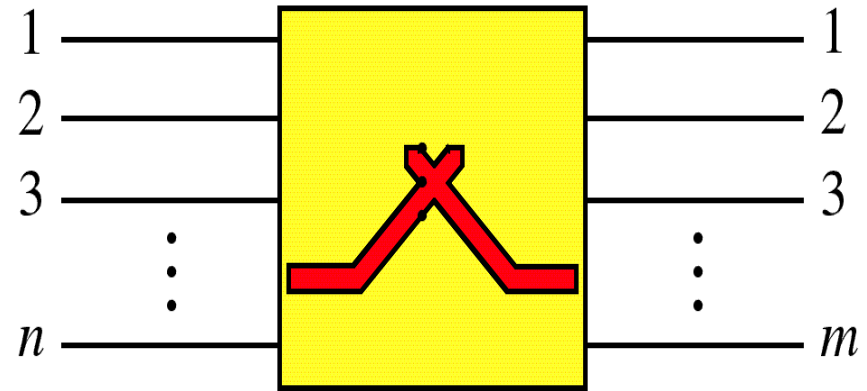# Taxonomy of Switched Networks
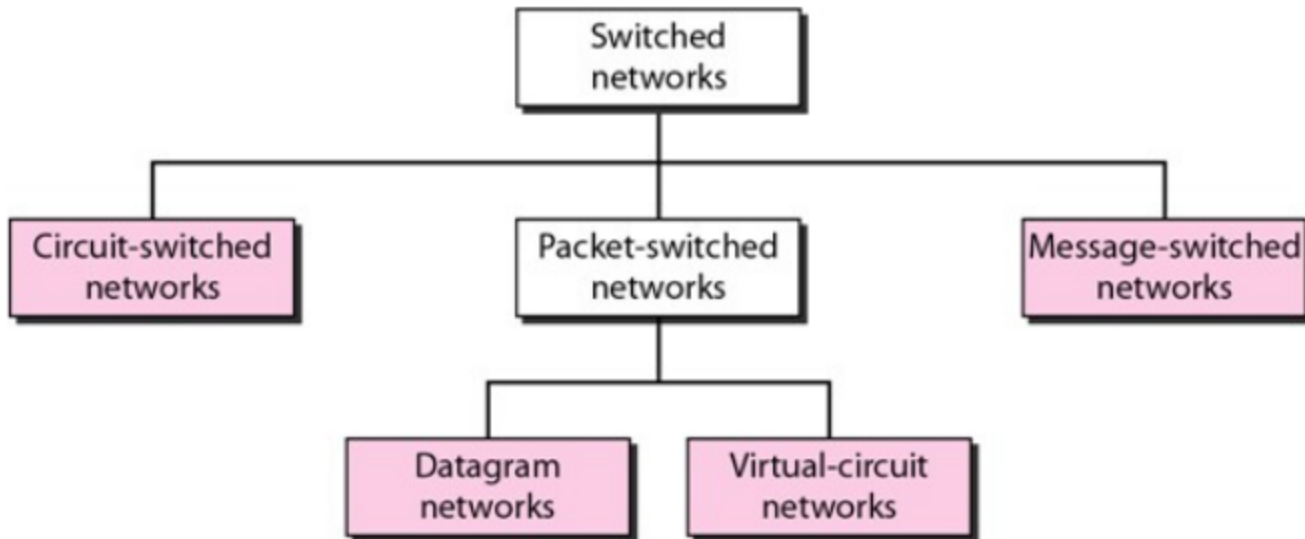
Q. What is a switch?

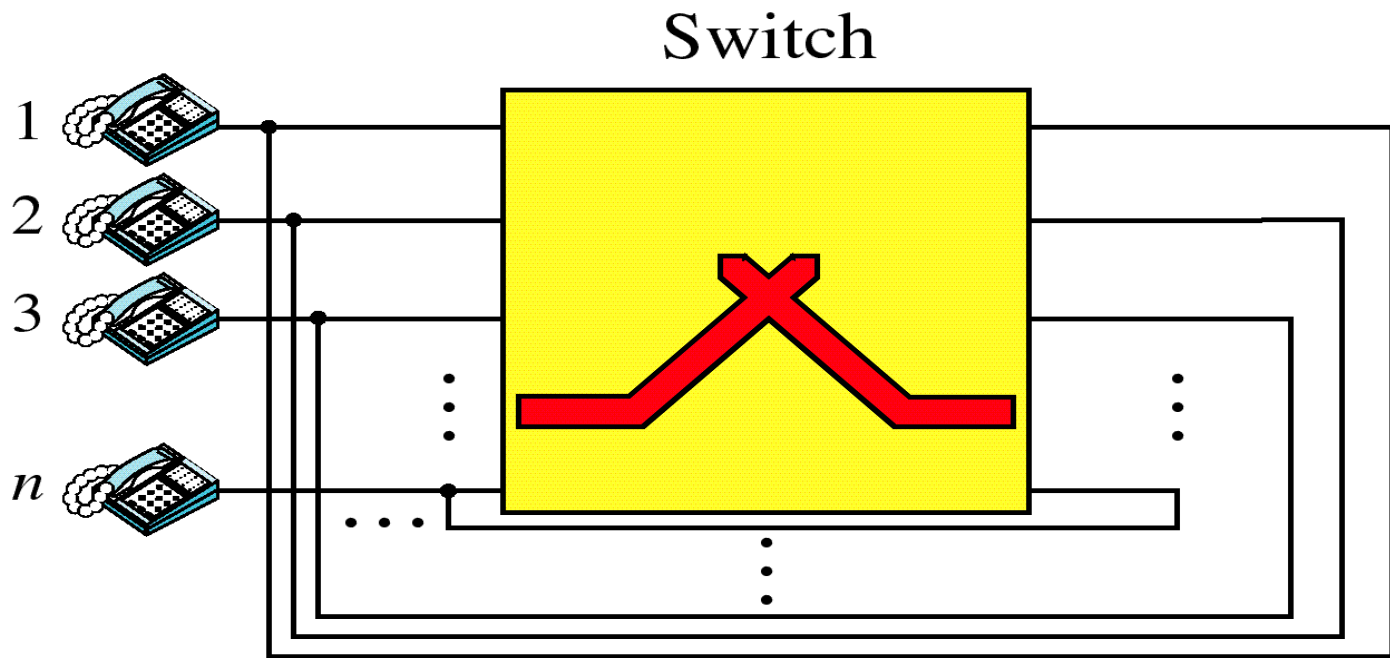Q. What is switching?

