

Wireless Communications

Winter 2010
MW 1700-1850
CAP 1308

Course Info

- Office hours: before and after the classes at capital center, MW 1 – 2 at PSU FAB160-10, 725-3824, fli@ece.pdx.edu
- Text: Fundamentals of Wireless Communication (David Tse, *Berkeley*, and Pramod Viswanath, *UIUC*) ISBN-13: 9780521845274 | ISBN-10: 0521845270
- References:

Course Info

- Prerequisite: ECE 461/462 or equivalent
- Grading:
 - Option 1:
 - Mid-terms 40% and
 - final 60%
 - Option 2:
 - Mid-terms 20% and
 - final 30%, and
 - project 50%

Introduction - Objectives

- Topic of study since 60s
- Real surge since mid-90, due to
 - the demand of tetherless connectivity,
 - cellular telephony
 - wireless data applications
 - The progress of VLSI technology
 - small area and low power implementation of
 - DSP and coding
 - Success of standards, e.g. CDMA

Introduction - Objectives

- Two challenging and interesting aspects unlike wireline:
 - Fading: the time variation of the channel strengths due to
 - Small scale of multipath
 - Large scale like power loss (attenuation and shadowing)
 - Interferences between
 - Transmitters with a common receiver (uplink of a cell)
 - Receivers with a common transmitter (downlink of a cell)
 - transmitter-receiver pairs (users from different cell)

Introduction - Objectives

- Traditional focus: reliability – countering fading and interference
- Recent focus: spectral efficiency – may use fading and interference
- Unified view of above
- Advanced topics

Introduction - Wireless

- Wireless history
 - Ancient time: smoke
 - 1891: telegraphy
 - 1901: radio
 - Wireless to Wireline
 - Television: terrestrial broadcasting replaced by cable
 - Transmission: microwave replaced by fiber
 - Wireline to Wireless
 - Telephone: fixed networks replacing by cellular
 - Data network: increasing WLAN

Introduction - Wireless

- Cellular network: consists of many subscribers using phone in cars, buildings, streets and of base-stations
- Cell: area covered by one base-station, theoretically hexagonal
- Base-stations connect to Mobile Telephone Switching Office (MTSO) by wire or microwave
- MTSOs connect to public wired telephone network
- Downlink – forward channel: base-station to users
- Uplink – reverse channel: users to base-station

Introduction - Wireless

- 1G systems (analog): e.g. AMPS in US,
 - Frequency-multiplexing users
 - Frequency reuse in distance cells
- 2G systems (digital): GSM, TDMA, CDMA
 - Primarily for voice
 - So the data suffers from voice requirement
- 3G systems (digital): UMTS, CDMA2K, WiMAX?
 - More accommodating to data vs. voice
 - Bursty vs fixed rate
 - Different latency vs. fixed latency
- 4G Systems (B3G): LTE, WiMAX?
- *Technical advantages vs. business interests*

Introduction - Wireless

- Different systems
 - Broadcasting – AM, FM, TV, similar to downlink of cellular networks
 - WLANs – 802.11, Bluetooth, UWB, similar to a single-cell network (less mobility and more portability)
 - Ad hoc network – similar to a cell without base-station

Introduction - Outline

- Fading – centric
- Coherence time and bandwidth, Doppler delay and delay spread, statistical model
- Detection and performance: fading vs. AWGN channels, diversity
- Multiple access and interference management, GSM, TDMA, and CDMA
- Wireless Channel Capacity
- Recent development