

Welcome to

CSE 489/589

Modern Networking Concepts

Time: *Mon-Wed-Fri 12:00–12:50*

Place: *NSC 220*

Fall 2010

Today's Agenda

- Administrative aspects
- A brief overview of the course

- Know how to design the Internet in 10 minutes

What is the course about?

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

Not that bad

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

What you'd achieve from this course

- Have fun!!
- Learn the **fundamentals** of computer networking
 - Some technologies that make networking possible
 - Software architectures integrating the technologies to build a computer network, the Internet in particular
 - Network programming
 - Shortcomings and challenges of current Internet architecture (technologically, politically)
- Coverage broad on most topics, deep on a few

What you will **not** learn from this course

- A lot

- Why?
 - There are *lots* of things I don't know
 - The field is *enormous*
 - There are numerous inessential details
 - Technologies evolve super-rapidly
 - Fundamental design ideas are here to stay

Prerequisites

- Elementary calculus and probability
- Elementary computer architecture, data structures and algorithms
- C system programming in Unix/Linux
 - No other language allowed
 - Except for C++ if you have to (not recommended though)
 - No other operating system allowed (we will grade your programming assignments on Solaris and Linux)

Our TAs

- Mr. **Anand N. Sathyaraja**
 - ans25 @ buffalo
 - Office hours: Thursdays 2-4pm
- Mr. **Aditya S. Wagh**
 - aswagh @ buffalo
 - Office hours: Tuesdays 2-4pm
- Bell 232

Very Important URLs

Website

(assignments, notes, syllabus, readings)

<http://www.cse.buffalo.edu/~hungngo/classes/2010/589/>

Blog

(announcements, lecture clarification, discussions)

<http://ubmnc.wordpress.com/>

When/where/how to talk to me ?

Algorithm 1 (to be made distributive)

1: course blog

2: else

 email me at hungngo@buffalo.edu

3: else

 use office hours 09:30-10:30am
 Mon & Wed, 238 Bell

4: else

 sneak in whenever the door is opened

5: goto 1

Course Materials

- **Textbook:**
 - [James F. F. Kurose](#) and [Keith W. Ross](#), "*Computer Networking: A Top-Down Approach Featuring the Internet*", 5th edition.
- **Online Materials:** (including lecture notes)
 - <http://www.cse.buffalo.edu/~hungngo/classes/2010/589>
- **Highly Recommended Reference:**
 - W. Richard Stevens, "*UNIX Network Programming : Networking APIs : Sockets and XTI : Volume 1, Second Edition*", Prentice Hall.
- Other reference books & materials: see website

Work Load

- **Heavy! Start early!!**
- Approx. 80 pages of (light) reading per week
- 4 written homework assignments (individuals)
- 2 programming assignments
to be done in groups of size \leq **2**
- Find a partner **now**
- 1 midterm exam
- 1 final exam

Grading Policy

- 4 written assignments: 4% each
- First project: 10%
- Second project: 24%
- Midterm: 20%
- Final: 30%
- Assignments due at the end of the lecture date
 - 1 day late: 20% reduction
 - Each extra day late: 40% reduction
- Incomplete/make-up exams: not given, except in **provably extraordinary** cases

Academic Honesty

- **No tolerance** on plagiarism:
 - 0 on the particular assignment/exam for first attempt, report to the department
 - 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 **must be your own work**
- On the Programming Assignments: discussions of ideas are welcomed, but **NO** exchanges of source codes, please! If you take some pieces of codes from the Internet, **say so!**
- **I will take cheating VERY seriously.**

Grade Expectation

- On the curve
- Just for reference:
 - **A:** top 15-20%
 - **A-:** next 10-15%
 - **B+, B, B-:** next 25-40%
 - **C+,C,C-:** next 10-20%
 - **D and below:** you don't want to know
- I reserve the right to assign grades based on the overall performance.