Q. What is switched network?

Switch

Switches are the hardware or software devices capable of creating temporary connections between two or more devices linked to the switch but not to each other.

It is a device which connects multiple communication lines together.

Folded Switch

An n by n folded switch can connect n line in full duplex mode.
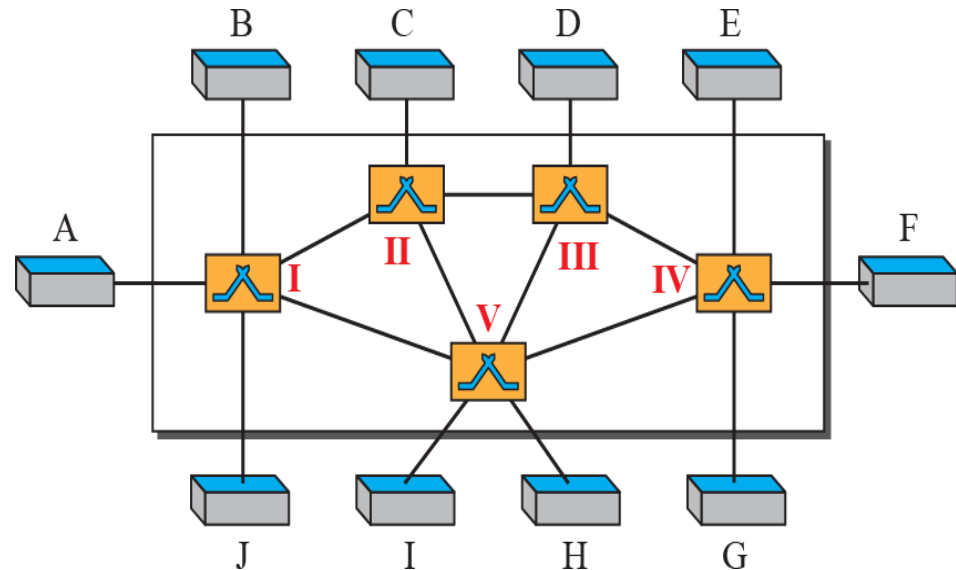
Switching

- A network is a set of connected devices. Whenever we have multiple devices, we have the problem of how to connect them to make one-to-one communication possible.

- The solution is switching.

- A switched network consists of a series of interlinked nodes, called switches.

Switched Network

- A Computer network in which connectivity is provided by using numbers of switches.

- A fully switched network uses only switches for connecting all devices used in that network.

Switched network (Networking using Switches)

Methods of switching

1.Circuit switching

2.Packet switching

      a. Virtual circuit

      b. Datagram

3.Message switching

Switching and TCP/IP Layers

Switching takes place at several layers of the TCP/IP protocol suite:

1.At the physical layer it is circuit switching. There is no exchange of packets at PL. The switches at PL allow signals to move in one path or another.

2.At the data-link layer we can have packet switching.   However, the packet can mean frame or cells here. Packet switching is done normally using Virtual Circuit Approach.

3. At the network layer we can have packet switching.

Here, either a virtual circuit or datagram approach can be used. Internet uses datagram approach.

