# Computer Network

## Lecture-35

Dharmendra Kumar (Associate Professor)
Department of Computer Science and Engineering
United College of Engineering and Research, Prayagraj

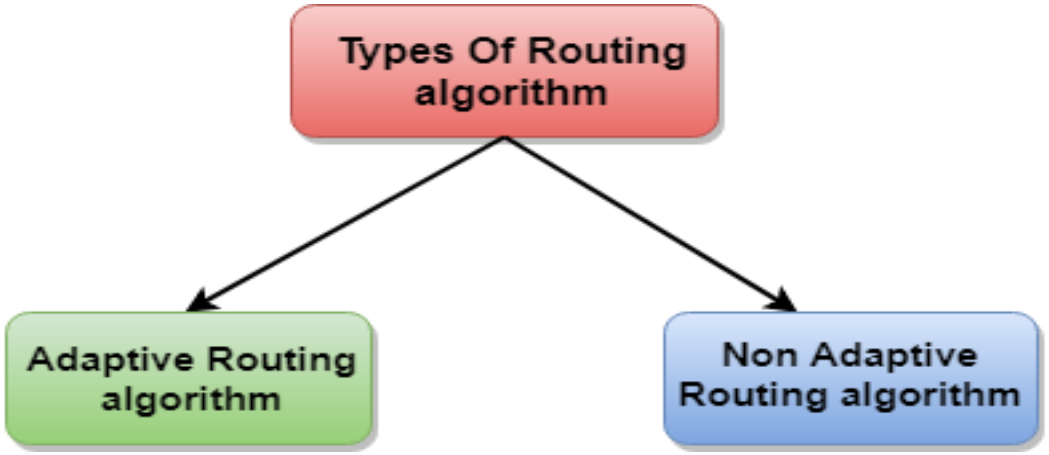
# Delivery, Forwarding, and Routing

**Routing algorithm**

- The routing protocol is a routing algorithm that provides the best path from the source to the destination. The best path is the path that has the "least-cost path" from source to the destination.
- Routing is the process of forwarding the packets from source to the destination but the best route to send the packets is determined by the routing algorithm.

# Delivery, Forwarding, and Routing

## Classification of a Routing algorithm




## Adaptive Routing algorithm

- An adaptive routing algorithm is also known as dynamic routing algorithm.
- This algorithm makes the routing decisions based on the topology and network traffic.
- The main parameters related to this algorithm are hop count, distance and estimated transit time.

# Delivery, Forwarding, and Routing

**Non-Adaptive Routing algorithm**

- Non-Adaptive routing algorithm is also known as a static routing algorithm.
- Non-Adaptive routing algorithms do not take the routing decision based on the network topology or network traffic.

The Non-Adaptive Routing algorithm is of two types:

**Flooding:** In case of flooding, every incoming packet is sent to all the outgoing links except the one from it has been reached. The disadvantage of flooding is that node may contain several copies of a particular packet.

**Random walks:** In case of random walks, a packet sent by the node to one of its neighbors randomly. An advantage of using random walks is that it uses the alternative routes very efficiently.

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**Unicast Routing Protocols**

- A routing table can be either static or dynamic. A static table is one with manual entries.
- A dynamic table, on the other hand, is one that is updated automatically when there is a change somewhere in the internet.
- Today, an internet needs dynamic routing tables.
- A routing protocol is a combination of rules and procedures that lets routers in the internet inform each other of changes. It allows routers to share whatever they know about the internet or their neighborhood.

# Delivery, Forwarding, and Routing

**Intra domain and Inter domain Routing**

- An internet is divided into autonomous systems.
- An autonomous system (AS) is a group of networks and routers under the authority of a single administration.
- Routing inside an autonomous system is referred to as intra domain routing.
- Routing between autonomous systems is referred to as inter domain routing.
- Each autonomous system can choose one or more intra domain routing protocols to handle routing inside the autonomous system. However, only one inter domain routing protocol handles routing between autonomous systems.

# Delivery, Forwarding, and Routing

- We are going to discuss two intra domain routing protocols: distance vector and link state and one inter domain routing protocol: Path vector.
- Routing Information Protocol (RIP) is an implementation of the distance vector protocol.
- Open Shortest Path First (OSPF) is an implementation of the link state protocol.
- Border Gateway Protocol (BGP) is an implementation of the path vector protocol.

