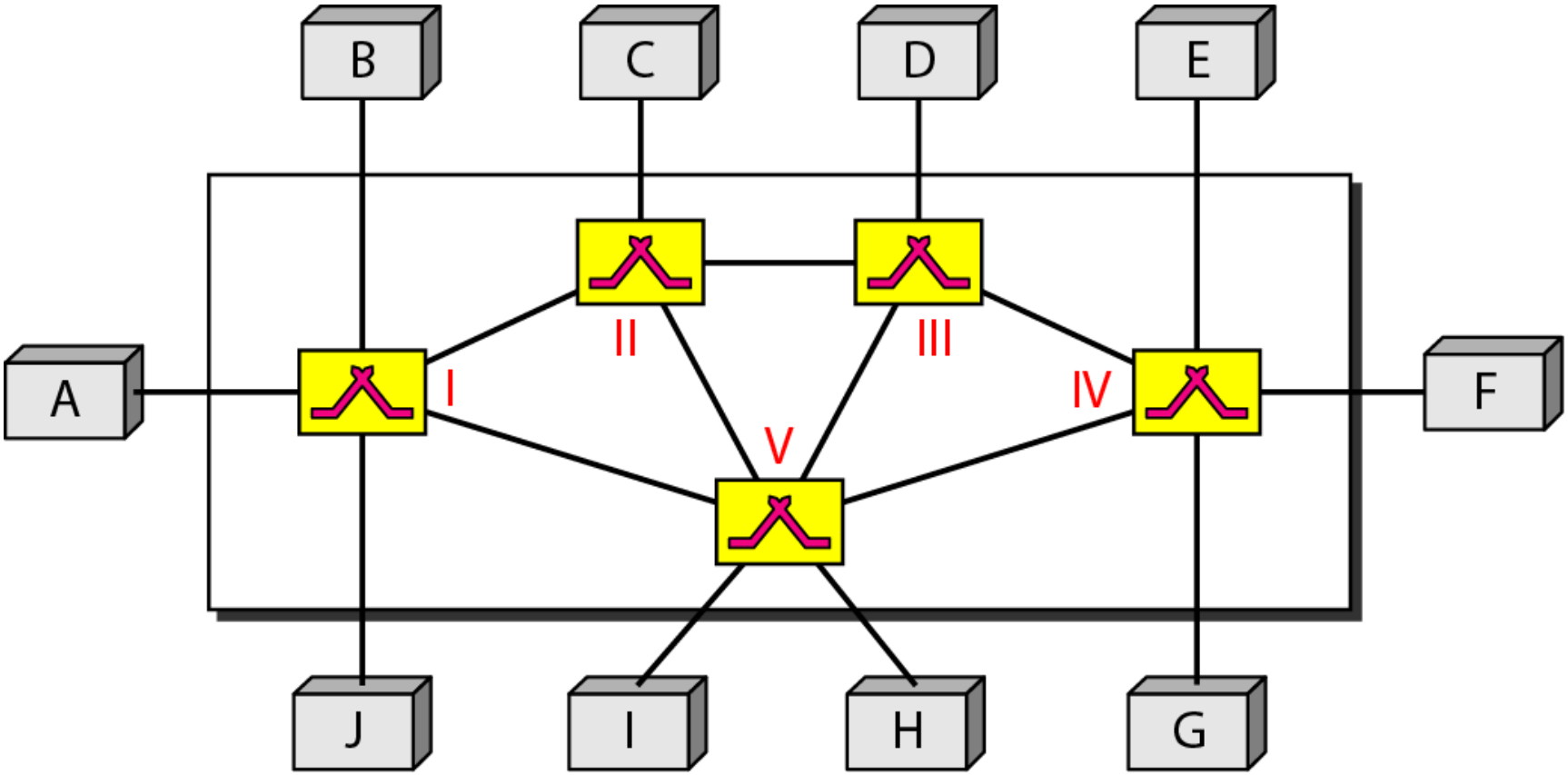
Unit -II

Switching

Simple Switched Network



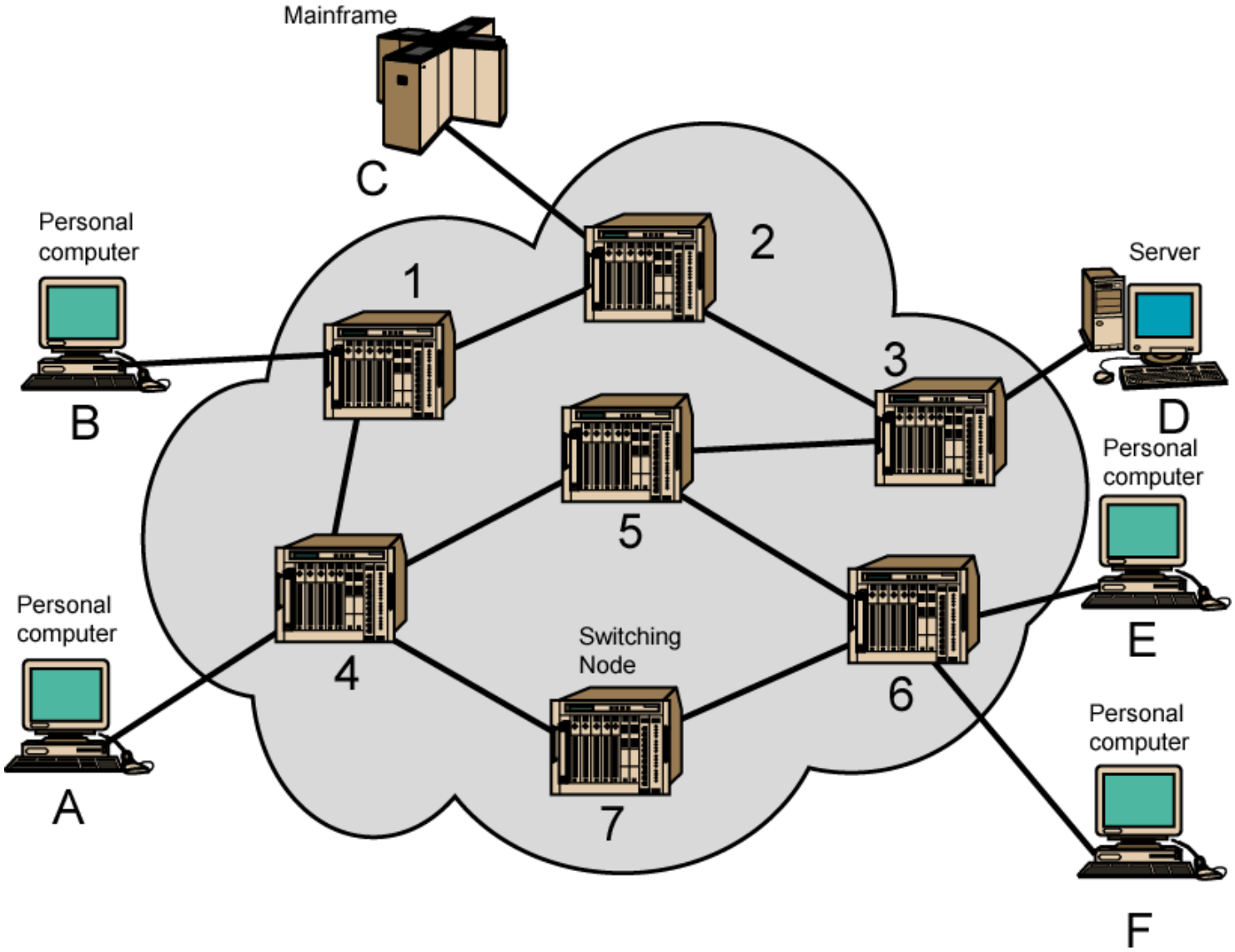
Switching Networks

- Long distance transmission is typically done over a network of switched nodes
- Nodes not concerned with content of data
- End devices are stations
  - Computer, terminal, phone, etc.
- communications network -A collection of nodes.
- Data routed by being switched from node to node

