CS 290i – Networking for Multimedia Systems

Winter 1998

1 Course Information

- **Lecture Time/Place**: Tuesday/Thursday; 11:00am to 12:50pm (Phelps 1401)
- **Course WWW Page:** http://www.cs.ucsb.edu/~almeroth/classes/290i/
- **Course Material**
  - There is no required textbook. Papers on the reading list can either be found online or will be handed out in class.
  - Three very helpful books are:
    * Andrew S. Tannenbaum, Computer Networks, 3rd Edition.
    * Douglas E. Comer, Internetworking with TCP/IP, 3rd Edition.
    * W. Richard Stevens, UNIX Network Programming.
- **Required Prerequisites:** CS 176 – Introduction to Computer Communication Networks

2 Professor Information

Kevin Almeroth
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Phone: 893-2777
Office Hours: By appointment and/or just stop by.

3 Teaching Assistant Information

We have no official TA as of yet, though this may change. Stay tuned for more info.

4 Student Evaluation

Group Project – Group Part	50%
Group Project – Individual Part	20%
In-Class Presentation	20%
Class Participation	10%

Group Project. Since the group project totals 70% of your final grade, let me say something about how the 70% breaks down.

Pre-Proposal	5%
Project Technical Merit	25%
Project Intangibles	10%
Project Demonstration	10%
Written Summary	10%
Class Presentation	10%

Homework and Tests. There are none. Enough said.

5 Course Objectives

The goal for this class is to explore "applied research". This course is designed to give you hands on experience in building a significant piece of software while exploring the related research issues.

- The course is going to have two components: (1) software development project, and (2) related research issues.
- The project will be the single most significant thing we do and we will begin working on the project from day one.
  - Since there are no tests and only one other component to the course grade, almost all of the time for the course should be spent working on the project.
  - Evaluation of the project will roughly be based on the fact that I expect each student to spend an average of about 6-8 hours a week working on the project.
  - With teams of four students and a little less than 10 weeks we are talking about a team effort totaling around 300 hours of work. Expect to be graded accordingly.
  - One final note about the project. You will be responsible for finding a suitable group. This will be the major topic of the second lecture. Groups should be formed based on two things: (1) common interest for a project area, and (2) skill sets that are complementary.
- The other component of the class is the study of recent literature relating to issues in providing networking services for multimedia traffic.
  - This part of the course will be very similar to a seminar course.
  - I will present half the papers, and project groups will present the other half.
  - Papers that I present will be taken from the reading list and will be organized around a common theme.
  - Papers presented by the project groups will either be from the reading list provided or in a related area. I have prepared a theme for the class and my hope is that students will present papers in research areas that are related to this theme and that are related to specific research interests. The project group presentations will augment the class theme.

6 Reading List

6.1 MBone Tools and Operation

- S. Casner, *Frequently Asked Questions (FAQ) on the Multicast Backbone (MBone).* University of Southern California Information Sciences Institute (USC/ISI), December 1994.
  Available from ftp://ftp.isi.edu/mbone/faq.txt.

- V. Jacobson and S. McCanne, *VAT: Visual Audio Tool.* Lawrence Berkeley Laboratory (LBL), February 1992. Available from ftp://ee.lbl.gov/conferencing/vat/.

- S. McCanne and V. Jacobson, *VIC: Video Conference Tool.* Lawrence Berkeley National Laboratory (LBL), November 1994. Available from ftp://ee.lbl.gov/conferencing/vic/.

- V. Jacobson and S. McCanne, *WB: Whiteboard Tool.* Lawrence Berkeley Laboratory (LBL), July 1994. Available from ftp://ee.lbl.gov/conferencing/wb/.

- S. Floyd, V. Jacobson, S. McCanne, C.-G. Liu, and L. Zhang, "A reliable multicast framework for light-weight sessions and application level framing," in *ACM SIGCOMM 95*, (Cambridge, MA), September 1995.