4. Switching at Application Layer : we can have only message switching at AL. It is done by exchanging   messages like email etc. So such communication can   be called as message switched communication. As such there is no concept of message switched Network.
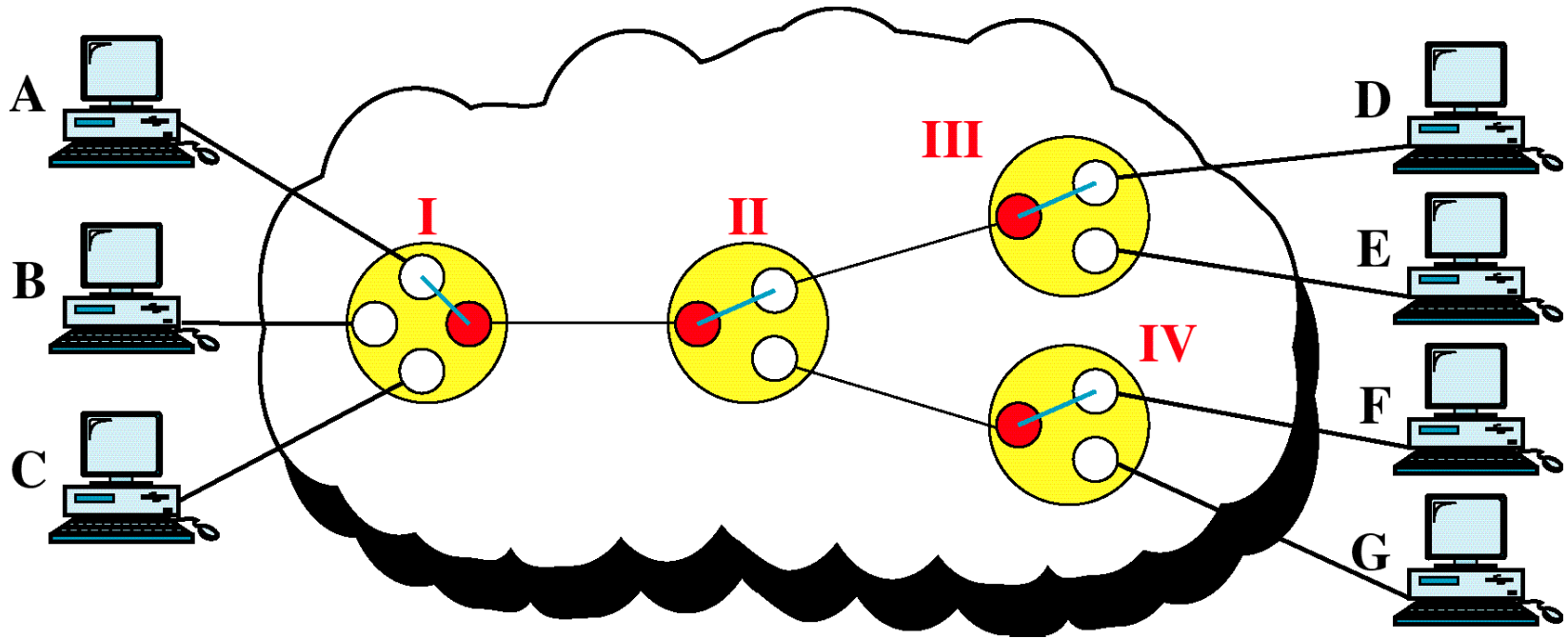
Circuit switching

- Circuit switching is used in public telephone network but it is used for data transmission also along with voice communication

- Voice communication is efficient but data communication is not that efficient

- In this method a dedicated path is established between two computer using one or more switch

- The transfer mode of a network involves setting up a dedicated end to end connection. This path is maintained till the end of communication.

