Telephone Systems & the CO

Part 12c of
"Electronics and Telecommunications"
A Fairfield University E-Course
Powered by LearnLinc

Section 11: Broadcast Systems

- Frequency Division Multiplexing
- AM
  - Modulation
  - Demodulation (The Envelope Detector)
- FM
  - Modulation
  - Demodulation (The Phase-Locked-Loop)
- Super Heterodyne Receivers
- Television
- Sampling

Section 12: Transmission and Networks

- Transmission Lines
  - Twisted pair
  - Coaxial Cable
  - Optical Fiber
- Microwave Systems
- Satellite Links
- Telephone Systems
- Local Area Networks
- Cellular Phone Systems

Section 12 Schedule

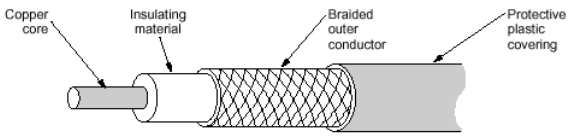
Session 12a	09/24	Transmission Lines, Radio, Microwave & Satellites	Bigelow: 36-42; WWW, notes
Session 12b	09/29	POTS	Bigelow: 1-36, 47-78, WWW, notes
Session 12c (No Class 10/06)	**10/01**	**Telephone Systems & the CO**	**Bigelow: 79-106, 211-251**
Session 12d (No class 10/13)	10/08	LANs	WWW, notes
Session 12e	10/15	Cell Phone Systems	Bigelow: 332-341; WWW, notes
Session 12f (Lab - 10/25, Sat.) (Quiz 12 due 10/26)	10/20	Review for Quiz 12	
Session 12g	10/27	Quiz 12 Results	
Session 12h	10/29	MT 6 Q&A	
MT6 (Sat, Cheshire)	11/01	MT 6	
MT6 Results	11/03	MT 6 Results	

References

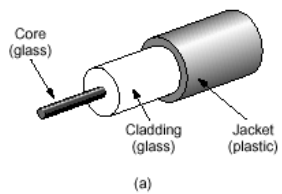
- http://www.privateline.com/TelephoneHistory/History1.htm
  - An early history of the telephone by Tom Farley
  - Also on the DoctorD Web Server under EE357
- http://www.comlab.hut.fi/opetus/423/2002/2_pstn1.ppt
  - An overview of the Public Switched Telephone Network (PSTN) by Timo O. Korhonen
  - A Power Point presentation
  - Available on the LearnLinc Server

Transmission Media: Get signals from here to there

- Copper
  - Unbalanced, open wire line
  - Pair (*used in telephone cables)
    - Untwisted or Twisted*
    - Unbalanced or Balanced*
  - Coaxial cable



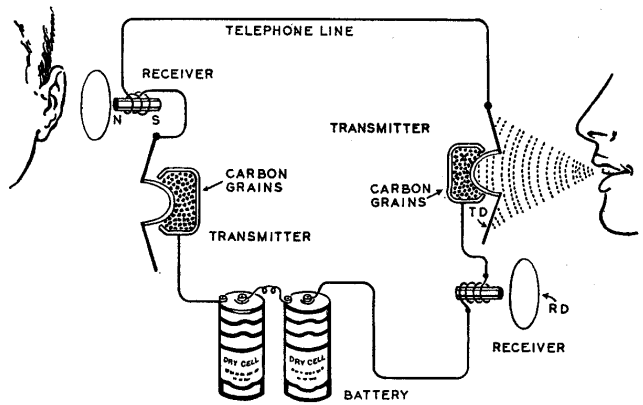
- Radio
  - Free Space: Antennas
  - Microwave:
    - Free Space
    - Wave Guides
  - Satellite
- Optical
  - Free Space (Laser)
  - Fiber

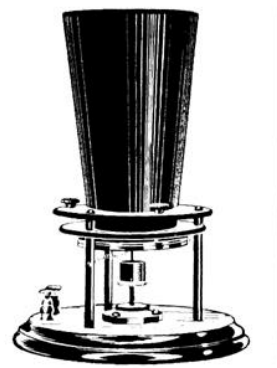


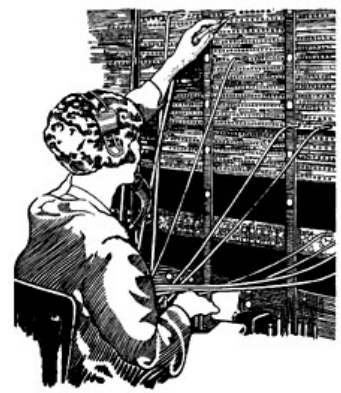
- Transmission Lines
  - Characteristic Impedance
  - Termination
    - = Zo: matched, energy absorbed
    - ≠ Zo: mismatched, energy reflected
  - Bridge Taps
    - Mismatch at tap location
    - Any reflection at end of bridging line⇨reflection returns to bridged line with a delay