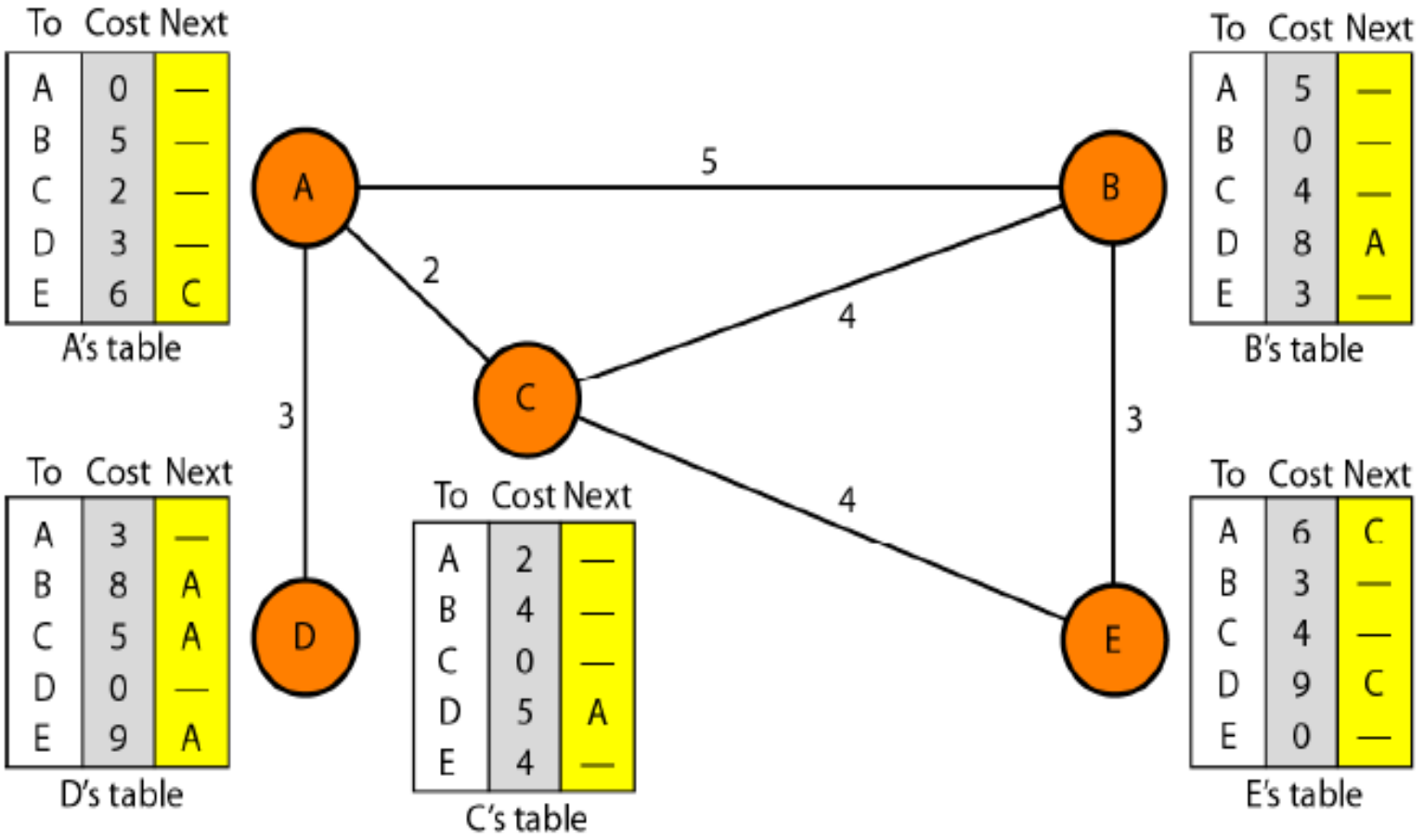
# Delivery, Forwarding, and Routing

**Distance Vector Routing**

In distance vector routing, the least-cost route between any two nodes is the route with minimum distance. In this protocol, as the name implies, each node maintains a vector (table) of minimum distances to every node. The table at each node also guides the packets to the desired node by showing the next hop in the route (next-hop routing).