6.2 Scalable Video-on-Demand

- T. Little and D. Venkatesh, "Prospects for interactive video-on-demand," *IEEE Multimedia*, pp. 14–23, Fall 1994.

- K. Almeroth and M. Ammar, "The use of multicast delivery to provide a scalable and interactive video-on-demand service," *IEEE Journal on Selected Areas in Communications*, vol. 14, pp. 1110–1122, August 1996.

- A. Dan, D. Sitaram, and P. Shahabuddin, "Scheduling policies for an on-demand video server with batching," in *ACM Multimedia '94*, (San Francisco, CA), October 1994.

- L. Golubchik, J. Lui, , and R. Muntz, "Reducing I/O demand in video-on-demand storage servers," in *ACM SIGCOMM 95*, (Boston, MA), August 1995.

- S. Cheung, M. Ammar, and L. Xue, "On the use of destination set grouping to improve fairness in multicast video distribution," in *Infocom '96*, (San Francisco, CA), March 1996.
  file://ftp.cc.gatech.edu/pub/coc/tech_reports/1995/GIT-CC-95-08.ps.

- S. McCanne, V. Jacobson, and M. Vetterli, "Receiver-driven layered multicast," in *ACM SIGCOMM 96*, (Stanford, CA), pp. 117–130, August 1996.

6.3 Multicast Communication/Protocols

- Y. Dalal and R. Metcalfe, "Reverse path forwarding of broadcast packets," *Communications of the ACM*, pp. 1040–1048, December 1978.

- S. Deering and D. Cheriton, "Multicast routing in datagram internetworks and extended LANs," *ACM Transactions on Computer Systems*, pp. 85–111, May 1990.

- L. Wei and D. Estrin, "The trade-offs of multicast trees and algorithms," Tech. Rep. 93-560, University of Southern California, 1993.
- K. Calvert, R. Madhavan, and E. Zegura, "A comparison of two practical multicast routing protocols," tech. rep., Georgia Tech College of Computing, February 1994. file://ftp.cc.gatech.edu/pub/coc/tech_reports/1994/GIT-CC-94-25.ps.

6.4 Internet Related Multicast Protocols

- G. Malkin, "The tao of the IETF," Tech. Rep. RFC 1718, Internet Engineering Task Force (IETF), November 1994. (see also http://www.ietf.org/tao.html).
- M. Handley and V. Jacobson, "SDP: Session description protocol," Tech. Rep. draft-ietf-mmusic–sdp-*.txt, Internet Engineering Task Force (IETF), November 1996.
- M. Handley, "SAP: Session announcement protocol," Tech. Rep. draft-ietf-mmusic–sap-*.txt, Internet Engineering Task Force (IETF), May 1996.
- M. Handley, H. Schulzrinne, and E. Schooler, "SIP: Session initiation protocol," Tech. Rep. draft-ietf-mmusic–sip-*.txt, Internet Engineering Task Force (IETF), December 1996.
- D. Waitzman, C. Partridge, and S. Deering, "Distance vector multicast routing protocol (dvmrp)," Tech. Rep. RFC 1075, Internet Engineering Task Force (IETF), November 1988.
- S. Deering, D. Estrin, D. Farinacci, V. Jacobson, G. Liu, and L. Wei, "PIM architecture for wide-area multicast routing," *IEEE/ACM Transactions on Networking*, pp. 153–162, Apr 1996.
- T. Ballardie, P. Francis, and J. Crowcroft, "Core based trees (CBT): An architecture for scalable multicast routing," in *ACM SIGCOMM 93*, (San Francisco, CA), pp. 85–95, September 1995.
- W. Fenner, "Internet group management protocol, version 2," Tech. Rep. draft-ietf-idmr-igmp-v2-*.txt, Internet Engineering Task Force (IETF), January 1997.

6.5 MBone Monitoring and Debugging

- K. Almeroth and M. Ammar, "Multicast group behavior in the Internet's multicast backbone (MBone)," *IEEE Communications*, June 1997.
- M. Handley, *An Examination of MBone Performance.* University of Southern California Information Sciences Institute (USC/ISI), January 1997. Not sure about availability yet.