- Link is released after communication is over

- Circuit switching takes place at physical layer

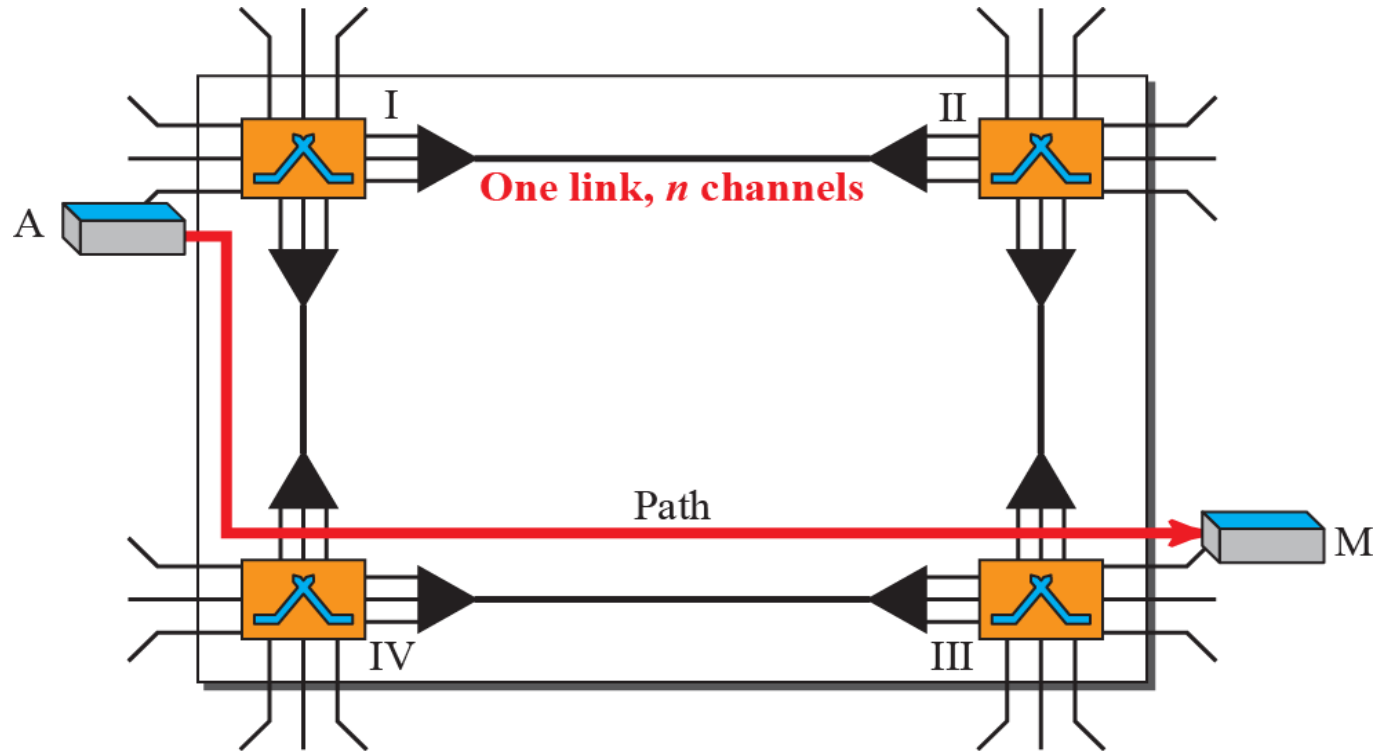- Data transfer may use FDM or TDM

Circuit-Switched Network

In place of using 3x4=12 point to point connections only 3 switches are used in above figure.

A trivial circuit-switched network

- *4 switches*

- *4 links*

- *Each   link divided into n=3 channels here using FDM or TDM*

- *2 end systems A & M; these may be computers*

- *If A has transmit to M, it will do through this circuit switched network*
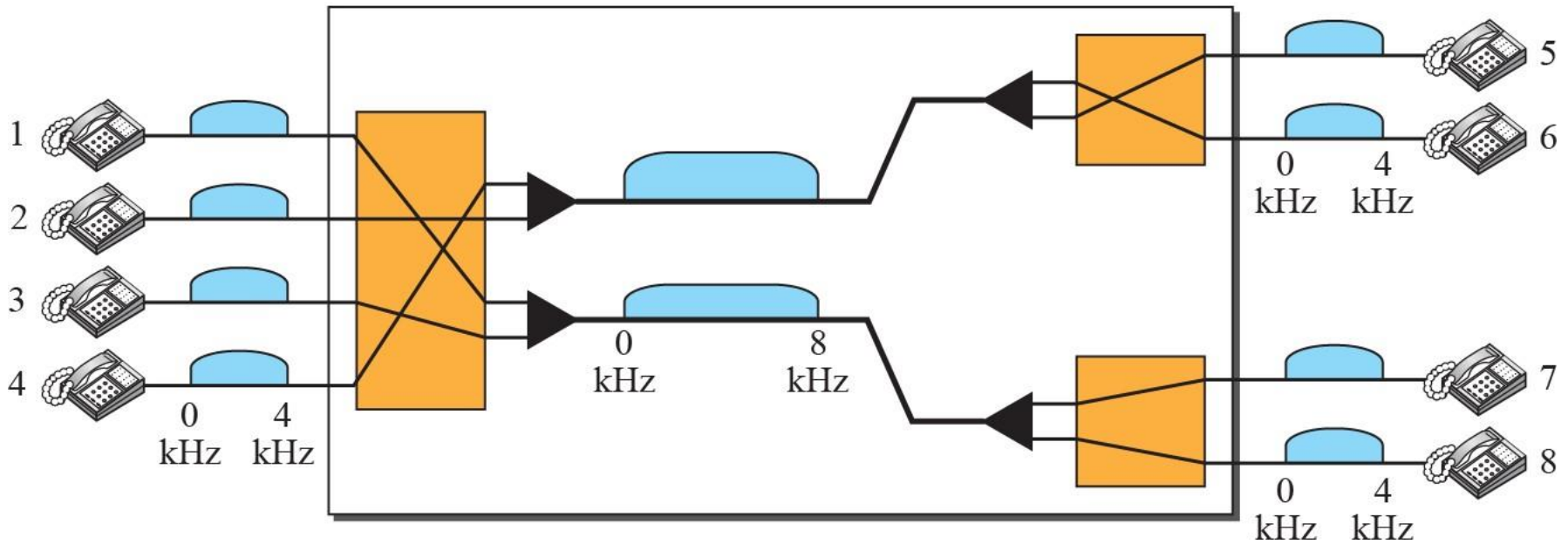
The actual communication in a circuit-switched network requires three phases:

1. *connection setup,*

2. *data transfer, and*

3. *connection teardown.*

Circuit-switched network used in Example

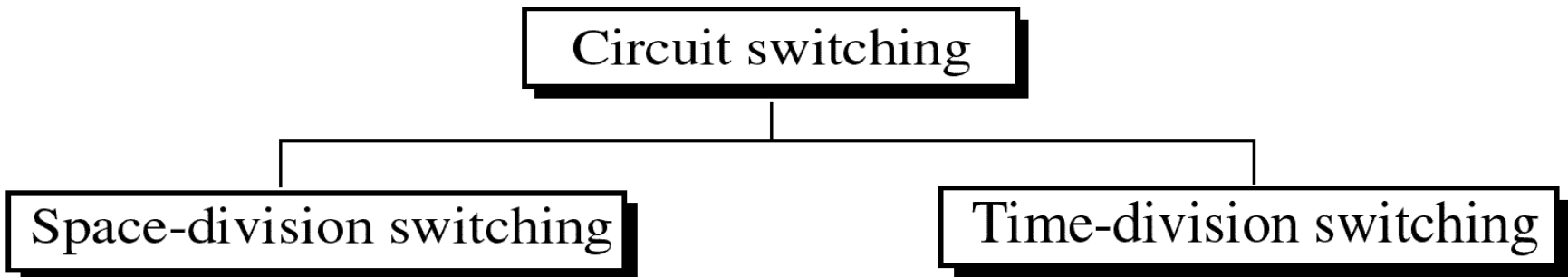Circuit-switched network

Issues:
1. Efficiency – low
2. Delay – despite low efficiency there is very low delay in transmission

