SWITCHING **Concept of Switching:** When there are multiple devices, the main issue is how to connect them so we can make to have one-to-one communication devices. One solution is to have a mesh topology or star topology. However, for very large networks, this is highly impractical. A multipoint connection like bus is also not possible due to the distances involved.

A better solution is switching. A switched network consists of a series of interlinked nodes called *switches.*These *switches* are capable of creating temporary connections between two or more devices connected to the switch.

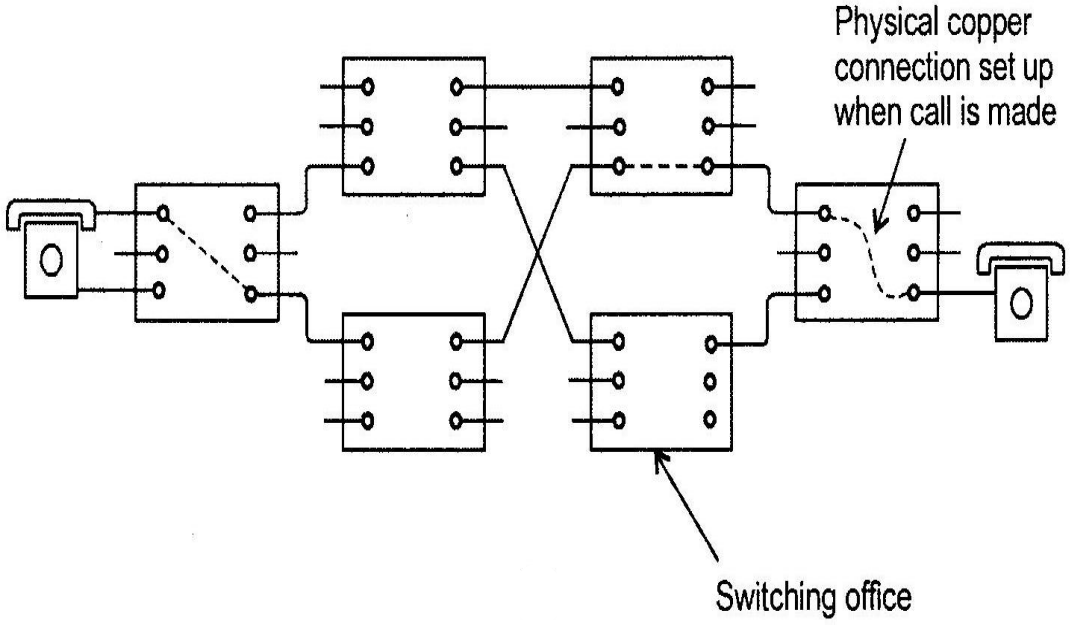
Types of Switching:

1. Circuit Switching 2.Message Switching 3.Packet Switching

1. Circuit Switching

This is a method in which an end-to-end path or circuit is established between the communicating machines. The machines have exclusive use of this path until the connection is released.

This technique is used in applications that handle voice traffic because voice traffic requires no transmission delay. Thus, it is used in the telephone system. The schematic of circuit switching is shown in *Figure below.* Here,



the six rectangles represent switching offices, each having 3 incoming and 3 outgoing lines. When a call is placed, a physical connection is established between the incoming line and one of the output lines (shown by dotted lines). The connection could also be established via microwave links. The circuit or path is a connected sequence of links between nodes in a network. This involves three phases:

i. Circuit establishment: Before any data transfer can begin, an end-to-end path has to be set up. Some setup time is required.

ii. Data Transfer: Once the circuit is established, analog or digital data can be transmitted depending upon the nature of the network. The only delay now is the propagation delay. There is no danger of congestion or a busy signal.

iii. Circuit Disconnection: The circuit can be released by either of the connected stations after data transfer is completed.

Advantage

This method transfers data in real time with the only delay being in circuit setup and propagation delay.

