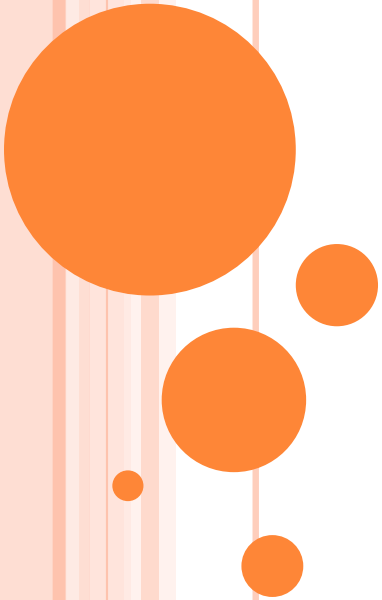
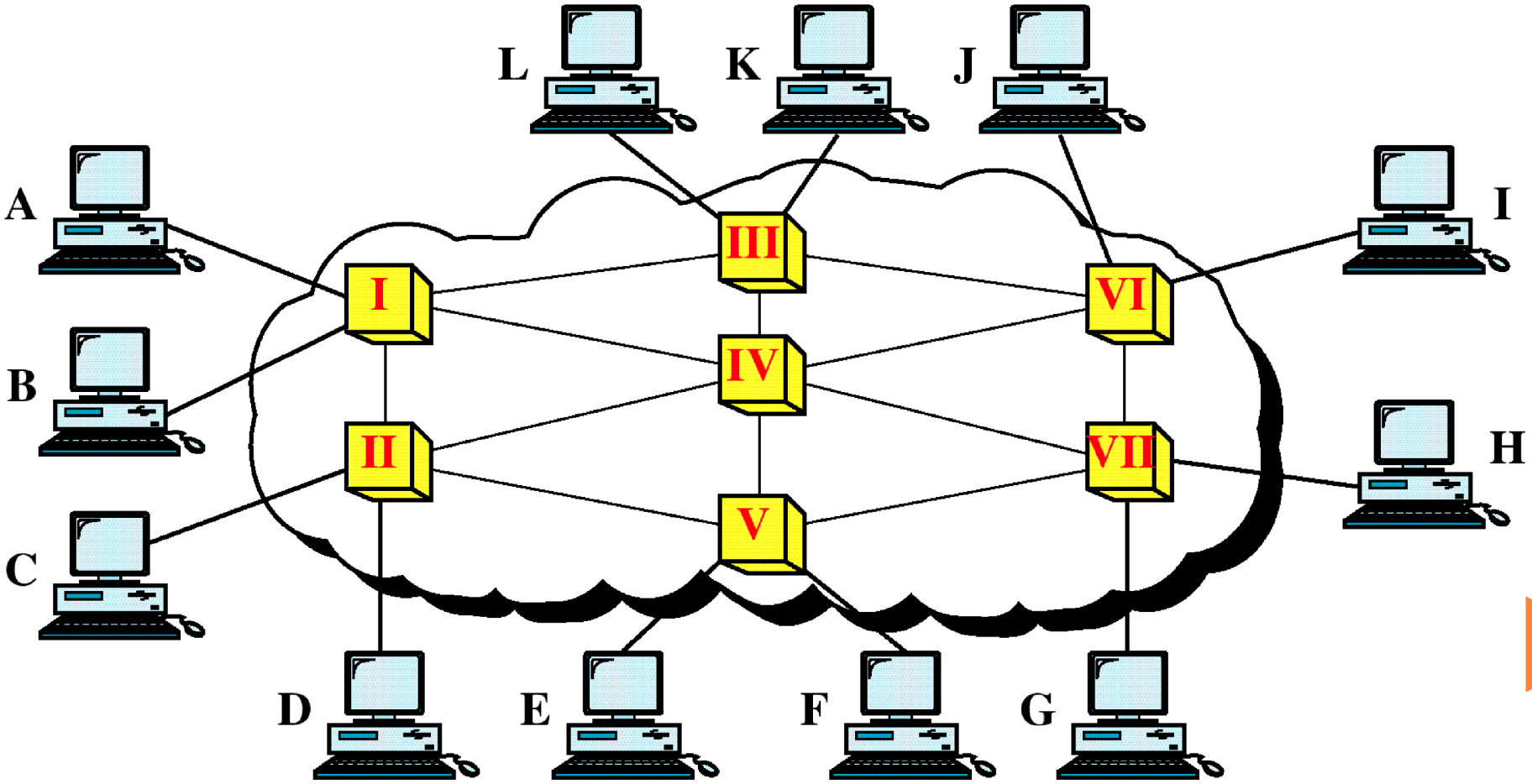


Switching

SWITCHED NETWORK

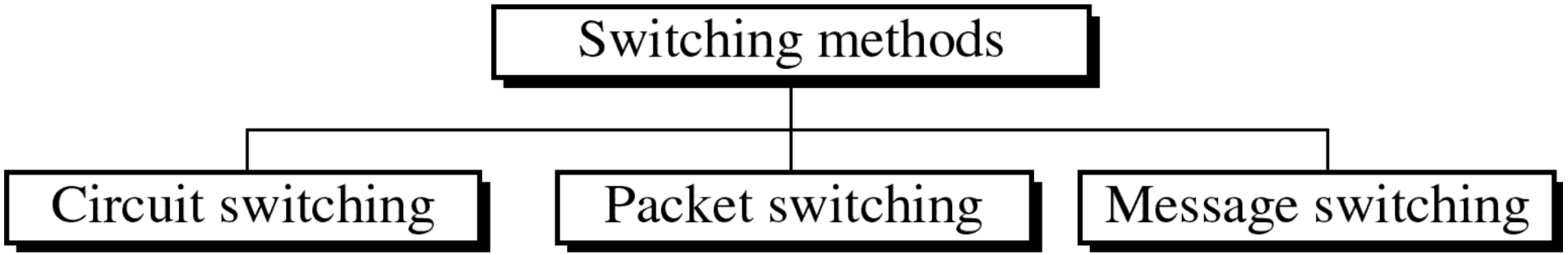
A switched network consist of series of interlinked nodes called *Switches*. Switches are Hardware or Software devices that are capable of creating temporary connections between 2 or more devices linked to the switch.



Switching Techniques

In large networks there might be multiple paths linking sender and receiver. Information may be switched as it travels through various communication channels. There are three typical switching techniques available for traffic.

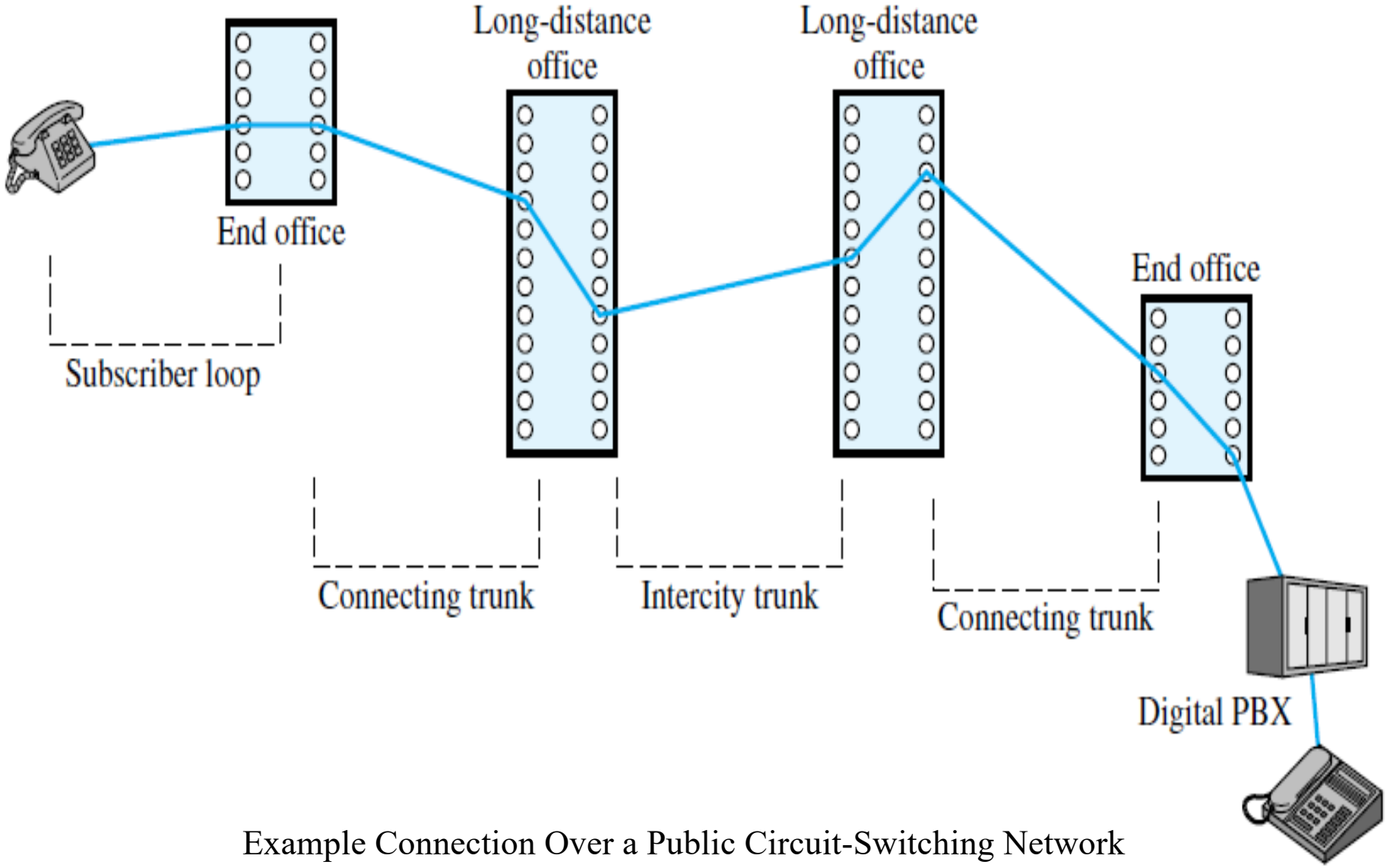
- Circuit Switching
- Message Switching
- Packet Switching


