1. **Explain the routing process in a network. Describe how a router determines the best path for packet forwarding, including the role of routing tables, metrics, and administrative distance.**

→Routing is the process of selecting the best path for data packets to travel across a network. A **router** determines this path based on the **routing table, metrics, and administrative distance.**

1. Routing Table

A router maintains a **routing table**, which contains network destinations and the next-hop addresses. It uses this table to decide where to forward packets.

2. Metrics

Metrics are values used to determine the best route. Common metrics include:

- **Hop Count** (number of routers a packet must pass through)
- **Bandwidth** (speed of the link)
- **Latency** (delay in data transmission)

3. Administrative Distance (AD)

When multiple routes to the same destination exist, **administrative distance** (AD) helps select the most reliable source. Lower AD values indicate higher trust. For example:

- **Directly Connected Route (AD = 0)** → Most preferred
- **Static Route (AD = 1)** → Manually set
- **RIP (AD = 120)** → Less preferred compared to OSPF (AD = 110)

4. Path Selection Process

1. Router receives a packet and checks the destination IP.
2. Looks up the **best match** in the routing table.
3. Considers **metrics and AD** if multiple routes exist.
4. Forwards the packet to the next-hop router or destination.

2. **Explain the key differences between static and dynamic routing. Discuss their advantages, disadvantages, and scenarios where each is preferred**.

Feature	Static Routing	Dynamic Routing
Configuration	Manually configured by an admin	Automatically learns routes
Adaptability	Does not change unless manually updated	Adjusts to network changes automatically
Scalability	Suitable for small networks	Ideal for large, complex networks
Overhead	No extra CPU or bandwidth usage	Uses CPU and bandwidth for updates
Fault Tolerance	Less resilient to link failures	Automatically reroutes if a path fails
Complexity	Simple to implement	More complex setup

3. **Describe the role of dynamic routing protocols (e.g.,RIP, OSPF, BGP,EIGRP) in managing default routes.**

Dynamic routing protocols like **RIP, OSPF, BGP, and EIGRP** help routers automatically learn and manage default routes, ensuring efficient data forwarding when a destination is unknown.

1. Default Route (0.0.0.0/0)

A **default route** is used when no specific route exists for a destination in the routing table. Dynamic protocols can distribute default routes to ensure all routers know where to send unknown traffic.

2. Role of Routing Protocols

- **RIP (Routing Information Protocol)**
  - Uses hop count as a metric.
  - Supports default route propagation using:

    Router(config)# ip route 0.0.0.0 0.0.0.0 next-hop
    Router(config-router)# default-information originate

OSPF (Open Shortest Path First)

- Uses cost (based on bandwidth) as a metric.
- Propagates default routes with:

  Router(config-router)# default-information originate

BGP (Border Gateway Protocol)

- Used for internet routing between ISPs.
- Manages default routes dynamically using:

  Router(config-router)# neighbor X.X.X.X default-originate

EIGRP (Enhanced Interior Gateway Routing Protocol)

- Uses a combination of bandwidth and delay as metrics.
- Advertises default routes with:

  Router(config-router)# redistribute static