

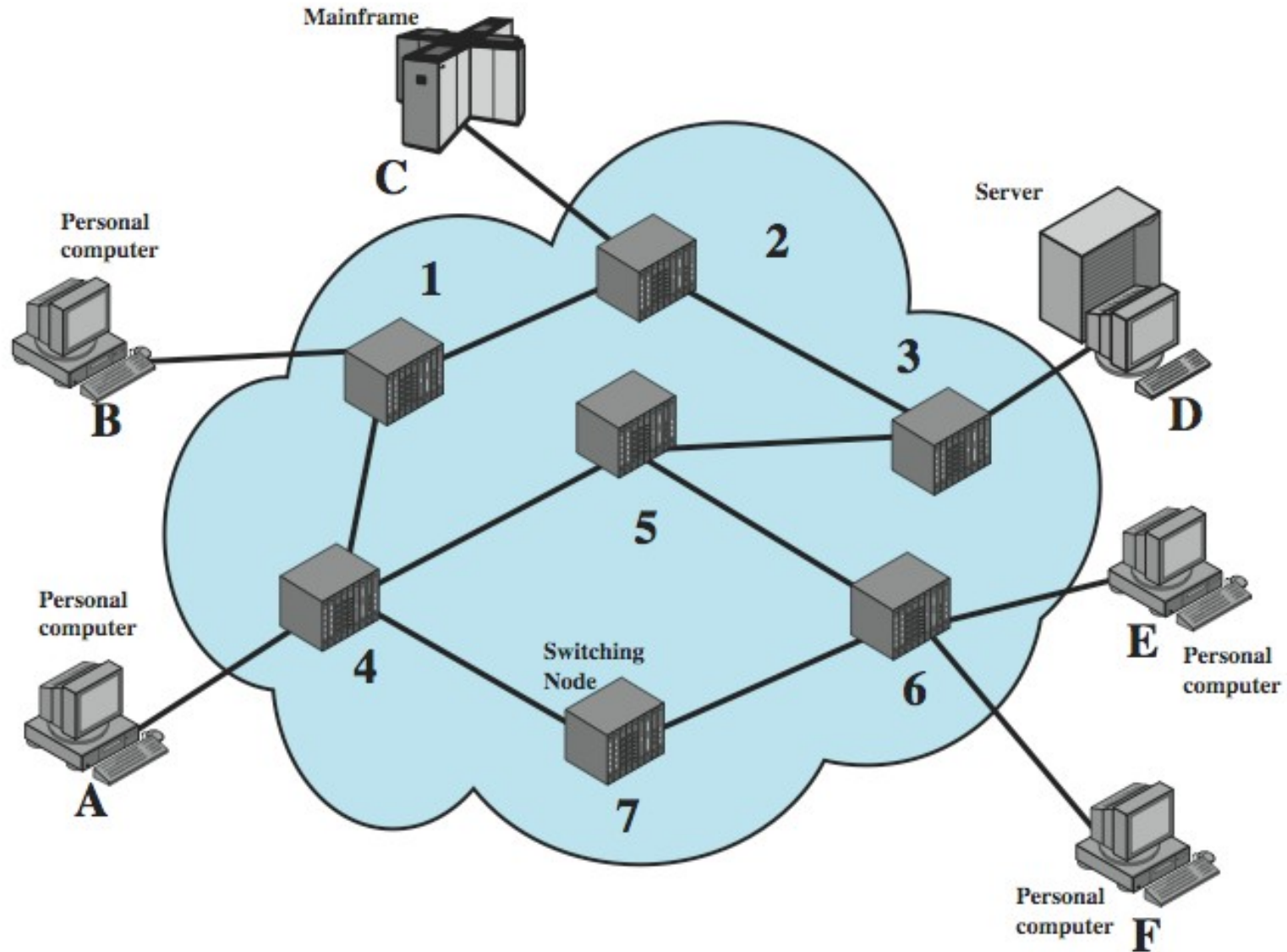
ET4254 – Communications and Networking 1

Topic 8

Aims:-

- circuit versus packet switching network approaches
 - X.25
- frame relay

Switched Network



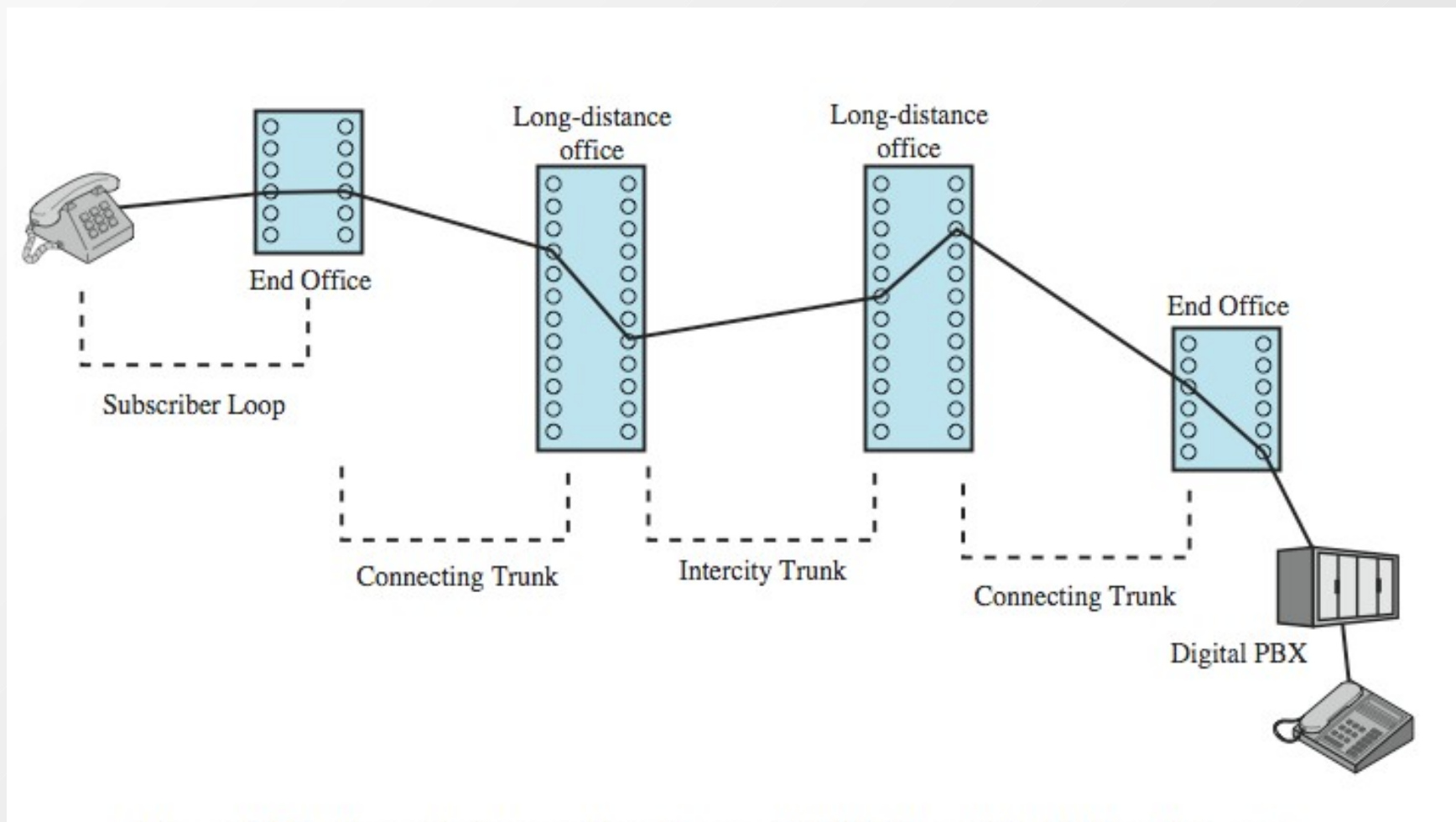
Nodes

- a collection of nodes and connections is a communications network
- nodes may connect to other nodes only, or to stations and other nodes
- network is usually partially connected
 - some redundant connections are desirable
- have two different switching technologies
 - circuit switching
 - packet switching