- Advantages
  - Dedicated transmission
  - No delay in transmission
- Disadvantages
  - Because of dedicated connection other devices waste time in waiting
  - Dedicated connection will consume all bandwidth
  - Sometimes it may take long time to establish a connection
- Applications – Public Switched Telephone Network (PSTN)

Circuit switching

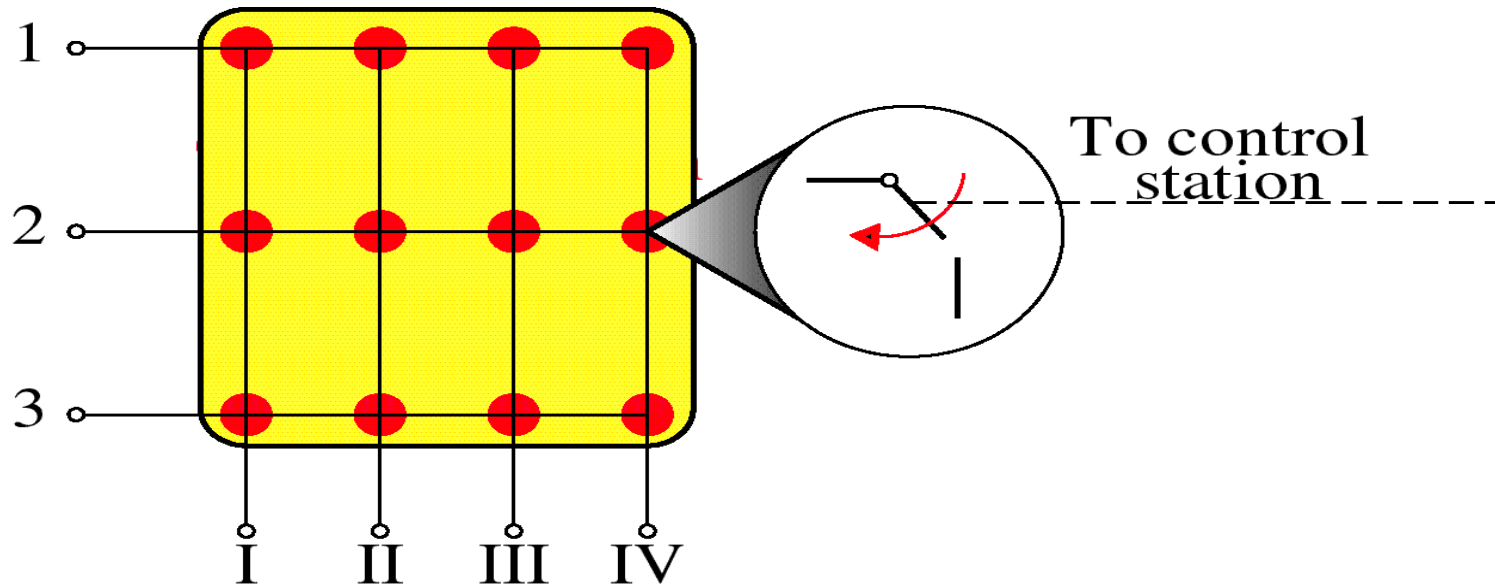Space-division switching   Time-division switching

Space Division Switching

In space division switching, the paths in the circuit are separated from each other spatially. This technology is used in both analog & digital networks. It uses following switches for connection:

