



Switching

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Aim of the session

To define switching and types of switching circuits for data communication

Learning Outcomes

Understand circuit and packet switching techniques



Switching

Switching is the process of transferring data packets from one device to another in a network using specific devices called switches..

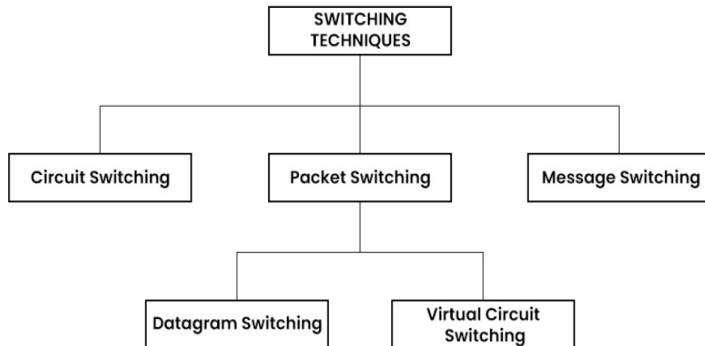


Figure: Switching Classification



Circuit switching: When you place a telephone call, the switching equipment within the telephone system sought out a physical path all the way from your telephone to the receiver's telephone and maintained it for the duration of the call.

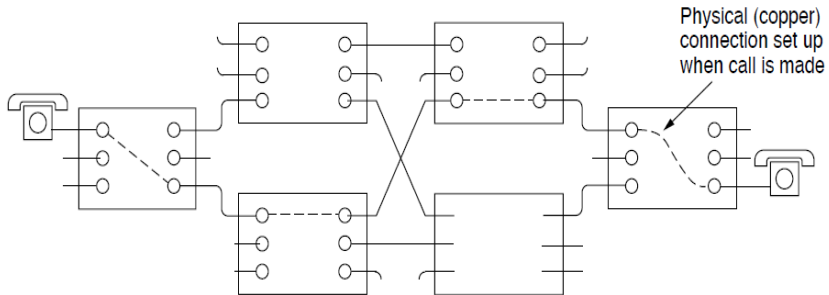


Figure: Circuit switching



Circuit switching

Circuit switching has three stages

- **Circuit (path) establishment:** A dedicated circuit is established from the source to the destination through a number of intermediate switching centers
 - Before data transmission can even begin, the call request signal must propagate all the way to the destination and be acknowledged.
- **Data transmission:** Once the circuit has been established, data and voice are transferred from the source to the destination
- **Circuit path termination:** When data transfer is complete, the connection is relinquished
 - Disconnection involves removal of all intermediate links from the sender to the receiver



Space division switching

- A space division switch is one in which the signal paths are physically separate from one another (divided in space).
- Each connection requires the establishment of a physical path through the switch that is dedicated solely to the transfer of signals between the two endpoints.

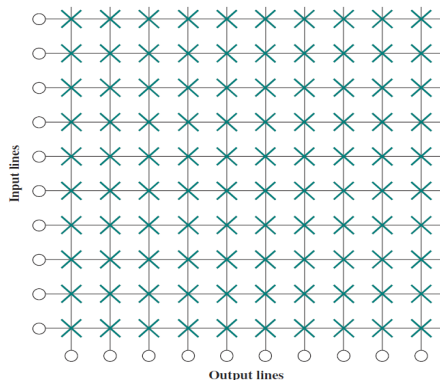


Figure: Space Division Switch



Space division switching

Single-stage crossbar matrix:

- Basic building block of a crossbar switch: Metallic crosspoint or semiconductor gate -Enabled/disabled by a control unit
- **Limitations** of crossbar switch
 - Costly: The number of crosspoints grows with the square of the number of attached stations.
 - The loss of a crosspoint prevents connection between the two devices
 - Crosspoints are inefficiently utilized
 - Even when all of the attached devices are active, only a small fraction of the crosspoints are engaged



Space division switching

Multiple-stage switch

- The number of crosspoints is reduced, increasing crossbar utilization
- There is more than one path through the network to connect two endpoints, increasing reliability

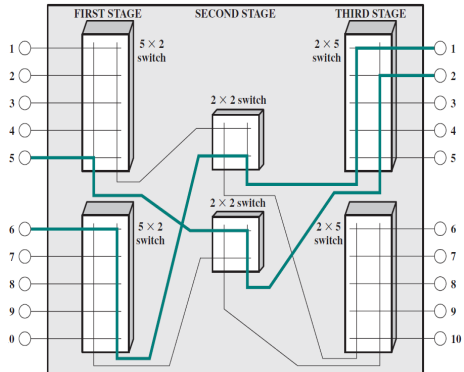


Figure: Three-stage Space Division Switch



Circuit switching

Advantages:

- It can transmit data at a guaranteed constant rate, no intermediate delays .
- Suitable for long continuous transmission

Disadvantages

- Circuit switching is inefficient
- Dedicated connection cannot be used for transmitting any other data, even if the data load is very low
- Time required to establish connection may be high



Packet Switching

Data are transmitted in short packets.