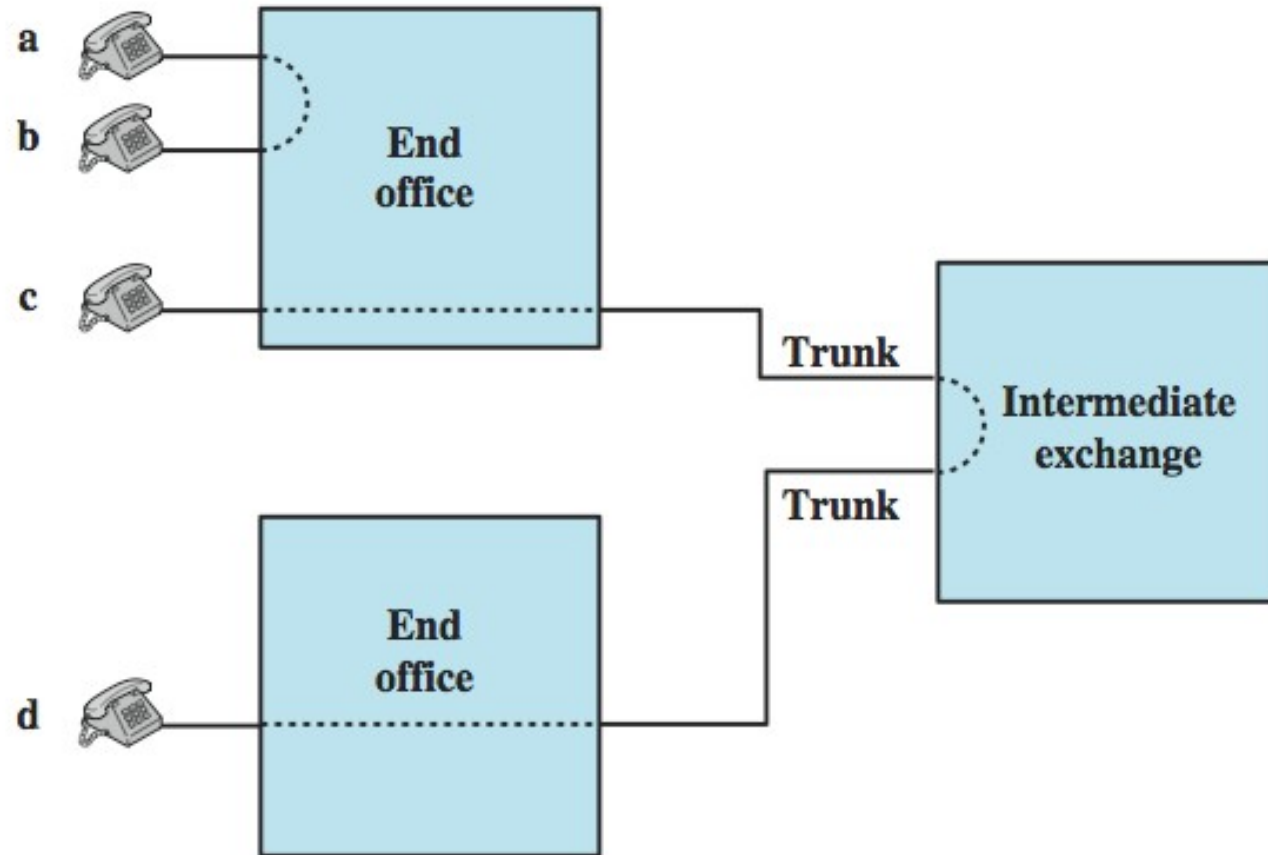
Circuit Switching

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

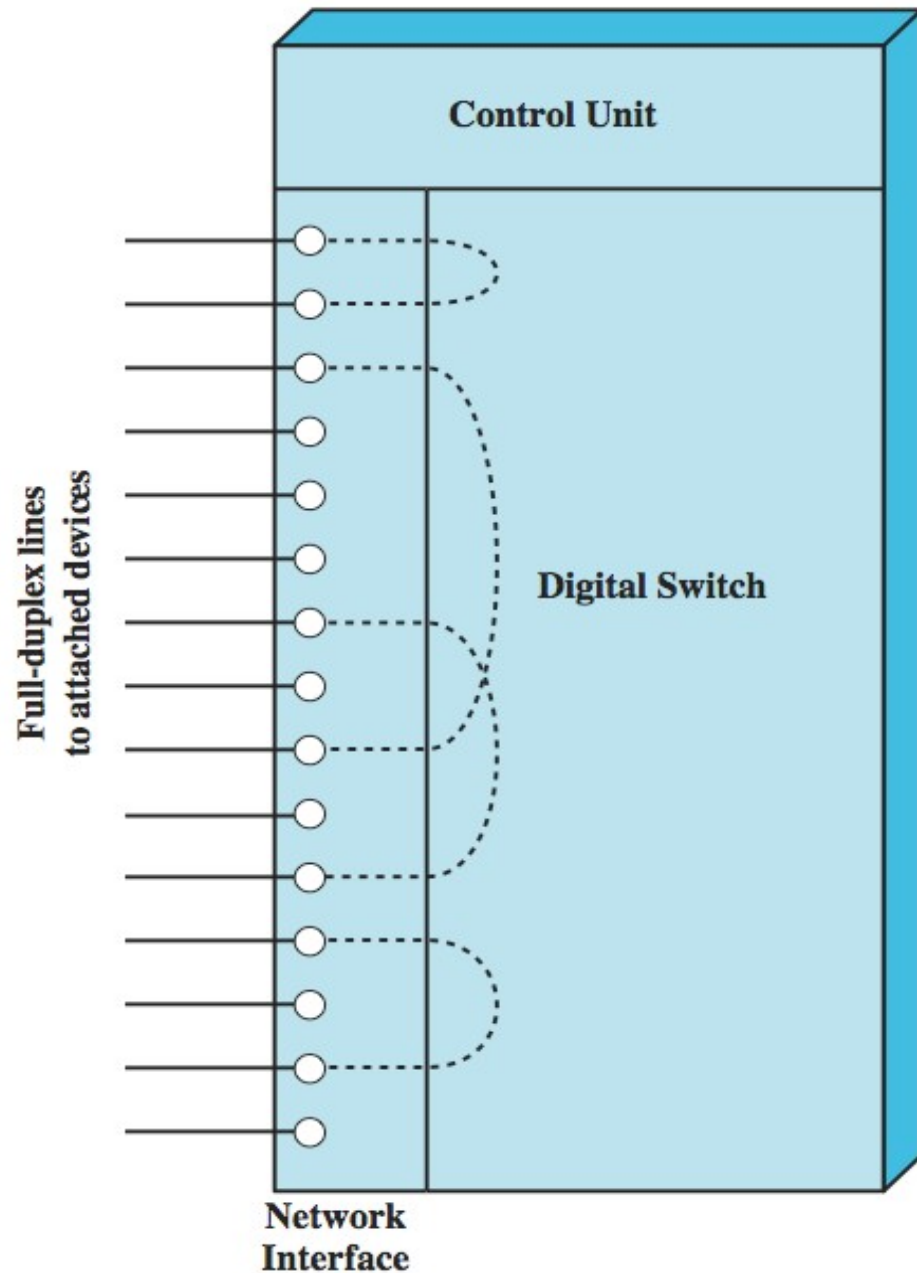
Public Circuit Switched Network



Circuit Establishment



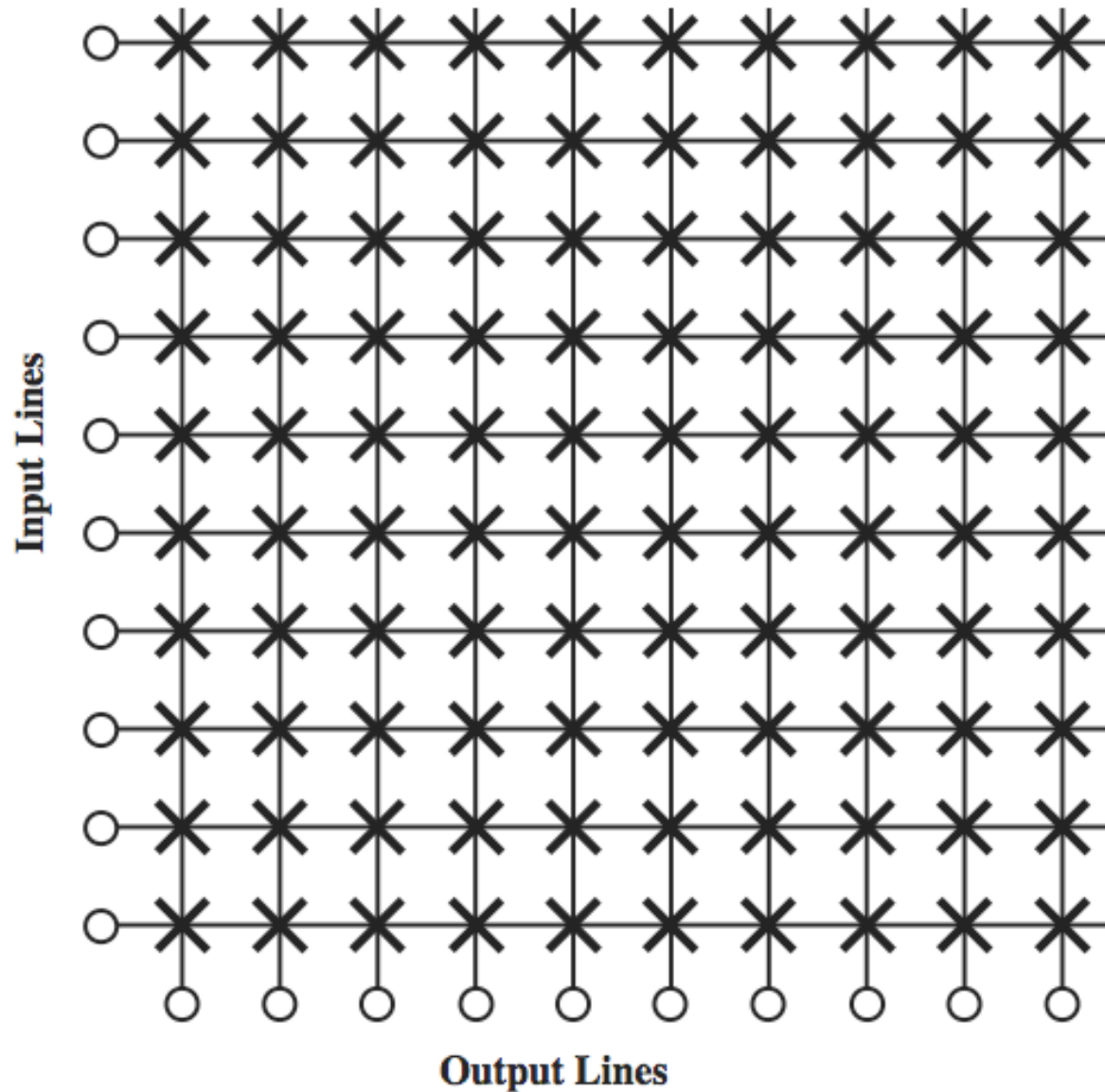
Circuit Switch Elements