Plain Old Telephone Service

- Phone Facts
  - Bell's liquid phone - 1876
  - Variable resistance transmitt
    1877 – Edison, Blake
  - Battery feed current
  - Electromagnetic receiver
  - Switchboard
    1878 – New Haven CT!!
  - Two-wire Circuit
    1881- Bell (Tip & Ring)
  - First Coin Phone
    1889- Hartford CT!!




1876 - Bell's original telephone


Cord switchboard

Signaling & Supervision

- Ringing
  - "Crank delivered low frequency AC
    - ~ 20 Hz
    - High Voltage (90 V - ring a bell at the other end)
- "On-Off Hook"
  - Off Hook
    - completes the circuit
    - battery current flows (line resistance, 24 volts)
- "Dial Tone"
  - Supports user protocol
  - Tells the user that the other end is ready to receive dialing

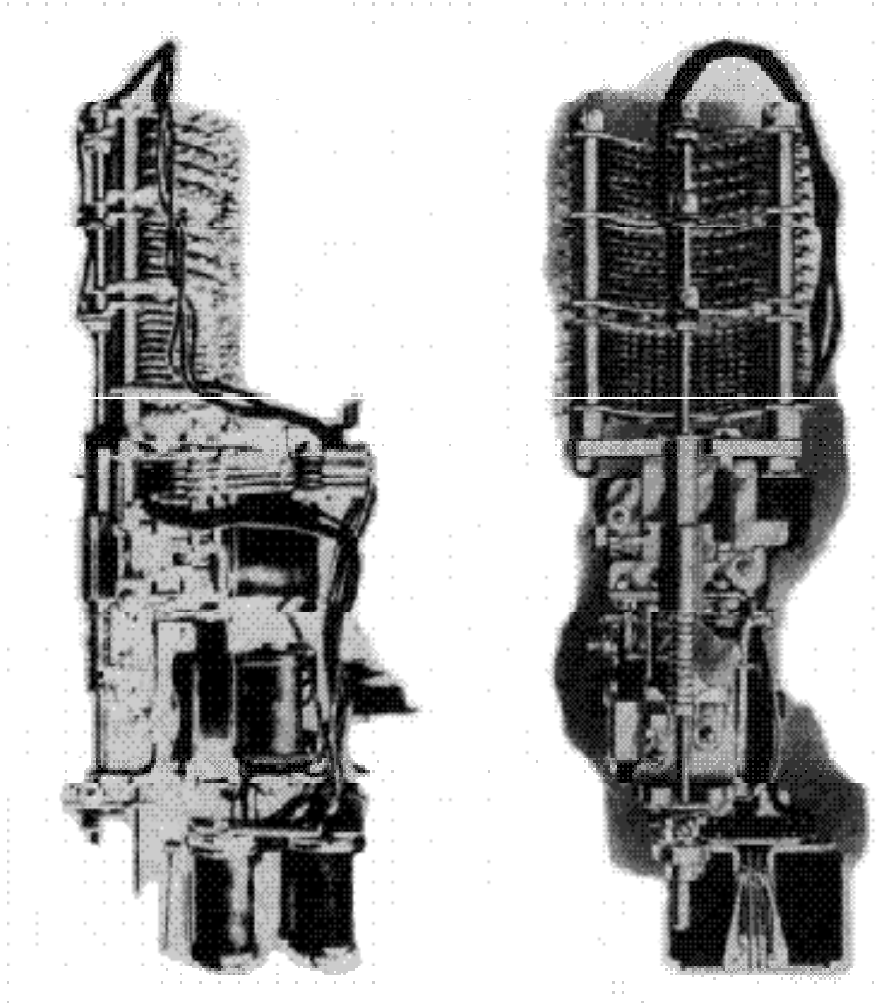
Signaling and Supervision 2

- Dialing
  - Dial pulses
    (Strowger Rotary Telephone Switch – next session)
    - Formed by momentary interruption of battery current
    - 10 per second rate
    - One through ten pulses send a digit (1-9,0)
  - Touch Tones (1950's)
    - Two simultaneous tones
      - One from low freq. group
      - One from high freq. group
      - 16 codes