Disadvantages

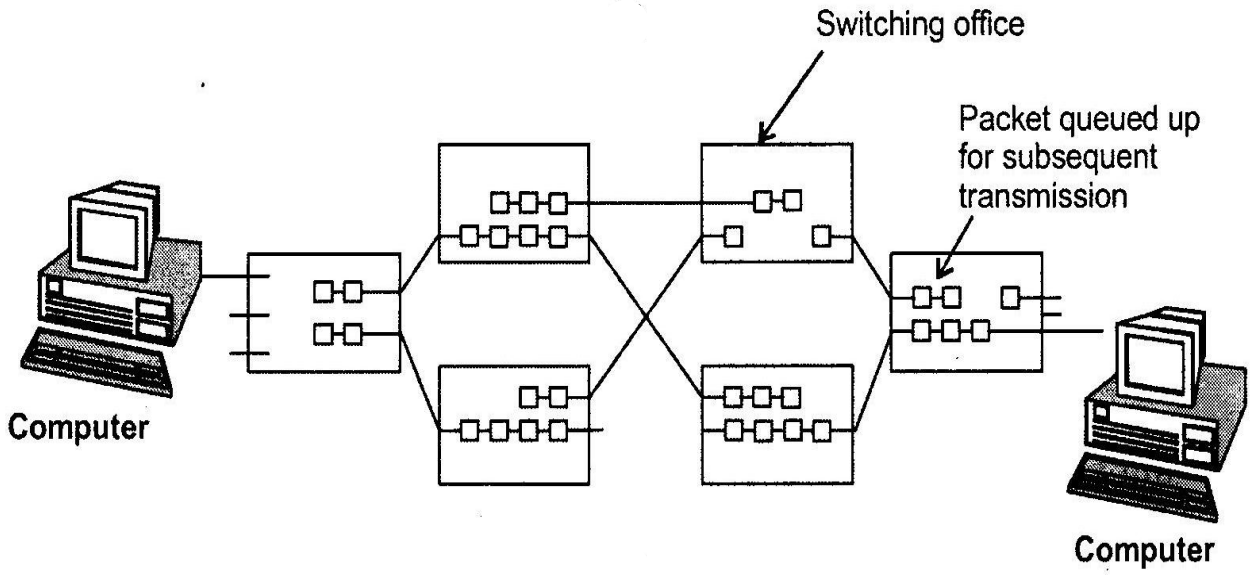
i. Circuit switching can be inefficient. Even if no data is being transferred, the channel remains connected for the duration of the connection.

ii. Problems occur when two or more stations attempt to try a link with the same station. Such situations have to be resolved.

Message Switching

An alternative strategy is message switching as shown in *figure below.* Here, no physical path is set up between the sender and the receiver. Instead, when the sender has a block of data to send, it is sent to intermediate switching station which store it and sends it to the appropriate station

when an output line is free. This mechanism is referred to as **'Store and Forward'** method. Each block is received as a whole, checked for errors and retransmitted. Thus, a block may 'visit' several switching



Advantages

i. No circuit has to be set-up in advance.

ii. The sender can send data whenever it wants to and does not need to check the status of the receiver-whether it is busy or idle.

Disadvantages

i. Thecomputer using message switching requires sufficiently large data buffers to hold the messages.

ii. A single block may tie up an IMP-IMP line for a long time, thereby causing delay to the other messages.

iii. If there's a lot of traffic on the network, the delay will be very high thereby, reducing throughput.

iv. Complicated routing algorithms are required.

3. Packet Switching

An alternate method to message switching is to 'break up' the message into several blocks called *"packets". A* limit is placed on the maximum block size, thereby, making it easier to store packets and route them through the network.

Each packet contains control information including source and destination address and are routed independent of the other packets to the same destination, i.e. two packets for the same destination may be..sent via different paths. Thus, it is possible that the packets arrive out of order. So, some identification scheme has to be employed.

Advantages

*i.*Call setup stage is avoided.

ii. This is more flexible. Thus, if congestion develops in one part of the network, the packets can be routed via different paths.

Disadvantages

i. There is no guarantee that packets will be delivered.

ii. Requires more overheads since each packet has to carry a lot of control information.

iii. The packets may arrive out of order.

