# EIGRP Observation Lab – Route Advertisements

## Objective

The purpose of this lab is to observe the basic **behavior and requirements for EIGRP routers to exchange routes**. This is an **observation-focused lab**. The learner should focus on what changes in the **EIGRP topology table**.

## Topology Overview

There are 3 routers in the topology. **RTR1** and **RTR2** are the primary focus of this lab.

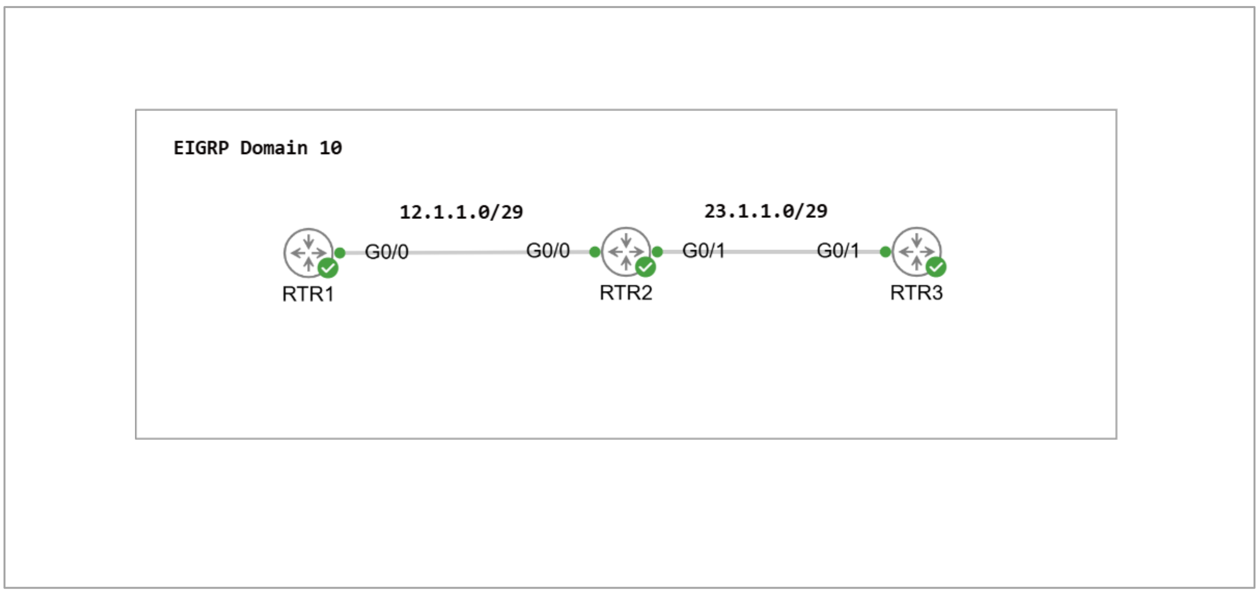


*Figure 1 – Lab topology*

## Task 1 – View EIGRP topology

On RTR1, view the EIGRP topology table.

### Expected Behavior

- There is a single route for the connected network 12.1.1.0/29.

### Verification

*Figure 2 shows RTR1 is only aware of its connected network of 12.1.1.0/29.*

```
RTR1#sh ip eigrp topology
EIGRP-IPv4 Topology Table for AS(10)/ID(12.1.1.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 12.1.1.0/29, 1 successors, FD is 2816
        via Connected, GigabitEthernet0/0

RTR1#
```

*Figure 2 – RTR1 show ip eigrp topology output*

## Task 2 – Enable EIGRP

On RTR2, enable interface GigabitEthernet0/1 for EIGRP AS 10.

### Expected Behavior

- RTR1's Topology table contains route to network 23.1.1.0/29.
- RTR2's Topology table contains route to network 23.1.1.0/29.

