

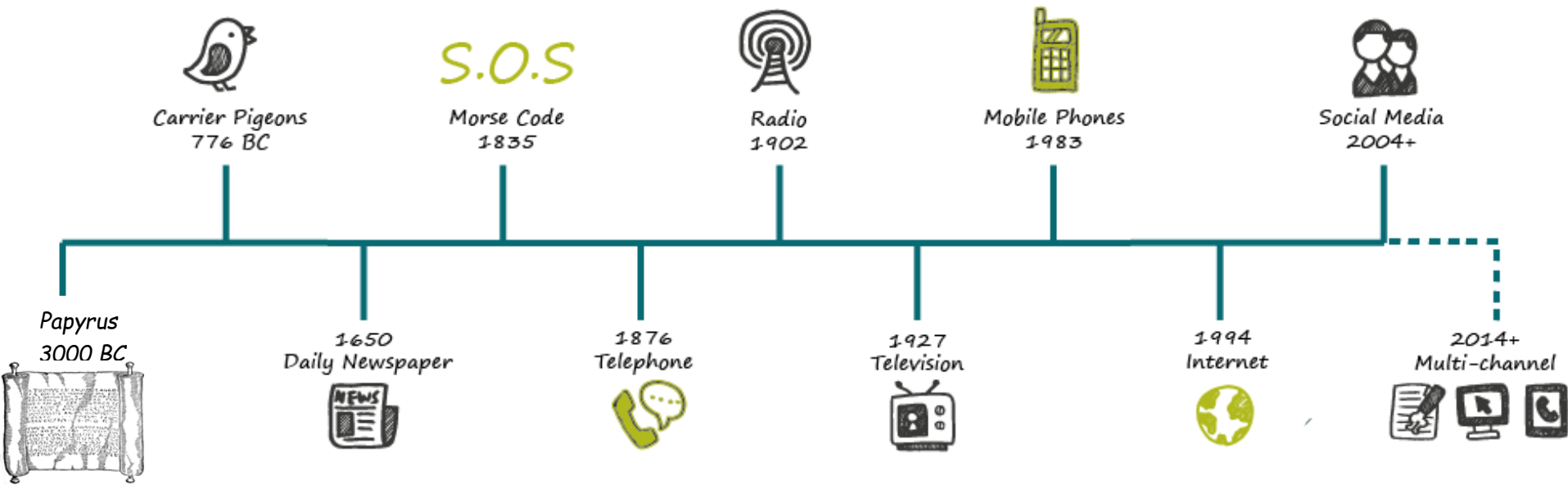
History of Communication

Required reading:
Forouzan Ch. 1
Garcia 1.1 and 1.2

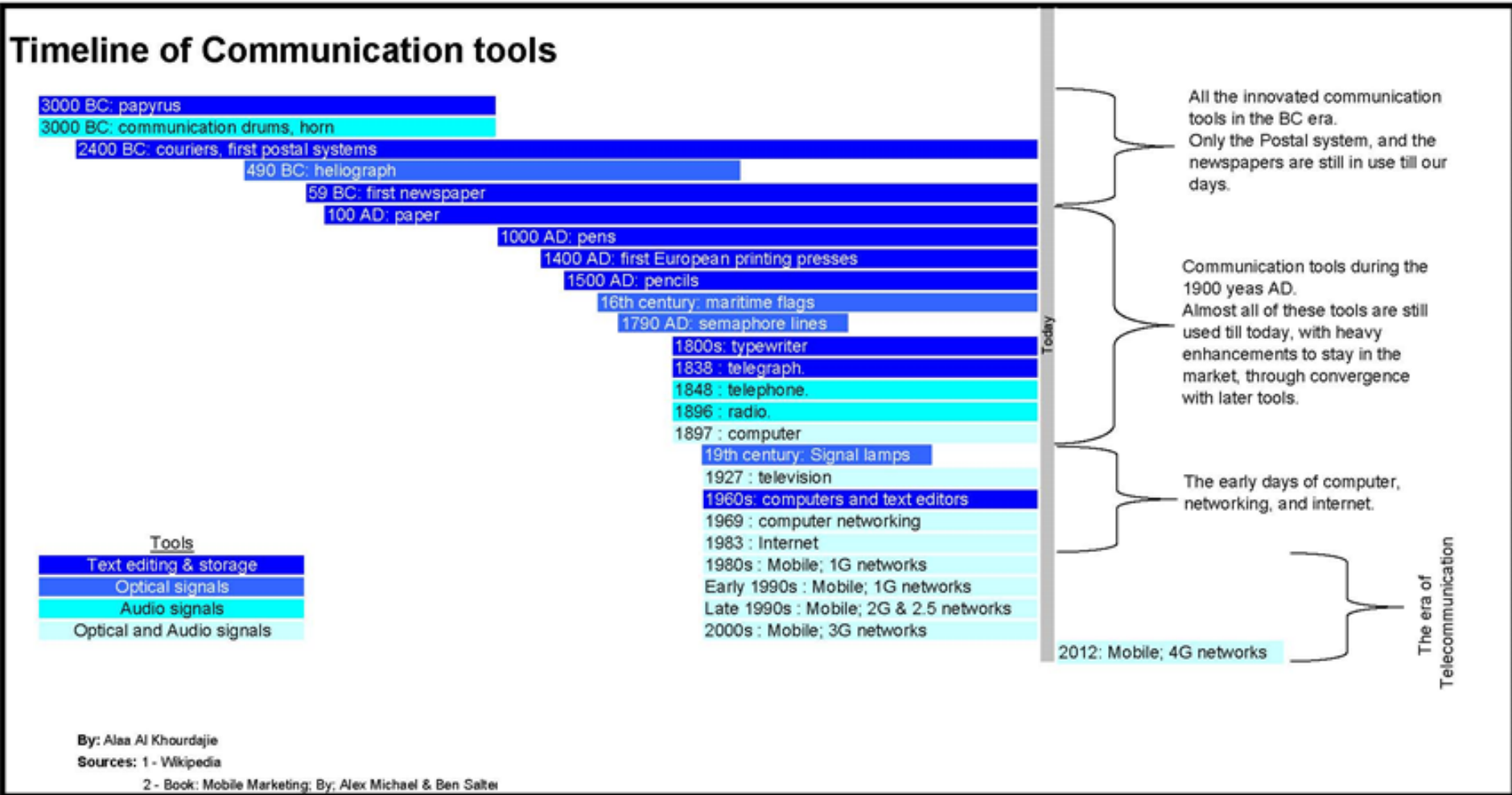
CSE 3213, Fall 2015
Instructor: N. Vlajic

History of Telecommunications

Evolution of Communication



<http://www.prologprintmedia.co.uk/news-whats-next-in-the-evolution-of-communication>

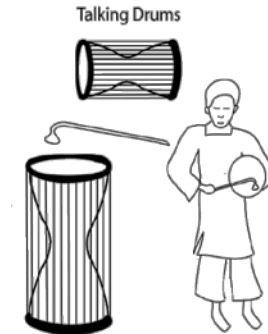


Types of Communication by **Transmission Medium**

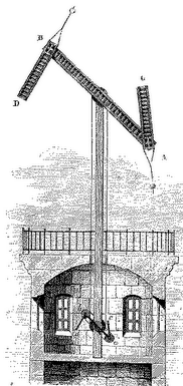
- Papyrus/paper (postal system)



- Audio signals (drums)



- Optical signals (smoke, optical telegraph)



- **Electro-magnetic signal**



Types of Communication by Number of Senders & Receivers

- Point to Point



Communication takes place between two end points.

Example: voice (phone) communication.

- Point to Multipoint



Communication in which there is one sender and multiple receiver.

Senders can alternate.

Example: voice and video conferencing.

