

Lecture 15- EIGRP Unequal Cost,Loopback Interface



1 Unequal Cost Load Balancing in EIGRP

What is Unequal Cost Load Balancing?

Most routing protocols (like RIP, OSPF) support **equal-cost load balancing only**.

But **EIGRP is special** 

It supports **Unequal Cost Load Balancing** using the **variance command**.

 That means traffic can be shared between routes that have **different metrics**.

Why is it Useful?

Imagine:

- One road is 4 lanes (fast)
- Another road is 2 lanes (slower)



Normally, routers use only the best road.

But EIGRP can use **both roads** intelligently based on their capacity.

This improves:

- Bandwidth usage
 - Network performance
 - Redundancy
-



Terms in EIGRP

EIGRP uses **DUAL (Diffusing Update Algorithm)**.

◆ 1. Feasible Distance (FD)



Definition:
Total metric from **your router to destination**.

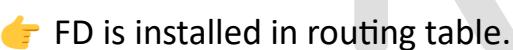
It includes:

- Cost from your router to neighbor
- - Neighbor's cost to destination

Example:

- Cost to neighbor = 20
- Neighbor says cost to destination = 30

$$FD = 20 + 30 = \mathbf{50}$$



FD is installed in routing table.



◆ 2. Reported Distance (RD)

(Also called Advertised Distance)



The metric your neighbor reports to reach destination.

In above example:

$$RD = 30$$

$$FD = 50$$

◆ 3. Successor

🏆 Best path (lowest FD).

Installed in routing table.

Every reachable network must have a successor.

◆ 4. Feasible Successor (Backup Route)

⌚ Backup path stored in topology table.

Used immediately if successor fails.

🔒 Feasibility Condition (Very Important)

A route becomes feasible successor only if:

RD < FD of current successor

This prevents routing loops 

📊 How Variance Works

Default:

variance 1

Means → Only equal-cost paths used.

✍ Formula

A path is eligible if:

Route Metric \leq (Best FD \times Variance)

Example:

Path FD

A 100

B 120

C 200

If Variance = 1

Eligible:

≤ 100

Only Path A

If Variance = 2

$100 \times 2 = 200$

Eligible:

A, B, C

Now EIGRP can use all 3 paths 



❖ How to Configure Variance

On router:

router eigrp 100

variance 2

That's it 

Traffic Sharing

By default:

traffic-share balanced

Traffic is shared proportionally based on metric.

Loopback Interface (Virtual Interface)

What is Loopback Interface?

Loopback is:

- Virtual interface
 - Always UP (unless shutdown)
 - Not connected to physical cable
-

Why We Create Loopback?

Used for:

- Router ID
 - Testing
 - Stability
 - Management
 - Simulation in labs
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Real-Life Example

Think of loopback like:

 Your permanent home address

Even if roads close, your home address stays same.

Router ID Selection Rules (3 Rules)

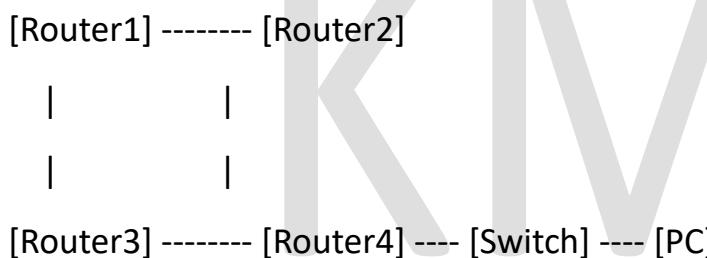
- 1 Highest IP on Loopback interface
- 2 If no loopback → Highest IP on physical interface
- 3 If manually configured → That value used

Loopback is preferred because:

- Always stable
 - Never goes down
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EIGRP LOOPBACK LAB (4 Routers)

Topology



IP Addressing Plan

Link Network

R1–R2 10.0.12.0/30

R1–R3 10.0.13.0/30

R2–R4 10.0.24.0/30

R3–R4 10.0.34.0/30

LAN:

192.168.4.0/24 (PC Network)

Q1.Router Configurations (Step-by-Step)

◆ **Router 1**

hostname R1

int g0/0

ip address 10.0.12.1 255.255.255.252

no shutdown

int fa1/0

ip address 10.0.13.1 255.255.255.252

no shutdown

◆ **Router 2**

hostname R2

int g0/0

ip address 10.0.12.2 255.255.255.252

no shutdown

int fa1/0

ip address 10.0.24.1 255.255.255.252

no shutdown

◆ Router 3

hostname R3

int fa1/0

ip address 10.0.13.2 255.255.255.252

no shutdown

int fa2/0

ip address 10.0.34.1 255.255.255.252

no shutdown

◆ Router 4

hostname R4

int fa2/0

ip address 10.0.34.2 255.255.255.252

no shutdown

int fa1/0

ip address 10.0.24.2 255.255.255.252

no shutdown

int g0/0

ip address 192.168.4.254 255.255.255.0

no shutdown



PC Configuration

IP: 192.168.4.1

Mask: 255.255.255.0

Gateway: 192.168.4.254

Q2. Configure Loopback Interfaces

R1

```
int loopback0  
ip address 1.1.1.1 255.255.255.255
```

R2

```
int loopback0  
ip address 2.2.2.2 255.255.255.255
```

R3

```
int loopback0  
ip address 3.3.3.3 255.255.255.255
```

R4

```
int loopback0  
ip address 4.4.4.4 255.255.255.255
```

Q3.Configure EIGRP (Disable Auto Summary)