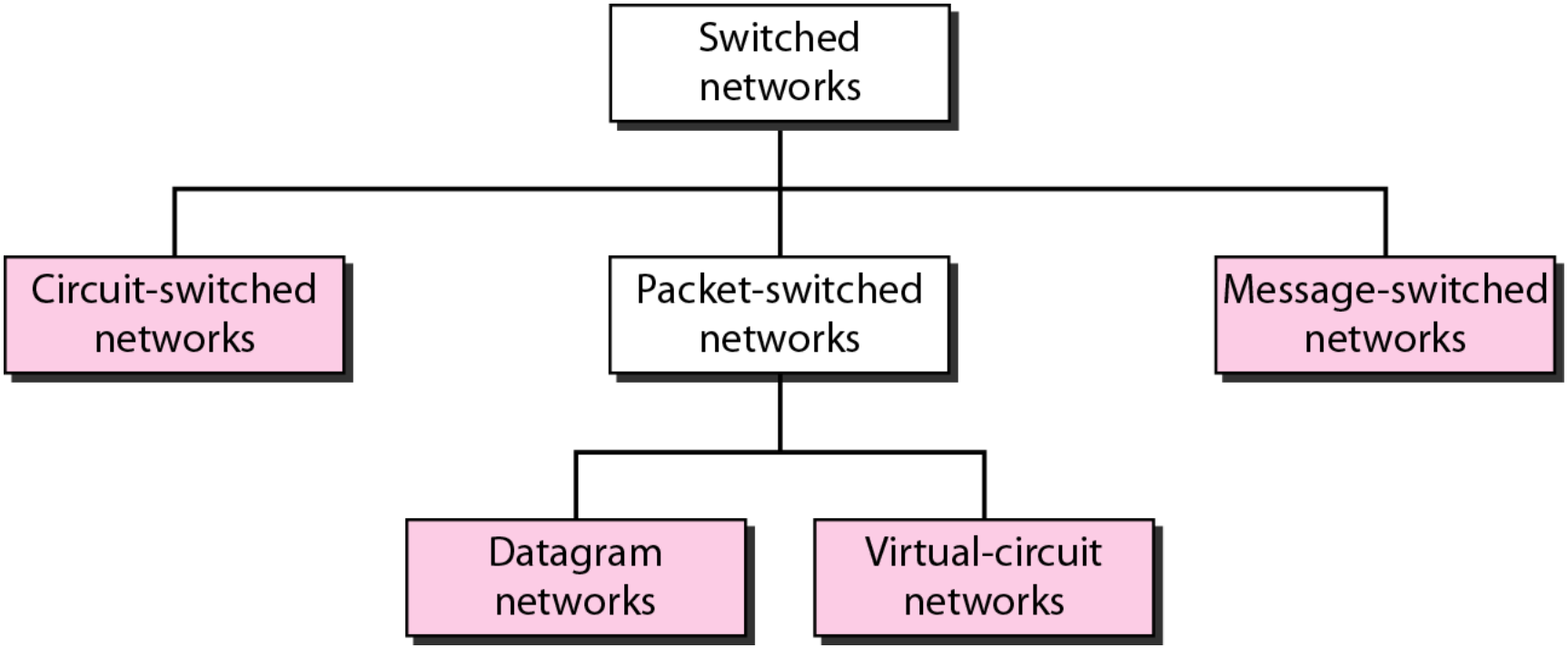
Nodes

- Nodes may connect to other nodes only, or to stations and other nodes
- Node to node links usually multiplexed.
- Node-station links are generally dedicated point-to-point links.
- Network is usually partially connected
  - Some redundant connections are desirable for reliability

Simple Switched Network



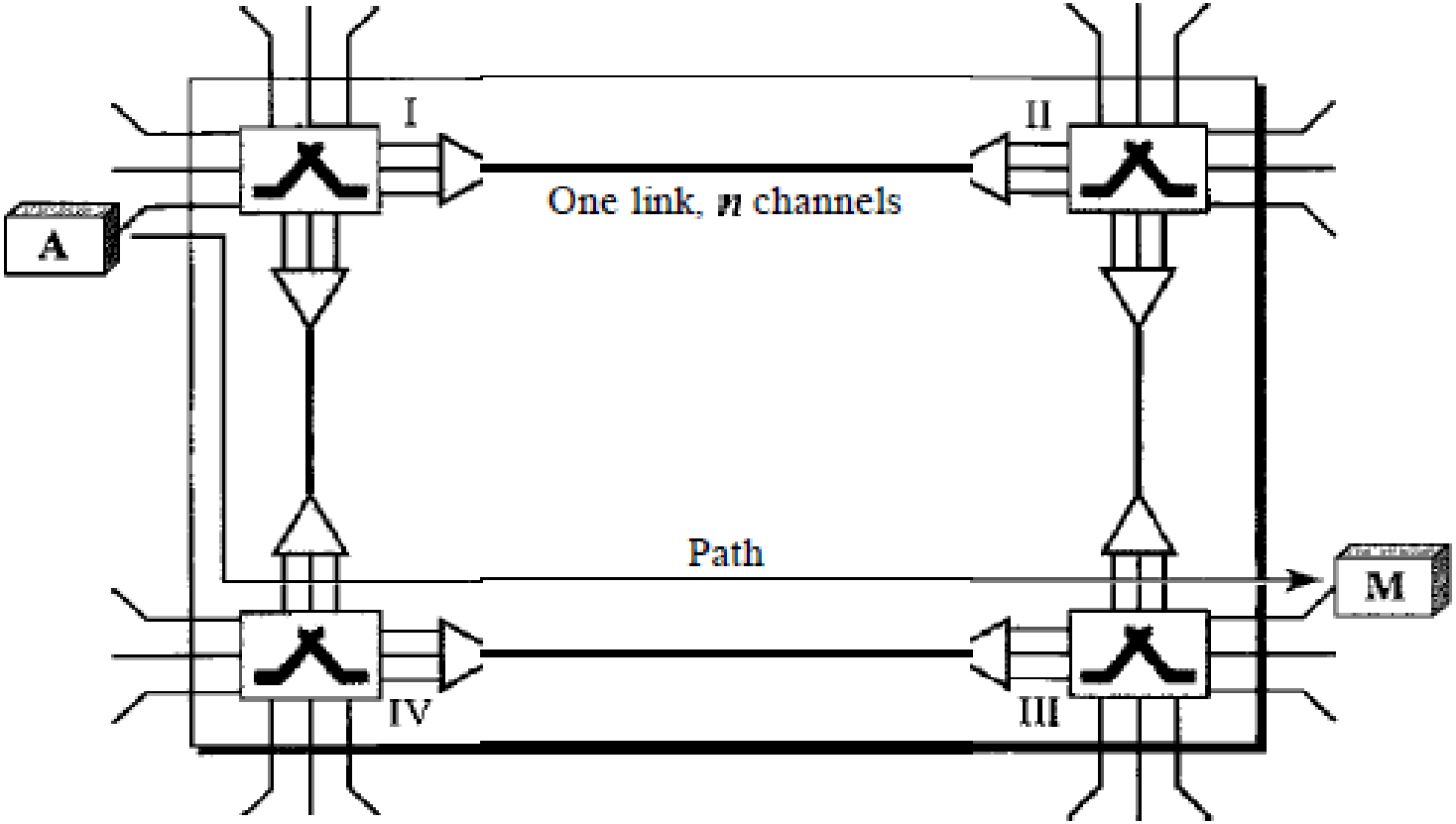
Taxonomy of switched networks



Circuit Switching(Physical Layer)

- A circuit-switched network consists of a set of switches connected by physical links.
- A connection between two stations is a dedicated path made of one or more links. However, each connection uses only one dedicated channel on each link.
- Each link is normally divided into *n* channels by using FDM or TDM

