Cellular Phone Systems

Part 12e 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

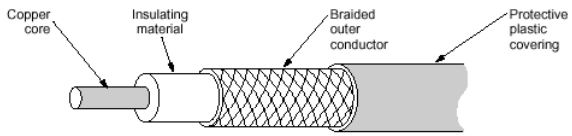
- Transmission Lines
  - Twisted pair
  - Coaxial Cable
  - Optical Fiber
- Microwave Systems
- Satellite Links
- Telephone Systems
- Local Area Networks
- Cellular Phone Systems

Section 12 Schedule

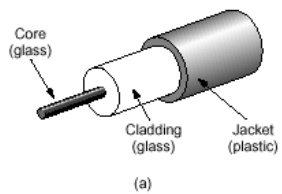
Session 12a	09/24	Transmission Lines, Radio, Microwave & Satellites	Bigelow: 36-42; WWW, notes
Session 12b	09/29	POTS	Bigelow: 1-36, 47-78, WWW, notes
Session 12c (No Class 10/06)	10/01	Telephone Systems & the CO	Bigelow: 79-106, 211-251
Session 12d (No class 10/13)	10/08	LANs	WWW, notes
Session 12e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

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



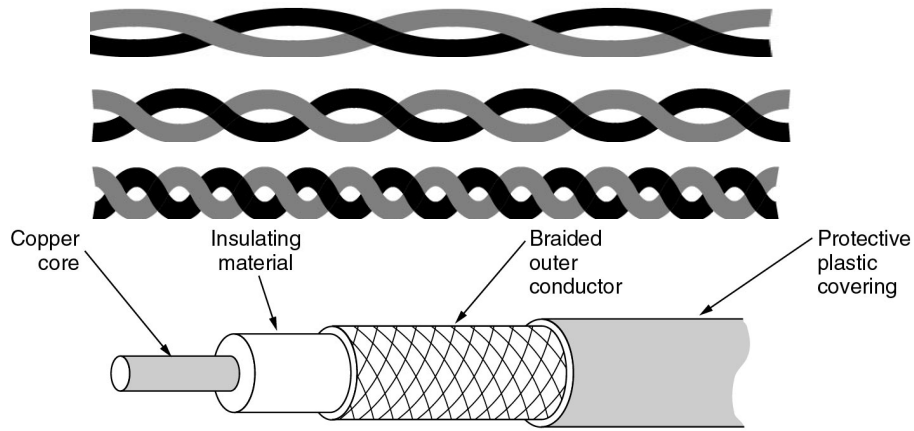
- Radio
  - Free Space: Antennas
  - Microwave:
    - Free Space
    - Wave Guides
  - Satellite
- Optical
  - Free Space (Laser)
  - Fiber



