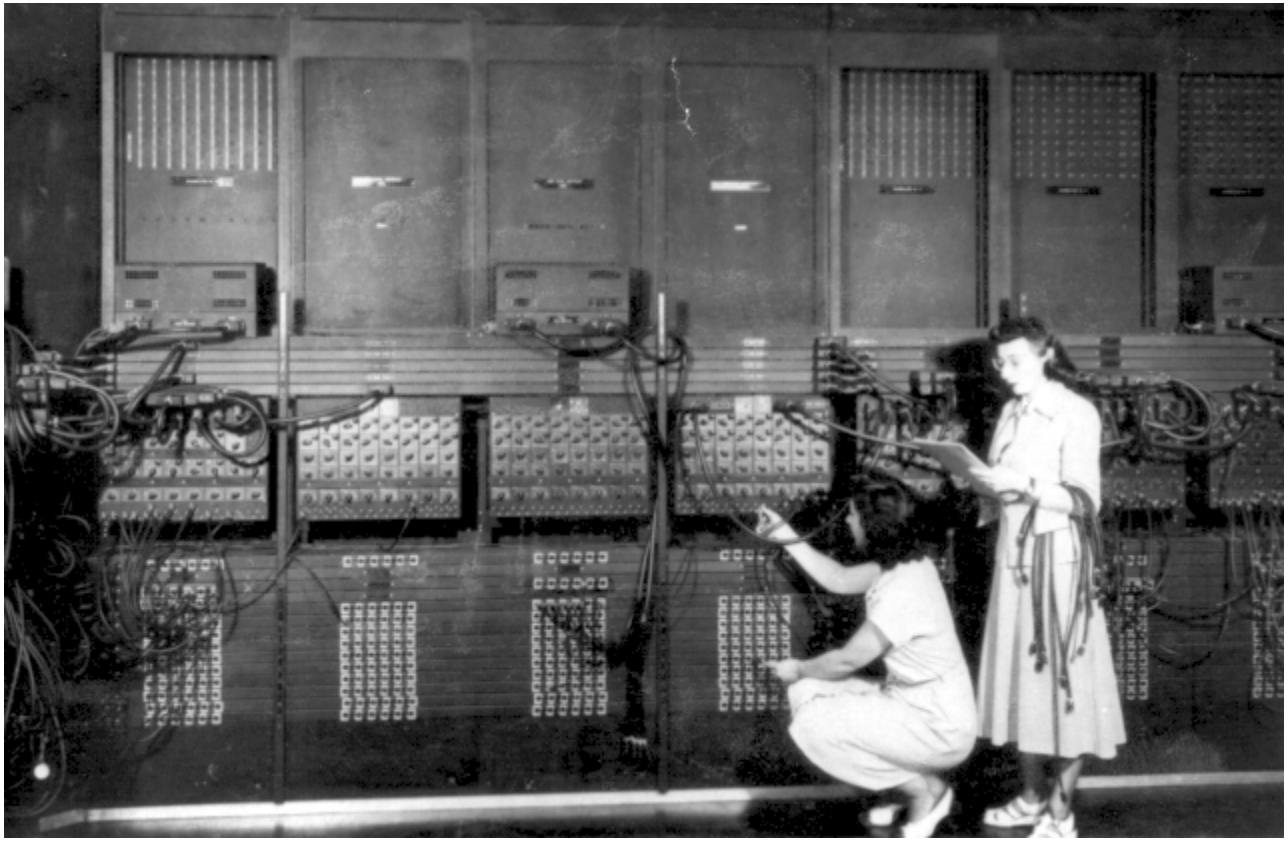
Computer Networks: LANs, WANs The Internet