Switching methods
Circuit switching
Packet switching
Message switching

Circuit Switching

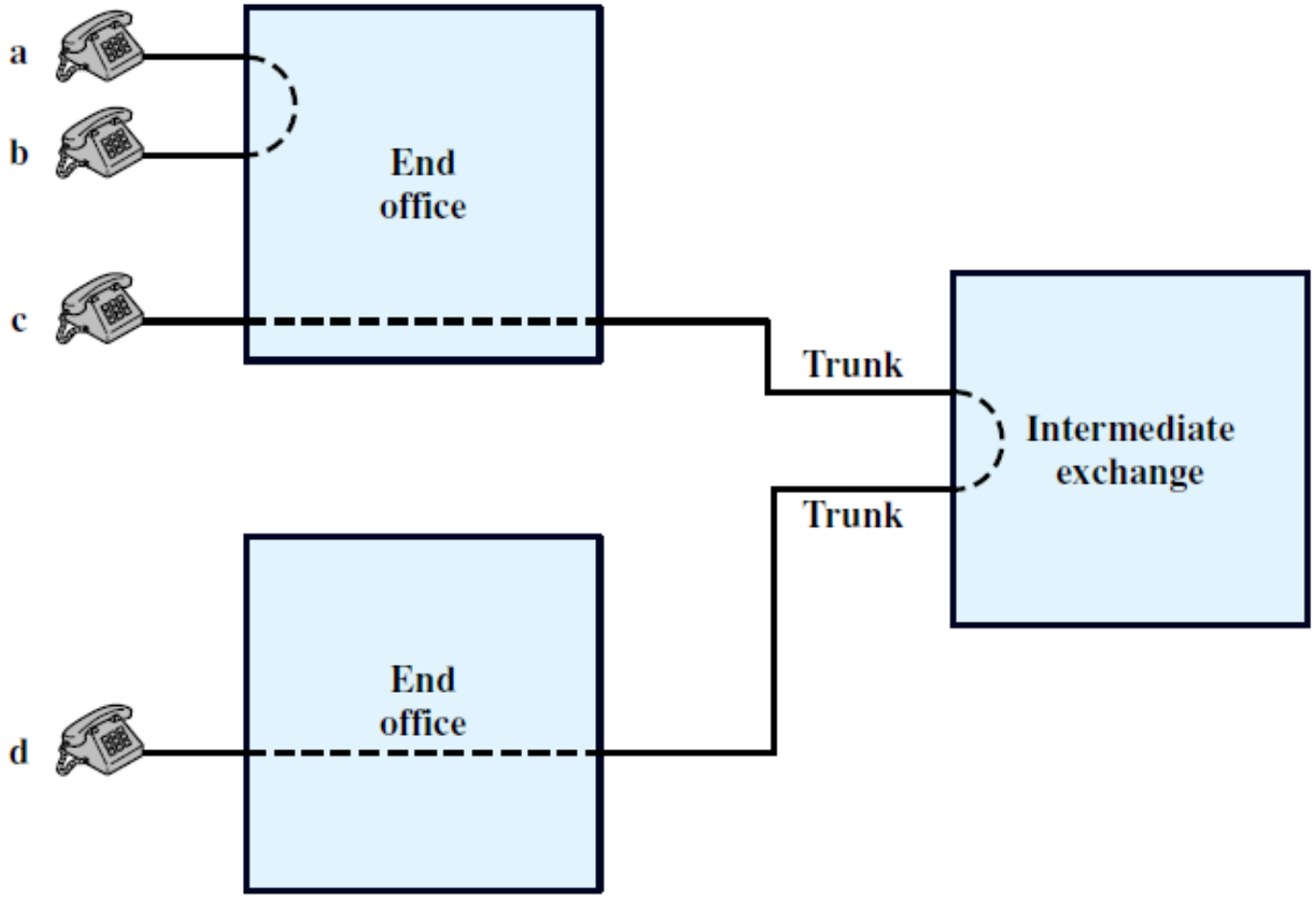
- Simplest method of data communication.
- Dedicated physical connection or path is established between the sending and receiving device.
- The link or path is released only when data transmission between sender and receiver is over.
- It takes place at Physical layer.
- For e.g. Telephone systems (PSTN) use Circuit Switching.

