

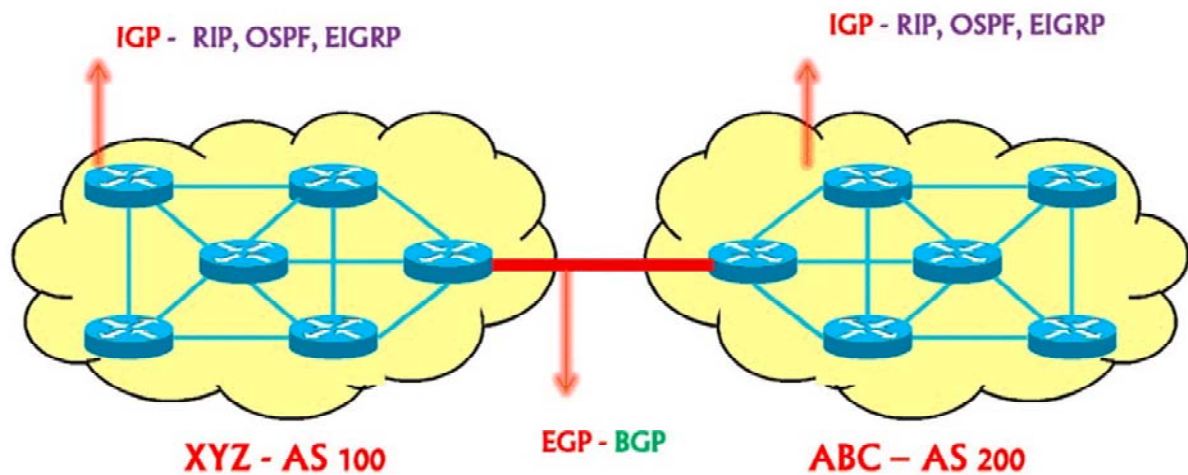
Routing Protocol Classification

IGP

- Interior Gateway Protocol
- used to communicate within same autonomous system
- RIP, IGRP, EIGRP, OSPF, IS-IS

EGP

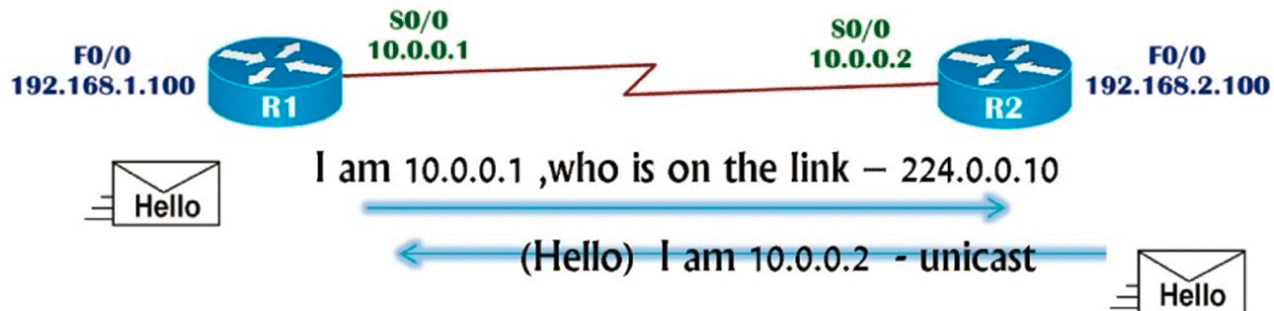
1. Exterior Gateway Protocol
2. used to communicate between two or more autonomous system
3. Border Gateway Protocol (BGP)



