

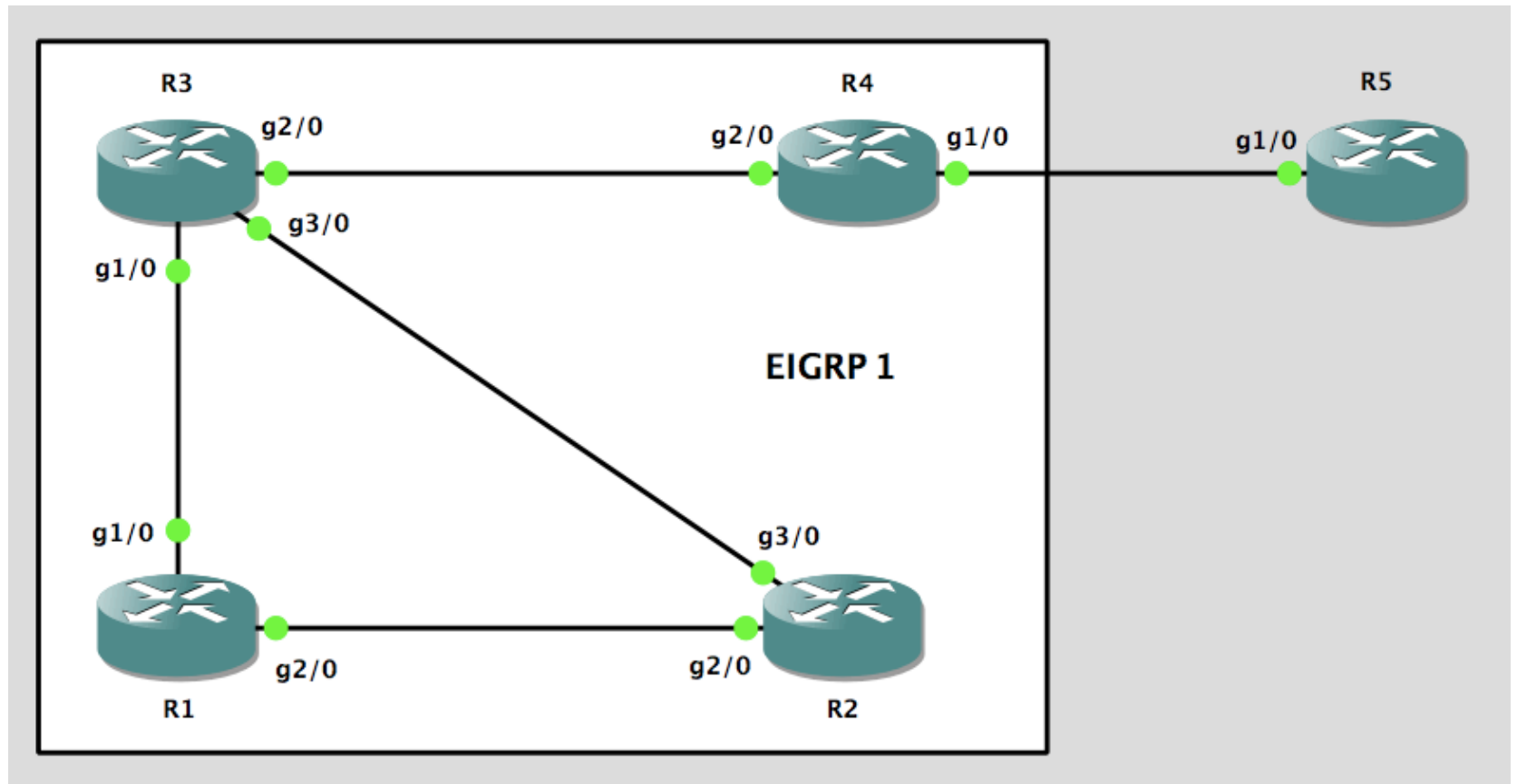
EIGRP

Lab Activity



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Topology



IP Plan

- R1 – R4
 - Loopback 10: 10.10.10.X/32
 - Peering IP: 100.100.XY.X(Y)/24
 - Process/AS: 1
- R4 and R5
 - Loopback 20: 20.20.20.X/32
 - Peering IP: 100.100.XY.X(Y)/24
 - No EIGRP between R4 and R5

Task 0: Troubleshooting Basics

Verification

- `show ip eigrp neighbors`
- `show ip protocols`
- `show ip eigrp topology`
- `show ip route eigrp`
- `show ip eigrp interfaces`
- `show ip eigrp traffic`
- `debug eigrp <AS> packets`
- `show key chain`

R3#show ip eigrp neighbors

EIGRP-IPv4 Neighbors for AS(1)

| H | Address | Interface | Hold (sec) | Uptime | SRTT (ms) | RT0 | Q Cnt | Seq Num |
|---|--------------|-----------|------------|----------|-----------|------|-------|---------|
| 2 | 100.100.34.4 | Gi2/0 | 10 | 00:25:07 | 45 | 270 | 0 | 6 |
| 1 | 100.100.23.2 | Gi3/0 | 12 | 00:28:08 | 491 | 2946 | 0 | 21 |
| 0 | 100.100.13.1 | Gi1/0 | 13 | 00:29:03 | 386 | 2316 | 0 | 25 |