Required reading:
Forouzan Ch. 1
Garcia 1.1 and 1.2

CSE 3213, Fall 2015
Instructor: N. Vlajic

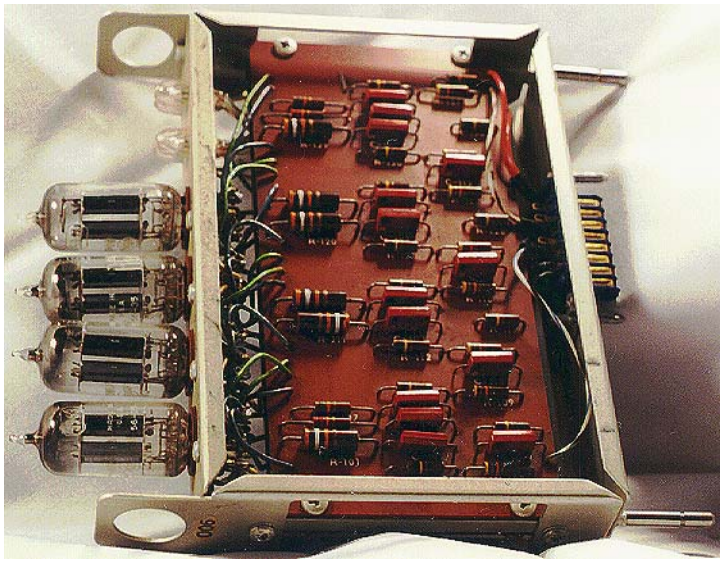
History of Computers

Computer – **a machine that manipulates data according to a set of instructions**



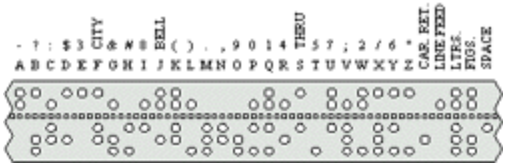
Eniac – the first modern electronic computer. (1950s)

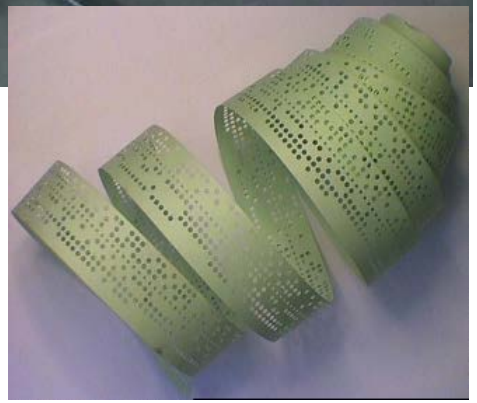
http://ftp.arl.army.mil/ftp/historic-computers/gif/eniac4.gif



“Four dual triodes are used to count and store the 4 bits needed to represent a decimal digit. “