CIRCUIT-SWITCHED NETWORK

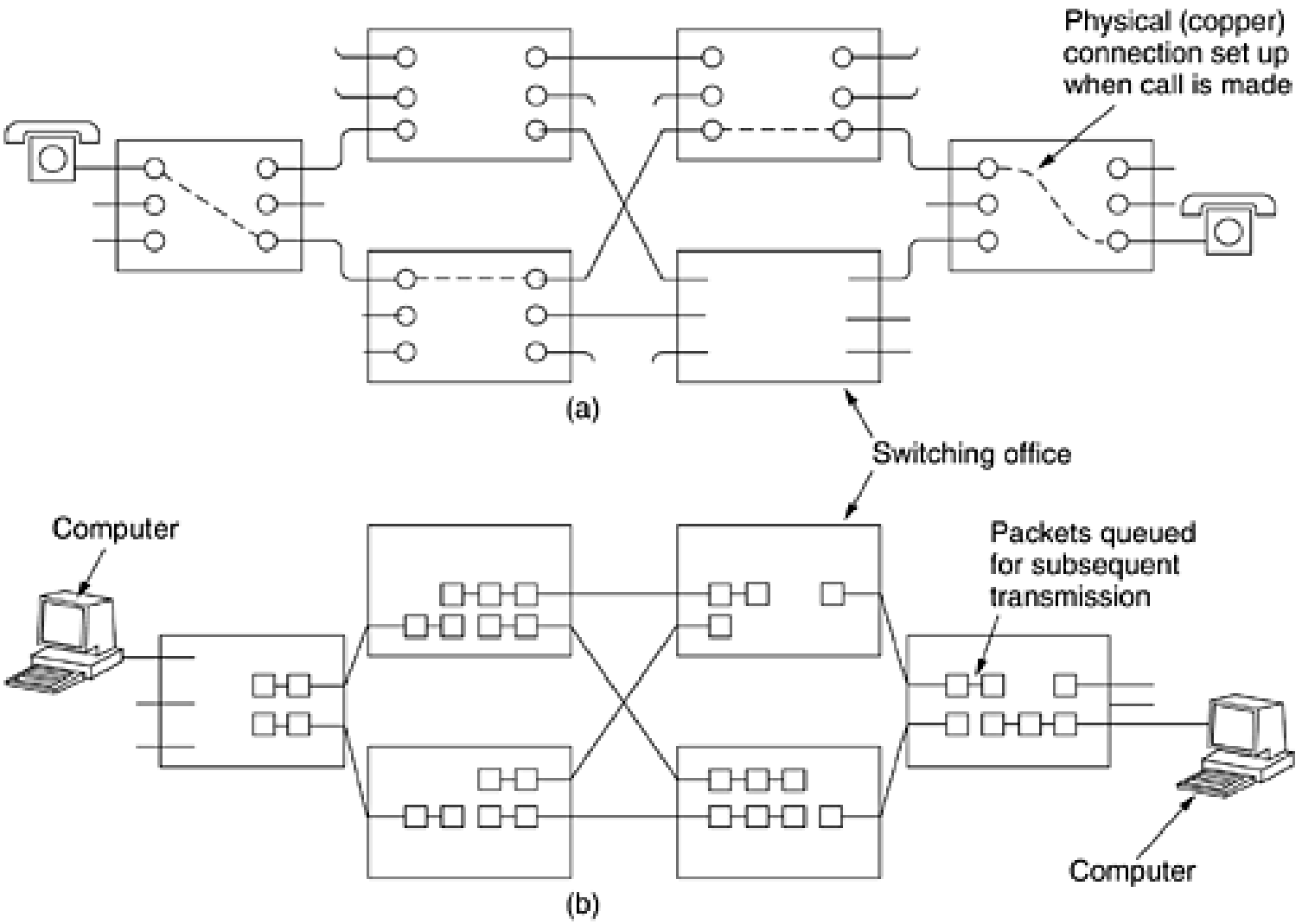


Example Connection Over a Public Circuit-Switching Network

Circuit Establishment

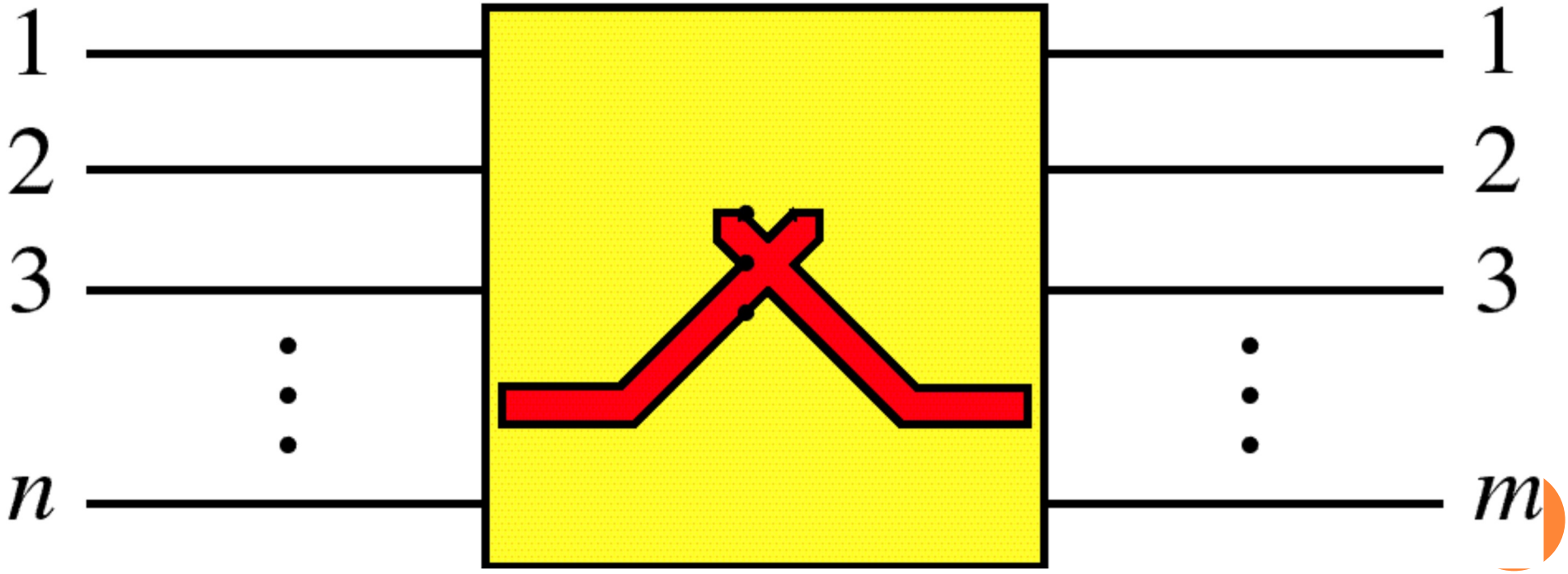


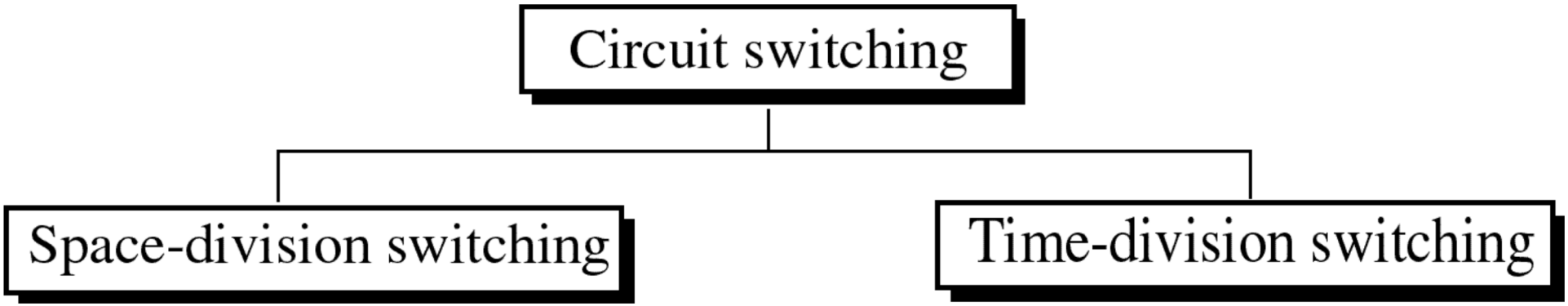
Circuit Switching



CIRCUIT SWITCH

- A Circuit Switch is a device that creates a temporary connection between an input link and output link.
- It usually has *n* input and *m* output lines (no. of input and output lines may not be equal).

