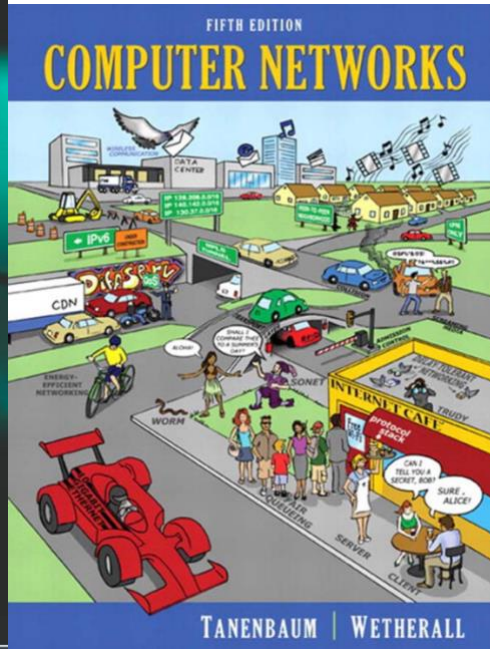
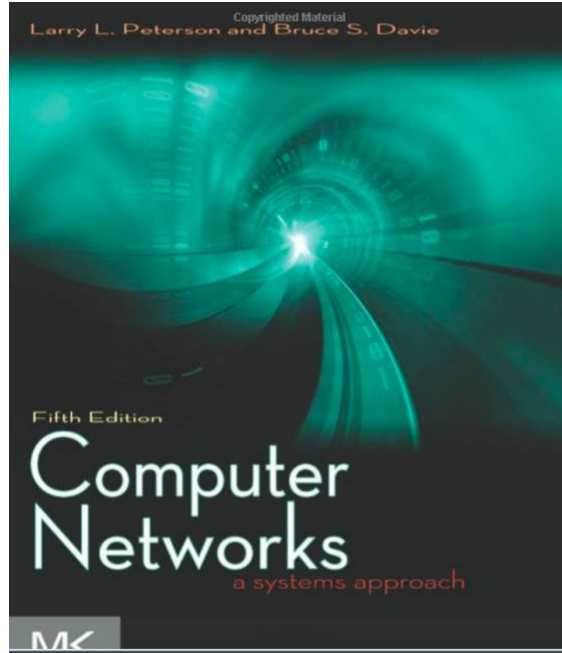


CSE 461: Computer Networks

cs.washington.edu/461



<https://github.com/SystemsApproach/book>

Class Structure

Grading

- **Assignments: 10%**
 - Reading from the books
 - Canvas homework (try as many times as you want)

Grading

- Assignments: 10%
- **Surprise Quizzes: 5%**
 - Short unannounced timed quizzes during the quarter
 - Drop lowest

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- **3 Projects: (15 + 17 + 18)%**
 - Use canvas groups (feel free to start making groups now)
 - 3 coding exercises:
 - Socket programming
 - Link and Network layer behavior
 - TCP Bufferbloat

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (15 + 17 + 18)%
- **Midterm: 15%**
- **Final: 20%**

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (15 + 17 + 18)%
- Midterm: 15%
- Final: 20%

Late Policy: Each **person** gets 13 late days.

Administrivia

- Office hours
 - Opportunity to have more personal interactions with both me and the TAs.
- Tools
 - Mailing list: backup class announcements
 - Canvas Announcements: Primary communication idiom
 - Canvas Assignments: Homework and projects
 - Canvas Discussion: Back and forth discussions on class content
 - Canvas Gradebook: Grades will be posted here

Administrivia (2)

- Slides
 - Adapted from David Wetherall and Kurtis Heimerl
 - I will be posting class slides right before lecture as well
- No Section or office hours this week.

