Switching

Whenever we have multiple devices, we have the problem of how to connect them. One solution is to install a point-to-point connection between each pair of devices (a mesh topology) or between a central device and every other device (a star topology). These methods, however, are impractical and wasteful when applied to very large networks. Other topologies employing multipoint connections, such as a bus, are ruled out because the distance between devices and the total number of devices increase beyond the capacities of the media.

A better solution is switching. A switched network consists of a series of interlinked switches. Switches are hardware and/or software devices capable of creating temporary connections between two or more devices linked to the switch but not to each other. In switched network, some of switches are connected to the communications devices. Others are used only for routing.

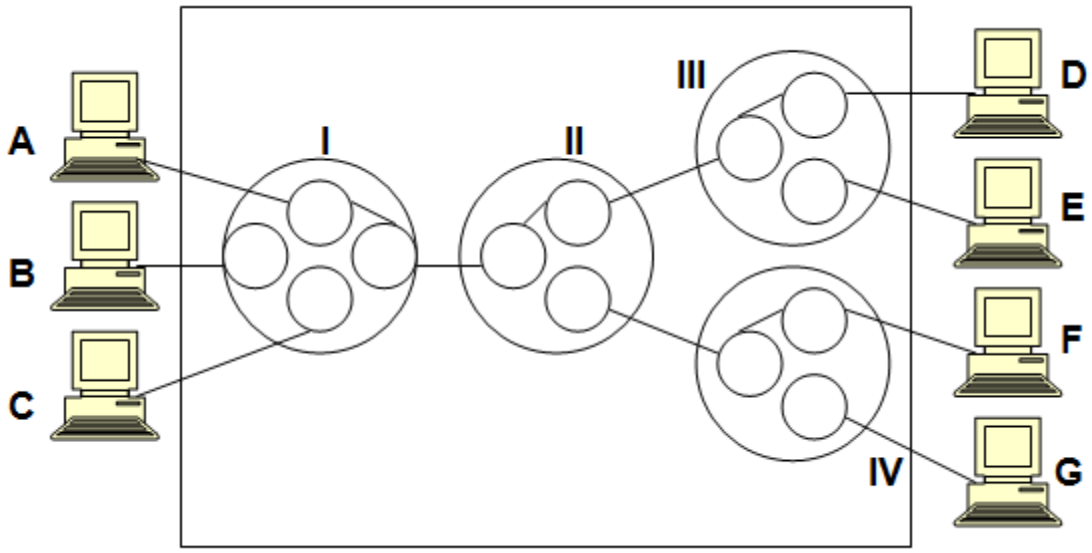
Three methods of switching have been important: circuit switching, packet switching, and message switching. The first two are commonly used today. The third has been phased out in general communications but still has networking applications. New switching strategies are gaining prominence, among them cell relay (ATM) and frame relay.

1- Circuit Switching:

Circuit switching creates a direct physical connection between two devices such as phones or computers. For example, in figure below, instead of point-to-point connections between the three computers on the left (A, B, and C) to the four computers on the right (D, E, F, and G), requiring 12 links, we can use four switches to reduce the number and the total length of the links.

By moving the levers of the switches, any computer on the left can be connected to any computer on the right.

Circuit switching today can use either of two technologies: space-division switches or time-division switches



Circuit switching was designed for voice communication. In a telephone conversation, for example, once a circuit is established, it remains connected for the duration of the session. Circuit switching creates temporary (dialed) or permanent (leased) dedicated links that are well suited to this type of communication.

Circuit switching is less well suited to data and other non voice transmissions. Non voice transmissions come with idle gaps between them. When circuit switched links are used for data transmission, therefore, the line is often idle and facilities wasted.

A second weakness of circuit switched connections for data transmission is in its data rate. Third, circuit switching is inflexible. Once a circuit has been established, that circuit is the path taken by all parts of the transmission whether or not it remains the most efficient or available. Finally, circuit switching sees all transmissions as equal.