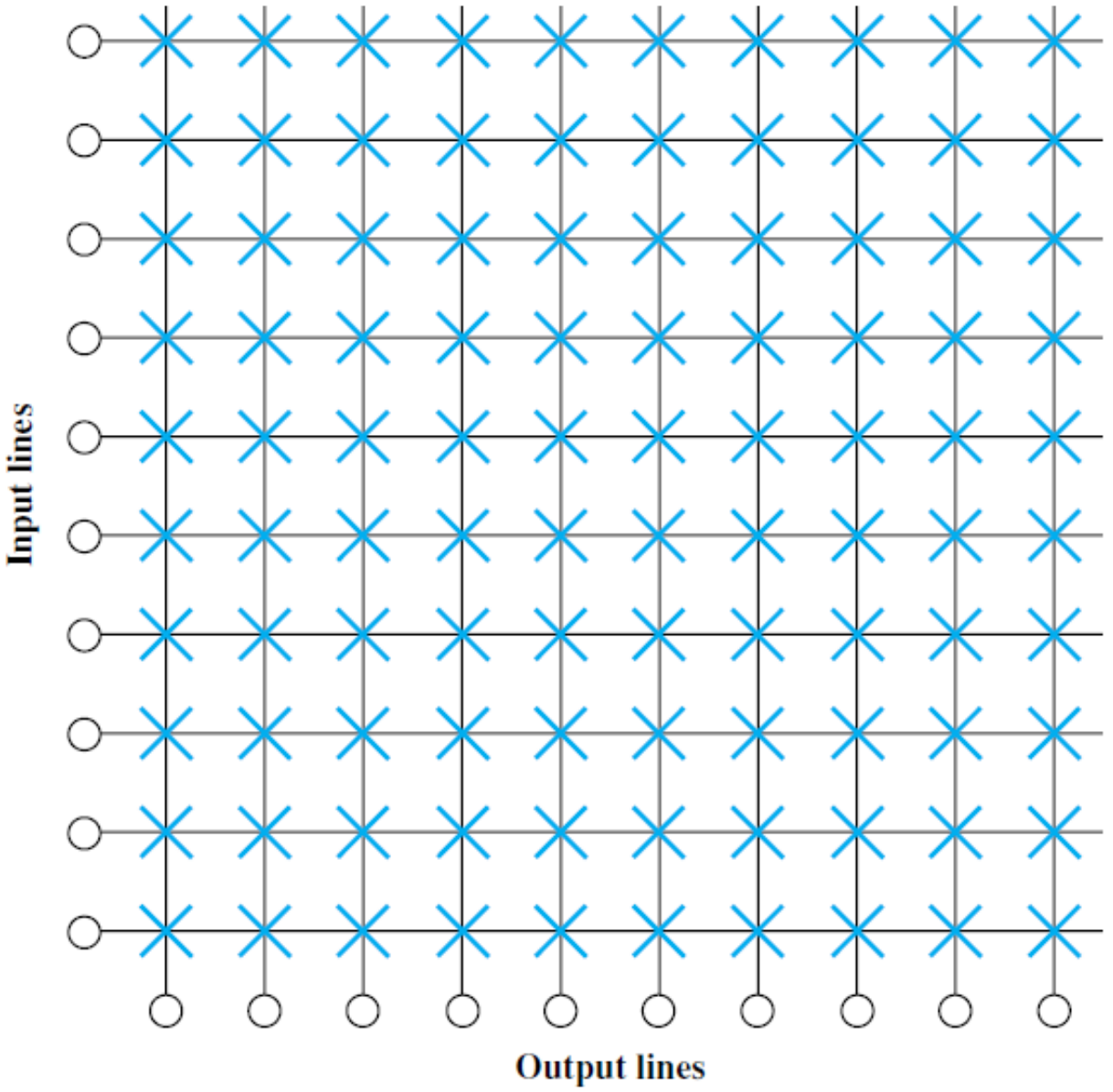



Circuit switching
Space-division switching
Time-division switching

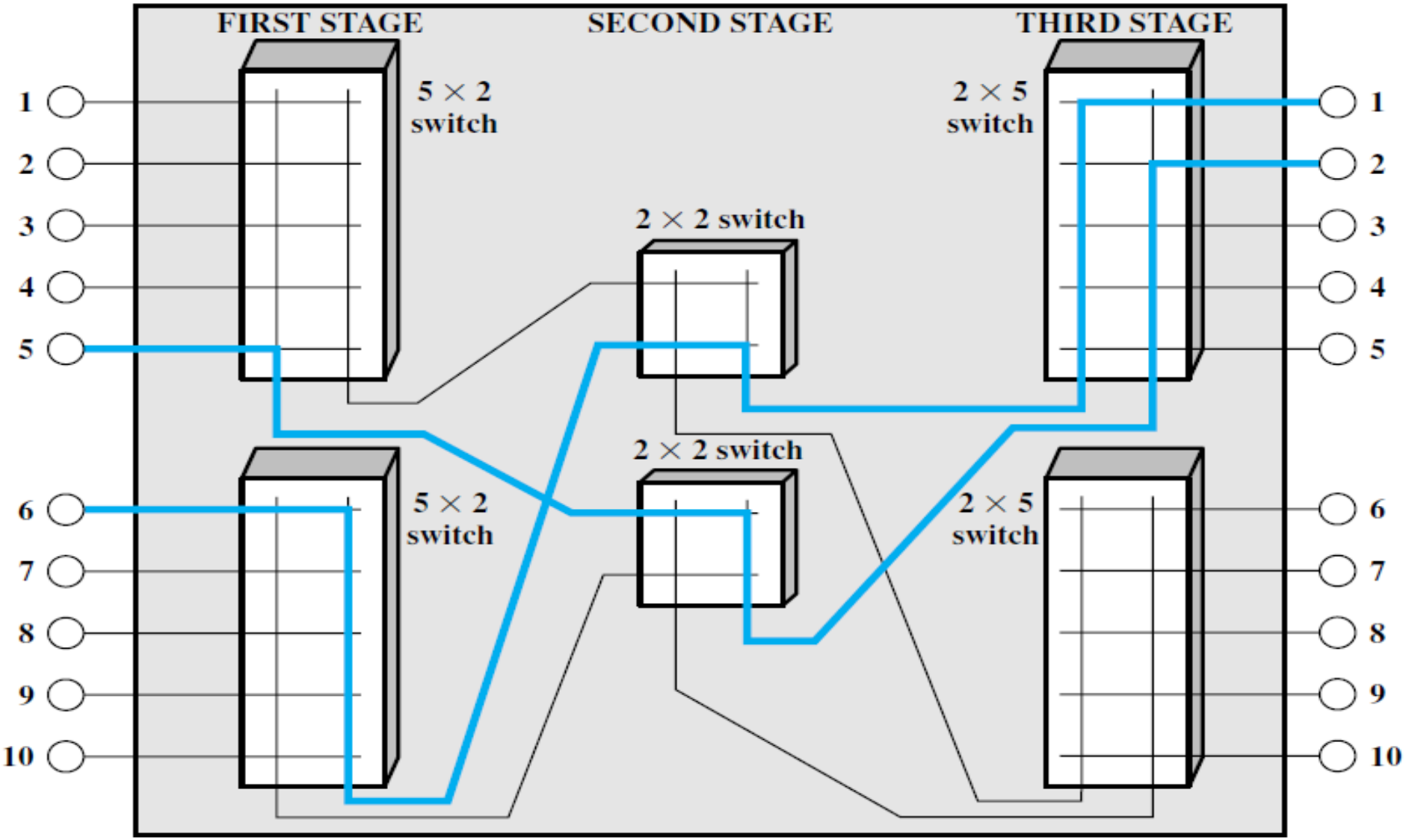
SPACE DIVISION SWITCHING

- As its name implies, a space division switch is one in which the signal paths are physically separate from one another (divided in space).
- Each connection requires the establishment of a physical path through the switch that is dedicated solely to the transfer of signals between the two end points.
- The basic building block of the switch is a metallic cross point or semiconductor gate that can be enabled and disabled by a control unit.

SPACE DIVISION SWITCHING



Three-Stage Space Division Switch



MULTISTAGE SWITCHING

Advantages

- The number of cross points is reduced, increasing crossbar utilization. (e.g reduce from 100 to 48)
- There is more than one path through the network to connect two endpoints, increasing reliability.

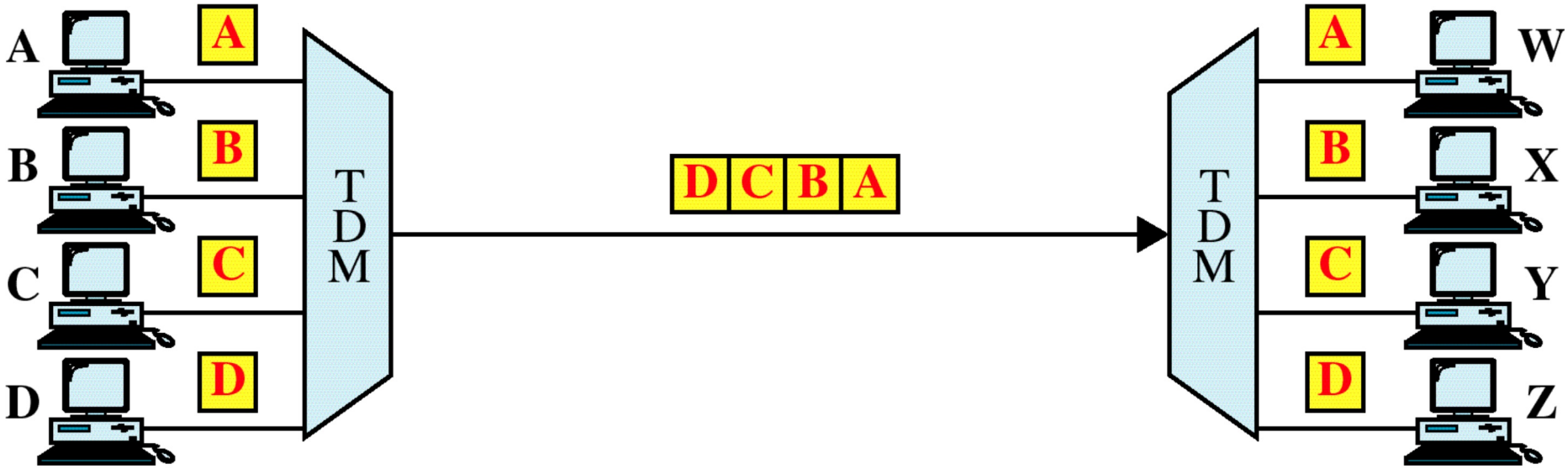
Disadvantages

- Multistage network requires a more complex control scheme.
- By considering multistage cross bar switch is a blocking switch even though single state cross bar switch is non blocking switch(e.g. 10 can't connect with 3,4,5)
- Multiple-stage switch can be made non blocking by increasing the number or size of the intermediate switches, but of course this increases the cost.

TIME DIVISION SWITCHING

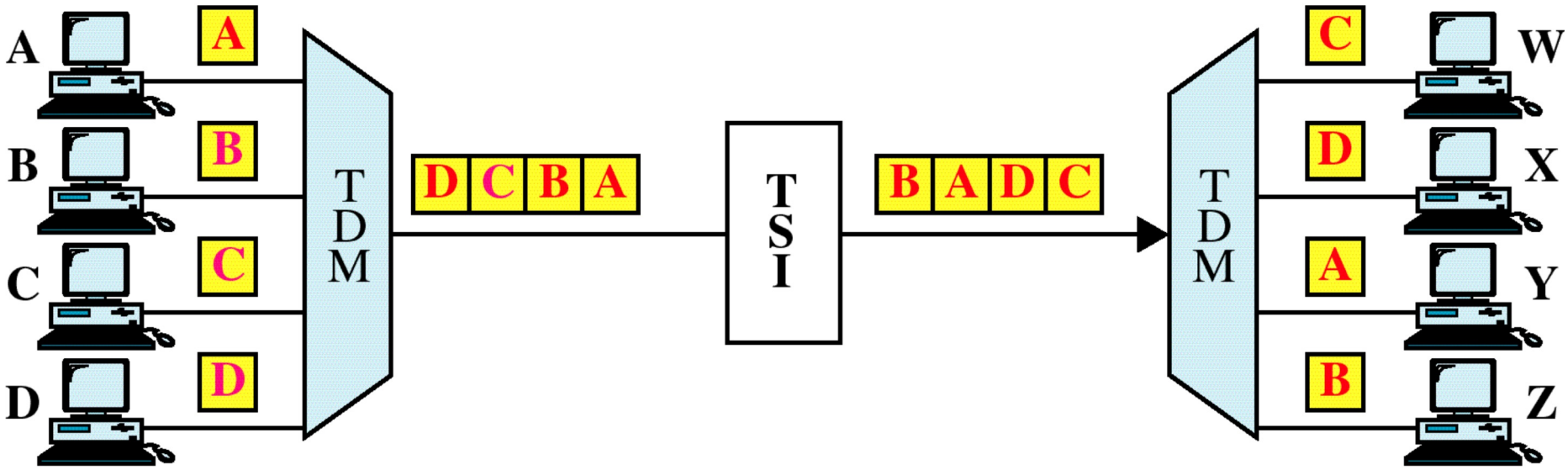
- With the rise of digital technology and the development of pulse code modulation (PCM) both voice and data could be transmitted via digital signals.
- Digital technology led to a fundamental change in the design and architecture of switching systems.
- The need for time division switching arises from the fact that digital signals are often carrying multiple individual circuits, or channels, in appropriate timeslots(TS).
- In such systems, when two different multiplexed channels are interconnected together through the switch matrix a virtual circuit is established.
- This is done by interchanging timeslots. This operation is referred to as timeslot interchanging TSI