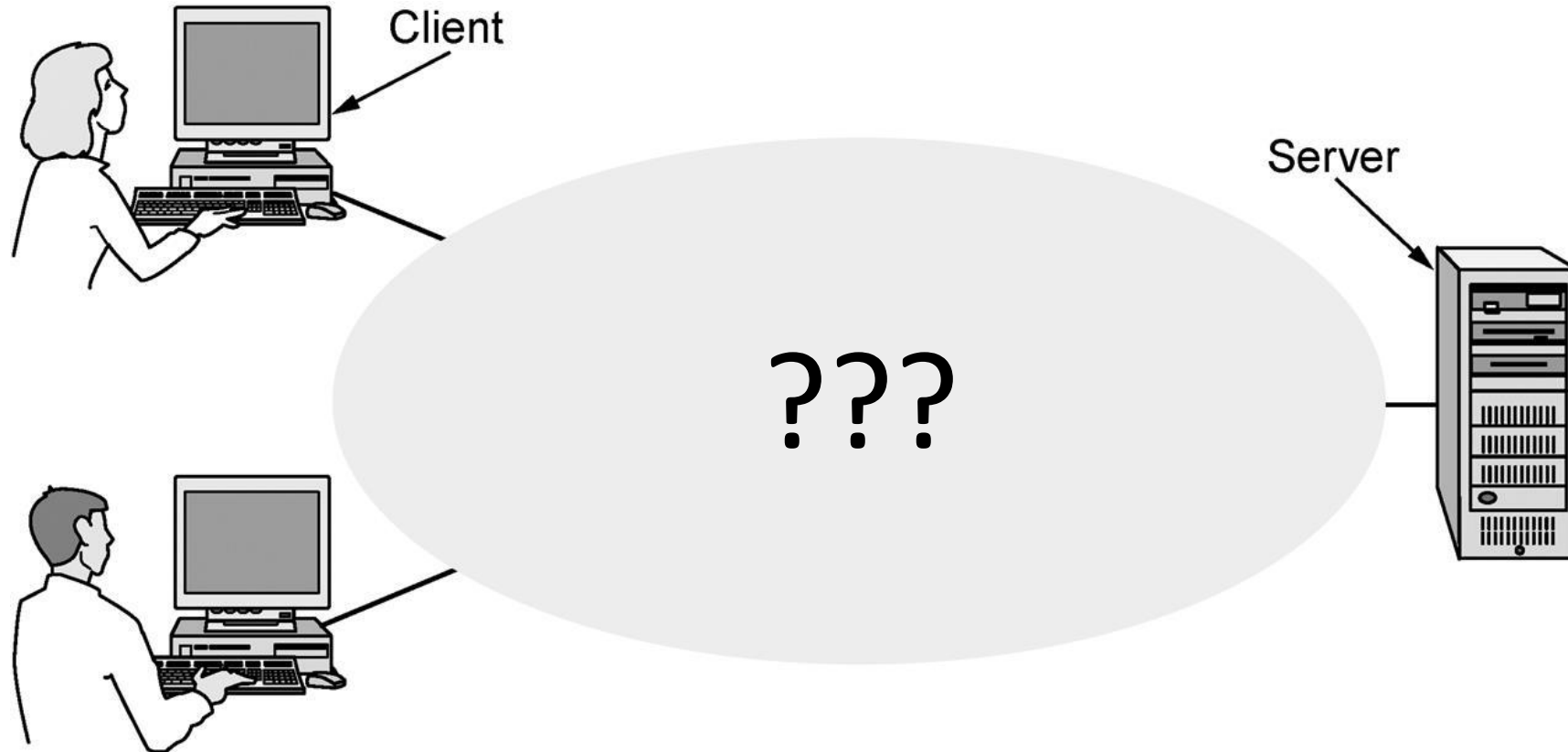
Masking

- Things are hard now
- All the students should be masked in the classes/sections
- Be kind
 - Staff are people too
 - We are following UW and state rules
 - Don't be that person that will lead to canceling the class
 - If you forgot a mask, the front desk has single-use masks

