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CSE 3213: Communication Networks
Fall 2010

Course Web-Page: http://www.cs.yorku.ca/course/3213/
(all lecture notes will be posted on this page)

Instructor: Natalija Vlajic (vlajic@cse.yorku.ca)

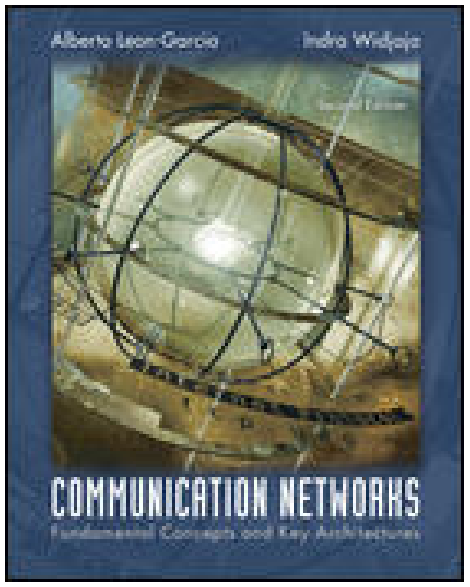
Office Hours: Thursday 14:00 - 16:00 (CSE 2047)

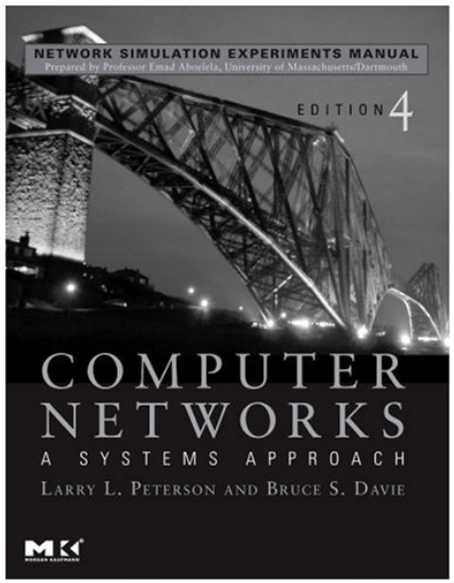
Prerequisite: General Prerequisite.

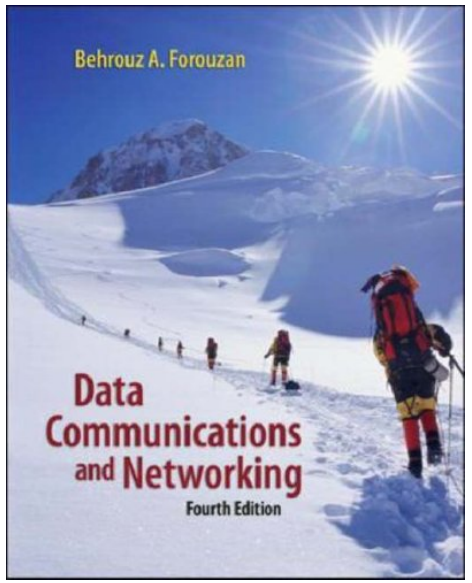
Textbook: "Communication Networks:
Fundamental Concepts and Key Architectures",
A. Leon-Garcia and I. Widjaja,
McGraw Hill, 2004, 2nd edition.

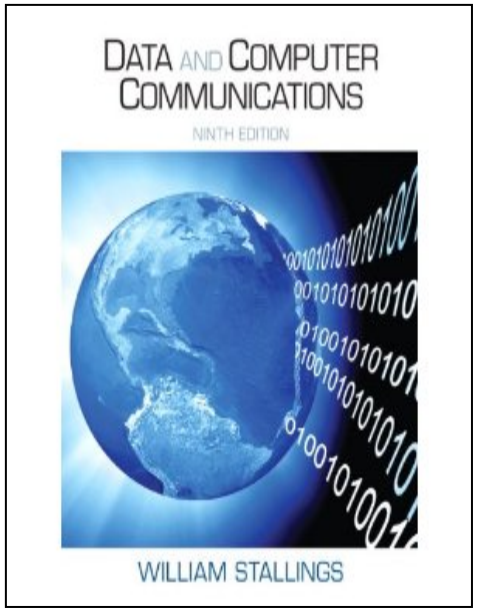
Other Material: "Data Communications and Networking",
B. A. Forouzan, McGraw Hill, 2007, 4th edition.

