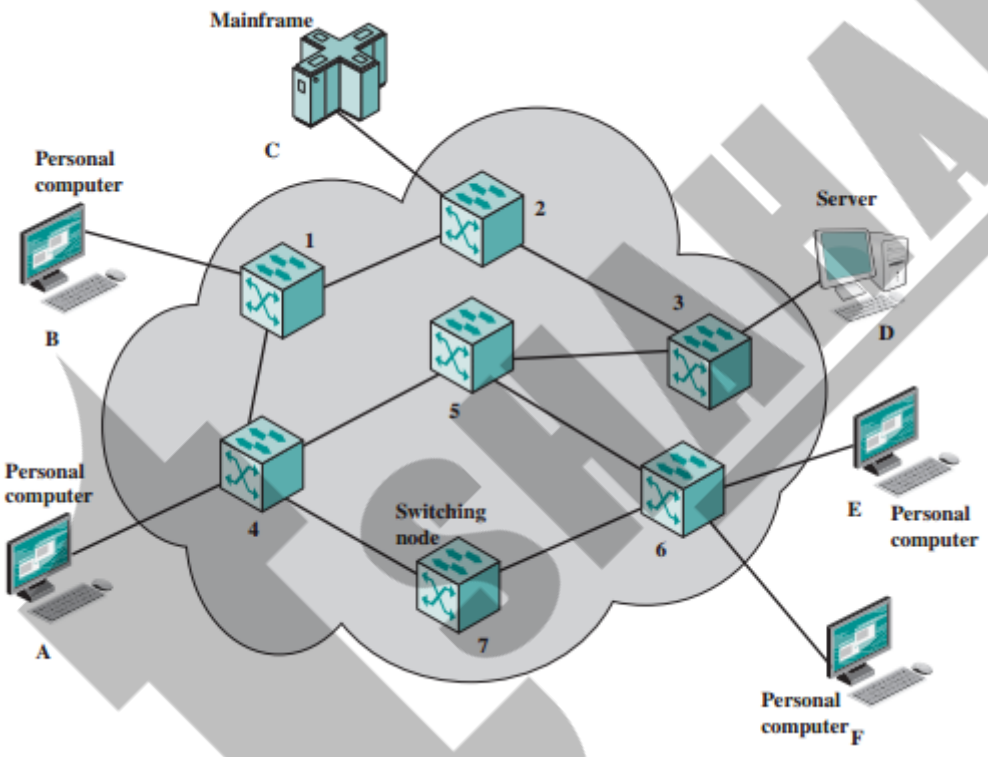
Switched Networks

In a switched communication network, data entering the network from a station are routed to the destination by being switched from node to node. A switched network consists of a series of interlinked nodes, called **switches.**

A circuit switch is a device that creates a temporary connection between an input link and output link. A circuit switch usually has n input lines and m output lines i.e. number of input lines and number of output lines may not be equal.

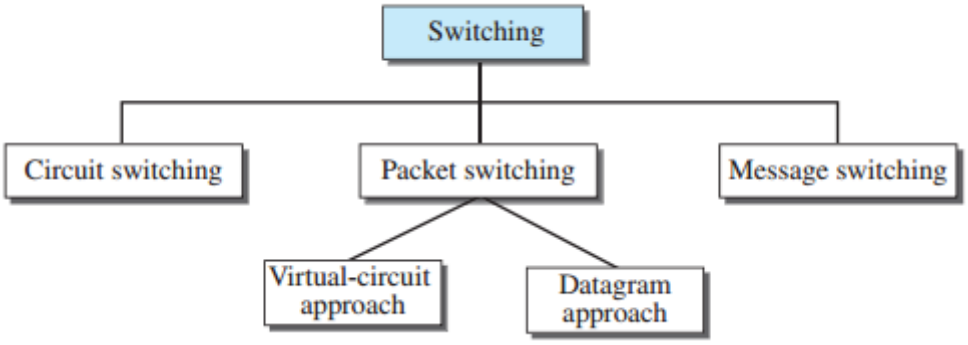
Switches are devices capable of creating temporary connections between two or more devices linked to the switch. The switching nodes are not concerned with the content of the data; rather, their purpose is to provide a switching facility that will move the data from node to node until they reach their destination. The devices attached to the network may be referred to as stations. The stations may be computers, terminals, telephones, or other communicating devices.



Methods of Switching

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

The first two are commonly used today. The third has been phased out in general communications but still has networking applications.