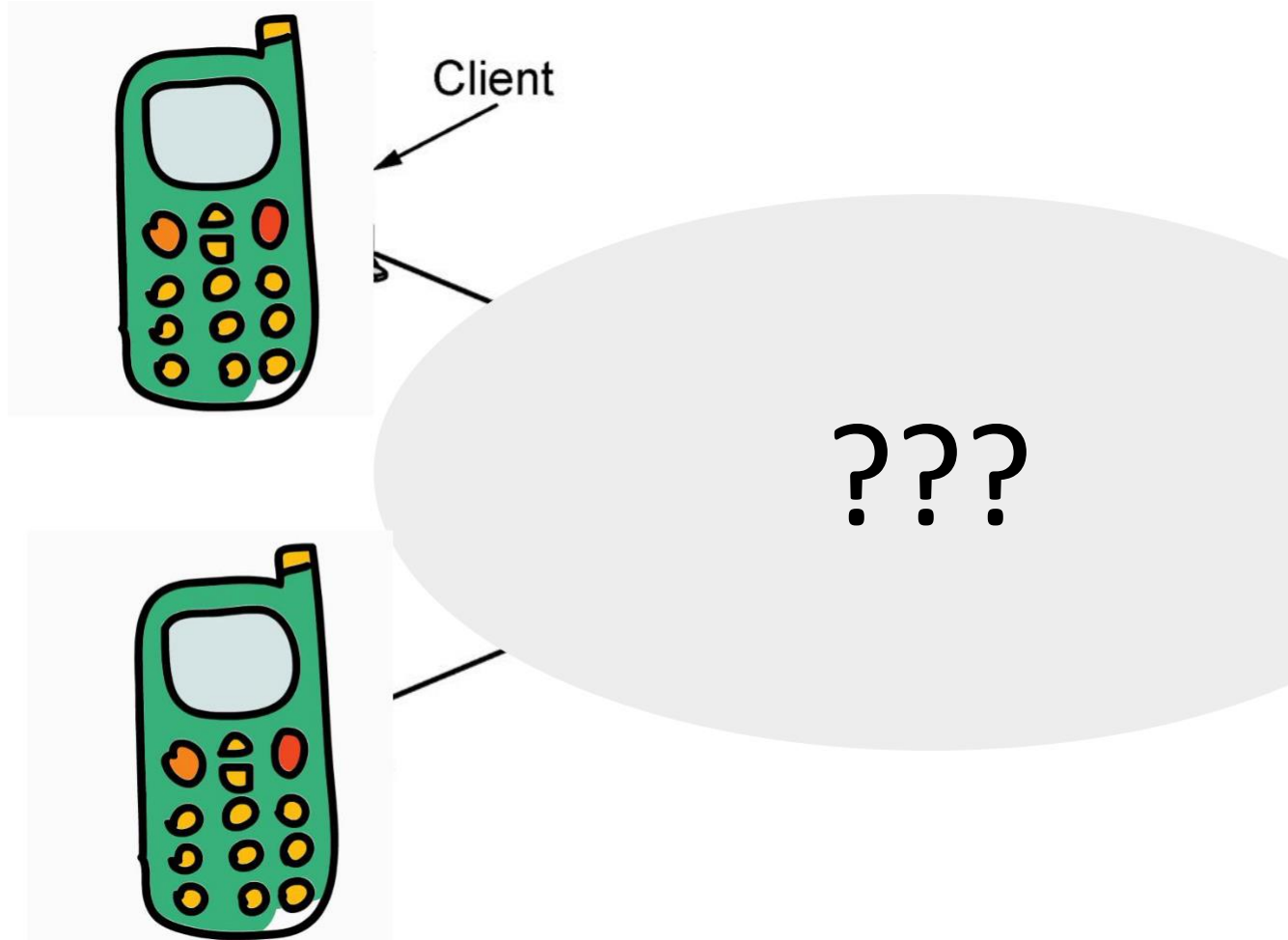
Questions?