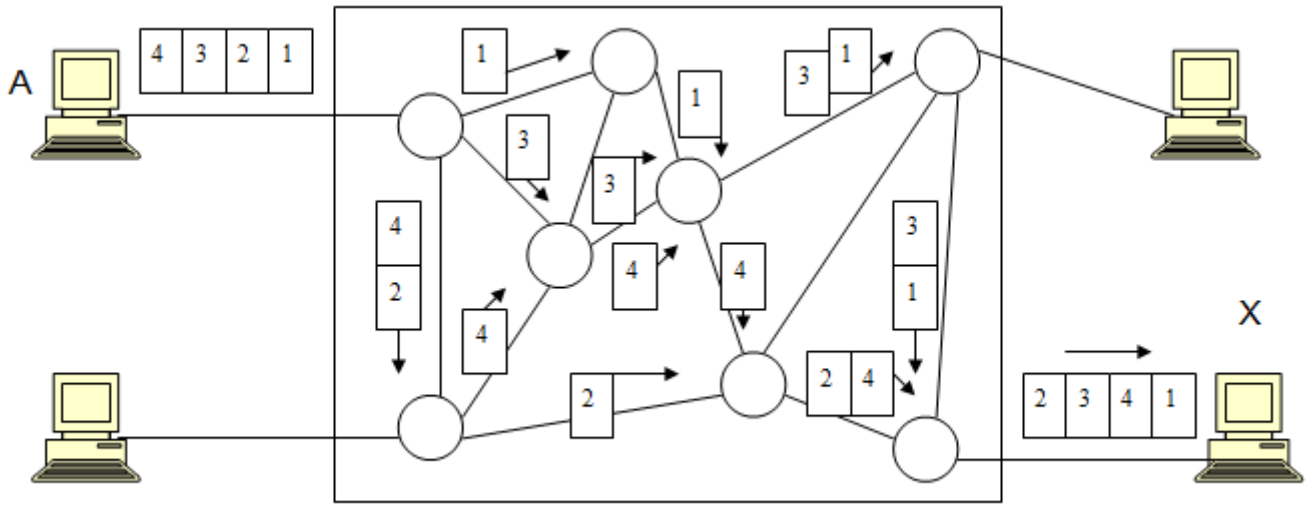
2- Packet Switching:

A better solution for data transmission is packet switching. In packet switching networks, data are transmitted in discrete units of variable length blocks called packets. The maximum length of the packet is established by the network. Longer transmissions are broken up into multiple packets. Each packet contains not only data but also a header with control information (such as source and destination addresses). The packets are sent over the network node to node. At each node, the packet is stored briefly then routed according

to the information in its header. There are two popular approaches to packet switching: datagram and virtual circuit.

a\ Datagram Approach:

In datagram approach to packet switching, each packet is treated independently from all others. Packets in this technology are referred to as datagrams.



