ELEN 619–600, Spring 2009: "Internet Protocols and Modeling"

Instructor: Prof. Xi Zhang, **Department:** Electrical & Computer Engineering,
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Class meeting time/room: Tue. & Thur.: 02:20PM-03:35PM ZACH 322

Prerequisite: This course is open to all engineering or other disciplinary graduate students who are interested in Internet protocols and modeling. Desirable prerequisites of the course are basic knowledge of Computer Networks and computer programming, or consent of the instructor.

Course Description: Today's Internet represents a new information technology revolution. This course aims at equipping graduate students with not only a wide spectrum of Internet protocols that make it work, but also the analytical capabilities to evaluate the performance of complex Internet protocols. It will focus on two important, and also closely related, aspects of the Internet protocols -- (1) principles, design, and implementations, and (2) performance modeling and analysis. Specifically, this course will cover the core components of Internet protocols, such as transport (TCP, UDP), network and routing (IP, RIP, OSPF, EGP, BGP-4, etc.). Advanced topics include QoS architectures for the Internet (Diff-Serv, RSVP, MPLS, RTP) and TCP-Friendly Rate-Based Flow Control for Continuous Media (CM); Queuing theory and delay and loss modeling; TCP over wireless networks and Mobile IP; Multicast Delivery: SRM, IGMP, PIM, MBONE; Flow/Error Control for Multimedia Streaming and Data Dissemination; Multicast Flow/Error-Control Signaling Retransmission-Scoping; Channel-coding (RS & LDPC codes) based multicast flow/error control over wireless networks. Complementing the descriptions of Internet protocols, this course will also introduce a number of emerging performance-modeling and analysis techniques to quantitatively characterize the Internet protocols, including the deterministic, stochastic, and optimization-based approaches. The emphasis is on how to draw the tractable mathematical models from the complex Internet protocols. While these analytical techniques are developed for Internet protocols, they are also applicable to evaluating other dynamic systems.

Course Contents Outline:

- Overviews of Internet and its fundamental architectures
- Internet protocol stack and UDP, IP, RIP, OSPF, EGP, BGP-4
- Principles of TCP/IP protocols including TCP-Vegas/Reno, etc
- Rate-based versus window-based flow control and AQM
- Coupled versus decoupled flow and error control
- Fluid analysis of rate-based flow control scheme
- Fluid analysis of error control scheme and modeling
- TCP-friendliness and compatibility, fairness, and modeling
- Queuing theory and network delay and loss modeling
- Wireless Internet over fading channel modeling
- Multimedia quality of service (QoS) provisions over wired/wireless networks
- Multiple Protocol Label Switching (MPLS) based QoS
- Channel-coding (RS & LDPC) based multicast flow/error control
- Multicast service over mobile wireless networks & Internet Mbone
- Optimization based flow control and modeling --- duality principles

Grading Policy:
Examinations: One Midterm Exam (20%);
One Final Exam (20%)
Other Assignments: Homework (20%),
Projects (40%)

Course Text books: I will use multiple books as references for this course. A partial list of references is listed below. Handouts and classical & recent journal/conferences papers will also be distributed to serve as course references.

1) "Data networks", by Dimitri Bertsekas & Robert Gallager, Prentice Hall Publishers, 2nd Edition
2) "Communication networks, fundamental concepts and key architectures", by Leon-Garcia & Widjaja, McGraw Hill Publishers, 2nd Edition

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Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit: www.tamu.edu/aggiehonor/

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"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."