

# Comp 346 / Comp 446 Telecommunications Packet Switching and Circuit Switching

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## Introduction to Wide Area Switching

- Switching often distinguishes LOCAL or ACCESS layer (“last mile” “last kilometer”)
  - First place individual devices connect to the network
  - Example: olden days phone to human operator
  - Example: mobile phone to cell tower (or MTSO)
- From INTERCONNECTION or WIDE AREA or LONG DISTANCE switching (“core network”)
  - Connecting cooperating switching nodes into a network. Connected via Trunks or Gateways
  - Example: two ISPs delivering traffic between them
- Both can have multiple companies, many technologies (and protocols)



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## Basic Network Architecture

- Often distinguish between
  - Circuit
    - A path / route / connection exists for as long as you want to use it for a conversation
    - Whole conversation stays together and has the channel for the entire time (or thinks it has the channel)
    - Some things added to help it on its way through the network
  - Packet
    - A more ad hoc way to send things by breaking up the whole conversation and sending it in pieces.
    - The channel or connection is used when needed (and free for other uses when not needed)
    - Some functions need to be provided during the connection to keep things organized
- And the two coexist in many networks



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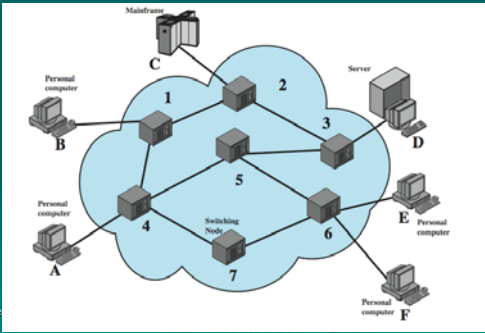
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## Switched Network



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## 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

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## 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

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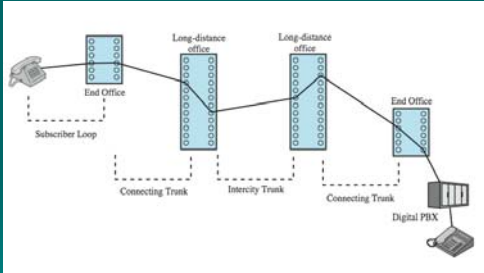
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# Public Circuit Switched Network



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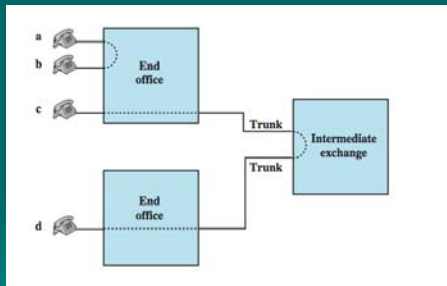
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# Circuit Establishment



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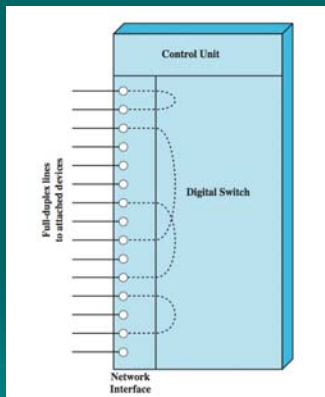
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# Circuit Switch Elements



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# 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

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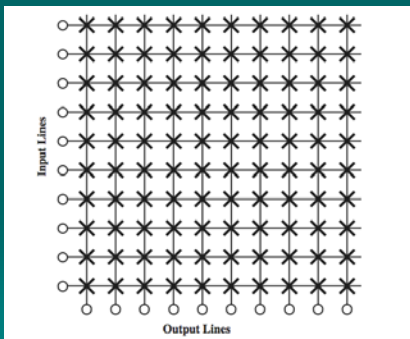
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# Space Division Switch