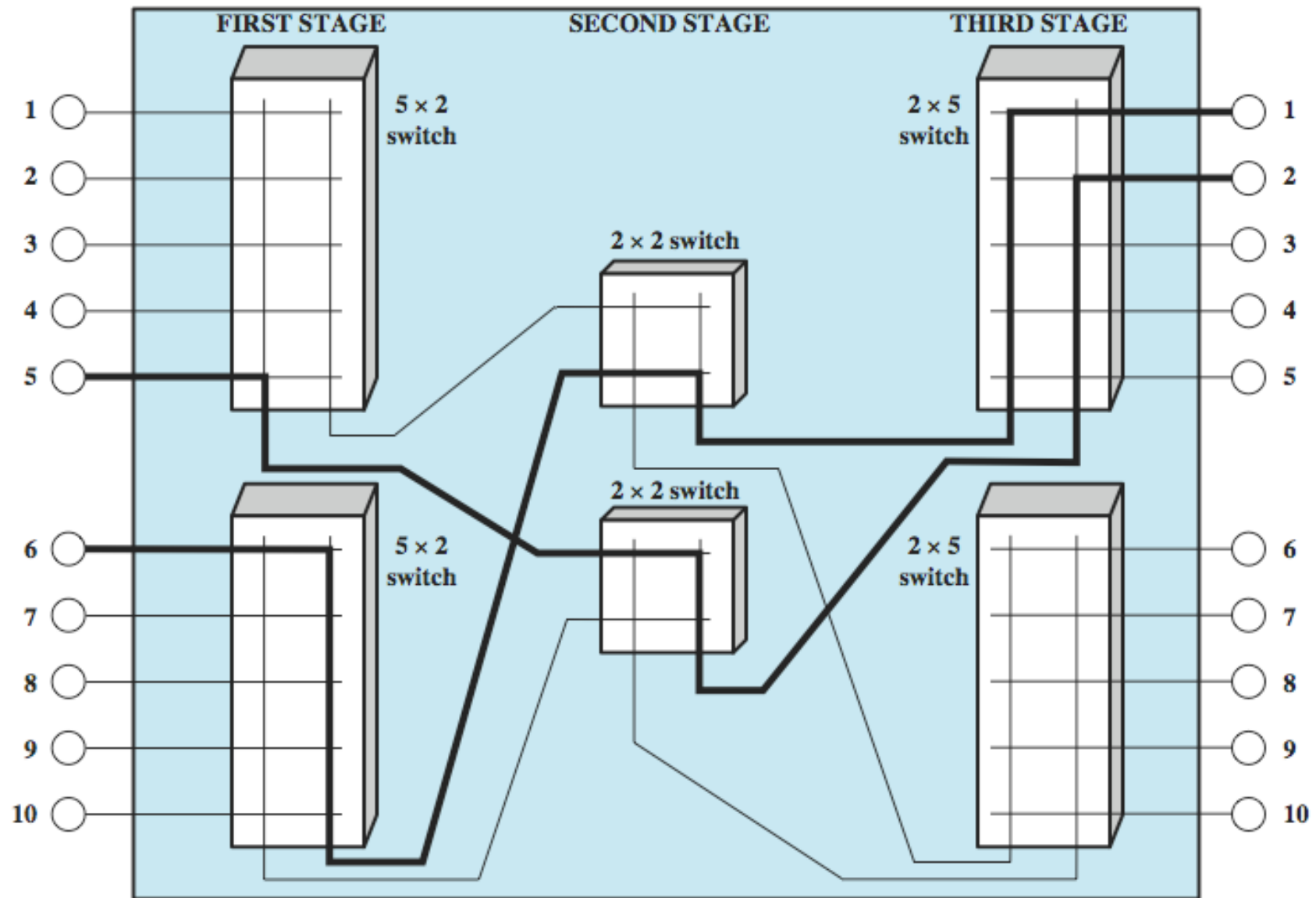
Blocking or Non-blocking

- blocking network
 - may be unable to connect stations because all paths are in use
 - used on voice systems
- non-blocking network
 - permits all stations to connect at once
 - used for some data connections