R3#

R3#show ip eigrp interfaces

EIGRP-IPv4 Interfaces for AS(1)

| Interface | Peers | Xmit Queue Un/Reliable | PeerQ Un/Reliable | Mean SRTT | Pacing Time Un/Reliable | Multicast Flow Timer | Pending Routes |
|-----------|-------|------------------------|-------------------|-----------|-------------------------|----------------------|----------------|
| Lo10 | 0 | 0/0 | 0/0 | 0 | 0/0 | 0 | 0 |
| Gi1/0 | 1 | 0/0 | 0/0 | 386 | 0/0 | 1884 | 0 |
| Gi2/0 | 1 | 0/0 | 0/0 | 45 | 0/0 | 50 | 0 |
| Gi3/0 | 1 | 0/0 | 0/0 | 491 | 0/0 | 2408 | 0 |

R3#

```
R3#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
```

```
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: 10.10.10.3
```

```
  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:
```

```
  10.10.10.3/32
```

```
  100.100.13.0/24
```

```
  100.100.23.0/24
```

```
  100.100.34.0/24
```

```
Routing Information Sources:
```

| Gateway | Distance | Last Update |
|---------|----------|-------------|
|---------|----------|-------------|

| | | |
|--------------|----|----------|
| 100.100.13.1 | 90 | 00:19:37 |
|--------------|----|----------|

| | | |
|--------------|----|----------|
| 100.100.23.2 | 90 | 00:19:37 |
|--------------|----|----------|

| | | |
|--------------|----|----------|
| 100.100.34.4 | 90 | 00:19:37 |
|--------------|----|----------|

```
Distance: internal 90 external 170
```

```
R3#show ip eigrp topology
EIGRP-IPv4 Topology Table for AS(1)/ID(10.10.10.3)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status
```

```
P 10.10.10.1/32, 1 successors, FD is 130816
    via 100.100.13.1 (130816/128256), GigabitEthernet1/0
P 10.10.10.2/32, 1 successors, FD is 130816
    via 100.100.23.2 (130816/128256), GigabitEthernet3/0
P 100.100.23.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet3/0
P 10.10.10.3/32, 1 successors, FD is 128256
    via Connected, Loopback10
P 100.100.12.0/24, 2 successors, FD is 3072
    via 100.100.13.1 (3072/2816), GigabitEthernet1/0
    via 100.100.23.2 (3072/2816), GigabitEthernet3/0
P 100.100.34.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet2/0
P 10.10.10.4/32, 1 successors, FD is 130816
    via 100.100.34.4 (130816/128256), GigabitEthernet2/0
P 100.100.13.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet1/0
```

```
R3#
```


R3#show ip route eigrp

Codes: L - local, 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, su - IS-IS summary, 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, H - NHRP, l - LISP
 + - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 4 subnets

D 10.10.10.1 [90/130816] via 100.100.13.1, 00:43:37, GigabitEthernet1/0

D 10.10.10.2 [90/130816] via 100.100.23.2, 00:43:37, GigabitEthernet3/0

D 10.10.10.4 [90/130816] via 100.100.34.4, 00:40:35, GigabitEthernet2/0

100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks

D 100.100.12.0/24

[90/3072] via 100.100.23.2, 00:43:37, GigabitEthernet3/0

[90/3072] via 100.100.13.1, 00:43:37, GigabitEthernet1/0

R3#

Task 1: Basic Configuration

Task 1: Basic Configuration

- Configure all routers
 - Loopback Address
 - Interface IP Address
- Configure routing for R5
 - Static route in R4 for R5's loopback 20
 - Default route in R5 towards R4

Example: R1

```
R1(config)# interface loopback10
R1(config-if)# description R1's Loopback 10
R1(config-if)# ip address 10.10.10.1 255.255.255.255
```

```
R1(config)#interface Gi1/0
R1(config-if)# description Connected to R3 Gi1/0
R1(config-if)#ip address 100.100.13.1 255.255.255.0
R1(config-if)#no shutdown
```

```
R1(config)#interface Gi2/0
R1(config-if)# description Connected to R2 Gi2/0
R1(config-if)#ip address 100.100.12.1 255.255.255.0
R1(config-if)#no shutdown
```

Example: R4-R5 Routing

```
R4(config)# ip route 20.20.20.5 255.255.255.255 100.100.45.5
```

```
R5(config)# ip route 0.0.0.0 0.0.0.0 100.100.45.4
```

Task 2: Basic EIGRP Config

Task 1: Basic EIGRP Config

- Configure all routers
 - EIGRP Process/AS
 - Networks with subnet mask/wildcard mask
 - [no] auto-summary
- Verify
 - Check routing table
 - show ip route [eigrp]**
 - Ping loopback of other routers