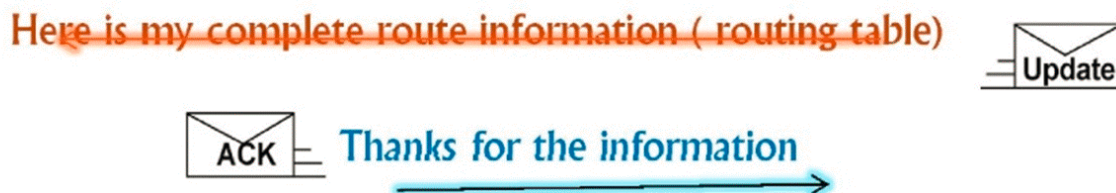
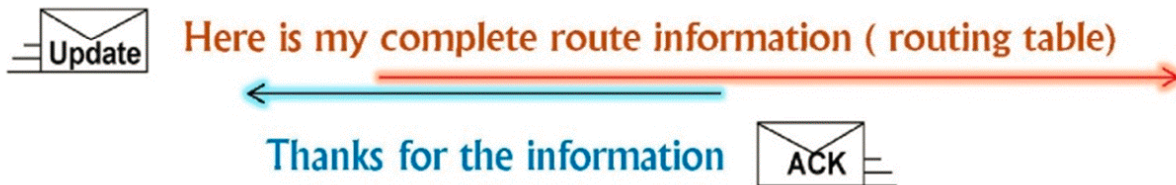
Enhanced Interior Gateway Routing Protocol

- ▶ Advanced distance vector (Hybrid protocol)
- ▶ Standard protocol (initially was cisco proprietary)
- ▶ Classless routing protocol (carry subnet-mask , support subnets/VLSM)
- ▶ Max Hop count is 255 (100 by default)
- ▶ Administrative distance is 90
- ▶ Easy and Flexible network design. (unlike OSPF)
- ▶ Uses Multicast (224.0.0.10) and unicast for initial neighbor discovery process

EIGRP step by step initial process



They become neighbors, built **neighbor table**

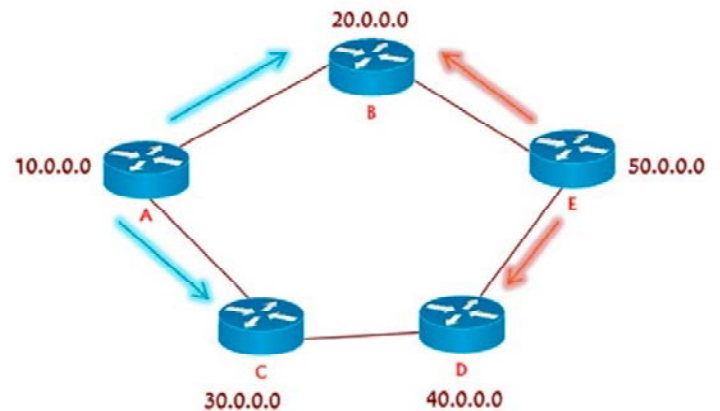


Converged, calculate best route builds routing table

EIGRP Tables

Neighbor table

- Contains list of directly connected routers
- # **show ip eigrp neighbor**

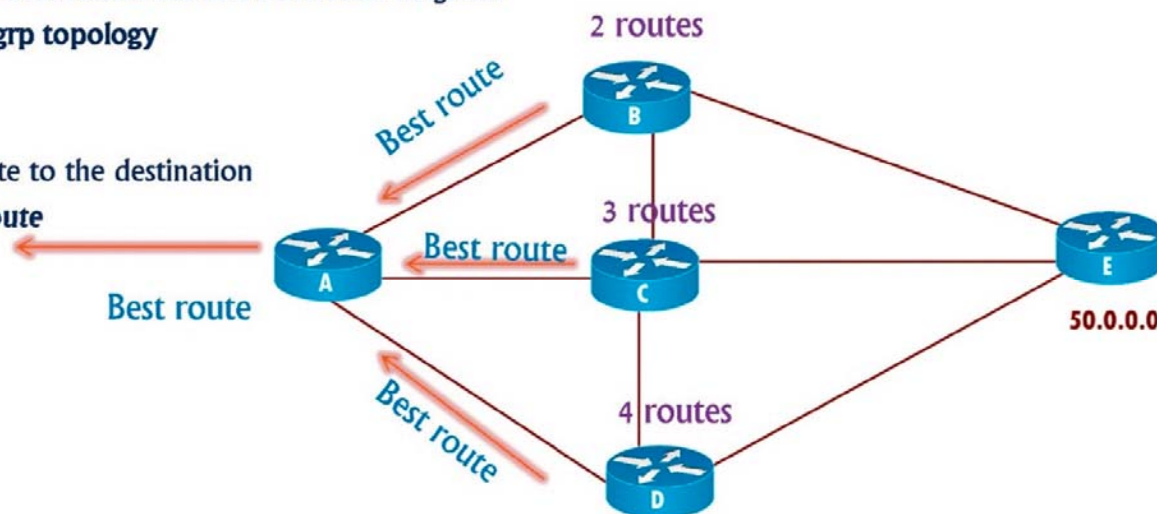


Topology table

- List of all the best routes learned from each neighbor
- # **Show ip eigrp topology**

