CSE 461:
Computer Networks

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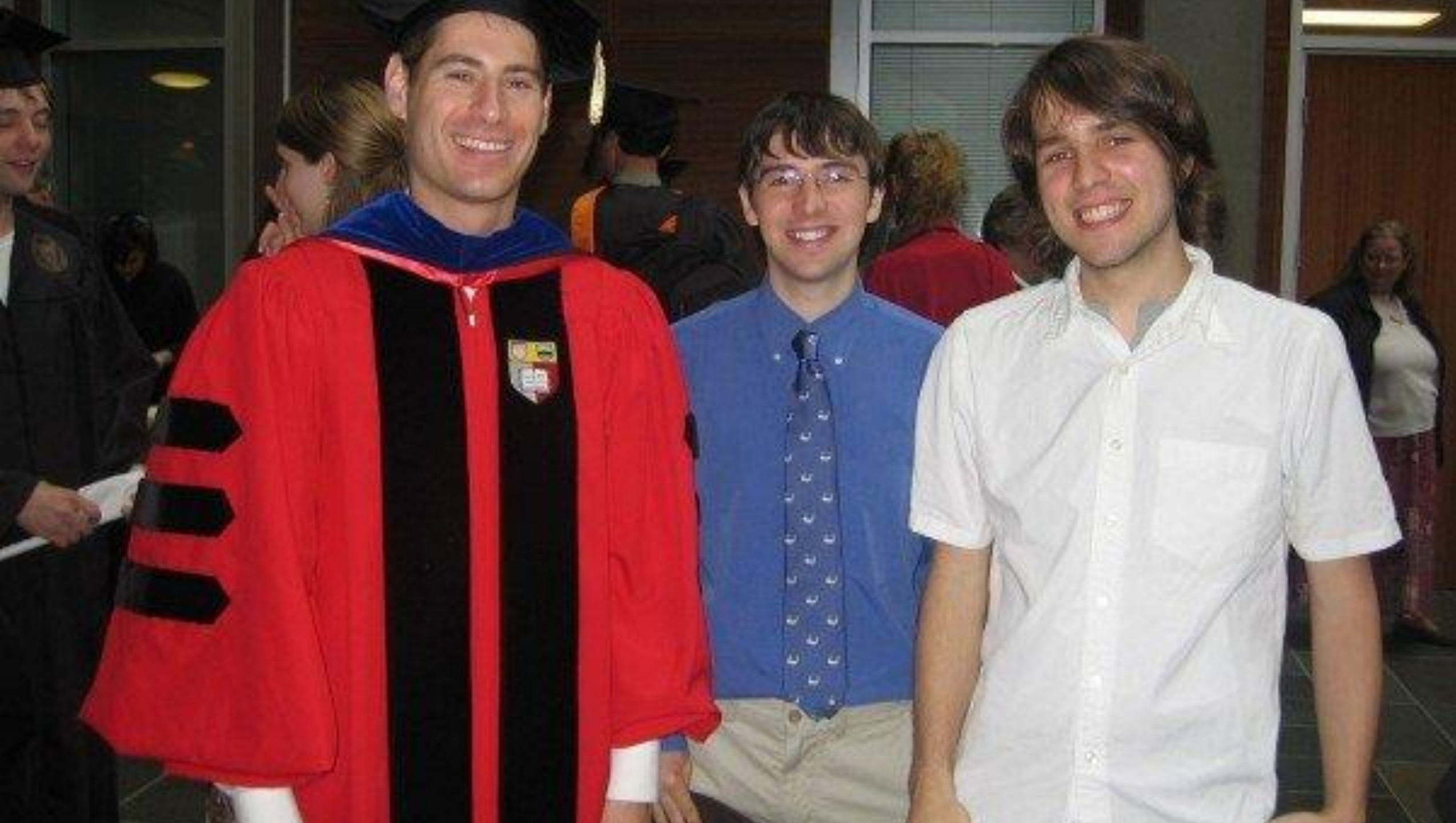
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Who we are

ICTD

- Information and Communication Technology for Development
  - Development -> Poverty Alleviation (not software development)
  - Broad field covering health, justice, and **access**
- Why?
  - Lots of natural intuition from Alaska, I know rural.
  - Able to use networking skill -> Many opportunities (NSRC)
- My subfield: Cellular access
- My Answer: Community Cellular

BE THE PHONE COMPANY.

