Review for Quiz 12

Part 12f 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

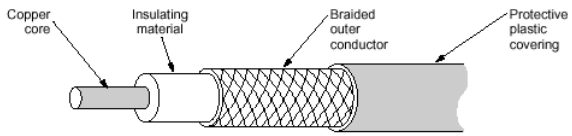
- Transmission Lines
  - Twisted pair
  - Coaxial Cable
  - Optical Fiber
- Microwave Systems
- Satellite Links
- Telephone Systems
- Local Area Networks
- Cellular Phone Systems

Section 12 Schedule

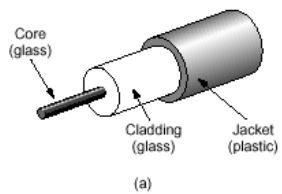
Session 12a	09/24	Transmission Lines, Radio, Microwave & Satellites	Bigelow: 36-42; WWW, notes
Session 12b	09/29	POTS	Bigelow: 1-36, 47-78, WWW, notes
Session 12c (No Class 10/06)	10/01	Telephone Systems & the CO	Bigelow: 79-106, 211-251
Session 12d (No class 10/13)	10/08	LANs	WWW, notes
Session 12e	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**	**Lab 12 Cancelled: Schedule conflict**
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	

Transmission Media: Get signals from here to there

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



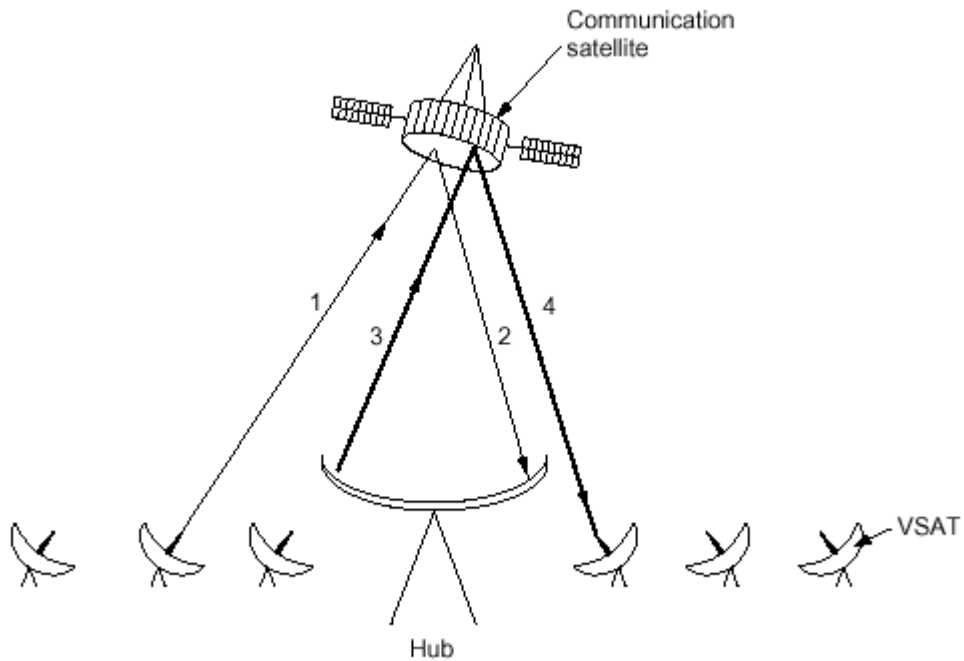
- Radio
  - Free Space: Antennas
  - Microwave:
    - Free Space
    - Wave Guides
  - Satellite
- Optical
  - Free Space (Laser)
  - Fiber



- 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

Satellite

- Uplink
  - Earth station
- Downlink
  - Satellite transmits a "footprint"
  - Received by microwave "dish"
- Geo-stationary (vs. low orbit)
  - 22,000 miles high
  - Remains fixed over a spot on the equator.
  - Allows a fixed receiving antenna

