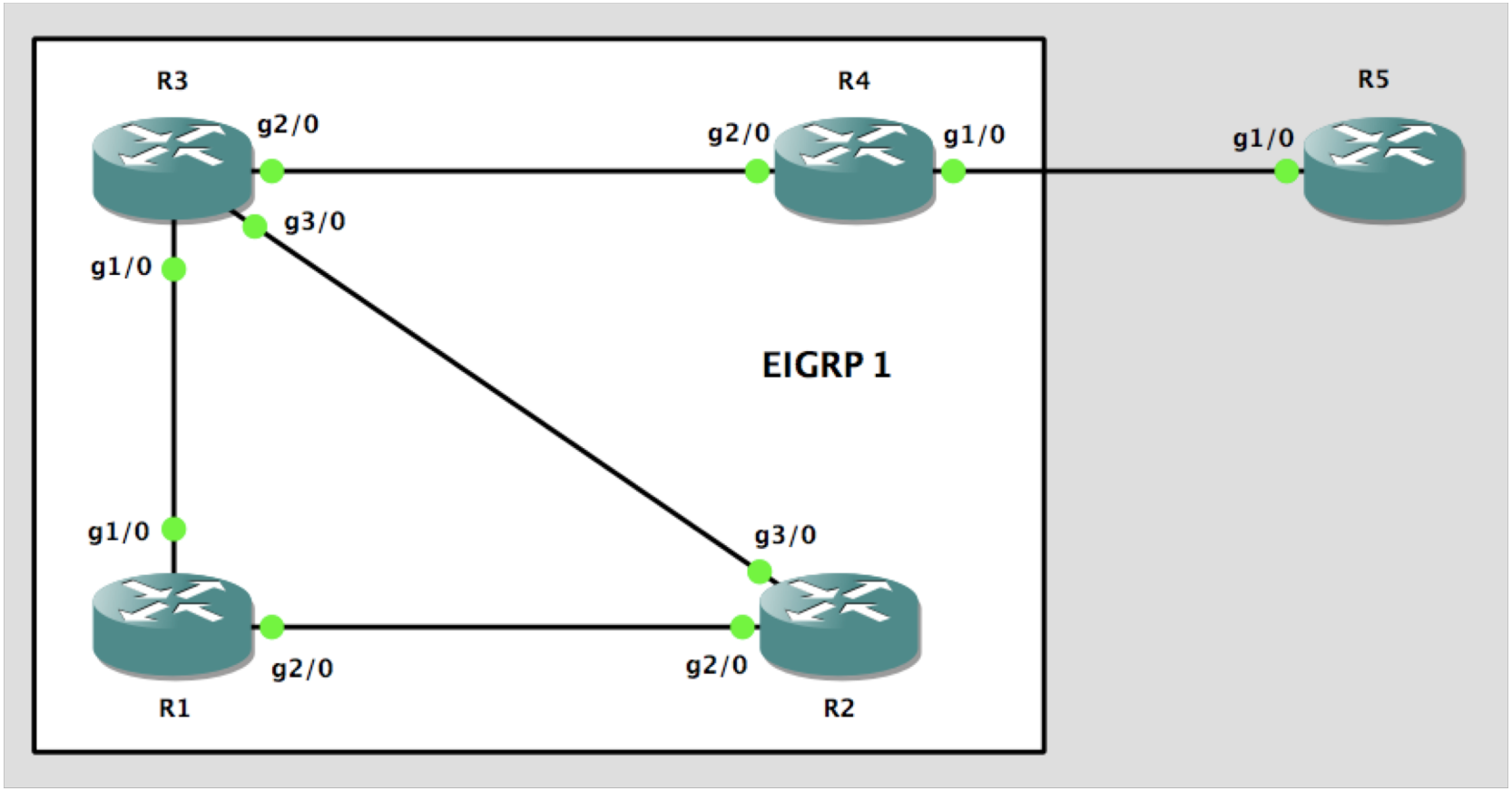
EIGRP

Lab Activity

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`

awal — R3 — telnet 127.0.0.1 5002 — 87×8

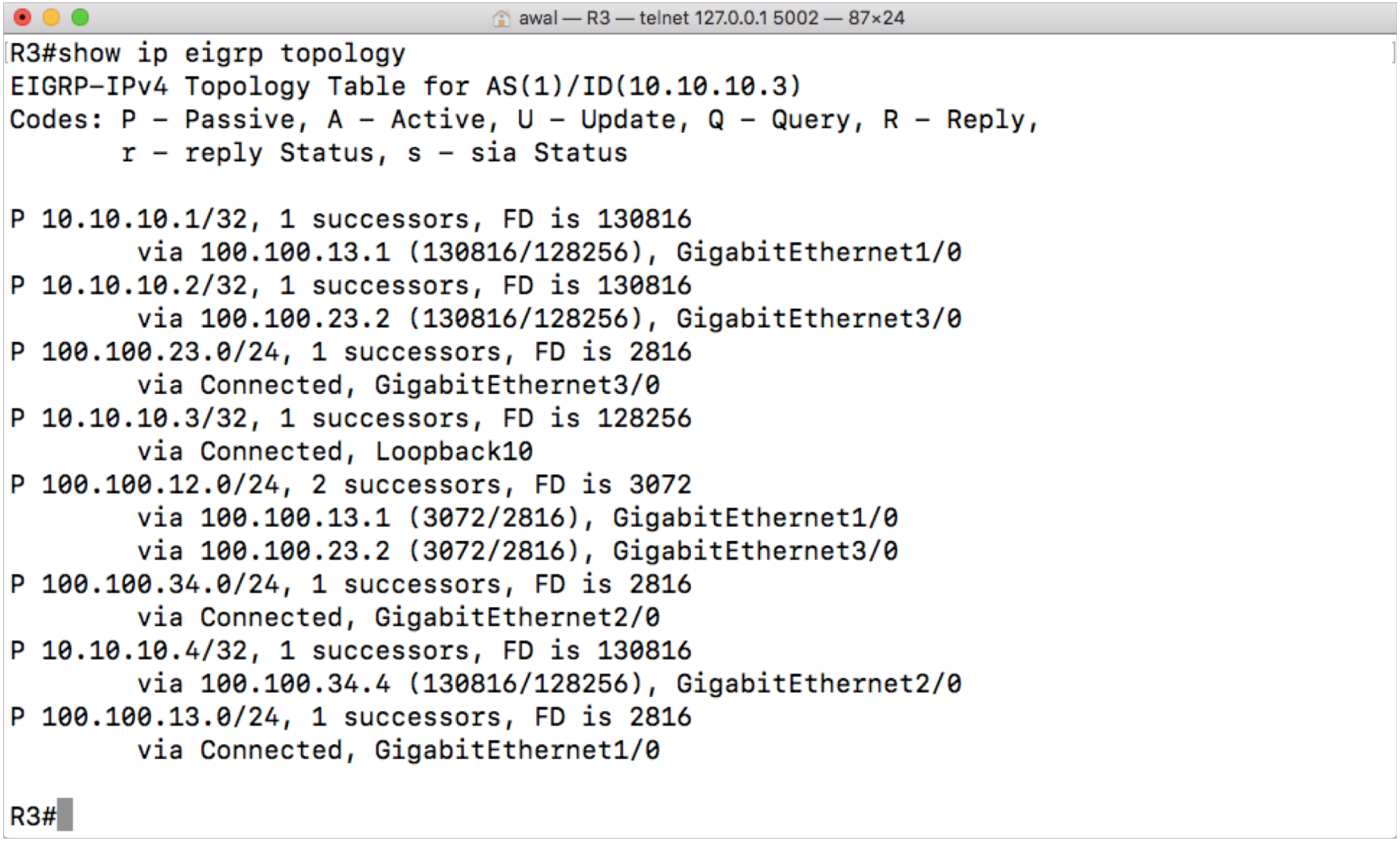
```
R3#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(1)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
2   100.100.34.4            Gi2/0                    10 00:25:07   45   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#
```

