

WIRELESS NETWORKING

Lecture: Monday, 12 PM - 2PM

Office hours: Monday, 2PM - 4PM (after the lecture)

Instructor: Ewa Obarska

SUMMARY

The goal of this course is to introduce material about wireless data transmission systems: WPANs, WLANs and WMANs. At first, transmission techniques used in wireless networks are introduced - it is direct sequence spread spectrum and frequency-hopped spread spectrum schemes and Orthogonal Frequency Division Multiplexing. In this course, the most important, mature and efficient WPAN, WLAN and WMAN standards are described, and also some evolving new standards are introduced. Among various technologies proposed for PAN networks, the description of the infrared standard IrDA and the RF technologies: Bluetooth, IEEE 802.15.3, IEEE 802.15.4 are given. In the section of WLAN, the 802.11 family of standards are compared with ETSI technologies - HiperLAN 1 and HiperLAN 2. The last group of the wireless systems - WMAN is represented by the LMDS system and the 802.16 family of standards.

Lectures:

1. Lecture 1 - introduction, course details

Elements of wireless technology, global wireless standards, protocol stack

2. Lecture 2 - Spread spectrum signals

Direct sequence SS, frequency hopping SS, processing gain, PN sequences, Gold codes, CDMA systems

3. Lecture 3 - OFDM systems

Delay spread, intersymbol interference ISI, multicarrier communications, FFT

4. Lecture 4 - IrDA standard

Infrared transmission, synchronous and asynchronous format, protocols: IrLAP, IrLMP, IrOBEX, IRCOMM, Tiny-TP

5. Lecture 5 - Bluetooth standard

Piconet, scatternet, baseband links, packet types, baseband state machine, ad-hoc connectivity

6. Lecture 6 - Software protocols in Bluetooth

Host Controller Interface, L2CAP, Service Discovery Protocol

7. Lecture 7 - Bluetooth profiles and usage models

File transfer, Internet bridge, LAN access, synchronization, three-in-one phone

8. Lecture 8 - Summary of WPAN systems

Low-rate WPAN, ZigBee standard, 802.15 standards, home networking

9. Lecture 9 - Elements of WirelessLAN

Independent and infrastructure network, access point, portal, collision avoidance CSMA/CA, „hidden node” problem, virtual carrier sense, backoff algorithm

10. Lecture 10 - 802.11 physical layer

FHSS, DSSS, baseband IR, frame format, frame types, Barker code

11. Lecture 11 - 802.11b - High Rate physical layer

Complementary Code Keying, Packet Binary Convolutional Coding, cover sequence, coding gain

12. Lecture 12 - 802.11a and 802.11g

OFDM transmission, extended rate physical layer, frame format

13. Lecture 13 - European WLAN standards - HiperLAN/1 and HiperLAN/2

OFDM transmission, forward error control, convergence layer, QoS

14. Lecture 14 - Technologies comparison

Coexistence of 802.11b and Bluetooth, collaborative and noncollaborative mechanisms, security algorithms, WEP

15. Lecture 15 - Introduction to the line-of-sight microwave transmission

Propagation channel, free space loss, rain attenuation

16. Lecture 16 - LMDS system

System architecture, standards: DAVIC and ETSI (DVB)

17. Lecture 17 - WirelessMAN air interface

WirelessMAN-Single Carrier, wirelessMAN-OFDM, wirelessMAN-OFDMA

18. Lecture 18 - Physical layer details

Reed-Solomon coding, convolutional coding, downlink and uplink subframe structure

19. Lecture 19 - Comparison of WLAN and WMAN technologies

Number of users, QoS, range, security, WEP and DES algorithm

20. Lecture 20 - Final test

Projects:

1. Generation of DSSS and FHSS signals.
2. Generation of OFDM signals.
3. Error correction and ARQ protocol in Bluetooth.
4. Bluetooth - how it is working? (how units can be added and released from the piconet, how the channel is established)
4. WLAN in the small office/laboratory - project.
5. Wireless transmission in your home - project.

6. Complementary Code Keying in 802.11b.
7. 802.16a FEC coding in OFDM transmission.

Recommended text/web places:

1. Benny Bing „Wireless Local Area Networks”, John Wiley & Sons, Inc., 2002
2. Alister Burr „Modulation and Coding for Wireless Communication”, Prentice Hall, 2001
3. www.wirelessman.org - IEEE WMAN standards zone
4. www.bluetooth.org
5. www.palowireless.org

Evaluation:

Total: 100 points, test: 60 points, project: 40 points

100 - 91: 5, 90 - 81: 4.5, 80 - 71: 4, 70 - 61: 3.5, 60 - 51: 3