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Universidade Politécnica de Macau
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Faculty of Applied Sciences
B.Sc. in Computing

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COMP123 – 121/122

Data Communications

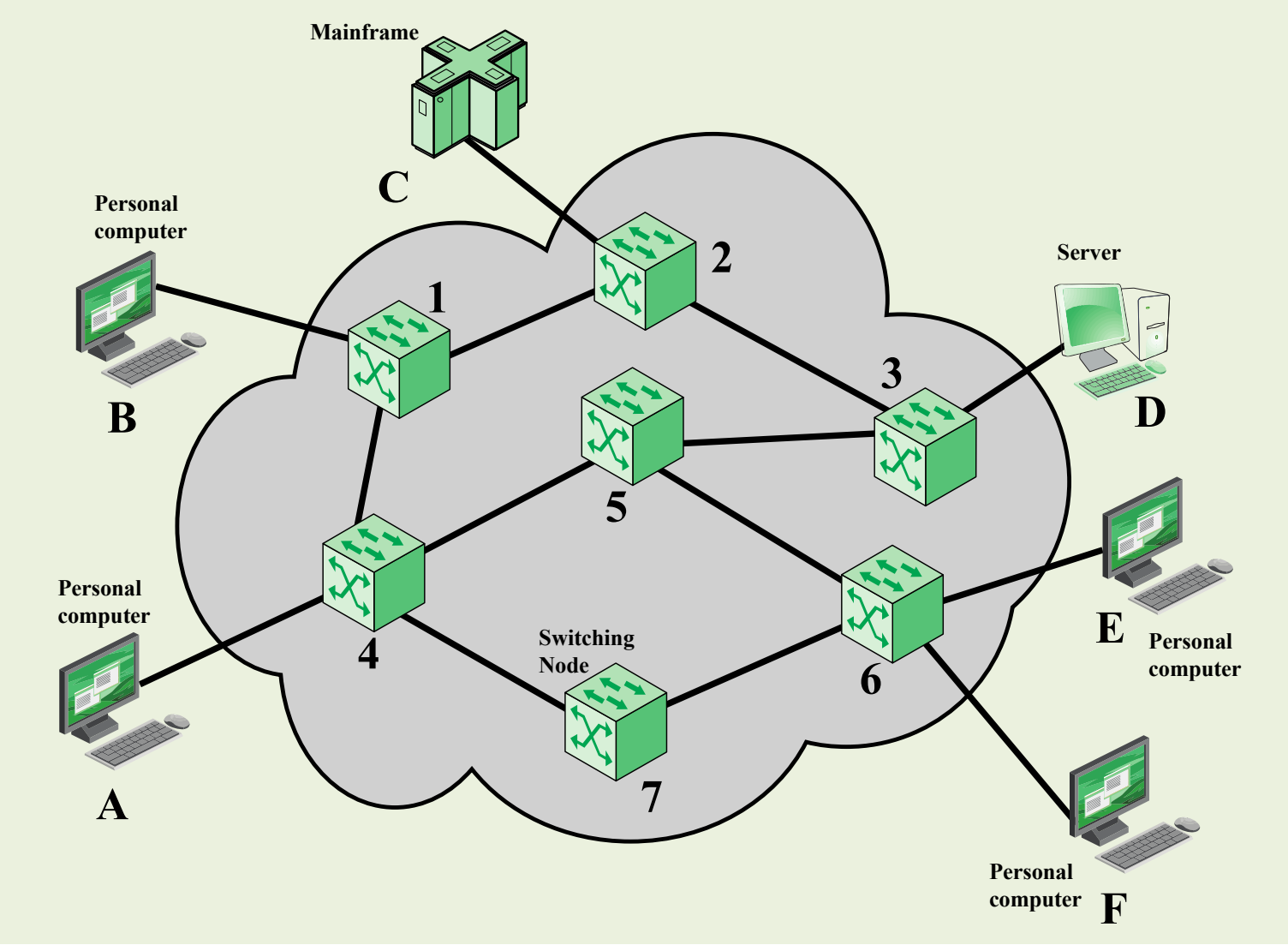
Data Transport Networks

(Circuit and packet switching)