No more waiting for coverage: now you can build cellular networks yourself.

Learn More

TAs Now!

- Sixto (Joshua) Rios
- Zhitao (Reid) Zhang
- Peter McEldowney

Class Structure

Grading

- **Assignments: 10%**
  - Reading and homework from the book

Grading

- Assignments: 10%
- **Surprise Quizzes: 10%**
  - Short unannounced quizzes during the quarter
  - 1 Make-up if you miss it (email me)

Grading

- Assignments: 10%
- Surprise Quizzes: 10%
- **3 Projects: (7 + 8 + 25)%**
  - 2 traditional coding exercises
  - 1 larger freeform group (3-4 people) project

Grading

- Assignments: 10%
- Surprise Quizzes: 10%
- 3 Projects: (7 + 8 + 25)%
- **Midterm: 20%**
- **Final: 20%**

Reading Material:

Q: Who here has bought a book already?

Administrivia

- Office hours
  - Opportunity to have more persona interactions with both me and the TAs.
- Tools
  - Mailing list: primary class communications
  - Dropbox: Homework
  - GoPost Forum: Back and forth discussions on class content
  - Gradebook: Grades will be posted here
- Slides
  - Adapted from David Wetherall, his talks are online
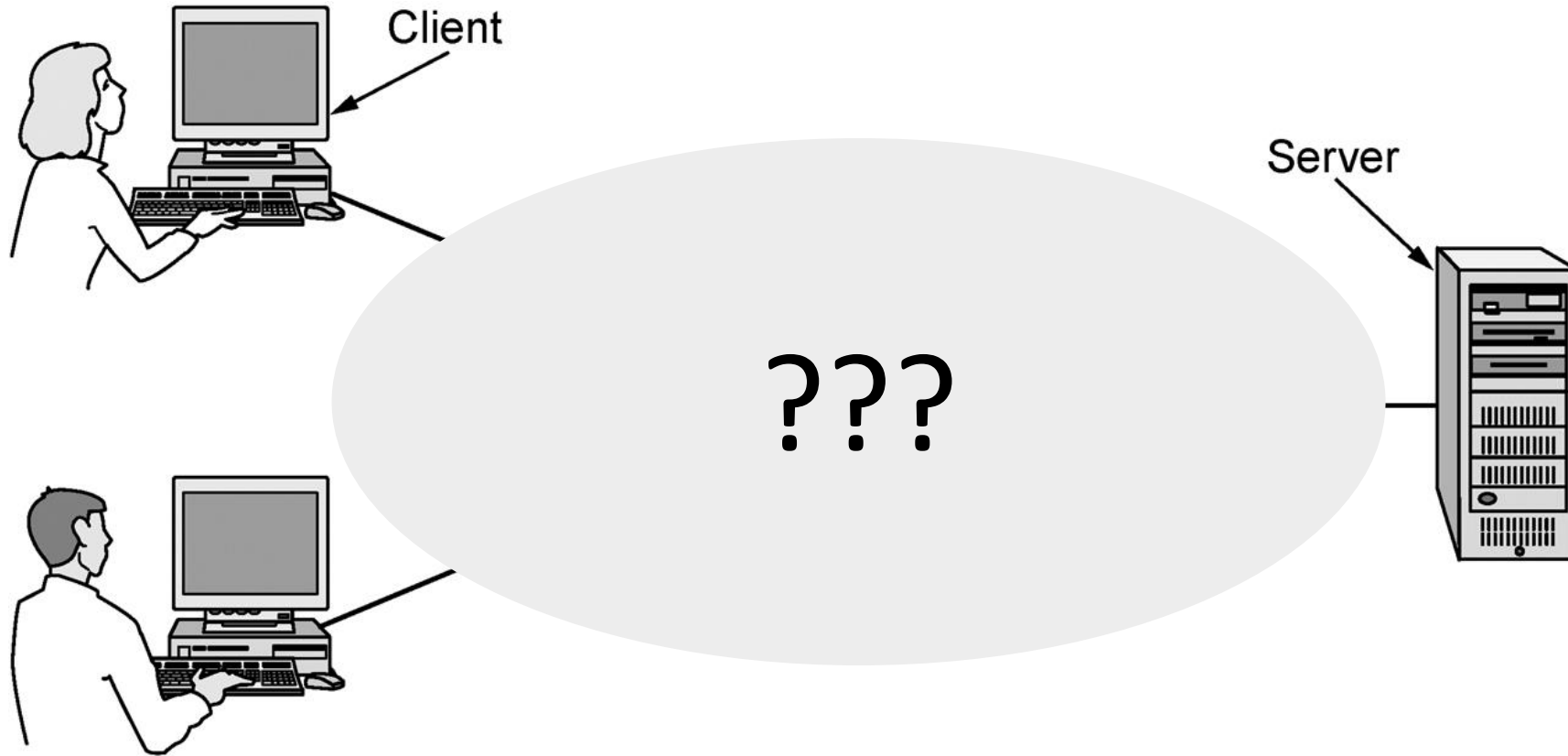 - I will be posting my own slides right before lecture as well

