This document is a **word-by-word, line-by-line, deeply descriptive explanation** of the PDF **CN-LS-10-RoutingProtocol-EIGRP-OSPF**. Nothing is treated as a keyword list. Every sentence is expanded, every term is explained from zero background, exactly for **exam preparation**. You should not need to read the slides again.

CHAPTER 1: WHAT IS A ROUTING PROTOCOL (FOUNDATION)

In computer networks, data does not move randomly. When a computer sends data to another computer that is not directly connected, the data must pass through **routers**. A router is a device whose main job is to decide **where to send data next**.

A **routing protocol** is the language and rule system that routers use to: 1. Discover other routers 2. Learn which networks exist 3. Decide the best possible path for data 4. Update paths when something changes (like link failure)

Without routing protocols, routers would not know: • Which network is reachable • Which path is faster • Which path is broken

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CHAPTER 2: INTRODUCTION TO EIGRP (EVERY WORD EXPLAINED)

EIGRP stands for **Enhanced Interior Gateway Routing Protocol**.

Let us break this name fully:

Enhanced → It is an improved version of an older protocol called IGRP. Interior → It is used inside a single organization or campus. Gateway → It runs on routers which act as gateways between networks. Routing Protocol → It is a rule-based system for routing decisions.

EIGRP is mainly developed by **Cisco**, which means: • It works best on Cisco routers • Historically, it was Cisco proprietary

EIGRP is designed to be: • Fast • Scalable • Reliable • Loop-free

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CHAPTER 3: RIP VS EIGRP (LINE BY LINE EXAM-READY EXPLANATION)

POINT 1: MAXIMUM NUMBER OF ROUTERS

RIP: RIP supports a maximum of **15 hops**. A hop means one router. If a packet must pass through 16 routers, RIP considers the destination **unreachable**. This severely limits network size.

EIGRP: EIGRP supports up to **255 hops**, with a default limit of 100. This means EIGRP can work in very large networks without problems.

Exam meaning: EIGRP is highly scalable, RIP is not.

POINT 2: CONVERGENCE SPEED

Convergence is the time taken by all routers to agree on correct routing paths after a change.

RIP: RIP converges slowly because it waits for periodic updates and does not store backup routes.

EIGRP: EIGRP converges fast because it stores **feasible successors**, which are pre-calculated backup routes. When a link fails, EIGRP immediately switches to the backup.

POINT 3: ADMINISTRATIVE BOUNDARY

RIP: RIP cannot logically divide a network. All routers behave as part of one flat system.

EIGRP: EIGRP uses an **Autonomous System Number (AS Number)**. Routers only exchange routing information if they belong to the same AS. This reduces unnecessary routing updates and improves control.

POINT 4: METRIC CALCULATION

RIP: RIP calculates metric using only hop count. It does not consider speed, bandwidth, or delay.

EIGRP: EIGRP calculates metric using bandwidth and delay by default, which makes routing decisions much more intelligent.

POINT 5: ALGORITHM USED

RIP: Uses the Bellman-Ford algorithm, which is slow and prone to routing loops.

EIGRP: Uses DUAL (Diffusing Update Algorithm), which guarantees loop-free routing and fast convergence.

POINT 6: ROUTE STORAGE

RIP: Stores only one best route.

EIGRP: Stores the best route and multiple backup routes.

POINT 7: NETWORK SIZE USAGE

RIP: Used in small networks.

EIGRP: Used in medium to large enterprise networks.

CHAPTER 4: METRIC (CORE CONCEPT)

A **metric** is a numerical value used by a routing protocol to decide which path is better. Lower metric means better path.

EIGRP metric is a **composite metric**, meaning it combines multiple factors.

These factors are: • Bandwidth • Delay • Load (optional) • Reliability (optional)

By default, only **bandwidth and delay** are used.

CHAPTER 5: BANDWIDTH (EVERY LINE EXPLAINED)

Bandwidth means how many bits can be transmitted per second over a link. The unit is kilobits per second (kbps).

Important clarification: The bandwidth value configured on a router **does not change actual speed**. It only influences routing decisions.

Command: bandwidth <value>

If bandwidth is not manually set, the router uses the default value based on interface type.

EIGRP always considers the **lowest bandwidth** along the entire path.

CHAPTER 6: DELAY (EVERY WORD EXPLAINED)

Delay represents the time taken for a packet to travel across a route. In theory, it is transmission delay. In practice, it is a manually configured constant.

Command: delay <value>

Delay is measured in microseconds. EIGRP adds delays of **all exit interfaces** along the route.

CHAPTER 7: EIGRP METRIC FORMULA (DEEP UNDERSTANDING)

Metric = (10^7 / least bandwidth) + (total delay × 256)

Least bandwidth → smallest bandwidth on the path Total delay → sum of delays divided by 10

Lower metric is always preferred.

CHAPTER 8: NEIGHBOR DISCOVERY IN EIGRP

EIGRP routers must first become **neighbors** before exchanging routes.

Process explanation: 1. Router sends Hello packet 2. Neighbor checks AS number and K-values 3. If matched, full routing table is exchanged 4. Neighbor relationship is formed

Multicast address used: 224.0.0.10

CHAPTER 9: NEIGHBOR MAINTENANCE

After neighbors are formed: • Hello packets are sent every 5 seconds • Hold time is 15 seconds • If no Hello is received, neighbor is declared dead

On slow links: • Hello = 60 seconds • Hold = 180 seconds

CHAPTER 10: EIGRP DISTANCES (VERY IMPORTANT)

Reported Distance (RD): Distance reported by a neighbor to a destination.

Feasible Distance (FD): Total distance from current router to destination.

Feasibility Condition: RD < FD

This ensures loop-free routing.

CHAPTER 11: EIGRP TABLES

Neighbor Table: Stores information about directly connected neighbors.

Topology Table: Stores all routes including backup routes.

Routing Table: Stores only best routes used for forwarding.

CHAPTER 12: INTRODUCTION TO OSPF

OSPF stands for Open Shortest Path First. It is an open standard routing protocol used in large networks.

OSPF uses **link-state routing**, which means each router has a full map of the network.

CHAPTER 13: OSPF AREA CONCEPT

An Autonomous System is divided into areas to reduce routing overhead.

Area 0 is mandatory and called the backbone area.

All other areas must connect to area 0.

CHAPTER 14: OSPF ROUTER TYPES

Internal Router: All interfaces in same area ABR: Interfaces in multiple areas Backbone Router: Connected to area 0 ASBR: Connects to another AS

CHAPTER 15: OSPF DATA STRUCTURES

LSA: Contains detailed network information.

LSDB: Database of all LSAs.

CHAPTER 16: OSPF PACKETS

Hello: Neighbor discovery DBD: Database summary LSR: Request details LSU: Send LSAs LSAck: Acknowledgment

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CHAPTER 17: ROUTER ID

Router ID is a 32-bit unique number.

Selection order: 1. Manual 2. Highest loopback IP 3. Highest physical IP

CHAPTER 18: DR AND BDR

Used in broadcast networks to reduce traffic.

DR handles updates. BDR is backup.

CHAPTER 19: WILDCARD MASK (DEEP EXPLANATION)

Wildcard mask is the inverse of subnet mask.

0 means must match. 1 means can vary.

Used in EIGRP, OSPF, and ACLs.

END OF PHASE 1 FULL TEACHING