Electrical, Computer And Systems Engineering Department

ESCE-6961 Internet Protocols

Winter 1999 Syllabus

Course Description

The information technology revolution is *just* beginning ! The Internet cuts across the barriers of space and time enabling rich forms of communications, a virtual marketplace, integration of supply chains of manufacturers with front-end customer interfaces. It redefines the business model for virtually every business not to mention the incredible number of new businesses (startups) it has spawned. This course aims to prepare you to participate actively in this revolution. We will equip you with a knowledge not only about a broad range of Internet protocols that make it work, but also help you develop critical insight into their design, and a first hand feel for implementation through lab exercises.

Specifically, we will study internet protocols including transport (TCP, UDP), network (IP, IPng), routing (RIP, OSPF), network management (SNMP, SNMPv2, RMON), and other important protocols like ARP, ICMP, DNS, BOOTP, DHCP and HTTP. Advanced topics like Mobile IP, QoS architecture for the Internet (Int-serv, Diff-serv, RTP, RSVP), IP multicast (IGMP, MBONE, Multicast Routing) and Network security (IPSEC and firewalls) will also be covered.

I will expect a student to be prepared for active research in the internetworking area after this course, and lead in the IT revolution.

Prerequisite

Required: ESCE-467 Computer Communication Networks, C programming knowledge
Desirable: Knowledge of Operating Systems, Computer Architecture (35473 or equivalent)

Instructor

Prof. S. Kalyanaraman. (Call me "**Shiv**").
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Office Hours: **Tue, Thu 10-11:30 am or by appointment**

Teaching Assistant(s)

Amit Rao, amit@networks.ecse.rpi.edu
One more TA TBD.

Required Text

1. *TCP/IP Illustrated, Vol 1*; W.R. Stevens, Addison-Wesley professional computing series.

Recommended Resources:

Internetworking with TCP/IP, Vol 1, Third Edition; D. Comer, Prentice-Hall
Other supplementary texts/ papers/RFCs will be recommended for various parts of the course

Tentative Grading Percentages

Exams (Quizzes)	40% (best two out of three)
Homeworks	20%
Labs & Case Study	40%

Exam (Quiz) Schedule and Conflicts

Since the exams will be held during class hours, you should not have any conflicts. However, if you do have a scheduled conflict for the exam period with a lower-numbered course, see the instructor.

There will be **NO make-up exams.** There will be three exams and the ***best two out the three scores*** will be considered for grading purposes. If you miss one exam for whatever reason, you have two others which can be used for grading purposes. All exams will be ***open book/notes***. Exams will typically consist of quantitative problems, multiple choice (true-false) questions and possible short answer questions. Exams will be extremely time-limited and will cover both text and additional reading material.

Exam dates to be announced in first day of class.

Course Delivery Format:

This course will consist of lectures, in-class exercises, informal quizzes, problem sets, a case study and examinations (quizzes).

- **Lectures** will be consist of upto 75% of class time. I want to promote an **interactive learning experience**. We will try to pose problems TOGETHER and DISCOVER together how the solutions have evolved in the Internet. Class participation and interaction is a MUST.
- **Informal quizzes** will be held at the end of every chapter (approx once a week or two weeks). Informal quizzes will consist of true/false answers. There is no grading of informal quizzes.
- **Homeworks** will contain reading exercises (detailed RFCs, seminal papers, real code etc), short experiments (using the tcpdump tool), and design problems which might be open-ended – but test your ability to think, pose the right questions and find approaches to solutions.
- **Lab assignments** (one on IP and one on TCP)**.** Each lab assignment comes in the form of a package with files and handouts. Support is provided by a simulation and a graphical user interface which allows you to visualize/debug the protocol code you write. Your coded protocol should match the performance of a dem (which is provided in the package) and you need to produce a short report for each lab.

- **Exams** will contain true/false questions, design questions, short-answer or quantitative type questions. Exams will be open-book, but will be time-constrained. **Best two out of three exams** will be considered for final grading (see below). Material from both slides, text and reading/homeworks will be included in the scope of exams.
- **Case study** is intended to give you a first hand experience in unveiling the architectural and implementation issues of some advanced protocol(s) which we have not directly covered in class. A good place to look for such studies is to look at the IETF Active Working Groups and the IRTF's active Research Groups (links provided from class homepage). I will also accept case studies studying code of key protocols (provided the project is substantial enough) or looking into key product lines of large networking companies and an exposition of their technical details (eg: router implementation issues) and market strategy. In any case, I expect a through critique of research and engineering issues which should reflect your deep understanding and original thinking.
  - **Original implementation & demo** of such advanced protocols on a BSD or Linux environment (provided in our networks lab) will earn **upto 5% extra credit**.

