Wireless Network and Mobile Computing

- Wireless & Cellular Telecommunication, by William C.Y. Lee, International Edition, MGH
- Mobile Cellular Telecommunications, by William C.Y. Lee, TMH
- Mobile Communication, by Jochen Schiller, Pearson Education
- Wireless Communication Systems, by Xiaodong Wang and H. Vincent Poor, Pearson Education
- Wireless Communication and Networking, by Jon W. Mark and Weihua Zhuang, Pearson Education
- Wireless Communication, by Sanjay Sharma, S.K. Kataria & Sons
- Wireless Communication: Principles & Practices, by Theodore S. Rappaport, Pearson Education

Course Content

- Introduction
- Wireless Channel
- Wireless Transmission (in brief)
- Wireless Reception
- Cellular Communication
- Mobility Management
- Mobile IP/TCP
- WAP/WML
- Wireless Standards

Course Content

- Multiuser Detection
- Monte Carlo Bayesian Signal Processing
- Signal Processing for Fading Channels and Interference Suppression
- Selected Papers from IEEE Transaction on Mobile Computing and IEEE Transaction on Communication
- Project Work and Practicals using J2ME, NS2, Wireless Network Simulator (Tiny OS or any other software)

Introduction

- Wireless transmission: radio, radar, television, satellite and mobile telephone
- AM $\rightarrow$ FM $\rightarrow$ 1G / 2G / 3G / 4G
- Wireless Communication Network
  - Base Station (BS)
    - Radio Cell
  - Mobile Station (MS)
  - Mobile Switching Centers (MSCs)
  - Backbone Network
  - MS to BS uplink or reverse channel
  - BS to MS downlink or forward channel

- Wireless channel impairments: Challenges
  - multipath delay spread
  - doppler spread
  - intercell interference
  - intracell interference
  - fading
  - noise: multiplicative and additive
    - multiplicative: fading, intersymbol interference - causes attenuation, reduction in usable frequency spectrum
    - additive: reduces signal detectability - out-of-band noise and in-band noise

- User Mobility
  - limited radio spectrum
  - frequency reuse
  - mobility management
    - handoff management
    - location management
- Protocol Stack
  - physical layer: signal transmission and reception
  - link layer: at base station - radio resource management (power control, rate allocation, error control, etc.)
  - network layer: mobility management, traffic control and management
- Aim: Maximizing resource utilization and enhancing quality of service

1G system: Analog

Region	America	Europe	Japan
Parameter	AMPS	ETACS	NTT
Multiple access	FDMA	FDMA	FDMA
Duplexing	FDD	FDD	FDD
Forward channel	869-894 MHz	935-960 MHz	870-885 MHz
Reverse channel	824-849 MHz	890-915 MHz	925-940 MHz
Channel spacing	30 kHz	25 kHz	25 kHz
Data rate	10 kbps	8 kbps	0.3 kbps
Spectral efficiency	0.33 bps/Hz	0.33 bps/Hz	0.012 bps/Hz
Capacity	832 channels	1000 channels	600 channels

- narrowband
- voice service
- AMPS: Advanced Mobile Phone System
- ETACS: European Total Access Communications System
- NTT: Nippon Telephone and Telegraph

2G system: Digital

Region	U.S.	Europe	Japan	U.S.
Parameter	IS-54	GSM	PDC	IS-95
Multiple access	TDMA/FDD	TDMA/FDD	TDMA/FDD	CDMA
Modulation	$\pi/4$ DQPSK	GMSK	$\pi/4$ DQPSK	QPSK/OQPSK
Forward channel	869-894 MHz	935-960 MHz	810-826 MHz	869-894 MHz
Reverse channel	824-849 MHz	890-915 MHz	940-956 MHz	824-849 MHz
Channel spacing	30 kHz	200 kHz	25 kHz	1,250 kHz
Data/chip rate	48.6 kbps	270.833 kbps	42 kbps	1.2288 Mcps
Speech codec rate	7.95 kbps	13.4 kbps	6.7 kbps	1.2/2.4/4.8/9.6 kbps

- higher transmission rate, narrow band, voice service
- support for multimedia service, capacity expansion
- reduction in RF transmit power, encryption
- CDMA: Code Division Multiple Access
- GSM: Global System for Mobile Communications
- DCS: Digital Cellular System, PDC: Personal Digital Cellular
- IS-41: two tiered network architecture for location management
- GSM: Mobile Applications Part (MAP) for location management

3G system

- wideband, 2 Mbps, CDMA, FDD
- International Telecommunication Union (ITU)
  - European IMT-2000: direct-sequence CDMA
  - North American cdma 2000: multicarrier CDMA
- high transmission rate: signal bandwidth larger compared to bandwidth of propagation channel
- different frequency of signal experience different fading characteristics: frequency selective fading
- signal partitioned into narrow band and sent over channel in parallel e.g. OFDM
- near-far problem : power level control
- cell size vs. degree of frequency reuse to increase system capacity

Types of wireless communication network

- Mobile and wired
- Fixed and wireless
- Mobile and wireless
- cellular system: fixed infrastructure
- ad hoc network: network architecture configurable