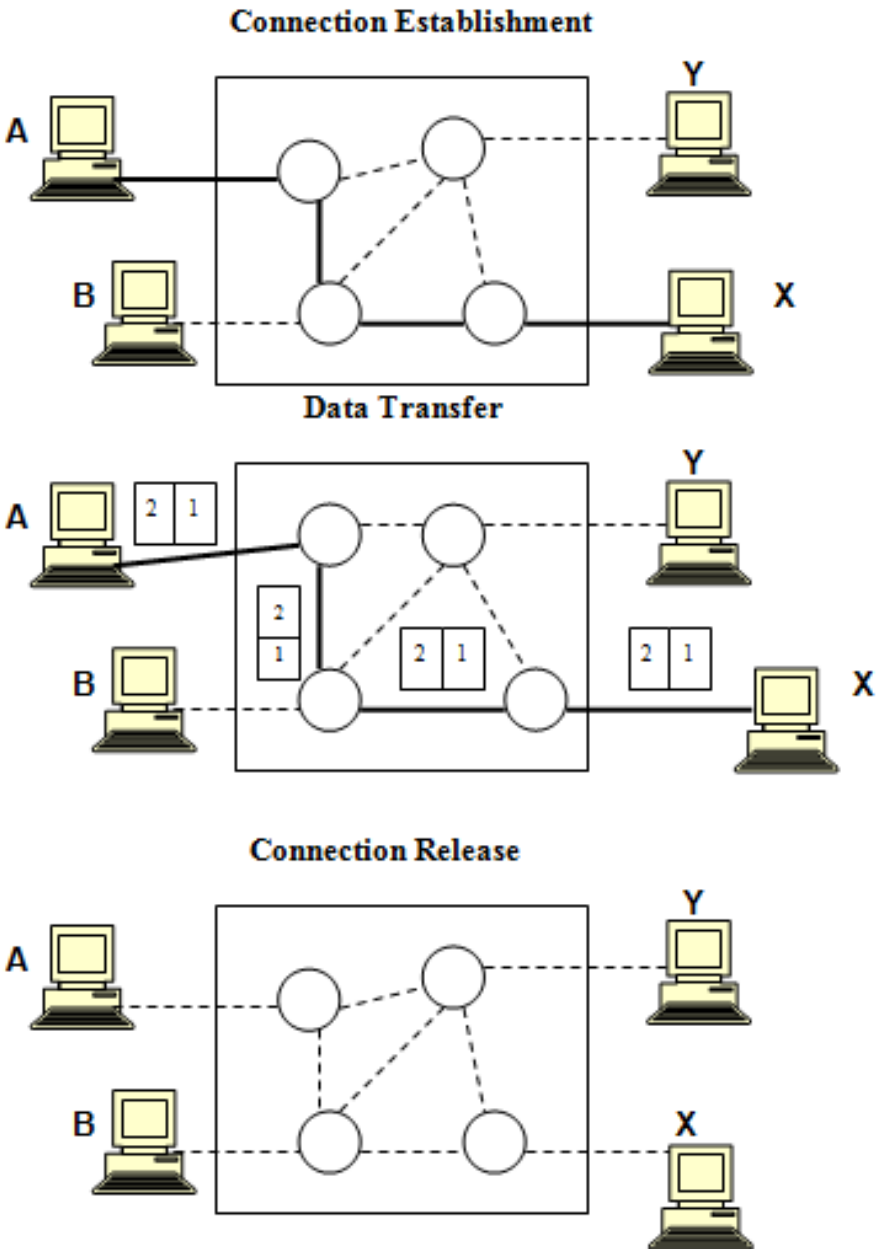
Above figure shows how the datagram approach can be used to deliver four packets from station (A) to station (X). This approach can cause the datagrams of transmission to arrive at their destination out of order. It is responsibility of the transport layer in most protocols to reorder the datagrams before passing them on to the destination port.

b\ Virtual Circuit Approach:

In the virtual circuit approach to packet switching, the relationship between all packets belonging to a message or session is preserved. A single route is chosen between sender and receiver at the beginning of the session. When data are sent, all packets of the transmission travel one after another along that route. Today, virtual circuit transmission is implemented in two formats: switched virtual circuit (SVC) and permanent virtual circuit (PVC).

b-1\ Switched Virtual Circuit (SVC):

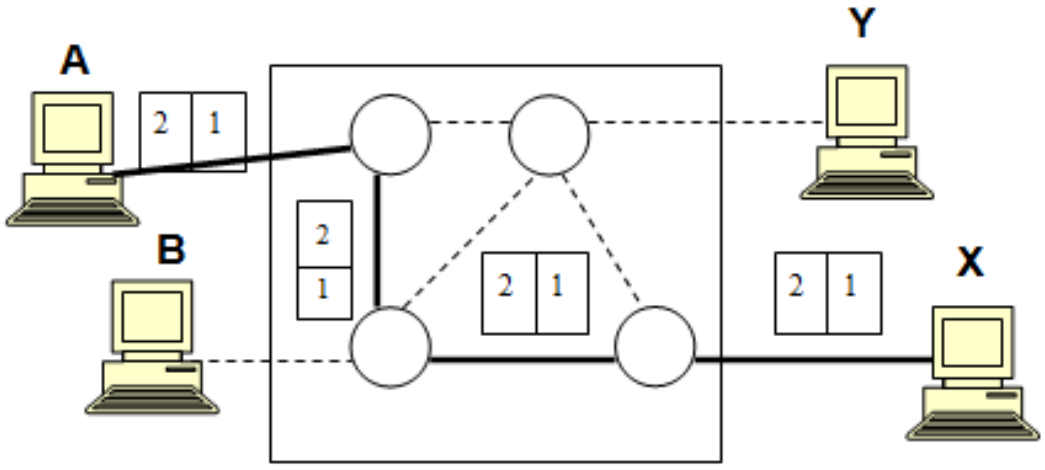
SVC format is comparable to dial-up lines in circuit switching. In this method, a virtual circuit is created whenever it is needed and exists only for the duration of the specific exchange. For example, imagine that station (A) wants to send four packets to station (X). First, (A) requests the establishment of a connection to (X). Once the connection is in place, the packets are sent one after another and in sequential order. When the last packet has been received and, if necessary, acknowledged, the connection is released as shown in figure below:



