

# Lecture 14- EIGRP (Enhanced Interior Gateway Routing Protocol)

## What is EIGRP?

**EIGRP (Enhanced Interior Gateway Routing Protocol)** is an advanced dynamic routing protocol.

- Initially, it was **Cisco proprietary** (1990–2013) 
- That means both routers had to be Cisco devices
- In 2013, Cisco made it open standard

## Special Feature of EIGRP

- Uses **DUAL Algorithm (Diffusing Update Algorithm)**
- Sends only updates, not full routing table
- Very fast convergence
- Loop-free routing

Unlike RIP  (which sends full table every 30 seconds),  
EIGRP sends **only changed routes**.

## EIGRP Metric

EIGRP uses **Composite Metric**:

-  Bandwidth (lowest link bandwidth)
-  Delay (total delay)
- Optional: Reliability, Load, MTU

## Formula:

$$\text{Metric} = 256 \times [(10^7 / \text{bandwidth}) + \text{delay}]$$

 This makes EIGRP more accurate than RIP (which only uses hop count).



## How EIGRP Works (Step-by-Step)

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### 1 Neighbor Discovery

- Sends **Hello packets**
- Uses multicast IP: **224.0.0.10**
- Routers must match:
  - AS number
  - K values

If matched → Neighbor relationship forms

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### 2 DUAL Algorithm (EIGRP's Brain

DUAL:

- Finds best path → **Successor**
  - Finds backup path → **Feasible Successor**
  - Prevents loops
  - Fast recalculation
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### 3 Routing Table Formation

- Successor = Best route
- Feasible Successor = Backup route

#### Feasibility Condition:

Reported Distance < Feasible Distance

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## Partial & Bounded Updates

- Sends only changed routes
  - Sends to specific neighbors
  - Saves bandwidth
  - Reduces CPU load
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## EIGRP Timers

Timer LAN    WAN

Hello 5 sec 60 sec

Hold 15 sec 180 sec

Hold = 3 × Hello

Active Timer = 3 minutes

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## EIGRP Packet Types

Packet	Purpose
Hello	Discover neighbors
Update	Send route changes
Query	Ask for route
Reply	Respond to query
Acknowledgement	Confirm update

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# Administrative Distance

- Internal EIGRP = **90**
  - External EIGRP = **170**
  - Summary route = **5**



## Multicast Address Meaning

Multicast = Send to specific group inside network

EIGRP → 224.0.0.10

RIP → 224.0.0.9

OSPF → 224.0.0.5



# What is AS Number in EIGRP?

## When we type:

router eigrp 100

## What is 100?

100 = Autonomous System Number

- Routers must have SAME AS number
  - Otherwise, they will NOT become neighbors



👉 Think AS number like a group ID.

## What is Wildcard Mask?

Example:

network 192.168.10.0 0.0.0.255

Wildcard mask = Opposite of subnet mask

Subnet mask:

255.255.255.0

Wildcard mask:

0.0.0.255

Used to specify range of IP addresses.

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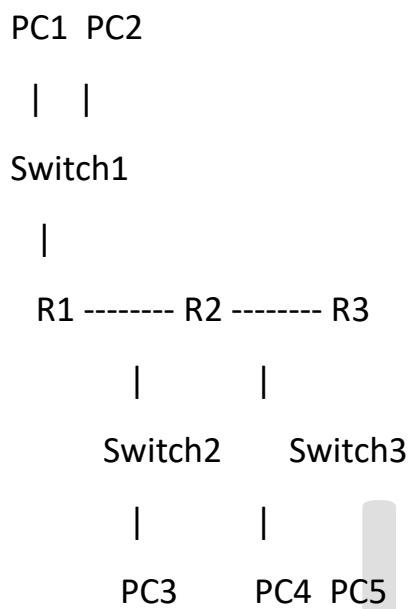


## EIGRP LAB (3 Routers, 3 Switches, 5 PCs)

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### Network Topology



### IP Addressing Plan

#### Connection Network

R1-R2	192.168.10.0
R2-R3	192.168.20.0
R1 LAN	192.168.30.0
R2 LAN	192.168.40.0
R3 LAN	192.168.50.0

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## ❖ Router Configuration (Step-by-Step)

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### ◆ Router 1 Configuration

#### Enter Configuration Mode

```
en
```

```
conf t
```

```
hostname R1
```

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#### Configure Interfaces

```
int g0/0
```

```
ip address 192.168.10.1 255.255.255.0
```

```
no shutdown
```

👉 Connects to R2

```
int g0/1
```

```
ip address 192.168.30.1 255.255.255.0
```

```
no shutdown
```

👉 Connects to Switch1

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### ◆ Router 2 Configuration

```
en
```

```
conf t
```

```
hostname R2
```

```
int g0/0
```

```
ip address 192.168.10.2 255.255.255.0
```

```
no shutdown
```

```
int g0/1
```

```
ip address 192.168.20.1 255.255.255.0  
no shutdown  
int g0/2  
ip address 192.168.40.1 255.255.255.0  
no shutdown
```