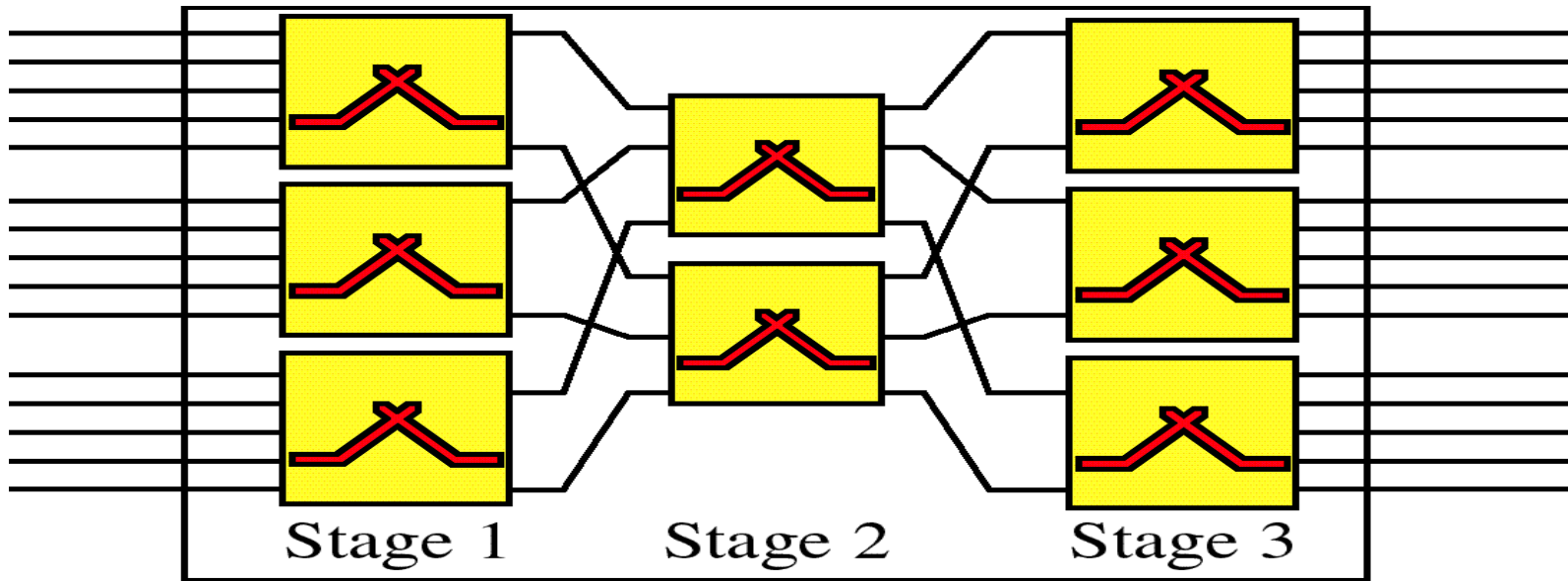1. Cross bar switch
2. Multistage switch

Crossbar Switch

A cross bar switch connects n input lines to m output lines in a grid using micro switches (transistor) at each cross point.

Multistage Switch

Stage 1   Stage 2   Stage 3

1. The limitations of crossbar switch is removed by multistage switch. In fact it combines cross bar switches in several stages.

2. In multistage switching, devices are linked to switches that, in turn are linked to a hierarchy of other switches.

Time-division multiplexed switch

- Time slot interchange reads bits from incoming slots in each frame and writes these into a register. Call setup would have created a permutation table for how the contents are read out.

- These switches are only used in voice calling.

Examples of Circuit Switched Network

- Public switched telephone network (PSTN)

- ISDN B-channel

- Circuit Switched Data (CSD) and

  High-Speed Circuit-Switched Data (HSCSD) service in

  cellular systems such as GSM

- Datakit

- X.21 (Used in the German DATEX-L and Scandinavian

  DATEX circuit switched data network)