- Broadcast



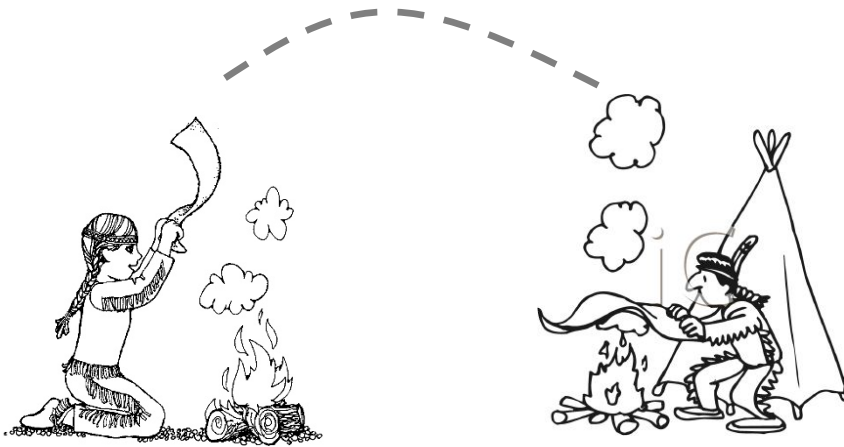
Communication in which there is one sender and a large number of receivers.

Receivers are generally passive!

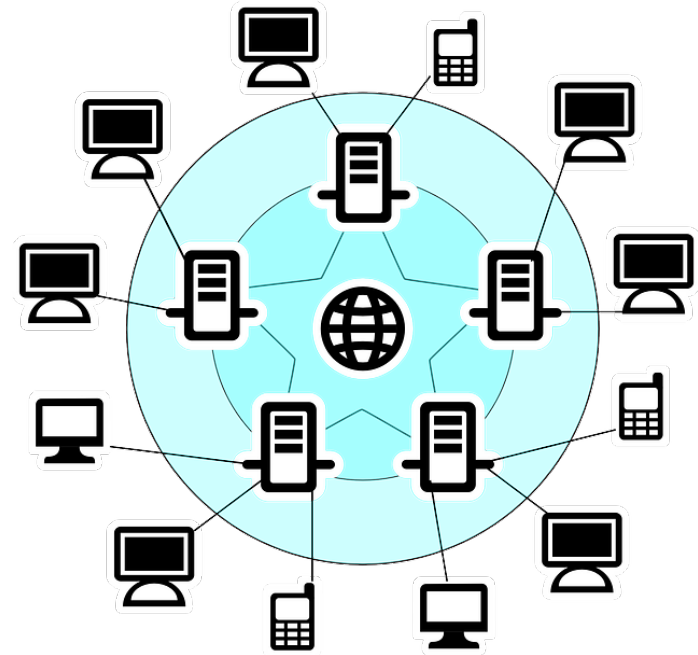
Example: radio and TV broadcasting.