# Delivery, Forwarding, and Routing

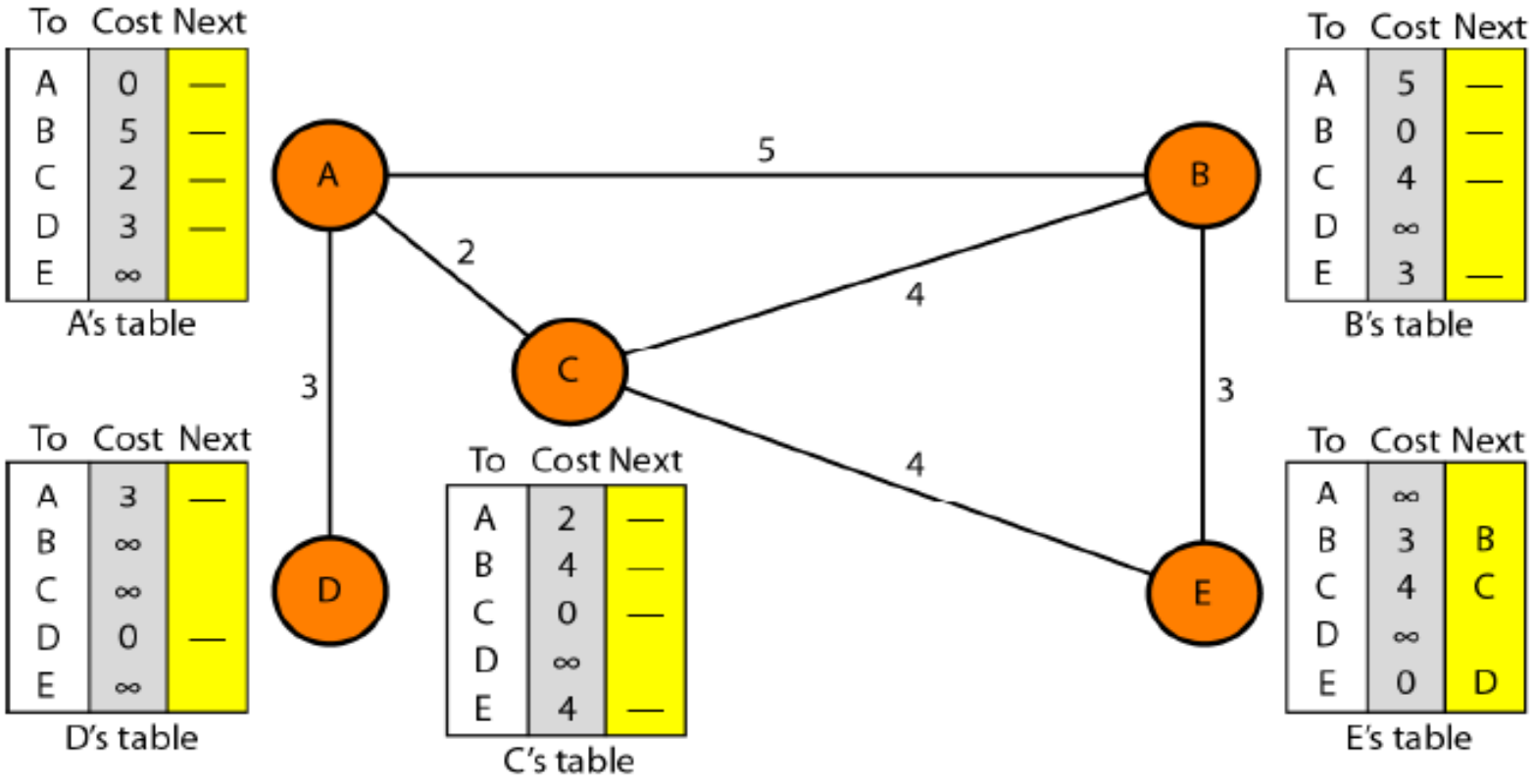
Consider a system of five nodes with their corresponding tables.



# Delivery, Forwarding, and Routing

## Procedure to compute routing table

### Initialization



# Delivery, Forwarding, and Routing

**Sharing**

In distance vector routing, each node shares its routing table with its immediate neighbors periodically and when there is a change.

When the neighbor receives a table, third column needs to be replaced with the sender's name. If any of the rows can be used, the next node is the sender of the table. A node therefore can send only the first two columns of its table to any neighbor.

In other words, sharing here means sharing only the first two columns.

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## Updating

When a node receives a two-column table from a neighbor, it needs to update its routing table. Updating takes three steps:

1. The receiving node needs to add the cost between itself and the sending node to each value in the second column.
2. The receiving node needs to add the name of the sending node to each row as the third column if the receiving node uses information from any row. The sending node is the next node in the route.

