

EE/NIS 653: Cross-layer design for wireless networks

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Prerequisite: Familiarity with Probability and Stochastic Processes

Course description:

New heterogeneous services emerging in wireless networks require efficient resource management and quality-of-service (QoS) support at all layers of the protocol stack.

As opposed to wireline networks, in which QoS can be guaranteed by independently optimizing each layer in the OSI model, in wireless networks there is a strong interconnection between layers, which makes the layered design approach inefficient.

In this course, we will outline the basic principles of cross-layer design in wireless networks, and we will discuss the tradeoffs involved. The course will first review basic network architectures such as cellular, wireless LAN's, and ad hoc networks, and will discuss the appropriate tools to provide QoS support at each layer of the protocol stack. Then, we will discuss examples of integrated design across layers for different network architectures, including studying examples of cross-layer design on a demo program. An important component of this course will be the project, which will give the students the opportunity to apply their knowledge to solve specific problems related to QoS provisioning in wireless networks.

Text book: no textbook required.

Narrated lecture presentations and problem examples will be available on the class web page. A demo program in Matlab will also be available.

Benchmark papers on cross-layer design will be part of mandatory reading.

Suggested reading:

1. Radio resource management for wireless networks, by Jens Zander et al, Artech House Publishers, 2001.
2. Wireless Communications. Principles and Practice, T. S. Rappaport, second edition, Prentice Hall, 2002.

Course outline:

1. Introduction to communication networks and layered network architectures
2. Principles of cross-layer design
3. Introduction to wireless communication
4. Multiuser communication in wireless systems
5. QoS support at different layers of the protocol stack with emphasis on radio resource management and mathematical models for various layers
6. Examples of cross-layer design for wireless networks

Course objectives

At the end of this course, students are expected to

- 1) understand the cross-layer design concept and the tradeoffs involved,

- 2) understand the QoS measures and the QoS provisioning tools at different layers of the protocol stack,
- 3) be able to analyze the system performance and provide alternate design solutions and illustrate the tradeoffs,
- 4) solve specific problems involving QoS support in wireless networks, using cross-layer optimization.

Grading:

1. Paper presentations 40%
3. Midterm: 30%
4. Project: 30%

Paper presentations:

A list of relevant research papers will be provided. Each student will prepare a power point presentation for each assigned paper.

Project:

A project to illustrate cross-layer design concepts will be assigned. The students may use the Matlab demo provided to obtain experimental results for the project.