## Verification

*Figure 3* shows RTR2's topology table containing a route to 23.1.1.0/29. *Figure 4* shows RTR1's route to network 23.1.1.0/29 in its topology table. Figure 5 shows the EIGRP-learned route installed in the routing table. Note that the letter for EIGRP routes is **D**. D stands for **DUAL**. Also note the administrative distance of **90**.

```
RTR2#sh ip eigrp topology
EIGRP-IPv4 Topology Table for AS(10)/ID(23.1.1.2)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 23.1.1.0/29, 1 successors, FD is 2816
        via Connected, GigabitEthernet0/1
P 12.1.1.0/29, 1 successors, FD is 2816
        via Connected, GigabitEthernet0/0

RTR2#
```

*Figure 3 – RTR2 show ip eigrp topology output*

```
RTR1#sh ip eigrp topology
EIGRP-IPv4 Topology Table for AS(10)/ID(12.1.1.1)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 23.1.1.0/29, 1 successors, FD is 3072
        via 12.1.1.2 (3072/2816), GigabitEthernet0/0
P 12.1.1.0/29, 1 successors, FD is 2816
        via Connected, GigabitEthernet0/0

RTR1#
```

*Figure 4 – RTR1 show ip eigrp topology output*

```
Gateway of last resort is not set

      12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        12.1.1.0/29 is directly connected, GigabitEthernet0/0
L        12.1.1.1/32 is directly connected, GigabitEthernet0/0
      23.0.0.0/29 is subnetted, 1 subnets
D        23.1.1.0 [90/3072] via 12.1.1.2, 00:03:19, GigabitEthernet0/0
RTR1#
```

*Figure 5 – RTR1 show ip route output*

## Task 3 – Modify Router-Id

On RTR2, change the router-id to 12.1.1.1.

### Expected Behavior

- RTR1's route to 23.1.1.0/29 is removed.
- RTR2 has a route to network 23.1.1.0/29 in its topology table.

### Verification

View the topology table of RTR1 and RTR2. RTR1 no longer knows of the route. Unlike OSPF, unique router-ids are not required for an EIGRP peering to form. Unique router-ids are however required for proper route advertisement and route installation behavior. Return RTR2 to default. Verify the route is in RTR1's topology table.

```
show ip eigrp events
```

```
RTR1#sh ip eigrp events
Event information for AS 10:
1    02:42:07.102 Ignored route, metric: 23.1.1.0/29 metric(3072)
2    02:42:07.102 Ignored route, dup routerid int: 12.1.1.1
```

*Figure 6 – RTR1 show ip eigrp events output*

## Task 4 – Observe Composite Metric

On RTR1, view the topology table details for 23.1.1.0/29. Note that the Composite Metric (CM) contains two separate values. The first value of 3072 is RTR1's calculated metric. The value of 2816 is RTR2's calculated FD that was advertised with the route. From the perspective of RTR1, the value 2816 is referred to as the **Reported** or **Advertised Distance (RD/AD)**.

```
RTR1#sh ip eigrp topology 23.1.1.0/29
EIGRP-IPv4 Topology Entry for AS(10)/ID(12.1.1.1) for 23.1.1.0/29
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 3072
  Descriptor Blocks:
  12.1.1.2 (GigabitEthernet0/0), from 12.1.1.2, Send flag is 0x0
      Composite metric is (3072/2816), route is Internal
      Vector metric:
        Minimum bandwidth is 1000000 Kbit
        Total delay is 20 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
        Originating router is 23.1.1.2
RTR1#
```

*Figure 7 – RTR1 show ip eigrp topology output*

```
Description: RTR2
Internet address is 12.1.1.1/29
MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 10 usec,
   reliability 255/255, txload 1/255, rxload 1/255
```

*Figure 8 – RTR1 show interface gi0/0 output*

```
Description: RTR3
Internet address is 23.1.1.2/29
MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 10 usec,
   reliability 255/255, txload 1/255, rxload 1/255
```

*Figure 9 – RTR2 show interface gi0/1 output*

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## Engineer Insight

EIGRP is an **Advanced Distance Vector (DV)** protocol. Recall that DV protocols are concerned with **distance** and **direction**. In EIGRP, the distance is represented by the route metric (the Feasible Distance for the best path), and the direction is represented by the next-hop router.  The shortest distance ( lowest metric) wins.