CSE 461: Computer Networks

Focus of the course

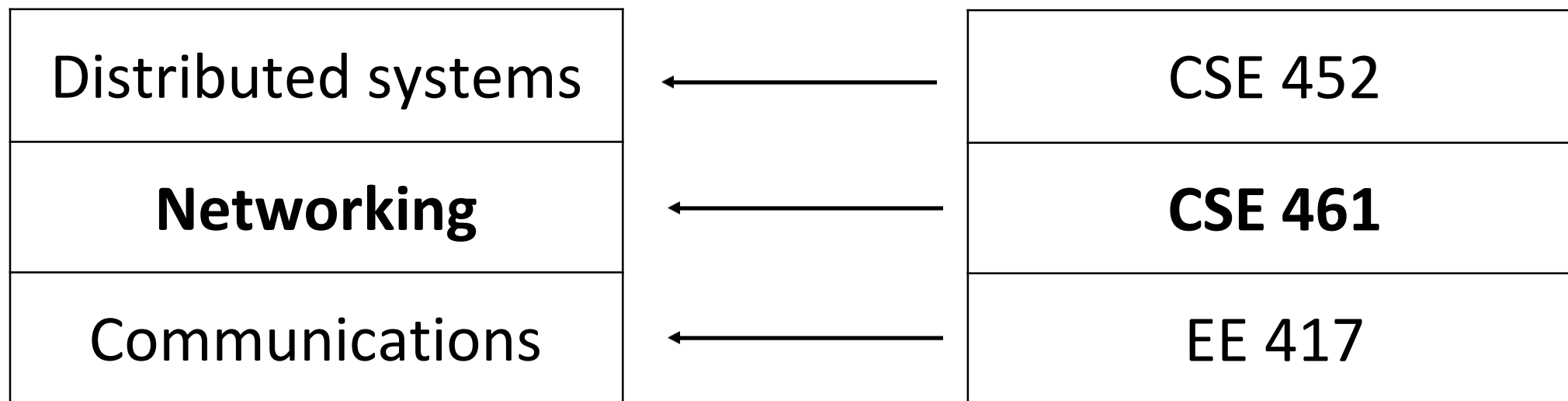


Focus of the course (in today's terms)



Focus of the course (2)

- Three “networking” topics:



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

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)