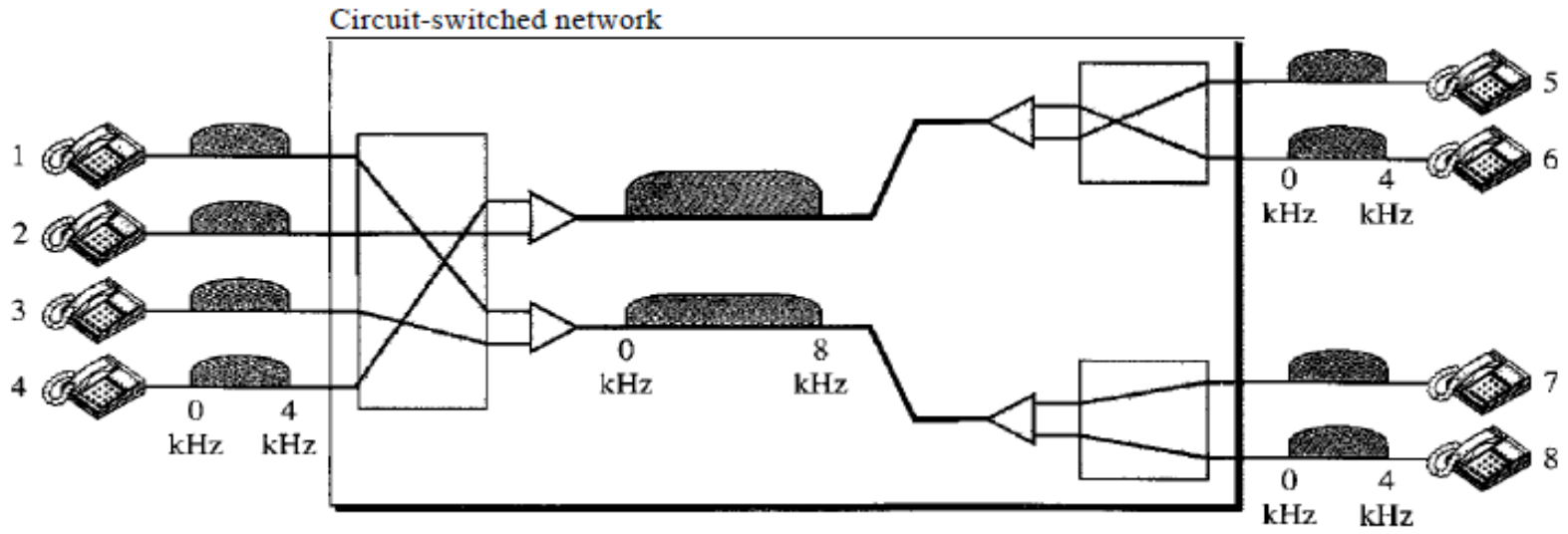
A trivial circuit-switched network



- Circuit switching takes place at the physical layer.
- Before starting communication, the stations must make a reservation for the resources to be used during the communication. These resources, such as channels (bandwidth in FDM and time slots in TDM), switch buffers, switch processing time, and switch input/output ports, must remain dedicated during the entire duration of data transfer until the teardown phase.
- Data transferred between the two stations are not packetized (physical layer transfer of the signal). The data are a continuous flow sent by the source station and received y the destination station, although there may be periods of silence.
- There is no addressing involved during data transfer. The switches route the data based on their occupied band (FDM) or time slot (TDM).

Example

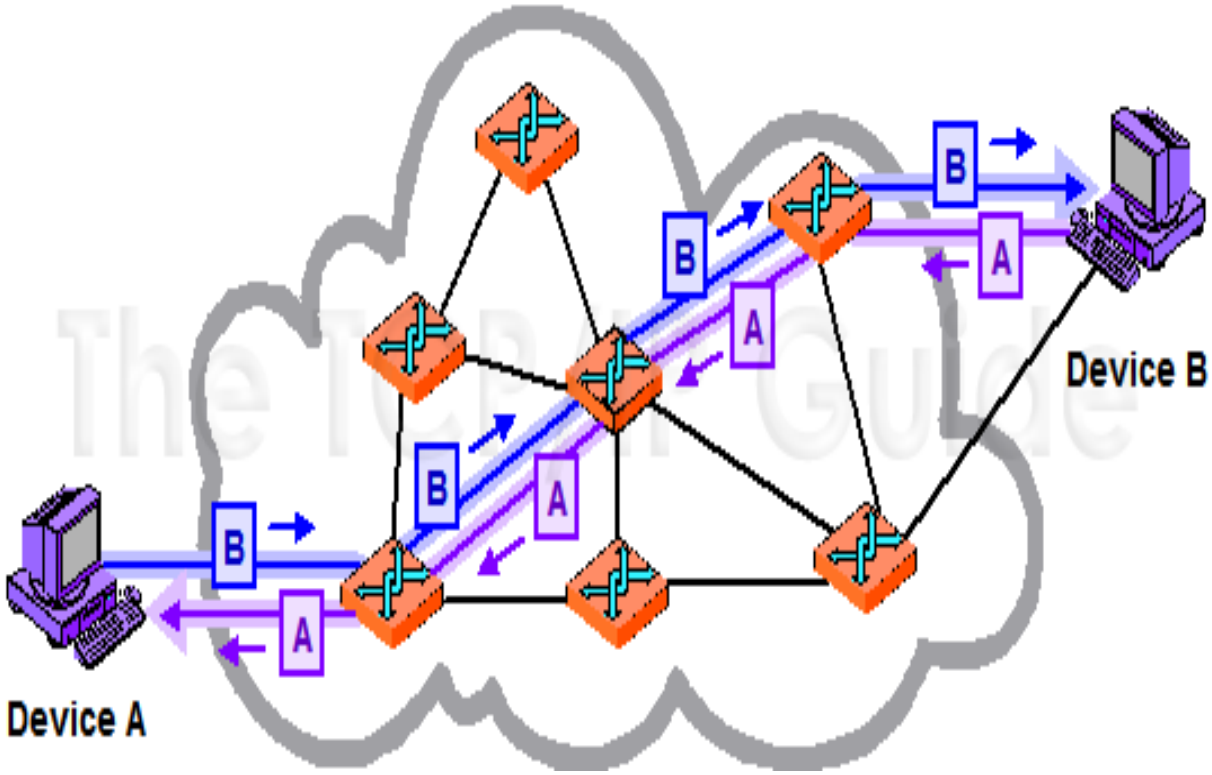
- As a trivial example, let us use a circuit-switched network to connect eight telephones in a small area. Communication is through 4-kHz voice channels. We assume that each link uses FDM to connect a maximum of two voice channels. The bandwidth of each link is then 8 kHz. Figure 8.4
- shows the situation. Telephone 1 is connected to telephone 7; 2 to *5;* 3 to 8; and 4 to 6. Of course the situation may change when new connections are made. The switch controls the connections.



Circuit Switching

- Dedicated communication path between two stations
- Three phases
  - Establish
  - Transfer
  - Disconnect
- Must have switching capacity and channel capacity to establish connection
- Must have intelligence to work out routing