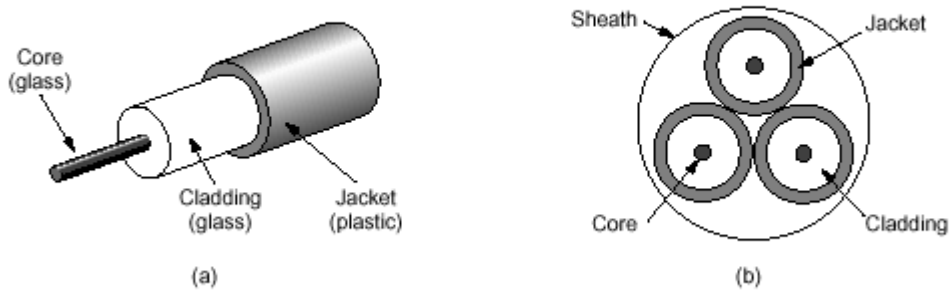


Satellite Systems

Band	Frequencies	Downlink (GHz)	Uplink (GHz)	Problems
C	4/6	3.7–4.2	5.925–6.425	Terrestrial interference
Ku	11/14	11.7–12.2	14.0–14.5	Rain
Ka	20/30	17.7–21.7	27.5–30.5	Rain; equipment cost

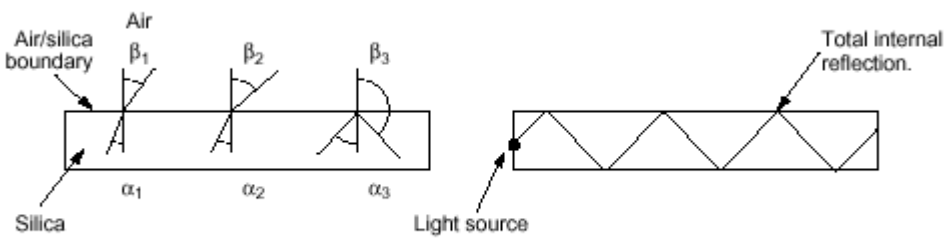
- Higher frequency – shorter wavelength – smaller dish
- Satellite TV uses high frequencies and a high power satellite transmitter to allow 18” receiving dish.

Optical Fiber



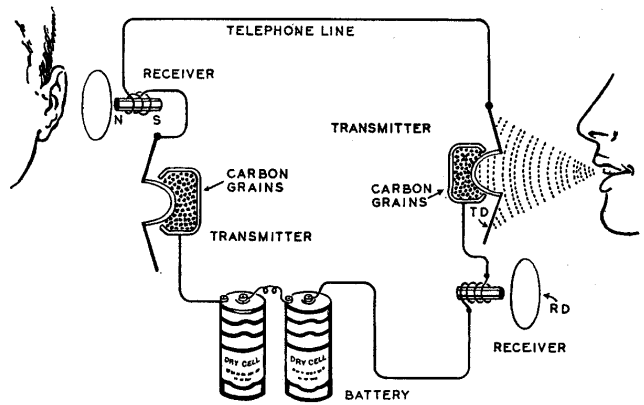
- Light travel down a thin Glass Fiber
- What keeps it in?

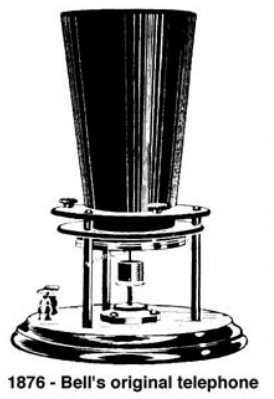
  hint: the speed of light is slower in high index glass

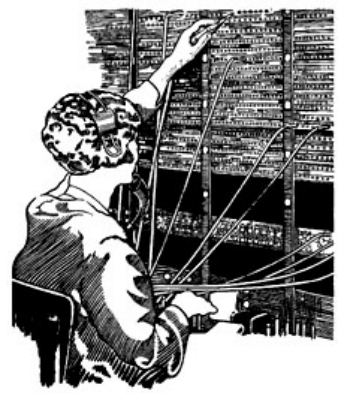


Plain Old Telephone Service

- Phone Facts
  - Bell's liquid phone - 1876
  - Variable resistance transmitter
    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