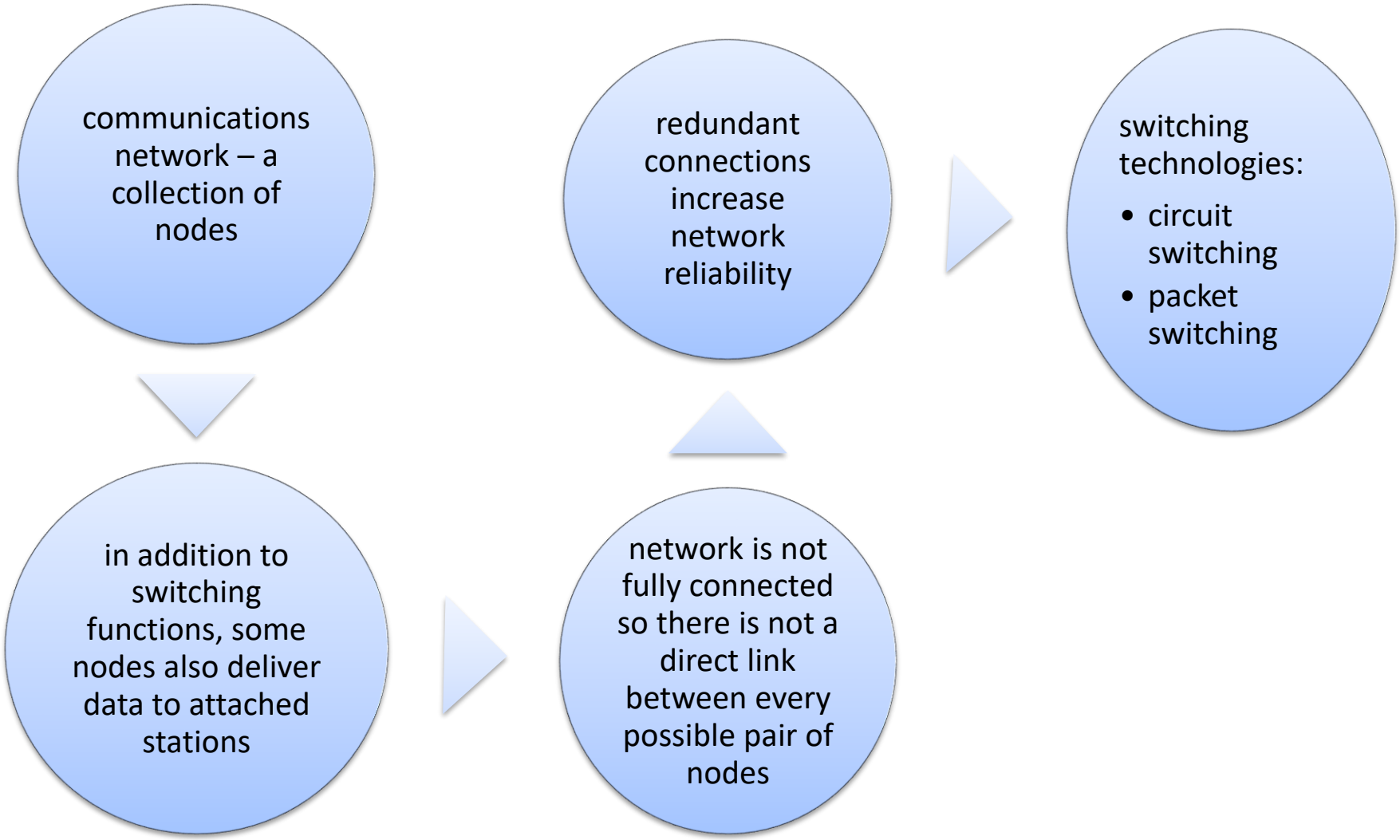
Switched Communications Networks

- switching nodes provide a switching facility that move data between nodes
- **stations** – devices attached to the network
- **nodes** – switching devices that provide communication
  - connected by transmission links
  - dedicated point-to-point
  - usually multiplexed using either FDM or TDM