TDM WITHOUT TSI



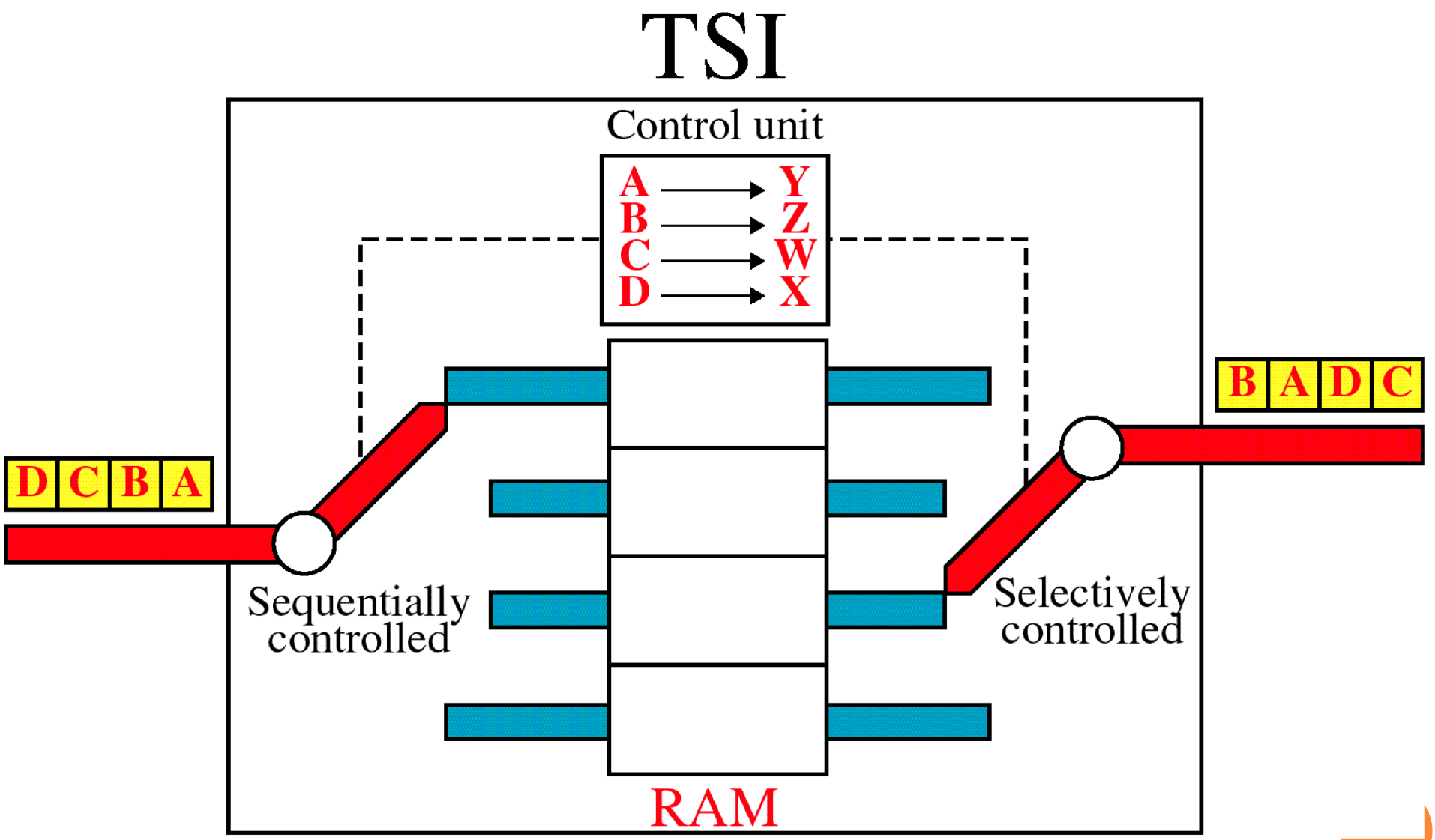
No switching

TDM WITH TSI



Switching

TIME-SLOT INTERCHANGE

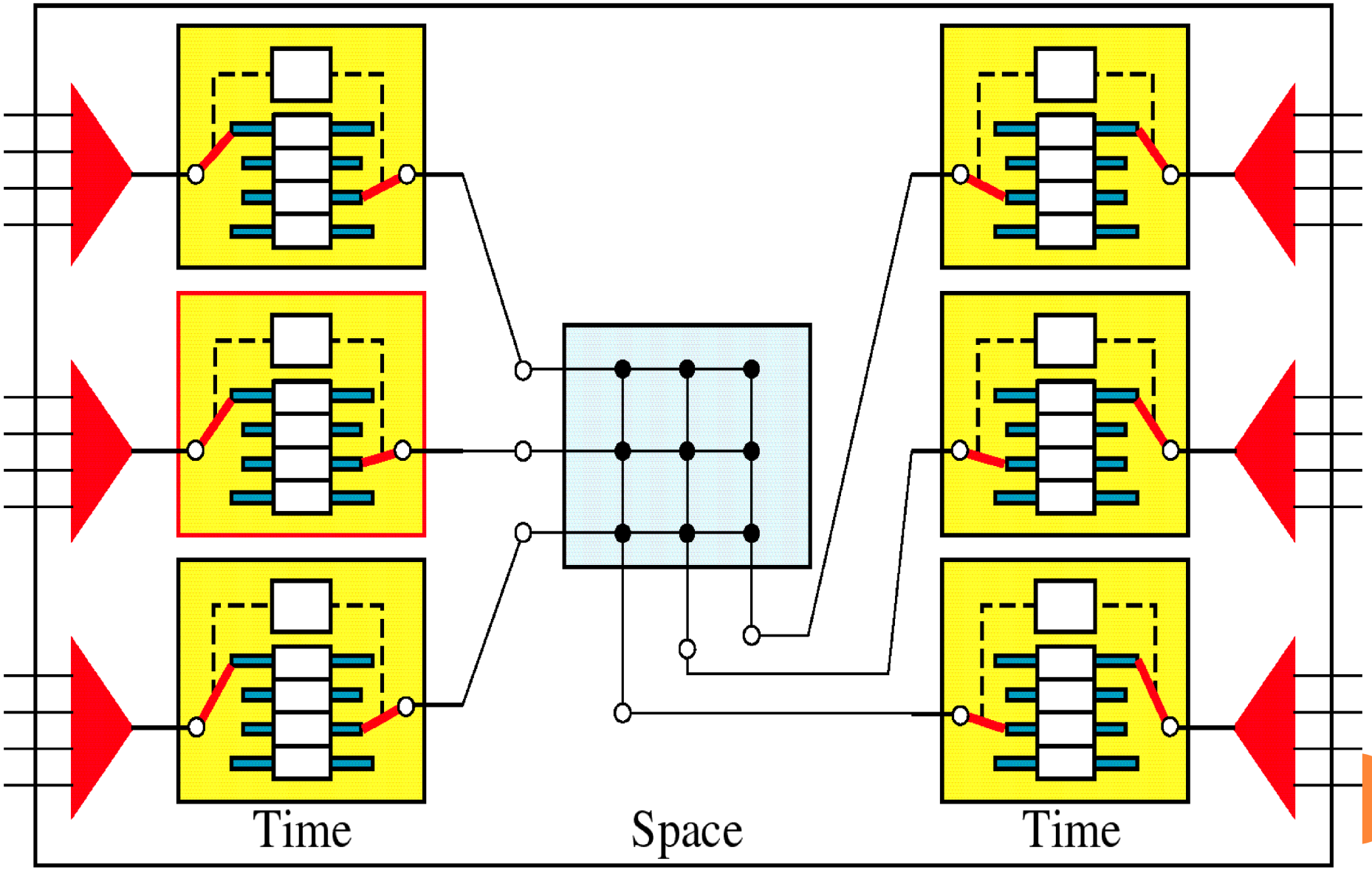


Time Space Time (TST) Switching

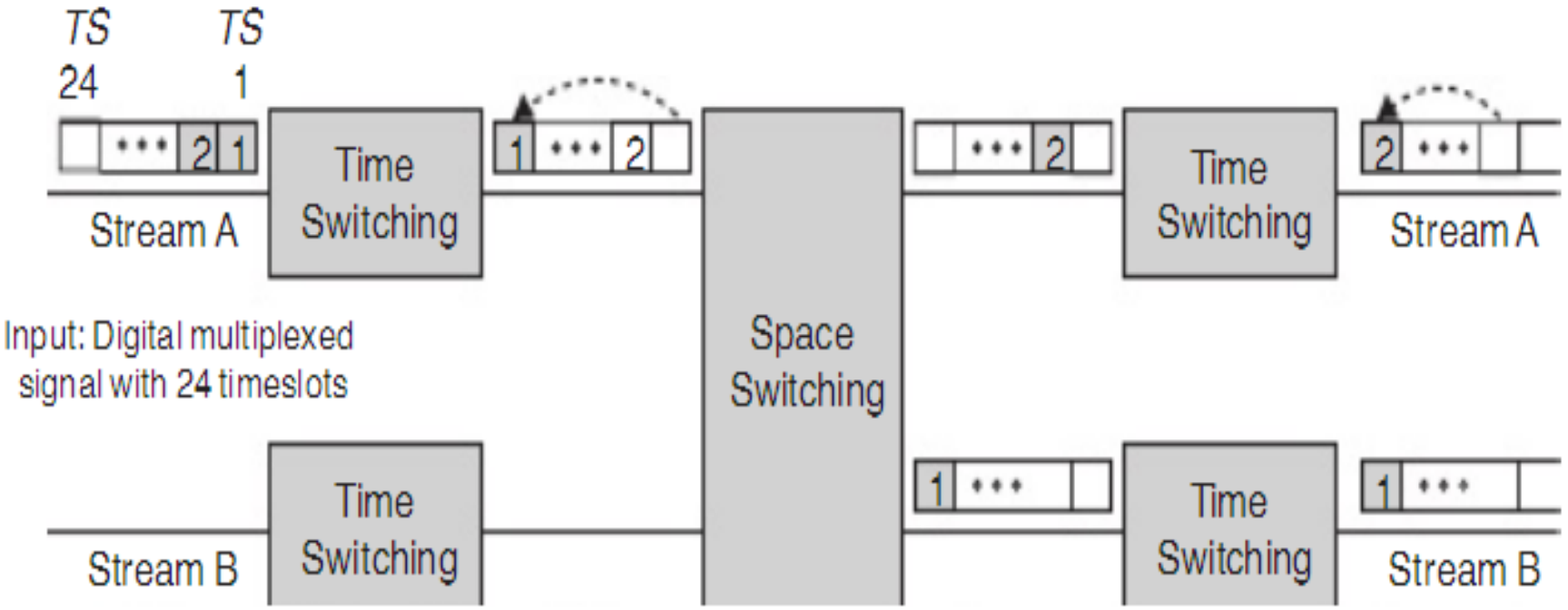
- In a digital switch architecture, an incoming channel must be connected to a channel on any outgoing stream.
- A common architecture to achieve this utilizes both time-division switch capability, to shift