

EEC 687 Mobile Computing Spring 2009

Time and location: MW 2 – 4 pm, Room SH 306

Instructor: Chansu Yu (c.yu91@csuohio.edu)
Room: SH 437
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Instructor office hours: M 4 – 5 pm, T 2 - 5 pm or by appointment

Objectives

EEC 687 Mobile Computing (4-0-4). Prerequisite: EEC 584. Mobile computing and wireless networks are new and dynamic areas of research and development. The rapid advances in miniaturization of computing devices and "untethered" communication technology, together with the increasing demands for ubiquitous access to information, have introduced new challenges as well as new opportunities in many traditional areas of computer science and engineering. In this course students will have a comprehensive overview of mobile computing and wireless networks.

Topics covered: (i) Link-, network- and transport-layer protocols for wireless networks such as CSMA/CA and Mobile IP, (ii) industry standards including IEEE 802.11 (WiFi) and IEEE 802.16 (WiMAX), (iii) various mobile networking styles including wireless LAN (WLAN), wireless metropolitan networks (WMAN), mobile ad hoc networks (MANETs), vehicular ad hoc networks (VANETs), wireless mesh networks, and wireless sensor networks, and (iv) state-of-the-art tools and hands-on experience with de facto standard ns-2 network simulator, palmtop computers (HP iPAQ 7570) and software radio toolchain (Universal Software Radio Platform or USRP from Ettus and Gnu Radio software package from GNU).

Prerequisites

This will be a fast-paced course that covers both the theoretical background and the practical issues of mobile computing and wireless networks. The algorithmic and programming background required is C, C++ and script languages such as Tcl, Awk, perl, and python. A basic knowledge of computer networks and operating systems will be required.

Prerequisites by topic: Computer networks, TCP/IP protocols, Digital communication.

However, do not panic! The instructor will offer a tour of key components in computer networks that are necessary to understand mobile network components. And, no need to worry about script languages. First, they are not hard to learn. Second, example codes will be given. Hey, script languages are in fact developed to make programmer's life easier!

Course requirements

Course requirements include nine labs, mostly based on ns-2 network simulator. Students are required to turn in the lab report summarizing the results as well as what they learned. Each report must not exceed 5 pages in single-column, 11-font format. Due date of each lab report is the following day of the lab (via email to c.yu91@csuohio.edu).

Each student will perform an individual class project, which consists of two stages and must involve experiments with iPAQ or USRP. Depending on the size of the project, two-person project is also allowed with the prior permission from the instructor. Submit your project title as well as teammates, if any, by Feb. 18 via email to c.yu91@csuohio.edu. A list of suggested project subjects will be provided. It is highly suggested to read published papers and search websites to understand what other researchers have already done in the chosen area as well as to appreciate good research in mobile computing and wireless networks. Interim report is due Mar 25 and the final report is due May 4. On both dates, students will make project presentations.

There will be two midterm examinations (Feb. 25 and Apr. 1) and a few pop quizzes. No homework assignments.

Course materials

References:

- "Mobile Communications, Second Edition," Jochen Schiller, Addison Wesley, Second Edition, 2003.
- IEEE Std 802.11-1999, Local and Metropolitan Area Network, Specific Requirements, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.
(<http://standards.ieee.org/getieee802/download/802.11-1999.pdf>)
- Wireless and Mobility Extensions to ns-2 (http://www.isi.edu/nsnam/ns/doc/ns_doc.pdf).

- Principles of Wireless Networks, by K. Pahlavan and P. Krishnamurthy, Prentice Hall PTR, 2002.
- Wireless Communications and Networks, W. Stallings, Prentice Hall, Inc., 2002.
- Ad Hoc Networking, edited by C. E. Perkins, Addison-Wesley, 2001.

Grading

- 20% Midterm #1
- 20% Midterm #2
- 25% Lab report
- 25% Project
- 10% Quiz (pop quizzes)

Collaboration

I strongly encourage you to discuss any topic with other students. However, when the time comes to write a report or program, such discussions are no longer appropriate---the solution or program must be your own. Do not copy another person's report or program under any circumstances. To do so is a clear violation of ethical/academic standards that, when discovered, will be referred to the school administration for disciplinary action.