Simple Switching Network

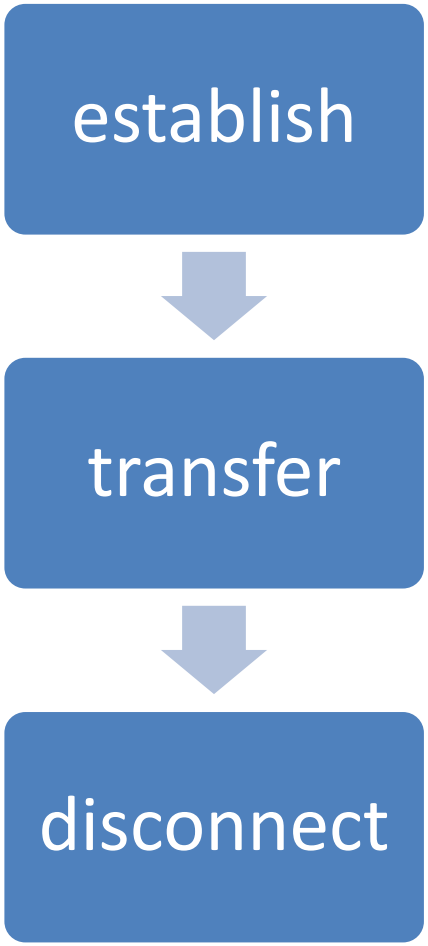


Communication Networks

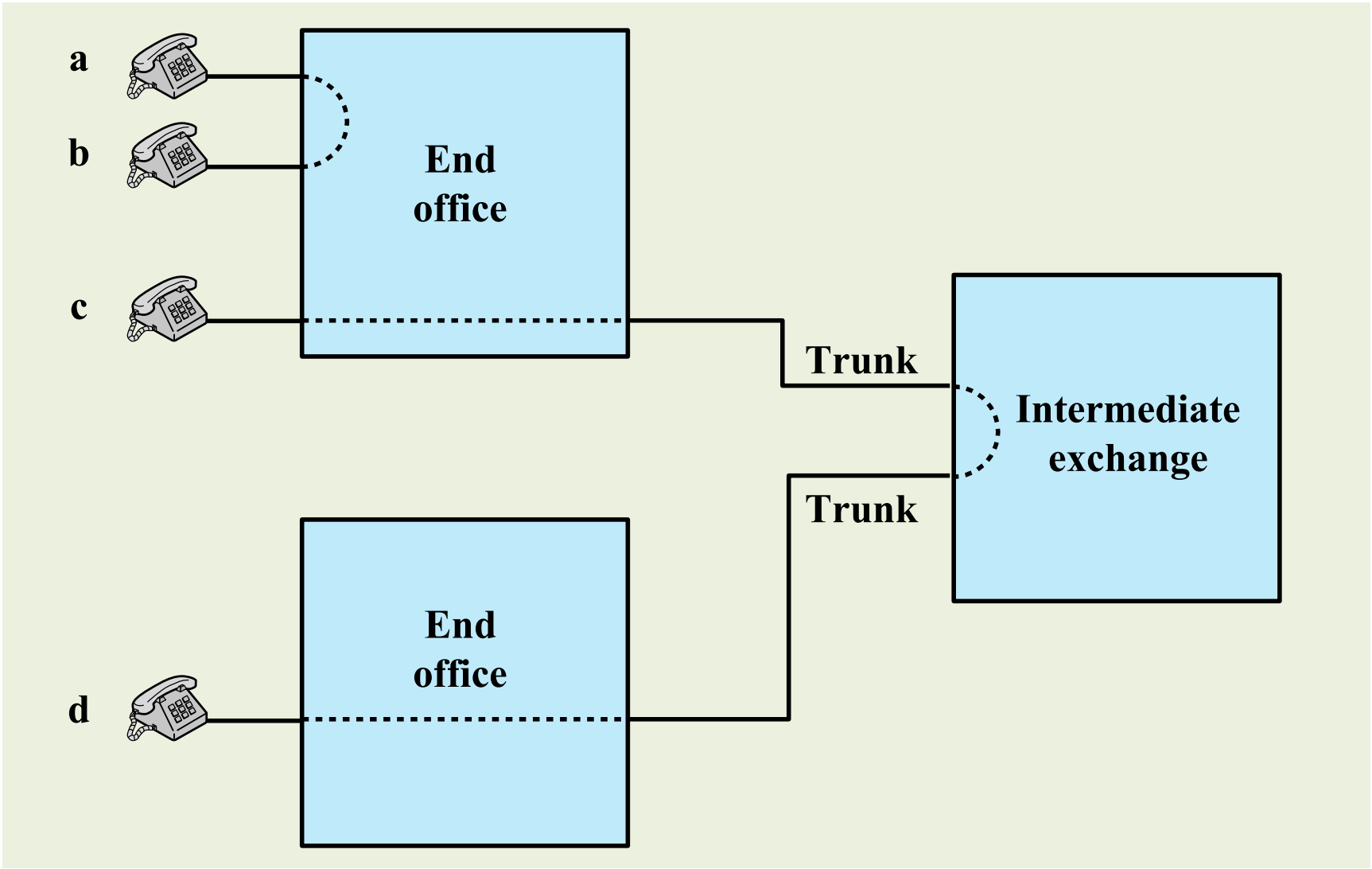


Circuit Switching

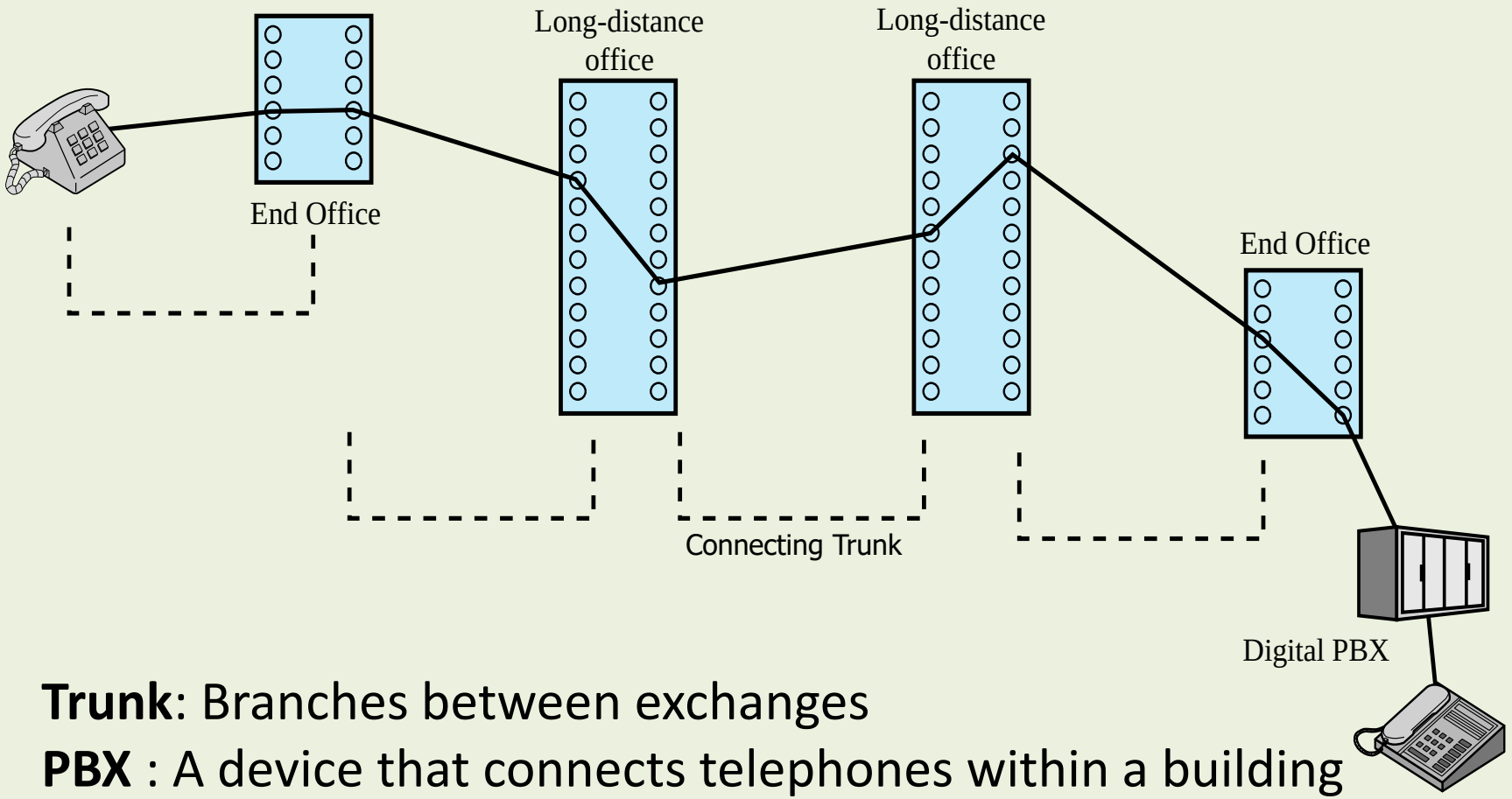
- uses a dedicated path between two stations
- can be inefficient
  - channel capacity dedicated for duration of connection
  - if no data, capacity wasted
- set up (connection) takes time
- once connected, transfer is transparent
- has three phases