# Delivery, Forwarding, and Routing

3. The receiving node needs to compare each row of its old table with the corresponding row of the modified version of the received table.

   a. If the next-node entry is different, the receiving node chooses the row with the smaller cost. If there is a tie, the old one is kept.

   b. If the next-node entry is the same, the receiving node chooses the new row.

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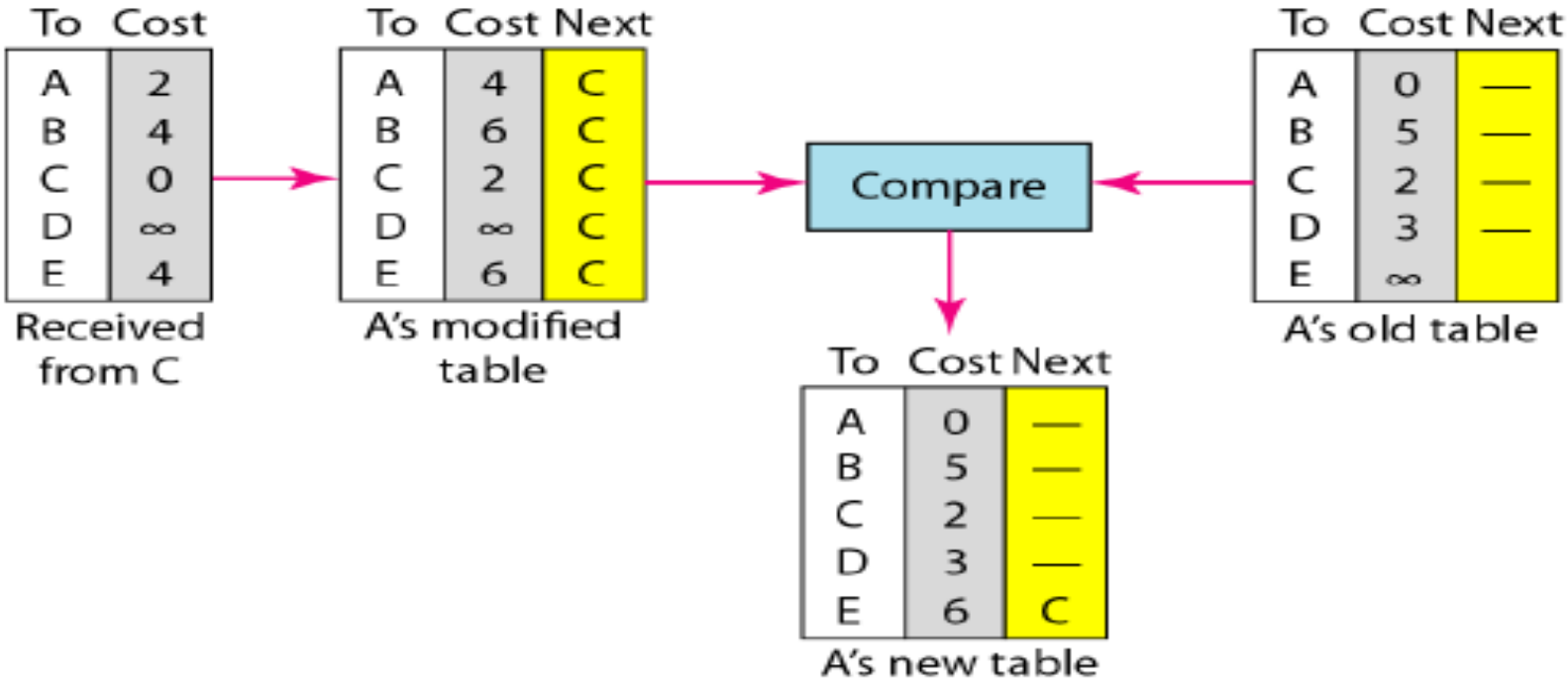
Following figure shows how node A updates its routing table after receiving the partial table from node C.



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**When to Share**

The question now is, When does a node send its partial routing table (only two columns) to all its immediate neighbors? The table is sent both periodically and when there is a change in the table.