1. Circuit Switching

Communication via circuit switching implies that there is a dedicated communication path between two stations. That path is a connected sequence of links between network nodes. The route for the whole length of the communication session between the two communicating bodies is dedicated, exclusive, and released only when the session terminates.

Circuit-switching is reliable because when you have a circuit dedicated for a session, you are sure to get all information across.

Communication via circuit switching involves three phases:

i. Circuit Establishment
ii. Data Transfer
iii. Circuit Disconnect

i. Circuit Establishment

In circuit .switched network, before actual data transfer takes place, a dedicated circuit or path is established between the sender and receiver. Different nodes are used to make an end-to-end connection between source and destination. End-to-End addressing (i.e. source and destination address) is required for creating a connection between two end systems.

ii. Data Transfer

Actual data transfer between the source and destination takes place after the dedicated path is set up between them. The data flows are continuous between sender and receiver. There may be periods of silence in between. Generally all the internal connections are duplex.

iii. Circuit Disconnect

When one of the parties needs to disconnect, a signal is sent to each switch to release the resources. It is also called teardown phase or terminate phase.

Note that the connection path is established before data transmission begins. Thus, channel capacity must be reserved between each pair of nodes in the path, and each node must have available internal switching capacity to handle the requested connection. The switches must have the intelligence to make these allocations and to devise a route through the network.

Circuit switching was developed to handle voice traffic but is now also used for data traffic. The best-known example of a circuit-switching network is the public telephone network

Advantages of Circuit Switching

- ✓ The dedicated path/circuit established between sender and receiver provides a guaranteed data rate.
- ✓ Once the circuit is established, data is transmitted without any delay as there is no waiting time at each switch.
- ✓ Since a dedicated continuous transmission path is established, the method is suitable for long continuous transmission.

Disadvantages of Circuit Switching

- ✓ As the connection is dedicated it cannot be used to transmit any other data even if the channel is free.
- ✓ It is inefficient in terms of utilization of system resources. As resources are allocated for the entire duration of connection, these are not available to other connections.
- ✓ Dedicated channels require more bandwidth.
- ✓ Prior to actual data transfer, the time required to establish a physical link between the two stations is too long.

2. Packet Switching

In the packet switched networks, data is sent in discrete units that have variable length. They are called as packets. The packet contains data and various control information. The size of the packet is determined by the network and the governing protocol. Multiple paths between a pair of sender and receiver may exist in a packet switched network.

In packet switching, there is no resource allocation for a packet. This means that there is no reserved bandwidth on the links, and there is no scheduled processing time for each packet. All the packets belonging to a transmission may or may not take the same route. The route of a packet is decided by network layer protocols.

We can have two types of packet-switched networks: datagram networks and virtual circuit networks.

i. Datagram Networks

In datagram packet switching each packet is transmitted without any regard to other packets. Every packet contain full packet of source and destination. Every packet is treated as individual, independent transmission.

Datagram approach can cause the datagrams to arrive at their destination out of order with different delays between the packets. Packets may also be lost or dropped because of lack of resources. The datagram networks are also referred as connectionless networks. Here connectionless means that the switch does not keep information about connection state. There are no connection establishment or tear down phases.

ii. Virtual Circuit Networks

In virtual circuit packet switching, a single route is chosen between the sender and receiver and all the packets are sent through this route.

Every packet contains the virtual circuit number. As in circuit switching, virtual circuit needs call setup before actual transmission can be started. The routing is based on the virtual circuit number.