- 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

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

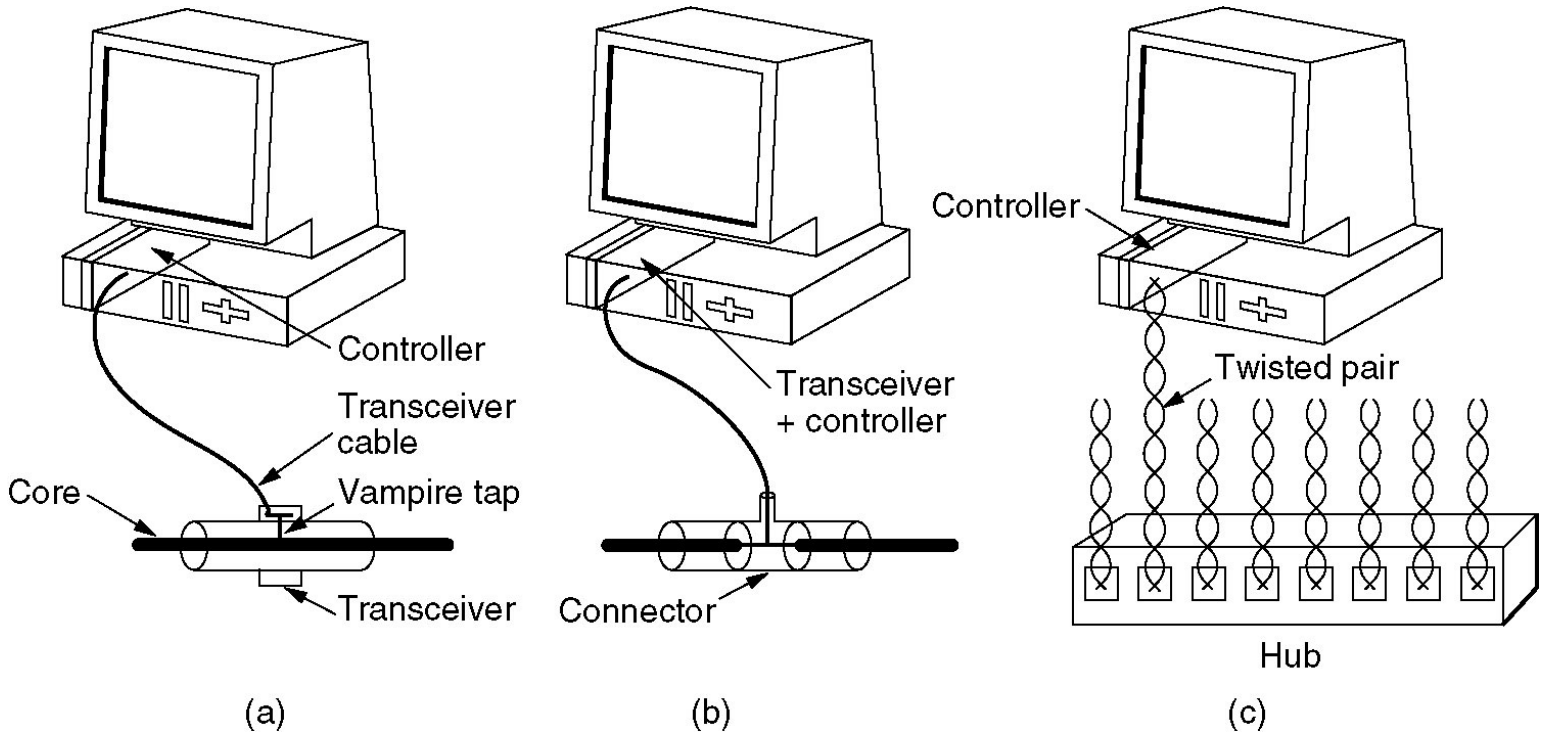
The most common kinds of Ethernet cabling.

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

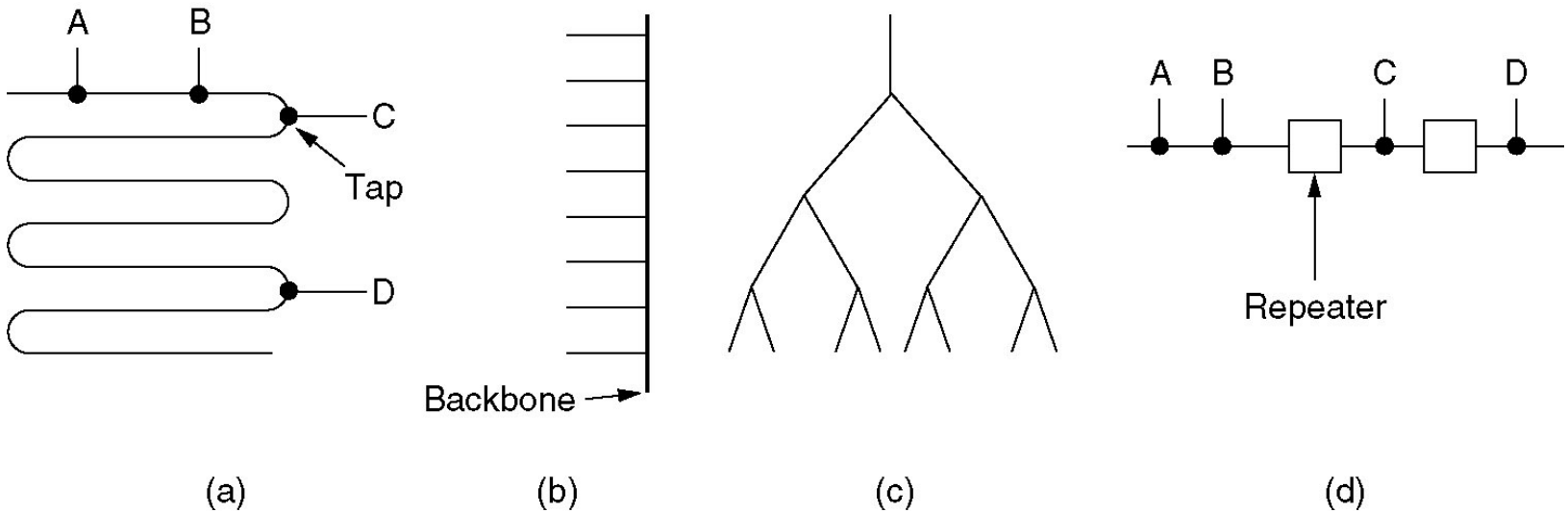
Name	Cable	Max. segment	Advantages
100Base-T4	Twisted pair	100 m	Uses category 3 UTP
100Base-TX	Twisted pair	100 m	Full duplex at 100 Mbps
100Base-FX	Fiber optics	2000 m	Full duplex at 100 Mbps; long runs