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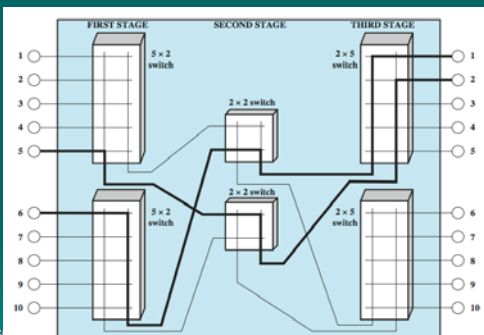
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# 3 Stage Space Division Switch



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# 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

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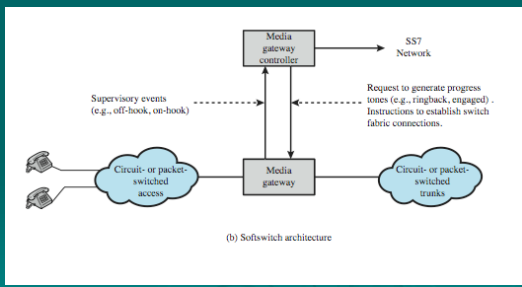
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# Softswitch



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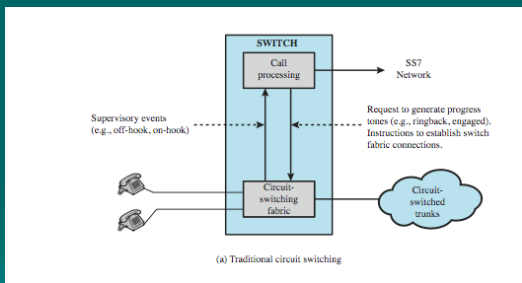
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# Traditional Circuit Switching



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## 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

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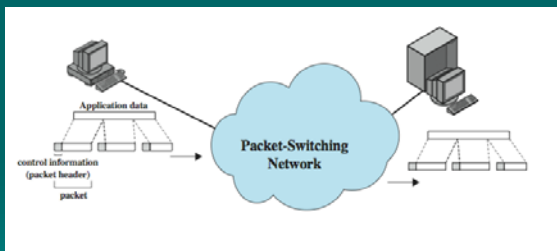
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## Packet Switching



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## 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

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# 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

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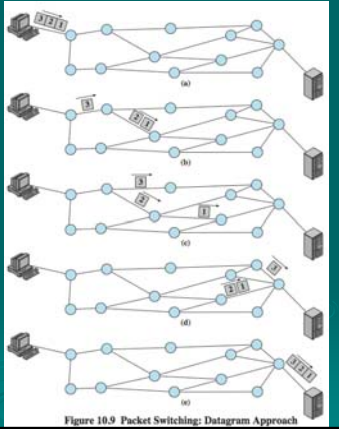
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## Datagram Diagram



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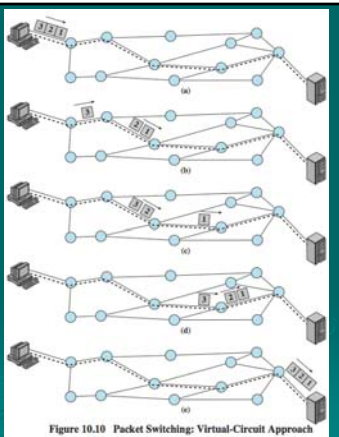
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## Virtual Circuit Diagram



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# 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

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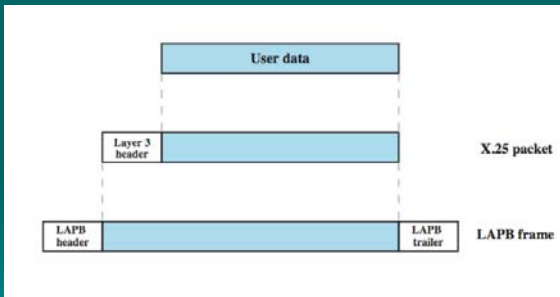
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# User Data and X.25 Protocol Control Information



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