Routing table

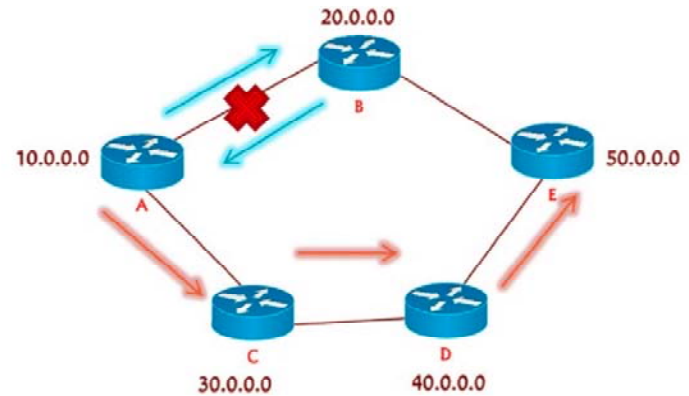
- The best route to the destination
- # **show ip route**



3 best routes from all 3 neighbors (stores in topology table)

Select the best route - (routing table) and advertise best route to neighbor

EIGRP Convergence



- ▶ Incremental updates
- ▶ Periodically send hello packets are sent every 5 seconds (dead – 15 sec)
- ▶ Convergence rate is fast (15 sec)

Also pre-calculates second best route

- best route = successor
- Second best route = feasible successor

EIGRP Metric – parameters

| | Bandwidth | Delay | load | Reliability | MTU |
|----------|-----------|-----------|----------|-------------|------------|
| Serial | 1544 Kbps | 20,000 Us | 1 – 255 | 1 – 255 | 1500 bytes |
| Ethernet | 10 Mbps | 200 Us | 1- less | 1- less | |
| Fasteth | 100 Mbps | 100 Us | 255 more | 255 more | |
| gigeth | 1000 Mbps | 10 Us | | | |

```
R-1(config)#interface serial 0/0
R-1(config-if)#bandwidth 1000
```

R-1#sh interfaces s0/0

```
Serial0/0 is up, line protocol is up (connected)
Hardware is HD64570
Internet address is 10.0.0.1/8
MTU 1500 bytes, BW 1000 Kbit, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
```



R-1#sh interfaces s0/0

```
Serial0/0 is up, line protocol is up (connected)
Hardware is HD64570
Internet address is 10.0.0.1/8
MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
```


EIGRP Metric Calculation

BW Delay load Reliability MTU

K1 = 1 K3 = 1 K2 = 0 K4 = 0 K5 = 0

The EIGRP metric calculation formula is as below:

$$metric = \left[\left(K1 \times \frac{10^7}{BW_{min}} + \frac{K2 \times BW_{min}}{256 - load} + K3 \times \sum delays \right) \times \frac{K5}{K4 + reliability} \right] \times 256$$

By default uses BW and Delay in the metric calculation.

Formula with default K values (K1 = 1, K2 = 0, K3 = 1, K4 = 0, K5 = 0):

$$Metric = [K1 * BW + ((K2 * BW) / (256 - load)) + K3 * delay]$$

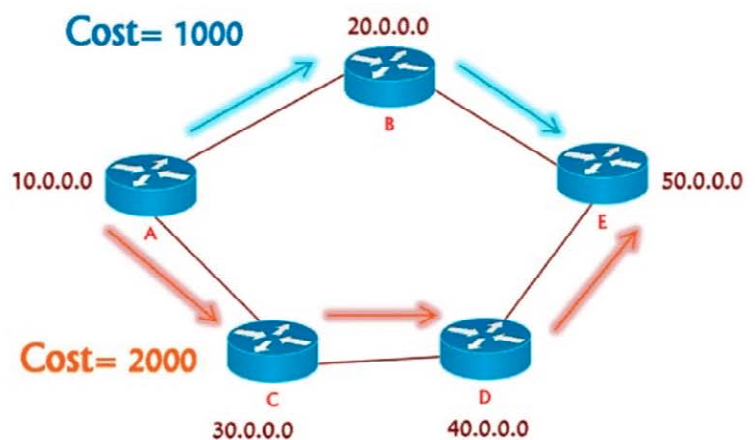
Default Metric = 256*(Slowest _BW+ All link Delay)