Laptop Policy

- Laptops are fine
  - If you are going to be on Facebook do it in the back of class
    - This is distracting to other students
  - TAs will be enforcing this policy

Questions?

CSE 461: Computer Networks

Focus of the course

Client

Server

???

Focus of the course (2)

- Three "networking" topics:

Distributed systems
Networking
Communications

- We're in the middle

The Main Point

1. **To learn the fundamentals of computer networks**
2. Learn how the Internet works
   - What really happens when you "browse the web"?
   - TCP/IP, DNS, HTTP, NAT, VPNs, 802.11 etc.
3. To learn how to build cool things
   - Tools of the trade: SDN, Load Balancers, Architectures

Why learn the Fundamentals?

1. Apply to all computer networks

2. Intellectual interest

3. Change / reinvention

Fundamentals – Intellectual Interest

- Example key problem: Reliability!
  - Any part of the Internet might fail
  - Messages might be corrupted
  - So how do we provide reliability?

- Reliability solutions
  - Codes to detect/correct errors
  - Routing around failures …

Fundamentals – Intellectual Interest (2)

Key problem	Example solutions
Reliability despite failures	Codes for error detection/correction (§3.2, 3.3) Routing around failures (§5.2)
Network growth and evolution	Addressing (§5.6) and naming (§7.1) Protocol layering (§1.3)
Allocation of resources like bandwidth	Multiple access (§4.2) Congestion control (§5.3, 6.3)
Security against various threats	Confidentiality of messages (§8.2, 8.6) Authentication of communicating parties (§8.7)

Fundamentals – Reinvention

- The Internet is constantly being re-invented!
  - Growth over time and technology trends drive upheavals in Internet design and usage
- Today's Internet is different from yesterday's
  - And tomorrow's will be different again
  - But the fundamentals remain the same

Fundamentals – Reinvention (2)

- Many billions of Internet hosts and growing …
  - 5B+ on Cell Networks
  - 3B+ on Internet

