Name of Course : E1-E2 CFA

Chapter 1

Topic : Concept of Packet Switching

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PACKET SWITCHING

In voice communication, the switching technology, which is widely used, is called circuit switching. In a telephone conversation, 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 transmission. Non-voice transmissions tend to be bursty, meaning that data come in spurts with idle gaps between them. When circuit-switched links are used for data transmission, therefore, the line is often idle and its facilities wasted.

A second weakness of circuit-switched connections for data transmission is in its data rate. a circuit-switched link creates the equivalent of a single cable between two devices and thereby assumes a single data rate for both devices. This assumption limits the flexibility and usefulness of a circuit-switched connection for networks interconnecting a variety of digital devices.

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.

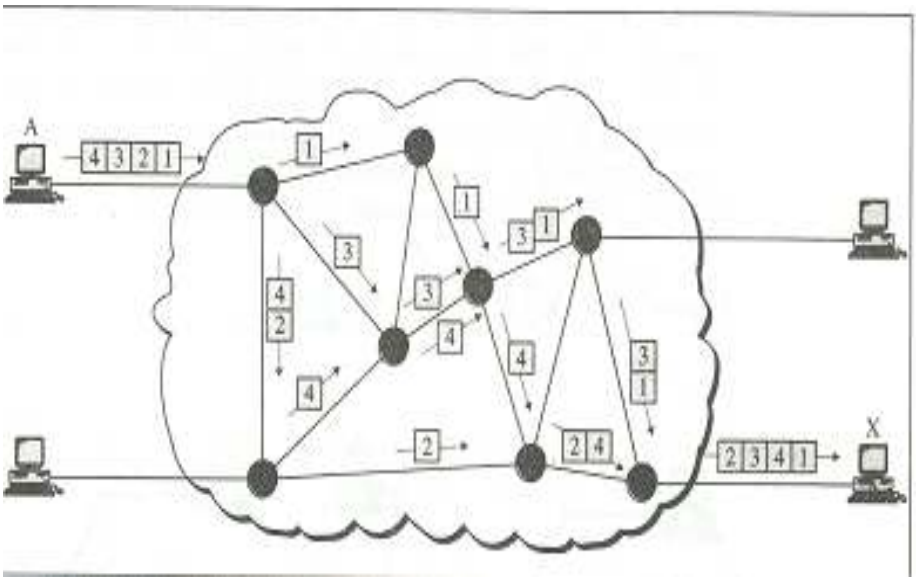
Finally, circuit switching sees all transmission as equal. Any request is granted to whatever links available. But often with data transmission. We want to be able to prioritize: to say, for example, that transmission x can go anytime but transmission z is time dependent and must go immediately.

A better solution for data transmission is **packet switching**. In a **packet-switched network,** data are transmitted in discrete units of potentially 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 priority codes and source and destination addresses). The packets are sent over the network node to node. At each node, the packet stored briefly then routed according to the information in its header.

There are two popular approaches to packet switching: data-gram and virtual circuit.