Each time that (A) wishes to communicate with (X), a new route is established. The route may be the same each time, or it may differ in response to varying network conditions.

b-2\ Permanent Virtual Circuit (PVC):

PVCs are comparable to leased lines in circuit switching. In this method, the same virtual circuit is provided between two users on a continuous basis. The circuit is dedicated to the specific users. No one else can use it and, because it is always in place, it can be used without connection establishment and connection termination. Whereas two SVC users may get a different route every time they request a connection, two PVC users always get the same route as shown in figure below:

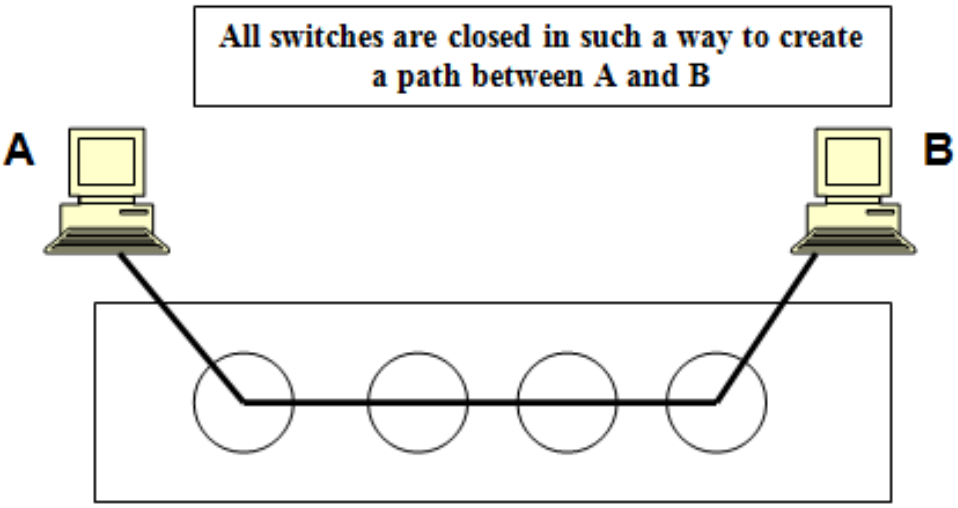


Permanent connection for the duration of the lease

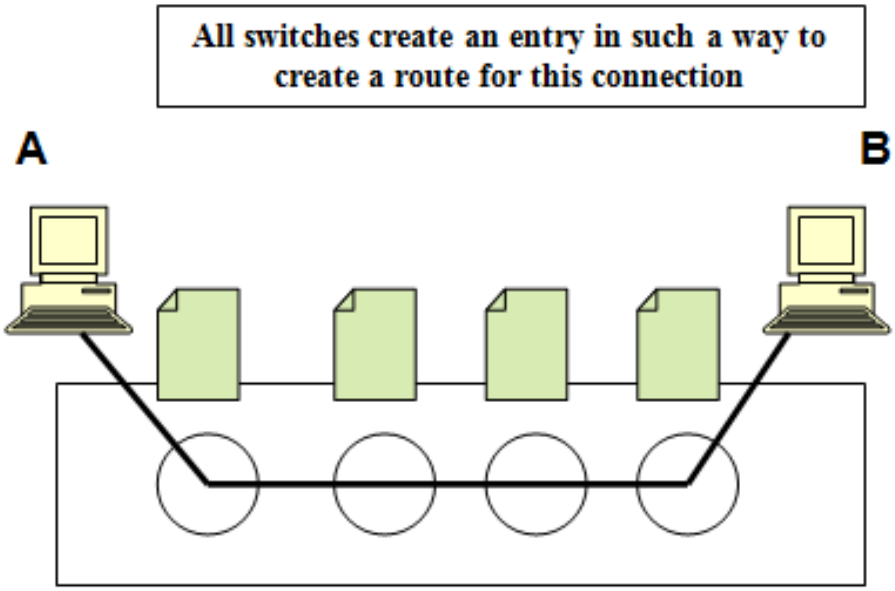
Circuit switched Connection versus Virtual Circuit Connection:

Although it seems that a circuit switched connection and a virtual circuit connection are the same, there are differences:

1-

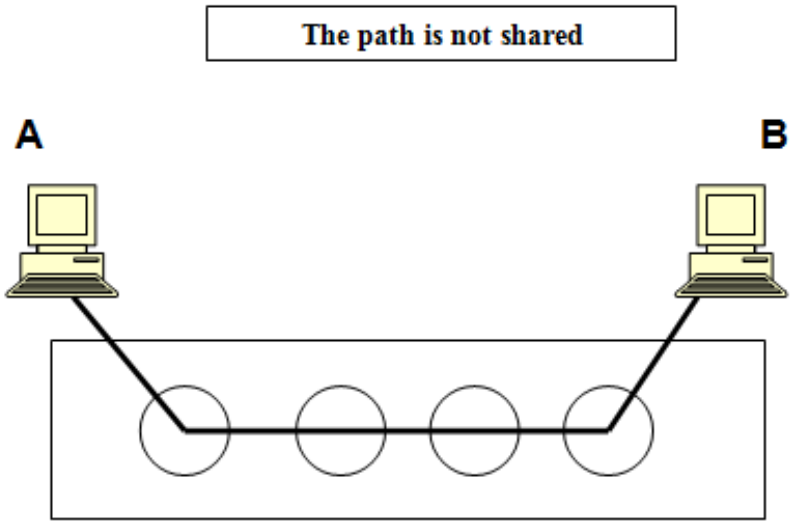


a- Circuit switched connection

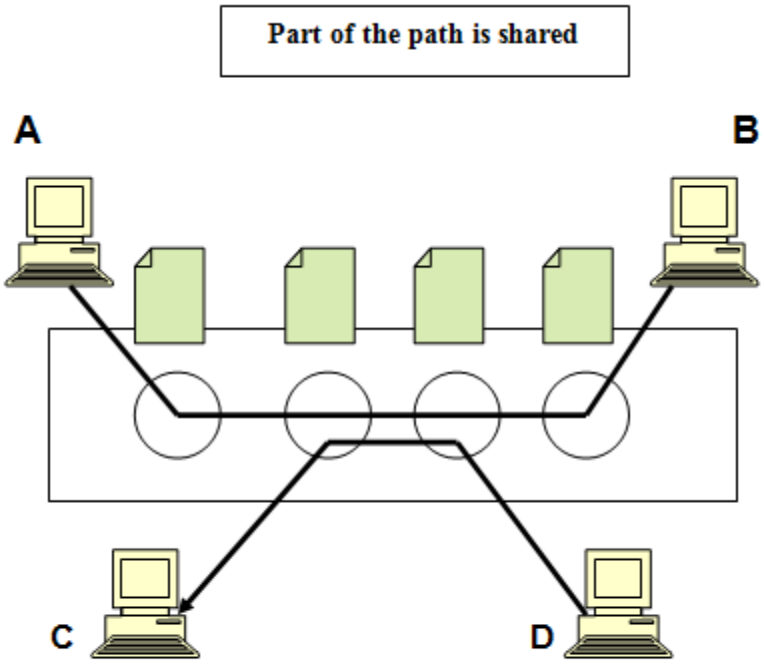


b-Virtual Circuit connection

2-



a-Circuit switched connection



b-Virtual Circuit connection

3- Message Switching:

Message switching is best known by the description term store and forward. In this mechanism, a node (usually a special computer with a number of disks) receives a message, stores it until the appropriate router is free, then sends it along.

Store and forward is considered a switching technique because there is no direct link between the sender and receiver of a transmission. A message is delivered to the node along one path then rerouted along another to its destination.

Note that in message switching, the messages are stored and relayed from secondary storage (disk), while in packet switching the packets are stored and forwarded from primary storage (RAM).

Message switching was common in the 1960s and 1970s. The primary uses have been to provide high level network services (e.g. delayed delivery, broadcast) for unintelligent devices. Since such devices have been replaced, this type of switch has virtually disappeared.