EIGRP advertises the best route for a destination to its neighbors through an **UPDATE** message. UPDATE messages are **1 of the 5** packet types used in EIGRP communications.  They can be sent as **multicast** or **unicast** in certain cases.   UPDATE messages relay the following information:

- **Prefix** - Destination
- **Metric** – Distance to destination
- **Next-hop** – Direction to destination

If an EIGRP router is aware of multiple paths to a destination it will still only advertise the successor route (the route with the best metric).  EIGRP routers are aware only of the routes their neighbors advertise to them.  This is unlike OSPF, where each router has full visibility of the topology “map” within its attached areas. Full visibility means each OSPF router can make its own independent path decision. EIGRP router decisions are limited to what is selected as best and advertised by the neighbor.

EIGRP routers advertise the **full routing table initially**. What this means is that the first UPDATE to a new neighbor contains **all** the **best EIGRP routes** from its topology table. The logic is that the best routes in the topology table would be the candidates submitted to be placed in the routing table. So even if a static route prevented an EIGRP route from entering the routing table, it would still be advertised to the neighbor. After the first full table advertisement, EIGRP will send an UPDATE only when something has changed (a change has been **triggered**) and only what has changed (**partial** update). In simpler terms, it sends a **triggered, partial update**. OSPF also reacts to topology changes, but it periodically refreshes LSAs every 30 minutes by default, even when the topology remains unchanged. Because EIGRP sends updates only when something changes, and only the information that changed, it generally consumes less bandwidth and processing overhead than protocols that periodically advertise routing information. *Table 1* outlines the values in the Composite metric.

| **Composite Metric** | |
|---|---|
| **Value** | **Significance** |
| 3072 | RTR1's calculated Feasible Distance |
| 2816 | RTR2's Feasible Distance as advertised to RTR1. From RTR1's perspective, this value is known as the **Reported Distance (RD)** or **Advertised Distance (AD).** |

*Table 1*

## Task 5 – Modify Bandwidth

On RTR2, change the bandwidth of interface GigabitEthernet0/1 to 1000 kbps.

### Expected Behavior

- RTR2's metric for network 23.1.1.0/29 is a value of 2560256.
- The Reported Distance, on RTR1, for network 23.1.1.0/29 is a value of 2560256.

## Verification

*Figure 11* shows RTR2's FD of 2560256 for network 23.1.1.0/29. Figure 12 shows this metric recorded as the RD within RTR1's CM. Note that the value for RTR1's Minimum BW metric is 1,000 kbps. RTR1's interface BW remains at the default of 10,000 kbps (1 Gig) but recall that this metric is the same for all EIGRP routers in the path to the destination. This is because the value corresponds to the lowest BW along the path to the single destination.

```
Description: RTR3
Internet address is 23.1.1.2/29
MTU 1500 bytes, BW 1000 Kbit/sec, DLY 10 usec,
   reliability 255/255, txload 1/255, rxload 1/255
```

*Figure 10 – RTR2 show interface GigabitEthernet0/1 output*

```
RTR2#sh ip eigrp topology 23.1.1.0/29
EIGRP-IPv4 Topology Entry for AS(10)/ID(23.1.1.2) for 23.1.1.0/29
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 2560256
  Descriptor Blocks:
  0.0.0.0 (GigabitEthernet0/1), from Connected, Send flag is 0x0
      Composite metric is (2560256/0), route is Internal
      Vector metric:
        Minimum bandwidth is 1000 Kbit
        Total delay is 10 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 0
        Originating router is 23.1.1.2
RTR2#
```

