ESE 506: Wireless Networking and Mobile Computing

Course Objective

Mobile computing and wireless networks is a dynamic field. Ubiquitous access to information, anywhere, anyplace, and anytime, will characterize whole new kinds of information systems in the 21st century. These are being enabled by rapidly emerging wireless communications systems such as Cellular transmissions, Personal Communications Systems, Mobile IP, Wireless Local Area networks (LANs), Ad Hoc networks, and Sensor networks. Moreover, the next generation communication systems are expected to provide a range of services to mobile users to support voice, video, multimedia, conventional data, and Internet access in an integrated fashion. However this comes at a price, in terms of capacity, quality, security and network complexity. The wireless Internet cannot really offer the same as the wired Internet. In order to understand the opportunities and limitations of wireless and mobile networking and computing, their potential for growth, how they relate to Internet technology, and how they can cooperate, this course brings the insight and knowledge of the underlying networking technologies, architectures and protocols, as well as principles of mobile computing and its enabling technologies together.

Course Description

This course will examine the area of wireless networking and mobile computing, looking at the unique network protocol challenges and opportunities presented by wireless communications and host or router mobility. The course will first give a brief overview of fundamental concepts in mobile wireless systems and mobile computing, it will then cover system and standards issues including wireless LANs, PAN, mobile IP, ad-hoc networks, sensor networks, as well as issues associated with small handheld portable devices and new applications that can exploit mobility and location information. This is followed by several topical studies around recent research publications in mobile computing and wireless networking field. This course will make the system architecture and applications accessible to the electrical engineer and computer scientist.

Course Outline

- Overview of fundamental challenges in wireless networking and potential techniques
- Wide area wireless networks: Mobile IP
- Wireless local area networks (WLAN): MAC design principles, 802.11 (WiFi)
- Wireless person area networks (WPAN): 802.15.4 (ZigBee), Bluetooth, 6LoPAN
- Mobile ad hoc and sensor networks (Topology-based routing. Geographic routing)
- Advanced topic in wireless networks, mobile computing, and wireless applications

(Millimeter wave wireless networks, Mobile IOT, Machine learning and its applications in wireless networks and applications, Cloud computing and mobile edge computing, software defined wireless networks, cognitive networks, mobile social networks, Mobile vehicle networks and

services, 5G network and network slicing, Wireless network for Smart Grid, cyber physical systems, healthcare, etc.)

Prerequisites

The course 505, Wireless Communications, is recommended, or permission of instructor

Course Benefits

- Learn state-of-the-art wireless technologies;
- Obtain background for original research in wireless networking and mobile computing field
- Learn the skill of independently identifying a problem and solving the problem.

Besides grasping basic course knowledge, as a graduate student, you are expected to be the technical leader in your future career. The class also trains the students with presentation skill, writing skill, leadership, and teamwork spirit.

Class Materials

- Class notes, copies of slides and reference reading list will be available at blackboard.

Course Grading

- Assignments 10%, midterm 30%, in class presentation 15%, Class participation 5%, Project 40%.

Class Presentation

Each student or a group is expected to thoroughly understand and present a research topic You are expected to thoroughly survey the field, provide background information and current research states as well as future research direction to share with your classmates. (15 %)

(Some suggested topics will be given, and you can discuss with me of any other topics of your interest).

Paper reading skills:

- What are the major problems the paper tries to solve?
- What are the major contributions of the paper?
- What are the problems existing in the paper?
- What are the improvements that can be made, and further work can be done?

Project

☐ Suggested project topics will be posted. You are also encouraged to come up with your own topic. Project can be done individually or in two people group. Some possible project styles

- systematically implement/simulate/analyze an existing approach and make big improvements
- revise existing methods to solve new research problems
- identify a novel research problem, and propose a creative solution

Note: the above options have increasing level of challenge, and more credits with be given to a project with a higher challenging level.

☐ Delivery

- Final report and results (analysis, simulation and implementation are commonly needed by your project). Published paper format is encouraged.

Proposal (10 %):

You are expected to submit a project proposal before the mid-term, describing the problems you would like to work on, the proposed solutions, and preliminary results if there are any. Please also provide the schedule/plan of your project. Early proposal submission is strongly encouraged.

Final project report (30 %):

- You are required to use the ACM conference proceeding format. The templates in MS Word and Latex are downloadable from: http://www.acm.org/sigs/pubs/proceed/template.html
- Each report should be about 8-12 page long in 10-point font two-column format. Single column paper is usually longer.
- There are many articles on how to write a paper/report. The following is one such an example on paper structure suggested by Henning Schulzrinne of Columbia CS.

Outcome of ESE 506

The course includes mathematical skills to analyze the network capacity. With the team oriented project on state of art research in the field, the students are trained with team work and communication skills, independent research capability, and writing skills to present the research ideas.

	Student Outcomes	% contribution
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	15
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	15
3	an ability to communicate effectively with a range of audiences.	15%
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	15%
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.	20%
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	20%