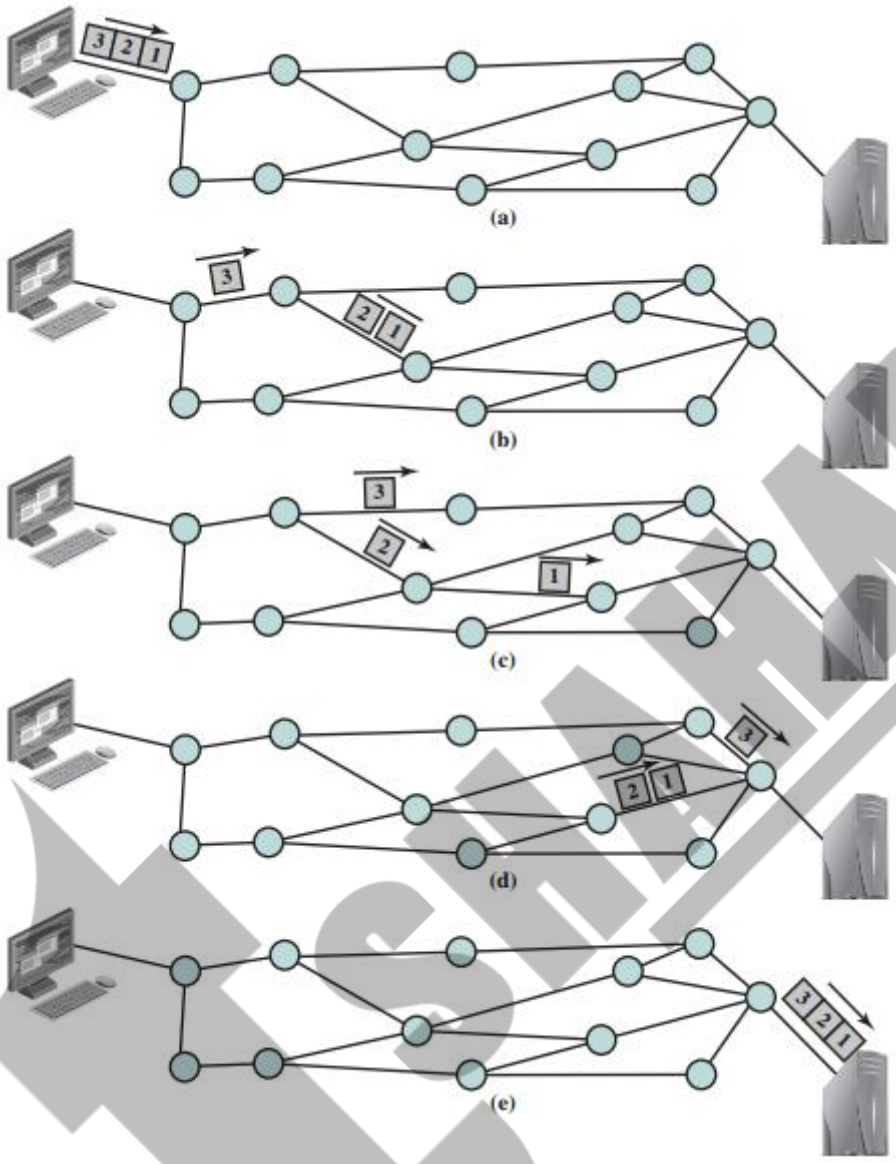
Advantages of packet Switching

- ✓ The main advantage of packet switching is the efficiency of the network. In circuit switching network, a reserved circuit cannot be used by others, till the sender and receiver leave it. Even if no data is being sent on a reserved circuit, no one else can access the circuit. This results in network bandwidth wastage. The packet switching reduces network bandwidth wastage.
- ✓ The other advantage is that the packet switching is more faults tolerant. In case of circuit switching, all the packets are lost if a router in the circuit is down as all the packets follow the same route. But, in case of packet switching network, the packets can be routed over the malfunctioning component of the network. This is because all the packets may follow a different route to the destination.
- ✓ The circuit switching bills the user depending on the distance and duration of connection whereas packet switching network bill users only on the basis of duration of connectivity.
- ✓ The advantage of circuit switching network over packet switching network is that the circuit switching network provides ordered delivery of packets. As all the packets follow the same route. They arrive in correct order at destination.
- ✓ It uses a digital network. This method enables digital data to be directly transmitted to a destination, and is therefore appropriate for data communication systems.
- ✓ High data transmission quality - The quality of data transmission in a packet switched network is kept high (error free) because the data distribution is checked and error detection is employed during data transmission.