channels between timeslots, and space-division switching capability, to enable a different physical outgoing line system to be selected.

- This architecture is referred to as time-space-time (TST)

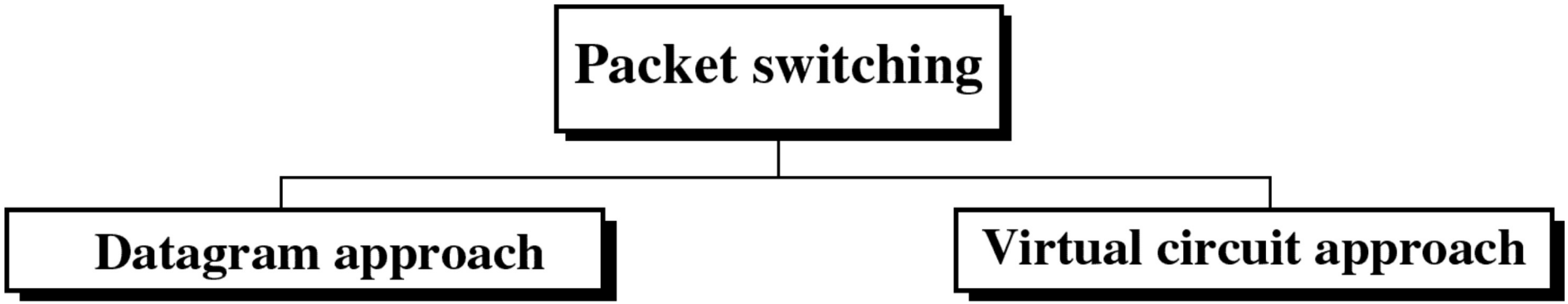
TST Switch



TST EXAMPLE



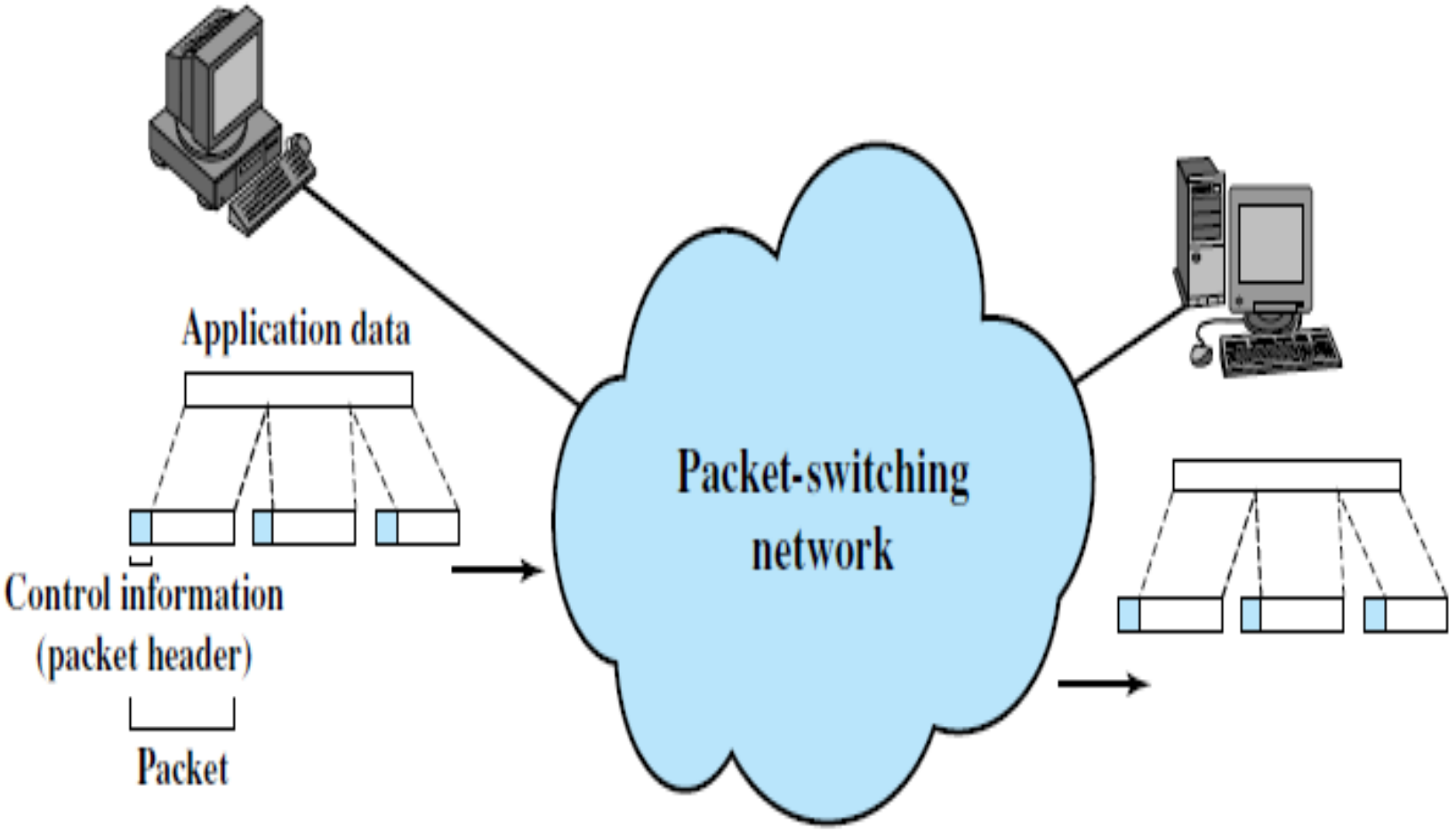
A time-space-time switch architecture, connecting channel 1 and 2 on incoming stream A to channel 24 on outgoing streams B and A, respectively


