SRI VASAVI INSTITUTE OF ENGINEERING & TECHNOLOGY
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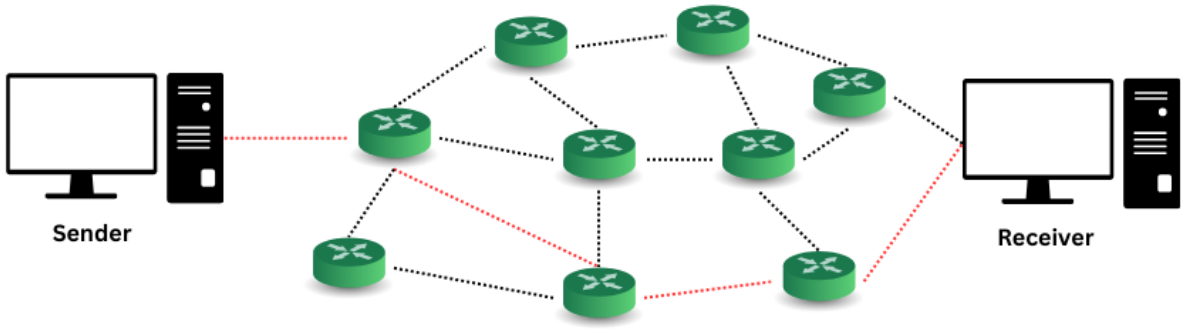
What is Routing algorithm, and why we need it?
What are the types?

Routing refers to the process of directing a data packet from one node to another. It is an autonomous process handled by the network devices to direct a data packet to its intended destination. Note that, the node here refers to a network device called - 'Router'.

A routing algorithm is a procedure that lays down the route or path to transfer data packets from source to the destination. They help in directing Internet traffic efficiently. After a data packet leaves its source, it can choose among the many different paths to reach its destination. Routing algorithm mathematically computes the best path, i.e. least cost path that the packet can be routed through.

Routing algorithms would explore how networks determine the best paths for data transmission, including various algorithms and their applications. It would cover topics like shortest path routing, flood-based routing, and link state routing

Routing is essential in computer networks because it enables efficient and reliable data transmission between devices, especially across different networks. It ensures that data packets find the most optimal path, minimizing delays and maximizing network capacity. Routing also allows networks to adapt to changing conditions, such as link failures, and manage traffic flow effectively.



Routing Working Example

Here's a more detailed explanation of why routing is needed:

1. Efficient Data Transmission: Routing algorithms determine the best path for data to travel from source to destination, considering factors like distance, bandwidth, and link reliability. This ensures that data packets reach their destination quickly and efficiently, minimizing delays and network congestion.

2. Scalability and Adaptability: Routing protocols allow networks to grow and evolve without requiring extensive manual configuration. Dynamic routing protocols automatically update routing tables to reflect changes in network topology, ensuring that the best paths are always used.

3. Network Redundancy: In case of a link failure, routers can automatically reroute traffic via alternative paths, ensuring that data continues to flow smoothly. This redundancy is crucial for maintaining network availability and reliability.

4. Load Balancing: Some routing protocols support load balancing, which distributes traffic across multiple paths to prevent any single link from becoming overloaded. This helps optimize network performance and prevent bottlenecks.