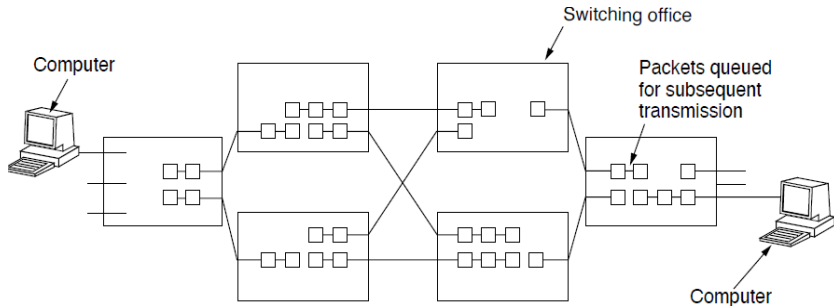


Figure: Packet switching



Packet Switching

- The long message is broken up into a series of packets
- Each packet contains a portion of the user's data plus some control information (packet header)
- Advantages over circuit switching
 - Line efficiency is greater. No need to set up a dedicated path in advance
 - A packet-switching network can perform data-rate conversion
 - When traffic becomes heavy, packets are still accepted, but delivery delay increases
 - Priorities can be used (higher-priority packets first)



Datagram switching

Datagram approach each packet is treated independently, with no reference to packets that have gone before

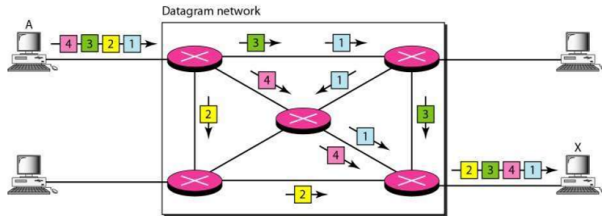


Figure: Datagram switching

Each node chooses the next node on a packet's path, taking into account information received from neighboring nodes on traffic or line failures



Datagram switching

- Each packet is referred to as a datagram
- The packets, each with the same destination address, do not all follow the same route
- Packets may arrive out of sequence at the exit point
- Exit node/destination restores the packets to their original order
- If a packet-switching node crashes momentarily, all of its queued packets may be lost
- It is up to either the exit node or the destination to detect the loss of a packet and decide how to recover it



Virtual circuit switching

- A preplanned route is established before any packets are sent
- Once the route is established, all the packets follow this same route through the network
- Since the route is fixed for the duration of the logical connection, it is somewhat similar to a circuit in a circuit-switching network and is referred to as a **virtual circuit**.
- Each packet contains a virtual circuit identifier as well as data
- Each node on the preestablished route knows where to direct such packets; no routing decisions are required.
- At any time, each station can have more than one virtual circuit to any other station and can have virtual circuits to more than one station

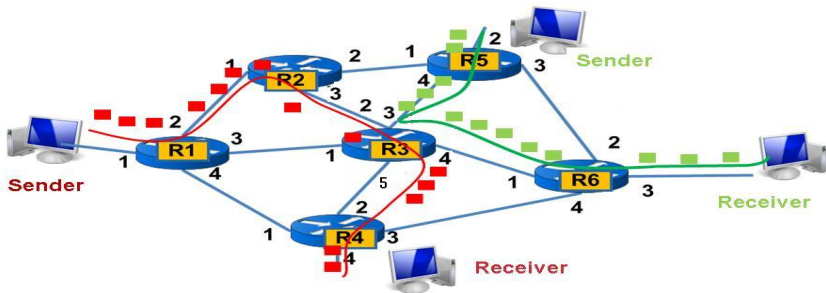


Figure: Virtual Circuit Packet switching



Virtual circuit switching

- Since route between stations is set up prior to data transfer \Rightarrow this is a dedicated path
- Other packets on other virtual circuits may share the use of the line
- The difference from the datagram approach is that, with virtual circuits, the node need not make a routing decision for each packet.



Message switching

- Message Switching is a switching technique in which a message is transferred as a complete unit and routed through intermediate nodes at which it is stored and forwarded
- It is evolved from circuit switching and was the precursor of packet switching
- There is no dedicated path between the sender and receiver
- The destination address is appended to the message
- **Store and forward:** The intermediate nodes have the responsibility of transferring the entire message to the next node. Hence, each node must have storage capacity
- A message will only be delivered if the next node and the link connecting it are both available, otherwise, it will be stored indefinitely.



Message switching

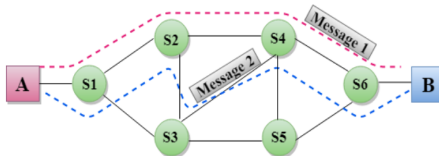


Figure: Message switching

- Advantages:
 - Traffic congestion can be reduced** because the message is temporarily stored in the nodes.
 - Message priority** can be used to manage the network.
 - Data channels are shared** among the communicating devices that improve the efficiency of using available bandwidth.
- Disadvantage:
 - The message switches must be equipped with **sufficient storage** to store the messages until the message is forwarded.
 - The **Long delay** can occur due to the storing and forwarding



Acknowledge various sources for the images.
Thankyou