*Figure 11 – RTR2 show ip eigrp topology output*

```
RTR1#sh ip eigrp topology 23.1.1.0/29
EIGRP-IPv4 Topology Entry for AS(10)/ID(12.1.1.1) for 23.1.1.0/29
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 2560512
  Descriptor Blocks:
  12.1.1.2 (GigabitEthernet0/0), from 12.1.1.2, Send flag is 0x0
      Composite metric is (2560512/2560256), route is Internal
      Vector metric:
        Minimum bandwidth is 1000 Kbit
        Total delay is 20 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
        Originating router is 23.1.1.2
RTR1#
```

*Figure 12 – RTR1 show ip eigrp topology output*

### Engineer Insight

The **Reported Distance (RD)** serves an important purpose in helping EIGRP select **loop-free** paths. A route must pass the **Feasibility Condition (FC).** The FC checks whether the neighbor's RD is lower than the local router's current Feasible Distance (FD). The logic is that if the neighbor's RD is lower than the local router's FD, the local router can reasonably assume it is not part of the neighbor's path to the destination. This helps prevent routing loops.

Think of it this way. If it takes your friend 5 minutes to get to the store and it takes you 20 minutes to get to the store, you know your friend's path to the store does not pass your house. If their path passed through your house, their travel time would also need to be at least 20 minutes.
This is one reason **EIGRP neighbors must use matching K-values to form an adjacency**. If routers calculate the CM using different K-values, the reported metrics may no longer be trustworthy or comparable.

## Task 6 – Modify Delay

On RTR2, change the delay of interface GigabitEthernet0/1 to 30. Return the BW to default.

### Expected Behavior

- The Total delay, as seen from RTR1, is 40.

### Verification

The Total delay for RTR1 is 40. This value is the combination of RTR1's interface delay of 10 and RTR2's interface delay of 30.

Think of it this way. You must traverse two different streets to reach your destination. The first street has traffic causing a 10-minute delay. The second street is also experiencing traffic, resulting in a 30-minute delay. Traversing both streets results in a total delay of 40 minutes to reach the destination. **Delay is cumulative** because each router adds its **outgoing interface delay** to the total metric calculation.

```
Description: RTR3
Internet address is 23.1.1.2/29
MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 400 usec,
   reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
```

*Figure 13 – RTR2 show interface GigabitEthernet0/1*

```
RTR2#sh ip eigrp topology 23.1.1.0/29
EIGRP-IPv4 Topology Entry for AS(10)/ID(23.1.1.2) for 23.1.1.0/29
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 12800
  Descriptor Blocks:
  0.0.0.0 (GigabitEthernet0/1), from Connected, Send flag is 0x0
      Composite metric is (12800/0), route is Internal
      Vector metric:
        Minimum bandwidth is 1000000 Kbit
        Total delay is 400 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 0
        Originating router is 23.1.1.2
RTR2#
```

*Figure 14 – RTR2 show ip eigrp topology 23.1.1.0/29 output*

```
Description: RTR2
Internet address is 12.1.1.1/29
MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 10 usec,
   reliability 255/255, txload 1/255, rxload 1/255
```

*Figure 15 – RTR1 show interface GIgabitEthernet0/0 output*

```
RTR1#sh ip eigrp topology 23.1.1.0/29
EIGRP-IPv4 Topology Entry for AS(10)/ID(12.1.1.1) for 23.1.1.0/29
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 13056
  Descriptor Blocks:
  12.1.1.2 (GigabitEthernet0/0), from 12.1.1.2, Send flag is 0x0
      Composite metric is (13056/12800), route is Internal
      Vector metric:
        Minimum bandwidth is 1000000 Kbit
        Total delay is 410 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
        Originating router is 23.1.1.2
RTR1#
```

*Figure 16 – RTR1 show ip eigrp topology 23.1.1.0/29 output*