

CS/ECE 707: Mobile and Wireless Networking (Fall 2007)

Summary of course content

The growing popularity of wireless-enabled mobile devices, such as laptop and palmtop computers, has necessitated extensive research, development, and deployment of wireless communication protocols. Communication over the wireless medium has fundamentally different properties than that over a wired medium, including higher error rates, lower bandwidths, nonuniform transmission characteristics, increased usage costs, increased susceptibility to interference and eavesdropping, and higher variability of performance. Similarly, mobile nodes behave differently and have fundamentally different limitations than stationary nodes. For example, mobile nodes generally operate on limited battery power and may move and change their point of connection to the network.

This course will examine the area of mobile and wireless networking, looking at the unique challenges and opportunities presented by wireless communication and host or router mobility to design of networks, systems, and applications. The course will commence with a short retrospective of wireless communication and initially touch on some of the fundamental physical layer properties of various wireless communication technologies. The focus will then shift to design of media access control and routing layers for various wireless systems. The course will also examine adaptations necessary at transport and higher layers to cope with node mobility and error-prone nature of the wireless medium. Finally, it will conclude with a brief overview of other related issues including emerging wireless services and wireless security.

Course syllabus and reading list

The course material will be drawn mainly from research literature and supplemented from readings from various text books. While it is natural to characterise topics according to layers of the protocol stack as discussed below, in many cases cross-layer design mechanisms are relevant. Such mechanisms will be discussed in an appropriate context.

- PHY layer: (2 weeks)
Spectrum allocation and characteristics; mobile radio environment, propagation characteristics, concept of channel and basic coding techniques; Spectrum efficiency issues; Frequency reuse/cellular/microcellular concepts including sectorization and cell splitting;
- MAC layer: Carrier sensing, CSMA/CA, RTS-CTS mechanisms, MACA, MACAW; IEEE 802.11 DCF and PCF (NAV, SIFS, DIFS, RTS/CTS, backoff, contention window, fragmentation, etc.); Power and rate control; Emerging technologies such as Bluetooth, WiMAX, new versions of 802.11, ZigBee;
- Routing layer: Network layer mobility support, Mobile IP and its variants; Proactive and reactive routing techniques for multi-hop wireless networks; Geographic routing, topology construction and management; Multi-radio mesh networks, routing metrics including energy costs; Routing techniques for sensor networks; Mobile access routers
- Transport layer: Interaction of TCP with single-hop and multi-hop wireless networks; FEC-based reliability approaches, and implications on energy efficiency;

- Application layer: File systems with mobility support; Application-aware mobility, energy-aware adaptations for applications including web, (real-time) streaming, bulk transfer; Proxy architectures; Adaptations for cellular systems;

Programming assignments

There will be about 1-2 programming assignments at the beginning of the semester that will help get your feet (or hands) wet about different aspects of wireless networking. You will each get an account on a wireless 802.11 enabled machine, and you will be required to analyze some traces and implement some modifications to existing 802.11 systems. One of these projects will require you to operate in groups of three. So please try to form these groups as soon as you can.

Class participation

This class is supposed to be interactive. So participation in class discussions is important. You are encouraged to ask questions, present your viewpoint, disagree, and lead discussions in class. In certain classes I may have a few students lead the discussion.

In addition, in each class we will have a “five minutes of fame” session. In this session, one student will prepare a short five minute oral presentation (no slides) on some interesting wireless and mobile networking related article that he or she found interesting. Slashdot is a good source of such articles.

There are points assigned to class participation on your overall grade.

Grading criteria (subject to change)

- Exams I and II (15% each): 30
- Programming assignments : 20
- Review assignments: 10
- Class participation: 5
- Project : 35

Total: 100

Reading List:

A copy of the reading list can be found at:

www.cs.wisc.edu/~suman/courses/707/readinglist.html