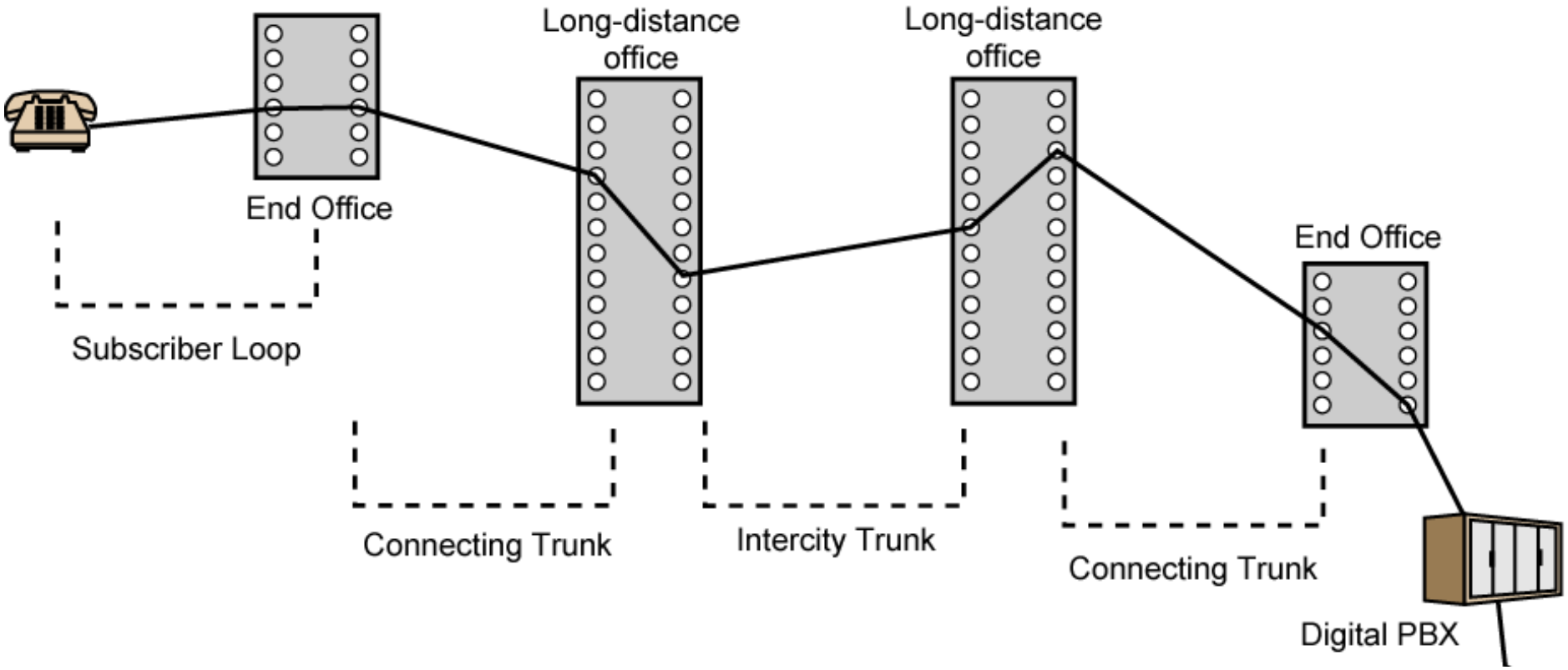
Circuit Switching



Circuit Switching

- Inefficient
  - Channel capacity dedicated for duration of connection
  - If no data, capacity wasted
- Set up (connection) takes time
- Once connected, transfer is transparent
- Circuit switching designed for voice
  - Resources dedicated to a particular call
  - Much of the time a data connection is idle
  - Data rate is fixed
    - Both ends must operate at the same rate

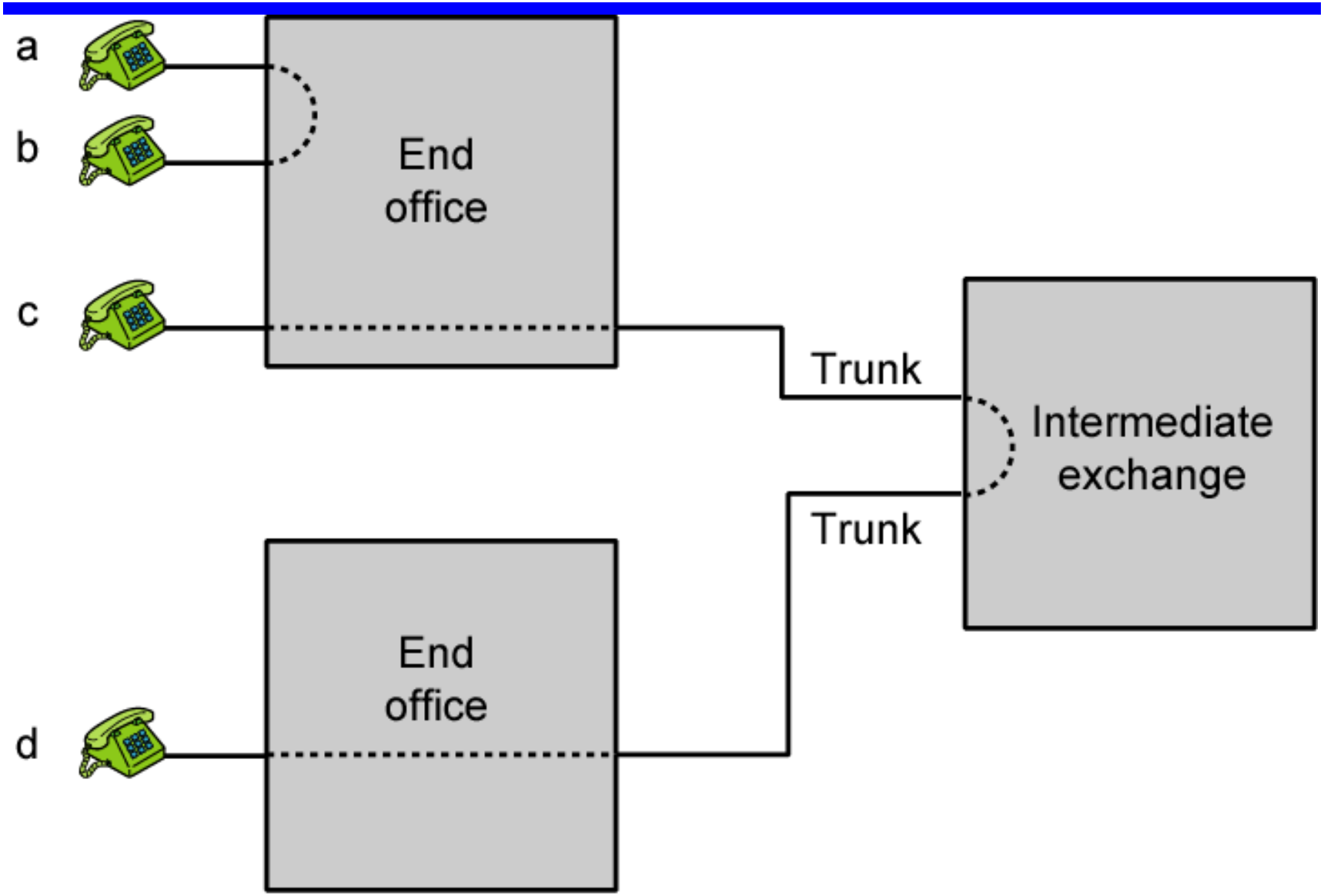
Public Circuit Switched Network



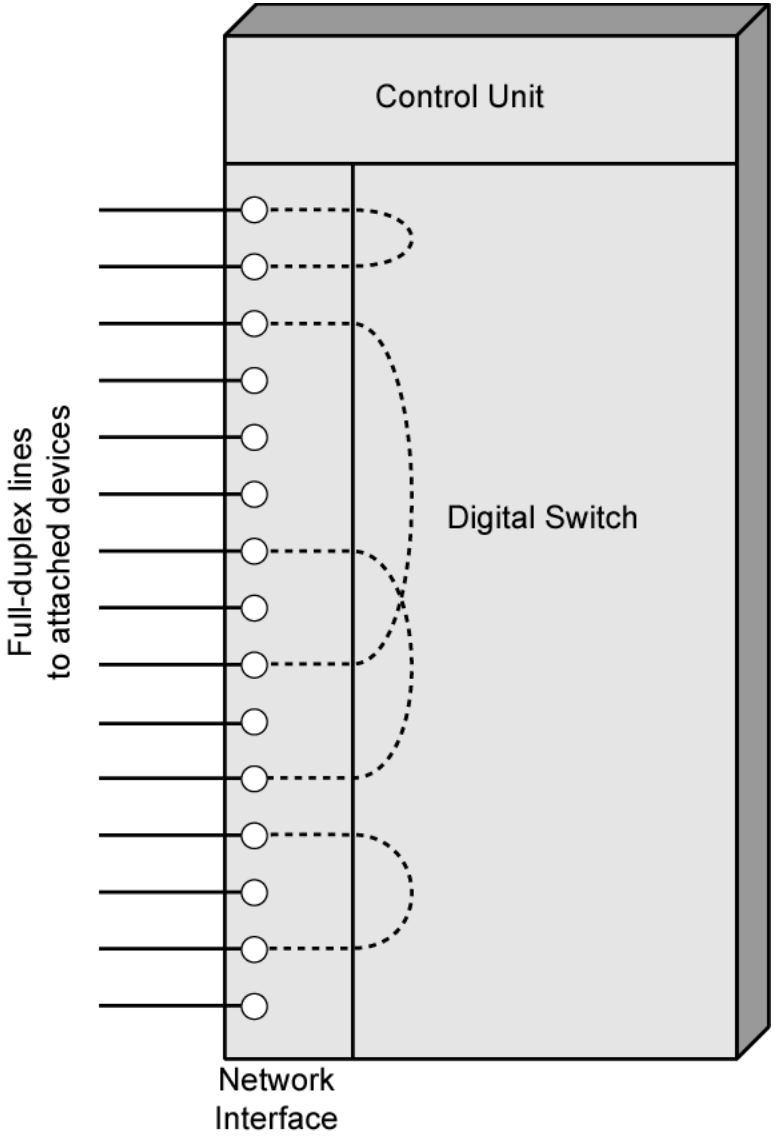
Telecommunication Components

- Subscriber
  - Devices attached to network
- Subscriber line
  - The link between the subscriber and the network
  - Known as Local Loop or Subscriber loop
  - Few km up to few tens of km
- Exchange
  - Switching centers in the network.
  - A switching center that directly supports subscribers is known as an end office.
- Trunks
  - Branches between exchanges
  - Trunks carry multiple voice frequency circuits using either FDM or synchronous TDM

