🚀 Lecture 10 – Routing & Static Routing Lab (R1, R2, R3)

🟦 1. What is Routing?

✔ Definition

Routing is the process in which a **router selects the best path** to send data from **source network → destination network**.

Routers use **routing tables** and **routing protocols** to make path-selection decisions.

✔ Why routing is required?

- Devices in **different networks** cannot communicate without a router

- Router decides **where to send packets**

- Prevents wrong routing, loops, delays

✔ Real-Life Example

When you send a message from your phone in India to a server in USA → Routers decide the **best possible path across multiple networks**.

🟦 2. Routing Protocols Overview

Routing protocols help routers communicate and share network information.

There are 4 main routing protocols:

🔵 1. RIP – Routing Information Protocol

- Very old protocol

- Uses **distance (hop count)** to decide best path

- **Maximum 15 hops** (16 = unreachable)

- Does NOT check speed or bandwidth

- Used in **very small networks**

✔ Daily-life example

A small shop with 2–3 routers may use RIP because the network is tiny.

🔵 2. OSPF – Open Shortest Path First

- Uses **Shortest Path First algorithm (Dijkstra)**
- Creates a **full map of the network**
- Faster and scalable
- Used in **medium to large companies**
- Supports areas (Area 0, Area 1…)

✔ Example

Banks or corporate offices use OSPF for faster and accurate routing.

🔵 3. EIGRP – Enhanced Interior Gateway Routing Protocol

- Cisco proprietary protocol
- Uses **bandwidth + delay** to calculate path
- Very fast, hybrid protocol
- Now moved from CCNA to CCNP

✔ Example

Cisco-based networks in multinational companies.

🔵 4. BGP – Border Gateway Protocol

- Used **between ISPs**
- Exterior routing (EGP)
- Uses **ASN numbers** assigned by IANA
- Runs the **Internet**

- Path-vector protocol

✓ Example

Whenever Airtel passes traffic to Jio or Google — BGP is used.

🟦 3. Types of Routing

✓ 1. Static Routing

- Manually configured routes
- Very secure
- Used in small networks
- Does NOT auto-update

✓ 2. Dynamic Routing

- Routers send updates automatically
- Self-healing (adapts to network changes)
- Uses RIP, OSPF, EIGRP, BGP

✓ 3. Default Routing

- Used when router does not know where to send traffic
- A default route is set manually

Example:

ip route 0.0.0.0 0.0.0.0 <next-hop>

🟥 4. STATIC ROUTING LAB (FULL EXPLANATION + COMMANDS)

Devices required:

- **3 Routers (R1, R2, R3)**

- **2 Switches**

- **2 PCs**

Network layout:

PC1 --- SW1 --- R1 --- R2 --- R3 --- SW2 --- PC2

PC IPs:

- PC1 → **192.168.1.1 /24**

- PC2 → **192.168.3.3 /24**

Router Interfaces:

Router	Interface	IP Address	Network
R1	g0/0	192.168.12.1	R1 ↔ R2
R1	g0/1	192.168.1.254	PC1 network
R2	g0/0	192.168.12.2	R1 ↔ R2
R2	g0/1	192.168.13.1	R2 ↔ R3
R3	g0/0	192.168.13.2	R2 ↔ R3
R3	g0/1	192.168.3.254	PC2 network

🟦 R1 Configuration

✔ Enter router

en

conf t

hostname R1

✔ Configure interfaces

int g0/0

ip address 192.168.12.1 255.255.255.0

no shutdown

int g0/1

ip address 192.168.1.254 255.255.255.0

no shutdown

✔ Static route (R1 → R3's network)

R1 must reach **192.168.3.0/24** via **R2 (192.168.12.2)**

ip route 192.168.3.0 255.255.255.0 192.168.12.2

🟦 **R2 Configuration**

✔ Enter router

en

conf t

hostname R2

✔ Configure interfaces

int g0/0

ip address 192.168.12.2 255.255.255.0

no shutdown

int g0/1

ip address 192.168.13.1 255.255.255.0

no shutdown

✔ Static routes

R2 needs **2 routes**:

1 To reach **192.168.1.0/24** (R1's network):

ip route 192.168.1.0 255.255.255.0 192.168.12.1

2 To reach **192.168.3.0/24** (R3's network):

ip route 192.168.3.0 255.255.255.0 192.168.13.2

🟦 **R3 Configuration**

✔ Enter router

en

conf t

hostname R3

✔ Configure interfaces

int g0/0

ip address 192.168.13.2 255.255.255.0

no shutdown

int g0/1

ip address 192.168.3.254 255.255.255.0

no shutdown

✔ Static route

To reach **192.168.1.0/24** via **R2 (192.168.13.1)**:

ip route 192.168.1.0 255.255.255.0 192.168.13.1

🟦 **PC-1 Configuration**

IP Address: 192.168.1.1

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.1.254

🟦 **PC-2 Configuration**

IP Address: 192.168.3.3

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.3.254

🟩 **5. How to Verify Routing Works**

On ANY router:

✔ **Check routing table**

do show ip route

You should see **static routes** marked as:

S   192.168.3.0/24 [1/0] via 192.168.12.2

✔ **End-to-end connectivity test**

From PC1:

ping 192.168.3.3

If the static routing is correct → **Reply will come (Success)**.

🟦 WHY STATIC ROUTING IS IMPORTANT?

- Full control over routing

- Used in small offices

- More secure (no automatic changes)

- Used with firewalls and DMZ

- Good for learning fundamentals

Real-life examples:

- ATM machines connected via private static routes

- Corporate branch office with 2–3 routers

- ISP using static routes to connect customer routers

🟩 SUMMARY SHEET (Perfect for Exams)

Routing = Router choosing best path

Protocols = RIP, OSPF, EIGRP, BGP

Types = Static, Dynamic, Default

Static Routing = Manual, stable, secure

R1 → R2 → R3 full setup explained

Verified using show ip route