    Minimum MTU is 1500
    Hop count is 1
R3#
R3#show ip route
!<Output omitted>
D      172.16.3.0/30 [90/41024000] via 192.168.10.9, 00:03:17, Serial0/1
        [90/41024000] via 192.168.10.5, 00:03:17, Serial0/0

!Here is how router R3's EIGRP calculates the EIGRP routing metric of
!41,024,000. We will use Serial 0/0 as our example, but the calculation is
!the same for Serial 0/1. The show ip interface serial 0/0
!command shows us the bandwidth and delay values for this interface.

R3#show interface s 0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
  Internet address is 192.168.10.6/30
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set

!Slowest Link
!There are two serial links, 1.5 Mbps and 64 Kbps, but only the slowest value
!is used in the metric. The 64 Kbps is the slowest of the two. Bandwidth is
!determined using the following calculation:
! Bandwidth
! = (107 / Bandwidth in Kbps) * 256
! = (10,000,000 / 64) * 256
! = (156,250) * 256
! = 40,000,000
!Sum of the Delays
!All of the links are used in determining the delay value. Each of the two
!links, R3's serial 0/0 and R1's serial 0/0, has a delay value of 20,000 for
!a total of 40,000.
! Delay
! = ( (20,000 + 20,000) /10 ) * 256
! = ( 40,000) /10 ) *256
! = (4,000) * 256
! = 1,024,000
!EIGRP Total Cost
! = Slowest Bandwidth + Sum of the Delays
! = 40,000,000 + 1,024,000
! = 41,024,000
!View the whole topology table
R1#show ip eigrp topology all-links
IP-EIGRP Topology Table for AS(1)/ID(192.168.10.5)

```

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - reply Status, s - sia Status

```
P 192.168.10.4/30, 1 successors, FD is 2169856, serno 34
  via Connected, Serial0/1
  via 172.16.3.2 (41536000/21024000), Serial0/0
P 192.168.10.8/30, 1 successors, FD is 21024000, serno 36
  via 192.168.10.6 (21024000/20512000), Serial0/1
  via 172.16.3.2 (41024000/20512000), Serial0/0
P 172.16.1.0/24, 1 successors, FD is 281600, serno 1
  via Connected, FastEthernet0/0
  via 172.16.3.2 (41561600/21049600), Serial0/0
P 172.16.2.0/24, 1 successors, FD is 21049600, serno 37
  via 192.168.10.6 (21049600/20537600), Serial0/1
  via 172.16.3.2 (40537600/281600), Serial0/0
P 172.16.3.0/30, 1 successors, FD is 40512000, serno 2
  via Connected, Serial0/0
P 192.1.0.0/16, 1 successors, FD is 2195456, serno 35
  via 192.168.10.6 (2195456/281600), Serial0/1
  via 172.16.3.2 (41049600/20537600), Serial0/0
```

R1#

```
R1#show ip eigrp topology 192.1.0.0 255.255.0.0
IP-EIGRP (AS 1): Topology entry for 192.1.0.0/16
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 2195456
  Routing Descriptor Blocks:
  192.168.10.6 (Serial0/1), from 192.168.10.6, Send flag is 0x0
    Composite metric is (2195456/281600), Route is Internal
    Vector metric:
      Minimum bandwidth is 1544 Kbit
      Total delay is 21000 microseconds
      Reliability is 254/255
      Load is 1/255
      Minimum MTU is 1500
      Hop count is 1
  172.16.3.2 (Serial0/0), from 172.16.3.2, Send flag is 0x0
    Composite metric is (41049600/20537600), Route is Internal
    Vector metric:
      Minimum bandwidth is 64 Kbit
      Total delay is 41000 microseconds
      Reliability is 255/255
      Load is 1/255
      Minimum MTU is 1500
      Hop count is 2
```

R1#

R1#show ip protocols

```
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
  EIGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
  EIGRP maximum hopcount 100
  EIGRP maximum metric variance 1
  Redistributing: eigrp 1
  Automatic network summarization is not in effect
```

```
Maximum path: 4
Routing for Networks:
 172.16.0.0
 192.168.10.0
Routing Information Sources:
 Gateway      Distance    Last Update
 192.168.10.6      90      00:05:57
 172.16.3.2        90      00:05:57
Distance: internal 90 external 170
R1#

!Propogate a default route
R2(config)#ip route 0.0.0.0 0.0.0.0 loopback1

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

!Manual summarization
R1(config)#inter s 0/1
R1(config-if)#ip summary-address eigrp 1 172.16.0.0 255.255.252.0
```