EE-555 Broadband Networks Architecture
Fall 2003
Prof. Ahmed Helmy
website and webcast through den.usc.edu

Description

This course will cover architecture and principles of design and analysis of broadband computer networks capable of supporting multimedia telecommunication services over local and wide areas. A characterization and discussion of the evolution of the Internet and the new patterns of demands and traffic types will be presented, along with the impact of these demands on next generation network architecture and protocol design. Emphasis will be given on network components and design issues. Topics will include a review of the state-of-the-art in high speed networking, LANs (e.g. Ethernet, FDDI), WANs (e.g. IPng, ATM), optical networks (e.g. WDM), and wireless networks. In addition, performance analysis topics include multimedia traffic modeling, policing and congestion control, fast switching, IP multicast and multicast routing protocols and quality of service (QoS) support. In addition, topics relating to IP mobility support, including Mobile IP, and multicast-based mobility arhictecutres will be discussed.

Prerequisite

EE 450: Introduction to Computer Networks
EE 465: Probabilistic Methods in Computer Systems Modeling

Recommended

CS 455: Introduction to Programming (or equivalent)

Required Texts

1. High-Speed Networks: TCP/IP and ATM Design Principles, William Stallings, Prentice Hall, 1998.
or the second edition of this book
High-Speed Networks and Internets: Performance and Quality of Service, William Stallings, Prentice Hall, 2002.

Optional Texts

1. An Introduction to Broadband Networks: LANs, MANs, ATM, B-ISDN, and Optical Networks for Integrated Multimedia Telecommunications, Anthony Acampora, Plenum, 1994.
2. High-Performance Communication Networks, Jean Walrand and Pravin Varaiya, Morgan Kaufmann, 1996.
3. Wireless Communications: Principles & Practice, Theodore Rapparport, Prentice Hall, 1996.

Additional Selected Readings (will be assigned by the Professor as needed)

(1)Wide-Area Traffic: The Failure of Poisson Modeling, Vern Paxon and Sally Floyd, IEEE/ACM Transactions on Networking, Vol. 3 No. 3, pp. 226-244, June 1995. http://www.aciri.org/vern/papers.html
(2)Why We Don't Know How To Simulate the Internet, Vern Paxon and Sally Floyd, Proceedings of the 1997 Winter Simulation Conference, December 1997. http://www.aciri.org/vern/papers.html
(3)Self-Similarity and Heavy Tails: Structural Modeling of Network Traffic, Walter Willinger, Vern Paxon and Murad Taqqu. In A Practical Guide to Heavy Tails: Statistical Techniques and Applications, Adler, R., Feldman, R., and Taqqu, M.S., editors, Birkhauser, 1998. http://www.aciri.org/vern/papers.html
(4)Small Forwarding Tables for Fast Routing Lookups, Mikael Degermark et al., Proceedings of the ACM SIGCOMM'97 Conference. http://www.cdt.luth.se/~micke/publications.html
(5)All-Optical Networks, Samir Chatterjee and Suzanne Pawlowski, Communications of the ACM, June '99, Vol. 42, No. 6, pp. 75-83.
(6)A Comparison of Mechanisms for Improving TCP Performance over Wireless Links, Hari Balakrishnan, Venkat Padmanabhan, Srinivasan Seshan, Randy H. Katz, IEEE/ACM Transactions on Networking, December 1997. http://wind.lcs.mit.edu/~hari/papers.
(7)Improving Reliable Transport and Handoff Performance in in Cellular Wireless Networks, Hari

Balakrishnan, Srinivasan Seshan, Randy H. Katz, ACM Wireless Networks, 1(4), December 1995.
http://wind.lcs.mit.edu/~hari/papers

Administration

Classroom: OHE 100 Studio B
Hours: 2:00pm-4:50pm Friday
Instructor:

Ahmed Helmy
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Office Hours: Monday 9:30-10:30am, Friday 12:30-2:00pm (watch for announcements on change of office hours)
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Grading:

- **~6 Homework Assignments (20%)**
- **Extra credit homeworks to be arranged with the Prof.**
- **1 Midterm (35%) – Midterm will be around the 8th week of classes, covering topics 1 through 5 (more details to be announced later).**
- **1 Final (45%) – Final (as in schedule of classes: Dec 12th 11:00-1:00) concentrating on topics 6,7 and 8.**

Completed assignments should be submitted on time. *No late assignments will be accepted for credit.*

Internet access is required. Course material, homework, homework solutions and other information will be distributed from the class web site. Students are responsible to obtain up-to-date information from the web site through frequent access (e.g., once a week).

Strict adherence to the class Academic Integrity Policy is required. Any type of cheating (whether in homeworks or exams) will NOT be tolerated. Students may NOT use previous semesters' materials (this would be unfair to other students) and this will be considered 'cheating'. Cheating WILL lead to complete failure in the class in addition to other disciplinary actions.

- **Course Topics**

Topic	Description	Chapters*
1	Overview and Introduction	S1.1-3
	Administrative Details, Network history and Internet evolution	W1.1.1-3
2	Protocol Architecture and Design	S2

	Layering and protocol stacks, Multiplexing, Service Requirements	W2, W3.1, W4.2
3	High Speed LANs and WANS	**S5.1, S4**
	Introduction and Analysis of Ethernet, Fast and Gigabit Ethernet, Token Ring, FDDI, ATM	W3.2-4, W5, A5
4	Network Congestion and Traffic Management	**S9,10,11,12**
	Error and Flow Control, TCP, TCP over ATM, Admission Control and Traffic Policing	A6
5	Network and Traffic Modeling	S8.1-3
	Traffic modeling and simulation, self-similar and heavy-tailed models, Network of Queues	W7
6	Fast Switching Architectures and Analysis	W10, A3
	Buffering, Blocking, Fast Forwarding, IP Switching *IP multicast, multicast routing*	S15.3, S14
7	Optical Networks	A7
	Fiber Optics, Wave Division Multiplexing, All-Optical Networks	W9
8	Wireless Networking	R1,2,5
	Multiple Access, FDMA, TDMA, CDMA, GSM *Mobile IP, multicast-based mobility*	R8,9,10

- W - Walrand and Varaiya, S – Stallings (first edition), A - Acampora, R - Rappaport

Additional reading material and notes (on IP-multicast, micro-mobility and other topics) to be provided as needed by the Prof.