Late lab report/project policy

A lab report is due midnight on the following day of the lab. Late lab report is not accepted. A project report is due at the beginning of the due date class. There is an automatic 3-day extension with 5% penalty. Later submissions will not be accepted.

Class Schedule (Tentative)

Date	Topic and reading	Assignments due
Week 01: Jan 21 W	Course overview	
Week 02: Jan 26 M	Physical layer issues Reading: J. Schiller, "Wireless transmission," Ch. 2 Reading: Ns2 manual, "Radio Propagation Models," Ch. 18 (http://www.isi.edu/nsnam/ns/tutorial/nsindex.html). Run ns-2 simulation and summarize the results Reading: <u>Wireless and Mobility Extensions to ns-2</u> (http://www.isi.edu/nsnam/ns/tutorial/nsindex.html). Ns installation guide (ns2_guide.pdf)	
Jan 28 W	Lab #1: 6-station simulation Reading: Ns simulator for beginners (ns2.pdf) Ns2 manual, "Trace and Monitoring support," Ch. 23 Ns2 manual, "Mobile networking in ns," Ch. 16	Lab report #1
Week 03: Feb 2 M	Medium access control Reading: J. Schiller, "Medium Access Control," Chapter 3 Kammerman, A., and Monteban, L. WaveLAN-II: A High-Performance Wireless LAN for the Unlicensed Band. <i>Bell Labs Technical Journal</i> , Summer 1997	
Feb 4 W	Lab #2: Carrier sense, signal capturing and multirate control in ns-2	Lab report #2
Week 04: Feb 9 M	IEEE 802.11 MAC Reading: J. Schiller, "Wireless LAN," Chapter 7.3.1~7.3.4 802 spec, "General description," Ch. 5 802 spec, "MAC service definition," Ch. 6 802 spec, "Frame formats," Ch. 7	
Feb 11 W	Introduction to iPAQ and GNU Radio/USRP	
Week 05: Feb 16 M	(No class, President's Day)	
Feb 18 W	Lab #3: Effect of contention window on MAC performance in ns-2	Lab report #3 * Project title (team)
Week 06: Feb 23 M	IEEE 802.11 MAC	
Feb 25 W	Midterm exam #1	* Midterm #1
Week 07: Mar 2 M	IEEE 802.11 MAC management Reading: J. Schiller, "Wireless LAN," Chapter 7.3.5~7.3.8 802 spec, "MAC sublayer functional description," Ch. 9 802 spec, "MAC sublayer management entity," Ch. 11	
Mar 4 W	Lab #4: General simulation – Mobility file, traffic file, alternatives	Lab report #4
Week 08: Mar 9 M	Lab #5: GNU Radio	Lab report #5
Mar 11 W	(No class, IEEE PerCom Conference)	
Week 09: Mar 16 M	(No class, Spring recess)	
Mar 18 W	(No class, Spring recess)	

Week 10: Mar 23 M	IP networking and Mobile IP Reading: J. Solomon, "Computer Networking Tutorial," Ch. 2, Mobile IP, Prentice Hall, 1998 J. Schiller, "Mobile network layer," Chapter 8.1~8.2	
Mar 25 W	Project presentation	Project report #1
Week 11: Mar 30 M	Mobile IP	
Apr 1 W	Midterm exam #2	Midterm #2
Week 12: Apr 6 M	MANET Routing Reading: J. Schiller, "Mobile ad hoc networks," Chapter 8.3	
Apr 8 W	Lab #6: Mobile IP in ns-2	Lab report #6
Week 13: Apr 13 M	Multicast in mobile networks	
Apr 15 W	Lab #7: MANET in ns-2	Lab report #7
Week 14: Apr 20 M	Network reliability (TCP) in Internet Reading: J. Schiller, "Mobile transport layer," Chapter 9.1	
Apr 22 W	Lab #8: TCP in ns-2	Lab report #8
Week 15: Apr 27 M	Network reliability (TCP) in mobile networks Reading: J. Schiller, "TCP over mobile networks," Ch. 9.2~9.3	
Apr 29 W	Lab #9: TCP in ns-2	Lab report #9
Week 16: May 4 M	Project presentation	Project report #2
May 6 W	Project presentation	