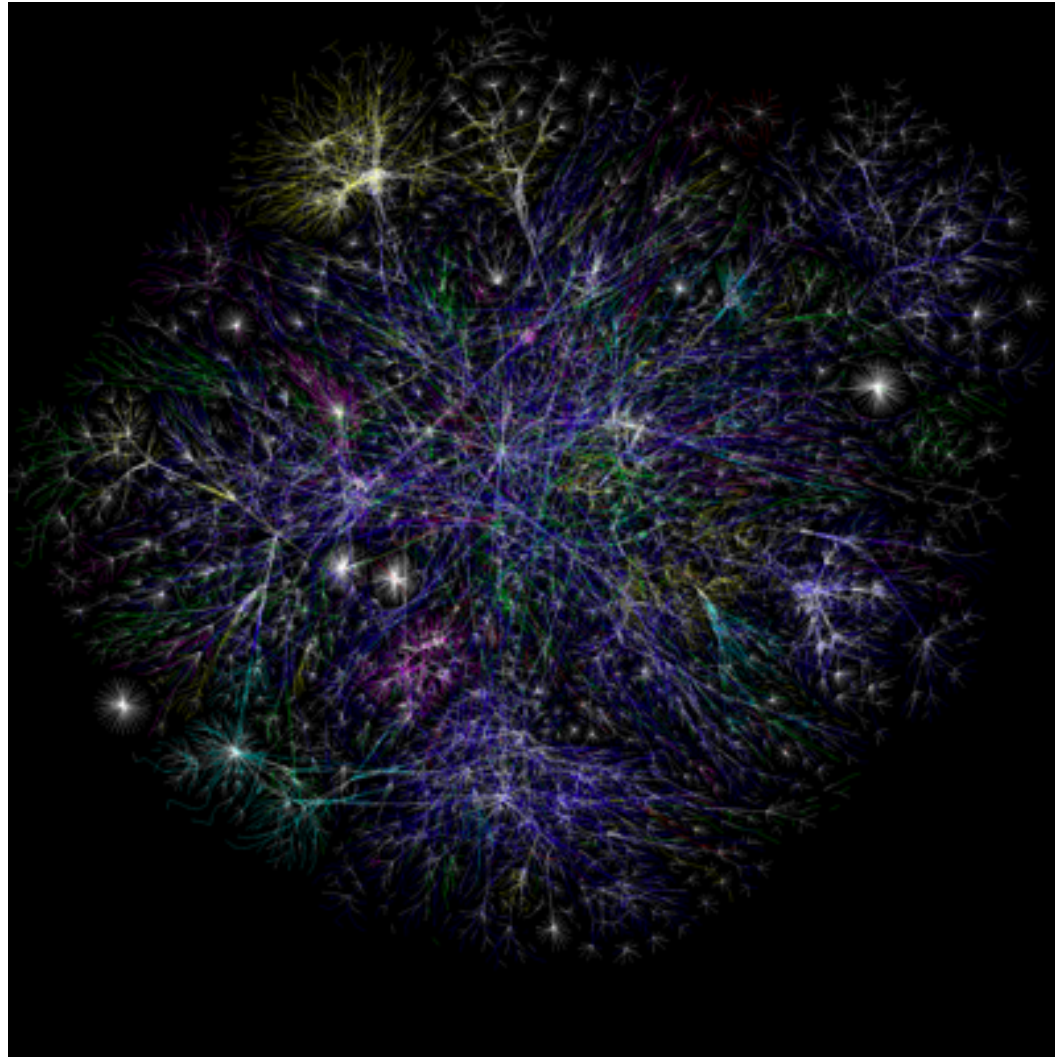
No lame excuses, please!!!

- I want to go home early, please allow me to take the final exam on April 1st
- I had a fight with my girlfriend
 - ... *you can have my deepest condolences*
- I've studied 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”*
- I will graduate this semester and won't be able to graduate unless I get at least a B+, blah blah blah

How to Make It Interesting? How to Do Well?

- 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 surf the web to read related things
- **Start early** on homework assignments and projects
- Make use of the TAs (and occasionally me too)

