

ELEN 689 Internet Protocols and Modeling

Instructor: Xi Zhang

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Description: As the early 50's were marked by the dawn of the information age, today the Internet era is *just* beginning! Cutting across all the barriers of space and time, the Internet enables rich forms of communications, a virtual marketplace, and integration of supply chains of manufacturers with front-end customer interfaces. Far beyond scientists' wildest dreams, today's Internet redefines the notions and ways that people live, work, and study — we are experiencing a new information technology revolution. This course aims at preparing you to participate actively in this revolution. It will equip you with a knowledge not only about a wide spectrum of Internet protocols that make it work, but will also help you develop the analytical capabilities to evaluate the performance of complex dynamics systems, like the Internet. It will provide you with the required research skills in exploring and advancing the state-of-the-art in computer networking. I will expect a student to be prepared for active research in the forefront of the internetworking area after taking this course.

This course will focus on two important, and also closely related, aspects of the Internet protocols — (1) principles, design, and implementation, 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 RAP Flow Control for Continuous Media (CM), TCP over wireless networks and Mobile IP, and Multicast Delivery: SRM, IGMP, PIM, MBONE, Flow/Error Control for Multimedia Streaming and Data Dissemination, and Multicast Flow/Error-Control Signaling/Retransmission-Scoping. 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 will be on how to draw the workable mathematical models from the complex Internet protocols. While these analytical techniques are developed in the context of Internet protocols, they are also applicable to evaluating other dynamic systems.

Prerequisite: A general “Computer Networks” course (e.g., ELEN 602) and a “Probability and Random Processes” course (e.g., ELEN 646), or any equivalents.

Course Outline:

Internetworking and Layered Protocols	1 week
Congestion Control and Traffic Engineering	1 week
UDP, TCP-Tahoe	1 week
TCP New-Reno, TCP-SACK	1 week
Rate-Based Transport Protocols — NETBLT, TCP-Friendly RAP, and Fluid-Based Analysis	1 week
TCP-Reno Stochastic Modeling and Self-Similar Traffic Model of Internet Traffic	1 week
TCP Vegas and Its Optimization-Based Modeling	1 week
IP and IP Unicast Routing (RIP, OSPF, EGP, BGP-4)	1 week
Internet Multicast Routing (IGMP, DVMRP, CBT, MOSPF, PIM) and MBONE	1 week
Protocols for Internet QoS Support and Multimedia Streaming	1 week
Internet Diff-Serv, RSVP, MPLS, and RTP	1 week
Active Queue Management (AQM), RED/REM	1 week
Duality-Based Internet Flow Control — REM and Optimization-Based Internet Modeling	1 week
TCP over Wireless Networks and Mobile IP	1 week
Optimization-Based Multicast Flow Control for Both Multimedia and Data Applications	1 week
Internet Multicast-Signaling/Retransmission-Scoping and Flow Control Stochastic Modeling	1 week
IP over Optical Networks	1 week

Class Time: TBA

Place: TBA.