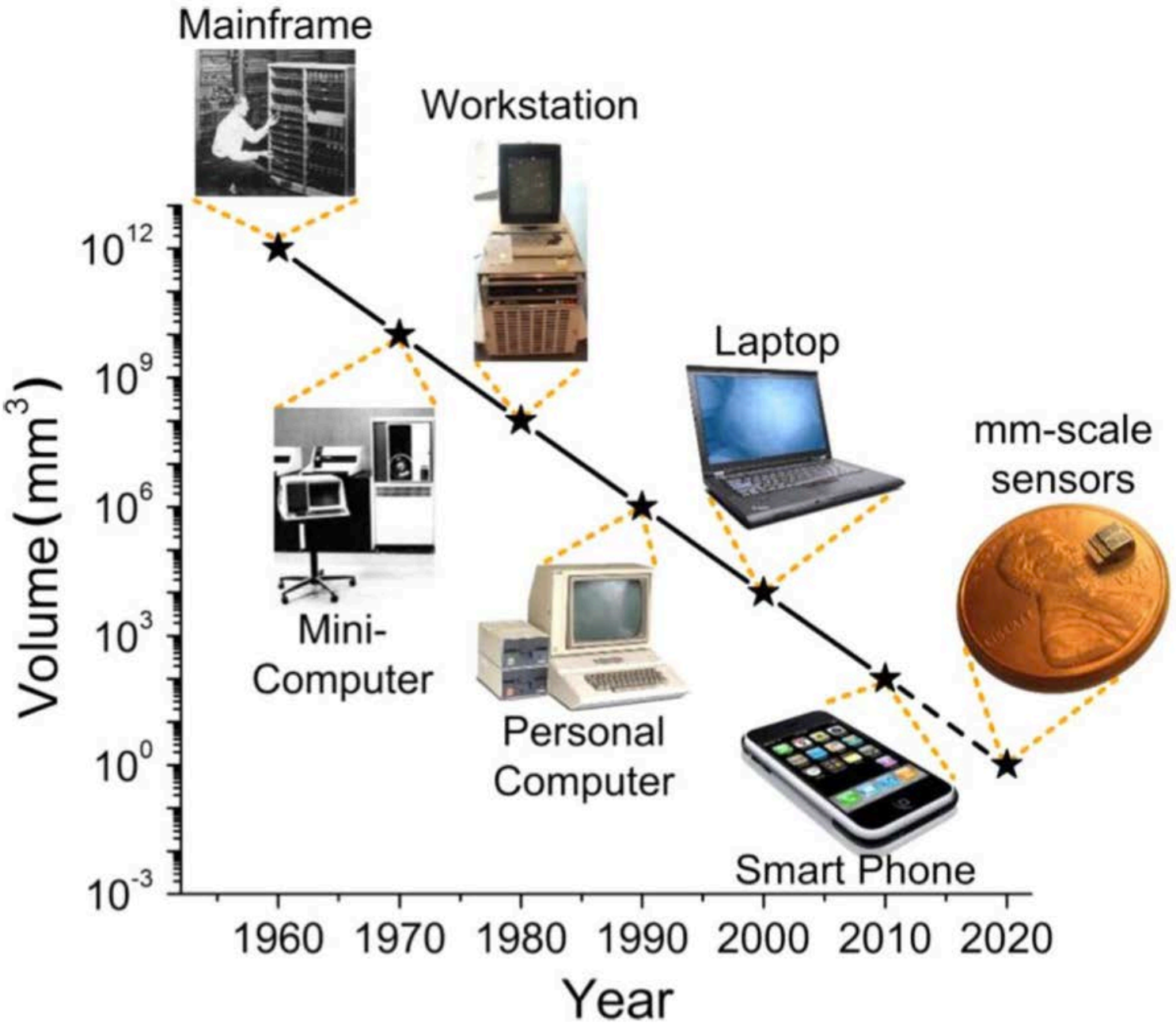
www.cs.virginia.edu/brochure/museum.html





“A teletype was a motorized typewriter that could transmit your keystrokes to the mainframe and then print the computer's response on its roll of paper. You typed a single line of text, hit the carriage return button, and waited for the teletype to begin noisily printing the computer's response (at a whopping 10 characters per second). On the left-hand side of the teletype in the prior picture you can observe a paper tape reader and writer (i.e., puncher).”

www.computersciencelab.com/ComputerHistory/HistoryPt4.htm



http://www.computerhistory.org/atchm/the-worlds-smallest-computer/

History of Computer Networks

1950s - 1960s: **Terminal-Oriented Computer Networks**

1960s – 1970s: **Computer-to-Computer Networks:**
the ARPANET – first Wide Area Network (WAN)