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#### ◆ Router 3 Configuration

```
en  
conf t  
hostname R3  
int g0/0  
ip address 192.168.20.2 255.255.255.0  
no shutdown  
int g0/1  
ip address 192.168.50.1 255.255.255.0  
no shutdown
```

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#### PC Configuration

##### Router 1 LAN

PC1:

- IP: 192.168.30.2
- Gateway: 192.168.30.1

PC2:

- IP: 192.168.30.3
  - Gateway: 192.168.30.1
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## Router 2 LAN

PC3:

- IP: 192.168.40.2
  - Gateway: 192.168.40.1
- 

## Router 3 LAN

PC4:

- IP: 192.168.50.2
- Gateway: 192.168.50.1

PC5:

- IP: 192.168.50.3
  - Gateway: 192.168.50.1
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🔥 **Enable EIGRP**

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◆ R1

```
router eigrp 100
```

```
network 192.168.10.0 0.0.0.255
```

```
network 192.168.30.0 0.0.0.255
```

```
passive-interface g0/1
```

### Why passive-interface?

- g0/1 connects to switch
- No router neighbor there
- Stops hello packets
- Improves security
- Saves bandwidth

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◆ **R2**

```
router eigrp 100
network 192.168.10.0 0.0.0.255
network 192.168.20.0 0.0.0.255
network 192.168.40.0 0.0.0.255
passive-interface g0/2
```

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◆ **R3**

```
router eigrp 100
network 192.168.20.0 0.0.0.255
network 192.168.50.0 0.0.0.255
passive-interface g0/1
```

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### Verification Commands

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#### ✓ Check Neighbors

```
show ip eigrp neighbors
```

Shows:

- Neighbor IP
  - Interface
  - Hold Time
  - SRTT
  - RTO
-

## ✓ Check Topology Table

show ip eigrp topology

Shows:

- Successors
  - Feasible Successors
  - FD (Feasible Distance)
  - RD (Reported Distance)
- 

## ✓ Check Routing Table

show ip route

D = EIGRP route



## 🏆 Final Understanding

EIGRP is:

- Faster than RIP
  - More accurate
  - Loop-free
  - Efficient bandwidth usage
-

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## SUMMARY

### 💡 What is EIGRP?

EIGRP is an **advanced dynamic routing protocol** developed by Cisco.

- Initially Cisco proprietary (1990–2013) 
- Now open standard
- Works inside an Autonomous System (AS)

It is known for:

- ⚡ Very fast convergence
- 🚧 Loop-free routing
- 📦 Partial updates (not full table like RIP)
- 🧠 Uses DUAL algorithm



### Core Features

#### ✓ 1. DUAL Algorithm (Brain of EIGRP)

- Finds **Best Path → Successor**
- Finds **Backup Path → Feasible Successor**
- Ensures **no routing loops**
- Very fast recalculation

#### ✓ 2. Composite Metric

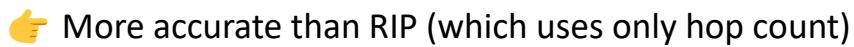
EIGRP uses:

- 📊 Bandwidth (lowest)
- ⏳ Delay (total)
- Optional: Reliability, Load, MTU



Formula:

$$\text{Metric} = 256 \times [(10^7 / \text{bandwidth}) + \text{delay}]$$



More accurate than RIP (which uses only hop count)

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### 3. Neighbor Discovery

- Uses Hello packets
- Multicast IP → **224.0.0.10**
- Must match:
  - AS Number
  - K-values

### 4. Partial & Bounded Updates

- Sends only changed routes
- Sends only to affected neighbors
- Saves bandwidth
- Reduces CPU load

### Timers

Timer	LAN	WAN
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Hello	5 sec	60 sec
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Hold	15 sec	180 sec
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Active Timer 3 min 3 min

Hold = 3 × Hello

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## **Packet Types**

### **Packet Purpose**

Hello Discover neighbors

Update Send route info

Query Ask for route

Reply Respond to query

ACK Confirm update

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## **Administrative Distance**

- Internal EIGRP → 90
- External EIGRP → 170
- Summary → 5

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## **Multicast Comparison**

- EIGRP → 224.0.0.10
- RIP → 224.0.0.9
- OSPF → 224.0.0.5

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## **AS Number**

router eigrp 100

- 100 = Autonomous System Number
- Must match on both routers

## Wildcard Mask

Example:

network 192.168.10.0 0.0.0.255

- Wildcard = Opposite of subnet mask
  - Used to define range of networks
- 

## CONCLUSION

EIGRP is a **hybrid routing protocol** combining features of:

- Distance Vector
- Link State

It provides:

-  Fast convergence
-  Loop prevention
-  Accurate path selection
-  Efficient bandwidth usage



Compared to RIP:

- Faster
- More intelligent
- Scalable
- Production-ready

 EIGRP is ideal for medium to large enterprise networks.