Types of Communication by System Complexity

- Direct-Link Communication

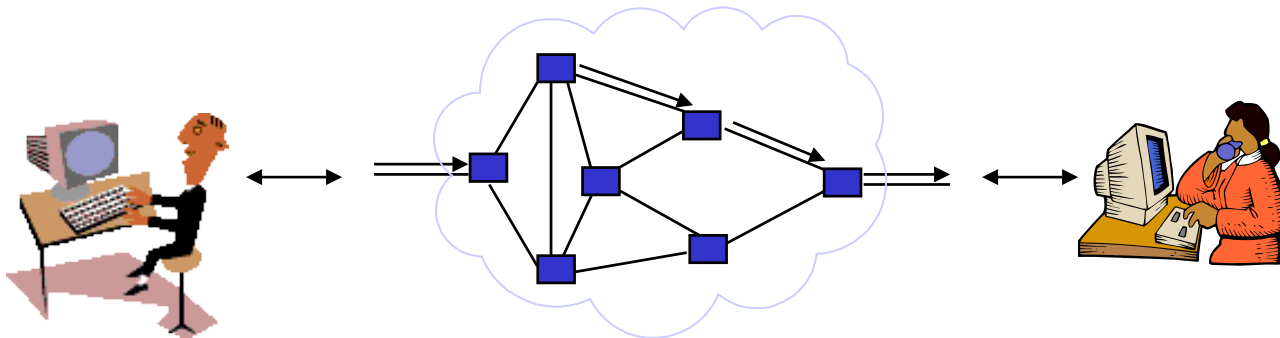


- Networked Communication



(Tele)communication Networks and Services

- Communication Network** – set of equipment and facilities that provide a service: *enables transfer of inform. 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**
 - **different networks/services differ in how and what form of data 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

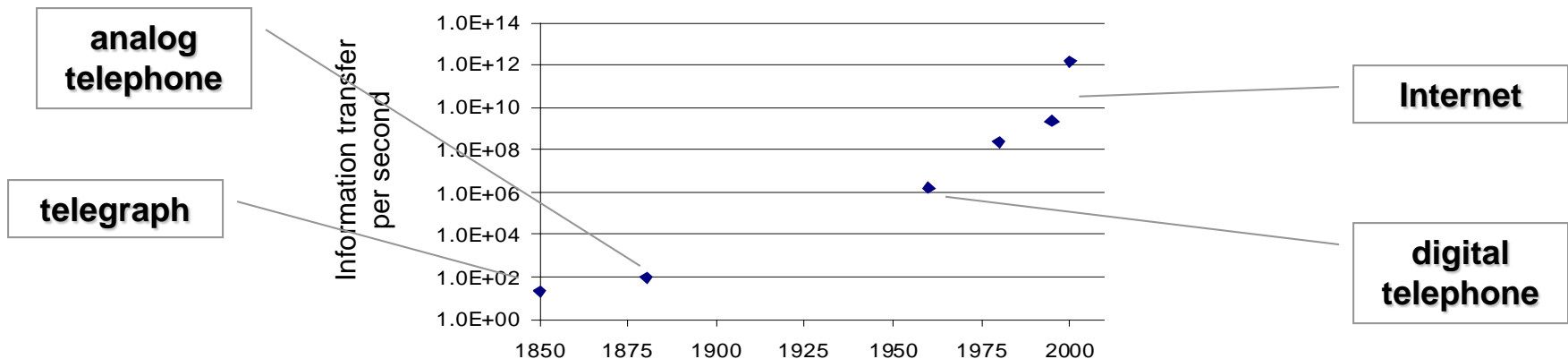
- message switching
- “store and forward” transmission

(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 – human to human transmission of coded messages