Comparison of Circuit, Message and Packet Switching

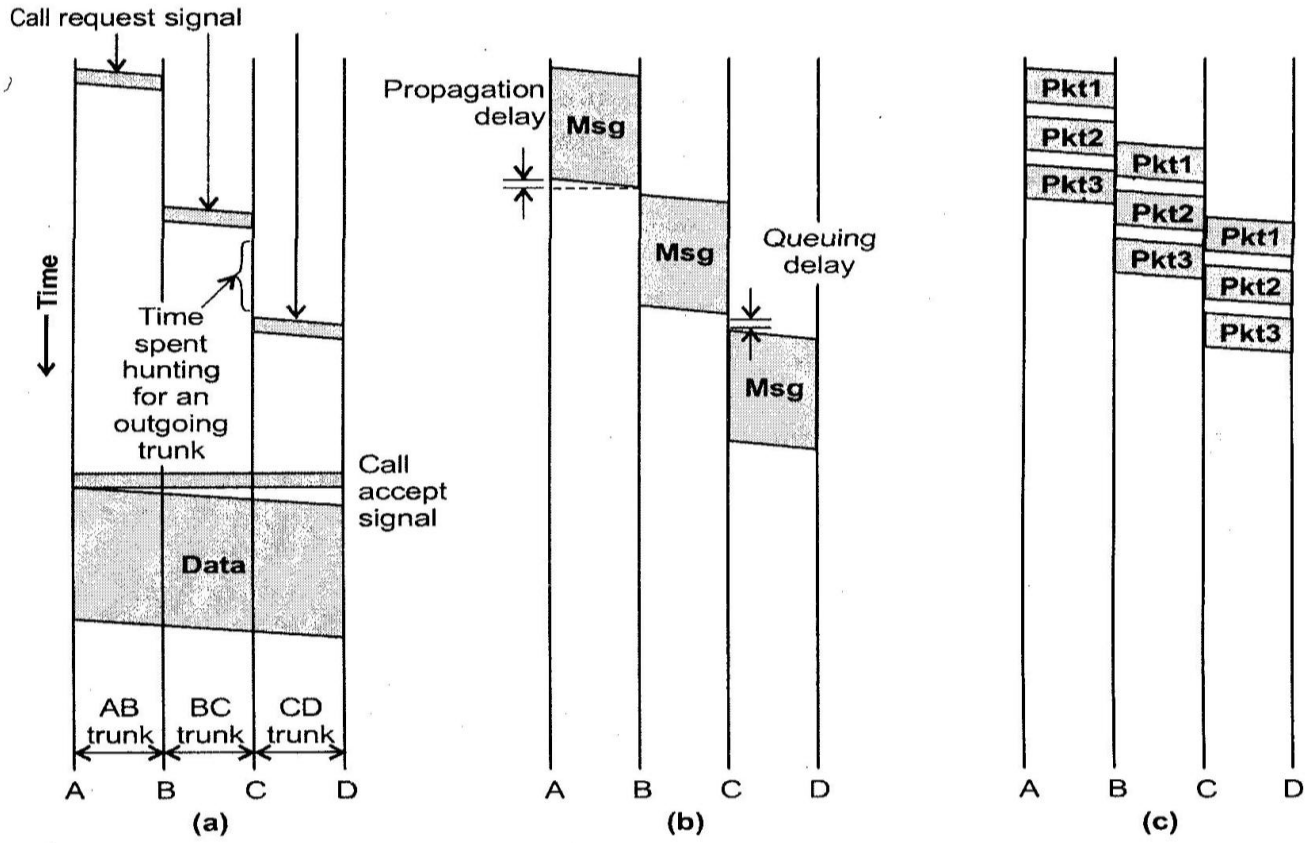


Figure 3.25: Timing of Events
(a) Circuit Switching (b) Message Switching (c) Packet Switching

1. Circuit switching requires preallocation of channel bandwidth. Packet and "message switching utilize bandwidth only when there is data to be transmitted.

2. In Circuit switching, the call setup time is high since the call request signal has to be sent and a call accept signal has to be received. No setup time is required in Message Switching.

3. Once the call has been set up in Circuit Switching, transmission time is negligible.

   In Message and Packet Switching, each node has to process the message or packet, and route them appropriately. Thus, processing time is high.

4. No overheads are required after the call is setup in Circuit Switching. Message -Switching requires overheads in the form of source and destination addresses, sequence numbers, etc.
5. Circuit Switching is slower than Message or Packet Switching. Packet Switching is faster than Message Switching because a packet can be forwarded as soon as it is arrived without waiting for the others.
6. In Packet Switching .reordering of packets may take place. This can never happen in Circuit Switching.
7. Circuit switching requires a centralized control mechanism with global knowledge of the network configuration. Packet Switching requires distributed control mechanism where most nodes require very little information about the network configuration.
8. Circuit Switching is completely transparent. The sender and receiver can use any bit rate, format or framing mechanism. With Packet Switching, the network and carrier determine the basic parameters.
9. In Circuit Switching, the charges are based on the distance and time, and not on the amount of traffic.

   In Packet Switching, the charges are based on the amount of data sent.
10. In Circuit Switching, the routing decisions have to be made only during call setup.

    In packet switching, a routing decision has to be made for each packet at each intermediate node.
11. If two stations wish to exchange data over an extended period of time, Circuit Switching is better. However, if the stations wish to transmit data in rush and to different destinations, Message or Packet Switching is preferred.

SUMMARY

Characteristics	Circuit Switched	Packet switched
Call Setup	Required	Not needed
Dedicated physical path	Yes	No
Each packet follows the same route	Yes	No
Packets arrive in order	Yes	No
Is a switch crash fatal	Yes	No
Bandwidth available	Fixed	Dynamic
Time of possible congestion	At Setup time	On every packet
Potentially wasted bandwidth	Yes	No
Store-and-forward transmission	No	Yes
Transparency	Yes	No
Charging	Per minute	Per packet