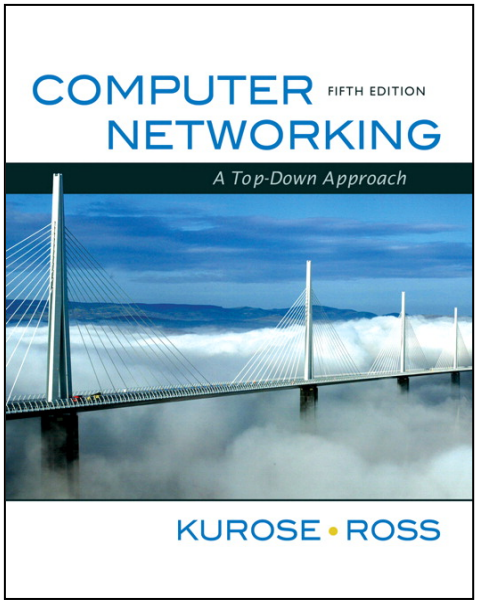
"Computer Networks: A Systems Approach –
Network Simulation Experiments Manual",
E. Aboelela, Morgan Kaufmann, 2008, 2nd edition.

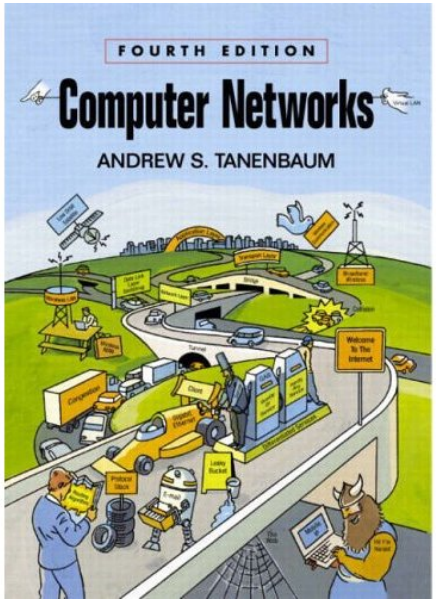

Alberto Leon-Garcia
Indra Widjaja
COMMUNICATION NETWORKS


NETWORK SIMULATION EXPERIMENTS MANUAL
EDITION 4
COMPUTER NETWORKS
A SYSTEMS APPROACH
LARRY L. PETERSON AND BRUCE S. DAVIE


Behrouz A. Forouzan
Data Communications and Networking
Fourth Edition


DATA AND COMPUTER COMMUNICATIONS
NINTH EDITION
WILLIAM STALLINGS


COMPUTER NETWORKING
FIFTH EDITION
A Top-Down Approach
KUROSE • ROSS


FOURTH EDITION
Computer Networks
ANDREW S. TANENBAUM

Grading Scheme:

Quiz 1, 2:	2 x 6 % = 12 %
Lab Report 1, 2:	2 x 4 % = 8 %
Midterm (Nov 02):	35%
Final:	45%

Missed Quizes:

Makeups of missed Quizzes will NOT be possible. Exact time of each Quiz will be announced on the course Web site, in advance.

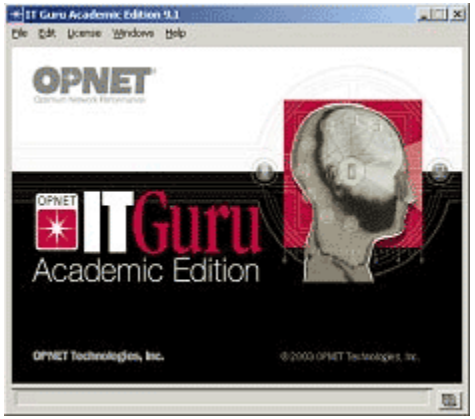
Missed Midterm:

Makeups of missed midterm exams are only possible in extremely exceptional situations, by arrangement well prior to the exam.