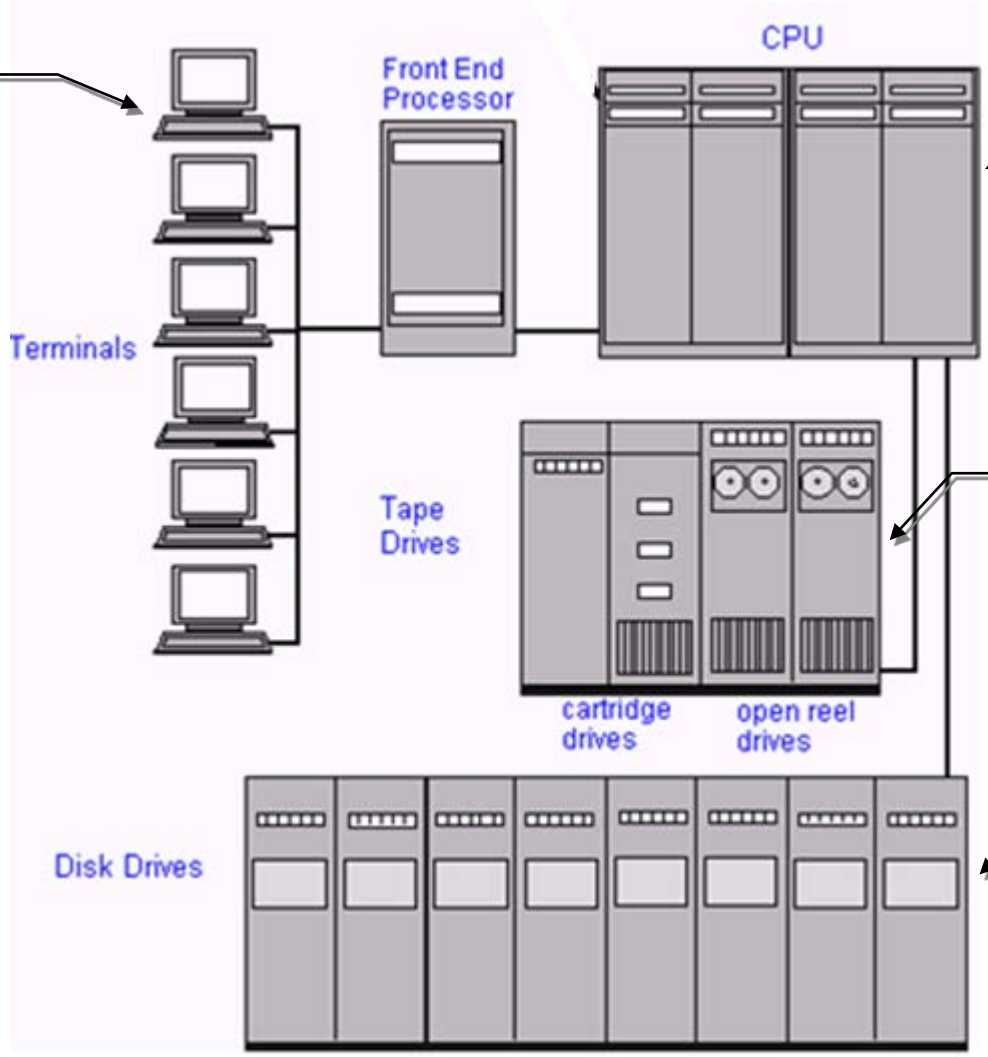
1980s: **Local Area Networks (LANs)**

1980s: **The Internet**

most superior telecommunication network

Terminal-Oriented Computer Networks

Terminal-Oriented Computer Networks = Mainframe Networks

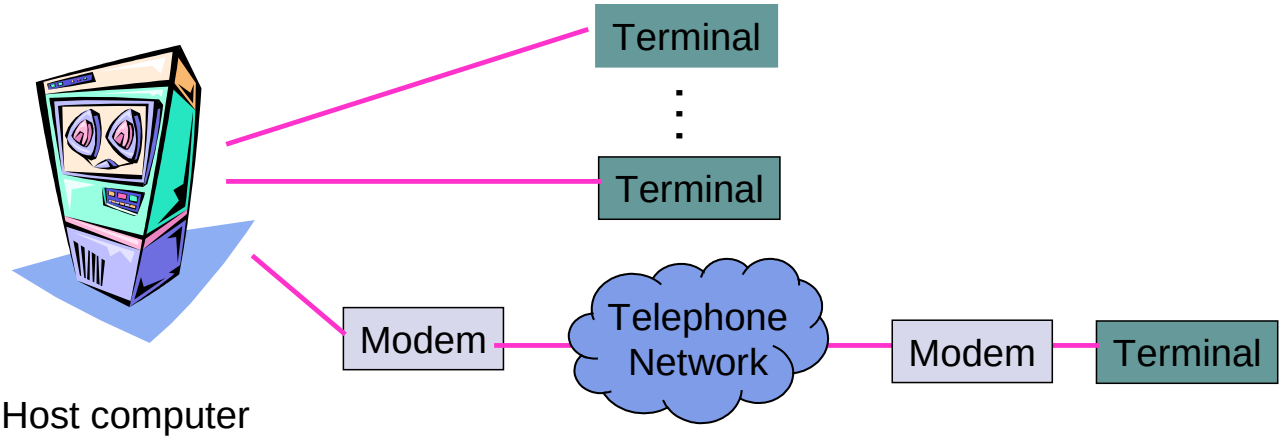


http://www.pcmag.com/encyclopedia/term/46536/mainframe

Terminal-Oriented Computer Networks

Terminal-Oriented Computer Networks of 1960s and 1970s

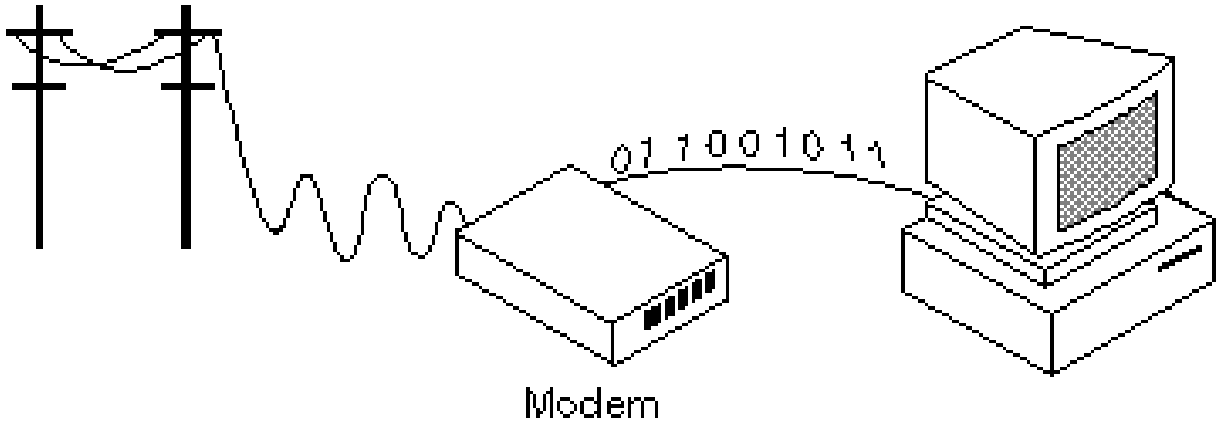
- early computers were extremely expensive, so time-sharing techniques were developed to allow them to be shared by many users
- through use of video/keyboard terminals multiple users were able to simultaneously input instructions and obtain results from the host computer
- modem devices* further enabled that terminals reach the host computer via telephone network, over a grater distance



(*) modem – device for sending digital data over phone line / analog network

Terminal-Oriented Computer Networks (cont.)

Example **[modulation / demodulation]**



A modem is a device or program that enables a computer to transmit data over, for example, telephone or cable lines. Computer information is stored digitally, whereas information transmitted over telephone lines is transmitted in the form of analog waves. A modem converts between these two forms.