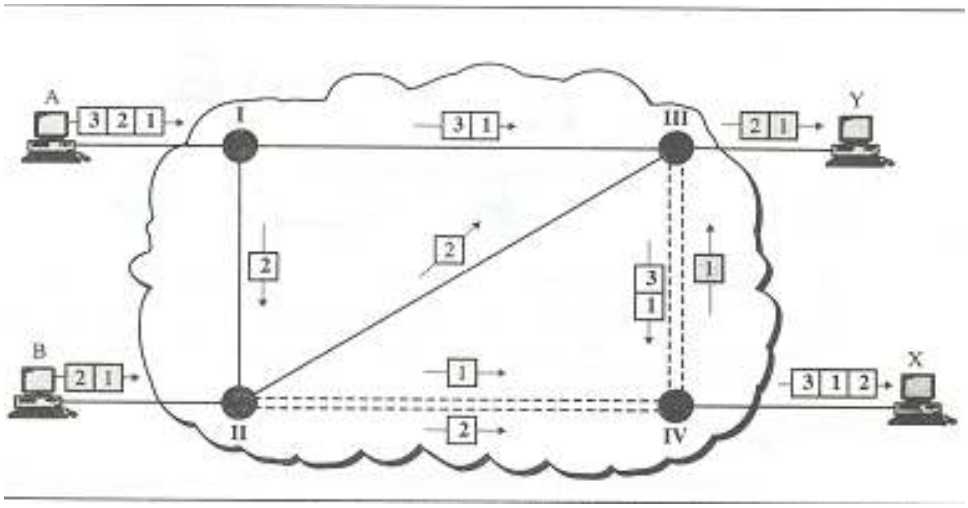
Data-gram Approach

In the data-gram approach to packet switching, each packet is treated independently form all other. Even when one packet represents just a piece of a multi-packet transmission, the network (and network layer functions) treats it as though in existed alone. Packets in this technology are referred to as data-grams



Example shows how the data-gram approach can be used to deliver four packets from station A to station X. In this example, all four packets (or data-grams) belong to the same message but may go by different paths to reach their destination.

This approach can cause the data-grams of a transmission to arrive at their destination out of order. It is the responsibility of the transport layer in most protocols to reorder the data-grams before passing them on to the destination port.



The link joining each pair of nodes can contain multiple channels. Each of these channels is capable, in turn, of carrying data-grams either from several different sources or from one source. Multiplexing can be done using TDM or FDM.
Device A and B are sending data-gram to device X and Y. Some paths use one channel while others use more than one. As you can see, the bottom link is carrying two packets form different source is the same direction. The link on the right, however, is carrying data-grams in two directions.

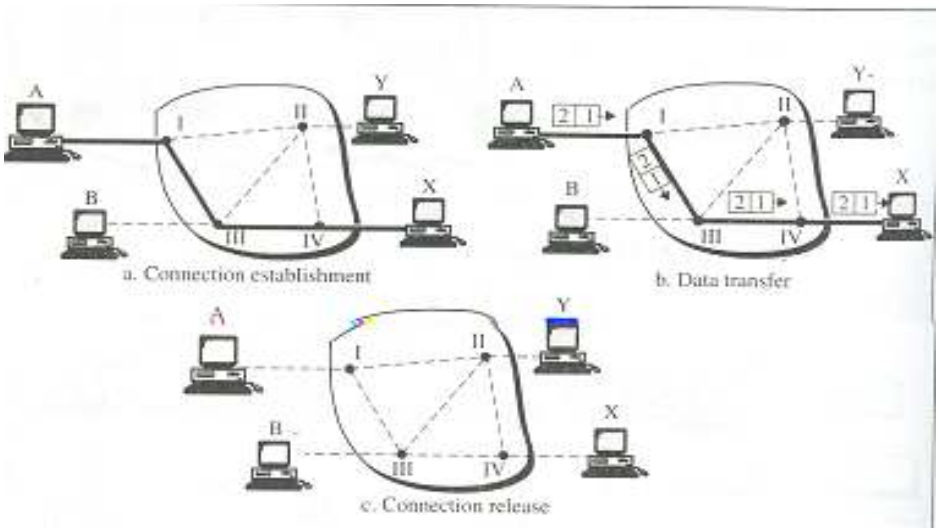
Virtual Circuit Approach

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 the 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).

SVC

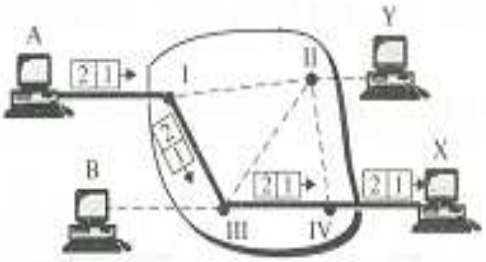
The **switched virtual circuit (SVC)** format is comparable conceptually to dial-up lines in circuit switching. In this method, a **virtual circuit** is created whenever it is needed and exists only for the duration of the specific exchange.



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 and that virtual circuit ceases to exist. Only one single route exists for the duration of transmission, although the network could pick an alternate route in response to failure or congestion.

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.