BW = 10⁷/BW in kbps

Delay = delay in Microsecond

EIGRP cost

Least cost = best route



R-1#show ip route

Gateway of last resort is not set

C 10.0.0.0/8 is directly connected, Serial0/0

D 11.0.0.0/8 [90/2681856] via 10.0.0.2, 00:05:45, Serial0/0

C 192.168.1.0/24 is directly connected, FastEthernet0/0

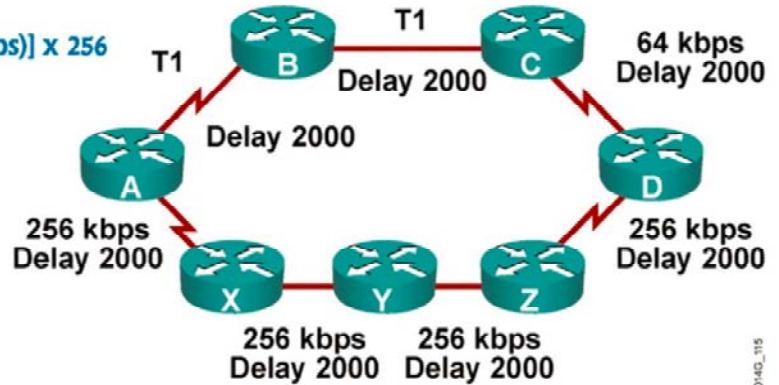
D 192.168.2.0/24 [90/2172416] via 10.0.0.2, 00:05:48, Serial0/0

D 192.168.3.0/24 [90/2684416] via 10.0.0.2, 00:02:49, Serial0/0

EIGRP Metric Calculation Example

Over all Delay = [sum of delays] x 256

Over all Bandwidth = $[10^8 / (\text{Min bandwidth in kbps})] \times 256$



A → B → C → D

Least bandwidth 64 kbps

Total delay 6,000

A → X → Y → Z → D

Least bandwidth 256 kbps

Total delay 8,000

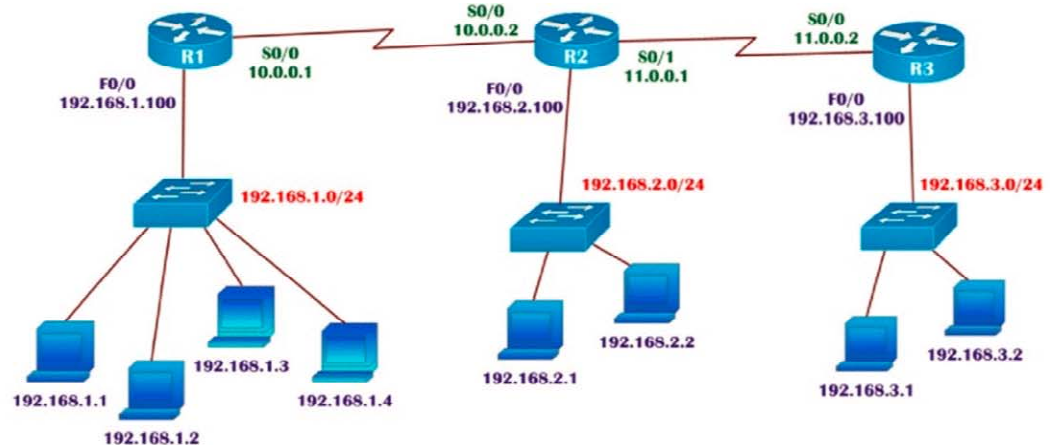
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$$metric = \left[\left(K1 \times \frac{10^7}{BW_{min}} + \frac{K2 \times BW_{min}}{256 - load} + K3 \times \sum delays \right) \times \frac{K5}{K4 + reliability} \right] \times 256$$