Space Division Switch



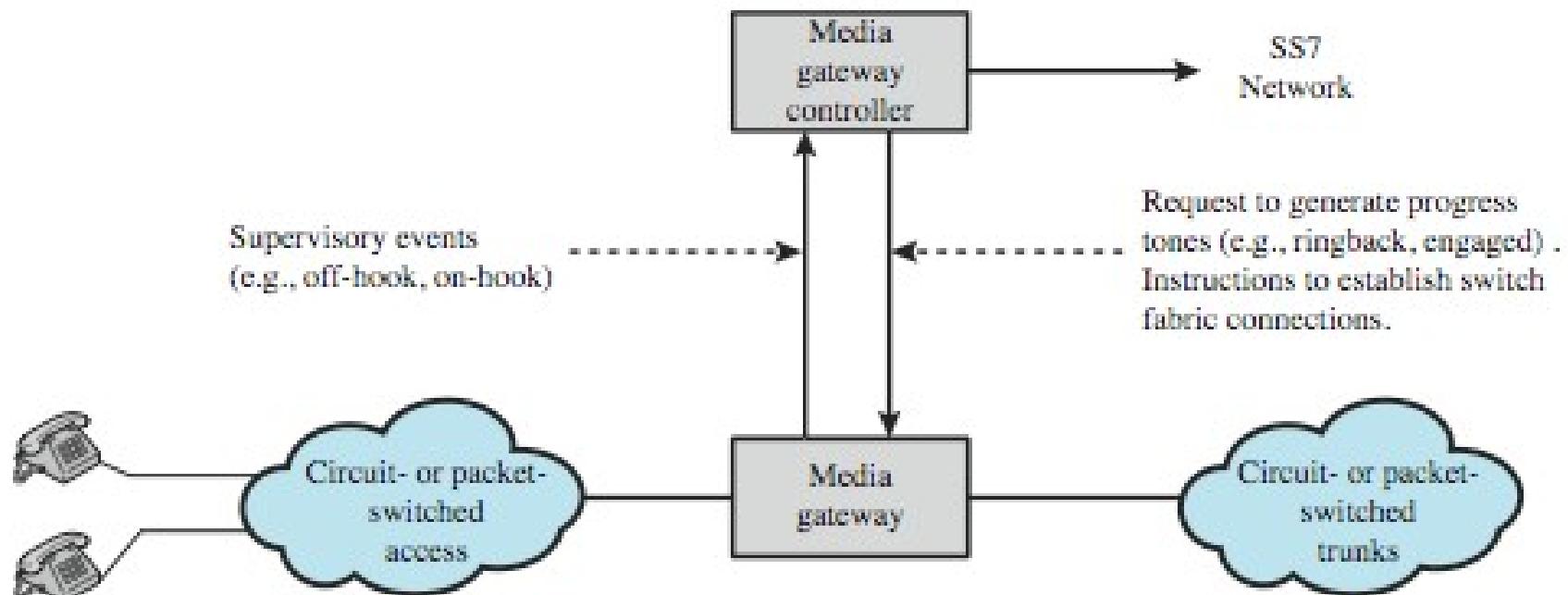
3 Stage Space Division Switch



Time Division Switching

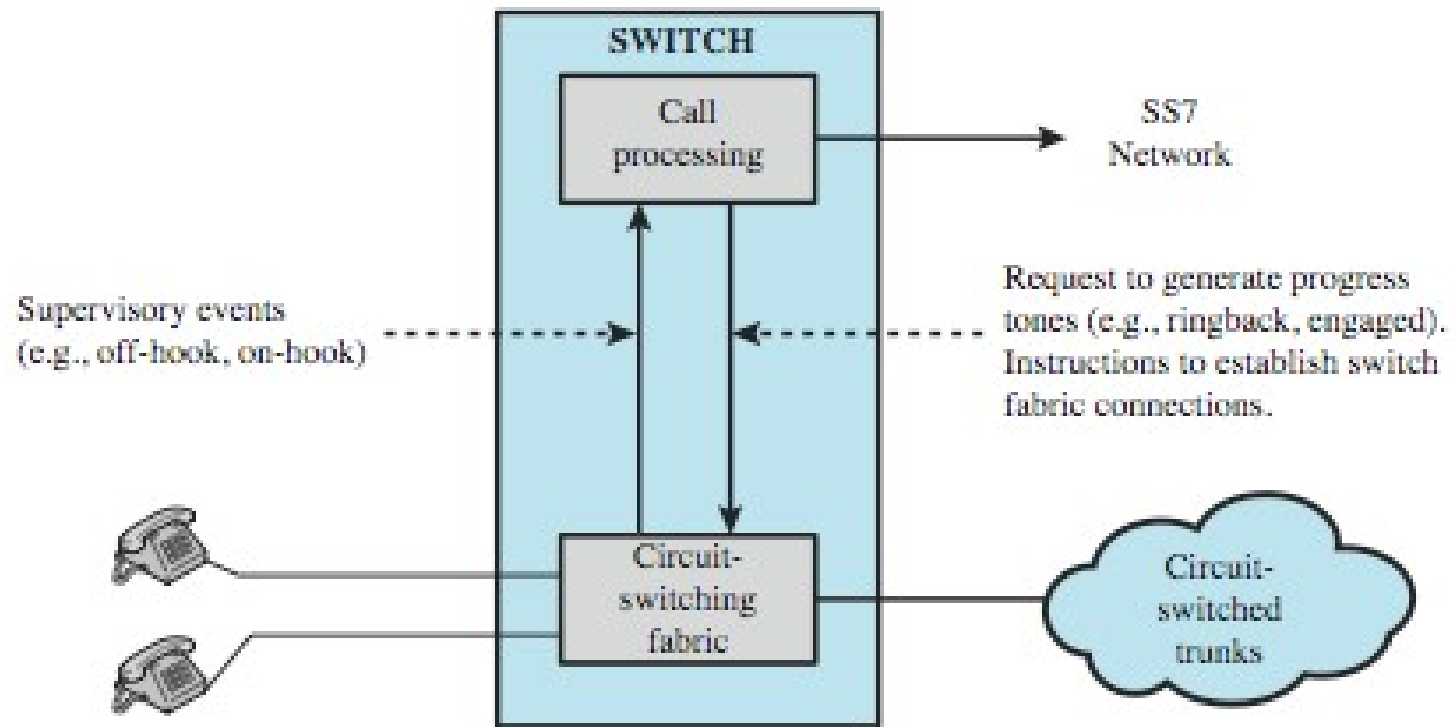
- modern digital systems use intelligent control of space & time division elements
- use digital time division techniques to set up and maintain virtual circuits
- partition low speed bit stream into pieces that share higher speed stream
- individual pieces manipulated by control logic to flow from input to output