Circuit Establishment



Public Circuit Switched Network



Trunk: Branches between exchanges

PBX : A device that connects telephones within a building

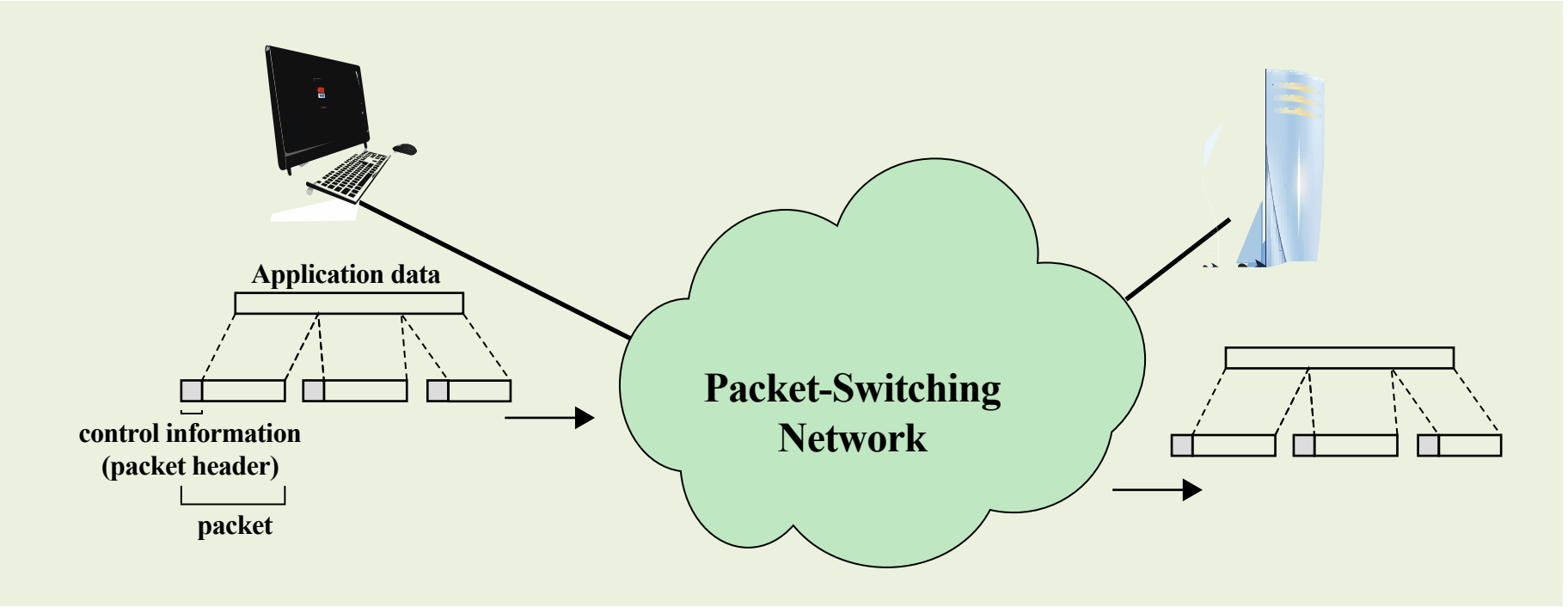
Circuit-Switching Technology

- Driven by applications that handle voice traffic
  - Key requirement is no transmission delay and no variation in delay
- Efficient for analog transmission of voice signals
- Inefficient for digital transmission
- Transparent
  - once a circuit is established it appears as a direct connection; no special logic is needed

Packet Switching

- circuit switching was designed for voice
- packet switching was designed for data
- transmitted in small packets
- packets contains user data and control info
  - user data may be part of a larger message
  - control information includes routing (addressing)
- packets are received, stored briefly (buffered) and passed on to the next node