	1209	**1336**	**1477**	**1633**
697	1	2	3	**A**
770	4	5	6	**B**
852	7	8	9	**C**
941	*	0	#	**D**

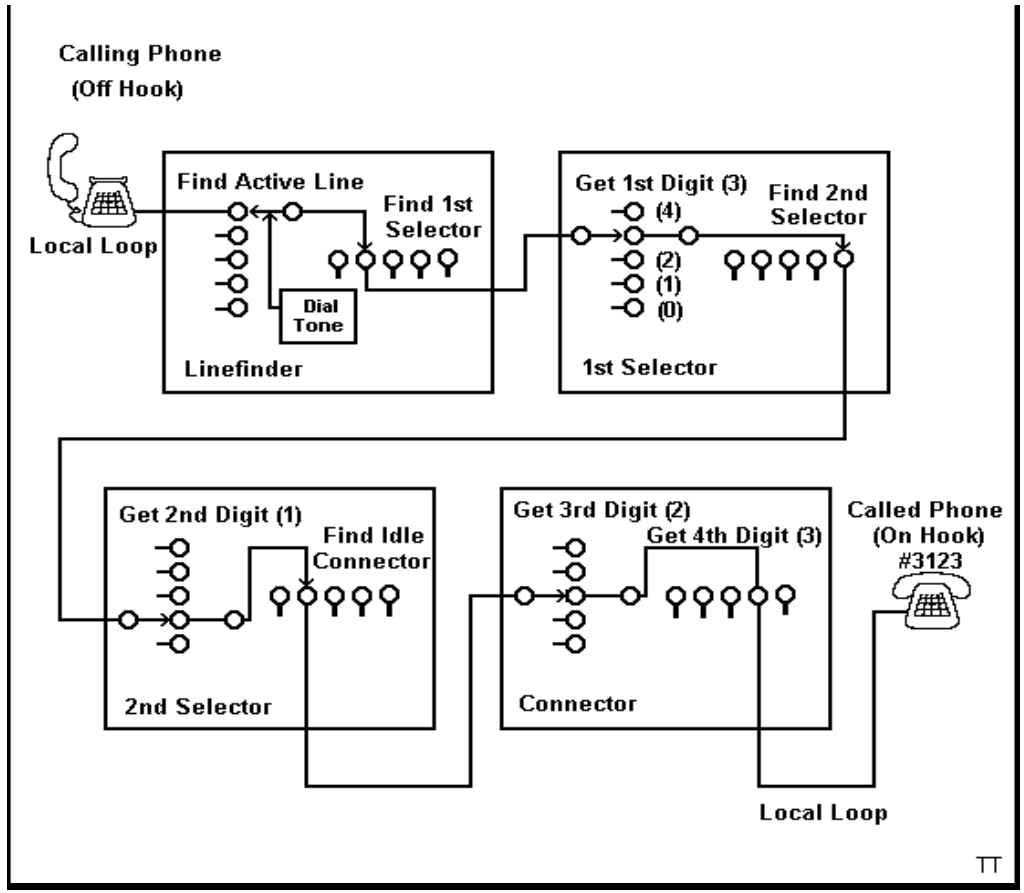
Strowger Rotary Switch

- Undertaker in Kansas City
- System to replace an operator (1891)
- A two-pole, 100-throw switch
  - 1 through 10 pulses for vertical movement
  - 1 through 10 pulses for rotational movement
- Three types
  - Linefinder:
    - Finds active (off-hook) line
    - Finds a free selector
  - Selector:
    - accepts a digit,
    - finds next free selector
  - Connector: accepts two digits