Internet Domain Survey Host Count

Source: Internet Systems Consortium (www.isc.org)
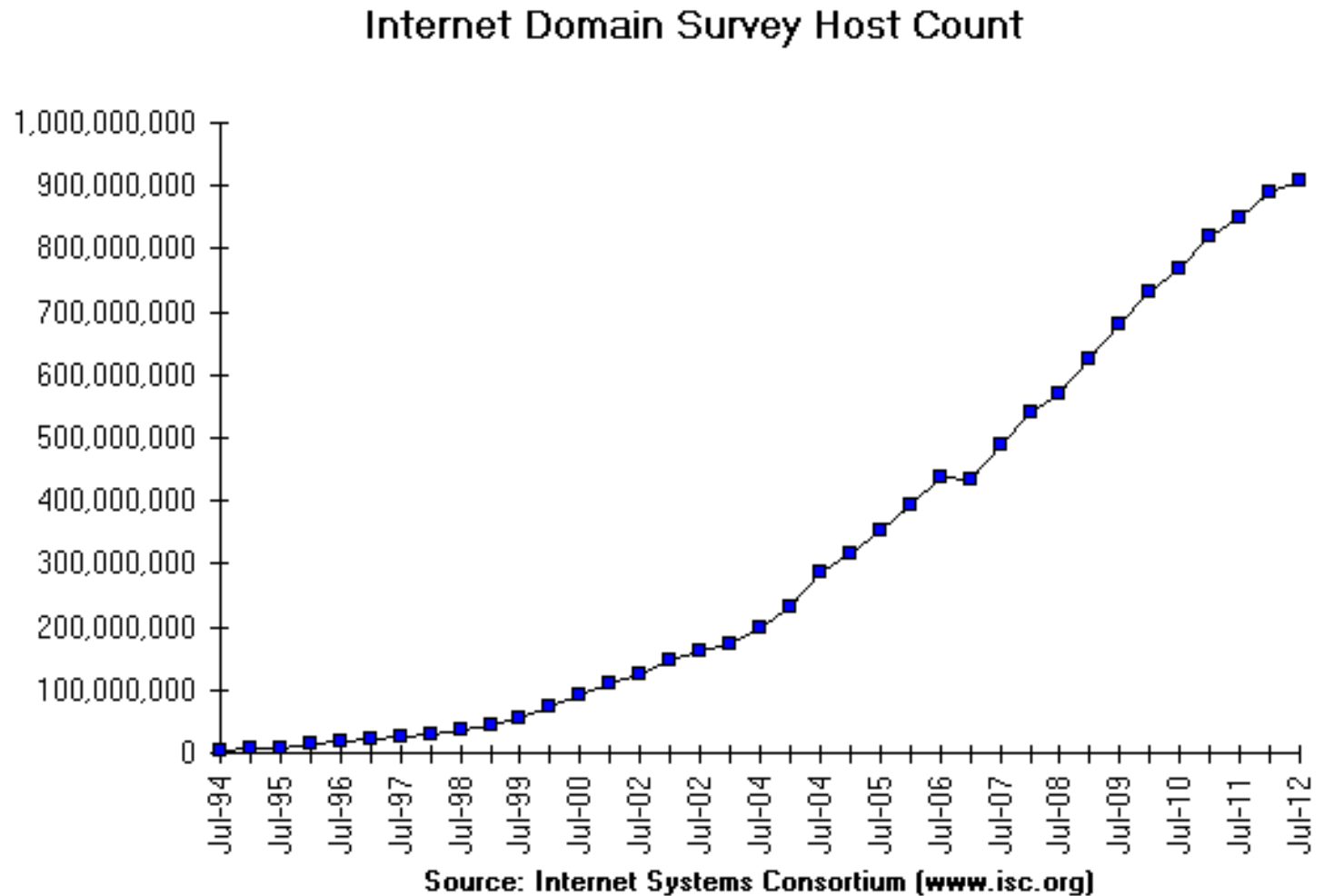
Fundamentals – Reinvention (3)

- Examples of upheavals in the past 1-2 decades

Growth / Tech Driver	Technology
Emergence of the web	Content Distribution Networks
Digital songs/videos	Peer-to-peer file sharing
Falling cost/bit	Voice-over-IP calling
Many Internet hosts	IPv6
Ubiquitous Computing	Mobile devices

Fundamentals – Reinvention (4)

- Upcoming upheavals?

| Growth / Tech Driver	Technology
Fake News?	Social Media
No-power devices?	Backscatter
Generic Networks?	SDN
Ubiquitous Networks?	Satellite/Long-Distance Networks
Videos as Comms	High-Bandwidth Mobile (4G/5G)

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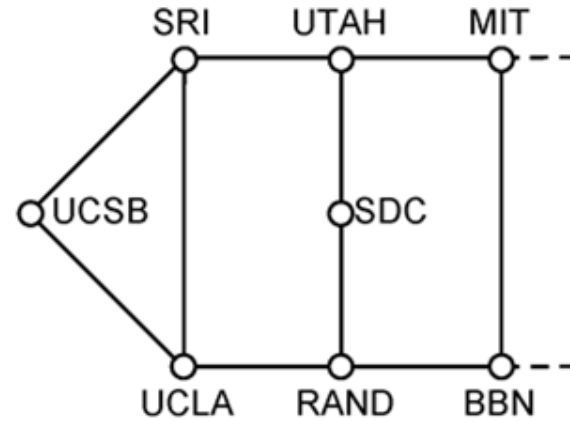
Who cares about the internet?