EIGRP Configuration

Router(config)# **router eigrp <AS NO>**

Router(config-router)# **network <Network ID>**



R-1(config)# **router eigrp 100**

R-1(config-router)# **network 192.168.1.0**

R-1(config-router)# **network 10.0.0.0**

EIGRP AS number has to match on all routers to establish neighbors and exchange routes

EIGRP Configuration

R-1(config)# router eigrp 100

R-1(config-router)# network 192.168.1.0

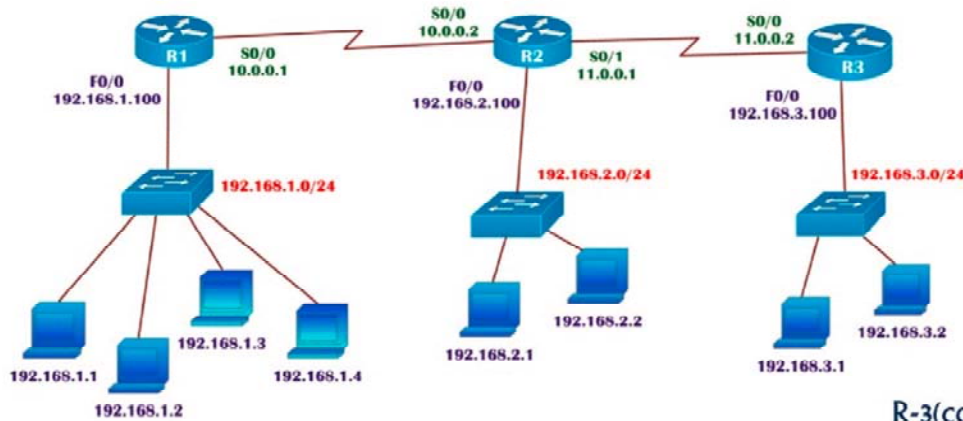
R-1(config-router)# network 10.0.0.0

R-2(config)#router eigrp 100

R-2(config-router)# network 192.168.2.0

R-2(config-router)# network 11.0.0.0

R-2(config-router)# network 10.0.0.0



R-3(config)# router eigrp 100

R-3(config-router)# network 192.168.3.0

R-3(config-router)# network 11.0.0.0

EIGRP verification

R-1#show ip route

Gateway of last resort is not set

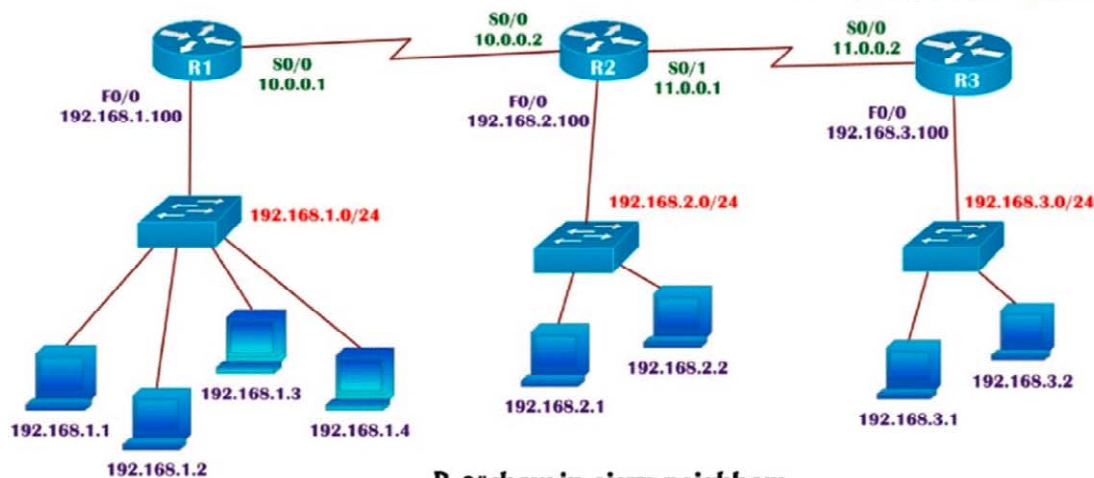
C 10.0.0.0/8 is directly connected, Serial0/0