Circuit Establishment



Circuit Switch Elements



Circuit Switching Concepts

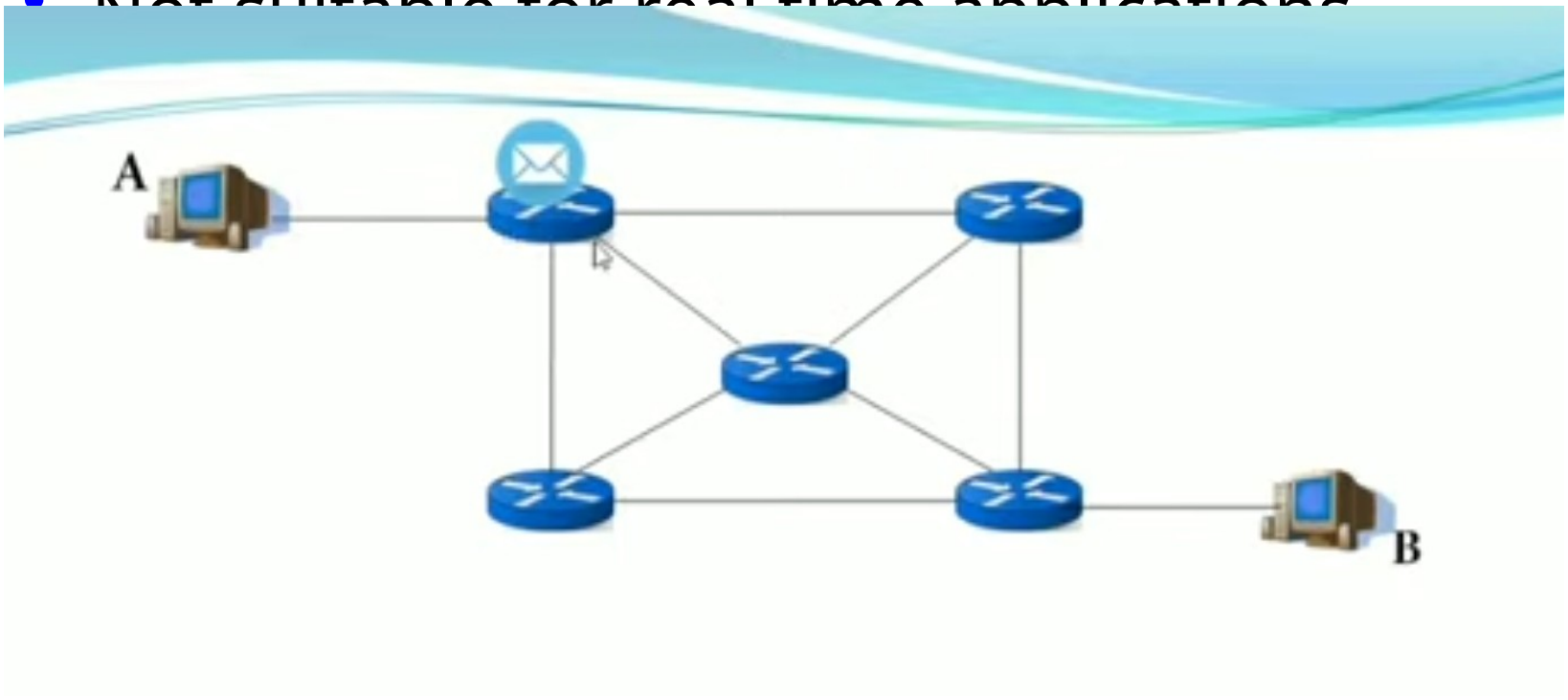
- Digital Switch
  - —Provide transparent signal path between devices
- Network Interface Element
  - represents the functions and hardware needed to connect digital devices, such as data processing devices and digital telephones.
- Control Unit
  - —Establish connections
    - Generally on demand
    - Handle and acknowledge requests
    - Determine if destination is free
    - construct path
  - —Maintain connection
  - —Disconnect