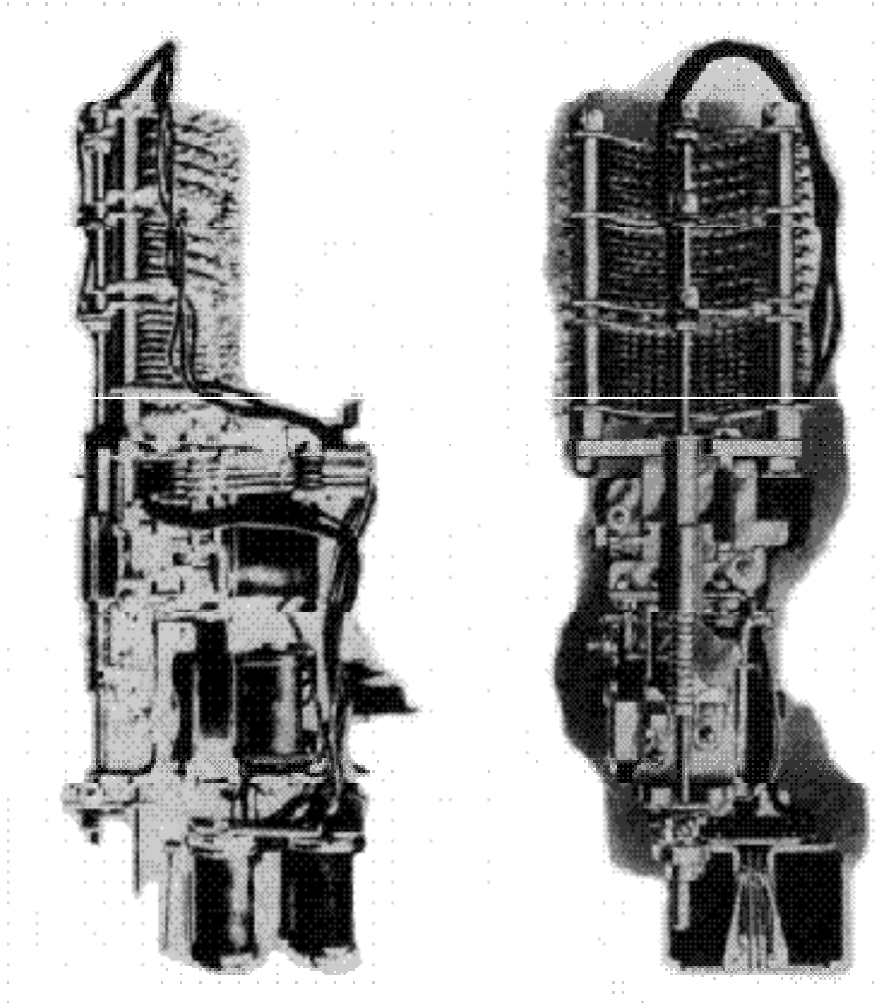
Signaling and Supervision 2

- 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 (12 used)