Lab Software:

OPNET IT Guru (Academic Edition)

- free network simulation software
- 6-mont renewable licence
- lab-manual will be available after reading week
- labs to take place in November

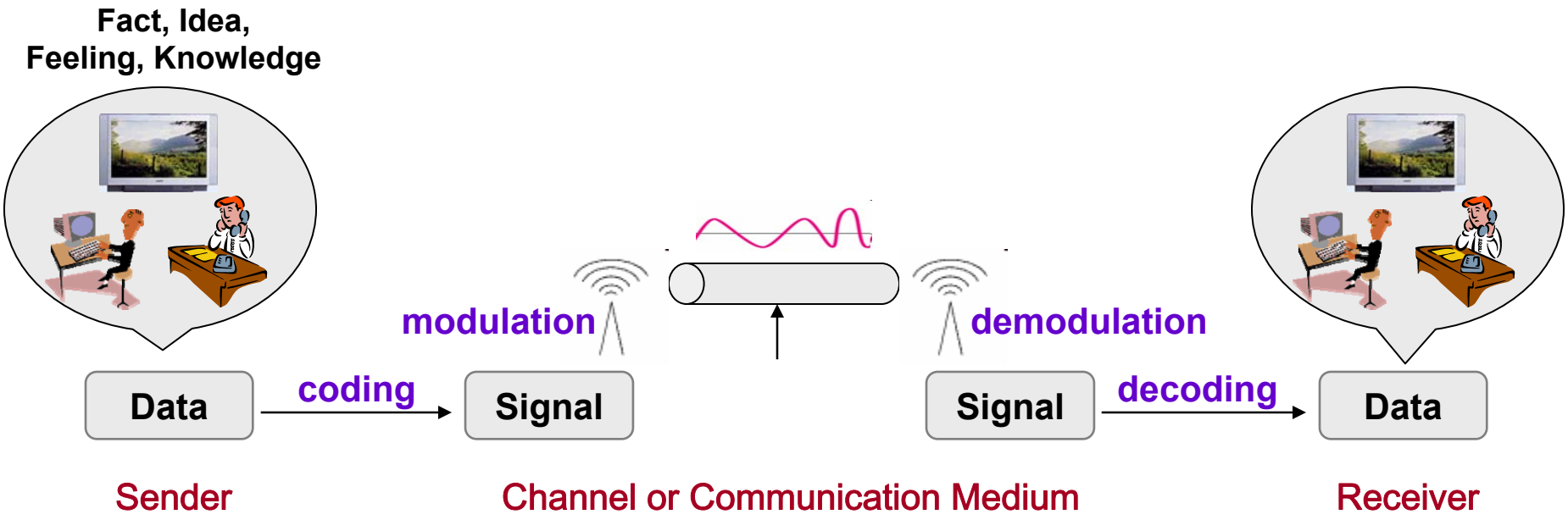


Course Objective and Schedule:

The course is an introduction to communications and networking. Topics covered include:

- **Message, Circuit, Packet Switching LANs, WANs**
- **Applications and Layered Architectures**
- **Time and Frequency Representations of Signals**
  Intro to Fourier Analysis
- **Digital vs. Analog Communications**
- **Channel Capacity, Nyquist and Shannon Theorems**
- **Line Coding (RZ, NRZ, Bipolar, Manchester)**
- **Digital Modulation (ASK, PSK, FSK)**
- **Analog Modulation (AM, FM, PM)**
- **PCM and Delta Modulation**
- **Error Detection and Correction**
- **Flow and Error Control**
- **Medium Access Control (Aloha, CSMA, Scheduling)**
- **LAN Protocols (Ethernet, Token Ring, Wireless LANs)**
- **Connecting LANs**
- **Network Layer**
- **IP Protocol**

