

# Classifications of Wireless Systems

ECE 4823

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## Ways to Classify

- By modulation type: analog or digital
- By relative times of transmission and reception
- By application

## Analog Modulation

- Frequency modulation (FM) is the most popular analog wireless modulation technique
- In FM, the carrier frequency is varied linearly with the baseband message signal
- The Advanced Mobile Phone Service (AMPS), introduced in 1983 and still in use today, uses FM
- The thermal noise inevitably generated in the receiver cannot be completely removed

## Digital Modulation

- Time is divided into symbol periods
- Each symbol period has a symbol waveform selected from a finite set
- If there are  $2^m$  in the set, each symbol waveform carries  $m$  bits of information
- The thermal noise in the receiver *can* be completely removed when the receiver detects the symbol waveforms correctly
- Global System Mobile (GSM), introduced in 1990 uses digital modulation

## By Time of Transmission and Reception

- Simplex: unidirectional communication
  - Pagers
- Full-duplex: simultaneous transmission and reception
  - Frequency-division Duplex (FDD): Tx on one carrier frequency and Rx on another; requires a duplexer
- Half-duplex: bidirectional over the same frequency—unidirectional for the duration of a message
  - Walkie-Talkies: "push-to-talk"
  - Time-division Duplex (TDD): Tx in specified time slots, Rx in others; allows for asymmetric loads in packet networks

## By Application

- Radiophones: public channels, use when free
  - Walkie-talkies, CB radio
- Private Mobile Radio: infrastructure owned by user
  - dispatching systems, emergency services, fleet communications
- Cellular Mobile Radio: users are subscribers; base stations are connected to the public switched telephone network (PSTN)
  - High mobility; primarily voice



## By Application

- Paging Systems
  - Broadcast only; not-real-time; short messages
- Cordless telephone: low mobility; mostly indoors; base station connected to PSTN
  - Voice
  - Wireless Local Area Networks (LANs): data
- Satellite
  - Provides coverage in remote areas
  - Low earth orbit: pre-determined hand-offs; sat lives about 5 years
  - Broadcast television



## By Application

- Wireless Local Loop (WLL)
  - Connects PSTN to the home
  - Cellular structure, but subscriber unit (a home) is stationary
  - Fast deployment in developing countries
  - In developed countries, competes with other technologies that access the PSTN
    - twisted pair, coaxial cable, satellite, cellular
- Video Distribution Systems
  - For cable services, like WLL is for telephony
  - MMDS @ 2 GHz, LMDS @ 28GHz (MVDS @ 40GHz in Europe)



## References

- [Rapp, '96] T.S. Rappaport, *Wireless Communications*, Prentice Hall, 1996
- [Webb, '99] W. Webb, *The Complete Wireless Communications Professional*, Artech House, 1999