Permanent connection for the duration of the lease

PVC

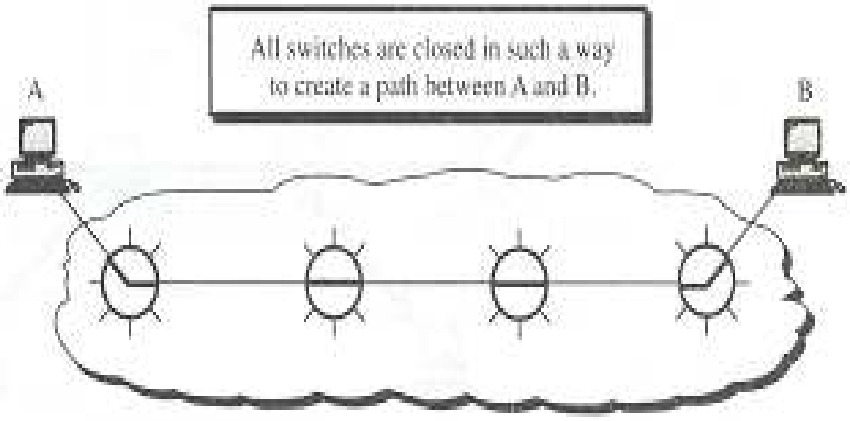
Permanent virtual circuits (PVC) are comparable to leased lines in circuit switching. In this method, the same virtual circuit is provided between two users on a continuous basis. The circuit is dedicated to the specific users. No one else can use it and, because it is always in place, it can be used 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

Circuit-Switched Connection versus Virtual-Circuit Connection

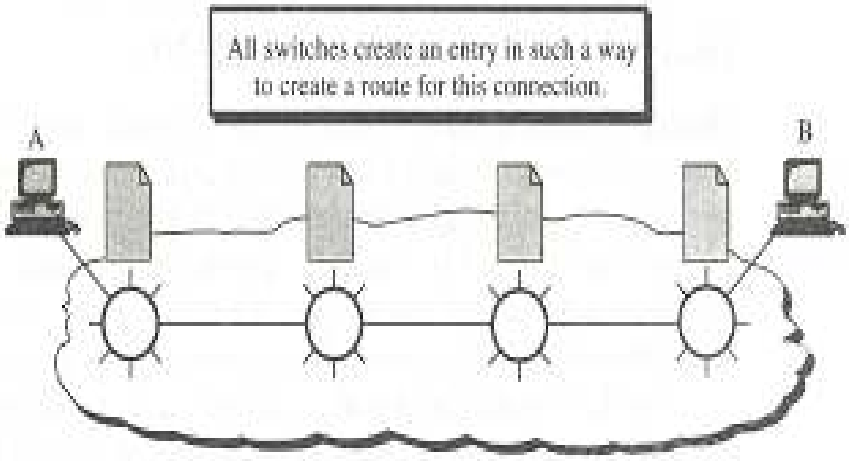
Although it seems that a circuit-switched connection and a virtual-circuit connection are the same, there are differences:

- **Path versus route: -** A circuit-switched connection creates a path between two points. The physical path is created by setting the switches for the duration of the dial (dial-up line) or the duration of the lease (leased line). A virtual-circuit connection creates a route between two points. This means each switch creates an entry in its routing table for the duration of the session (SVC) or duration of the lease (PVC). Whenever, the switch receives a packet belonging to a virtual connection, it checks the table for the corresponding entry and routes the packet out of one of its interfaces.
- **Dedicated versus sharing: -** In a circuit-switched connection, the links that make a path are dedicated; they cannot be used by other connections. In a virtual circuit connection, the links the make a route can be shared by other connections.