Strowger: Routing a call

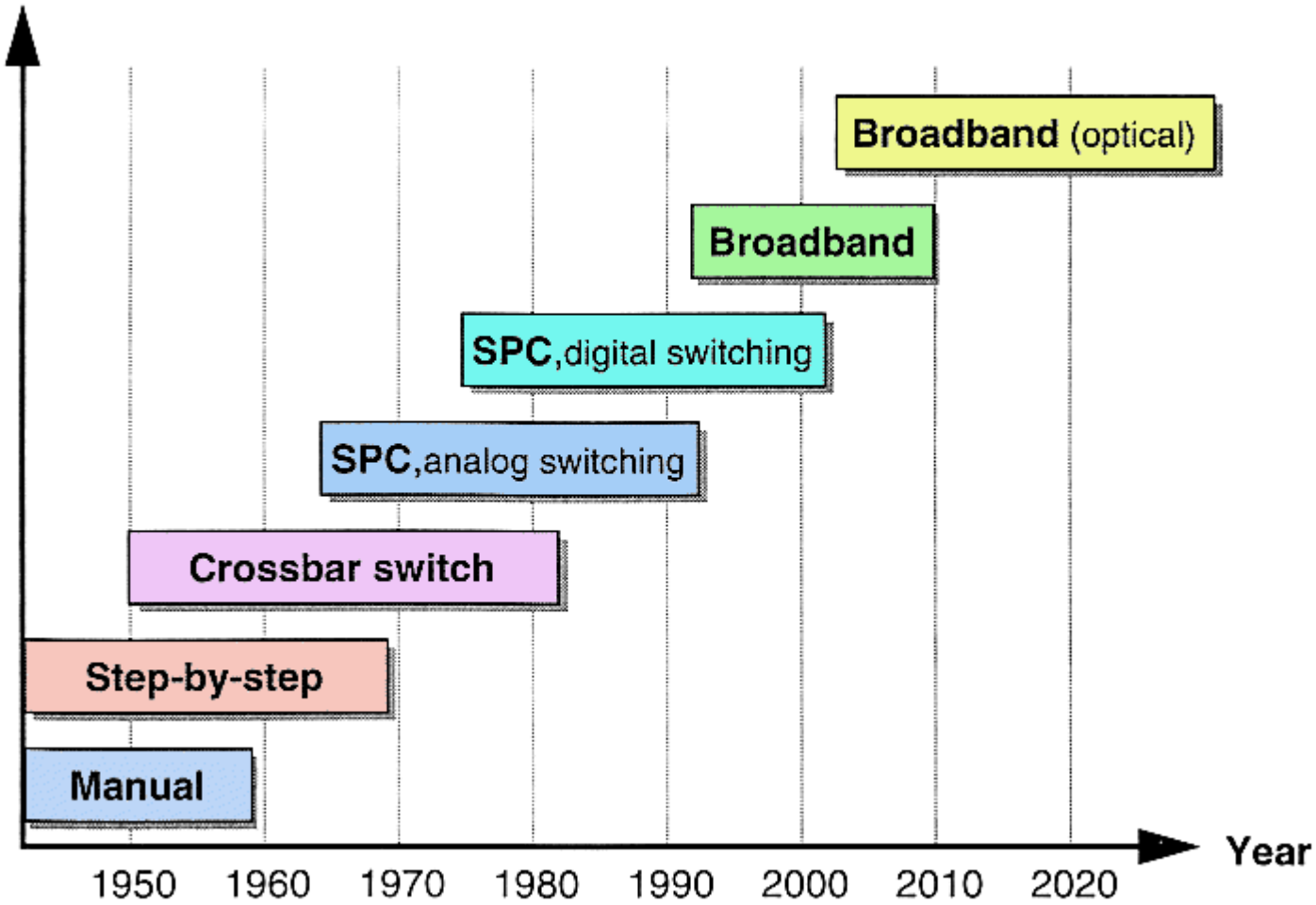
- Phone goes off-hook
  - Linefinder locks on and finds free 1st selector
- 1st Digit Dialed (3)
  - 1st Selector 3 steps up
  - 1st selector rotates to find free 2nd selector
- 2nd digit dialed (1)
  - 2nd selector 1 step up
  - 2nd selector rotates to find free connector
- 3rd, 4th digits dialed (2,3)
  - Connector 2 steps up
  - Connector rotates 3 steps to connect to called party



Subscriber Line Interface: Borscht

- **B**attery Feed (24 VDC)
- **O**ver voltage protection (Surge supression)
- **R**inging (90 volts AC 20 Hz)
- **S**upervision (on-off hook)
- **C**odec (A/D and Filter)
- **H**ybrid (2-4 wire conversion)
- **T**esting

Telephone Switch Evolution



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