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

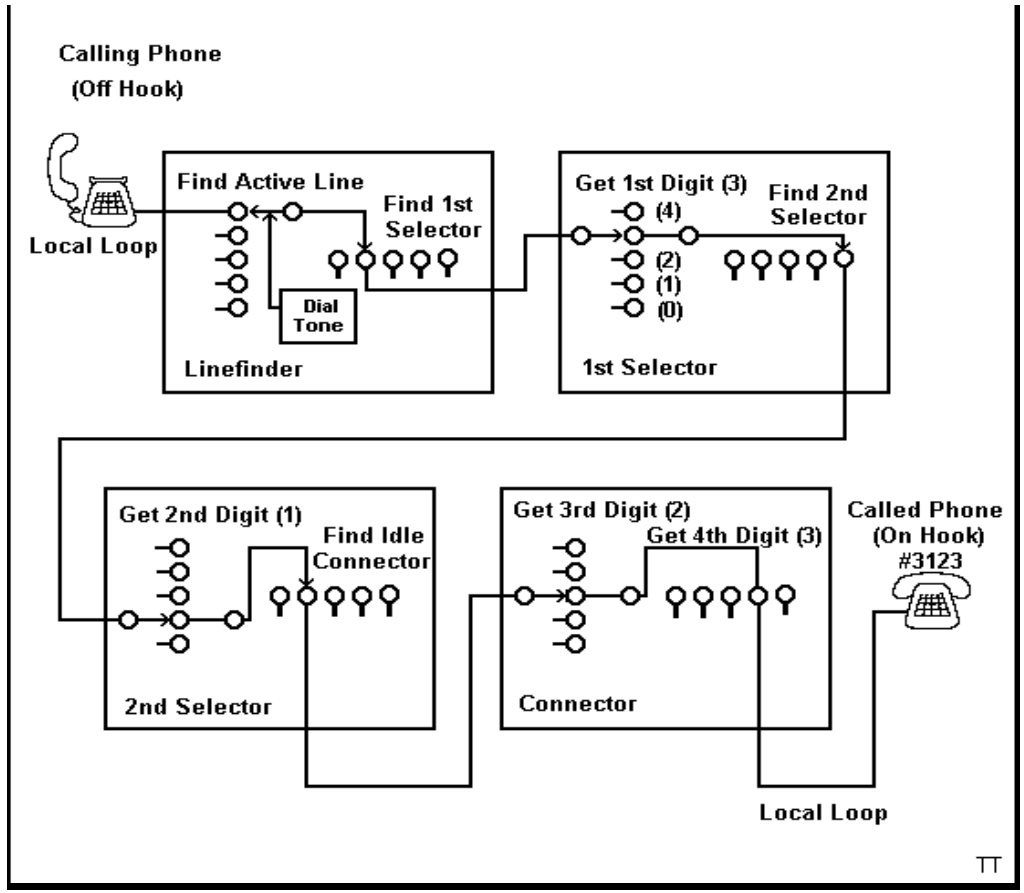
Strowger Rotary Switch

- 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

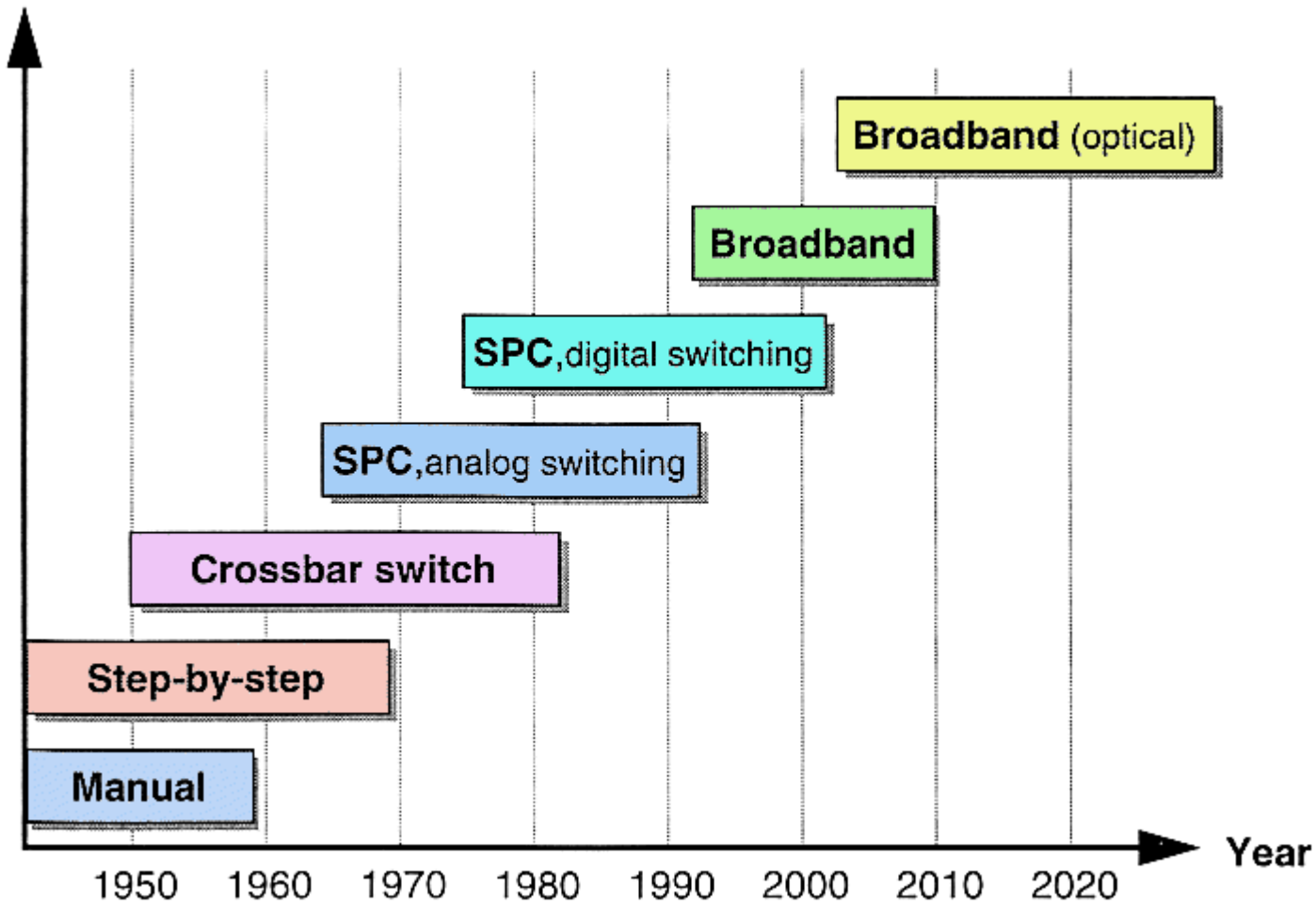
- Phone goes off-hook
  - Linefinder locks on and finds free 1st selector
- 1st Digit Dialed (3)
  - 1st Selector 3 steps up
  - 1st selector rotates to find free 2nd selector
- 2nd digit dialed (1)
  - 2nd selector 1 step up
  - 2nd selector rotates to find free connector
- 3rd, 4th digits dialed (2,3)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



