

Welcome to

CSE 620 **Advanced Networking Concepts**

Time: MWF 16:00-16:50

Place: PARK 250

Fall 2005

Today's Agenda

- Administrative aspects of this class
- A brief overview of the course
- A brief history of computer networking if time allows

Who Am I ?

Hung Q. Ngô

Assistant Professor

Computer Science & Engineering Department

SUNY at Buffalo

Office: 238 Bell Hall

Email: hungngo@cse.buffalo.edu

URL: <http://www.cse.buffalo.edu/~hungngo>

Phone: 645-3180 x 160

What is CSE 620 ?

A Computer Science graduate course on

- The present and future of computer networking
- Contemporary problems and research topics in computer networking
 - Lectured topics to be chosen at my discretion
 - I want to learn new things too!
- Highly research oriented

Who Should Take This Course ?

Anyone who

- Is a graduate student in CSE
- Is interested in computer networking and in doing networking research
- Love sleepless nights

Or

- Thinks this course is a good choice for M.S. project
- Think it might help land a good job
- Like taking my classes

The catch is

- Basic statistics, probability
- Basic knowledge of computer networking (CSE 589)
- Mathematical maturity
- Good critical thinking
- Hard-working

Who Should Teach This Course ?

ME

Course Objectives:

MTU P2P 10BaseT WAN IMAP TDMA IPsec PDU
ESP TCP TDM ACM PCM NIC ARP
DES QoS EIA FDDI DHCP
MTU RTP MAN EGP PDU
HTTP MANET RFC IP T3 WAP DCE
PIM ICMP HTTP RPF CGI
ABR ATM MAC OSPF MOSPF RSVP IGMP
SMTP UDP CDMA DSL IPv6 CIDR
IRSG PSTN LAN NAP VBR FDM CRC
IGMP PPP NAT BGP CSMA/CD XNS
MIB TLIS ISP NAT BGP CSMA/CD RIP COPS
CBT TLIS ISP NAT BGP CSMA/CD RIP COPS
AUI DDN SVC SNMP L2CAP SLIP OC12
RTSP BNC NIS DNS ARQ SONET 10Base3

Not that bad

Just memorize all the **TLA**, and that's about it.

What you'd achieve from this course

- Have fun!!
- Have a good overall picture of computer networking in general and the Internet in particular.
- Be able to identify research problems in networking, have a good idea of how to go about solving them.
- Improve research skills significantly, from critical thinking, problem solving, to writing and presentation.
- You are a graduate student. Grade should not be the main issue!

Our TA

- Dazhen Pan

dpan@cse.buffalo.edu

Office hours: ???

Phone:

Place:

When/Where to talk to me ?

Algorithm 1 (to be made distributive)

1: send questions to class news group

 sunyab.cse.620

2: else

 email me at hungngo@cse.buffalo.edu

3: else

 use office hours 10-12 Thursdays – 239 Bell

4: else

 sneak in whenever the door is opened

5: goto 1

Course Materials

- **Online Materials:** (including lecture notes)
 - www.cse.buffalo.edu/~hungngo/classes/2005/620
- Online lecture notes: hopefully 12 hours before class time

Work Load

- Heavy! So, start early!!
- Approx. 80 pages of assigned reading per week
- Summaries of papers (almost) every week
- Research proposal review
- Research project review
- Research project: implementations, reports and presentations.

Grading Policy

- Research project (50%)
- Paper summaries (20%)
- Research reviews (25%)
- Class participation (5%) - this includes participation in lectures and classmates' presentations
- Assignments due at the beginning of the due date
 - No late assignment will be accepted
- **No incompletes will be given**

Academic Honesty

- **No tolerance** on plagiarism:
 - 0 on the particular assignment for first attempt
 - Fail the course on the second
 - Consult the University Code of Conduct for details on consequences of academic misconduct
- Group study/discussion is encouraged, but the submission (of paper summaries) must be your own work
- If you take materials from somewhere, cite the source!
- **“Taking” intellectual property is stealing!**
- **I will take cheating VERY seriously.**

Grade Expectation

- Absolute grading scale
 - You are competing with my standard, not with classmates
- Just for reference:
 - **A**: 90%
 - **A-**: 80%-90%
 - **B+**, **B**, **B-**: 65%-80%
 - **C+**, **C**, **C-**: 50%-65%
 - **D and below**: you don't want to know
- I reserve the right to assign grades based on the overall performance.

Absolutely no lame excuses, please!!!

