

# Chapter 1

## Data Communications and Networks Overview

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## Historical Review

- telegraph by Morse, 1837 (operational in 1844).
- telephone by Bell, 1876 (Bell Telephone Company in 1877).
- radio (wireless) by A. Popov in 1895 & G. Marconi in 1896.
- first transcontinental wireless transmission in 1901 by Marconi
- vacuum diode by Fleming (1904) & vacuum triode by De Foster (1906)
- Superheterodyne receiver by Armstrong (during WWI)
- transcontinental telephone transmission in 1915 (operational)
- AM broadcast, 1920
- first TV system by Zworykin, 1929 (broadcasting in London, 1936)
- first FM communication system by Armstrong, 1933

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# Fundamental Problem of Electrical Communication

- Reproduce at one point - either exactly or approximately - a message produced at another point by using electrical systems.

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## Historical Review

- 1st digital computer ENIAC at the University of Penn., 1945
- invention of transistor by Brattain, Bardeen & Shockley, 1947
- fundamental work of Shannon & birth of information theory, 1948
- transatlantic cable & telephone service between Europe and USA, 1953
- 1st Earth satellite is launched by USSR, 1957
- invention of IC by Kilby, 1958
- 1st commercial communication satellite, 1965
- single-chip microprocessor by Intel, 1971
- 1st cellular phone by Motorola, 1972
- personal computers, 1976
- birth of Internet, 1989

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## Types of Communication Systems

- Types of communication systems:
  - wireline & wireless,
  - RF & optical,
  - digital & analog,
  - point-to-point & broadcasting,
  - low frequency/high frequency etc.
- Examples: telephone, cell phone, TV, Internet, hard disk in a PC

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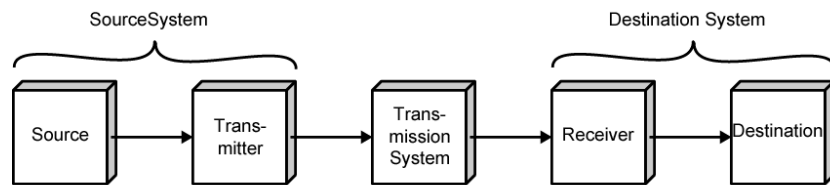
## A Communications Model

- Source
  - Generates data to be transmitted
- Transmitter
  - Converts data into transmittable signals
- Transmission System
  - Carries data
- Receiver
  - Converts received signal into data
- Destination
  - Takes incoming data

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## Simplified Communications Model



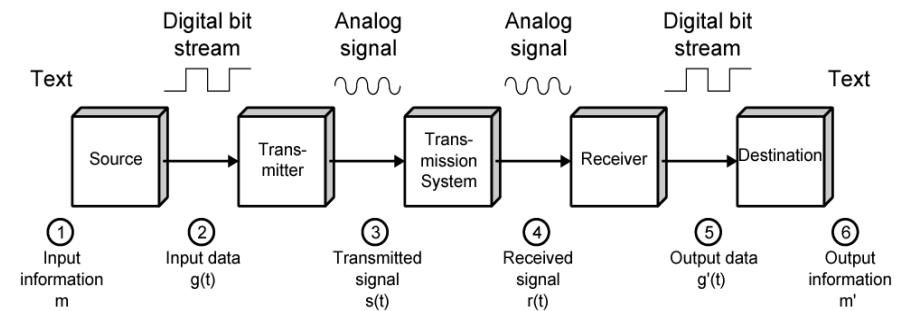
(a) General block diagram



(b) Example

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## Simplified Data Communications Model



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## Characteristics of Communication Channels

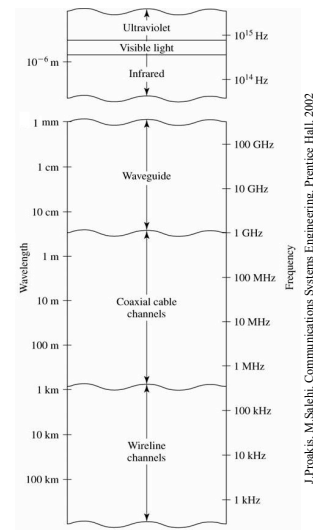
### Wireline channels:

- twisted-wire pair
- coaxial cable
- waveguides
- optic fiber

Signals are distorted in amplitude and phase. Some measures are required to reduce the effect of distortions.

Bandwidth of

- twisted pair: several hundred kHz
- coax cable: several hundred MHz
- wave guide: few GHz
- optic fiber: very wide

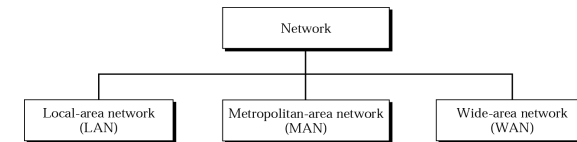


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## Networking

- Point to point communication not usually practical
  - Devices are too far apart
  - Large set of devices would need impractical number of connections
- Solution is a communications network