Softswitch



(b) Softswitch architecture

Traditional Circuit Switching

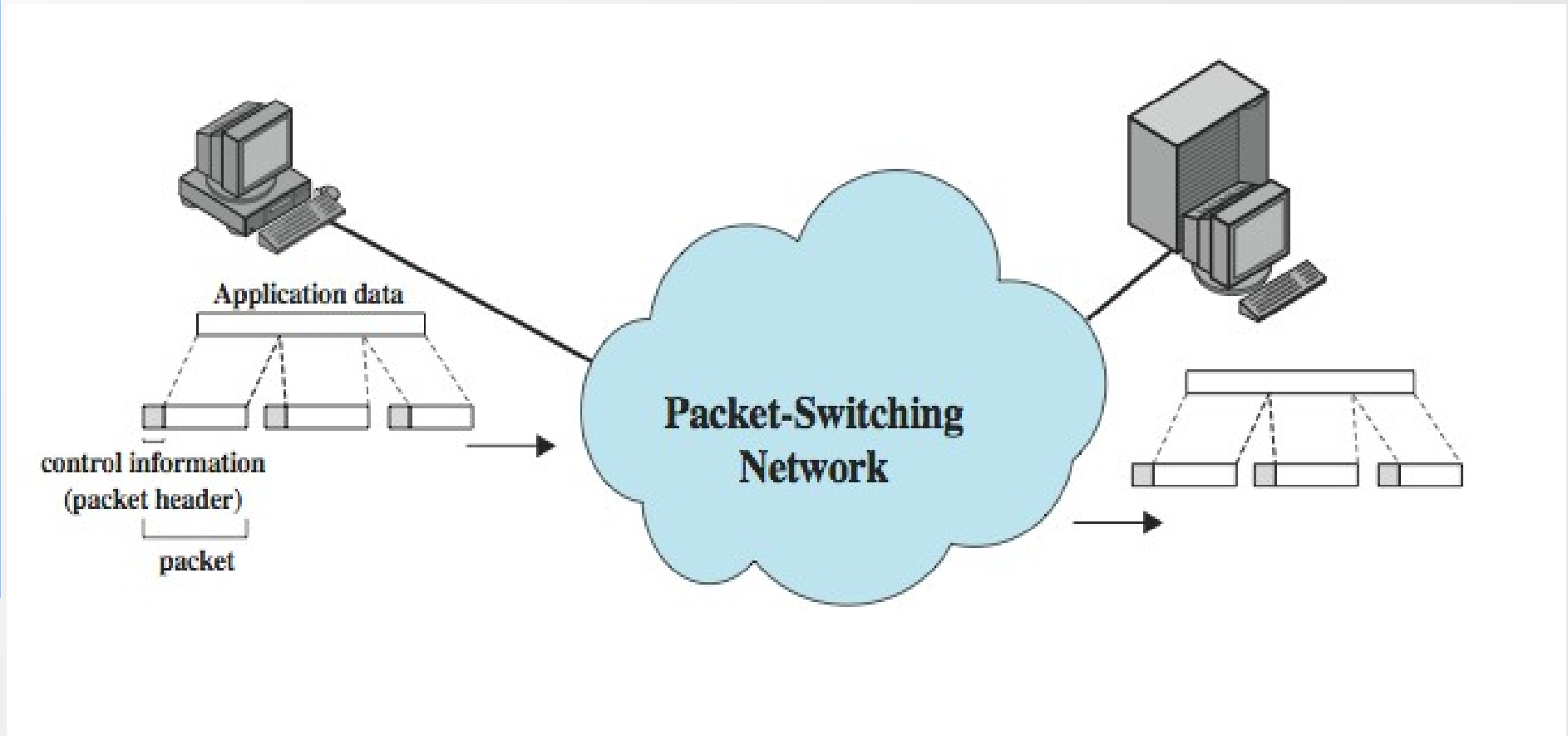


(a) Traditional circuit switching

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 info includes routing (addressing) info
- packets are received, stored briefly (buffered) and past on to the next node