The purpose of these different instruments is to have a positive learning experience, critical thinking about research issues, and sound grasp of Internet protocol fundamentals. **If you feel any of these instruments is not working for any reason, please send me an email and I will consider a change in the format of delivery.** You will also have an opportunity to express your opinion on course format and delivery in an **informal mid-semester feedback** sheet.

Important: Course materials will be put up on the **course homepage**. We will also set up a **mailing list** for administrative and discussion purposes. If you have questions which might be of interest to the entire group o students, please post to the mailing list and not send me the questions directly. Any one can reply to your questions, and you can reply to any one's questions. **PLEASE SEND AN EMAIL ASAP TO THE TA TO ALLOW US TO QUICKLY SETUP THE MAILING LIST.** We also need to set up accounts for you on our networks lab machines to allow you to do the experiments in homework assignments: for this **PLEASE SUGGEST A USER ID IF YOU PREFER SOMETHING OTHER THAN YOUR REGULAR USER ID.**

Tentative Schedule of topics:

Special emphasis will be placed on the topics marked in **boldface.**

Review of LAN & Datalink technologies
(**Ethernet, Fast Ethernet, PPP**)
Internetworking concept
IP concept & philosophy, other approaches
Internet Architecture, History and Roadmap
Internet Protocols
Addressing and Forwarding*:* **IP**
Address Resolution: **ARP**, RARP
Transport: **TCP**, **UDP**
Error control: ICMP (+ ping, traceroute etc)

Routing: **RIP**, **OSPF**, interdomain routing protocols (EGP, **BGP**, CIDR)
Name Resolution: **DNS**
Network Management: **SNMP**, SNMP v2, RMON
Booting, Configuration: BOOTP, **DHCP**
Multicast: IGMP, MBONE, Multicast Routing (intra & inter-domain)
Next generation IP: **IPv6**
Security: Encryption (**IPSEC**), firewalls
Middleware, Applications: **HTTP**, T/TCP, FTP, Telnet, SMTP, IMAP, MIME
Advanced topics:
Mobile IP
Beyond best-effort services: RTP, RSVP, Integrated & Differentiated Services model
Core IP networks: IP over ATM & SONET, Multi-protocol label switching (MPLS)

General Policies Regarding Graded Material:

1. The exams and problems sets are based upon lectures and required reading. So that you can plan your time well, a tentative schedule of topics and readings is included on the attached course calendar.

2. Homeworks (or problem sets) should be **handed in at the beginning of lecture on which it is due.** Any problem set submitted later than this will be marked as late. There won't be a penalty for one or two late submissions. However if you make a habit of late submissions, there will be a **penalty of 10% for lateness**. Any papers not handed in during the problem section (e.g. slipped under a door, placed in a mailbox) will be marked as late. No makeups for problem sets. Late submissions of labs/code reading reports will be assessed with a 10% penalty. Late submissions **will NOT BE accepted** after the day solutions are made available to the class.

3. If you feel that an error was made in grading, do not wait toward the end of the semester to tell us about it. . PLEASE DIRECT ALL GRADING RELATED REQUESTS TO THE TA. **You should submit a regrading request to the TA within a week of the date the graded material was returned to the class. Requests for regrading will not be accepted after that time.** Any graded material that is not picked up within two weeks will be discarded.

Use of Email and Web

This course relies on email and the web for administrative course communication. Please send a note to the TA so that we have your email address. The note should include the following:

- Full name (if you have a short/nickname you like to go by, include that too)
- Email address
- Section #
- If you have a phone number where you can be reached on campus for emergencies, please include also. Mention whether you are a campus student or an RSVP student.

The course homepage is not yet ready. It will soon be accessible through the instructor's website:
http://www.ecse.rpi.edu/Homepages/shivkuma/
All slides of lectures, and homeworks will be available there. The slides/homeworks of the previous offering of the course are also available through this site.

Academic Integrity

Student-teacher relationships are based on trust. Acts which violate this trust undermine the educational process. Violations of academic integrity will not be tolerated by your classmates, teaching assistants, nor instructors. Please refer to the *Rensselaer Handbook* for definitions of various forms of academic dishonesty and the applicable penalties. We take cheating very seriously;
you can expect to be punished for violations of academic integrity.