Example: R1

```
router eigrp 1
  network 10.10.10.1 0.0.0.0
  network 100.100.12.0 0.0.0.255
  network 100.100.13.0 0.0.0.255
  no auto-summary
```


Example: R4

```
router eigrp 1  
  redistribute static
```

Verify the Connectivity

- Ping R4 and R5 from R1
 - It should be successful

Task 3: Passive Interface

Task 3: Passive Interface

- Prevents EIGRP updates out a specified router interface.
- Prevents neighbor relationships from being established.
- Routing updates from a neighbor are ignored.
- Allows a subnet on a passive interface to be announced in EIGRP.
- Network must be included in EIGRP network command.
- Hellos are not sent to Loopback interfaces.

Task 3: Passive Interface

- Check interfaces in R4
 - show ip eigrp interfaces**
 - show ip eigrp interfaces detail gi1/0**
- Configure all interfaces passive in R4 except Gi2/0
 - Recheck the interfaces
 - show ip eigrp interfaces**
 - show ip eigrp interfaces detail gi1/0**

Example: R4

```
router eigrp 1
  passive-interface default
  no passive-interface gi2/0
```

OR:

```
router eigrp 1
  passive-interface loopback 10
  passive-interface loopback 20
  passive-interface gi1/0
```

Task 3: Passive Interface

```

R4#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(1)

Interface                Peers    Xmit Queue  PeerQ      Mean      Pacing Time  Multicast   Pending
                        Un/Reliable Un/Reliable SRTT      Un/Reliable Flow Timer  Routes
Gi2/0                    1         0/0         0/0        37        0/0          140        0
Lo20                     0         0/0         0/0        0         0/0          0         0
Lo10                     0         0/0         0/0        0         0/0          0         0
Gi1/0                    0         0/0         0/0        0         0/0          0         0
R4#
R4#
R4#show ip eigrp interfaces detail gi1/0
EIGRP-IPv4 Interfaces for AS(1)

Interface                Peers    Xmit Queue  PeerQ      Mean      Pacing Time  Multicast   Pending
                        Un/Reliable Un/Reliable SRTT      Un/Reliable Flow Timer  Routes
Gi1/0                    0         0/0         0/0        0         0/0          0         0
Hello-interval is 5, Hold-time is 15
Split-horizon is enabled
Next xmit serial <none>
Packetized sent/expedited: 0/0
Hello's sent/expedited: 21/1
Un/reliable mcasts: 0/0  Un/reliable ucasts: 0/0
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 not set
R4#
```

Task 3: Passive Interface

awal — R1 — telnet 127.0.0.1 5000 — 81x23

Gateway of last resort is not set

```
10.0.0.0/32 is subnetted, 4 subnets
C      10.10.10.1 is directly connected, Loopback10
D      10.10.10.2 [90/130816] via 100.100.12.2, 00:10:13, GigabitEthernet2/0
D      10.10.10.3 [90/130816] via 100.100.13.3, 00:10:13, GigabitEthernet1/0
D      10.10.10.4 [90/131072] via 100.100.13.3, 00:00:09, GigabitEthernet1/0
20.0.0.0/32 is subnetted, 2 subnets
D      20.20.20.4 [90/131072] via 100.100.13.3, 00:00:09, GigabitEthernet1/0
D EX   20.20.20.5 [170/3328] via 100.100.13.3, 00:00:09, GigabitEthernet1/0
100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
C      100.100.12.0/24 is directly connected, GigabitEthernet2/0
L      100.100.12.1/32 is directly connected, GigabitEthernet2/0
C      100.100.13.0/24 is directly connected, GigabitEthernet1/0
L      100.100.13.1/32 is directly connected, GigabitEthernet1/0
D      100.100.23.0/24
        [90/3072] via 100.100.13.3, 00:10:13, GigabitEthernet1/0
        [90/3072] via 100.100.12.2, 00:10:13, GigabitEthernet2/0
D      100.100.34.0/24
        [90/3072] via 100.100.13.3, 00:10:13, GigabitEthernet1/0
D      100.100.45.0/24
        [90/3328] via 100.100.13.3, 00:00:09, GigabitEthernet1/0
```

R1#

Task 3: Passive Interface

```
awal — R4 — telnet 127.0.0.1 5004 — 98x16
R4#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(1)

```

| Interface | Peers | Xmit Queue Un/Reliable | PeerQ Un/Reliable | Mean SRTT | Pacing Time Un/Reliable | Multicast Flow Timer | Pending Routes |
|-----------|-------|---------------------------|----------------------|--------------|----------------------------|-------------------------|-------------------|
| Gi2/0 | 1 | 0/0 | 0/0 | 64 | 0/0 | 272 | 0 |

```

R4#
R4#
R4#
R4#show ip eigrp interfaces detail gi1/0
EIGRP-IPv4 Interfaces for AS(1)