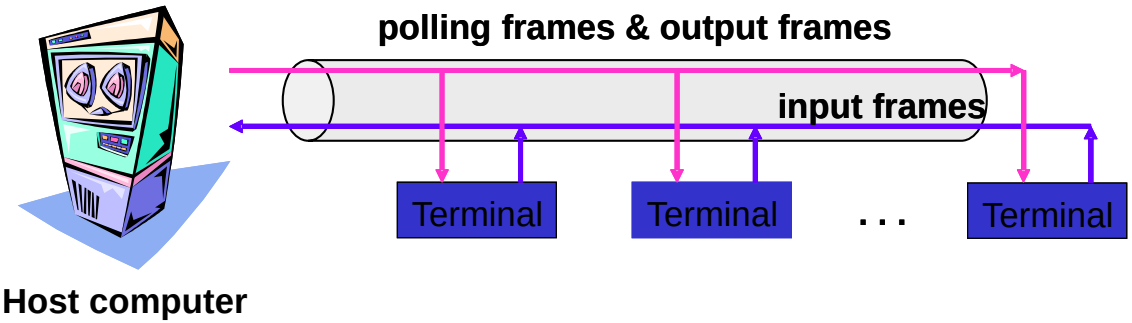
http://www.webopedia.com/TERM/M/modem.html

Terminal-Oriented Computer Networks (cont.)

Line Sharing Challenges:

- in a mainframe system, a large number of terminals had to be connected to a central computer
- cost of providing individual lines to each terminal was prohibitive
- line sharing was more practical, but - how to share a common medium in manner that is:
  - **fair** – each machine gets a chance to send, long waits prevented
  - **orderly** – data from each machine is received by the intended recipient and is properly assembled and reassembled
  - **error-free** – discard/resend erroneous data

Line-sharing challenges:
- **medium access control**
- **framing**
- **addressing**
- **error control**

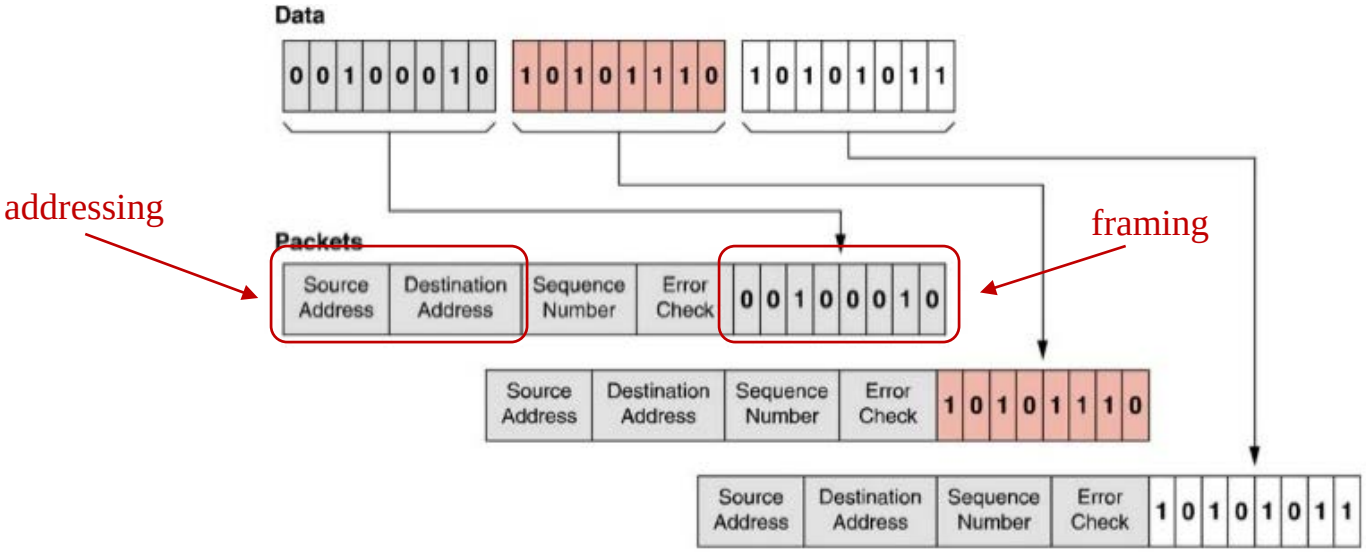


Terminal-Oriented Computer Networks (cont.)