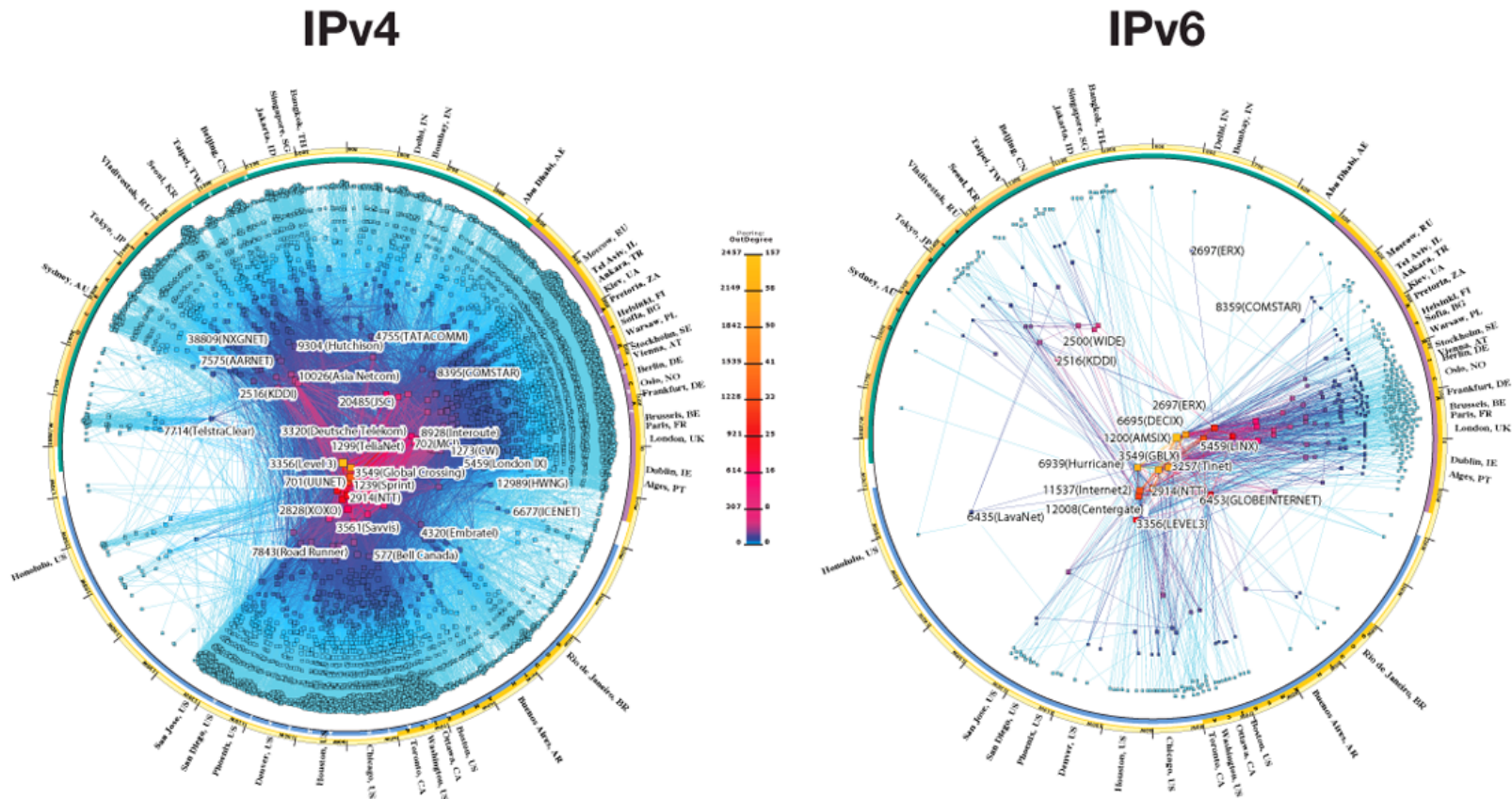
A (Dramatized) Visualization of the Internet



From the Opte Project (<http://www.opte.org/>)

IPv4 & IPv6 INTERNET TOPOLOGY MAP JANUARY 2009

AS-level INTERNET GRAPH



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The Rest of This Lecture

1. What is a computer network, what is the Internet?
2. What are the features we want the Internet to possess? (Assuming we're free to design a new Internet.)
 - Socially
 - Economically
 - Politically
 - Technically (influenced by the first 3)

Inter-related
3. What are some of the challenges involved in designing a (new) Internet?
4. How do we design the Internet satisfying (2) subject to (3)?

1. Computer Network and Internet

- *Computer network*: collection of *nodes* and *links* allowing data communications between nodes
 - **Nodes**: computing devices (computers, PDA, cellular phones, sensors, etc.)
 - **Links**: media which can carry electromagnetic waves (TV cables, phone cables, fiber optics, the air, “a dog carrying a diskette”, etc.)

- *The Internet*: a global computer network
 - For technical convenience, we often think of the Internet as a network of computer networks

2. Desired Internet's Features -- Socially

- Allow for freedom of expression
- Be easy to use
- Be fair
- Be accessible for billions of people
- Serve as a great educational tool
- Ensure security, privacy for individuals
- Block malicious forces from abusing the system (spams, botnets, worms, viruses, distortions, slanders, etc.)