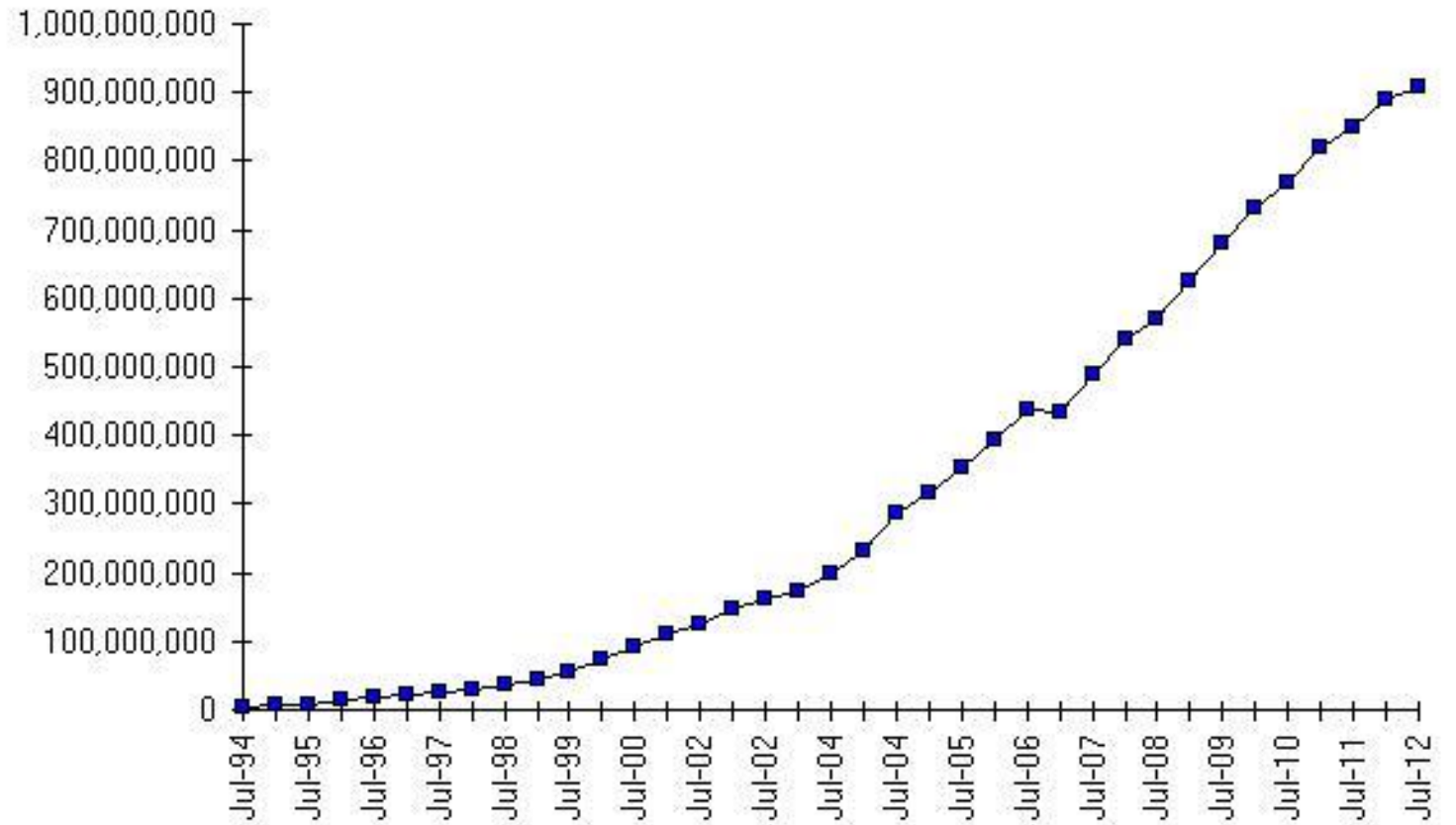
Fundamentals – Reinvention

- 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

Change	Enabling Technology
Emergence of the web	Content Distribution Networks
Piracy	Peer-to-peer file sharing
Voice over IP (VoIP)	Quality of Service (QoS)*
Internet of Things	IPv6
Mobile Devices	Wireless Networking

*mostly actually spare capacity

Fundamentals – Reinvention (4)

- Upcoming/Ongoing upheavals?

Change	Enabling 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)

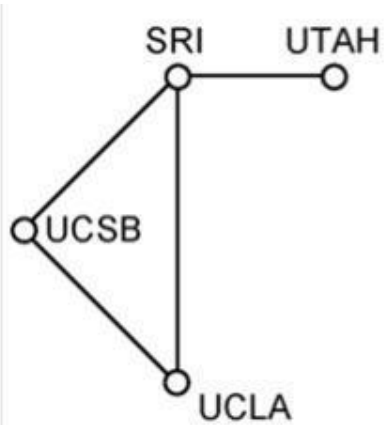
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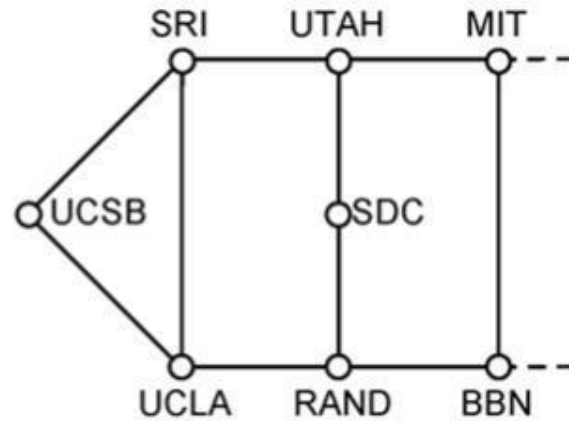
Who cares about the internet?

1. Curiosity
2. Impact on our world
3. Job prospects!

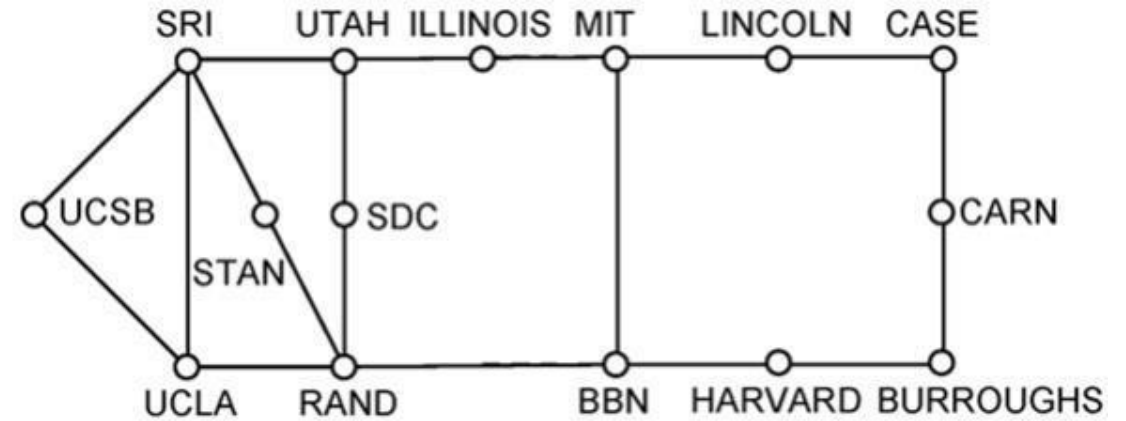
From this experimental network (~1970)...