Packet Switching



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
 - virtual circuit

Datagram Diagram

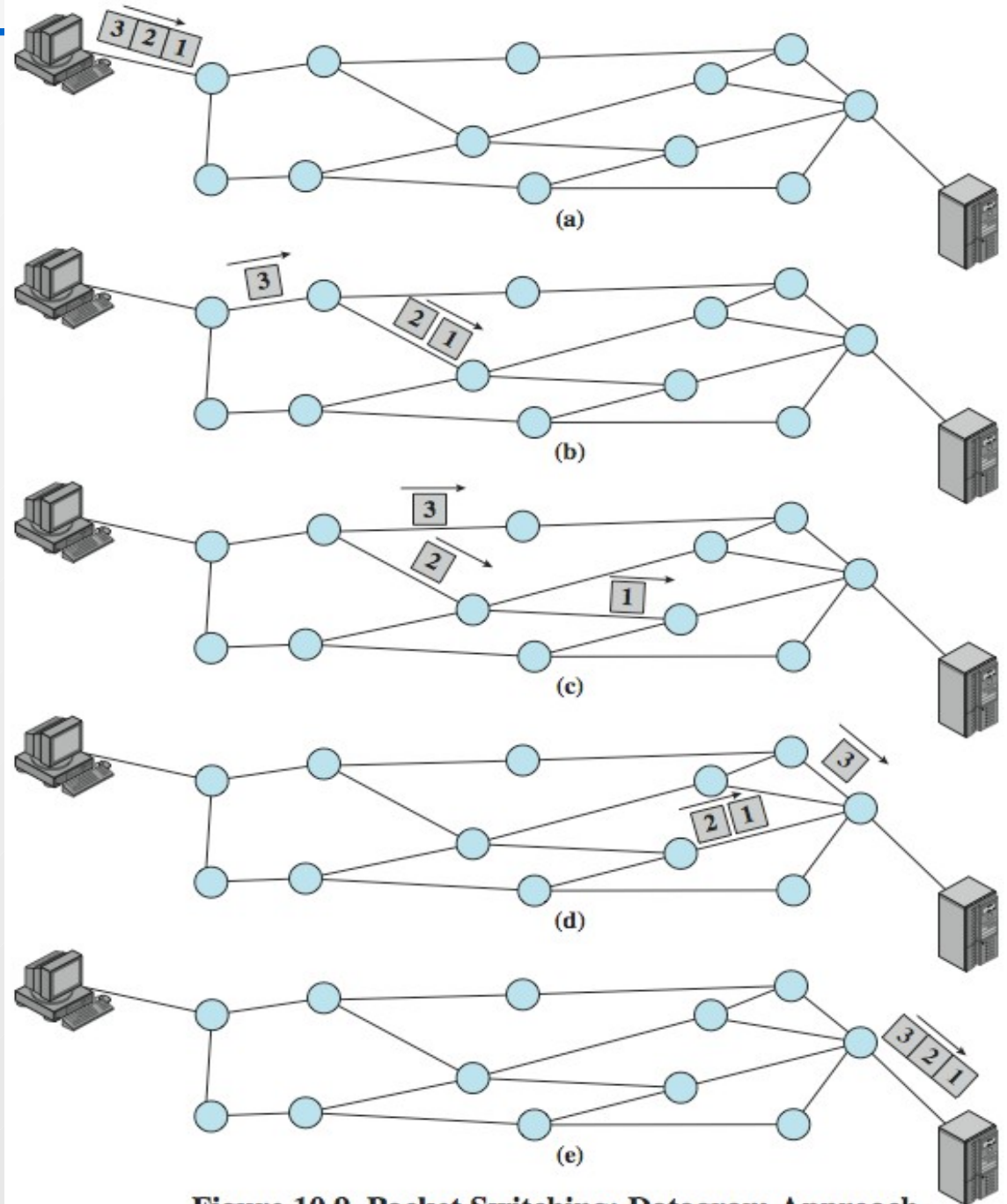


Figure 10.9 Packet Switching: Datagram Approach

Virtual Circuit Diagram

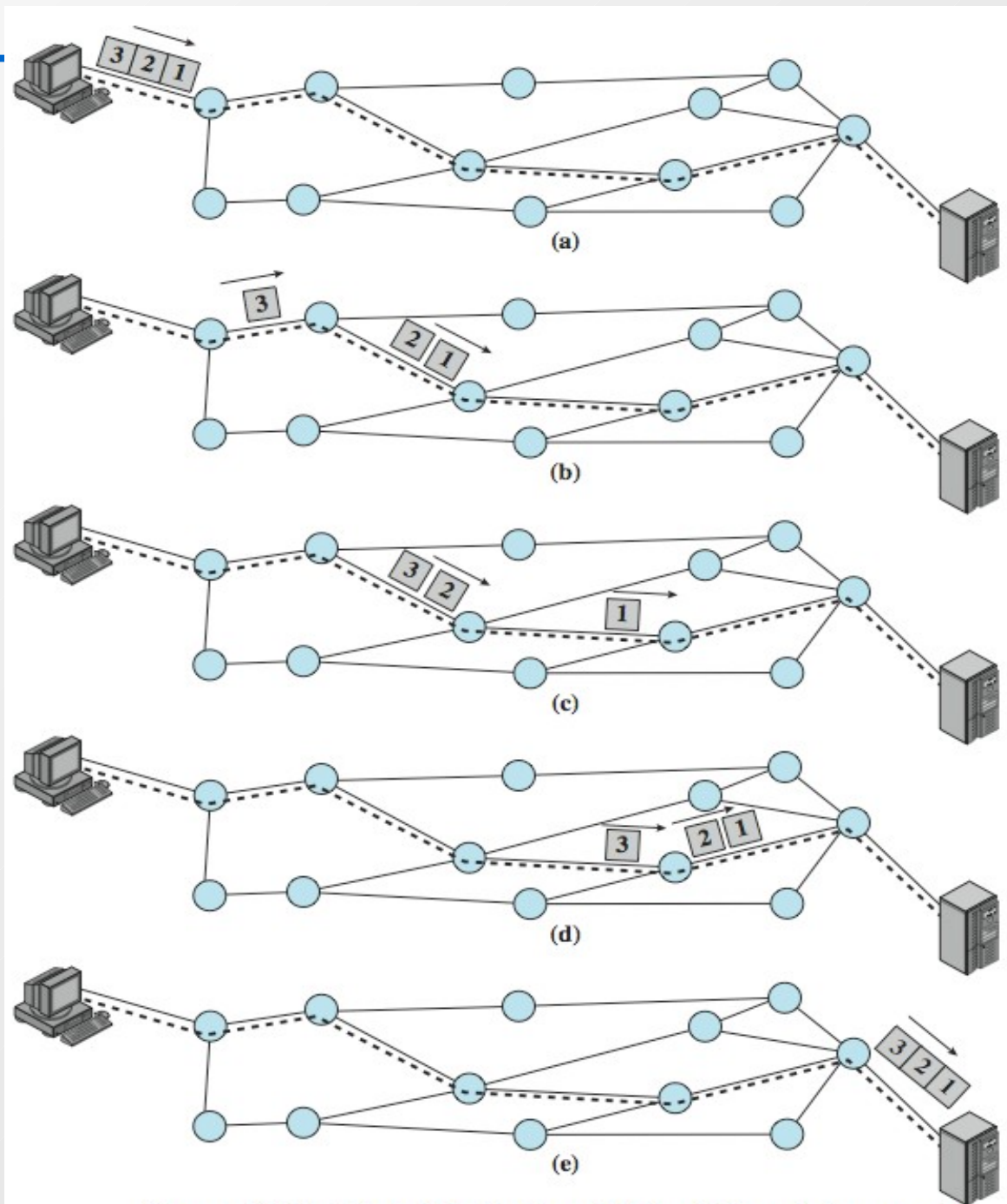


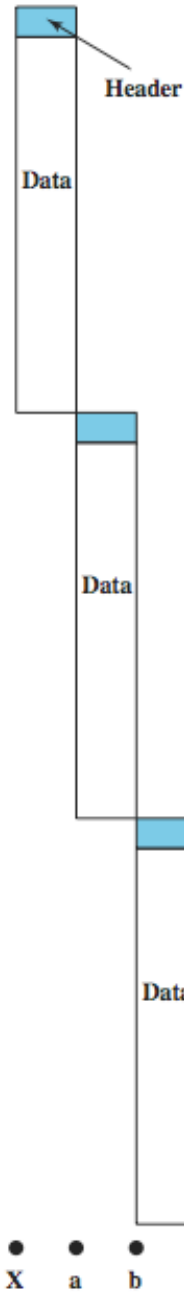
Figure 10.10 Packet Switching: Virtual-Circuit Approach

Virtual Circuits v Datagram

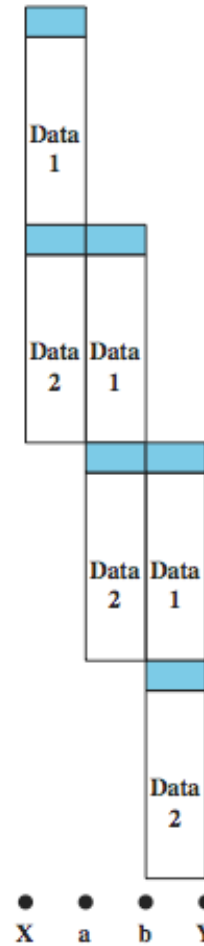
- virtual circuits
 - network can provide sequencing and error control
 - packets are forwarded more quickly
 - less reliable
- datagram
 - no call setup phase
 - more flexible
 - more reliable