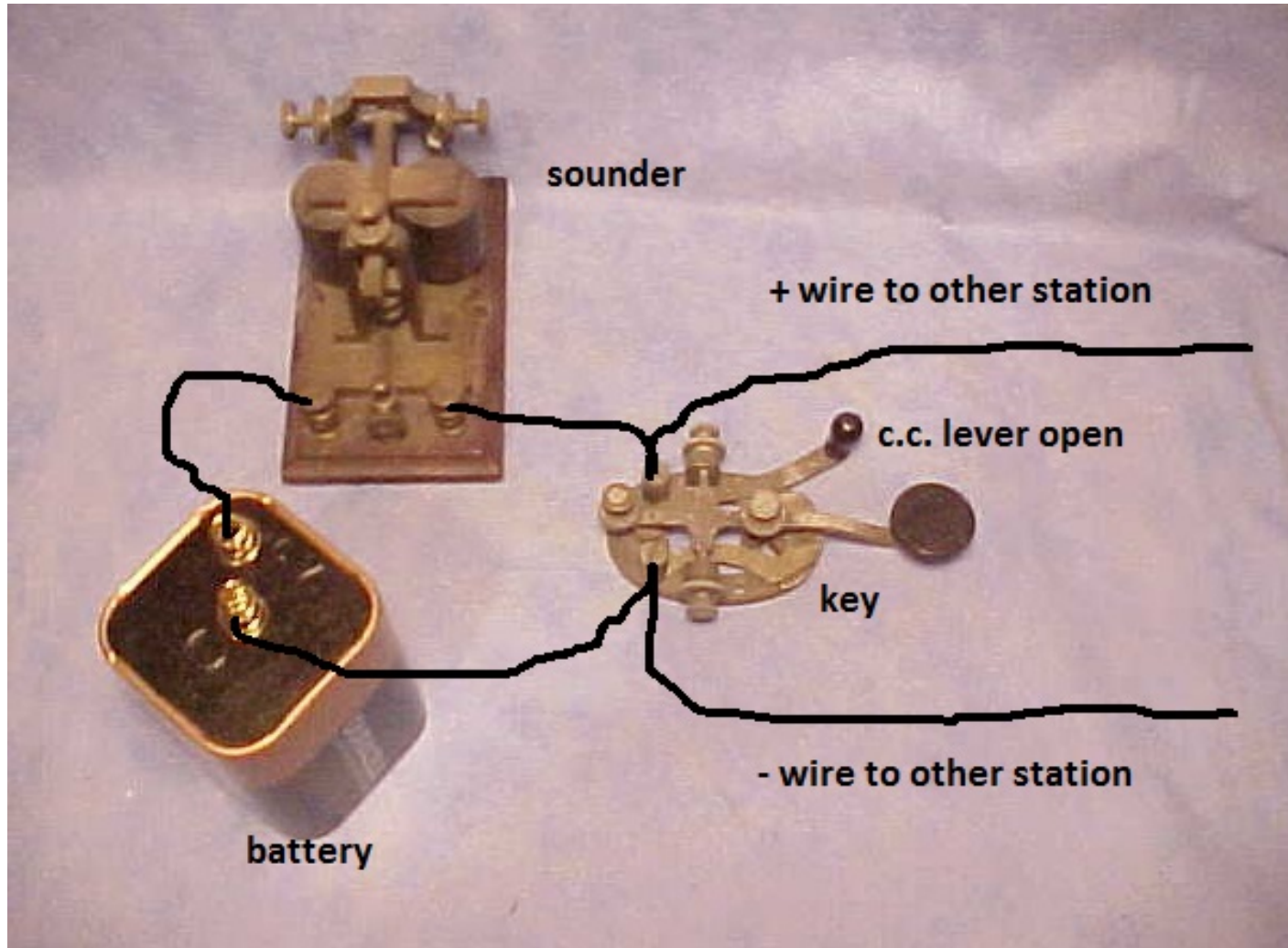
- wires are stretched from one point to another; electric current is either allowed to flow through the wires or is broken by a switch called **telegraph key**
- electric current is used to activate a **sounder** which makes clicking sounds – short / long times between clicks are decoded into letters 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