```

| Interface | Peers | Xmit Queue Un/Reliable | PeerQ Un/Reliable | Mean SRTT | Pacing Time Un/Reliable | Multicast Flow Timer | Pending Routes |
|-----------|-------|---------------------------|----------------------|--------------|----------------------------|-------------------------|-------------------|
|-----------|-------|---------------------------|----------------------|--------------|----------------------------|-------------------------|-------------------|

```

R4#
R4#
R4#
R4#
```

Task 3: Passive Interface

```

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 4 subnets
C      10.10.10.1 is directly connected, Loopback10
D      10.10.10.2 [90/130816] via 100.100.12.2, 00:11:43, GigabitEthernet2/0
D      10.10.10.3 [90/130816] via 100.100.13.3, 00:11:43, GigabitEthernet1/0
D      10.10.10.4 [90/131072] via 100.100.13.3, 00:01:39, GigabitEthernet1/0
20.0.0.0/32 is subnetted, 2 subnets
D      20.20.20.4 [90/131072] via 100.100.13.3, 00:01:39, GigabitEthernet1/0
D EX   20.20.20.5 [170/3328] via 100.100.13.3, 00:01:39, GigabitEthernet1/0
100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
C      100.100.12.0/24 is directly connected, GigabitEthernet2/0
L      100.100.12.1/32 is directly connected, GigabitEthernet2/0
C      100.100.13.0/24 is directly connected, GigabitEthernet1/0
L      100.100.13.1/32 is directly connected, GigabitEthernet1/0
D      100.100.23.0/24
        [90/3072] via 100.100.13.3, 00:11:43, GigabitEthernet1/0
        [90/3072] via 100.100.12.2, 00:11:43, GigabitEthernet2/0
D      100.100.34.0/24
        [90/3072] via 100.100.13.3, 00:11:43, GigabitEthernet1/0
D      100.100.45.0/24
        [90/3328] via 100.100.13.3, 00:01:39, GigabitEthernet1/0

R1#
```

Task 4: EIGRP Timers

Task 4: EIGRP Timers

- Hello Interval:
 - High Bandwidth = 5 seconds
 - Low bandwidth = 60 seconds
- Dead Interval: Three times the Hello Interval
 - High bandwidth (3 x 5 sec.) = 15 seconds
 - Low Bandwidth (3 x 60 sec.) = 180 seconds
- Active Timers (SIA): 180 Seconds
- Hello/Hold timers do not need to match

Task 4: EIGRP Timers

- Check the timers in R3

```
sh ip eigrp interface detail gi2/0
```

- Turn on debug in R4

```
debug eigrp packet
```

- Configure hello, hold and active timers in R3
- Check the timers in R3 again
- Analyze the debug messages in R4

Example: R3

```
interface GigabitEthernet2/0  
  ip hello-interval eigrp 1 3  
  ip hold-time eigrp 1 10
```

```
router eigrp 1  
  timers active-time 2
```

Task 5: EIGRP Authentication

Task 5: EIGRP Authentication

- EIGRP supports MD5 authentication.
 - Router generates a message digest, or hash, of the key, key-id, and message.
 - EIGRP allows keys to be managed using key chains.
 - Specify key-id (number, key, and lifetime of key).
 - First valid activated key, in order of key numbers, is used.

Task 5: EIGRP Authentication

- Turn on debug in R4
debug eigrp packet
- Configure authentication between R3 and R4
 - With wrong password
 - With correct password
 - With multiple key ID
- Analyze the debug messages in R4

Example: R3

```
key chain lab
  key 1
    key-string labkey
    accept-lifetime 00:00:00 Jan 1 2018 infinite
    send-lifetime 00:00:00 Jan 1 2018 infinite

interface GigabitEthernet2/0
  ip authentication mode eigrp 1 md5
  ip authentication key-chain eigrp 1 lab
```

Task 6: EIGRP Metric

Task 6: EIGRP Metric

- EIGRP uses a composite metric which can be based on the following metrics:
 - Bandwidth
 - Delay
 - Reliability
 - Load
- Only **Bandwidth and Delay** are used by default.
 - Calculated BW = Reference BW (10^7) / slowest BW (Kbps)
 - Calculated Delay = Sum of delays (in μsec) / 10

Task 6: EIGRP Metric

- The EIGRP composite metric formula consists of values K1 through K5, known as EIGRP metric weights.
 - By default, only K1 (bandwidth) and K3 (delay) are set to 1.
 - K2 (load), K4 (reliability), and K5 (MTU) are set to 0.
- K values can be changed with the EIGRP router command:

```
metric weights tos k1 k2 k3 k4 k5
```

Task 6: EIGRP Metric

- Default Composite Formula:

$$EIGRP \text{ Metric} = [(K1 * BW) + (K3 * DLY)] * 256$$

- Default Composite Formula:

$$EIGRP \text{ Metric} = [(K1 * BW) + \{(K2 * BW) / (256 - Load)\} + (K3 * DLY) + \{(K5 / (K4 + Reliability))\}] * 256$$