- Optical mesh network
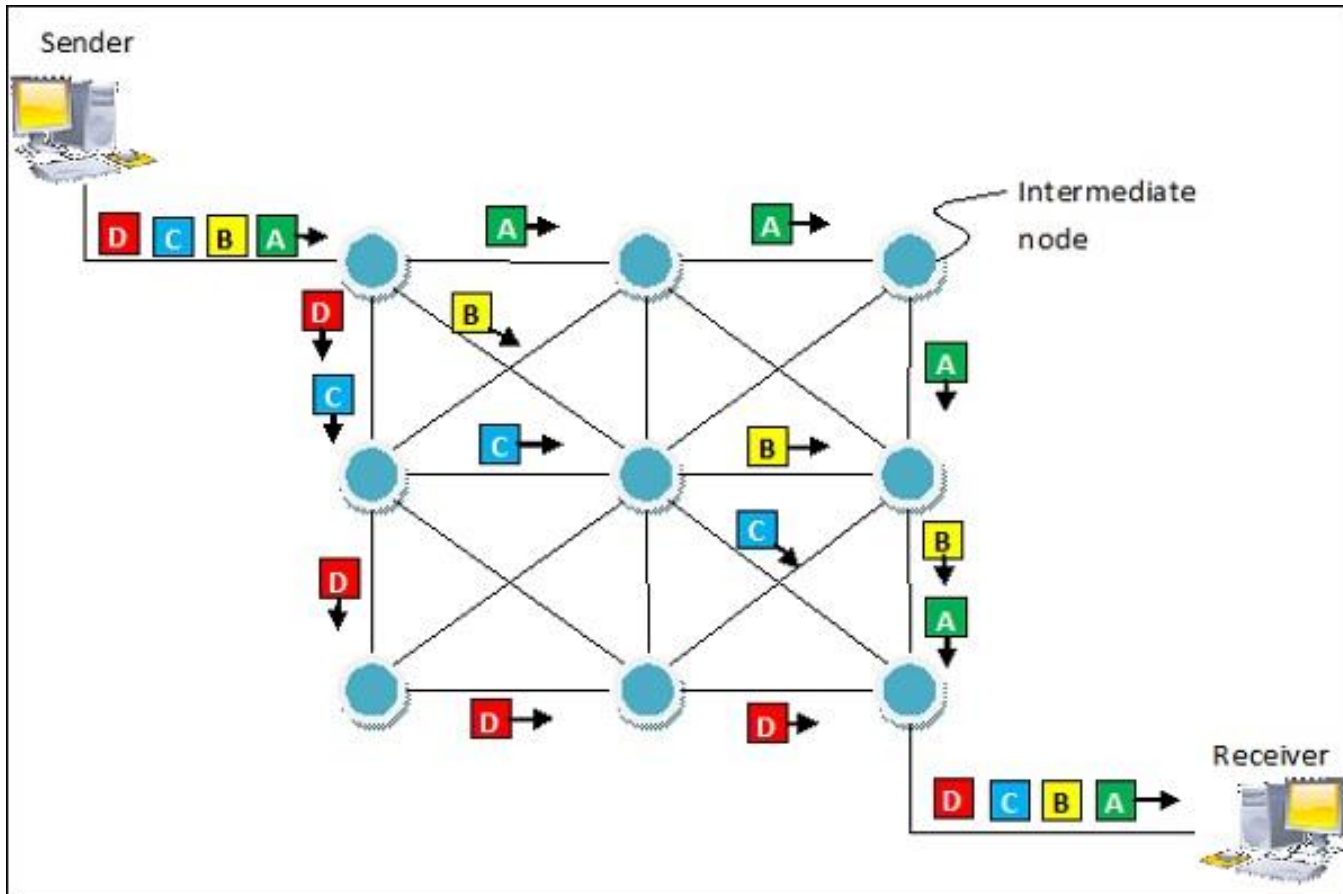
Packet Switching

1. Packet switching is a connectionless network switching technique.

2. The message is divided and grouped into a number of units called packets.

3. Individually routed from the source to the destination.

4. There is no need to establish a dedicated circuit for communication.

Process

1. Each packet has two parts: a header and a payload.

2. Header: addressing information

3. The payload: carries the actual data.

4. The packets of a message are not routed via the same path.

5. So, the packets in the message arrives in the destination out of order.

6. It is the responsibility of the destination to reorder the packets in order to retrieve the original message.
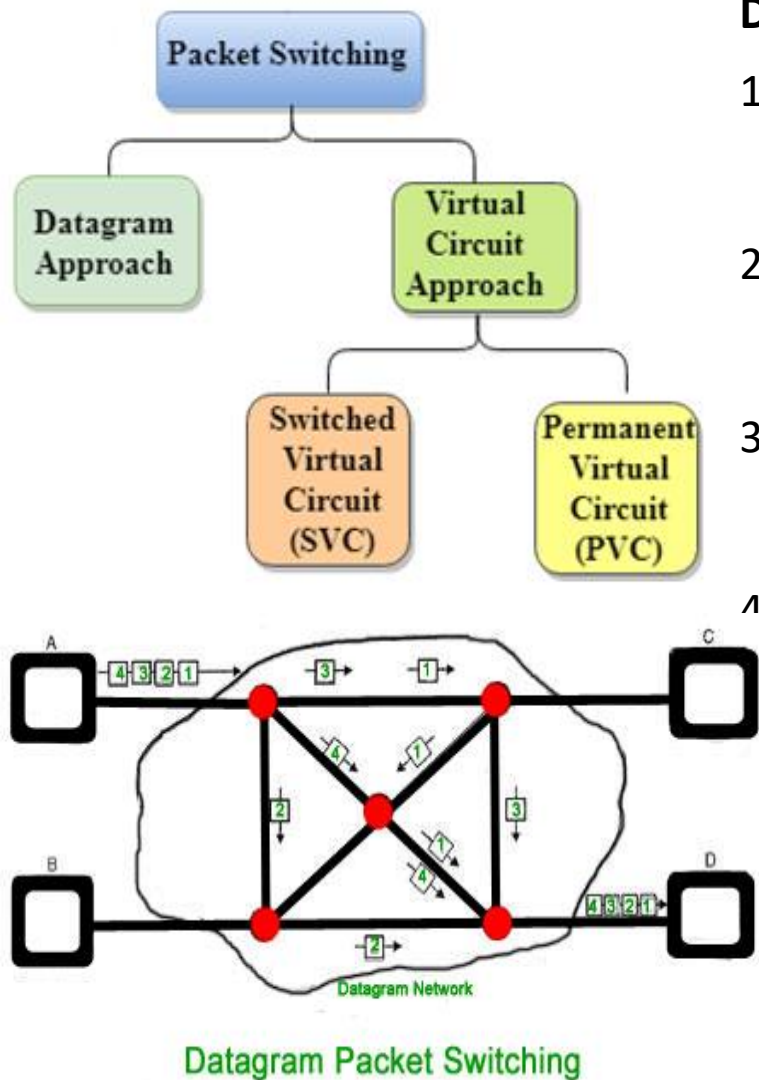
Packet Switching

Two approaches of Packet Switching
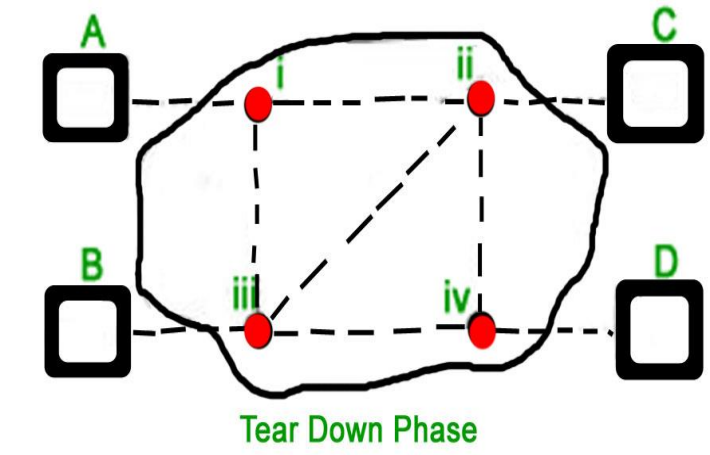

Datagram Packet Switching

Datagram Packet switching:

1. Known as a datagram, is considered as an independent entity.

2. Each packet contains the information about the destination

3. The packets are reassembled at the receiving end in correct order.

4. In Datagram Packet Switching technique, the path is not fixed.

. Intermediate nodes take the routing decisions to forward the packets.