Subscriber Line Interface: Borscht

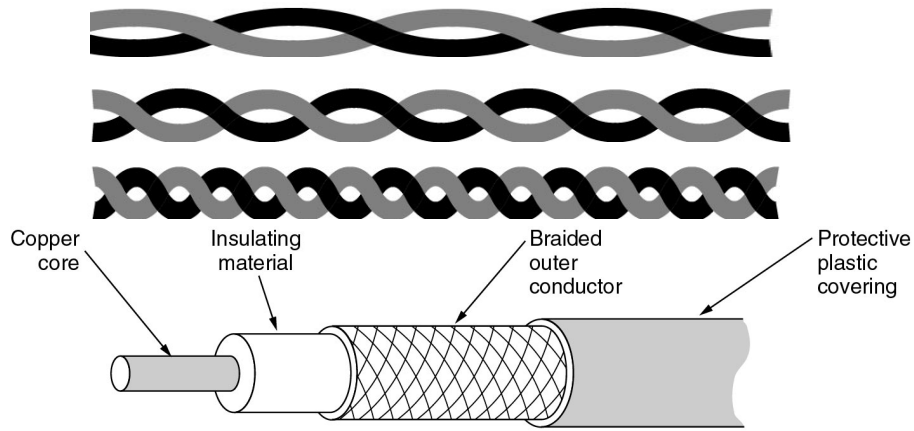
- **B**attery Feed (24 VDC)
- **O**ver voltage protection (Surge supression)
- **R**inging (90 volts AC 20 Hz)
- **S**upervision (on-off hook)
- **C**odec (A/D and Filter)
- **H**ybrid (2-4 wire conversion)
- **T**esting

Telephone Switch Evolution



LAN Cabling

- Copper
  - Twisted Pair
    - Cat 1: Telephone
    - Cat 3: 10 MHz
    - Cat 5: 100 MHz
  - Coaxial cable (old)
- Radio 802.11(a,b,g)
- Optical Fiber



