Lecture 1: Course Introduction

CSE 222A: Computer Communication Networks
Alex C. Snoeren

Thanks: Mike Freedman & Amin Vahdat
Logistics

- **Instructor:** Alex C. Snoeren
  - Office hours Tuesday 10:00-11:00am or by appointment
  - EBU3b 3114

- **TA:** Rajdeep Das
  - Office hours Monday 1:00-2:00pm or by appointment
  - Room CSE B240A

- **Course Web page**
  - http://www.cs.ucsd.edu/classes/wi19/cse222A-a/
  - Piazza is *only* for Q&A
CSE 222A Class Overview

- Course materials taught through class lecture, paper readings, and term project
  - Lectures are interactive—attendance is crucial to success

- Course grade based upon:
  - Pop quizzes based on readings
  - In-class quiz at end of term (based on lectures/readings)
  - Term project with paper and presentation

- Piazza discussion forums
  - The place to ask questions about lectures, readings, project
Term Project

- Group project; teams of 2—3 people
  - Your chance to explore what networking research is like
  - The very best projects can—and do—result in publication

- We will post a list of project ideas on Piazza
  - You can review old lists as well while you wait

- Several milestones to keep you on track
  - Topics of interest due Jan 24th
  - Teams formed January 29th
  - Project proposal due February 5th

- Final exam period will be a mini conference
  - Each group will prepare a report and a presentation
Background

- 1957: USSR launches Sputnik, first artificial earth satellite
  - U.S. responds by forming ARPA
- 1962: Licklider’s *Galactic Network*
- 1966: Roberts (MIT) *Towards a Cooperative Network of Time-Shared Computers*
- 1967: ACM SOSP *Multiple Computer Networks and Intercomputer Communication*
- 2008: Amazon EC2 (the “cloud”)
- 2009: Android phones hit the market at volume
Vannevar Bush established the U.S. military / university research partnership that later developed the ARPANET.

“Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

“It consists of a desk, and while it can presumably be operated from a distance, it is primarily the piece of furniture at which he works. On the top are slanting translucent screens, on which material can be projected for convenient reading. There is a keyboard, and sets of buttons and levers. Otherwise it looks like an ordinary desk.

Vannevar Bush, *As We May Think*; Atlantic Monthly, July 1945.

Source: Livinginternet.com
Joseph Carl Robnett "Lick" Licklider developed the idea of a universal network, spread his vision throughout the IPTO, and inspired his successors to realize his dream by creation of the ARPANET.

“It seems reasonable to envision, for a time 10 or 15 years hence, a 'thinking center' that will incorporate the functions of present-day libraries together with anticipated advances in information storage and retrieval.”

“The picture readily enlarges itself into a network of such centers, connected to one another by wide-band communication lines and to individual users by leased-wire services. In such a system, the speed of the computers would be balanced, and the cost of the gigantic memories and the sophisticated programs would be divided by the number of users.”

1969 Internet Map
This visualization represents a macroscopic snapshot of the Internet for two weeks in April 2002. The data comes from the skitter project, which monitors the Internet traffic at several points around the globe. The visualization shows the peering relationships between different Internet Service Providers (ISPs). The thickness of the lines represents the volume of traffic exchanged between these providers.

The skitter project is a collaborative effort between several universities and organizations, including UC Regents, 3DESIGN, and DARPA. The data is collected using specialized network measurement tools and then analyzed to produce visualizations like this.

For more information about the skitter project, visit www.caida.org.
Google’s Datacenters

Data center locations

We own and operate data centers around the world to keep our products running 24 hours a day, 7 days a week. Find out more about our data center locations, community involvement, and job opportunities in our locations around the world.

Americas
- Berkeley County, South Carolina
- Council Bluffs, Iowa
- Douglas County, Georgia
- Jackson County, Alabama
- Lenoir, North Carolina
- Mayes County, Oklahoma
- Montgomery County, Tennessee
- Quilicura, Chile
- The Dalles, Oregon

Asia
- Changhua County, Taiwan
- Singapore

Europe
- Dublin, Ireland
- Eemshaven, Netherlands
- Hamina, Finland
- St Ghislain, Belgium
Racks and racks and racks…
Internet Growth Trends

- 1977: 111 hosts on Internet
- 1981: 213 hosts
- 1983: 562 hosts
- 1984: 1,000 hosts
- 1987: 10,000 hosts
- 1989: 100,000 hosts
- 1992: 1,000,000 hosts (i.e., on the order of Google or FB)
- 2002: over 200 million hosts
- 2011: over 2 billion users
- 2014: mobile users surpasses desktop (~1.75B each)
- 2018: almost 4 billion users (earth population 7.6B)
Internet Timeline

- 1971: Tomlinson develops email program, big hit
- 1972: Telnet
- 1973: FTP
- 1974: TCP
- 1978: TCP split into TCP and IP
- 1979: USENET established
- 1984: DNS introduced
- 1988: Morris worm brings down 10% of Internet
- 1991: WAIS, Gopher, WWW released
Usage is changing!

Proportion of Total U.S. Internet Traffic

1995

2010

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Goal: effective multiplexed use of existing networks

- Minimal support from underlying networks
e.g., no support for multicast, real-time, fast failover, congestion control, etc.
- Packet switching (fine-grained resource sharing)
  AT&T said it could not be built
- Routers connecting networks

Recommended reading:
- “Where Wizards Stay Up Late” by Hafner & Lyon
Internet History: Other Goals

- Survive hardware failure
- Support multiple types of applications
- Run on wide variety of networks
- Distributed management of resources
- Cost-effective
- Low cost host attachment
- Accounting
Survivability

- Telephone approach
  - Ultra reliable switches
  - Make the network very smart

- Internet approach
  - Cheap, commodity components
  - Stateless routers + self-healing
  - Keep routing simple (non-adaptive)
  - End to end recovery
For Next Class...

- Browse the course Web site
  - http://www.cs.ucsd.edu/classes/wi19/cse222A-

- Read/review P&D Chapters 1 & 2

- Read Saltzer, Reed, and Clark ‘84

- Start thinking about term project ideas/groups
  - Suggestions will be available on the web soon