- I have to go home early, please allow me to do XYZ early
 - NO, NO, NO, NO, NO
- I had a fight with my girlfriend
 - ... you can get my deepest condolences,
just not the grade
- I've worked very hard, I understood the stuff very well, but I got a C, please consider giving an A-
 - ... you could easily win "Last Comic Standing"
- My partners suck, I'm good!
 - Then get the job done!
- *Make up another lame excuse here.*

About M.S. Projects

- Taking this course to fulfill M.S. project requirement is not the reason you'll get B or more
- This is the risk you chose to take

Make it more interesting

- Participate: discuss & answer and ask questions
("the only stupid question is the question you don't ask")
- Give suggestions: I'll take them seriously
- **Tips & Tricks** every week

- Do the assigned readings and occasionally surf the web to read related things
- **Start early!**

Brief history of the Internet

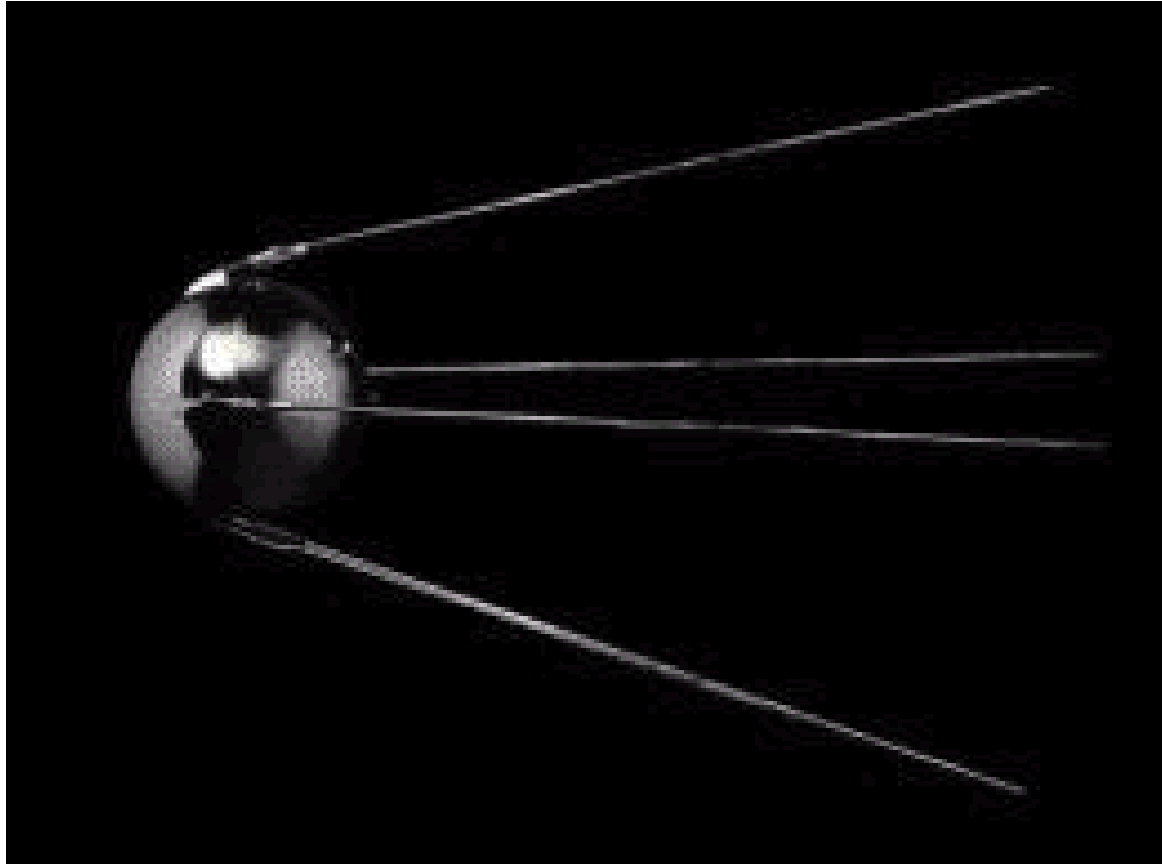
- 1947-1991: The cold-war, the space race
- 1961-1972: Formalization of Early Packet Switching Principles
- 1972-1980: Internetworking and Proprietary Networks
- 1980-1990: A Proliferation of Networks
- 1990-present: Commercialization and the Web
- The future: wireless + optical, nomadic/intelligent/pervasive, and ... ???