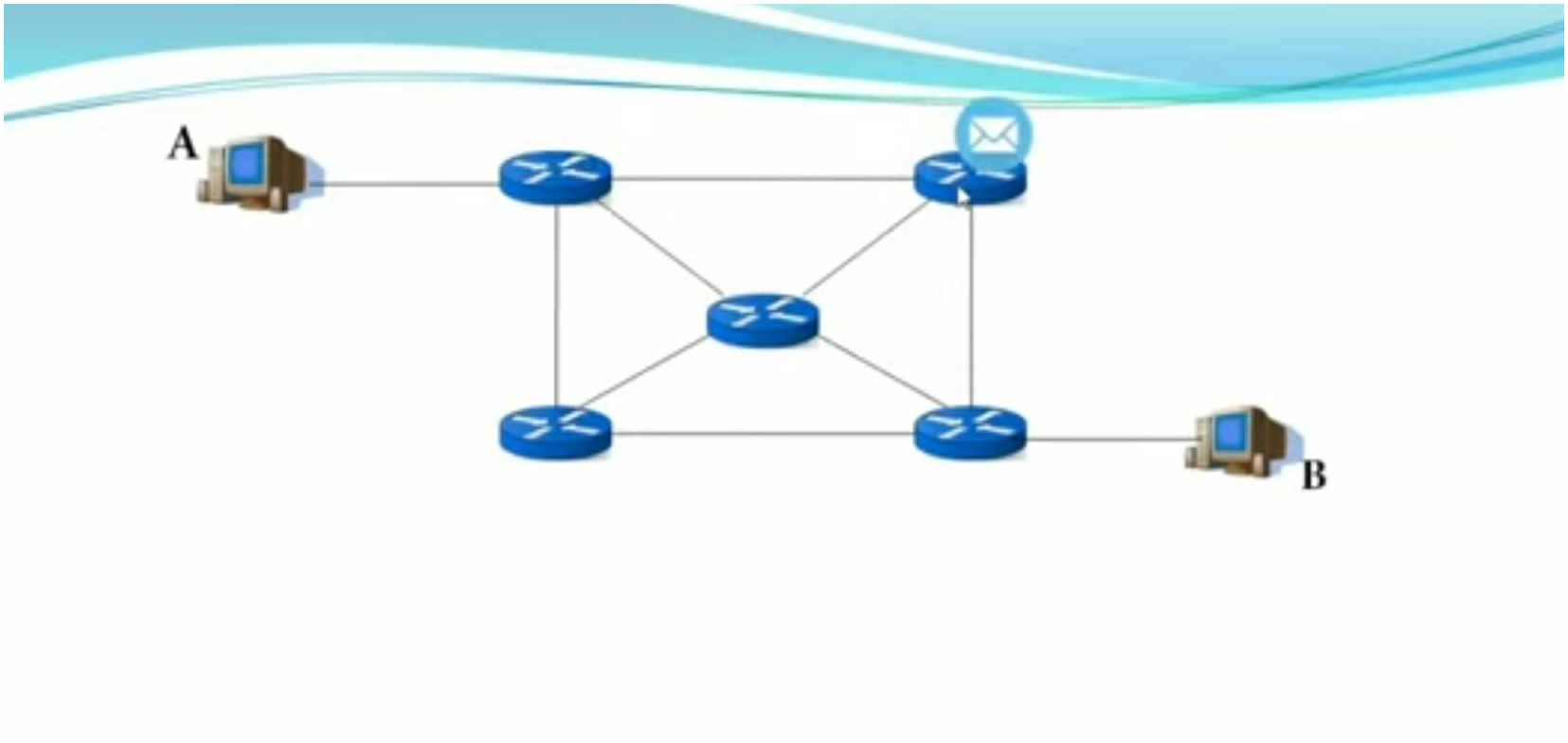
Characteristics of Circuit Switching

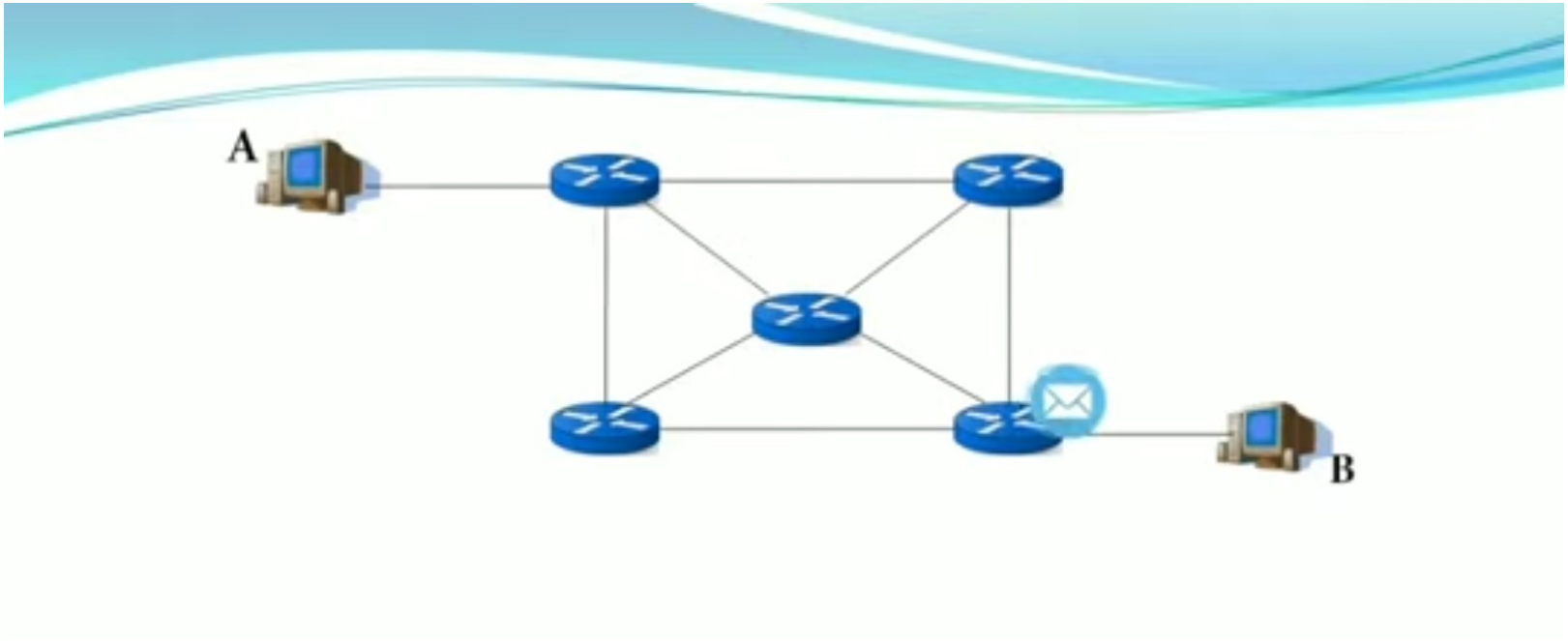
- Blocking
  - A network is unable to connect stations because all paths are in use
  - Used on voice systems
    - Short duration calls
- Non-blocking
  - Permits all stations to connect (in pairs) at once
  - Used for some data connections

Message switching(Application Layer)

- No dedicated path between sender and receiver.
- Store and forward.
- Not suitable for real time applications




A
B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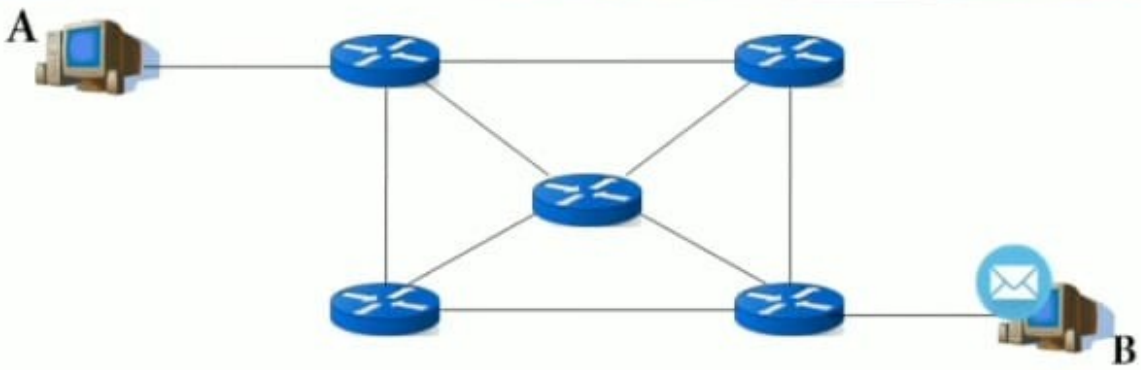
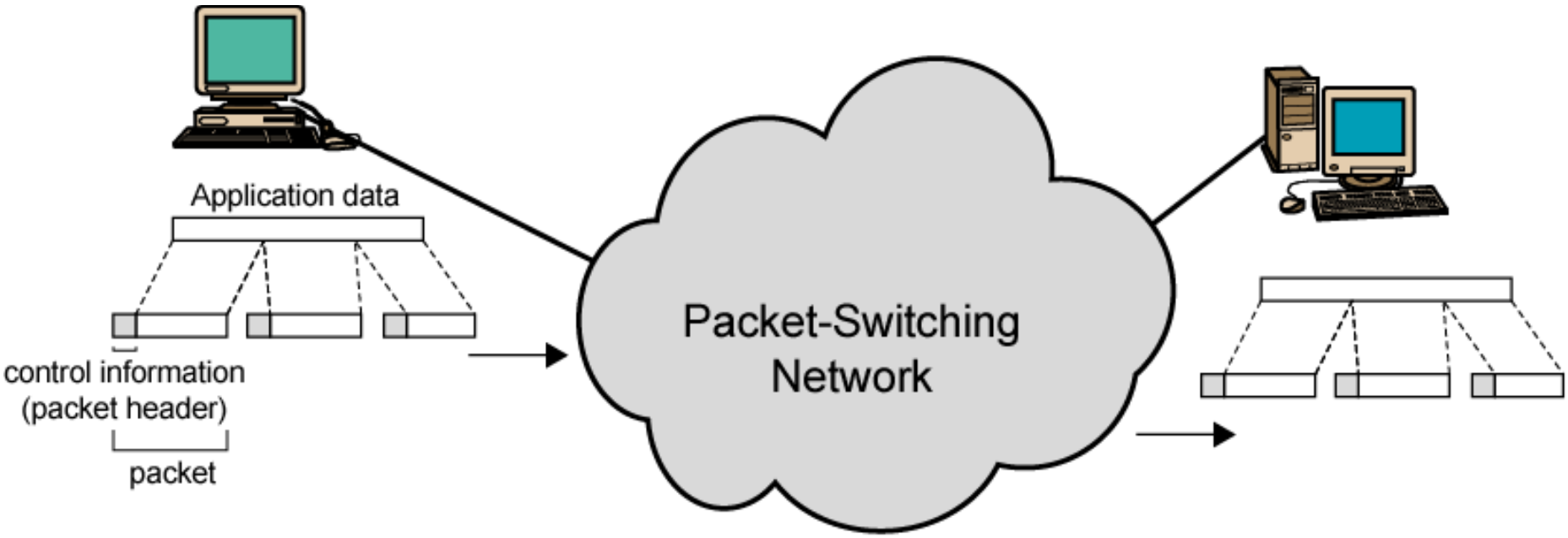


- Each message is treated as an independent unit
- Each and every node stores the entire message and forwards to the next node
- It is also called as **store and forward network**
- The device should have sufficient storage capacity to store the incoming messages

Packet Switching Principles

- In a packet-switched network, there is no resource reservation; resources are allocated on demand.
- Data transmitted in small packets
  - Typically 1000 octets
  - Longer messages split into series of packets
  - Each packet contains a portion of user data plus some control info
- Control info
  - Routing (addressing) info
- Packets are received, stored briefly (buffered) and past on to the next node

Use of Packets



Advantages

- Line efficiency
  - Single node to node link can be shared by many packets over time
  - Packets queued and transmitted as fast as possible
- Data rate conversion
  - Each station connects to the local node at its own speed
  - Nodes buffer data if required to equalize rates
- Packets are accepted even when network is busy
  - Delivery may slow down
- Priorities can be used