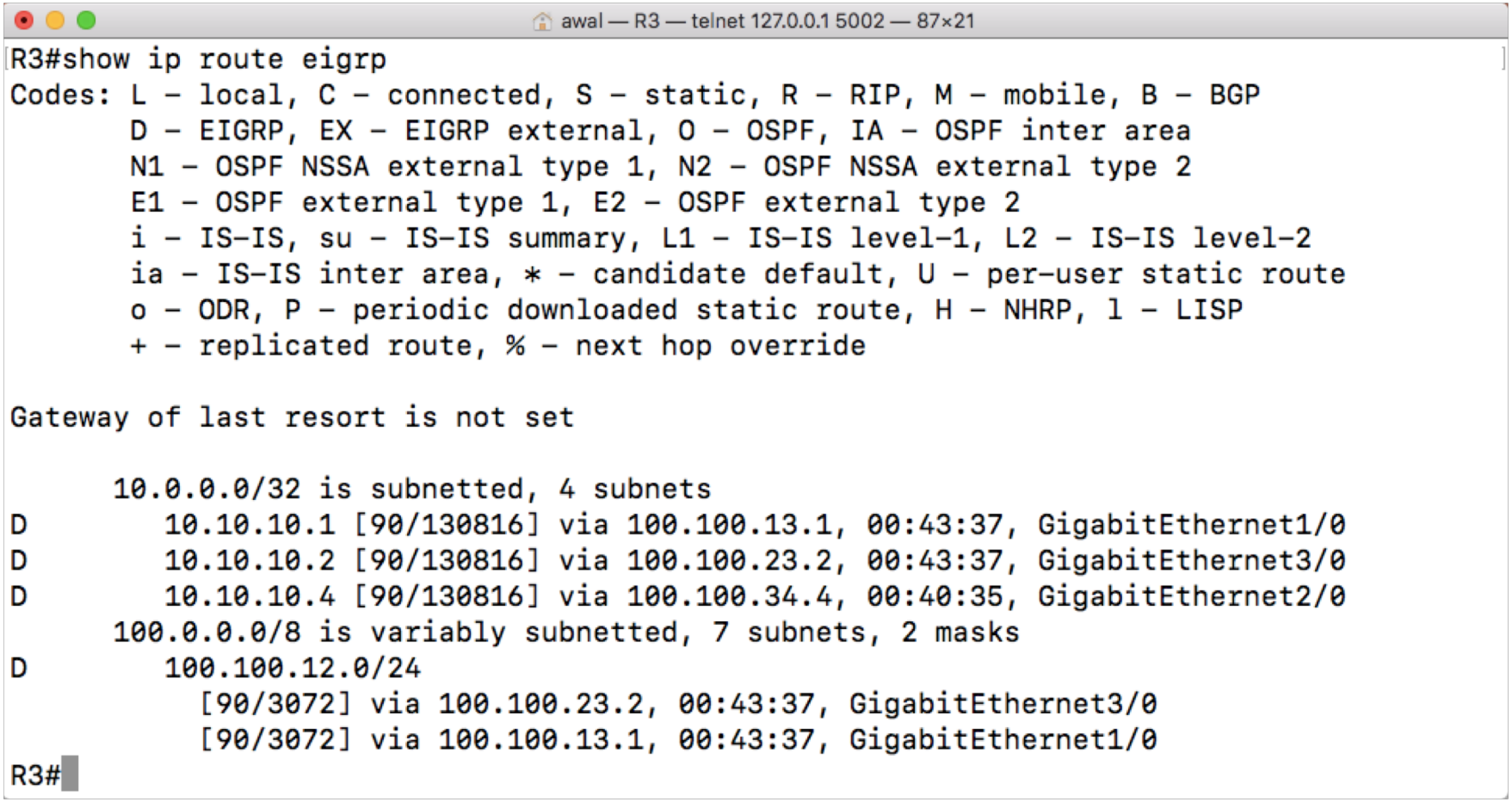
awal — R3 — telnet 127.0.0.1 5002 — 98×9

```
R3#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(1)
                        Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface               Peers  Un/Reliable  Un/Reliable  SRTT  Un/Reliable  Flow Timer  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#
```