The Use of Packets



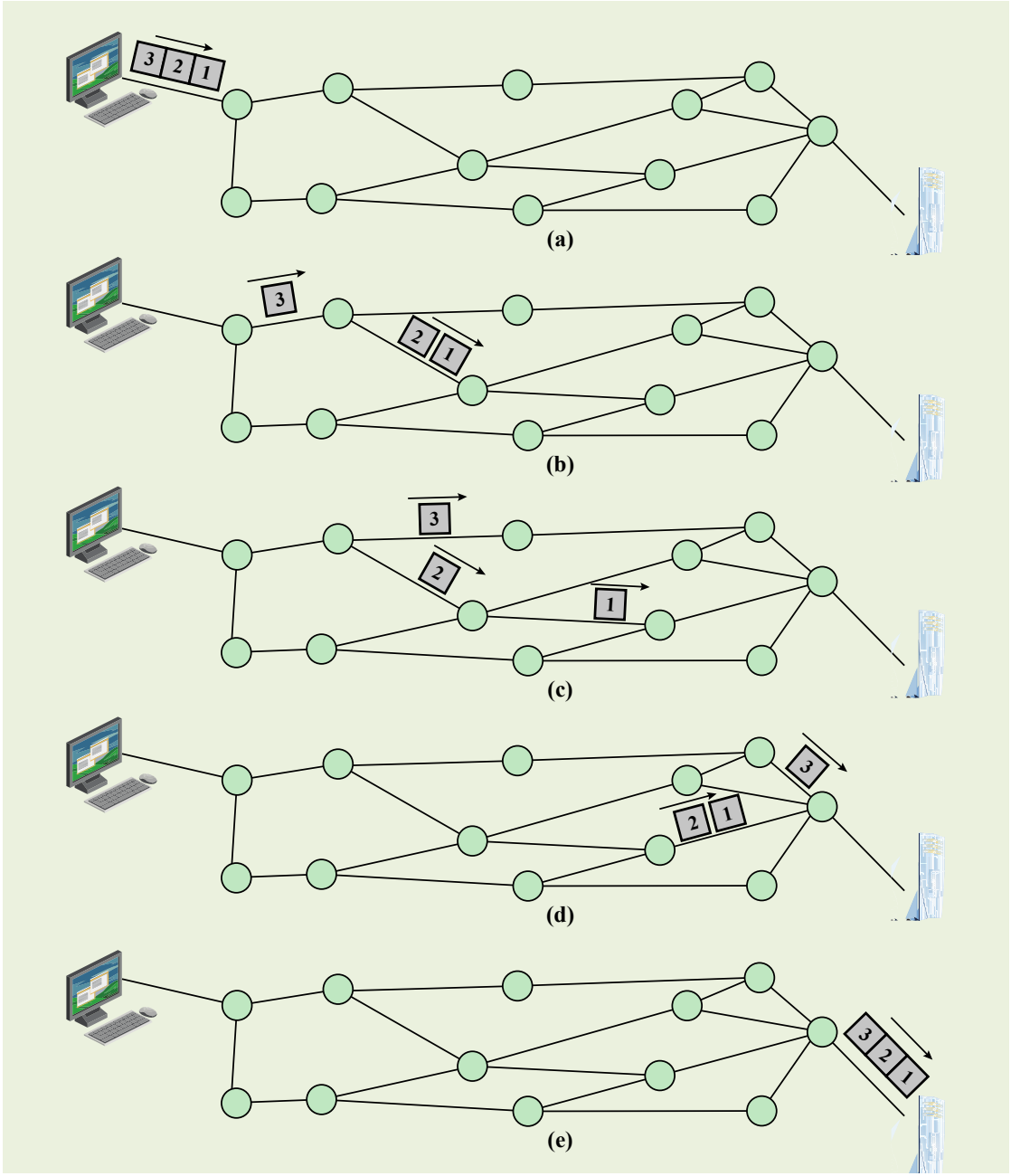
Advantages

- line efficiency
  - single link shared by many packets over time
  - packets queued and transmitted as fast as possible
- data rate conversion
  - stations connects to local node at own speed
  - nodes buffer data if required to equalize rates
- packets accepted even when network is busy
- priorities can be used