Task 6: EIGRP Metric

- Check metrics of a local link

```
show interface interface_id
```

- Check metrics of a network

```
show ip eigrp topology network/mask
```

- Configure metrics

```
interface gi1/0
```

```
bandwidth <in kbps>
```

```
delay <in tens of microseconds>
```

Task 6: EIGRP Metric

```
R1#show int gi2/0
```

```
GigabitEthernet2/0 is up, line protocol is up  
  Hardware is 82543, address is ca01.60b9.0038 (bia  
ca01.60b9.0038)  
  Internet address is 100.100.12.1/24  
    MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 10 usec,  
      reliability 255/255, txload 1/255, rxload 1/255
```

<output omitted for brevity>

Task 6: EIGRP Metric

```
R1#show ip eigrp topology 10.10.10.2/32
```

```
EIGRP-IPv4 Topology Entry for AS(1)/ID(10.10.10.1) for 10.10.10.2/32
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 130816
  Descriptor Blocks:
    100.100.12.2 (GigabitEthernet2/0), from 100.100.12.2, Send flag is 0x0
      Composite metric is (130816/128256), route is Internal
      Vector metric:
        Minimum bandwidth is 1000000 Kbit
        Total delay is 5010 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
        Originating router is 10.10.10.2
    100.100.13.3 (GigabitEthernet1/0), from 100.100.13.3, Send flag is 0x0
      Composite metric is (131072/130816), route is Internal
      Vector metric:
        Minimum bandwidth is 1000000 Kbit
        Total delay is 5020 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 2
        Originating router is 10.10.10.2
```

Task 6: EIGRP Metric

R1#show ip eigrp topology

EIGRP-IPv4 Topology Table for AS(1)/ID(10.10.10.1)

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

```
P 10.10.10.1/32, 1 successors, FD is 128256
    via Connected, Loopback10
P 10.10.10.2/32, 1 successors, FD is 130816
    via 100.100.12.2 (130816/128256), GigabitEthernet2/0
P 100.100.23.0/24, 2 successors, FD is 3072
    via 100.100.12.2 (3072/2816), GigabitEthernet2/0
    via 100.100.13.3 (3072/2816), GigabitEthernet1/0
P 10.10.10.3/32, 1 successors, FD is 130816
    via 100.100.13.3 (130816/128256), GigabitEthernet1/0
P 100.100.12.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet2/0
P 100.100.34.0/24, 1 successors, FD is 3072
    via 100.100.13.3 (3072/2816), GigabitEthernet1/0
P 10.10.10.4/32, 1 successors, FD is 131072
    via 100.100.13.3 (131072/130816), GigabitEthernet1/0
P 100.100.13.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet1/0
```

Task 6: EIGRP Metric

R1#show ip route

Gateway of last resort is not set

```
10.0.0.0/32 is subnetted, 4 subnets
C    10.10.10.1 is directly connected, Loopback10
D    10.10.10.2 [90/130816] via 100.100.12.2, 00:23:52, GigabitEthernet2/0
D    10.10.10.3 [90/130816] via 100.100.13.3, 00:23:52, GigabitEthernet1/0
D    10.10.10.4 [90/131072] via 100.100.13.3, 00:20:38, GigabitEthernet1/0
100.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C    100.100.12.0/24 is directly connected, GigabitEthernet2/0
L    100.100.12.1/32 is directly connected, GigabitEthernet2/0
C    100.100.13.0/24 is directly connected, GigabitEthernet1/0
L    100.100.13.1/32 is directly connected, GigabitEthernet1/0
D    100.100.23.0/24
      [90/3072] via 100.100.13.3, 00:23:52, GigabitEthernet1/0
      [90/3072] via 100.100.12.2, 00:23:52, GigabitEthernet2/0
D    100.100.34.0/24
      [90/3072] via 100.100.13.3, 00:23:52, GigabitEthernet1/0
```

Task 6: EIGRP Metric

- Check the routing table in R1
 - Check AD value and metric
 - Calculate the composite metric of a network
- Check topology table in R1
 - Compare with the routing table
 - Why there is 2 successors for R2-R3 link but only 1 successor for their loopbacks?

Task 6: EIGRP Metric

- Set BW of gi2/0 700 Mbps for R1-R2 link

```
R1 (config) # int gi2/0
```

```
R1 (config-if) # bandwidth 700000
```

- Recheck the topology table and routing table in R1
 - Any change for the prefix of R2's loopback 10?
 - Can you explain it?