Telecommunication = communication over distance

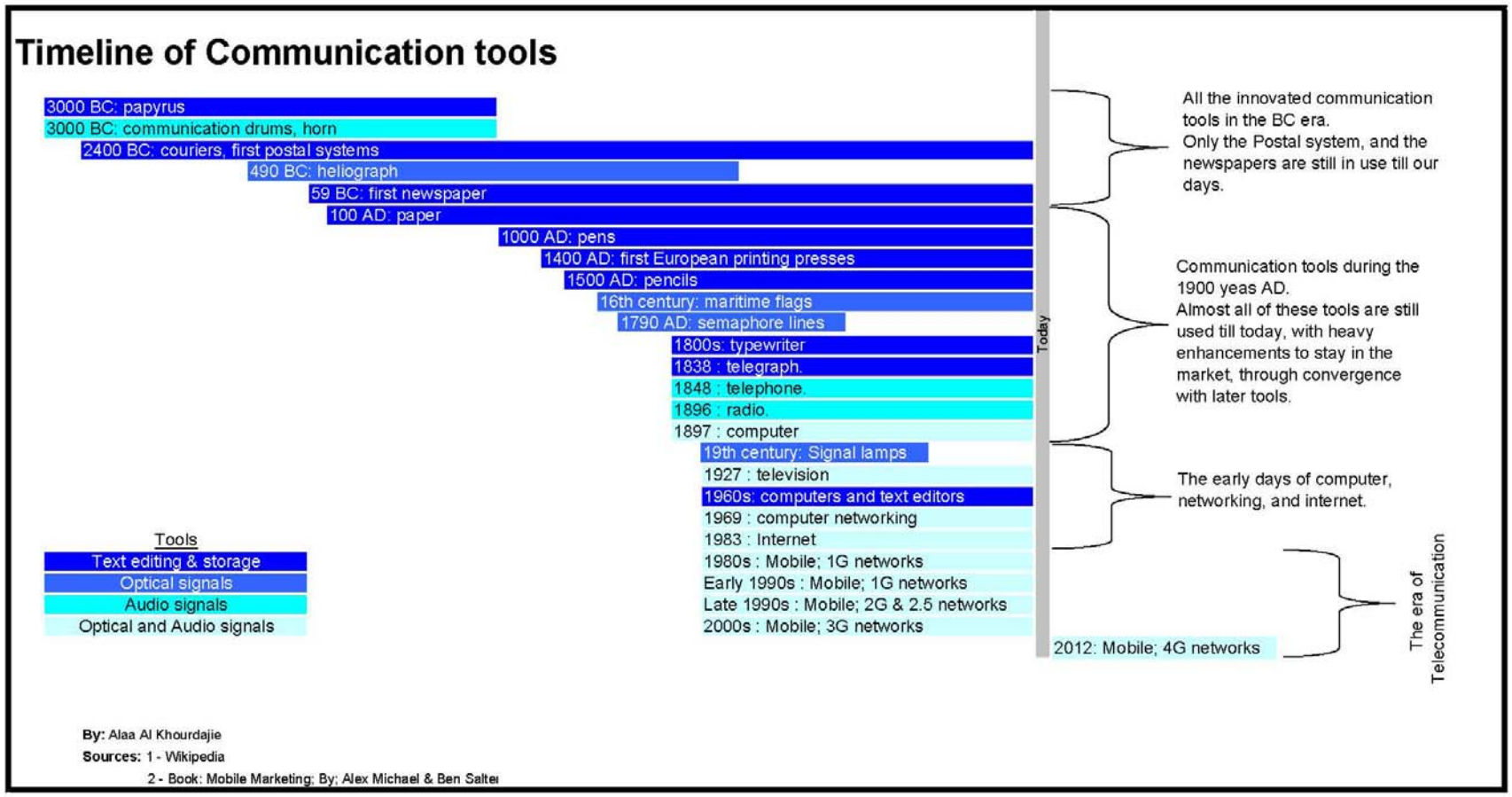


Communication Networks and Services

Required reading: Garcia 1.1 and 1.2

CSE 3213, Fall 2010
Instructor: N. Vlajic

History of Telecommunications



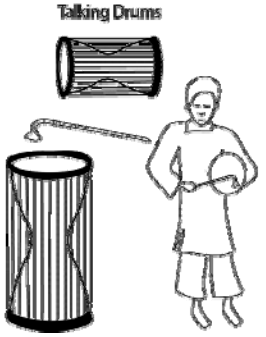
http://en.wikipedia.org/wiki/File:Timeline_of_communication_tools.jpg

History of Telecommunications (cont.)