“Toy projects” from University played big role

Students played big roles, too

1947-1991: The cold war & the space race

- 1957: Sputnik 1 surprises the West



[picture taken from Wikipedia]

- 1958: Eisenhower formed ARPA and NASA in response

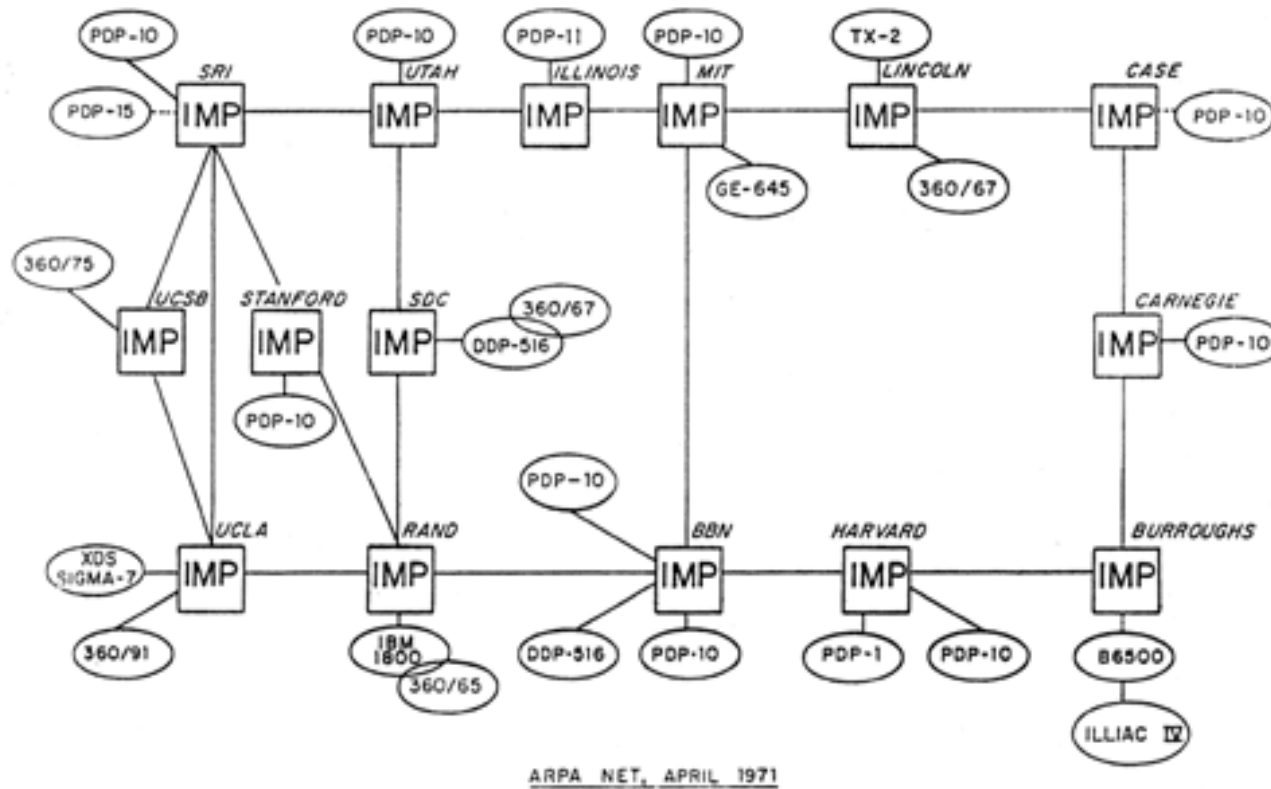
1961-1972: Early Packet Switching Principles (1)

- In the 60's:
 - telephone networks dominate – circuit switching
 - Computers are expensive – networking “makes sense”
 - Data traffic pattern is intrinsically different than telephone's
- Three independent efforts on packet switching:
 - MIT's Leonard Kleinrock – 1961, 1964 – queuing theory
 - RAND's Paul Baran – 1964 – packet switching for secured voice over military networks
 - National Physical Lab (England)'s D. Davies & R. Scantlebury – 1964

1961-1972: Early Packet Switching Principles (2)

- **J. Licklider & L. Roberts** lead CS program at **DARPA**
 - 1967: Roberts published a proposal for **ARPAnet**
- **BBN Corp.** contracted to build **IMPs** – early routers
- **By 1969**
 - First IMP at UCLA (Sep 2)
 - Node 2 at SRI, node 3 at UCSB, node 4 at U. Utah
 - First test from UCLA to SRI: **crash!!**
- **By 1972**, ARPAnet has 15 nodes
- First email program: **R. Tomlinson** at BBN (197[1,2])