	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	— — — — —

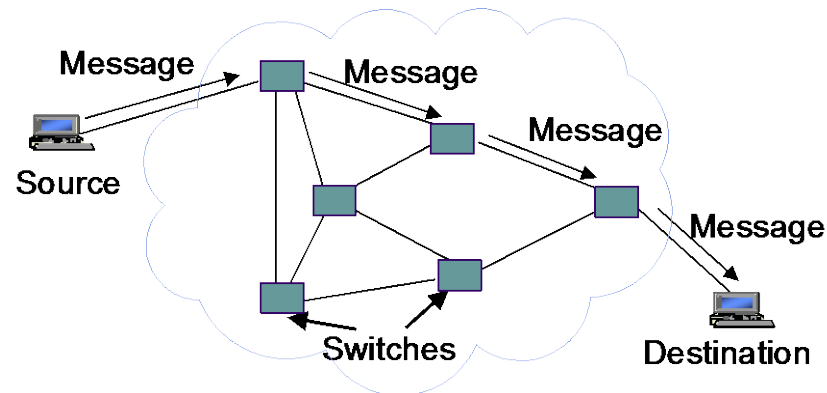


<http://artifaxbooks.com/landline-circuit-photo.JPG>

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

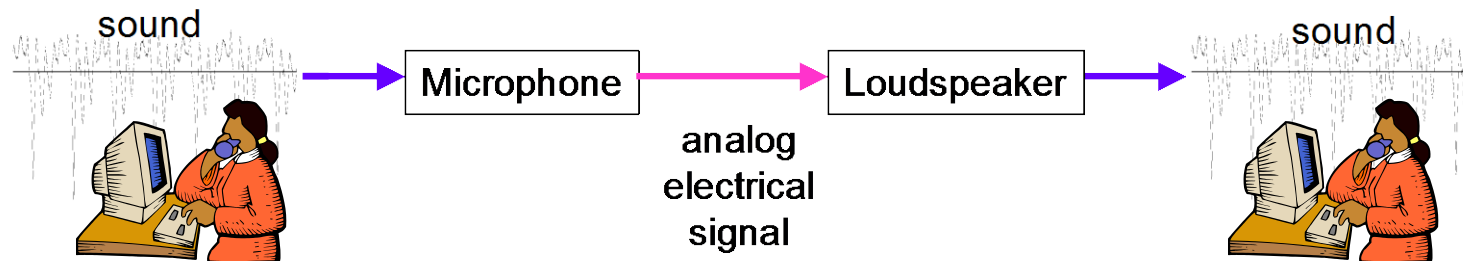
- “**store and forward**” message transmission
- intermediate telegraphs = **message switching** stations



Telephone Networks – Circuit Switching

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

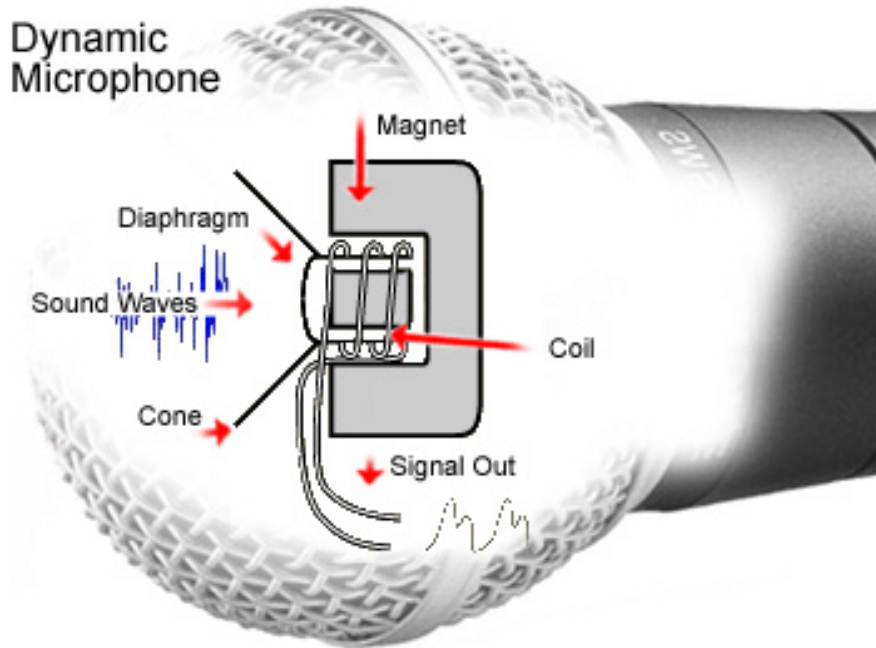
- **microphone** converts voice pressure variation (sound) into *analogous* electrical signal
- **loudspeaker** converts electrical signal back into sound