◆ **Router 1**

```
router eigrp 100
no auto-summary
network 10.0.12.0 0.0.0.3
network 10.0.13.0 0.0.0.3
network 1.1.1.1 0.0.0.0
passive-interface loopback0
```

◆ **Router 2**

```
router eigrp 100
no auto-summary
network 10.0.12.0 0.0.0.3
network 10.0.24.0 0.0.0.3
network 2.2.2.2 0.0.0.0
passive-interface loopback0
```



◆ **Router 3**

```
router eigrp 100
no auto-summary
network 10.0.13.0 0.0.0.3
network 10.0.34.0 0.0.0.3
network 3.3.3.3 0.0.0.0
passive-interface loopback0
```

◆ Router 4

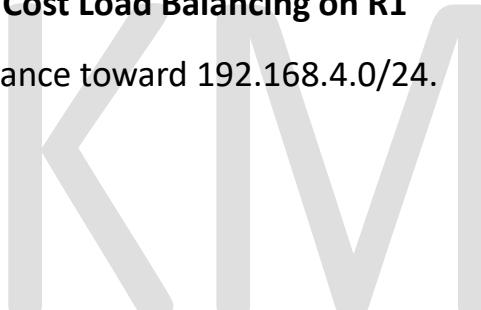
```
router eigrp 100
no auto-summary
network 10.0.24.0 0.0.0.3
network 10.0.34.0 0.0.0.3
network 192.168.4.0 0.0.0.255
network 4.4.4.4 0.0.0.0
passive-interface g0/0
passive-interface loopback0
```

Q4. Configure Unequal Cost Load Balancing on R1

We want R1 to load balance toward 192.168.4.0/24.

R1 has 2 paths:

- Via R2
 - Via R3
-



Step 1: Check Metrics

show ip eigrp topology

Find FD of best path.

Step 2: Configure Variance

If best FD = example 10000

Second path = 15000

Then:

```
router eigrp 100
```

```
variance 2
```

Now R1 will use both paths.

✓ Commands to Verify Lab Success

🔍 Check Neighbors

show ip eigrp neighbors

🔍 Check Routing Table

show ip route

Look for:

D 192.168.4.0

🔍 Check Topology Table

show ip eigrp topology

🔍 Check Load Balancing

show ip route 192.168.4.0

You should see multiple next-hops.

🔍 Ping Test

From R1:

ping 192.168.4.1

From PC:

ping 1.1.1.1

🏆 Final Summary

EIGRP Advanced Concepts:

- ✓ Supports unequal-cost load balancing
 - ✓ Uses FD and RD
 - ✓ Uses DUAL
 - ✓ Loopback improves stability
 - ✓ Variance controls traffic sharing
 - ✓ Passive interface improves security
-





1 DETAILED SUMMARY



1 Unequal Cost Load Balancing in EIGRP

💡 What is Unequal Cost Load Balancing?

Most routing protocols like:

- RIP
- OSPF

Support only **Equal-Cost Load Balancing**.

But **EIGRP** is special 💎

It supports **Unequal Cost Load Balancing** using:

variance command

👉 It allows traffic sharing between routes with different metrics.

🧠 Why It Is Useful?

Imagine:

- 🚗 Road A = 4 lanes (fast)
- 🚗 Road B = 2 lanes (slower)

Normally → Only best path used.

With EIGRP:

- ✓ Both paths can be used
 - ✓ Traffic shared intelligently
 - ✓ Better bandwidth utilization
 - ✓ Higher redundancy
-

Important EIGRP Terms

EIGRP uses **DUAL (Diffusing Update Algorithm)** 

◆ **1 Feasible Distance (FD)**

 Definition:

Total metric from your router to destination.

It includes:

- Cost to neighbor
- Neighbor's cost to destination

Example:

- Cost to neighbor = 20
- Neighbor's cost = 30

$$FD = 20 + 30 = 50$$

 Installed in routing table.



◆ **2 Reported Distance (RD)**

Also called:

- Advertised Distance

 Definition:

Distance reported by neighbor to destination.