Ethernet (802.3) Cabling

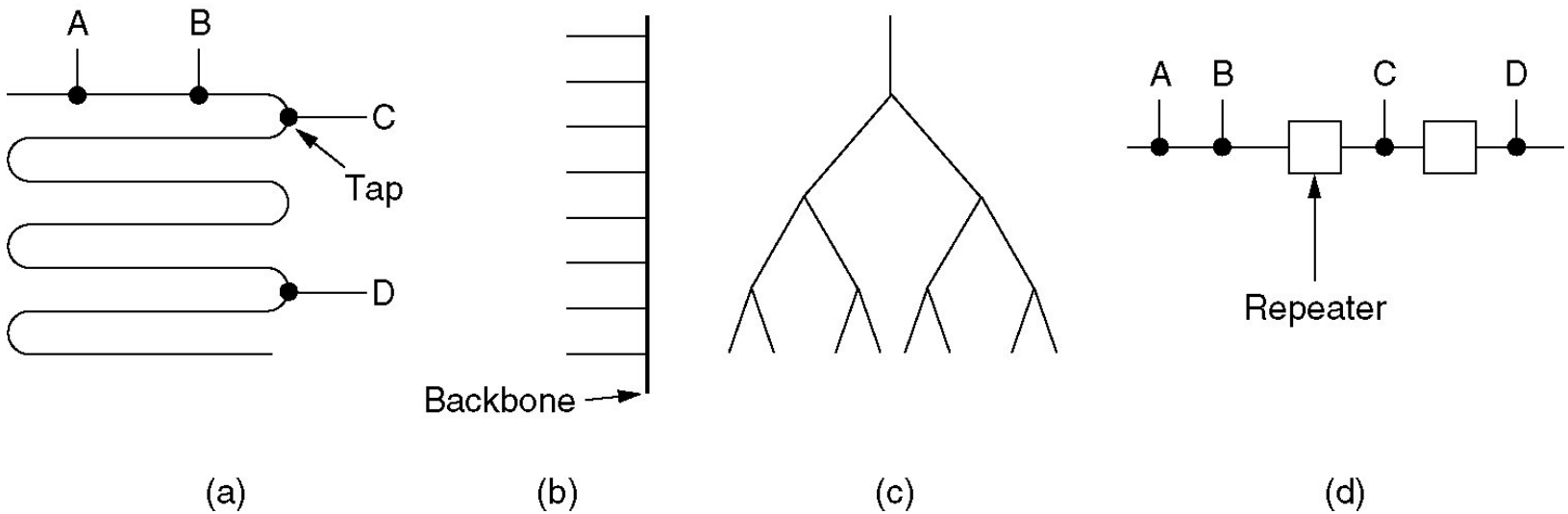
The most common kinds of Ethernet cabling.

Name	Cable	Max. seg.	Nodes/seg.	Advantages
10Base5	Thick coax	500 m	100	Original cable; now obsolete
10Base2	Thin coax	185 m	30	No hub needed
10Base-T	Twisted pair	100 m	1024	Cheapest system
10Base-F	Fiber optics	2000 m	1024	Best between buildings

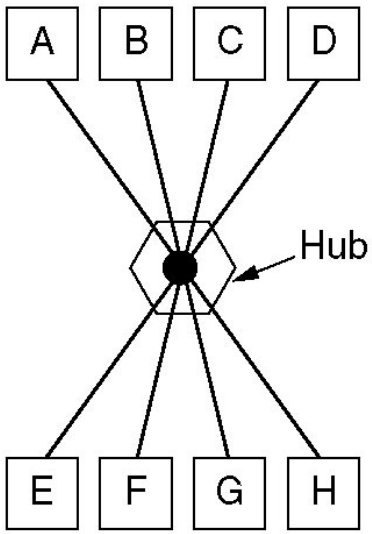
Name	Cable	Max. segment	Advantages
100Base-T4	Twisted pair	100 m	Uses category 3 UTP
100Base-TX	Twisted pair	100 m	Full duplex at 100 Mbps
100Base-FX	Fiber optics	2000 m	Full duplex at 100 Mbps; long runs