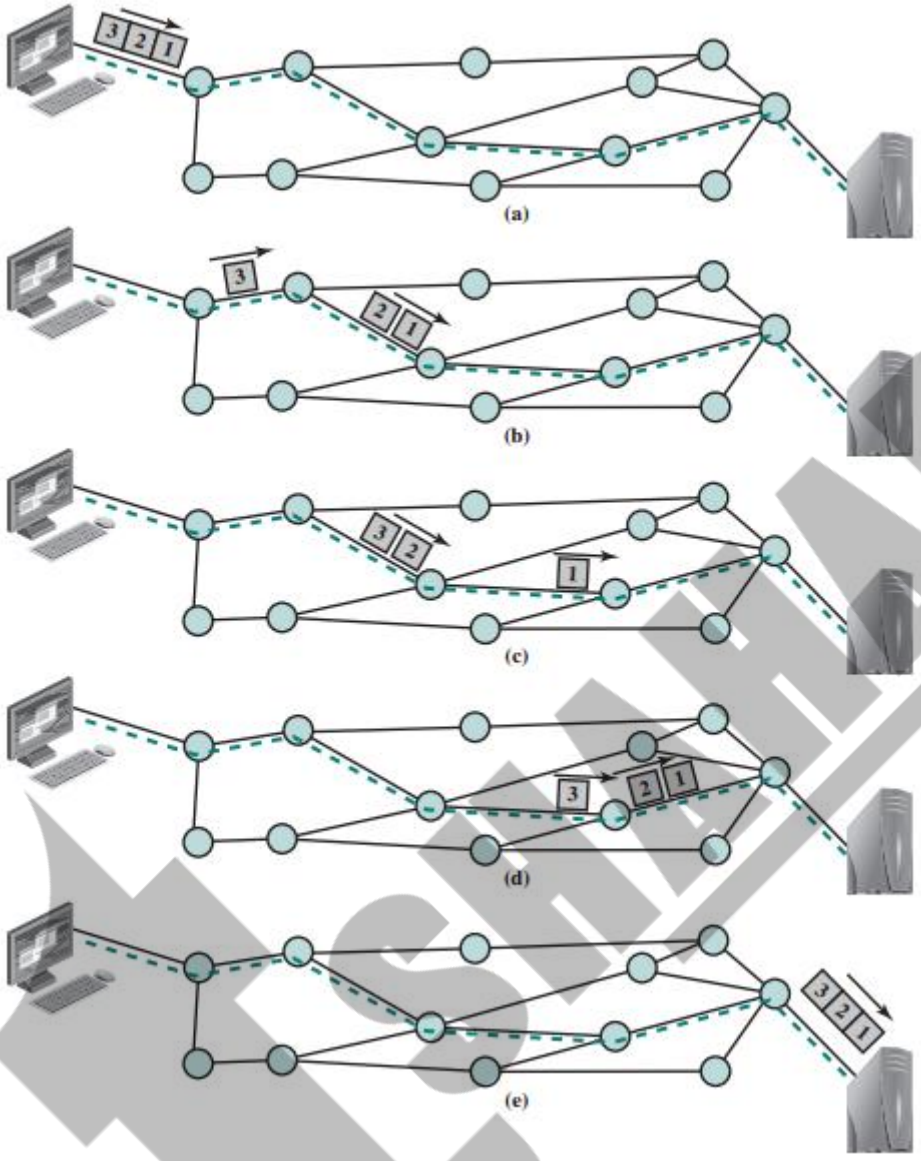
Disadvantages of Packet Switching

- ✓ Packets may be lost on their route, so sequence numbers are required to identify missing packets.
- ✓ Switching nodes requires more processing power as the packet switching protocols are more complex.
- ✓ Switching nodes for packet switching require large amount of RAM to handle large quantities of packets.
- ✓ A significant data transmission delay occurs - Use of store and forward method causes a significant data transmission.

Datagram Approach



Virtual Circuit Approach



Comparison

Circuit Switching	Datagram Packet Switching	Virtual Circuit Packet Switching
Dedicated transmission path	No dedicated path	No dedicated path
Continuous transmission of data	Transmission of packets	Transmission of packets
Fast enough for interactive	Fast enough for interactive	Fast enough for interactive
Messages are not stored	Packets may be stored until delivered	Packets stored until delivered
The path is established for entire conversation	Route established for each packet	Route established for entire conversation
Call setup delay; negligible transmission delay	Packet transmission delay	Call setup delay; packet transmission delay
Busy signal if called party busy	Sender may be notified if packet not delivered	Sender notified of connection denial
Overload may block call setup; no delay for established calls	Overload increases packet delay	Overload may block call setup; increases packet delay
Electromechanical or computerized switching nodes	Small switching nodes	Small switching nodes
User responsible for message loss protection	Network may be responsible for individual packets	Network may be responsible for packet sequences
Usually no speed or code conversion	Speed and code conversion	Speed and code conversion
Fixed bandwidth	Dynamic use of bandwidth	Dynamic use of bandwidth
No overhead bits after call setup	Overhead bits in each packet	Overhead bits in each packet