D 11.0.0.0/8 [90/2681856] via 10.0.0.2, 00:05:45, Serial0/0

C 192.168.1.0/24 is directly connected, FastEthernet0/0

D 192.168.2.0/24 [90/2172416] via 10.0.0.2, 00:05:48, Serial0/0

D 192.168.3.0/24 [90/2684416] via 10.0.0.2, 00:02:49, Serial0/0

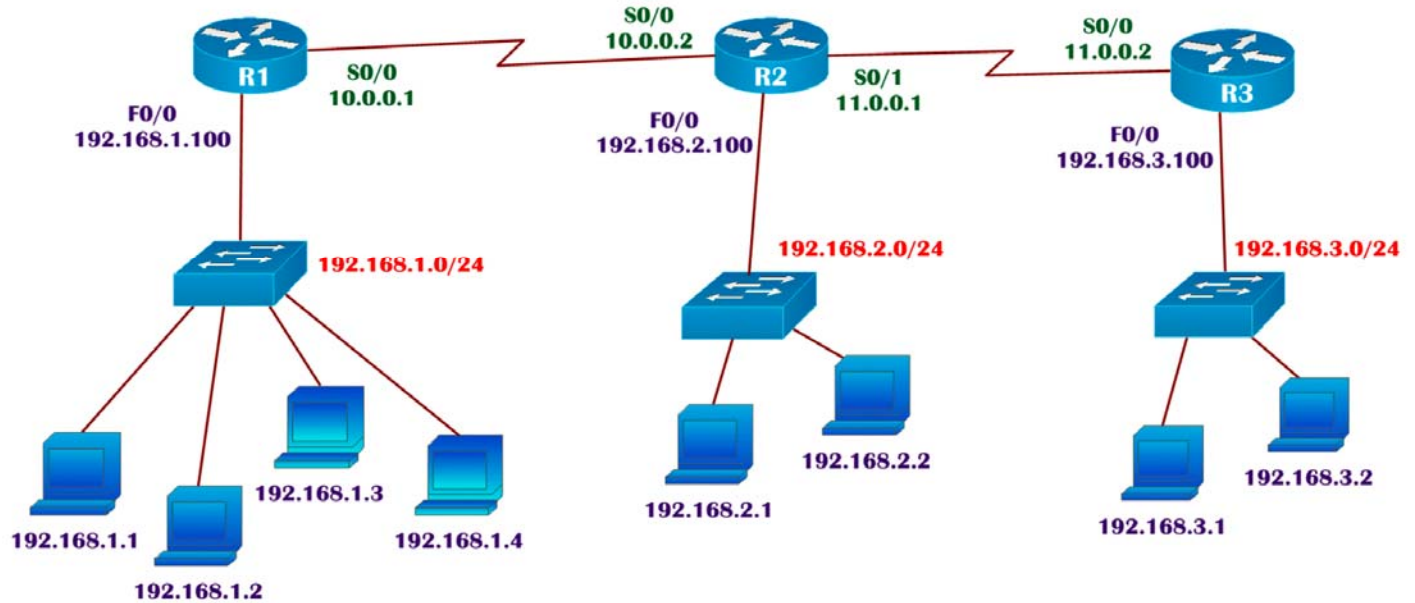


R-2#show ip eigrp neighbors

IP-EIGRP neighbors for process 100

| H | Address | Interface | Hold | Uptime | SRTT | RTO | Q | Seq |
|---|----------|-----------|-------|----------|------|------|---|-----|
| | | | (sec) | | (ms) | Cnt | | Num |
| 0 | 10.0.0.1 | Se0/0 | 10 | 00:03:44 | 40 | 1000 | 0 | 8 |
| 1 | 11.0.0.2 | Se0/1 | 12 | 00:01:10 | 40 | 1000 | 0 | 7 |

LAB: DYNAMIC ROUTING USING EIGRP



- Configure Dynamic routing using EIGRP 100
- Verify Routing table and reachability between the LAN's (using PING and TRACE commands)

LAB: Dynamic Routing using EIGRP – using Redundant links