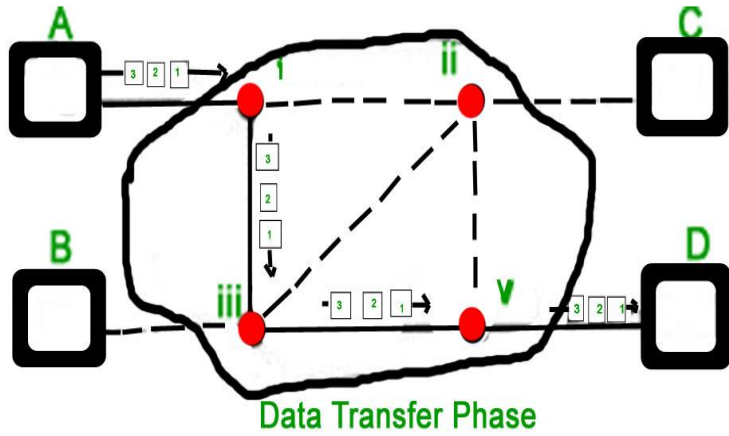. Datagram Packet Switching is also known as connectionless switching.

Two approaches of Packet Switching

Data Transfer Phase

Set up phase

Tear Down Phase
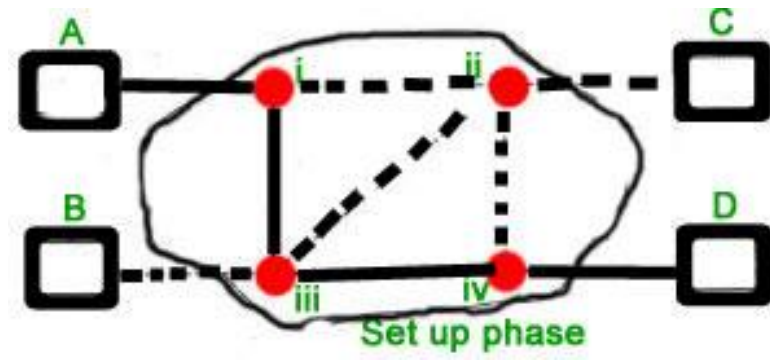
Phases in virtual circuit packet switching

Virtual Circuit Switching

1. Known as connection-oriented switching.

2. Preplanned route is established before the messages are sent.

3. Call request and call accept packets are used to establish the connection

4. The path is fixed for the duration of a logical connection.

Advantage

1. **Cost-effective:** Do not require massive secondary storage to store the packets, so cost is minimized to some extent.
2. **Reliable:** If any node is busy, then the packets can be rerouted.
3. **Efficient:** It does not require any established path prior to the transmission, hence makes use of available bandwidth very efficiently.

Disadvantage

1. Require low delay and high-quality services.
2. Protocols used in a packet switching technique are very complex and requires high implementation cost.
3. If the network is overloaded or corrupted, then it requires retransmission of lost packets.

Message Switching

Message Switching it is not necessary to established a dedicated path in between any two communication devices. Here each message is treated as an independent unit and includes its own destination source address by its own.

Each complete message is then transmitted from one device to another through internetwork.

Each intermediate device receive the message and store it until the next device is ready to receive it and then this message is forwarded to the next device. For this reason a message switching network is sometimes called as **Store and Forward Switching.**

Message Switching
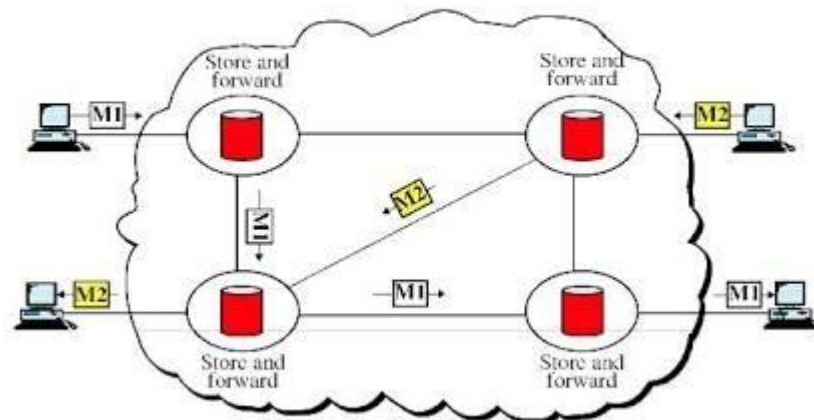
Comparison of Datagram and Virtual Circuit

Issue	Datagram	Virtual circuit
Connection setup	Not needed	Required
Addressing	Each packet contains the full destination address	Each packet contains a short VC identifier
State information	Switch doesn't hold state information	Switch holds VC state information in a table
Routing	Each packet is forwarded independently	All packets follow the same route
Effect of switch failures	None, except for packets lost during the crash	All VCs passing through the failed switch are broken
QoS support	Difficult	Easy
Congestion control	Difficult	Easy

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
Message 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

Thank You