awal — R3 — telnet 127.0.0.1 5002 — 87×32

```
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
```


awal — R3 — telnet 127.0.0.1 5002 — 87×24
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#


awal — R3 — telnet 127.0.0.1 5002 — 87×21
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

awal — R4 — telnet 127.0.0.1 5004 — 98×26

```
R4#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(1)
                              Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  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)
                              Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  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 — 81×23

```
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 — 98×16

```
R4#show ip eigrp interfaces
EIGRP-IPv4 Interfaces for AS(1)
                            Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   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)
                            Xmit Queue   PeerQ        Mean   Pacing Time   Multicast    Pending
Interface              Peers  Un/Reliable  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
R4#
R4#
R4#
R4#
```

Task 3: Passive Interface

awal — R1 — telnet 127.0.0.1 5000 — 81×23

```
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 Metric = [(K1*BW) + (K3*DLY)] * 256*

- Default Composite Formula:

  *EIGRP 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 matric 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

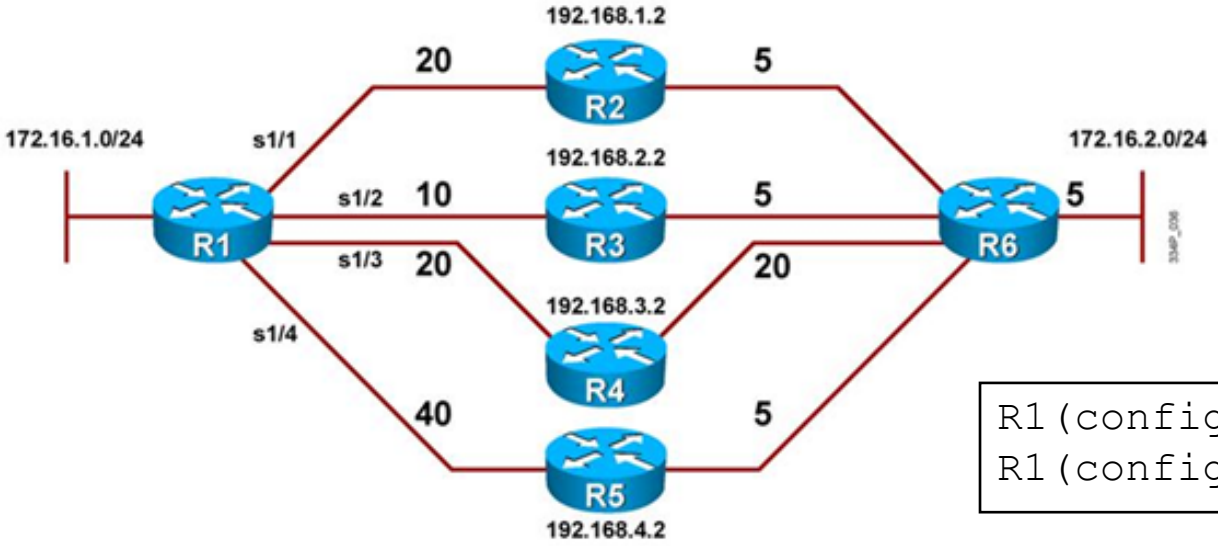
```
R1#show ip route

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 100.100.13.3, 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: R3

```
router eigrp 1
 redistribute static
 network 0.0.0.0
ip route 0.0.0.0 0.0.0.0 100.100.34.4
```

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?