In above example:

- RD = 30
- FD = 50

◆ **3 Successor 🏆**

- Best path (lowest FD)

- Installed in routing table
 - Every reachable network must have one
-

◆ Feasible Successor

- Backup path
 - Stored in topology table
 - Used immediately if successor fails
-

Feasibility Condition (Very Important)

A route becomes Feasible Successor if:

$RD < FD$ (of current successor)

✓ Prevents routing loops

✓ Ensures loop-free backup



How Variance Works

Default:

variance 1

Means:

Only equal-cost paths allowed.

Eligibility Formula

A path is used if:

$\text{Route Metric} \leq (\text{Best FD} \times \text{Variance})$

Example:

Path FD

A 100

B 120

C 200

If variance = 1

Eligible:

≤ 100

Only Path A

If variance = 2

$100 \times 2 = 200$

Eligible:

A, B, C 



Now EIGRP can load balance across all.

🛠 Configure Variance

router eigrp 100

variance 2

Done 

Traffic Sharing

Default:

traffic-share balanced

Traffic shared proportionally based on metric.

Loopback Interface

What is Loopback?

Loopback is:

- Virtual interface
 - No physical cable
 - Always UP (unless shutdown)
 - Logical interface
-

Why Use Loopback?

Used for:

- Router ID
 - Stability
 - Testing
 - Management
 - Lab simulation
- 
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Real-Life Example

Loopback = Permanent home address 

Even if roads close → Address remains same.

Router ID Selection Rules

Priority Order:

- 1** Highest IP on Loopback
- 2** Highest IP on Physical Interface
- 3** Manually configured Router ID

Loopback preferred because:

- ✓ Stable
 - ✓ Never goes down
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LAB OVERVIEW

Topology:

R1 — R2
| |
R3 — R4 — PC



Networks:

- 10.0.12.0/30
- 10.0.13.0/30
- 10.0.24.0/30
- 10.0.34.0/30
- 192.168.4.0/24

Loopbacks:

- 1.1.1.1
 - 2.2.2.2
 - 3.3.3.3
 - 4.4.4.4
-



COMPLETE MIND MAP

EIGRP Advanced

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 └— Unequal Cost Load Balancing

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 └— Variance

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 └— Eligibility formula

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 └— Traffic-share balanced

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 └— EIGRP Terms

 |

 └— FD

 |

 └— RD

 |

 └— Successor

 |

 └— Feasible Successor

 |

 └— Feasibility Condition

 |

 └— Variance Example

 |

 └— Loopback Interface

 |

 └— Virtual

 |

 └— Always UP

 |

 └— Router ID

 |

 └— Stability

 |

 └— Router ID Rules

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- └─ Lab
 - ├─ 4 Routers
 - ├─ Loopbacks
 - ├─ Disable auto-summary
 - └─ Verification

🎯 Q & A

Q 1 What is Unequal Cost Load Balancing?

Answer:

It allows EIGRP to use multiple paths with different metrics using variance command.

Q 2 Which routing protocol supports unequal cost load balancing?

Answer:

EIGRP supports unequal-cost load balancing.

Q 3 What is variance in EIGRP?

Answer:

Variance is a multiplier that allows routes within certain metric range to be used for load balancing.

Q 4 What is default variance?

Answer:

Default value is 1 (equal-cost only).

Q 5 Explain Feasible Distance (FD).

Answer:

FD is total metric from current router to destination.

Q 6 Explain Reported Distance (RD).

Answer:

RD is distance reported by neighbor to reach destination.

Q 7 What is Successor?

Answer:

Best path selected by DUAL, installed in routing table.

Q 8 What is Feasible Successor?

Answer:

Backup path that satisfies feasibility condition.

Q 9 What is Feasibility Condition?

Answer:

RD < FD of current successor.

It prevents routing loops.

Q 10 What happens if RD is greater than FD?

Answer:

It cannot become feasible successor.

Q 11 How does EIGRP prevent loops?

Answer:

Using DUAL algorithm and feasibility condition.

Q 1 2 What is Loopback Interface?

Answer:

Virtual interface that is always up and used for router ID and stability.

Q 1 3 Why is loopback preferred for Router ID?

Answer:

Because it never goes down, so router ID remains stable.

Q 1 4 Router ID selection order?

Answer:

1. Highest Loopback IP
 2. Highest Physical IP
 3. Manually configured
-

Q 1 5 What is traffic-share balanced?

Answer:

Traffic is shared proportionally according to metric.

Q 1 6 Why disable auto-summary?

Answer:

To prevent classful summarization and allow proper routing in discontiguous networks.

Q 1 7 How to verify load balancing?

Answer:

Use:

show ip route

show ip eigrp topology

Multiple next-hops should appear.

☒ FINAL CONCLUSION

- 🔥 EIGRP is powerful because it supports unequal cost load balancing.
 - 🔥 Variance allows intelligent traffic sharing.
 - 🔥 FD and RD are core concepts for interviews.
 - 🔥 Feasibility condition prevents loops.
 - 🔥 Loopback interface ensures stability and proper Router ID selection.
 - 🔥 Advanced EIGRP makes enterprise networks efficient and redundant.
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