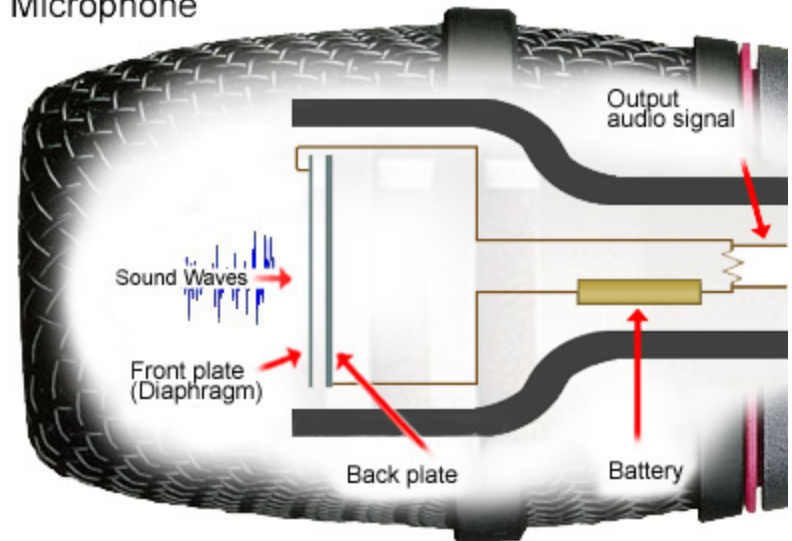
Telegraph vs. Telephone

- 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

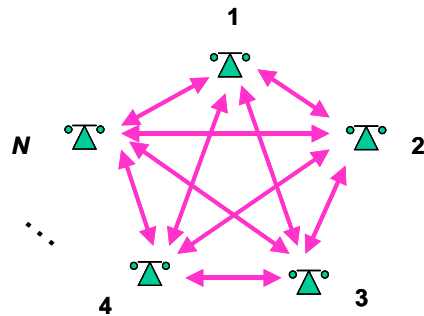
Microphone: **Audio Signal In – Electric Signal Out**



Condenser Microphone



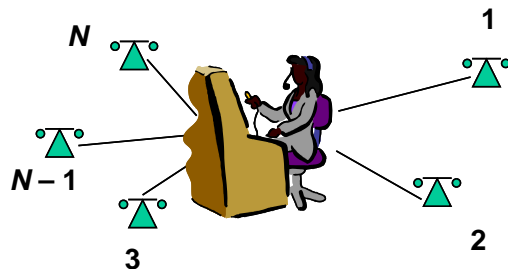
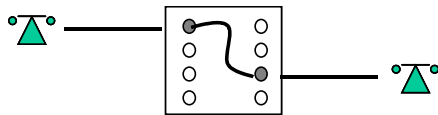
Dedicated Telephone Networks



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

- $O(N^2)$ connections per n users
- inefficient and costly

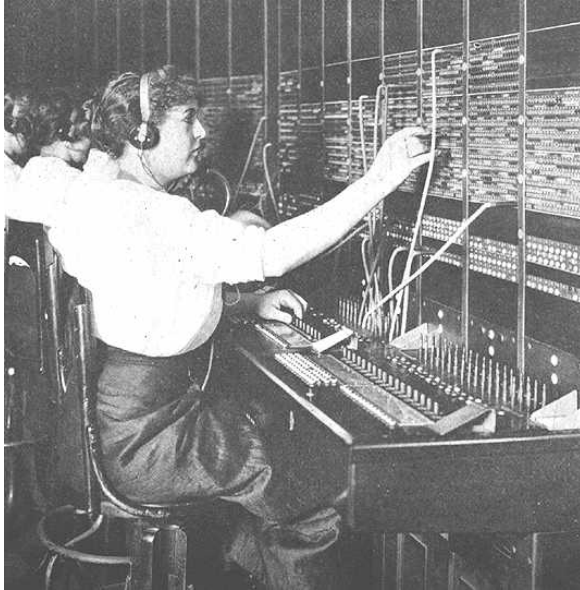
Circuit Switched Telephone Networks



– 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

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 \Rightarrow better transmission
- (2) digital switches \Rightarrow faster switching and advanced reservation of resources

Telephone Networks – Circuit Switching (cont.)