Line Sharing Challenges:

Medium Access Control, Frame-ing, Addressing

- **medium access control** methods allowed a number of terminals to communicate with central computer using a shared comm. line
  - **example:** **polling protocol**
- line sharing required that messages be partitioned into **frames** (header + data)
- frames / headers had to carry '**address**' to identify receiving terminal



Terminal-Oriented Computer Networks (cont.)

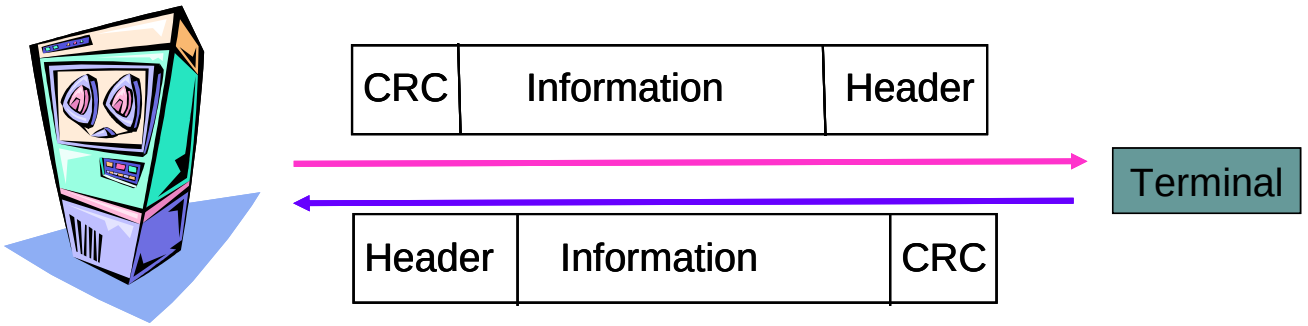
Frame-based Error Control Techniques

- communication lines and analog switching equipment introduced errors in transmission
- error-control techniques were developed to ensure error-free communication
- example: Cyclic Redundancy Check (CRC) algorithm – an error-detection scheme

  (1) CRC is calculated based on frame header and payload

  (2) CRC is appended to frame

  (3) if receiver detects error, retransmission is requested
- some error-control techniques attempt to send enough redundant info to enable both error-detection and error-correction

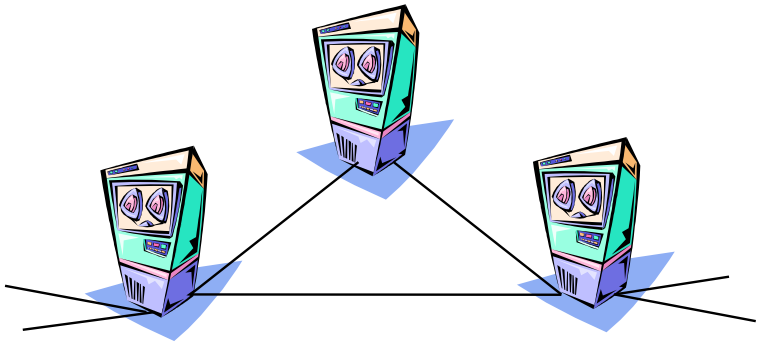


1950s - 1960s:	Terminal-Oriented Computer Networks
1960s – 1970s:	**Computer-to-Computer Networks: the ARPANET – first Wide Area Network (WAN)**
1980s:	Local Area Networks (LANs)
1980s:	The Internet

