Department of Electrical and Computer Engineering
ECE 645: Wireless Networks

Description: As traditional wireless communication networks move from circuit switching to packet switching, the traditional computer network based on TCP/IP is progressively moving to wireless. The rapid deployment of 4G wireless devices, such as Iphone from Apple and Android phones from Google, completely changed the landscape of competition. At the center of those driving forces, the scientific workers must quickly master new knowledge of inter-disciplines in order to stay at forefront of this revolution.

This course is to prepare students to be constructive in the new environment of 4G wireless communications by introduction to wireless network design, deployment, management, and optimization stages. Topics include demand modeling, radio planning, network optimization, and information handling architecture with emphasis on resource allocation and mobility management aspects. Investigation of signaling load optimizations and inter-networking problems.

The handout materials are the main focus, which are supplemented by the textbook. The handouts are to offer students a quick grasp of rapid industrial advancements which are not yet captured by published textbooks.

Prerequisites: EE 321 or Math 333 (see catalog for descriptions).
Students are encouraged to take ECE644 before taking this course

Textbook(s)/Materials required:

- Mischa Schwartz, "Mobile Wireless Communications," Cambridge University Press 2005.
- Fundamentals of Wireless Communication (new one). David Tse, University of California, Berkeley Pramod Viswanath, University of Illinois, Urbana-Champaign. ISBN:9780521845274 (note that the book is available online)
- Lecture outlines posted weekly on Moodle

Suggested references:

- By Arunabha Ghosh, Jeffrey G. Andrews, Rias Muhamed, Jun Zhang, "Designing a Broadband Wireless Network: Overview and Channel Structure of LTE", Prentice Hall 2010, ISBN-10: 0-13-703311-7
- Stefania Sesia, Issam Toufik, Matthew Baker (eds), "LTE – The UMTS Long Term Evolution: From Theory to Practice", Wiley 2009, ISBN 978-0-470-69716-0

Topics:

Tentative Course Schedule	**Lecture**
Network Design Basics - Capacity	1

This course outline serves to provide a big picture of the course. Instructional materials such as textbooks, individual topics, and grading policy are subject to revision and changes by individual instructors.

➢ Vision, path and current status ➢ Key takeaway of this course ➢ Access technologies, the spectrum reuse and the capacity calculation – Frequency Division Multiple Access (FDMA) – Time Division Multiple Access (TDMA) – Code Division Multiple Access (CDMA) – Orthogonal FDMA (OFDMA) ➢ Key Performance Indicators Overview (LTE for Example)	1
Network Design Basics - Link Quality ➢ Free space propagation model ➢ Propagation attenuation in dB expression ➢ Generic propagation model ➢ Simplified Radio Transmitter and Receiver ➢ Use of SNR to determine link quality	2
More about Network Design – A Systemic Approach ➢ Demand modeling ➢ Call arrival modeling ➢ Call length modeling ➢ Application of Erland-B for voice capacity ➢ Capacity planning for voice and data ➢ Radio planning – How big the cell should be and how many	3
3G EVDO ➢ Reference network architecture ➢ Protocol stack ➢ How EVDO achieve high data rates ➢ Session handoff and control signaling ➢ Hybrid (Dual Mode) AT and its impact on network operations	4
4G LTE ➢ Reference network architecture ➢ Protocol stack ➢ Radio Resource Control (RRC) Protocol ➢	5
More about Mobility: Optimized Registration and Paging ➢ Location Management ➢ Paging ➢ Optimization of Registration and Paging ➢ Location Area and Tracking Area in 3G/4G	6
Sign Up for Class Project and Mid-term Exam	7

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➢ List of candidate topics (handout) ➢ Grouping of work groups (3 memberss) ➢ Project requirement and schedule ➢ Review for Mid-term ➢ **Mid-term exam**	**Mid-term exam**
Performance Analysis of Wireless Communication Systems ➢ KPIs ➢ Prelaunch, cluster analysis and service level acceptance ➢ Platforms used in drive test ➢ Synthesis of network counters and pre connection measurement data	8
Self Optimized Network (SON) ➢ Dynamic X2 configuration ➢ Automatic Neighbor Relation (ANR) ➢ Automatic allocation of PCI ➢ Handover optimization ➢ Load balancing	9
Geolocation and Its Applications ➢ E911 ➢ Architectures about CP and UP ➢ LBS and its applications in performance monitoring ➢ Geolocation technologies – A-GPS method – TDOA based method – Cell ID based method	10
Advanced LTE (3GPP Release 10-11) ➢ What Is Advanced LTE ➢ Scalable system bandwidth exceeding 20 MHz, Up to 100 MHz ➢ Multiple Input Multiple Output (MIMO) DL/UL 8x8/4x4 ➢ Coordinated multipoint (CoMP) transmission and reception ➢ Carrier aggregation of contiguous and non-contiguous spectrum allocations ➢ Interference management and suppression	11
Thanksgiving – No class	
Project Presentations ➢ Oral presentations ➢ Discussions ➢ Written reports due	12-13

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Review	14
Final Exam	**Final Exam**

Grading: HW/Quiz 15 %; Attendance 10%; Midterm: 25 %; Project 30%; Final: 20 %

Honor Code: The NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students.

Lecture Outlines: Available before class date via emails

Instructor:

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Office hours: By appointment

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