Routing

What is Routing ?.

- Routing is the process of selecting and defining paths for data within or between networks.
- Communication between two nodes in an interconnected network can take place through many different paths.
- Routing is the process of selecting the best path using some predetermined rules.

Why routing is important ?.

- Routing creates efficiency in network communication. Network communication failures result in long wait times for website pages to load for users.
- It can also cause website servers to crash because they can't handle a large number of users.
- Routing helps minimize network failure by managing data traffic so that a network can use as much of its capacity as possible without creating congestion.

What is router ?.

- A router is a networking device that connects computing devices and networks to other networks. Routers primarily serve three main functions.
- **Path determination**
  - A router determines the path data takes when it moves from a source to a destination. It tries to find the best path by analyzing network metrics such as delay, capacity, and speed.
- **Data forwarding**
  - A router forwards data to the next device on the selected path to eventually reach its destination. The device and router may be on the same network or on different networks.
- **Load balancing**
  - Sometimes the router may send copies of the same data packet by using multiple different paths. It does this to reduce errors due to data losses, create redundancy, and manage traffic volume

How does routing work ?.

When a device wants to send data to another device on the network, it first needs to determine the destination address. The destination address is the IP address of the device that the data needs to be sent to.
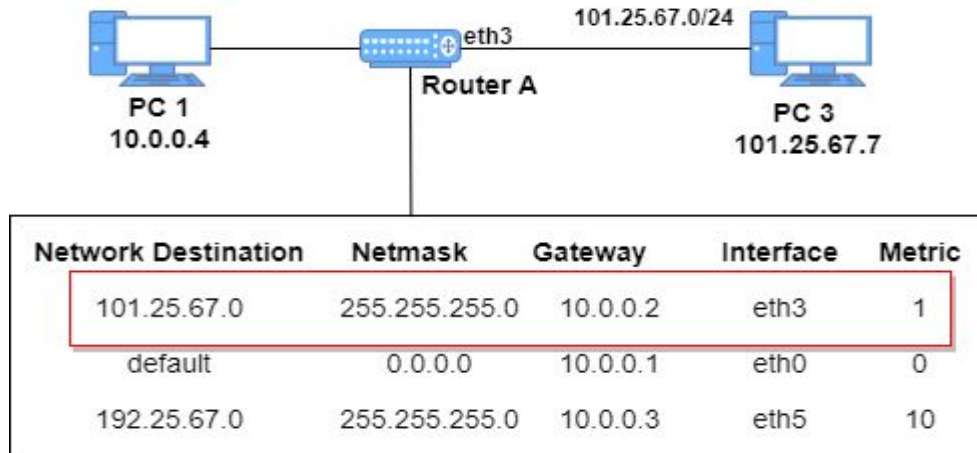
Once the device has the destination address, it needs to determine the best path to send the data. This is done by consulting a routing table. A routing table is a database of known paths to other networks.

The device will select the path that it believes is the best, based on the factors mentioned above. Once the path has been selected, the device will forward the data packet to the next device on the path.

The process continues until the data packet reaches its destination.

What is routing table ?

- When a data packet has to be sent to a destination via the source, the router delivers the packet by following a set of rules.
- These **sets of rules** viewed in a tabular format determine where these data packets will be delivered. These are called a **routing table**.

Network Destination	Netmask	Gateway	Interface	Metric
101.25.67.0	255.255.255.0	10.0.0.2	eth3	1
default	0.0.0.0	10.0.0.1	eth0	0
192.25.67.0	255.255.255.0	10.0.0.3	eth5	10

What are the type of routing ?.

There are two type of routing which is based on how router create its routing table.

- **Static routing**
  - Routers are manually configured with routing tables that specify the path to each network destination.
  - Static routing is simple to set up and manage, but it can be time-consuming and complex to maintain in large networks.
  - Static routing is not adaptable to changes in network topology or traffic conditions.
- **Dynamic routing**
  - Routers use routing protocols to communicate with each other and discover the best paths to network destinations.
  - Dynamic routing is more complex to set up and manage than static routing, but it is more scalable and adaptable to changes in the network.
  - Dynamic routing is the preferred routing method for large and complex networks.

Routing protocol

A routing protocol is a set of rules that specify how routers identify and forward packets along a network path. Routing protocols are grouped into two distinct categories: interior gateway protocols and exterior gateway protocols.

Interior gateway protocols

- These protocols assess the autonomous system and make routing decisions based on different metrics, such as the following:
  - Hop counts, or the number of routers between the source and the destination
  - Delay, or the time taken to send the data from the source to the destination
  - Bandwidth, or the link capacity between the source and the destination

- **Routing Information Protocol**
  - The Routing Information Protocol (RIP) relies on hop counts to determine the shortest path between networks. RIP is a legacy protocol that no one uses today because it does not scale well for larger network implementation.

- **Open Shortest Path First protocol**
  - The Open Shortest Path First protocol (OSPF) collects information from all other routers in the autonomous system to identify the shortest and fastest route to a data packet's destination. You can implement OSPF using various routing algorithms or computer processes.

External gateway protocols

The Border Gateway Protocol (BGP) is the only external gateway protocol.

Border Gateway Protocol

BGP defines communication over the internet. The internet is a large collection of autonomous systems all connected together. Every autonomous system has autonomous system number (ASN) that it obtains by registering with the Internet Assigned Numbers Authority.

BGP works by keeping track of the closest ASNs and mapping destination addresses to their respective ASNs.

What are routing algorithms?

- Routing algorithms are software programs that implement different routing protocols. They work by assigning a cost number to each link; the cost number is calculated using various network metrics. Every router tries to forward the data packet to the next best link with the lowest cost.

- The following are some example algorithms.

- **Distance Vector Routing**

  - The Distance Vector Routing algorithm requires all routers to periodically update each other about the best path information they have found. Each router sends information about the current assessment of the total cost to all known destinations.

  - Eventually, every router in the network discovers the best path information for all possible destinations.

- **Link State Routing**

- In Link State Routing, every router discovers all other routers in the network. Using this information, a router creates a map of the complete network and then calculates the shortest path for any data packet.

How has routing evolved?

Routing has evolved to meet the requirements of advances in network technology. Routing is no longer just about switching data packets between autonomous systems and the internet.

We now have cloud infrastructure with computing resources and hardware hosted by third-party cloud providers. These cloud resources are connected virtually to create a virtual network of resources that businesses can use to host and run applications.

Many organizations now have hybrid networks that consist of both on-premises networks with internal hardware and cloud networks. Routers must route traffic between these internal networks, the internet, and the cloud