Packet switching
Datagram approach
Virtual circuit approach

Packet Switching

- Message is broken up into packets of fixed or variable size.
- Each packet includes a Header that contains source address, destination address and other control information.
- The size of the packet depends upon type of Network and Protocol used.
- It uses 2 methods:
  - Datagram Approach
    In this technique, each packet, treated independently, is referred to as a datagram
  - Switched Virtual Circuit
    A preplanned route is established before any packets are sent. Once the route is established, all the packets between a pair of communicating parties follow this same route through the network

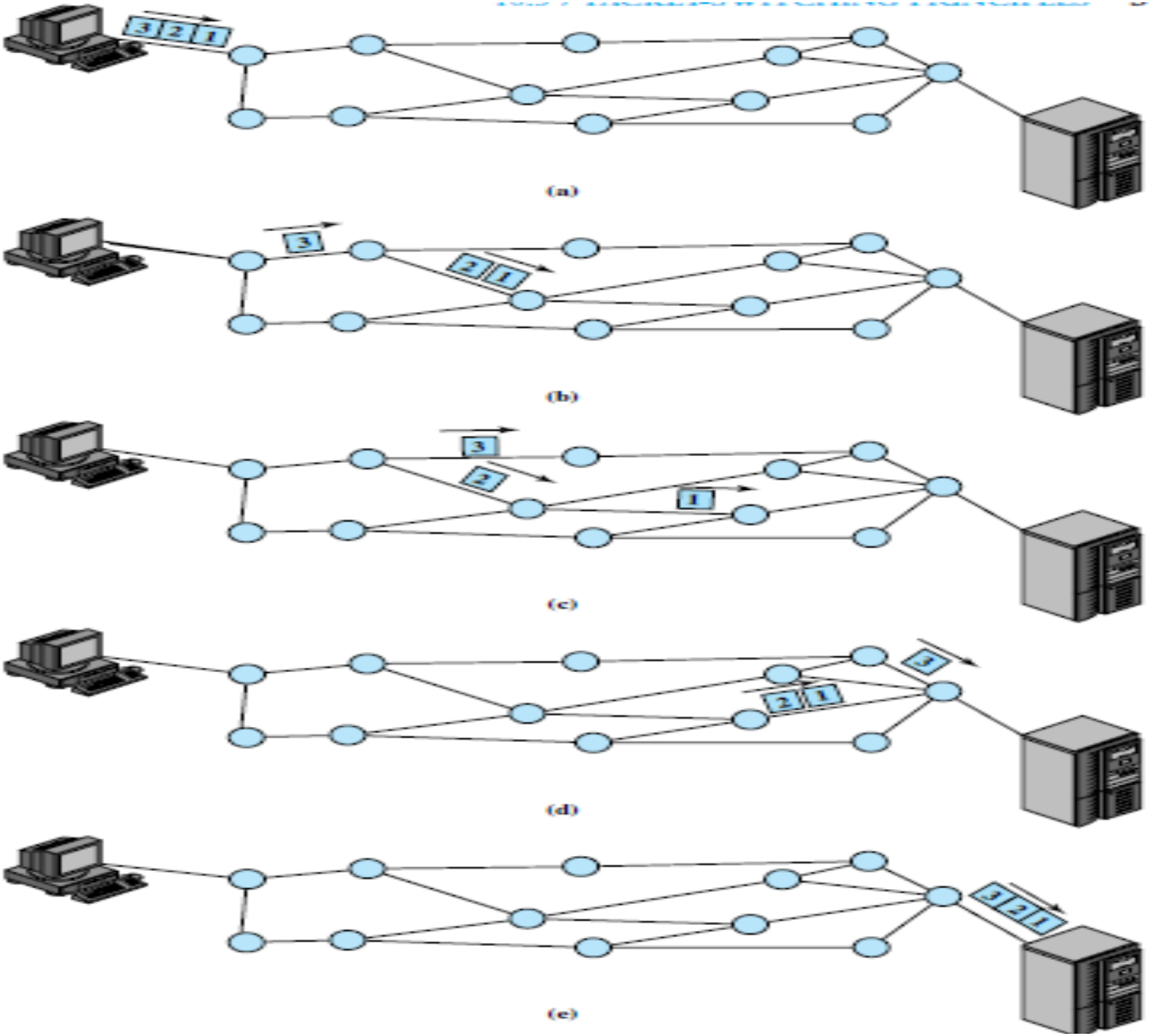
Packet Switching



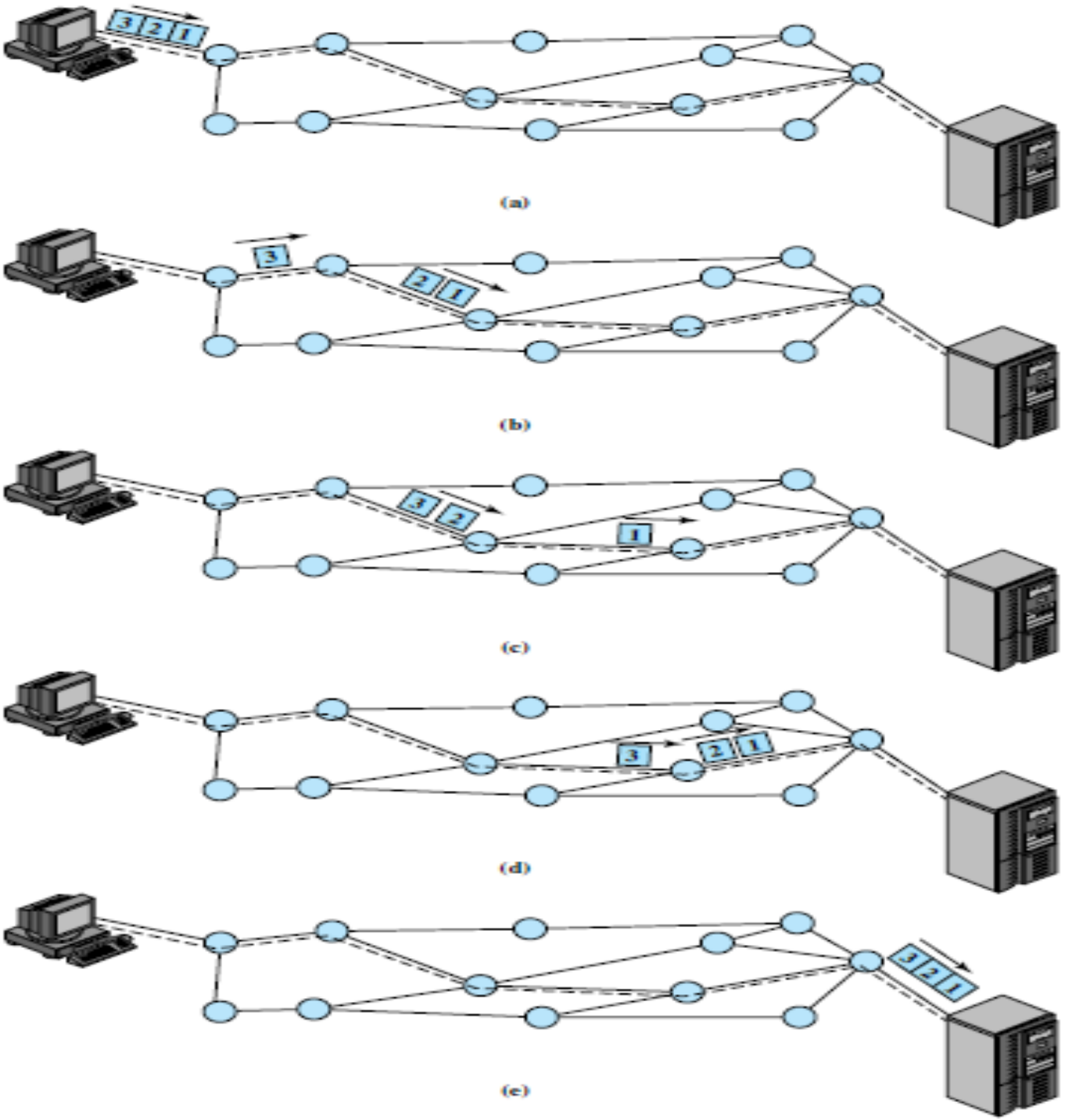
Advantages of packet switch over circuit switch

- Line efficiency is greater, because a single node-to-node link can be dynamically shared by many packets over time
- A packet-switching network can perform data-rate conversion.
- When traffic becomes heavy On a packet-switching network, packets are still accepted, but delivery delay increases (circuit switch network refuse accept additional connections)
- Qos can be achieve