(a) Dec. 1969.



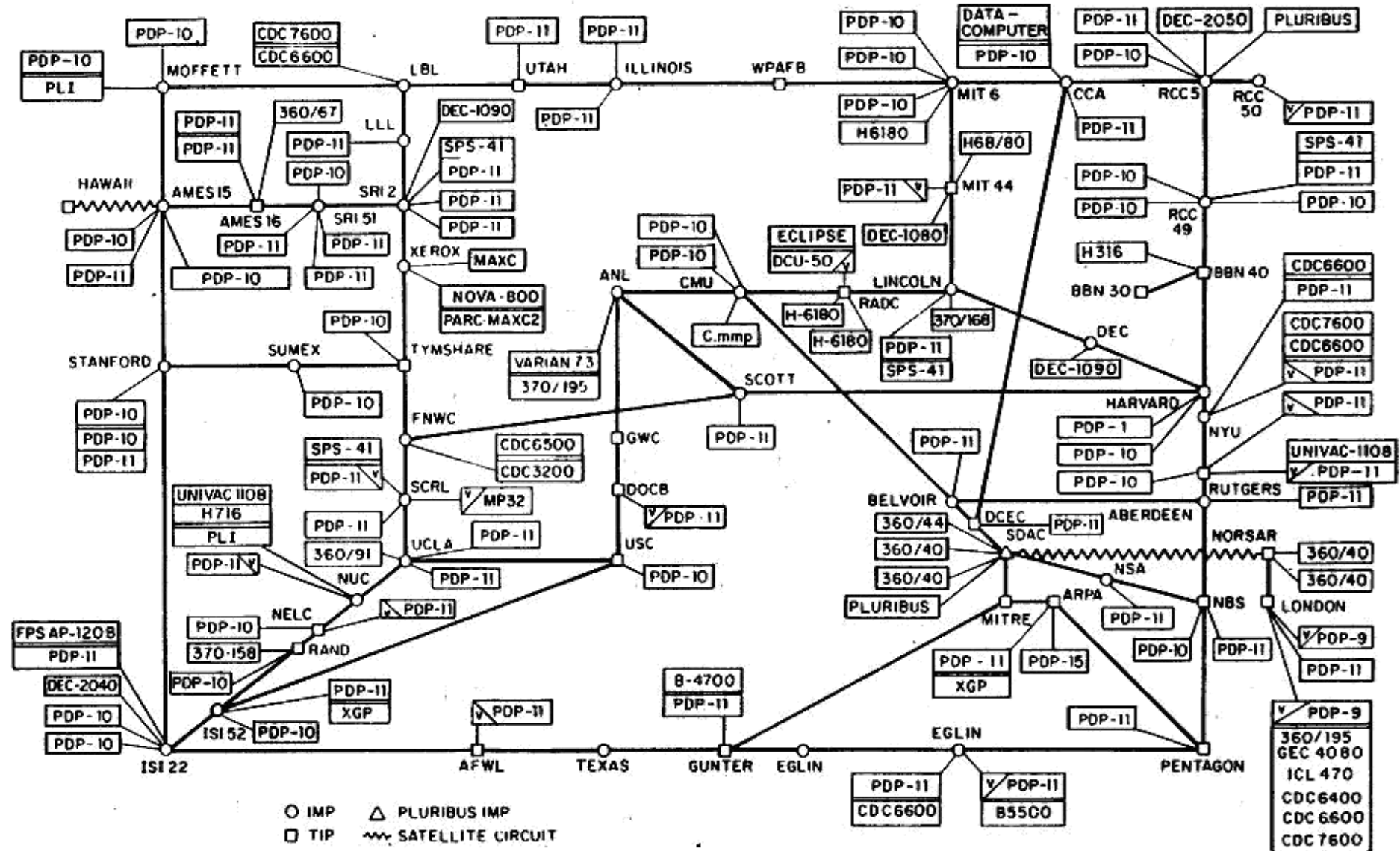
(b) July 1970.



(c) March 1971.