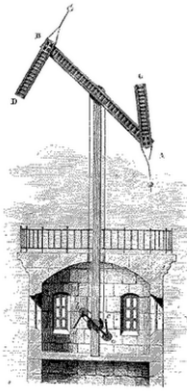
Transmission medium

- **Paper** (postal system)

- **Audio signals (drums)**



- **Optical signals (smoke, optical telegraph)**

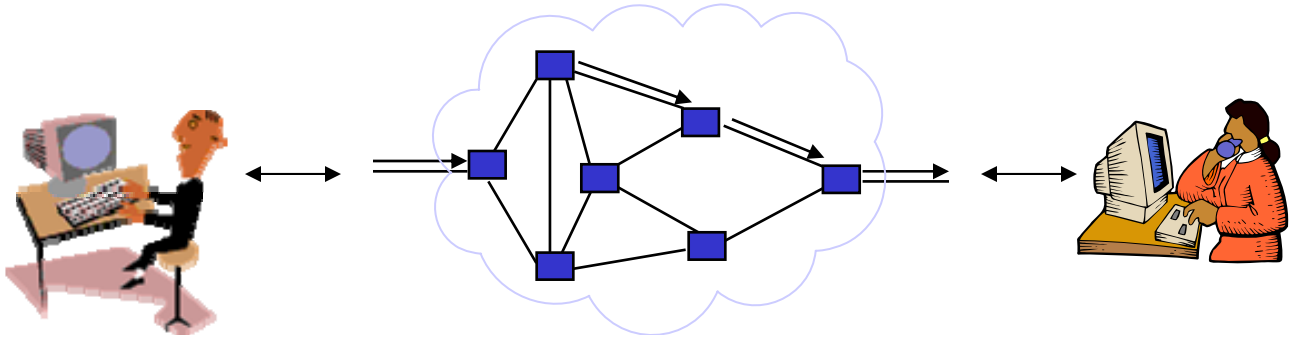


- **Electro-magnetic signal**

(Tele)communication Networks and Services

Communication Network – set of equipment and facilities that provide a service: *the transfer of information between users located at various geographical points*

- equipment = hardware + software: computers, switches, hubs, routers, modems, servers, etc.
- facilities: copper wires, coaxial cables, optical fiber, air
- examples:
  - telegraph networks
  - telephone networks (wired and wireless)
  - computer networks - the Internet
  - television broadcast / satellite networks
- different networks/services differ in how and what form of information is transferred



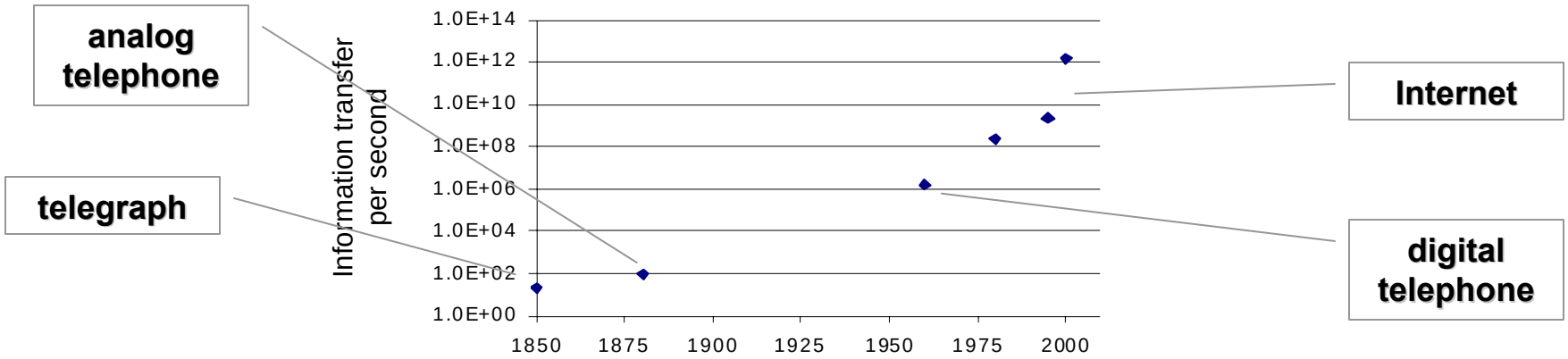
Evolution of Communication Networks

– an indicator of the progress in comm. technology is the speed at which data can be transmitted measured in [bps]

(1) Telegraph Networks – 20 bps
- message switching
- "store and forward" transmission

(2) Telephone Networks – 64 kbps
- circuit switching
- connection-oriented transmission

(3) Internet – n*Gbps
- packet switching
- "store and forward" transmission
- diverse computer applications!