1. Curiosity

2. Impact on our world

3. Job prospects!
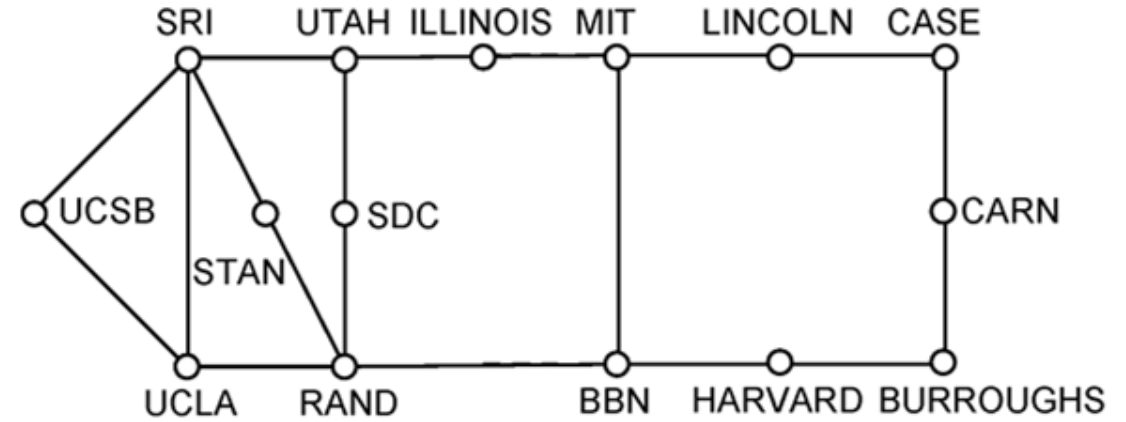
From this experimental network …

ARPANET ~1970
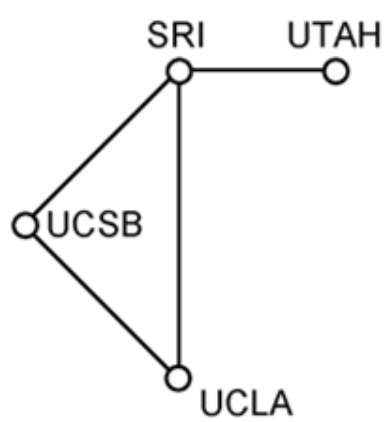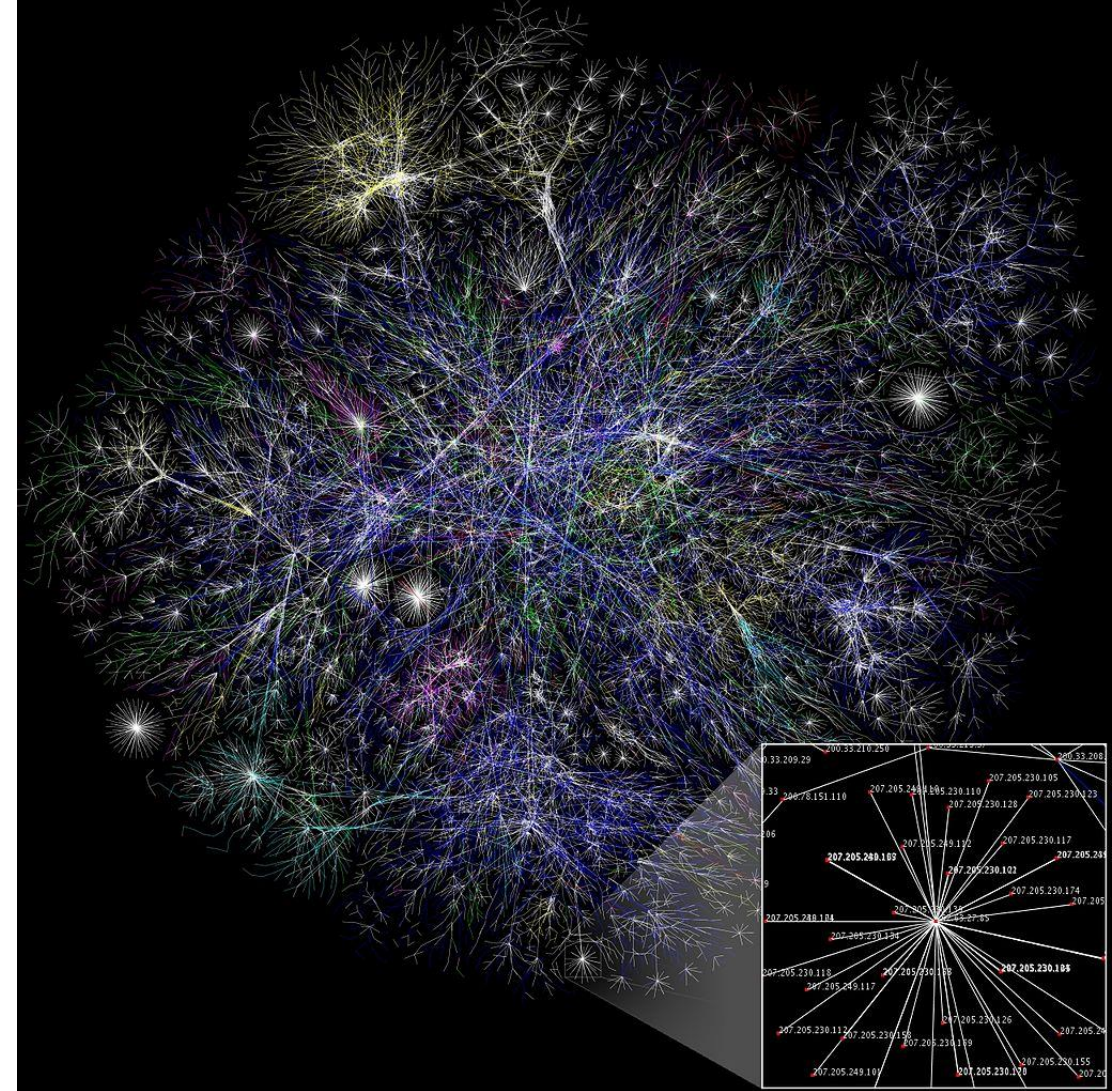

(a) Dec. 1969.   (b) July 1970.   (c) March 1971.

To this!

Internet ~2005

- An everyday institution used at work, home, and on-the-go

- Visualization contains millions of links

- Network now contains literally 3 billion **people**!

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Internet – Societal Impact

- An enabler of societal change
  - Easy access to knowledge
  - Electronic commerce
  - Personal relationships
  - Private communications

Internet – Economic impact

- An engine of economic growth
    - Information sources
        - And lots of ethical questions!
    - Online marketplaces
    - Social media/Crowdsourcing

The Main Point

1. To learn the fundamentals of computer networks
2. Learn how the Internet works
   - What really happens when you "browse the web"?
   - TCP/IP, DNS, HTTP, NAT, VPNs, 802.11 etc.
3. Understand why the internet is designed how it is designed
   - SDN, Load Balancers, Architectures

Architectures

- Lots of ways to build networks with different **tradeoffs**
- Goals:
  - Open Access (Internet)
    - Safety--, Security--, Flexibility++, Privacy++,
  - Identity First (Cellular)
    - Privacy --, Flexibility--, Safety++, Security++
  - Centralized (Comcast)
    - Complexity--, Freedom++
  - Decentralized (Mesh)
    - Complexity--, Freedom++

Why things are how they are

- A bit of a reach – might not make it here

- Modern networking
  - Software defined networks (SDN)
  - Content Delivery Networks (CDN)
  - Cellular Networks
  - Domain Name Service (DNS)
  - Debugging tools: Dig/traceroute/whois

Not a Course Goal

To learn IT job skills

- How to configure specific equipment or technologies
  - e.g., Cisco certifications,
  - Technical whack-a-mole
- But course material is relevant, and we use hands-on tools
  - Hopefully you'll be able to use these tools to build stuff at the end of class