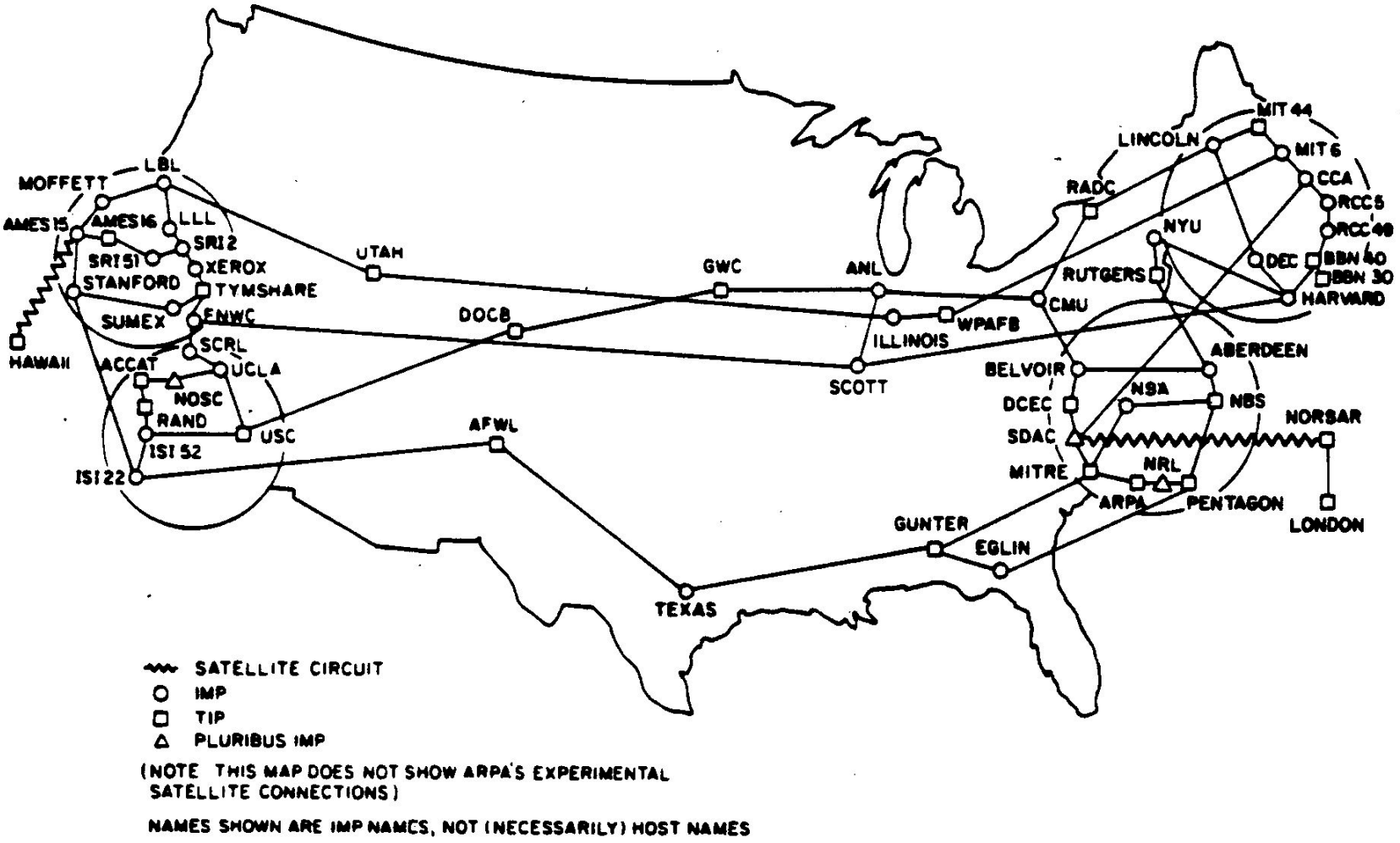
Computer-to-Computer Networks

Computer-to-Computer Networks

- as cost of computers dropped and new applications emerged, it became necessary to enable mainframe computers (not terminals!) to interconnect and communicate over long geographic distances
- application examples:
  - file transfer between computers
  - multiprocess operation over multiple computers
- ARPANET (1960s) - 1st major effort at developing a network to interconnect computers over a wide geographic area – first major WAN
- Internet (1970s) - emerged from ARPANET – network of interconnected networks



Example [ARPANET in 1977]



http://som.csudh.edu/cis/lpress/history/arpamaps/f15july1977.jpg