Task 6: EIGRP Metric

```
R1#show ip eigrp topology 10.10.10.2/32
```

```
EIGRP-IPv4 Topology Entry for AS(1)/ID(10.10.10.1) for 10.10.10.2/32
```

```
State is Passive, Query origin flag is 1, 1 Successor(s), FD is 131072
```

```
Descriptor Blocks:
```

```
100.100.13.3 (GigabitEthernet1/0), from 100.100.13.3, Send flag is 0x0
```

```
Composite metric is (131072/130816), route is Internal
```

```
Vector metric:
```

```
Minimum bandwidth is 1000000 Kbit
```

```
Total delay is 5020 microseconds
```

```
Reliability is 255/255
```

```
Load is 1/255
```

```
Minimum MTU is 1500
```

```
Hop count is 2
```

```
Originating router is 10.10.10.2
```

```
100.100.12.2 (GigabitEthernet2/0), from 100.100.12.2, Send flag is 0x0
```

```
Composite metric is (131840/128256), route is Internal
```

```
Vector metric:
```

```
Minimum bandwidth is 700000 Kbit
```

```
Total delay is 5010 microseconds
```

```
Reliability is 255/255
```

```
Load is 1/255
```

```
Minimum MTU is 1500
```

```
Hop count is 1
```

```
Originating router is 10.10.10.2
```

Task 6: EIGRP Metric

R1#show ip eigrp topology

```
P 10.10.10.1/32, 1 successors, FD is 128256
    via Connected, Loopback10
P 10.10.10.2/32, 1 successors, FD is 131072
    via 100.100.13.3 (131072/130816), GigabitEthernet1/0
    via 100.100.12.2 (131840/128256), GigabitEthernet2/0
P 100.100.23.0/24, 1 successors, FD is 3072
    via 100.100.13.3 (3072/2816), GigabitEthernet1/0
    via 100.100.12.2 (4096/2816), GigabitEthernet2/0
P 10.10.10.3/32, 1 successors, FD is 130816
    via 100.100.13.3 (130816/128256), GigabitEthernet1/0
P 100.100.12.0/24, 1 successors, FD is 3840
    via Connected, GigabitEthernet2/0
    via 100.100.13.3 (3328/3072), GigabitEthernet1/0
P 100.100.34.0/24, 1 successors, FD is 3072
    via 100.100.13.3 (3072/2816), GigabitEthernet1/0
P 10.10.10.4/32, 1 successors, FD is 131072
    via 100.100.13.3 (131072/130816), GigabitEthernet1/0
P 100.100.13.0/24, 1 successors, FD is 2816
    via Connected, GigabitEthernet1/0
```

Task 6: EIGRP Metric

R1#show ip route

Gateway of last resort is not set

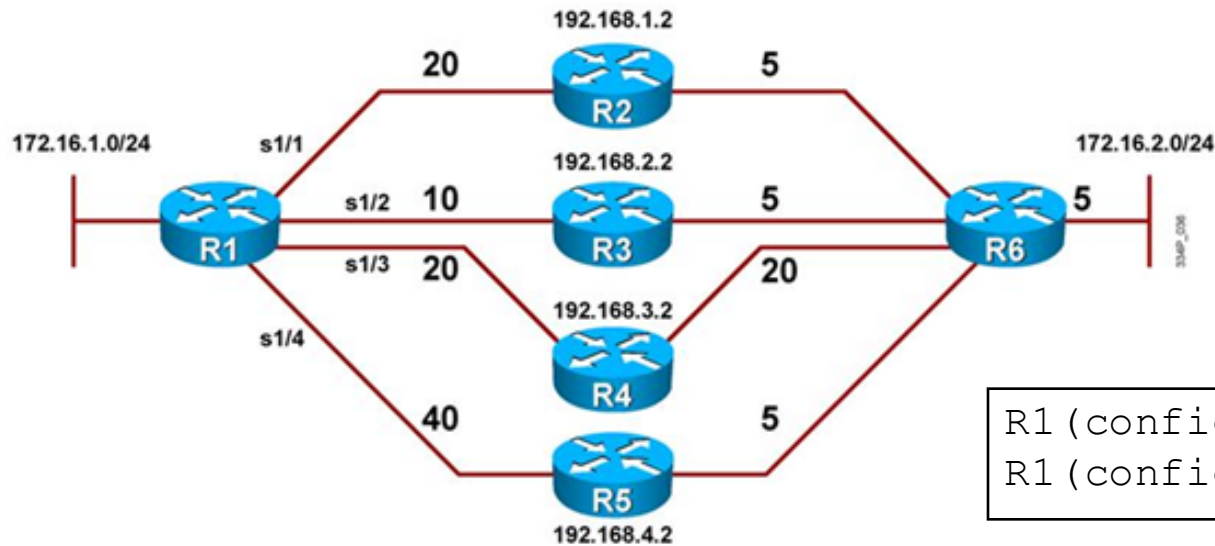
```
10.0.0.0/32 is subnetted, 4 subnets
C    10.10.10.1 is directly connected, Loopback10
D    10.10.10.2 [90/130816] via 100.100.12.2, 00:23:52, GigabitEthernet2/0
D    10.10.10.3 [90/130816] via 100.100.13.3, 00:23:52, GigabitEthernet1/0
D    10.10.10.4 [90/131072] via 100.100.13.3, 00:20:38, GigabitEthernet1/0
100.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C    100.100.12.0/24 is directly connected, GigabitEthernet2/0
L    100.100.12.1/32 is directly connected, GigabitEthernet2/0
C    100.100.13.0/24 is directly connected, GigabitEthernet1/0
L    100.100.13.1/32 is directly connected, GigabitEthernet1/0
D    100.100.23.0/24
      [90/3072] via 100.100.13.3, 00:23:52, GigabitEthernet1/0
      [90/3072] via 100.100.12.2, 00:23:52, GigabitEthernet2/0
D    100.100.34.0/24
      [90/3072] via 100.100.13.3, 00:23:52, GigabitEthernet1/0
```