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

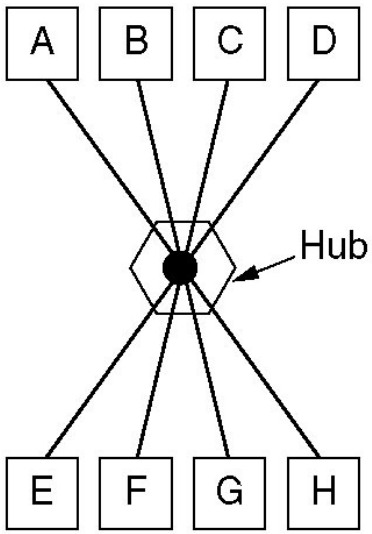
Ethernet Cabling (2)



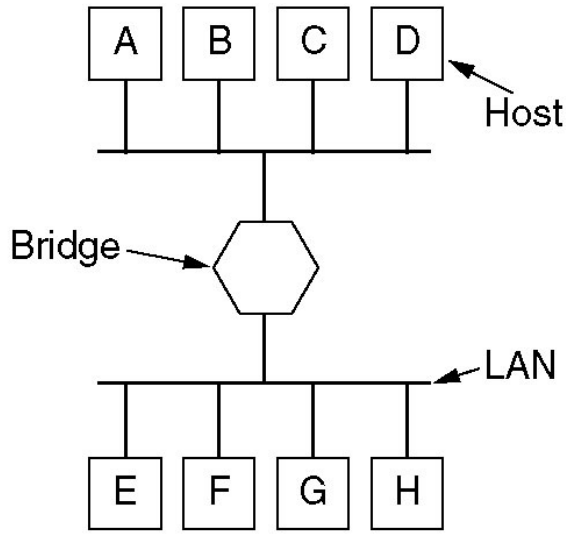
Ethernet Cabling (3)



Repeaters, Hubs, Bridges, and Switches



(a)