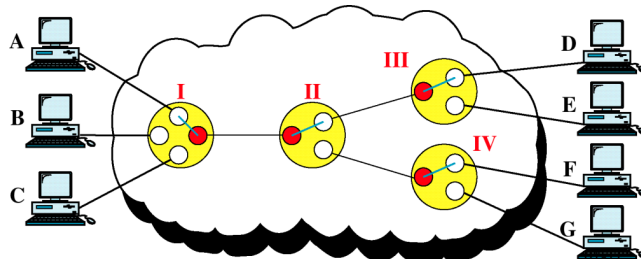


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## Circuit Switching

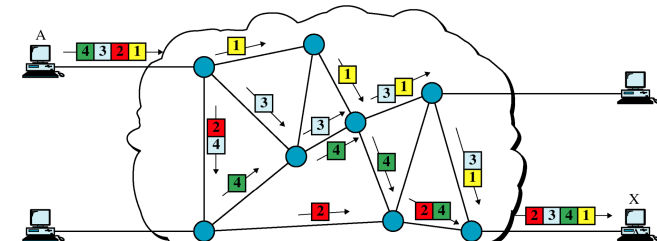
- Dedicated communications path established for the duration of the conversation
- e.g. telephone network



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## Packet Switching

- Data sent out of sequence
- Small chunks (packets) of data at a time
- Packets passed from node to node between source and destination
- Used for terminal to computer and computer to computer communications

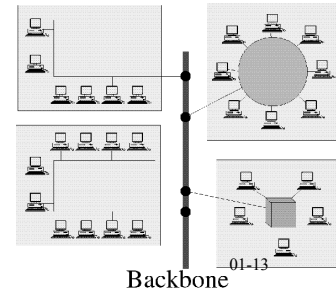
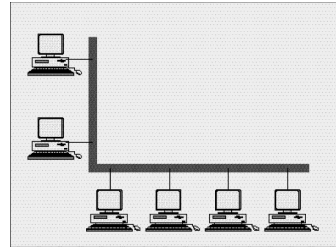


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## Local Area Networks

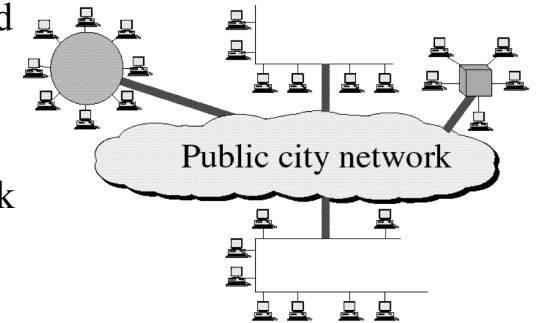
- Smaller scope
  - Building or small campus
- Usually owned by same organization as attached devices
- Data rates much higher
- Usually broadcast systems
- Now some switched systems and ATM are being introduced
- Wireless LAN



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## Metropolitan Area Networks

- MAN
- Middle ground between LAN and WAN
- Private or public network
- High speed
- Large area

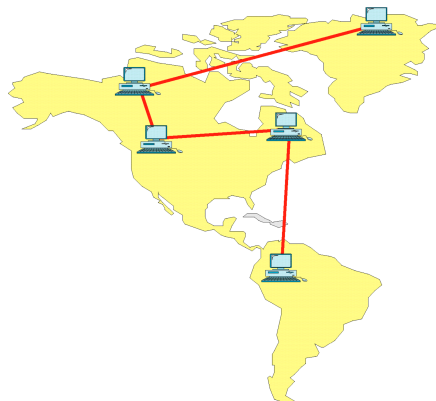


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## Wide Area Networks

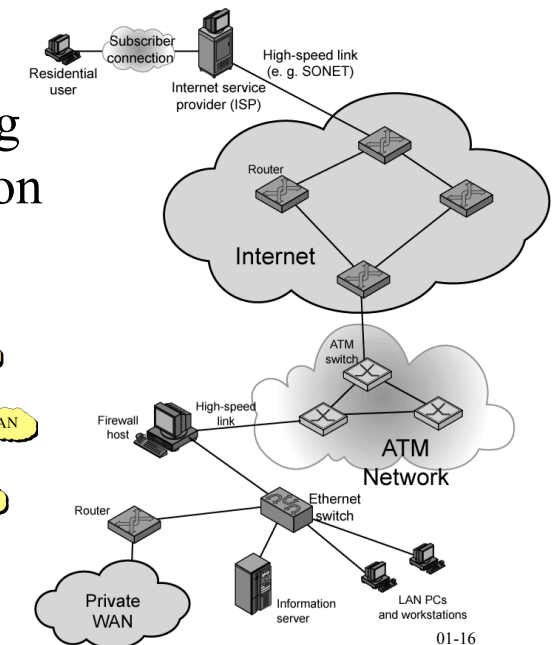
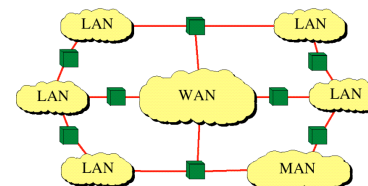
- Large geographical area
- Crossing public rights of way
- Rely in part on common carrier circuits
- Enabling technologies
  - Circuit switching
  - Packet switching
  - Frame relay
  - Asynchronous Transfer Mode (ATM)



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## Networking Configuration



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