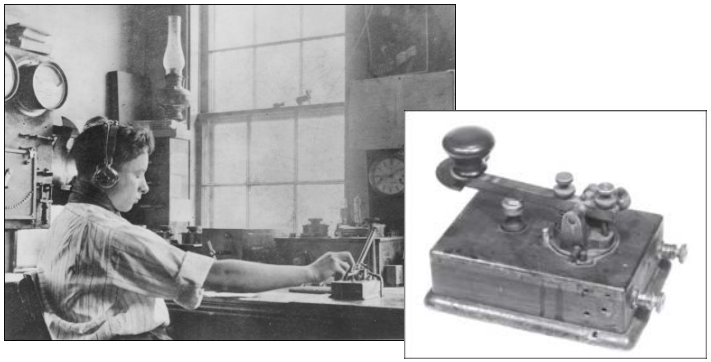
Telegraph Networks – Message Switching

Electric Telegraph – wires were stretched from one point to another; electric current is either allowed to flow through the wires or is broken by a switch called **telegraph key**

- electric current is used to activate a **sounder** which makes clicking sounds – short / long times between clicks are decoded into letters from the alphabet

Morse Telegraph – text message is encoded into a sequence of dots and dashes [1873]

- dots and dashes are converted into short and long pulses of electric current
- **digital transmission system** – relies only on 2 signal-levels



http://www.davidsarnoff.org/gallery-ds/DS_Telegraph_key.html

	Morse Code		Morse Code		Morse Code		Morse Code
A	· —	J	· — — —	S	· · ·	2	· · — — —
B	— · · ·	K	— · —	T	—	3	· · · — —
C	— · — ·	L	· — · ·	U	· · —	4	· · · · —
D	— · ·	M	— —	V	· · · —	5	· · · · ·
E	·	N	— ·	W	· — —	6	— · · · ·
F	· · — ·	O	— — —	X	— · · —	7	— — · · ·
G	— — ·	P	· — — ·	Y	— · — —	8	— — — · ·
H	· · · ·	Q	— — · —	Z	— — · ·	9	— — — — ·
I	· ·	R	· — ·	1	· — — — —	0	— — — — —

Telegraph Networks – Message Switching (cont.)

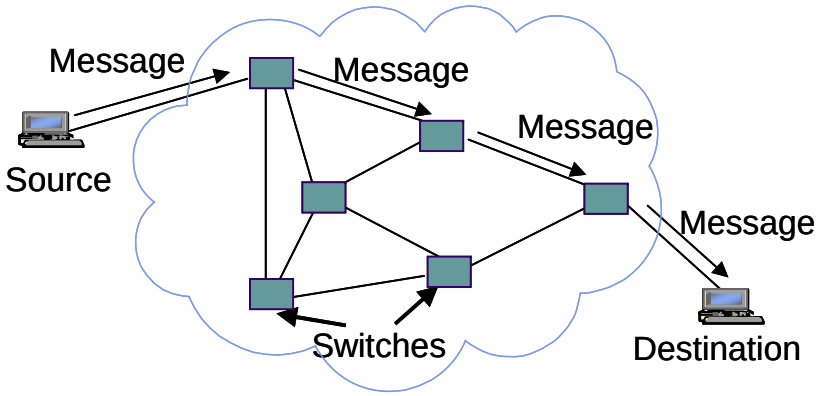
Electric Telegraph Networks – **network of interconnected telegraph stations**

(1) a message arrives at a station

(2) operator stores the message until the desired communication line becomes available