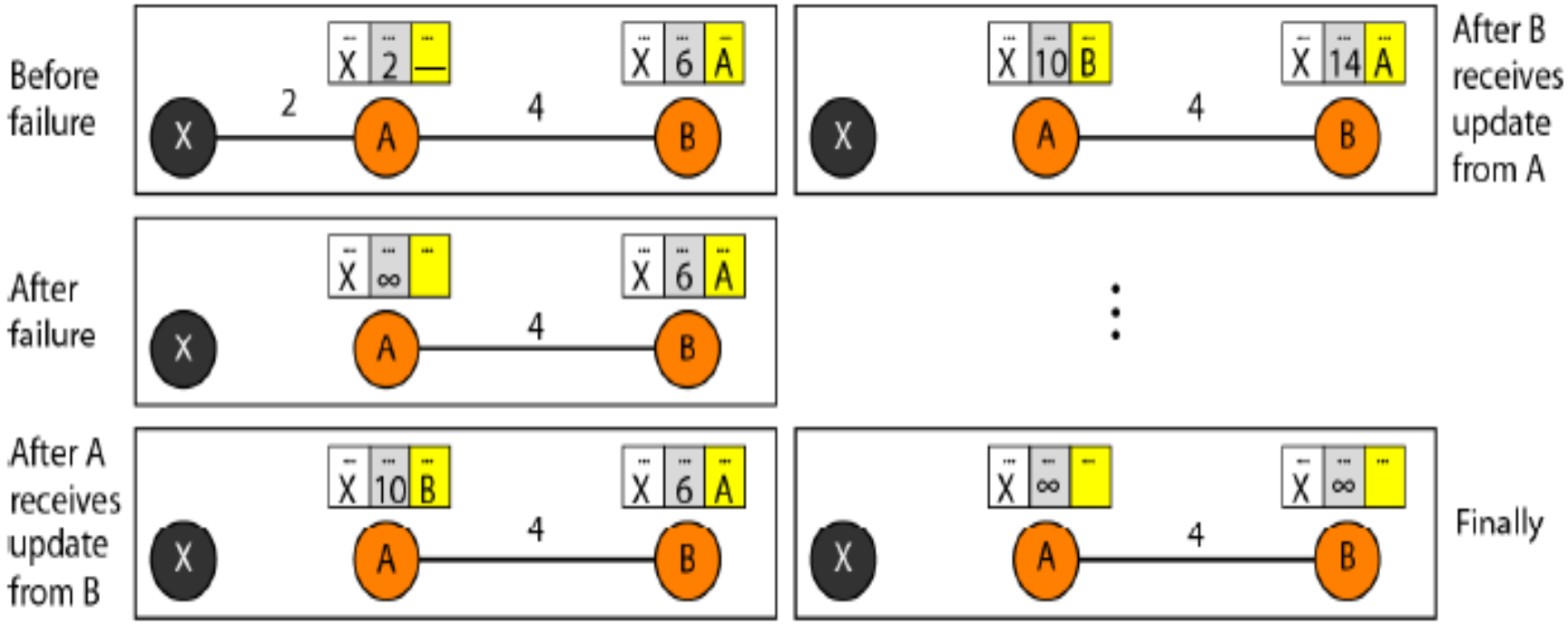
**Periodic Update:** A node sends its routing table, normally every 30 s, in a periodic update. The period depends on the protocol that is using distance vector routing.

**Triggered Update:** A node sends its two-column routing table to its neighbors anytime there is a change in its routing table. This is called a triggered update.

# Delivery, Forwarding, and Routing

**Two-Node Loop Instability (Count to infinity problem)**

A problem with distance vector routing is instability, which means that a network using this protocol can become unstable. To understand the problem, we consider the following figure:-



# Delivery, Forwarding, and Routing

- In this figure, at the beginning, both nodes A and B know how to reach node X. But suddenly, the link between A and X fails. Node A changes its table.
- If A can send its table to B immediately, everything is fine.
- However, the system becomes unstable if B sends its routing table to A before receiving A's routing table. Node A receives the update and, assuming that B has found a way to reach X, immediately updates its routing table.
- Based on the triggered update strategy, A sends its new update to B. Now B thinks that something has been changed around A and updates its routing table. The cost of reaching X increases gradually until it reaches infinity. At this moment, both A and B know that X cannot be reached. However, during this time the system is not stable. Node A thinks that the route to X is via B; node B thinks that the route to X is via A. If A receives a packet destined for X, it goes to B and then comes back to A. Similarly, if B receives a packet destined for X, it goes to A and comes back to B. Packets bounce between A and B, creating a two-node loop problem.