Path versus Route

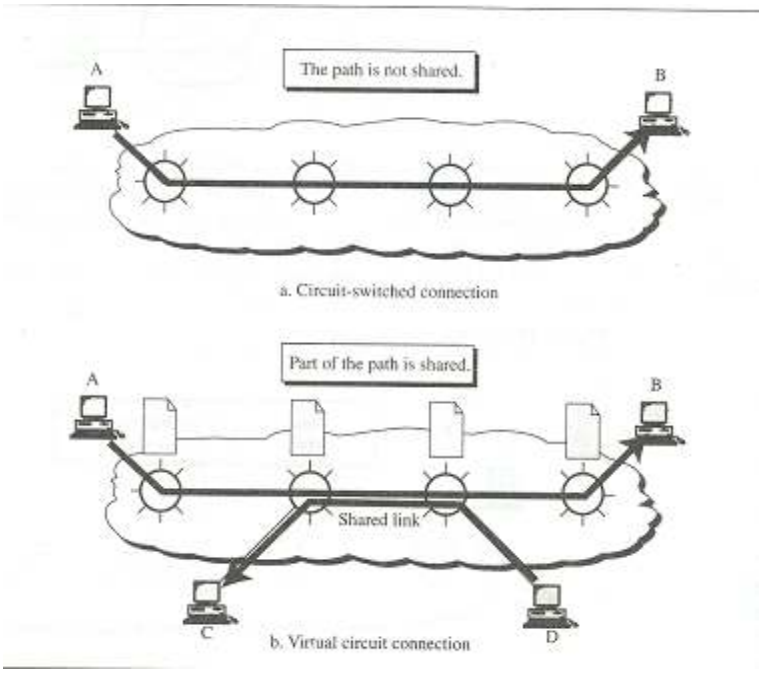


a. Circuit-switched connection



b. Virtual circuit connection

Dedicated versus Shared



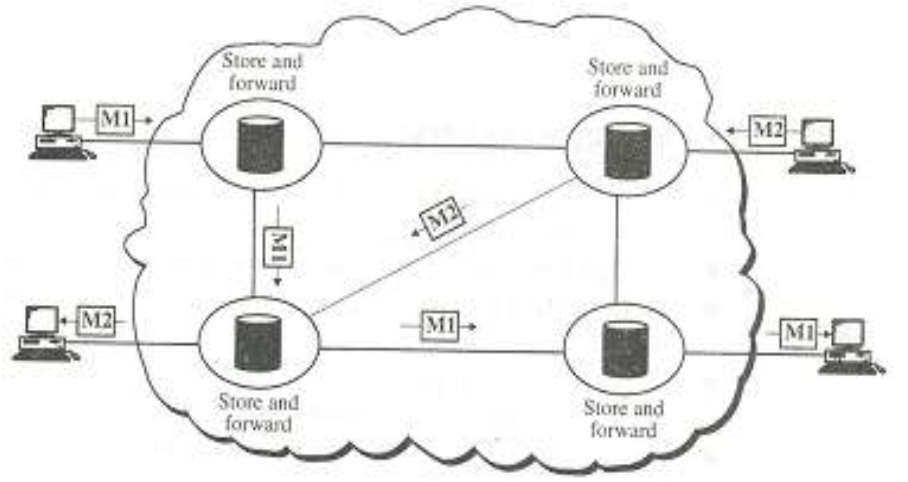
MESSAGE SWITCHING

Message switching is best known by the descriptive 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 route is free, them 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 alone 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 replaces, this type of switch has virtually disappeared. Also, the delays inherent in the process, as well as the requirements for large-capacity storage media at each node, make it unpopular for direct communication.



TIPS TO REMEMBER

1. There are three phases in circuit switching:
    a) Establish
    b) Transfer
    c) Disconnect

2. Circuit switching can be analogue or digital
3. Guaranteed the full bandwidth for the duration of the call
4. Takes a relatively long time to set up the circuit
5. Each packet is sent with a 'header address'.
6. Bandwidth used to full potential in Packet switching
7. Protocols are needed for a reliable transfer for packet switching
8. In datagram approach
    a) Packets can take any practical route
    b) Packets may go missing
    c) In heavy traffic conditions, datagram movement across the sub-network can stop altogether.
9. In Virtual circuit packet switching

a) packets follow the same route and therefore arrive in sequence.
b) packet contains a virtual circuit identifier instead of destination address
c) Susceptible to data loss in the face of link or node failure

10. A PVC is always connected, so always paying
11. Message switching is best known by store and forward technology.
12. Message switching is secondary storage (disk) dependent, while in packet switching it is (RAM) dependent

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