Datagram Approach



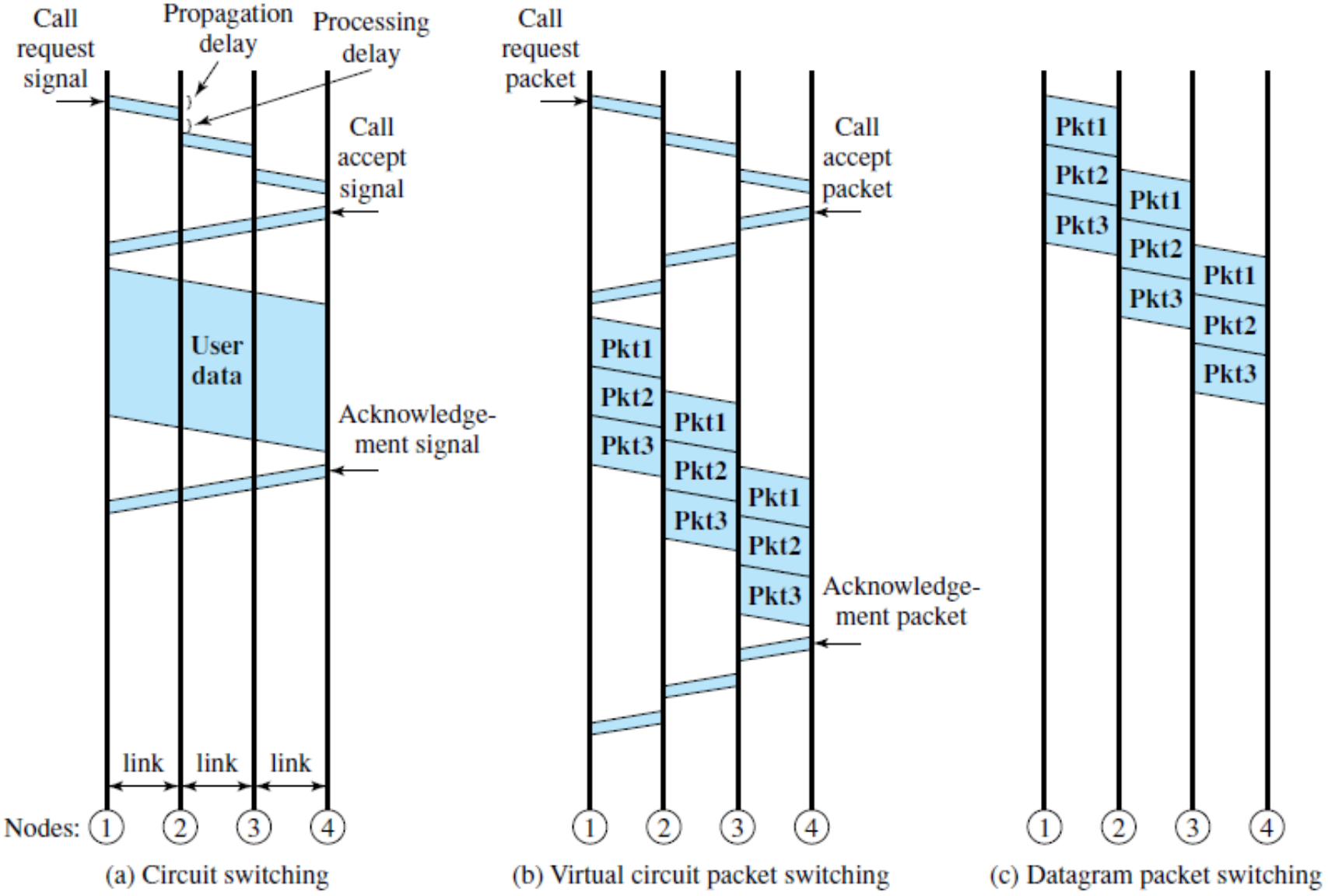
Switched Virtual Circuit



Q1. Try to find out pros and cons of above tow packet switching methods?

Q2. Find out the similarities and differences between circuit switching and switched virtual circuit(packet switching method)

Event Timing for Circuit Switching and Packet Switching



Item	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

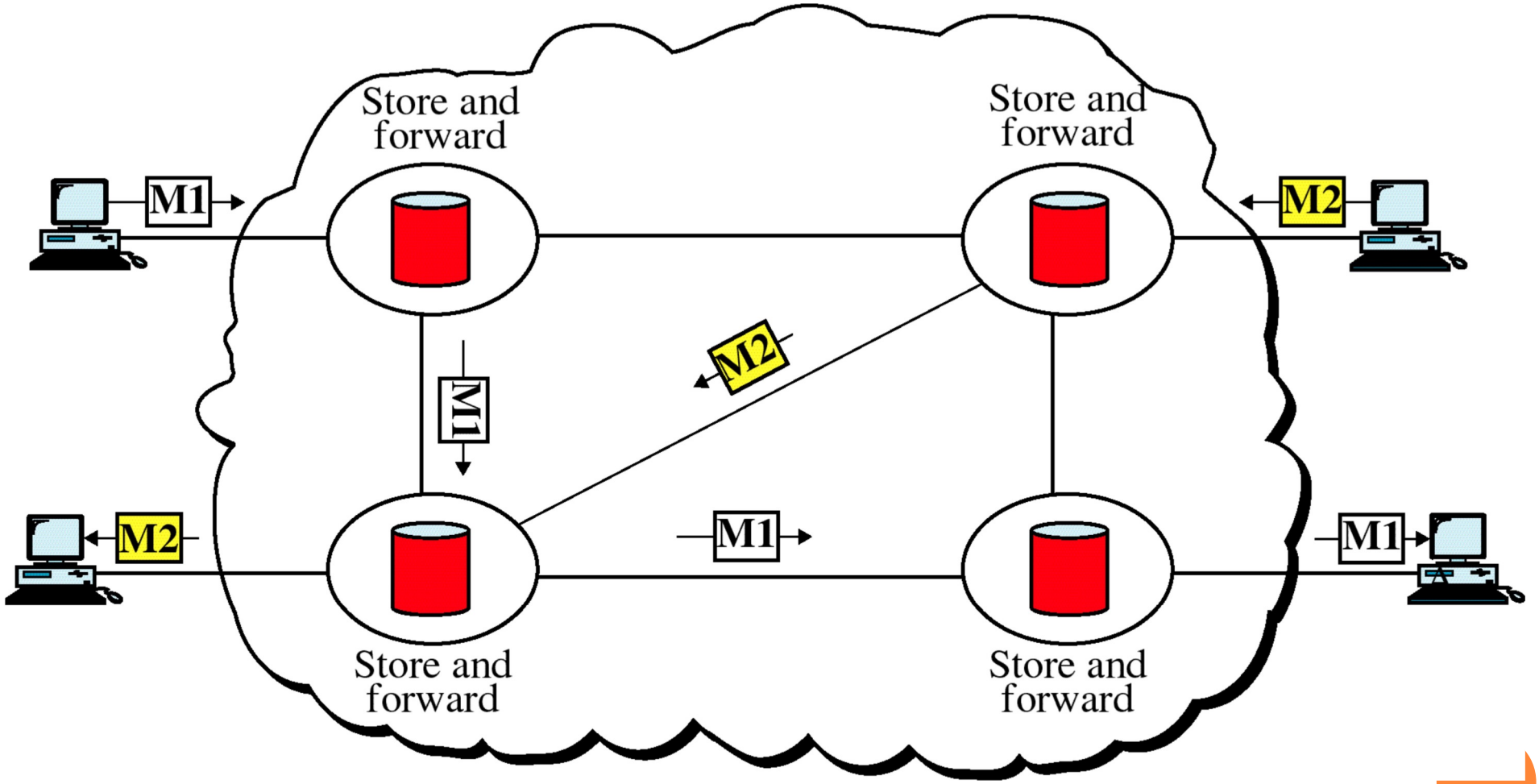
Message Switching

- With message switching there is no need to establish a dedicated path between two stations.
- When a station sends a message, the destination address is appended to the message.
- The message is then transmitted through the network, in its entirety, from node to node.
- Each node receives the entire message, stores it in its entirety on disk, and then transmits the message to the next node.
- This type of network is called a store-and-forward network.

Message Switching

- A message-switching node is typically a general-purpose computer.
- The device needs sufficient storage capacity to store the incoming messages, which could be long.
- A time delay is introduced using this type of scheme due to store- and-forward time, plus the time required to find the next node in the transmission path.

Message Switching



Message Switching

Advantages:

- Channel efficiency can be greater compared to circuit-switched systems, because more devices are sharing the channel.
- Traffic congestion can be reduced, because messages may be temporarily stored in route.
- Message priorities can be established due to store-and-forward technique.
- Message broadcasting can be achieved with the use of broadcast address appended in the message.

Message Switching

Disadvantages

- Message switching is not compatible with interactive applications.

- Store-and-forward devices are expensive, because they must have large disks to hold potentially long messages.

Message Switching Delay Consideration