Name	Cable	Max. segment	Advantages
1000Base-SX	Fiber optics	550 m	Multimode fiber (50, 62.5 microns)
1000Base-LX	Fiber optics	5000 m	Single (10 μ) or multimode (50, 62.5 μ)
1000Base-CX	2 Pairs of STP	25 m	Shielded twisted pair
1000Base-T	4 Pairs of UTP	100 m	Standard category 5 UTP

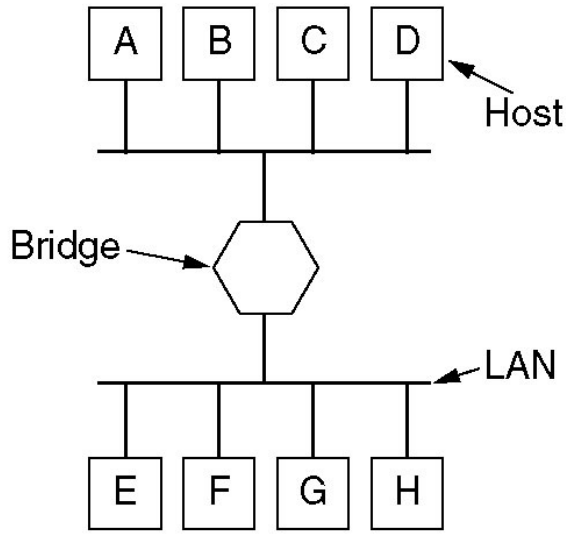
Ethernet Cabling (3)



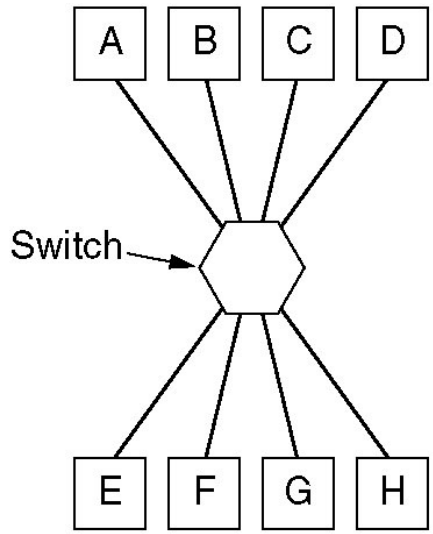
Repeaters, Hubs, Bridges, and Switches



(a)