(3) operator then forwards the message to next appropriate station

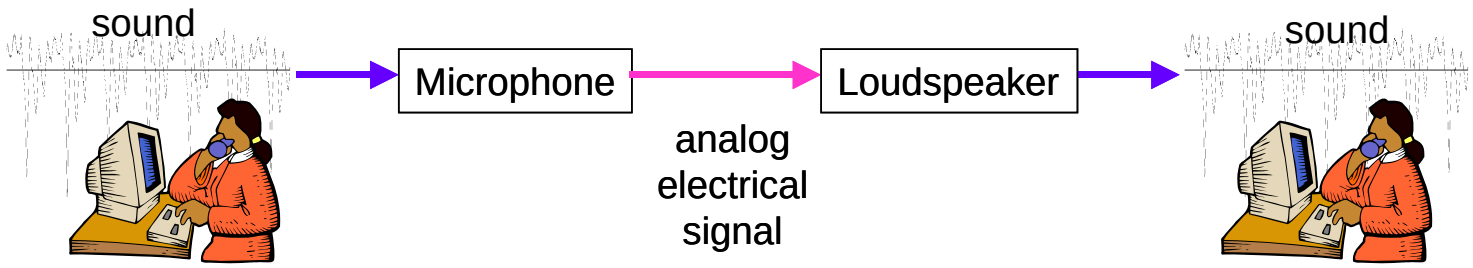
- **"store and forward" message transmission**
- **system of telegraph / message switching stations**



Telephone Networks – Circuit Switching

Bell's Discovery [1876] – **voice signals can be transmitted over wires - led to invention of telephone**

- **microphone converts voice pressure variation (sound) into *analogous* electrical signal**
- **loudspeaker converts electrical signal back into sound**

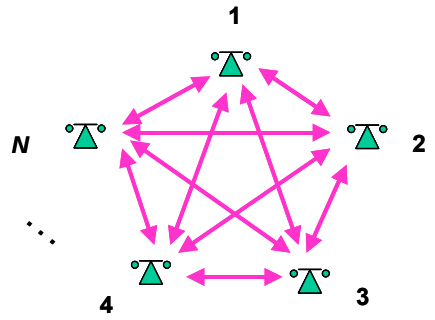


Telegraph vs. Telephone

- **telegraph was rather slow and required an expert operator with knowledge of Morse code**
- **telephone terminal was very simple and did not require any expertise - targeted as a direct service to end users**

Telephone Networks – Circuit Switching (cont.)

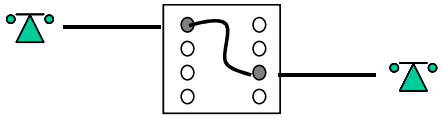
Dedicated Telephone Networks

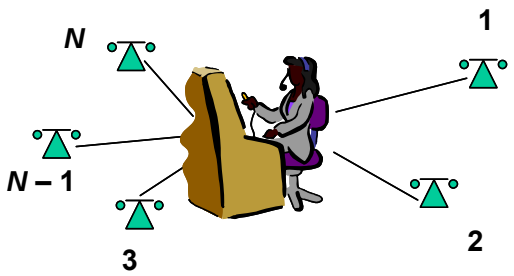


– dedicated lines between each pair of users – existed in early days of telephony

- ? connections per n users
- inefficient and costly

Circuit Switched Telephone Networks





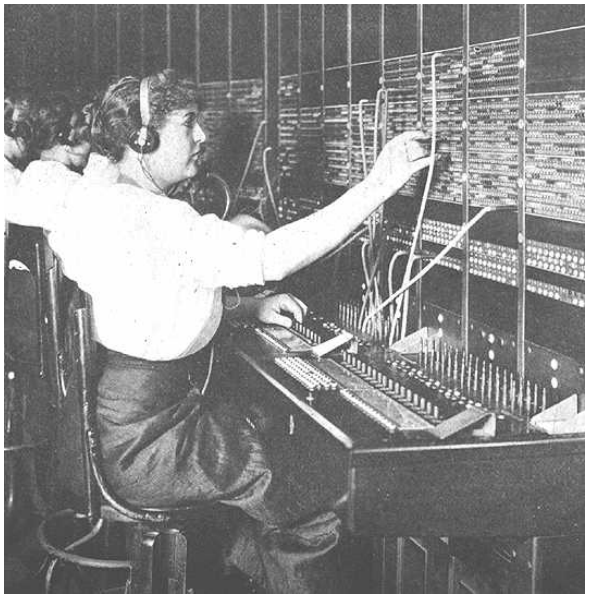
– patch cord panels + human operators [1878]

- only N connections to central office per N users
- operator connects users 'on demand' – establishes (switches) circuits to allow electrical current to flow from inlet to outlet
- by 1890s the patch panel switches were replaced by automated electromechanical switches that could take signal that contained the destination telephone number and automatically establish a circuit to the desired telephone

Telephone Networks – Circuit Switching (cont.)