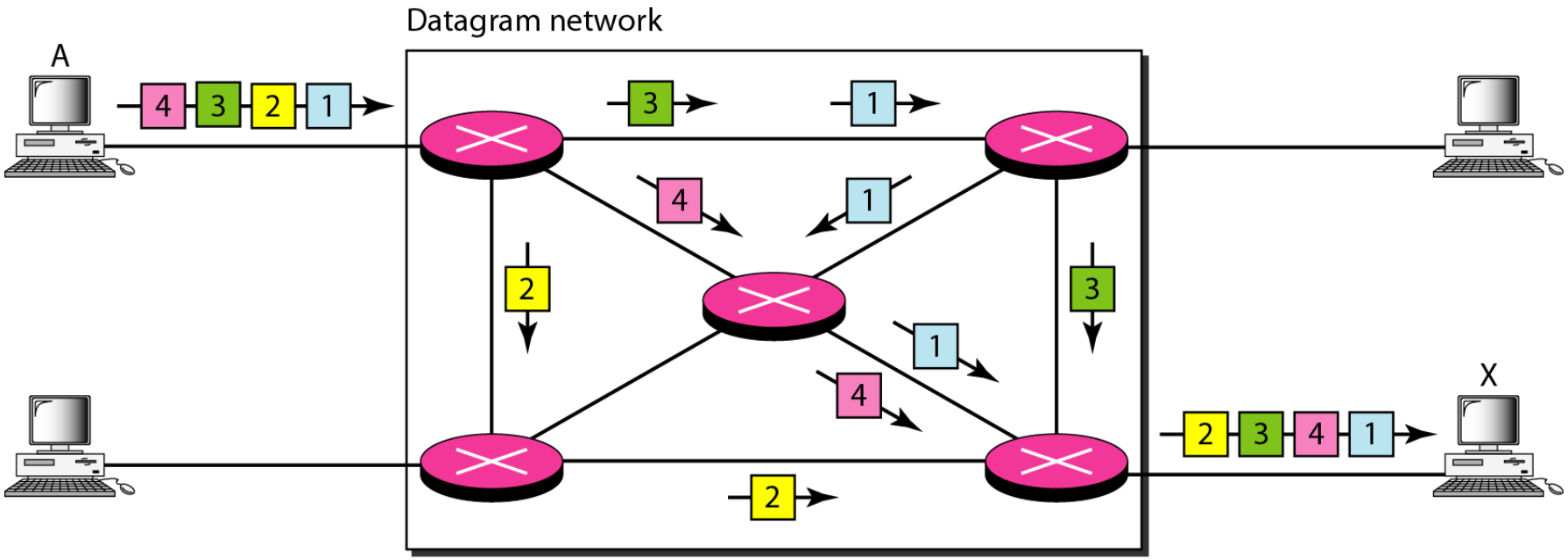
Packet Switching Technique

- Station breaks long message into packets
- Packets sent one at a time to the network
- Packets handled in two ways
  - —Datagram Approach
  - —Virtual circuit Approach

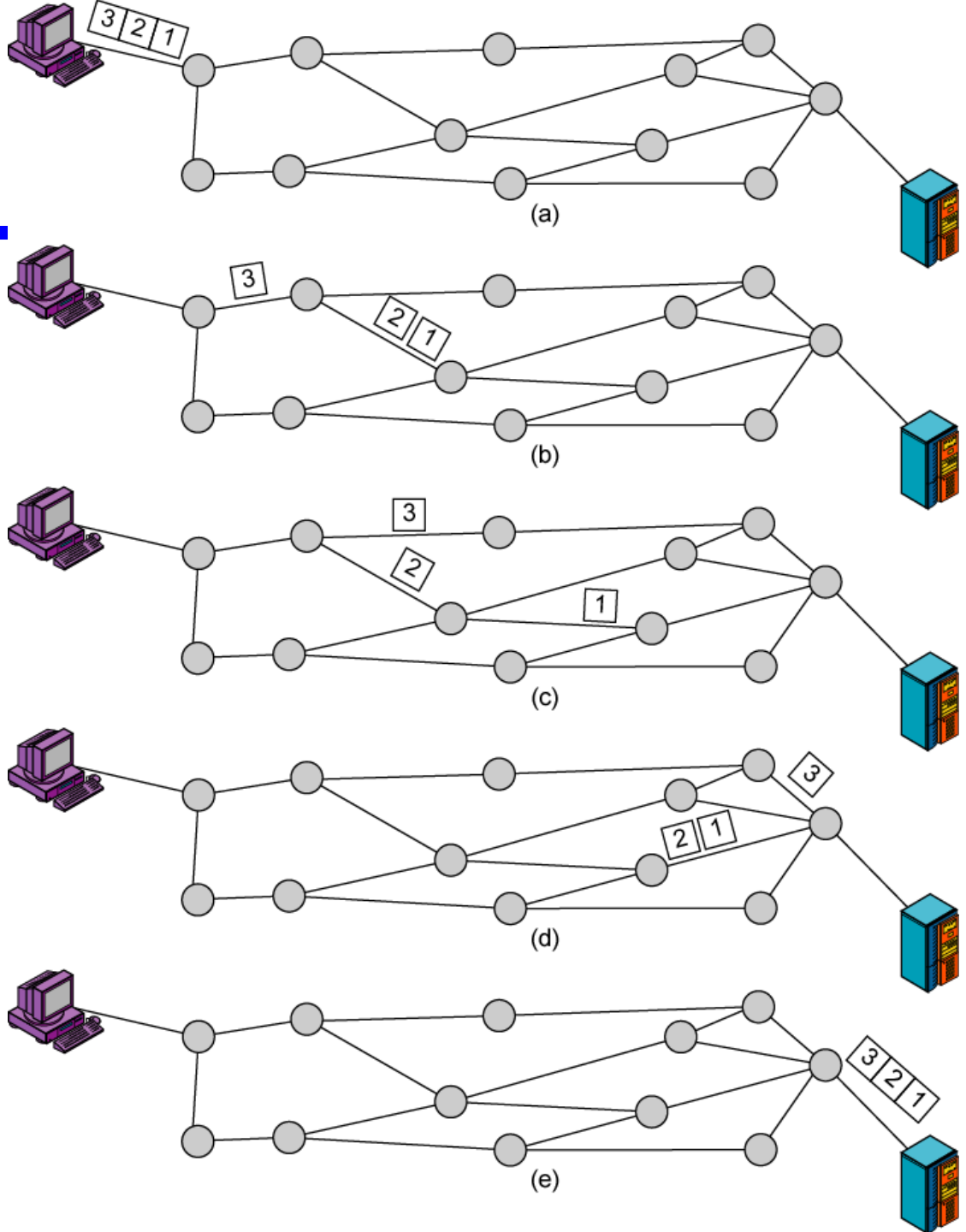
Datagram Approach(Network Layer)

- Each packet treated independently
- Packets can take any practical route
- Packets may arrive out of order
- Packets may go missing
- Up to receiver to re-order packets and recover from missing packets.
- A switch in a datagram network uses a routing table that is based on the destination address.

A datagram network with four switches



Datagram Diagram



Virtual Circuit Approach(DataLink Layer)

- Preplanned route established before any packets sent
- Call request and call accept packets establish connection (handshake)
- Each packet contains a virtual circuit identifier(VCI) instead of destination address
- No routing decisions required for each packet
- Clear request to drop circuit
- Not a dedicated path