Task 7: Unequal Cost Load Balancing

Task 7: Unequal Cost Load Balancing

- The degree to which EIGRP performs load balancing is controlled with the **variance** *multiplier* command.
 - The multiplier is a value, between 1 and 128, used for load balancing.
 - The default is 1, which means equal-cost load balancing.
 - Setting a variance value greater than 1 allows EIGRP to install multiple loop-free routes with unequal cost in the routing table.
 - EIGRP will always install successors (the best routes) in the routing table.
 - The variance allows feasible successors (and only feasible successor routes) as candidate routes to potentially be installed in the routing table.

Task 7: Unequal Cost Load Balancing



```
R1 (config) # router eigrp 1
R1 (config-router) # variance 2
```

R1 Topology Table

| Network | Neighbor | AD | FD |
|---------------|----------|----|----|
| 172.16.2.0/24 | R2 | 10 | 30 |
| | R3 | 10 | 20 |
| | R4 | 25 | 45 |
| | R5 | 10 | 50 |

R1 Routing Table

| Network | Neighbor | AD | FD |
|---------------|----------|----|----|
| 172.16.2.0/24 | R2 | 10 | 30 |
| | R3 | 10 | 20 |
| | R4 | 25 | 45 |
| | R5 | 10 | 50 |

Task 7: Unequal Cost Load Balancing

- Configure R1 to support unequal cost load balancing

```
R1 (config) # router eigrp 1
```

```
R1 (config-router) # variance ?
```

```
<1-128> Metric variance multiplier
```

```
R1 (config-router) # variance 2
```

- Recheck the topology table and routing table in R1
 - Any change for the prefix of R2's loopback 10?
 - Can you explain it?

Task 7: Unequal Cost Load Balancing

R1#show ip route

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 4 subnets

C 10.10.10.1 is directly connected, Loopback10

D 10.10.10.2 [90/131072] via 100.100.13.3, 00:00:06, GigabitEthernet1/0
[90/131840] via 100.100.12.2, 00:00:06, GigabitEthernet2/0

D 10.10.10.3 [90/130816] via 100.100.13.3, 00:00:06, GigabitEthernet1/0

D 10.10.10.4 [90/131072] via 100.100.13.3, 00:00:06, GigabitEthernet1/0

100.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C 100.100.12.0/24 is directly connected, GigabitEthernet2/0

L 100.100.12.1/32 is directly connected, GigabitEthernet2/0

C 100.100.13.0/24 is directly connected, GigabitEthernet1/0

L 100.100.13.1/32 is directly connected, GigabitEthernet1/0

D 100.100.23.0/24
[90/3072] via 100.100.13.3, 00:00:06, GigabitEthernet1/0
[90/4096] via 100.100.12.2, 00:00:06, GigabitEthernet2/0

D 100.100.34.0/24

[90/3072] via 100.100.13.3, 00:00:06, GigabitEthernet1/0

Task 8: Route Summarization

Task 8: Route Summarization

- EIGRP automatically summarizes routes at a major network boundary by default.
- Summarized route has an entry in the routing table pointing to null0.
- To disable automatic summarization:
no auto-summary
- Check if auto-summarization is in effect or not
show ip protocols

Task 8: Route Summarization

- Manually create a summary route at an arbitrary bit boundary.

```
ip summary-address eigrp as-number address  
mask [admin-distance]
```

- IP EIGRP summary routes are given an administrative distance value of 5.
 - Standard EIGRP routes receive an administrative distance of 90
 - External EIGRP routes receive an administrative distance of 170.