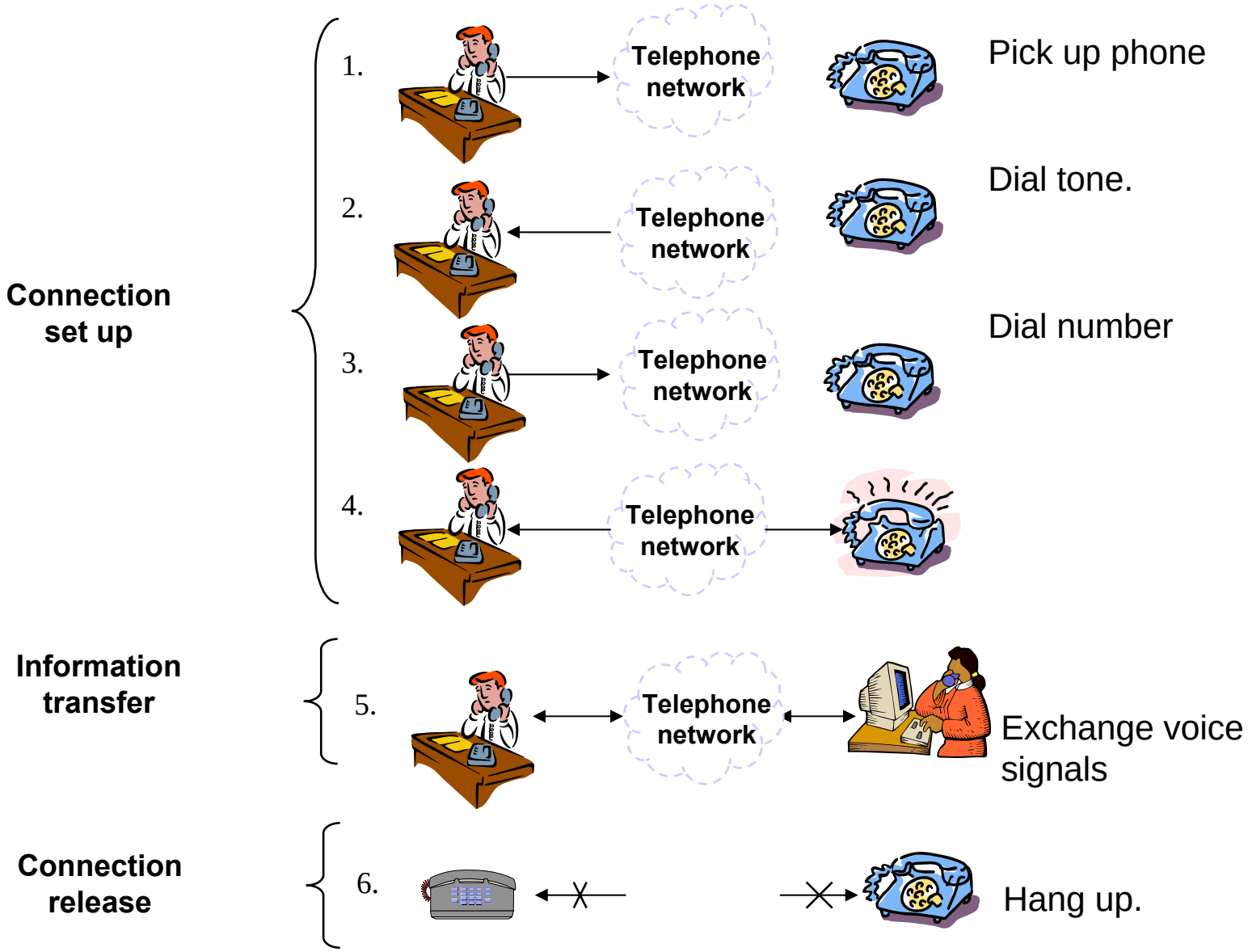
Connection-Oriented Service! – **connection has to be set up before the the actual transfer of information can take place**

- **"intelligence" inside the network**



Digital Telephone Systems – **evolution began with the invention of the transistor and integrated circuits**

(1) analog voice is converted into digital signal ⇒ better transmission

(2) digital switches ⇒ faster switching and advanced reservation of resources

Telephone Networks – Circuit Switching (cont.)