Packet Size

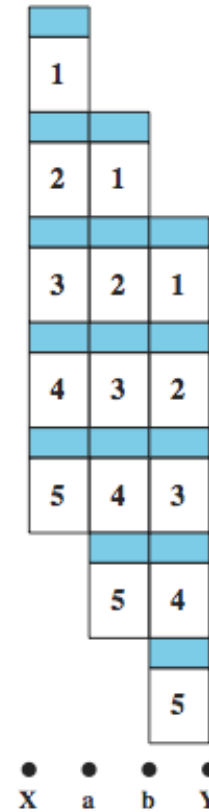
(a) 1-packet message



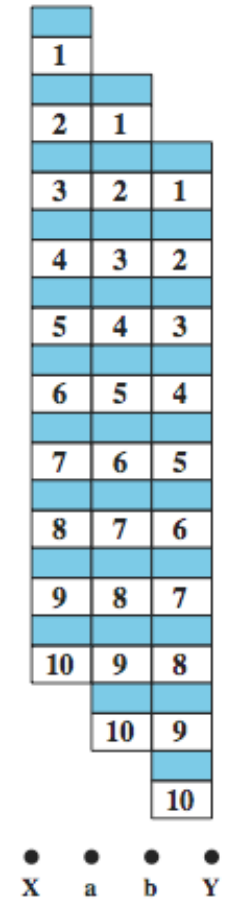
(b) 2-packet message



(c) 5-packet message



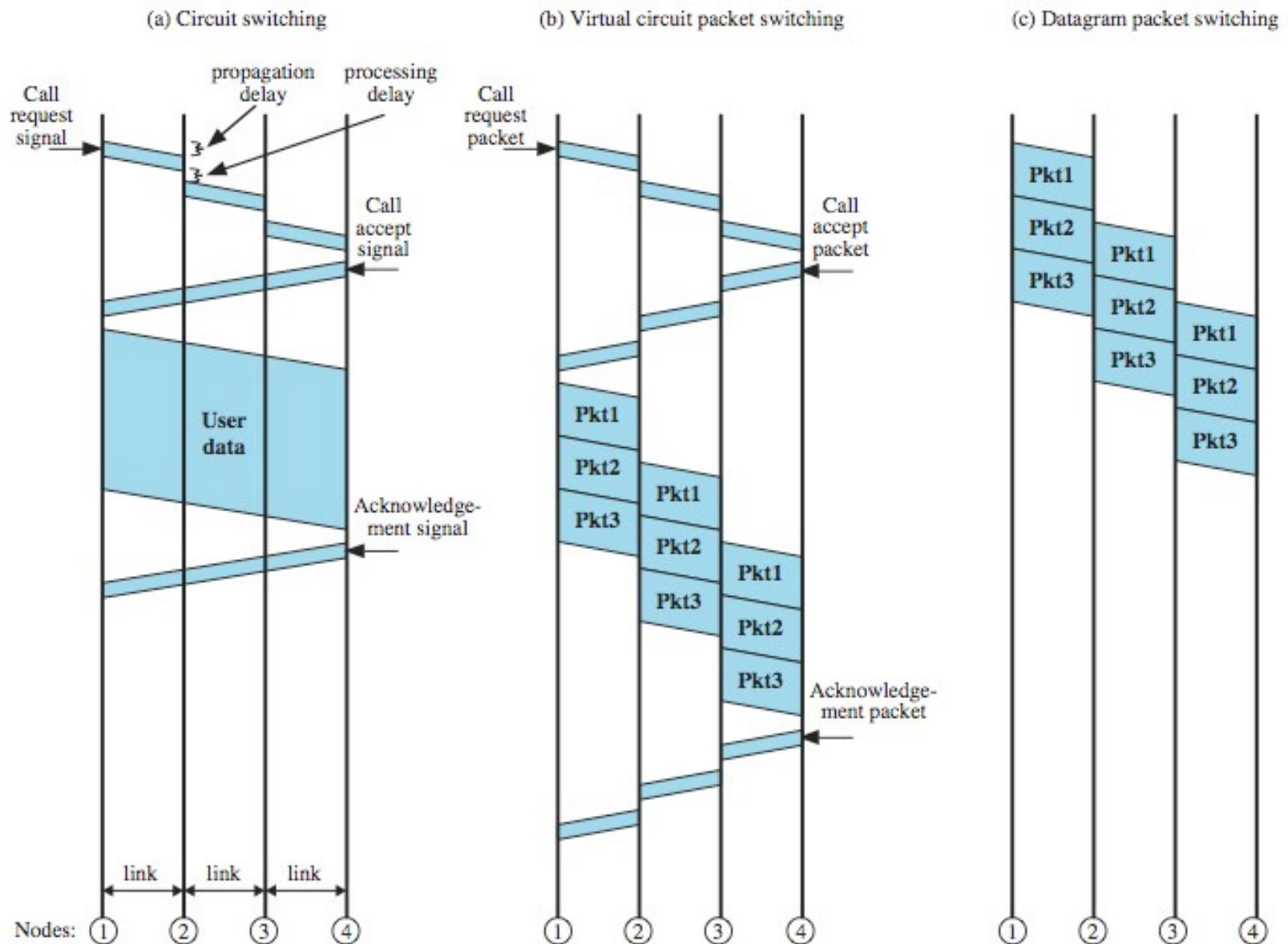
(d) 10-packet message



Circuit v Packet Switching

- performance depends on various delays
 - propagation delay
 - transmission time
 - node delay
- range of other characteristics, including:
 - transparency
 - amount of overhead

Event Timing



X.25

- ITU-T standard for interface between host and packet switched network
- almost universal on packet switched networks and packet switching in ISDN
- defines three layers
 - Physical
 - Link
 - Packet

X.25 - Physical

- interface between station node link
- two ends are distinct
 - Data Terminal Equipment DTE (user equipment)
 - Data Circuit-terminating Equipment DCE (node)
- physical layer specification is X.21
- can substitute alternative such as EIA-232

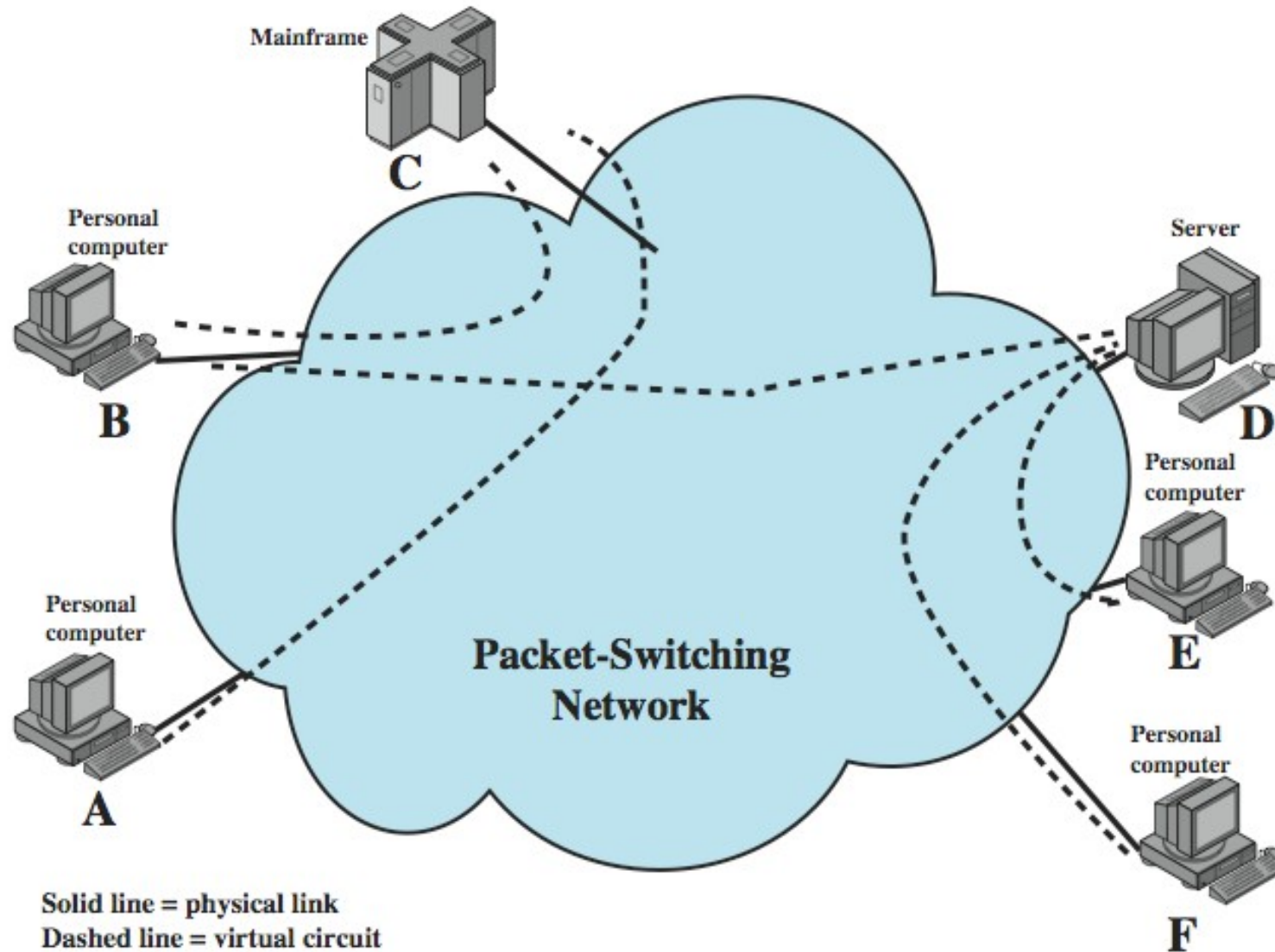
X.25 - Link

- Link Access Protocol Balanced (LAPB)
 - Subset of HDLC
 - see chapter 7
- provides reliable transfer of data over link
- sending as a sequence of frames