2. Desired Internet's Features -- Economically

- Be a really cheap commodity
- Be a platform for innovations from both an entrepreneurship standpoint and a pure technical standpoint
- Be highly scalable, allowing for innovations on new communication technologies (new “links”) and devices that can connect (new “nodes”)

2. Desired Internet's Features -- Politically

- Allow for freedom of expression
- Prevent higher authorities or the mob from oppressing dissenting or minority political voices
- Prevent a particular person/organization/country from absolutely controlling a particular aspect of the Internet (standards, protocols, etc.)
 - Dave Clark: “*we reject kings, presidents, and voting. We believe in rough consensus and running codes.*”
- Be neutral (this is a highly complex issue)
 - See *network neutrality* links on course website

2. Desired Internet's Features -- Technically

- Robust
- Scalable, evolvable
- Efficient (performance *and* resource)
- Manageable
- Easy to use, to develop various applications on
- Accessible from everywhere
- Secure, allow for forensics

3. Challenges -- Socially

- Social norms resist radical changes and freedom of expression
 - Religion
 - Tradition
 - Culture
 - ...
- Learning curve necessarily steep

3. Challenges-- Economically

- Hard to boost Internet market in 3rd world countries
- Entry cost for new businesses getting higher and higher as old technologies mature
 - E.g., very hard to become a new ISP
 - The market isn't very efficient

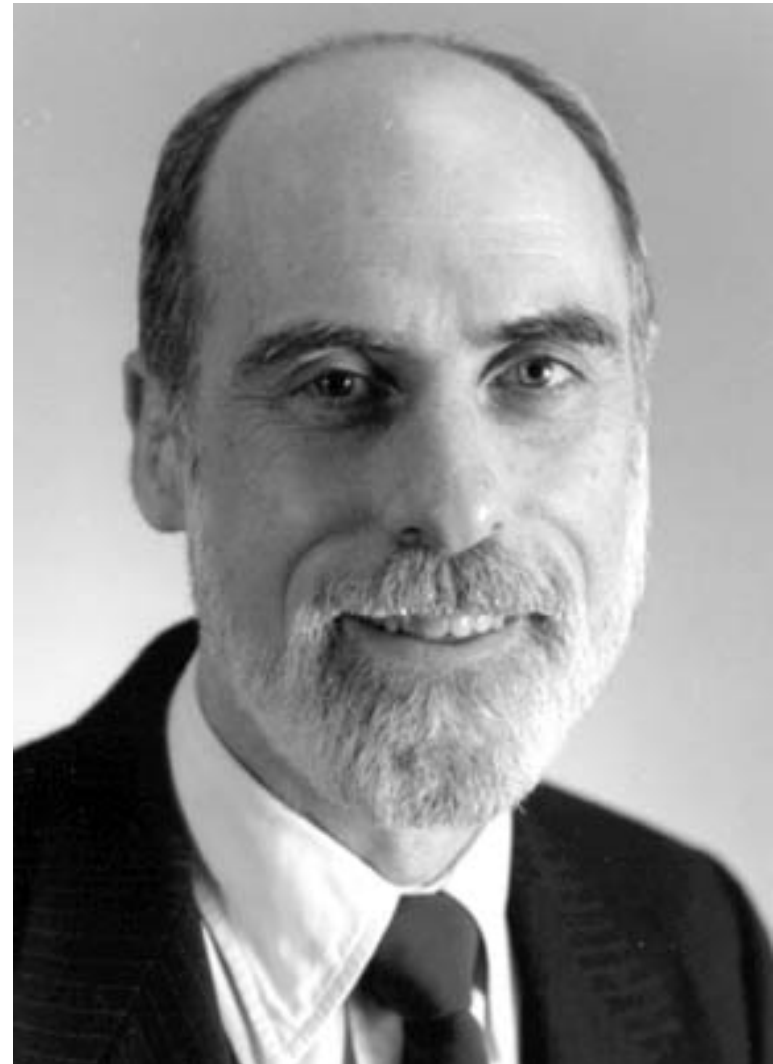
3. Design Challenges -- Politically

- Governments always want to suppress dissents
- Big corporations want control of various things (standards, protocols, implementations, etc.)
 - Google (“*Do no evil unless it’s profitable*”) & Verizon were under loss of heat last month
 - Court in DC in April ruled that FCC cannot control how ISPs treat their traffic
- Standard bodies dominated by a few big players
- No one really “controls” the entire Internet
 - Desirable!
 - Yet, changes are difficult to realize

3. Design Challenges -- Technically

- Internet is humongous in scope and scale
- *“Hard to predict, especially about the future”*
- Design objectives contradictory
- Extremely hard to experiment with new ideas
- Applications are so diverse in requirements (email vs. realtime streaming)
- Networks are diverse in requirements (corporate vs. home)

Quite amazing that current Internet works!



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

4. So, how do we design a (new) Internet?

Two principles that have worked so far

- Modularization (i.e. *layering*)

- *End-to-end Principle*

Last Words

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