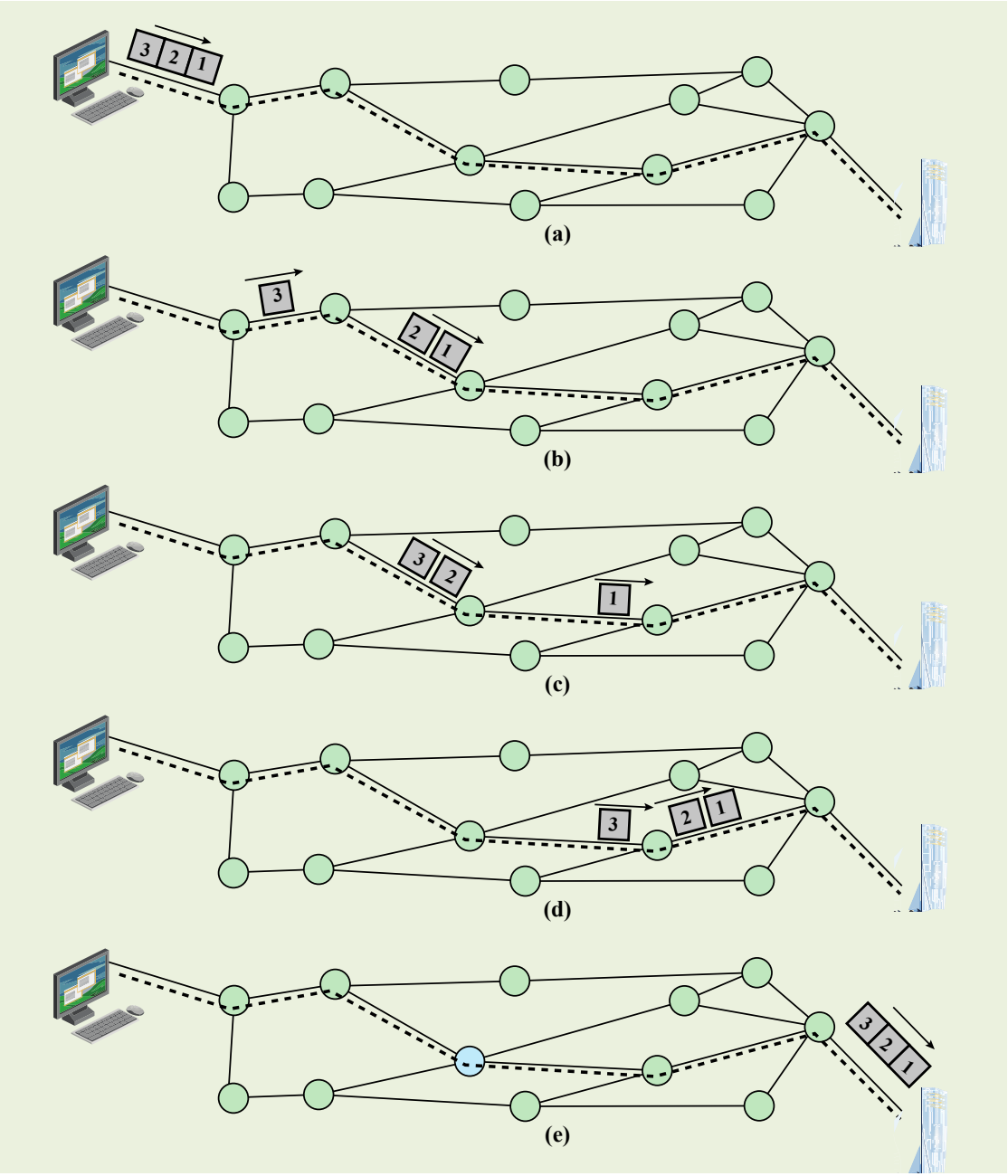
Switching Techniques

- station breaks long message into packets
- packets sent one at a time to the network
- packets can be handled in two ways:
  - datagram
    - each packet is treated independently with no reference to previous packets
  - virtual circuit
    - a preplanned route is established before any packets are sent

Datagram Diagram



Virtual Circuit Diagram



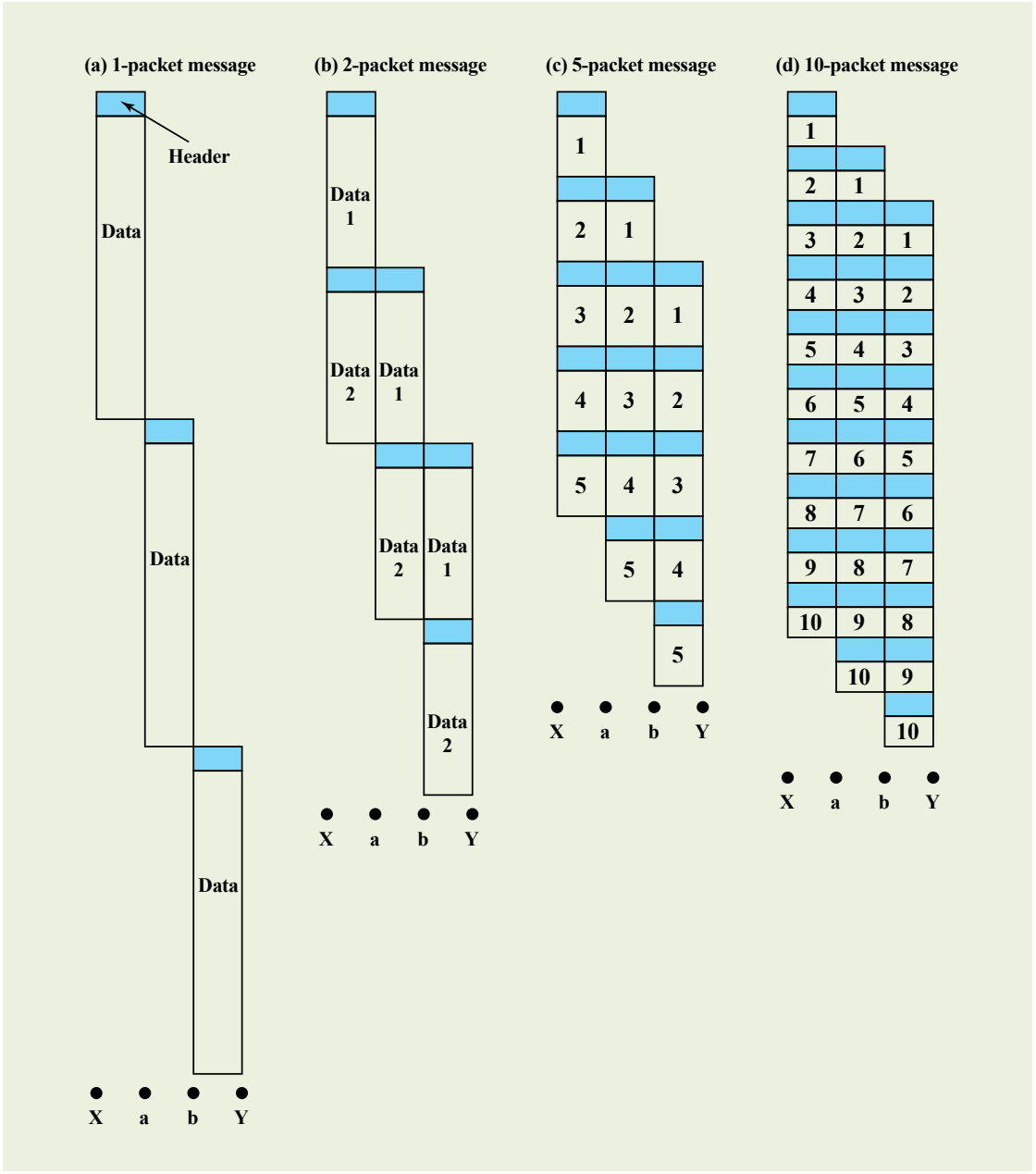
Virtual Circuits vs. Datagram

- virtual circuits
  - network can provide sequencing and error control
  - packets are forwarded more quickly
  - less reliable
- datagram
  - no call setup phase
  - more flexible
  - more reliable

