CS 3521 - TELCOM 2721 Mobile Data, Ad Hoc and Sensor Networks Spring 2007

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Meeting Time
Thursday: 6:00 – 8:50 p.m.
SENSQ 5313
http://www.cs.pitt.edu/~znati/Wireless.html

Office Hours
Tuesday and Thursday: 11:00 – 12:00 and by Appointments

Course Description

The convergence of the Internet, communications and information technologies, coupled with recent advances in wireless communications, is paving the way for a new generation of mobile, wireless and pervasive and

ubiquitous computing environments. The distributed and ad-hoc deployment of networks of sensors and wireless devices bears promises for a significant impact, not only on science and engineering, but equally importantly on a broad range of applications relating to mobile data communications, critical infrastructure protection and security, health care and environmental protection.

The mobile data, ad-hoc and sensor networks course focuses on advanced topics in the exciting and rapidly growing research and development areas of ad-hoc mobile wireless and sensor networks. The first part of the course provides a brief review of wireless communications, including data encoding and spread spectrum technology. The second part of the course discusses the fundamental design issues of MAC layer protocols for wireless networks. An in-depth discussion about IEEE 802.11 is provided. The third part of the course focuses on routing strategies in ad-hoc wireless networks. The fundamental routing design requirements will be discussed and a selected group of routing protocols will be studied. The fourth part of the course will focus

on mobility in IP networks and its impact on transport protocols, such as TCP. Several solutions to improve TCP performance over wireless networks will be presented. The final part of the course will delve deeply into the area of wireless sensor networks. The focus will be on the distributed protocols needed to enable wireless sensor networks and the interplay between communications and networking protocols, energy-aware design, data management and information dissemination algorithms, and distributed programming. The course will address the design of this new class of systems and will cover topics such as the design implications of energy and resource limitations on media access and networking protocols, network self-configuration and adaptation, localization and time synchronization, information processing and dissemination, tasking and programming sensor networks, and security in wireless sensor networks.

Course Prerequisites

In general, very good knowledge of fundamentals of computer networks and systems is required. The following background is required:

- A course in computer networks, at the senior or graduate level, is mandatory.
- The ability to program in C, C++, Java or other language is mandatory.
- Some knowledge of operating systems, data structures and algorithms, and graph theory is recommended.
- Knowledge of simulation packages, such as Csim, Opnet or ns2 is a plus.

Course Topics

- Introduction and Background
  - Wireless Communications and Networking Fundamentals
- Media Access Layer Design Requirements and Protocols
  - IEEE 802.11 – Case Study
- Routing in MANETs
  - Design Requirements
  - Overview of Different Classes of Routing Protocols

- **Mobility in Internet Protocols**
  - **Mobile IP**
  - **Enhancing TCP over Wireless Networks**
  - **Routing in MANETs**
- **Sensor Networks**
  - **Introduction and Overview**
  - ***Media Access Control for Wireless Sensor Networks.***
  - ***Routing Protocols for Wireless Sensor Networks***
  - ***Coverage and Topology Control***
  - ***Localization and Management***
  - ***Data Collection and Dissemination Protocols for Large Sensor Networks***
  - ***Reliable Transport Protocols***

for Sensor Networks

- **Scalable Coordination in Sensor Networks**

The lecture notes and reading materials will be available on the course web page. Students are responsible for obtaining a copy of the lecture notes.

Homework, Projects, Exams and Grading Policies

This will be a challenging course, requiring each student to read and write critiques for a number of technical papers, solve assigned homework problems, and on a substantial research project. The final grade for this course will be based on the following:

- **Homework and Paper Review Assignments (30%)**
  - **In addition to regular homework, students will be required to read and summarize assigned papers**

related to different topics of the course. Students will submit a written summary of the assigned papers. The summary must summarize the paper, give some context for the paper by discussing related research work and discuss the main aspects and contributions of the paper.

- Students may be asked to review a technical submission by a colleague and submit a detailed review of the submission along with a recommen

dation for the paper. Reviews will be assigned anonymously. Presentation Session

- **Research Project (30%)**
  - Students are required to, either individually or in a group of at most two, propose and execute a research project. This effort will entail the submission of a project proposal (20%), a project progress report, a project demonstration if applicable, and a final report. The research report must be in the form of a conference paper and

briefly present their results in class.

- **Final Exam (40%)**
  - Students are required to, either individually or in a group of at most two, propose and execute a research project. This effort will entail the submission of a project proposal (20%), a project progress report (10%), a project demonstration if applicable, and a final report (70%). The research report must be in the form of a conference paper.

Important Dates

- **Initial Project Proposal: February 8th**
- **Final Project Proposal: February 22nd**
- **Initial Project Report: March 15th**
- **Final Project Report and Demonstration: Last Week of the term**

Policy of Missed Homework and Exams

You must have a pressing reason for failing to miss an exam, submit on time a homework, a reading summary, a paper review or paper presentation material. Rescheduling will be allowed only if the instructor is notified at least one week prior to the original date. If you miss homework to an unforeseen emergency, you may be granted an extension only after providing written documentation of an excuse that is acceptable to the instructor.

Reading Material

There is no book required for this class. Each lecture is based on several papers covering a specific topic. Although reading all the

papers is recommended, students are required to read only the papers marked so. The papers for each lecture will be posted at least one week prior to that lecture. The lecture notes will be posted before each lecture.

Recent papers related to the course topics can be found in the following web sites

- **InfoCom: Communications Conference**
  - **http://www.comsoc.org/confs/ieee-infocom/2005/**
  - **http://www.comsoc.org/confs/ieee-infocom/2004/**
  - **http://www.comsoc.org/confs/ieee-infocom/2003/**
  - **http://www.comsoc.org/confs/ieee-infocom/2002/**
  - **http://www.comsoc.org/confs/ieee-infocom/2001/**
  - **http://www.comsoc.org/confs/ieee-infocom/2000/**
- **MobiCom: Communications Conference**
  - **http://www.acm.org/sigmobile/mobicom/2006/program.html**
  - **http://www.acm.org/sigmobile/mobicom/2005/program.html**

- http://www.acm.org/sigmobile/mobicom/2004/program.html
- http://www.acm.org/sigmobile/mobicom/2003/program.html
- http://www.acm.org/sigmobile/mobicom/2002/program/
- http://www.acm.org/sigmobile/mobicom/2001/conference_program.html
- http://www.acm.org/sigmobile/mobicom/2000/Conference.htm

MobiHoc: Mobile Ad Hoc Networks Conference

- http://www.sigmobile.org/mobihoc/2005/program.html
- http://www.sigmobile.org/mobihoc/2004/program.html
- http://www.sigmobile.org/mobihoc/2003/program.html
- http://www.sigmobile.org/mobihoc/2002/program.html
- http://www.sigmobile.org/mobihoc/2001/Conference.htm
- http://www.sigmobile.org/mobihoc/2000/program.html

SigCom: Communication Conference

- http://www.sigcomm.org/sigcomm2006

- http://www.sigcomm.org/sigcomm2005
- http://www.sigcomm.org/sigcomm2004/papers.html
- http://www.acm.org/sigs/sigcomm/sigcomm2003/conferenceprogram.html
- http://www.sigcomm.org/sigcomm2002/technical.html
- http://www.acm.org/sigs/sigcomm/sigcomm2001/technical_program.html
- http://www.acm.org/sigs/sigcomm/sigcomm2000/conf/techprog.htm