Task 8: Route Summarization

- Check routing table of R4 for 10.10.10.0/24
- Configure summary address in R3

```
interface GigabitEthernet2/0
```

```
ip summary-address eigrp 1 10.10.10.0 255.255.255.0
```

- Re-check routing table of R4
 - Check the summary routes and its AD value
- Remove the summarization configuration

Task 8: Route Summarization

R4#show ip route

Gateway of last resort is not set

```
10.0.0.0/32 is subnetted, 4 subnets
D    10.10.10.1 [90/131072] via 100.100.34.3, 00:38:53, GigabitEthernet2/0
D    10.10.10.2 [90/131072] via 100.100.34.3, 00:38:53, GigabitEthernet2/0
D    10.10.10.3 [90/130816] via 100.100.34.3, 00:38:53, GigabitEthernet2/0
C    10.10.10.4 is directly connected, Loopback10
100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks
D    100.100.12.0/24
      [90/3328] via 100.100.34.3, 00:06:20, GigabitEthernet2/0
D    100.100.13.0/24
      [90/3072] via 100.100.34.3, 00:38:53, GigabitEthernet2/0
D    100.100.23.0/24
      [90/3072] via 100.100.34.3, 00:38:53, GigabitEthernet2/0
C    100.100.34.0/24 is directly connected, GigabitEthernet2/0
L    100.100.34.4/32 is directly connected, GigabitEthernet2/0
C    100.100.45.0/24 is directly connected, GigabitEthernet1/0
L    100.100.45.4/32 is directly connected, GigabitEthernet1/0
```

Task 8: Route Summarization

R4#show ip route

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 4 subnets

D 10.10.10.0/24
[90/130816] via 100.100.34.3, 00:00:12, GigabitEthernet2/0

C 10.10.10.4 is directly connected, Loopback10

100.0.0.0/8 is variably subnetted, 7 subnets, 2 masks

D 100.100.12.0/24
[90/3328] via 100.100.34.3, 00:06:20, GigabitEthernet2/0

D 100.100.13.0/24
[90/3072] via 100.100.34.3, 00:38:53, GigabitEthernet2/0

D 100.100.23.0/24
[90/3072] via 100.100.34.3, 00:38:53, GigabitEthernet2/0

C 100.100.34.0/24 is directly connected, GigabitEthernet2/0

L 100.100.34.4/32 is directly connected, GigabitEthernet2/0

C 100.100.45.0/24 is directly connected, GigabitEthernet1/0

L 100.100.45.4/32 is directly connected, GigabitEthernet1/0

Task 9: Default Route

Task 9: Default Route

- To propagate a default route in EIGRP, use either the:

```
ip default-network network-number
```

Or

```
ip route 0.0.0.0 0.0.0.0 next-hop | interface
```

ip default-network

network-number

- There is no parameter to specify the subnet mask therefore only a **classful network** can be used with this command.
- The specified network **must be reachable**.
- If the specified network is reachable through:
 - EIGRP, then the default route is propagated automatically to other EIGRP routers in the AS.
 - A static route, then the static route must be **redistributed into EIGRP**.

```
ip route 0.0.0.0 0.0.0.0  
next-hop | interface
```

- If the **interface** parameter is used, then only the **network 0.0.0.0** needs to be configured in **router eigrp**.
- If the **next-hop** parameter is used, then the **network 0.0.0.0** and the **redistribute static** must be configured in **router eigrp**.

Task 9: Default Route

- Check routing table in R1 for default route
- Configure a default route in R3 (towards R4)
 - Check R3's routing table
 - Re-check R1's routing table
- Remove default route from R3

Example: R4

```
router eigrp 1
 redistribute static
 network 0.0.0.0
ip route 0.0.0.0 0.0.0.0 100.100.34.3
```

Or:

```
router eigrp 1
 network 0.0.0.0
ip route 0.0.0.0 0.0.0.0 gi2/0
```

Task 10: EIGRP Stub Network

Task 10: EIGRP Stub Receive-Only

- Check the routing table in R4 and R1
 - Can you see all the prefixes?
- Configure stub receive-only in R4

```
router eigrp 1
  eigrp stub receive-only
```
- Recheck the routing table in R4 and R1
 - Can you see all the prefixes in R4?
 - Can you see any prefix from R4 in R1?
- Remove the stub configuration from R4

Task 10: EIGRP Stub Summary

- Check the routing table in R1
 - Can you see all the prefixes from R4?

- Configure stub summary in R4

```
interface gi2/0
```

```
ip summary-address eigrp 1 20.20.20.0 255.255.255.0
```

```
router eigrp 1
```

```
eigrp stub summary
```

- Recheck the routing table in R1
 - Can you see the connected routes from R4?
 - Can you see the summary route from R4?
- Remove the stub configuration from R4

Task 10: EIGRP Stub Static

- Check the routing table in R1
 - Can you see all the prefixes from R4?

- Configure stub summary in R4

```
ip route 20.20.20.5 255.255.255.255 gi1/0
router eigrp 1
 redistribute static
 eigrp stub static
```

- Recheck the routing table in R1
 - Can you see the connected routes from R4?
 - Can you see the summary route from R4?
 - Can you see the static route (D EX) from R4?
- Remove the stub configuration from R4

Task 10: EIGRP Stub Connected

- Check the routing table in R1
 - Can you see all the prefixes from R4?
- Configure stub summary in R4

```
router eigrp 1
  eigrp stub connected
```
- Recheck the routing table in R1
 - Can you see the static routes from R4?
 - Can you see the summary route from R4?
 - Can you see the connected routes from R4?
- Remove the stub configuration from R4

Question?