6.6 Data and WWW Page Delivery via Multicast

- K. Almeroth and M. Ammar, *Scalable Delivery of Web Pages Using Cyclic Best-Effort (UDP) Multicast*, April 1998. (to appear).
- R. Clark and M. Ammar, "Providing scalable web service using multicast delivery," in *IEEE Workshop on Services in Distributed and Networked Environments*, (Whistler, Canada), June 1995. (to appear in *Computer Networks and ISDN Systems*).
- S. Acharya, M. Franklin, and S. Zdonik, "Dissemination-based data delivery using broadcast disks," *IEEE Personal Communications*, vol. 2, pp. 50–60, December 1995.

- G. Herman, G. Gopal, K. Lee, and A. Weinrib, "The datacycle architecture for very high throughput database systems," in *ACM SIGMOD*, 1987.
- P. Parnes, M. Mattsson, K. Synnes, and D. Schefstrom, "The mWeb presentation framework," in *Sixth International World Wide Web Conference*, (California, USA), April 1997.
- T. Liao, "WebCanal: a multicast web application," in *Sixth International World Wide Web Conference*, (California, USA), April 1997.
- R. Vetter and C. Jonalagada, "Multimedia system for asynchronous collaboration using the multicast backbone and the world wide web," in *Proceedings of the Annual Conference on Emerging Technologies and Applications in Communications*, (Portland, OR), pp. 60–63, May 1996.
- K. Lidl, "Drinking from the firehose: Multicast USENET news," in *USENIX Association Press*, pp. 33–45, January 1994.

6.7 Internet Audio/Video Servers

- K. Almeroth and M. Ammar, "The interactive multimedia jukebox (IMJ): A new paradigm for the demand-driven delivery of audio/video," tech. rep., Georgia Tech College of Computing, January 1997. (submitted).
- A. Klemets, *The Design and Implementation of a Media on Demand System for WWW.* Geneva, Switzerland, May 1994.
- P. Parnes, M. Mattsson, K. Synnes, and D. Schefstrom, *mMOD: the Multicast Media-on-Demand System.* Centre for Distance-spanning Technology, May 1997. (submitted).

6.8 Misc. Multimedia Papers

- W. Montgomery, "Techniques for packet voice synchronization," *IEEE Journal on Selected Areas in Communications*, pp. 1022–1027, December 1983.
- D. LeGall, "MPEG: A video compression standard for multimedia applications," *Communications of the ACM*, pp. 47–58, April 1991.

7 Project Information

The project is going to be very open-ended and can cover a range of topics. There are however a few requirements. These include:

- The project is to be done is groups of 4. Since the class size is right around 40 that should make about 10 groups. This is barely manageable but we'll have to try. Since I'm trying to maintain a reasonable number of groups, please don't have fewer than 4 people in a group.
- There will be a one page write up by the group due on Thursday, January 15. This is a very short deadline but the objective is to get everyone motivated to start on the project.
- There will be scheduled demo times at the end of the quarter for all projects. If we have time I'd like to have all the groups give a 10 minute presentation to the class.

- The final component of the project grade will be the project itself and the grade will be decided based on the demo and a written report. The report has two parts: (1) a user manual, and (2) a report of what was done, how, why, etc.

My original goal was to use the new Networking and Multimedia Systems Lab (NMSL) for all the projects, but this may prove difficult since there are so many groups and there are only 5 machines in the NMSL. However, the NMSL has equipment that cannot be found in other labs. We will have to decide if we can manage the lab so that everyone can use it.

And finally, let me say a word about what the projects should be about. Basically, I'm looking for a relatively polished prototype of a system that relies heavily on networking to provide some sort of multimedia-based service. This is very open-ended so you have lots of freedom. If I were to do this project, I would do something like a video server or an Internet telephone, or some Internet-based service. I would choose one of these only because this is were my expertise is. Projects in any research domain, as long as it is uses the network in some significant way, would be appropriate.