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### 3 MIND MAP

EIGRP

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|— Definition

| |

| |— Cisco Developed

| |

| |— Dynamic Routing

| |

| |— Hybrid Protocol

|

|— Core Mechanism

| |

| |— DUAL Algorithm

| | |

| | |— Successor

| | |

| | |— Feasible Successor

| | |

| | |— Loop Prevention

|

|— Metric Calculation

| |

| |— Bandwidth

| |

| |— Delay

| |

| |— Reliability (Optional)

| |

| |— Load (Optional)

| |

| |— MTU (Optional)

|

|— Neighbor Formation

| |

| |— Hello Packets

| |

| |— Multicast 224.0.0.10

| |

| |— AS Match

```
|   └─ K-value Match  
|  
|  
└─ Tables  
|   ├─ Neighbor Table  
|   ├─ Topology Table  
|   └─ Routing Table  
|  
|  
└─ Packet Types  
|   ├─ Hello  
|   ├─ Update  
|   ├─ Query  
|   ├─ Reply  
|   └─ ACK  
|  
|  
└─ Timers  
|   ├─ Hello  
|   ├─ Hold  
|   └─ Active  
|  
└─ Configuration  
    ├─ router eigrp 100  
    ├─ network command  
    ├─ passive-interface  
    └─ verification commands
```

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## Q & A

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### ◆ Q1. What is EIGRP?

**Answer:**

EIGRP (Enhanced Interior Gateway Routing Protocol) is an advanced dynamic routing protocol developed by Cisco. It uses the DUAL algorithm for fast convergence and loop-free routing. It is considered a hybrid protocol because it combines features of distance-vector and link-state routing.

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### ◆ Q2. Why is EIGRP better than RIP?

**Answer:**

- RIP uses hop count (max 15 hops)
- EIGRP uses composite metric (bandwidth + delay)
- RIP sends full table every 30 sec
- EIGRP sends only updates
- Faster convergence

Therefore, EIGRP is more scalable and efficient.

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### ◆ Q3. What is DUAL in EIGRP?

**Answer:**

DUAL (Diffusing Update Algorithm) is the algorithm used by EIGRP to calculate the best path. It ensures loop-free routing and provides fast convergence by maintaining a backup route called Feasible Successor.

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### ◆ Q4. What is Successor and Feasible Successor?

**Answer:**

- Successor = Best path to destination
- Feasible Successor = Backup path

Feasibility Condition:

Reported Distance < Feasible Distance

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◆ **Q5. What is Feasible Distance (FD)?**

**Answer:**

Feasible Distance is the lowest calculated metric to reach a destination from the local router.

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◆ **Q6. What is Reported Distance (RD)?**

**Answer:**

Reported Distance is the metric reported by the neighbor router to reach a destination.

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◆ **Q7. What multicast address does EIGRP use?**

**Answer:**

EIGRP uses 224.0.0.10 for sending hello packets and updates.

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◆ **Q8. What are EIGRP packet types?**

**Answer:**

1. Hello
  2. Update
  3. Query
  4. Reply
  5. Acknowledgment
-

◆ **Q9. What is Administrative Distance of EIGRP?**

**Answer:**

- Internal → 90
  - External → 170
  - Summary → 5
- 

◆ **Q10. What must match for neighbor formation?**

**Answer:**

- AS Number
  - K-values
  - Same subnet
- 

◆ **Q11. What is passive-interface?**

**Answer:**

It prevents sending hello packets on that interface but still advertises the network. Used for LAN interfaces connected to switches.

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◆ **Q12. What are EIGRP timers?**

**Answer:**

- Hello Timer
  - Hold Timer
  - Active Timer
- 

◆ **Q13. What happens if no feasible successor exists?**

**Answer:**

Router sends Query packets and enters Active state until reply is received.

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◆ **Q14. Why is EIGRP called Hybrid Protocol?**

**Answer:**

Because it combines:

- Distance vector behavior
  - Link-state features (like maintaining topology table)
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◆ **Q15. What command checks neighbors?**

show ip eigrp neighbors

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◆ **Q16. What does “D” mean in routing table?**

**Answer:**

"D" represents routes learned from EIGRP.

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◆ **Q17. Explain EIGRP metric formula.**

**Answer:**

Metric is calculated using bandwidth and delay to choose the most efficient path.

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◆ **Q18. What is AS Number?**

**Answer:**

Autonomous System number identifies the EIGRP routing domain. Routers must use same AS to become neighbors.

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◆ **Q19. Difference between Internal and External EIGRP?**

**Answer:**

- Internal → learned inside same AS
  - External → redistributed from another protocol
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◆ **Q20. What is Active and Passive state?**

**Answer:**

- Passive = Route stable
  - Active = Route recalculating
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