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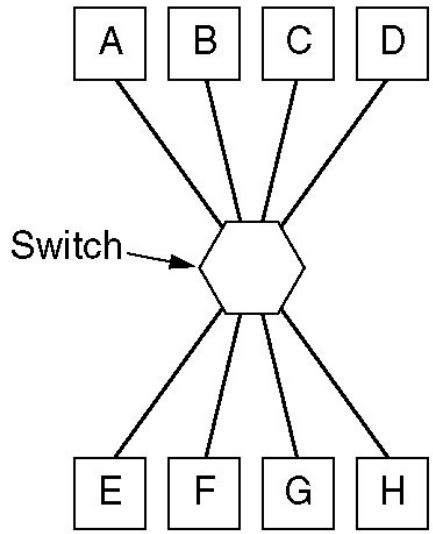
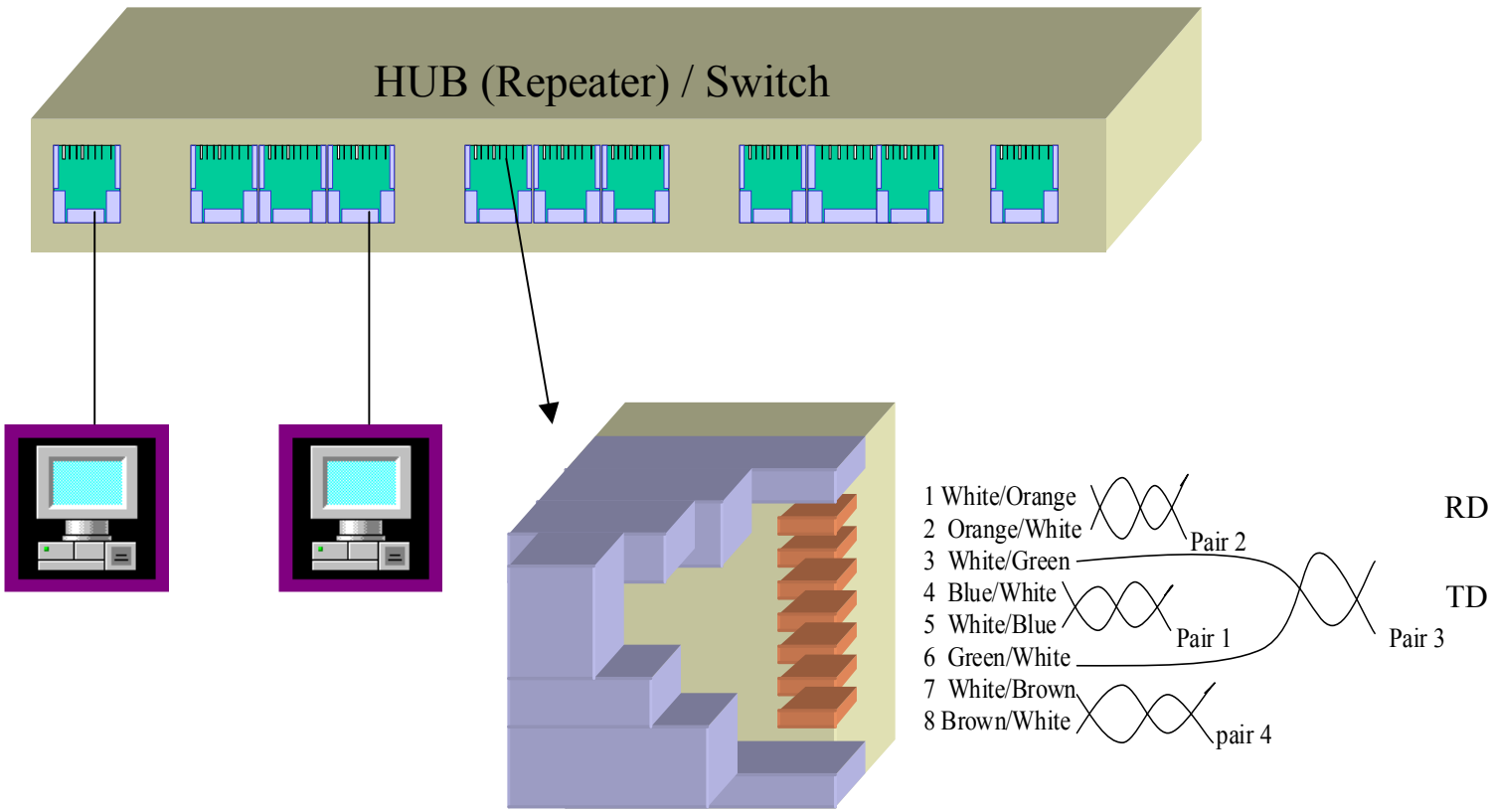


(c)

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** – FM, 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

North American Service Providers

- AT&T
- Cingular (SBC)
- MCI
- Nextel
- Sprint (PCS)
- Voice Stream
- Verizon (Bell Atlantic)

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