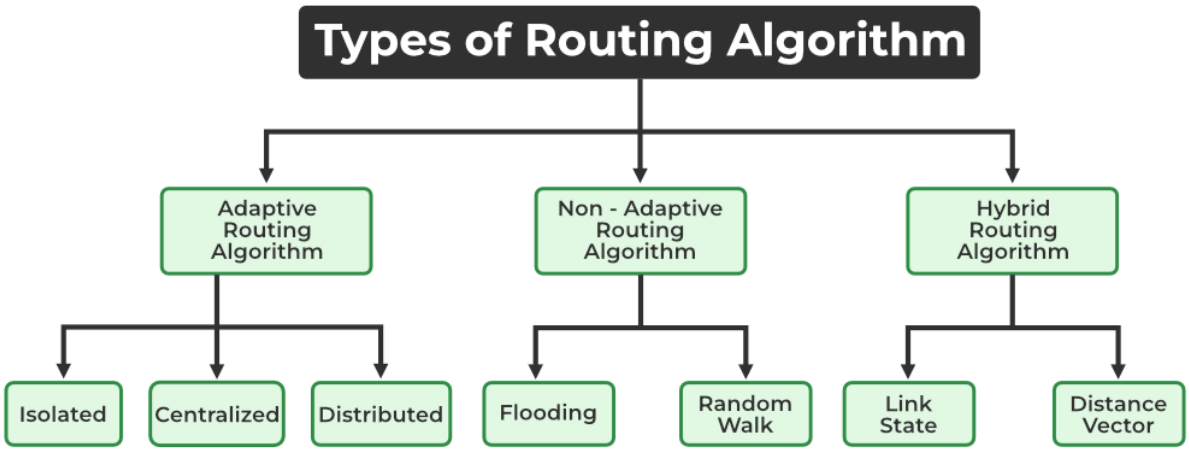
5. Inter-network Communication: Routing is essential for enabling communication between different networks, such as local area networks (LANs) and wide area networks (WANs), and connecting to the internet.

6. Security: Routers often come with built-in security features like firewalls and VPNs, which provide additional protection for network traffic.

In essence, routing is the backbone of modern computer networks, enabling reliable and efficient communication between devices across different networks.

Types of Routing Algorithms:

Routing algorithms can be broadly categorized into two types, adaptive and nonadaptive routing algorithms. They can be further categorized as shown in the following diagram



Adaptive Algorithms

These are the algorithms that change their routing decisions whenever network topology or traffic load changes. The changes in routing decisions are reflected in the topology as well as the traffic of the network. Also known as dynamic routing, these make use of dynamic information such as current topology, load, delay, etc. to select routes. Optimization parameters are distance, number of hops, and estimated transit time.

Further, these are classified as follows:

- **Isolated:** In this method each, node makes its routing decisions using the information it has without seeking information from other nodes. The sending nodes don't have information about the status of a particular link. The disadvantage is that packets may be sent through a congested network which may result in delay. Examples: Hot potato routing, and backward learning.
- **Centralized:** In this method, a centralized node has entire information about the network and makes all the routing decisions. The advantage of this is only one node is required to keep the information of the entire network and the disadvantage is that if the central node goes down the entire network is done. The link state algorithm is referred to as a centralized algorithm since it is aware of the cost of each link in the network.
- **Distributed:** In this method, the node receives information from its neighbors and then takes the decision about routing the packets. A disadvantage is that the packet may be delayed if there is a change in between intervals in which it receives information and sends packets. It is also known as a decentralized algorithm as it computes the least-cost path between source and destination.

2. Non-Adaptive Algorithms

These are the algorithms that do not change their routing decisions once they have been selected. This is also known as static routing as a route to be taken is computed in advance and downloaded to routers when a router is booted.

Further, these are classified as follows:

- **Flooding:** This adapts the technique in which every incoming packet is sent on every outgoing line except from which it arrived. One problem with this is that packets may go in a loop and as a result of which a node may receive duplicate packets. These problems can be overcome with the help of sequence numbers, hop count, and spanning trees.
- **Random walk:** In this method, packets are sent host by host or node by node to one of its neighbors randomly. This is a highly robust method that is usually implemented by sending packets onto the link which is least queued.

3. Hybrid Algorithms

As the name suggests, these algorithms are a combination of both adaptive and non-adaptive algorithms. In this approach, the network is divided into several regions, and each region uses a different algorithm.

Further, these are classified as follows:

- Link-state: In this method, each router creates a detailed and complete map of the network which is then shared with all other routers. This allows for more accurate and efficient routing decisions to be made.
- Distance vector: In this method, each router maintains a table that contains information about the distance and direction to every other node in the network. This table is then shared with other routers in the network. The disadvantage of this method is that it may lead to routing loops.