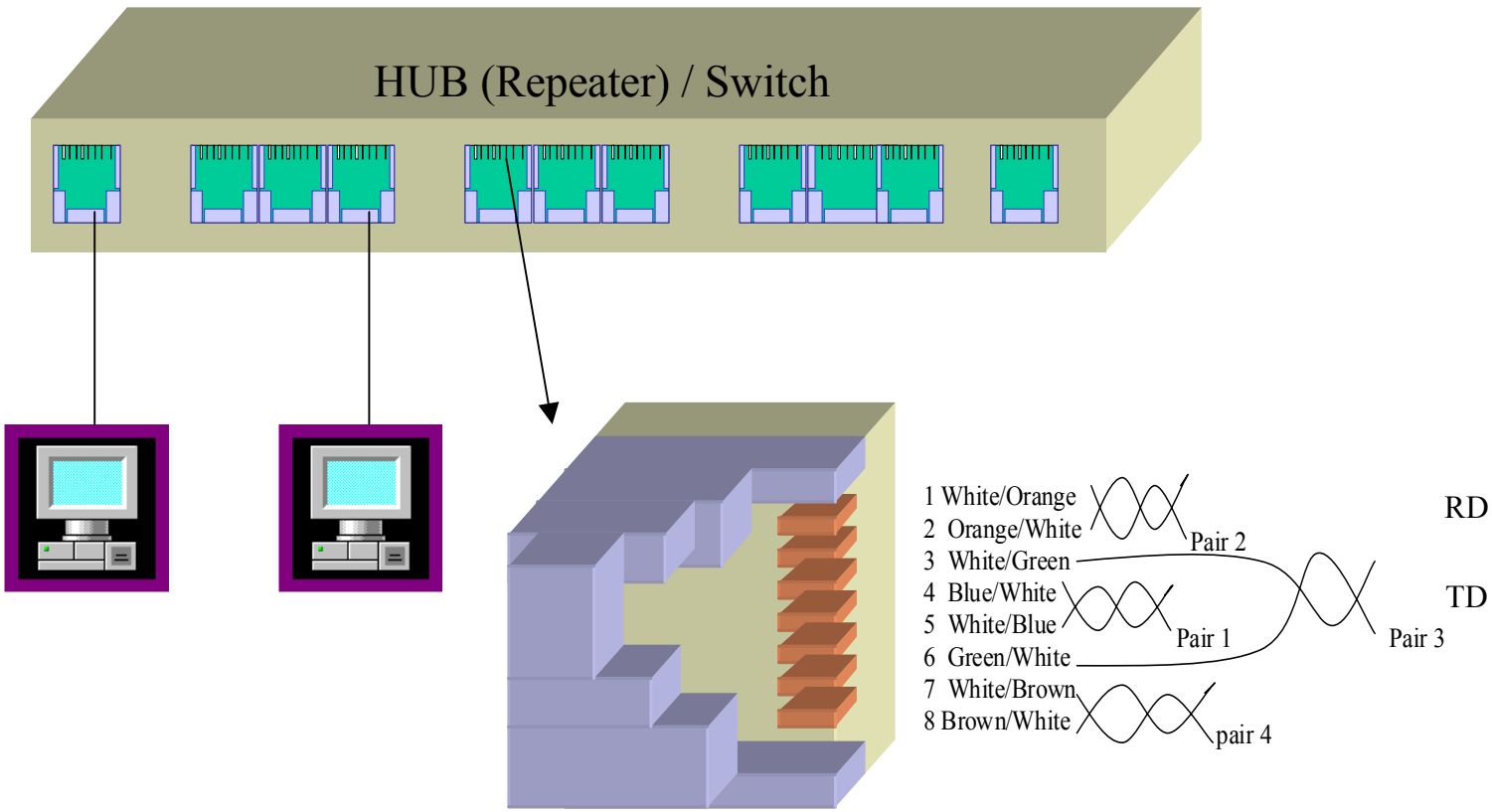


(b)



(c)

LAN Interconnect



Wireless: 802.11(a,b,g) Access Point (Bridge)

- 802.11b (2.4 GHz)
  - 11Mbit/sec
  - Up to 300 ft
- 802.11g (2.4 GHz)
  - 54 Mbit/sec (but compatible with 802.11b)
  - Up to 300 ft
- 802.11a (5 GHz)
  - 54 Mbit/sec
  - Up to 100 ft

Cell Phone Systems

- Cell Phone References (we'll use these today)
  - http://electronics.howstuffworks.com/cell-phone.htm
    Cell Phone Overview
  - http://electronics.howstuffworks.com/question31.htm
    Difference between Analog and Digital Cell Phones
- History
  - AdvancedMobilePhoneSystem: Bell Labs (Chicago, 1976)
    - Analog low-power FM (FrequencyDivisionMultipleAccess)
    - The Cellular Concept
      (each cell is about 10 square miles, 832 reused frequencies)
  - TimeDivisionMultipleAccess (GSM in Europe)
  - CodeDivisionMultipleAccess (Esp. from Qualcomm)
  - Cellular vs. PersonalCommunicationSystems

Cell Phone Glossary

- **Tri Mode** – FDMA (analog FM, AMPs), CDMA, TDMA
- **Roaming** – Using your phone on a competitor's network ($)
- **Hand-Off** – As you travel out of range of the cell tower you are using, the system switches you to one you are moving towards.
- **Location Tracking** – Using your carrier strength at each cell site that can hear you and the directional characteristics of the cell tower antennas to determine your approximate location
- **PCS** – The use of lower power transmitters and smaller cells to maximize system throughput (reuse of frequencies/codes)
- **Walkie-Talkie** – Redefining a lower quality service as a feature; Simplex operation uses half as much of the system facilities and can be provided for less money

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