Virtual Circuit Diagram

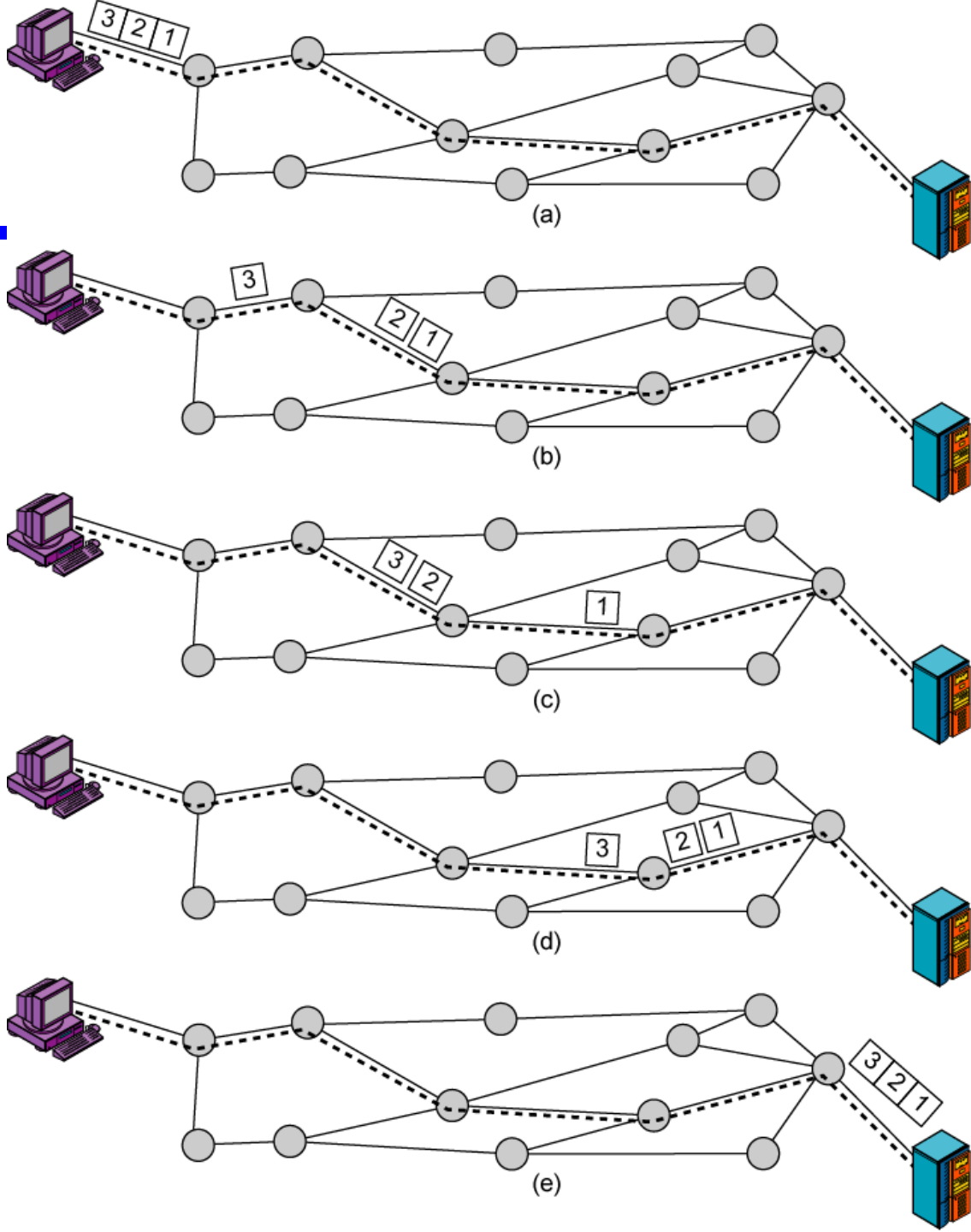
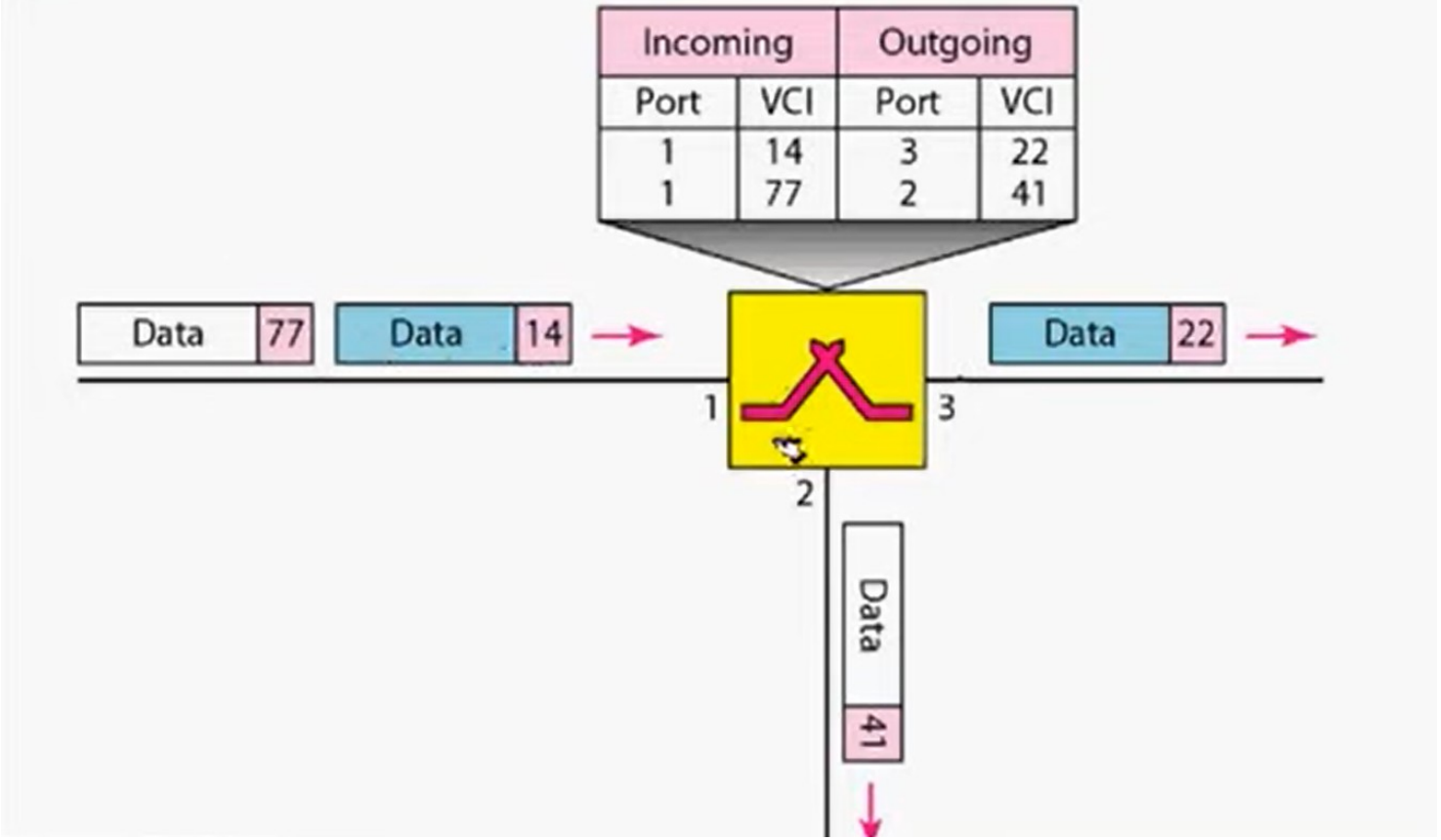
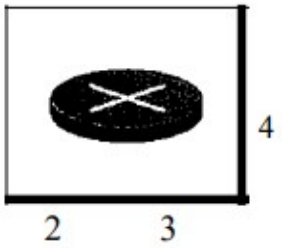


Figure 8.12 *Switch and tables in a virtual-circuit network*



- Figure shows a switch (router) in a datagram network. Find the output port for packets with the following destination addresses: Packet 1: 7176 Packet 2: 1233 Packet 3: 8766 Packet 4: 9144

Destination address	Output port
1233	3
1456	2
3255	1
4470	4
7176	2
8766	3
9144	2



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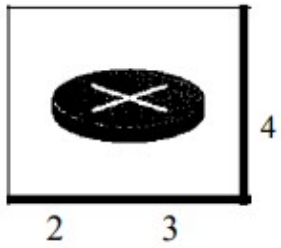


Packet 1: 2

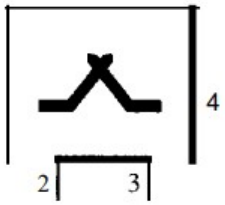
Packet 2: 3

Packet 3: 3

Packet 4: 2

- Find the output port and the output VCI for packets with the following input port and input VCI addresses: Packet 1: 3, 78 Packet 2: 2, 92 Packet 3: 4, 56 Packet 4: 2, 71

Incoming		Outgoing	
Port	VCI	Port	VCI
1	14	3	22
2	71	4	41
2	92	1	45
3	58	2	43
3	78	2	70
4	56	3	11



Packet 1: **2, 70**
Packet 2: **1, 45**
Packet 3: **3, 11**
Packet 4: **4, 41**

Virtual Circuits v Datagram

- Virtual circuits
  - —Network can provide sequencing and error control
  - —Packets are forwarded more quickly
    - No routing decisions to make
  - —Less reliable
    - Loss of a node looses all circuits through that node
- Datagram
  - —No call setup phase
    - Better if few packets
  - —More flexible
    - Routing can be used to avoid congested parts of the network