ARPANet Map by 1971

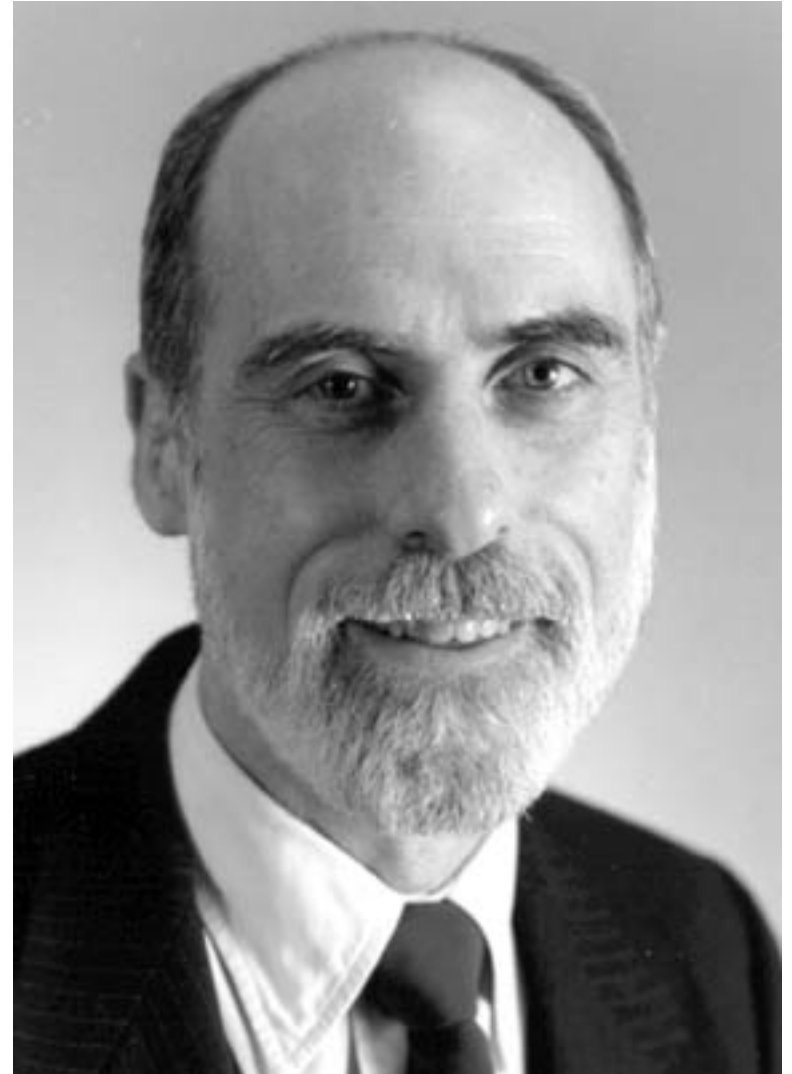


Courtesy of the Computer History Museum
<http://www.computerhistory.org/>

1972-1980: Internetworking and Proprietary Networks

- Other networks and network architectures were developed:
 - ALOHAnet (**Abramson**), DARPA's packet-satellite, packet-radio network
 - Telenet, Tymnet, Transpac, DECnet, Cyclades
 - Xerox's **XNS**, IBM's **SNA** (→ **ISO** protocol stack)
- Need internetworking: **Cerf & Kahn** (1974) proposed **Open Network Architecture** (**Turing Award!**)
- **Metcalfe & Boggs**: **Ethernet** (1975 – amazing!!) built upon on **ALOHA**
- TCP split into TCP & IP in 1978

Bob Kahn and Vint Cerf



Courtesy of the Computer History Museum
<http://www.computerhistory.org/>

Open Network Architecture

- **Minimalism, autonomy**: a network is on its own, no internal changes to interconnect
- **Best-effort service**: users responsible for losses → balance out the load, simplify **routers**, less costly for YOU
- **Stateless routers**: no per-flow maintenance
- **Decentralized control**: no single point of failure

Make sense ? The sense of Genius!!

These principles hold strong today! Or not.

1980-1990: A Proliferation of Networks

- End of 70s: 200 hosts on ARPAnet, end of 80's: 100,000
- How? More networks connected: MFENET, HEPNET (Dept. Energy), SPAN (NASA), BITnet, CSnet, NSFnet, ...
- TCP/IP standardized in 1980
- DNS by P. Mockapetris (USC)
- Berkeley incorporated TCP/IP into BSD Unix, key! Since incorporating networking modules into OSs is very important. They implemented it well, too!! Many networking applications were developed under BSD

1990-present: Commercialization and the Web

- 1990: ARPAnet decommissioned
- 1991: NSFnet privatized
- 1991: the WWW invented (Tim Berners-Lee at CERN), he and friends developed HTML, HTTP, web server, simple (text) web browser
 - Has anyone used Gophers (1991) before?
- M. Andreessen (UIUC) released Mosaic in 1993, formed Mosaic Communications in 1994, later Netscape Communications, later killed by IE
- Yahoo, Amazon, Google, E-commerce

Tim Berners-Lee



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The Future: Speculate for Yourself

- Proliferation and maturity of wireless, sensor, optical networks
- Nomadic computing, Pervasive computing
- ...

Last Words for Today

- You will learn as much from me as I will learn from you
- Welcome, again!!