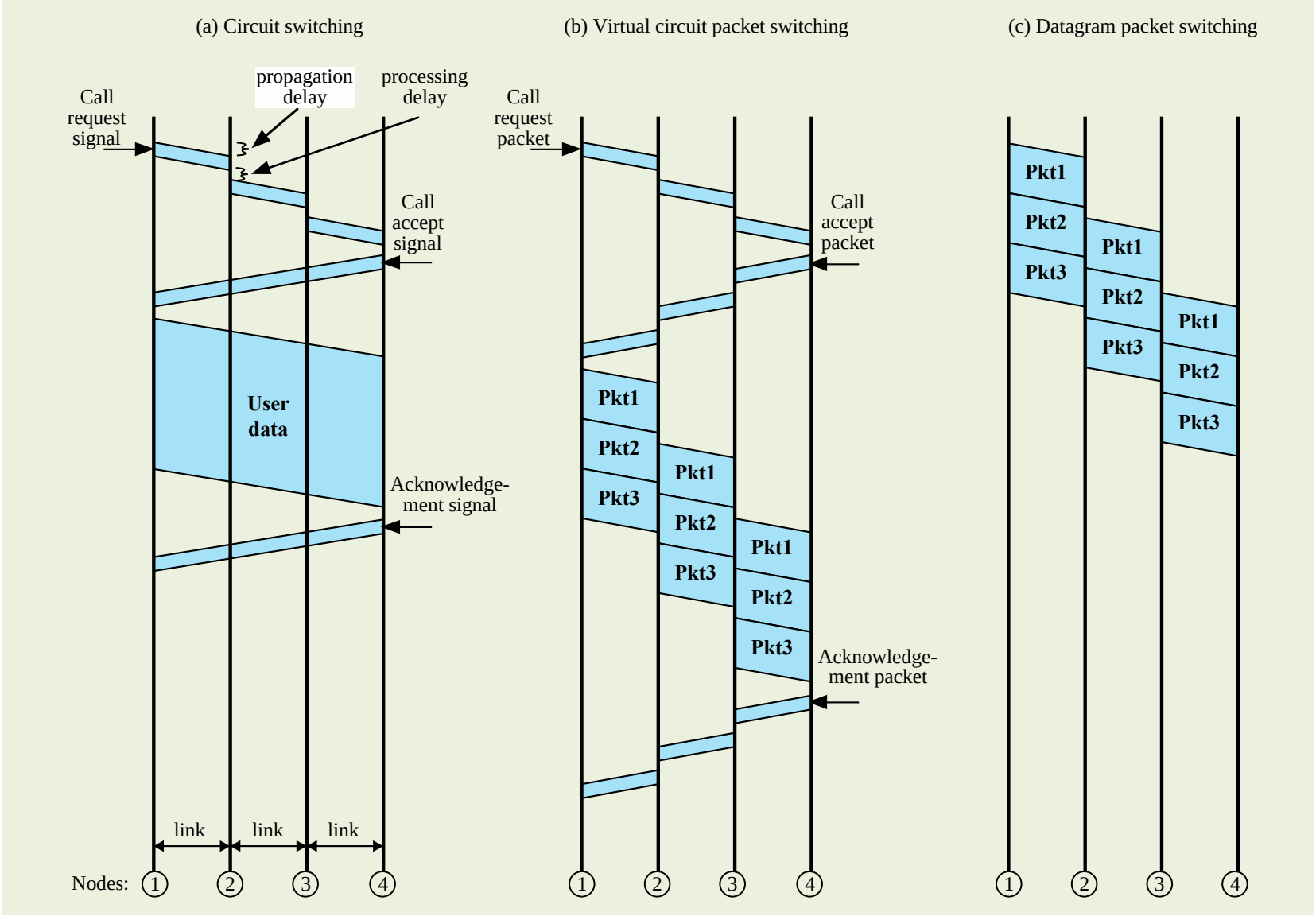
Circuit vs. Packet Switching

- performance depends on various delays
  - propagation delay
    - time it takes a signal to propagate between nodes
  - transmission time
    - time it takes for a transmitter to send a block of data
  - node delay
    - time it takes for a node to perform processing as it switches data
- range of other characteristics, including:
  - transparency
  - amount of overhead

Effect of Packet Size on TX Time



Event Timing for Circuit Switching and Packet Switching



Summary

- switched communications networks
  - stations / nodes
- circuit switching concepts and networks
- packet switching principles