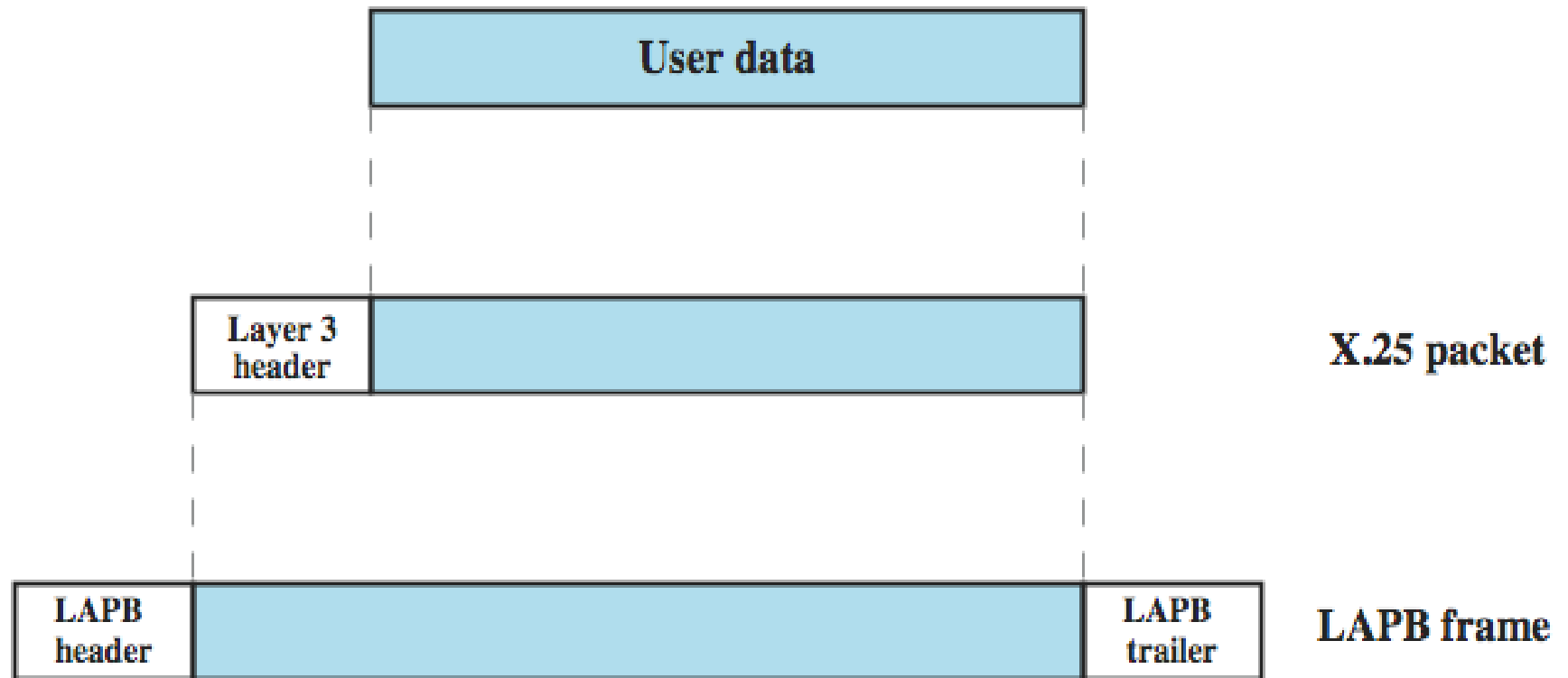
X.25 - Packet

- provides a logical connections (virtual circuit) between subscribers
- all data in this connection form a single stream between the end stations
- established on demand
- termed external virtual circuits

X.25 Use of Virtual Circuits



User Data and X.25 Protocol Control Information



Issues with X.25

- key features include:
 - call control packets, in band signaling
 - multiplexing of virtual circuits at layer 3
 - layers 2 and 3 include flow and error control
- hence have considerable overhead
- not appropriate for modern digital systems with high reliability

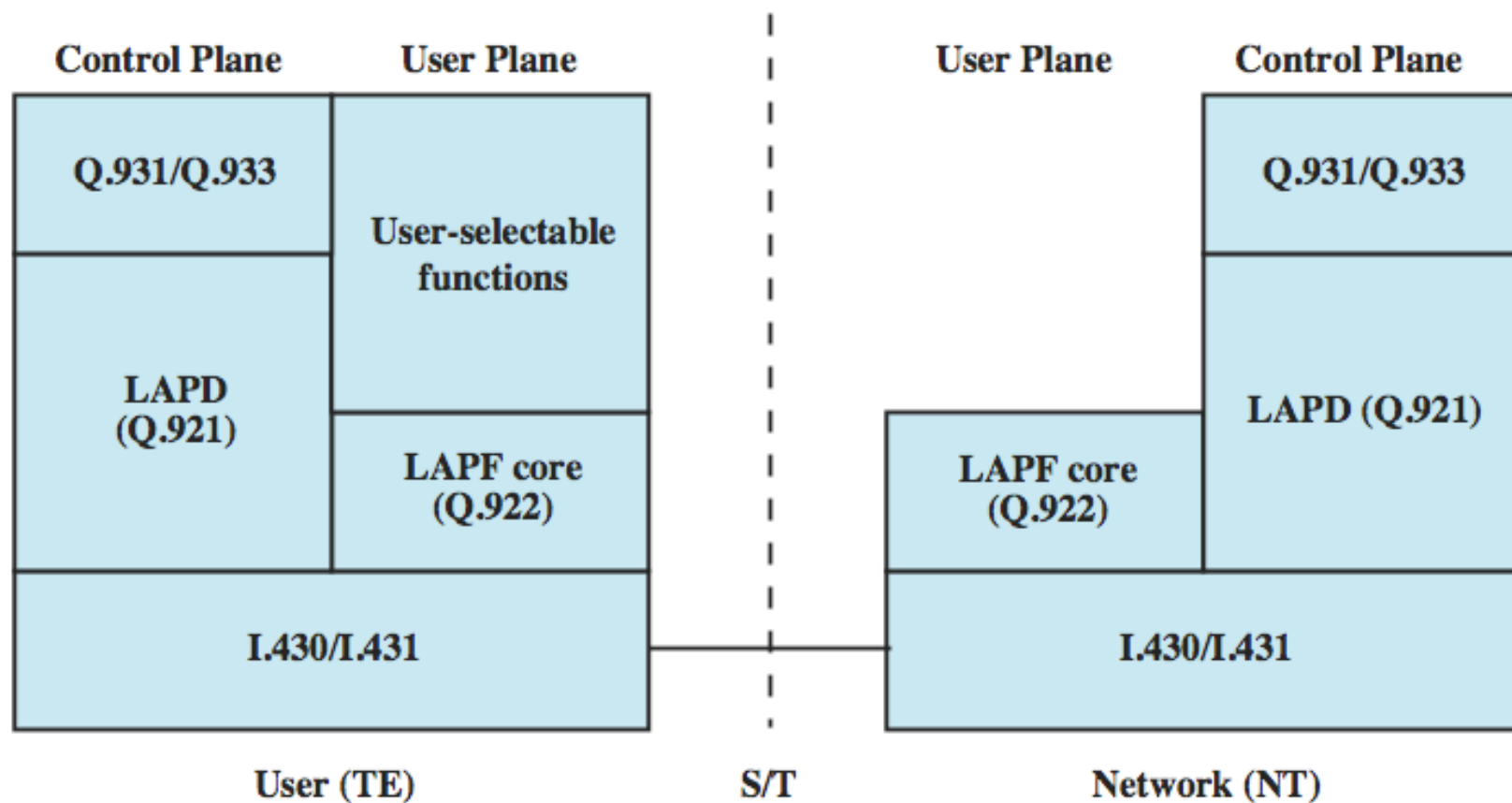
Frame Relay

- designed to eliminate most X.25 overhead
- has large installed base
- key differences:
 - call control carried in separate logical connection
 - multiplexing and switching at layer 2
 - no hop by hop error or flow control
 - hence end to end flow and error control (if used) are done by higher layer
- a single user data frame is sent from source to destination and higher layer ACK sent back

Advantages and Disadvantages

- lost link by link error and flow control
- increased reliability means less an issue
- streamlined communications process
 - lower delay
 - higher throughput
- frame relay can be used for access speeds up to and over 2Mbps

Protocol Architecture



LAPF Functionality

- LAPF (Link Access Procedure for Frame Mode Bearer Services) defined in Q.922
- only core functionality used:
 - frame delimiting, alignment and transparency
 - frame mux and demux using addressing field
 - ensure frame is integral number of octets
 - ensure frame is neither too long nor short
 - detection of transmission errors
 - congestion control functions
- form sub-layer of data link layer
 - data transfer between subscribers only

Frame Relay Data Link Connections

- logical connection between subscribers
- data transferred over them
- not protected by flow or error control
- uses separate connection for call control
- overall results in significantly less work in network

User Data Transfer

- only have one frame type which
 - carries user data
- no control frames means
 - no inband signaling
 - no sequence numbers
- flag and FCS function as in HDLC
- address field carries DLCI
- DLCI (Data Link Connection Identifier) has local significance only

Summary

- circuit verses packet switching network approaches
- X.25
- frame relay