Course Information

• Instructor: Kevin Fall (kfall@cs)
• Office Hours: Thursdays 10-11am in 741 Soda Hall
• Home Page:
  - http://www-inst.eecs.berkeley.edu/~ee122
• Tas: Hoi-Sheung “Wilson” So, Lin Hei
• Final Exam: May 21, 12:30-3:30 [19]
TA Information

• Wilson So
  – Office Hours: Th 2.15-3.15, 179M Cory
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• Lin He
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Description

Design and implementation of computer networks and inter-networks

Fundamental design principles

Common underlying technologies

Implementation and programming
Grading

- Final Exam (35%), Mid-term (20%)
- Problem Sets (10%)
- Project (35%)
- TA input and class participation will be used to assess borderline cases
- (Details will appear on web page -- check frequently!)

Books

- Required Textbook:
  L. Peterson & B. Davie,
  *Computer Networks: A Systems Approach*

- Other Useful Networking Texts:
  - A. Tanenbaum, *Computer Networks*
  - R. Stevens, *TCP/IP Illustrated (vol 1)*
  - S. Keshav, *An Engineering Approach to Computer Networking*
Problem Set #1

• P & D, Chapter 1, Problems:
  – 6, 7, 8, 9, 12, 16

• Due Jan 28th end of class

Programming

• This course will involve programming. Projects may be implemented in either C or C++, on either Windows or UNIX

• Your work can be done on your “named” account. If you lack one, you may log in as “newacct” on one of the clients listed below:

  http://www-inst.eecs.berkeley.edu/clients
Books on Programming

- S. Maguire, Writing Solid Code
- S. Lippman, C++ Primer
- R. Stevens, UNIX Network Programming, Volume 1, 2nd ed

Course Themes

- Supporting reliability and applications
- From bits to unreliable global messages
- Distributed applications
- Security, mobility, QoS and pricing
Course Outline

- Introduction and Motivation [1]
- Architecture, naming, addressing [2]
- Bits, LANs, unreliable transport [3]
- Switching, routing, multicast [3]
- Reliable transport [3]
- Distributed applications [2]
- Special topics [1]

Introduction

- What’s a network?
- Principles of network design
- What happens when you click on a Web link?
What’s a network?

- **Link**: carry bits from one place to another (or maybe to many other places)
- **Switch/gateway/router**: move bits between links, forming internetwork
- **Host**: communication endpoint (workstation, PDA, cell phone, toaster, tank)

An example link (a LAN):

- **Ethernet** is a *broadcast-capable, multi-access* LAN
An Internetwork

- Provides message delivery between multiple networks:
  - Subnet 1
  - ISP 1
  - ISP 2
  - Subnet 2

The Internet

- A global network of networks all using a common protocol (IP, the Internet Protocol)
- Focus of this class
- A challenge to understand:
  - large scale (10’s of millions of users, 10’s of thousands of networks)
  - heterogeneity, irregular topology, decentralized management
Scale of the Internet

• Data from www.nw.com

Other Networks

• The Telephone Network
• Processor interconnect networks
• ATM Networks
• Cable-TV Networks
Resource Sharing

• Networks are shared resources
• Sharing via multiplexing
• Fundamental Question:
  how to achieve controlled sharing

Multiplexing

• Methods for sharing a communication channel
• Tradeoff between utilization and predictability
• Common Approaches:
  – TDM (time-division multiplexing)
  – Statistical Multiplexing
**Time Division Multiplexing**
(also called STDM -- Synchronous Time Division Multiplexing)

- **Multiplexer**
  - n links
  - k speed each
  - 1 link, nk speed

**Frame:**
- Time "slots" are reserved

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**Statistical Multiplexing**

- **Multiplexer**
  - n links
  - any speed
  - 1 link, any speed

**Trace Excerpt:**
- Variable-sized "packets" of data are interleaved based on the statistics of the senders
Analysis of STDM/FDM

- TDM, FDM (frequency division multiplexing), and WDM (wavelength) may under-utilize channel with idle senders
- applicable only to fixed numbers of flows
- requires precise timer (or oscillator and guard bands for FDM)
- resources are guaranteed

Analysis of Statistical Mux’ing

- traffic is sent on demand, so channel is fully utilized if there is traffic to send
- any number of flows
- need to control sharing:
  - packets are limited in size
  - prevents domination of single sender
- resources are not guaranteed
Protocols

- Agreement dictating the form and function of data exchanged between two (or more) parties to effect a communication

- Two parts: syntax and semantics
  - syntax: where bits go
  - semantics: what they mean and what to do with them

Protocol Example

- Internet Protocol (IP)
  - if you can generate and understand IP, you can be on the Internet
  - media, OS, data rate independent

- TCP and HTTP
  - if you can do these, you are on the web
Protocol Standards

• New functions require new protocols
• Thus there are many (e.g. IP, TCP, UDP, HTTP, RIP, OSPF, IS-IS, SMTP, SNMP, Telnet, FTP, DNS, NNTP, NTP, BGP, PIM, DVMRP, ARP, NFS, ICMP, IGMP)
• Specifications do not change frequently
• Organizations: IETF, IEEE, ITU

The IETF

• specifies Internet-related protocols
• produces “RFCs” (www.rfc-editor.org)
• Quotation from IETF T-shirt:

  We reject kings, presidents and voting.
  We believe in rough consensus and running code.

  --- David Clark