ARPANET LOGICAL MAP, MARCH 1977

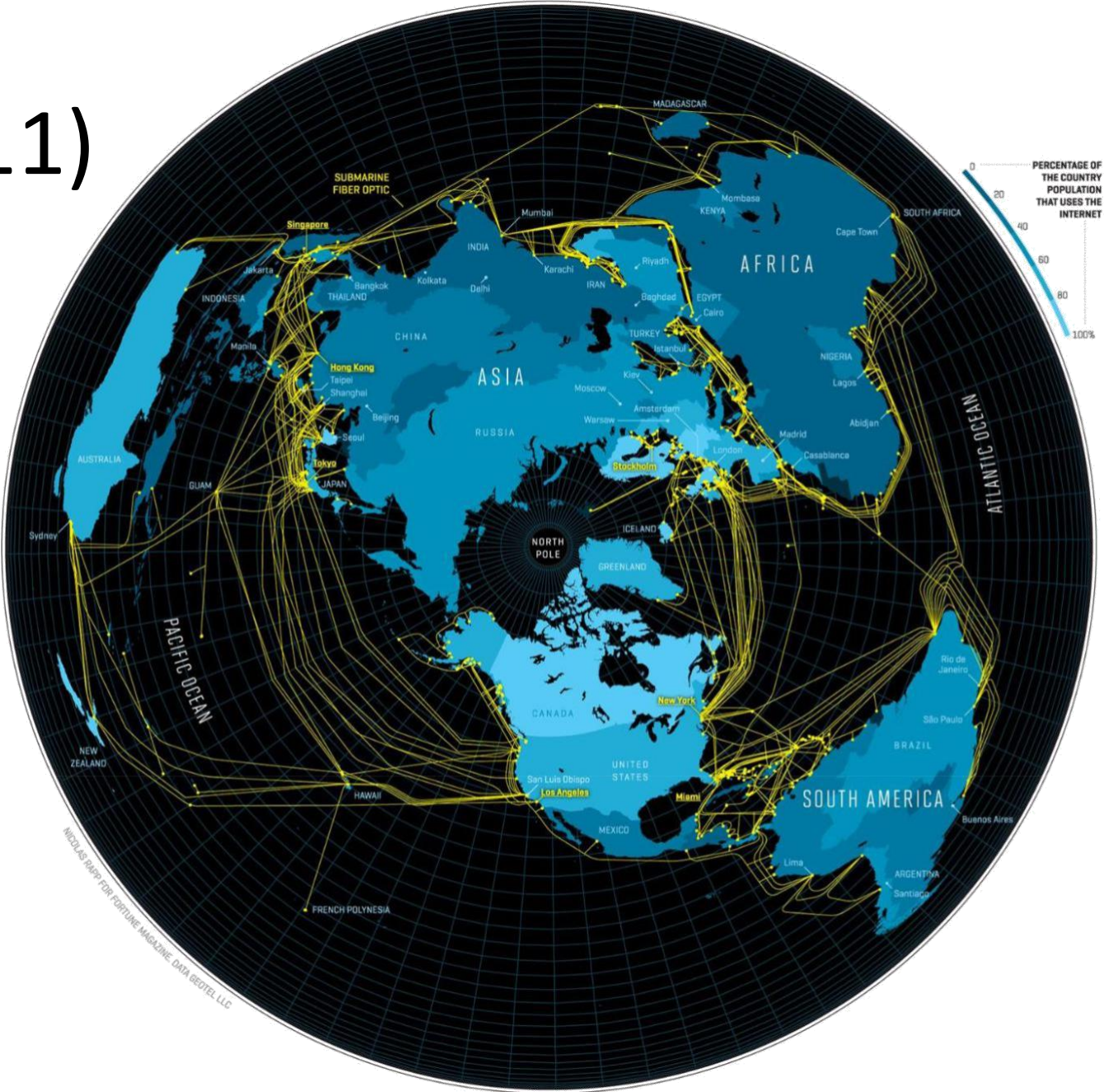
To this...



(PLEASE NOTE THAT WHILE THIS MAP SHOWS THE MOST POPULATION OF THE NETWORK ACCORDING TO THE BEST INFORMATION OBTAINABLE, NO CLAIM CAN BE MADE FOR ITS ACCURACY)

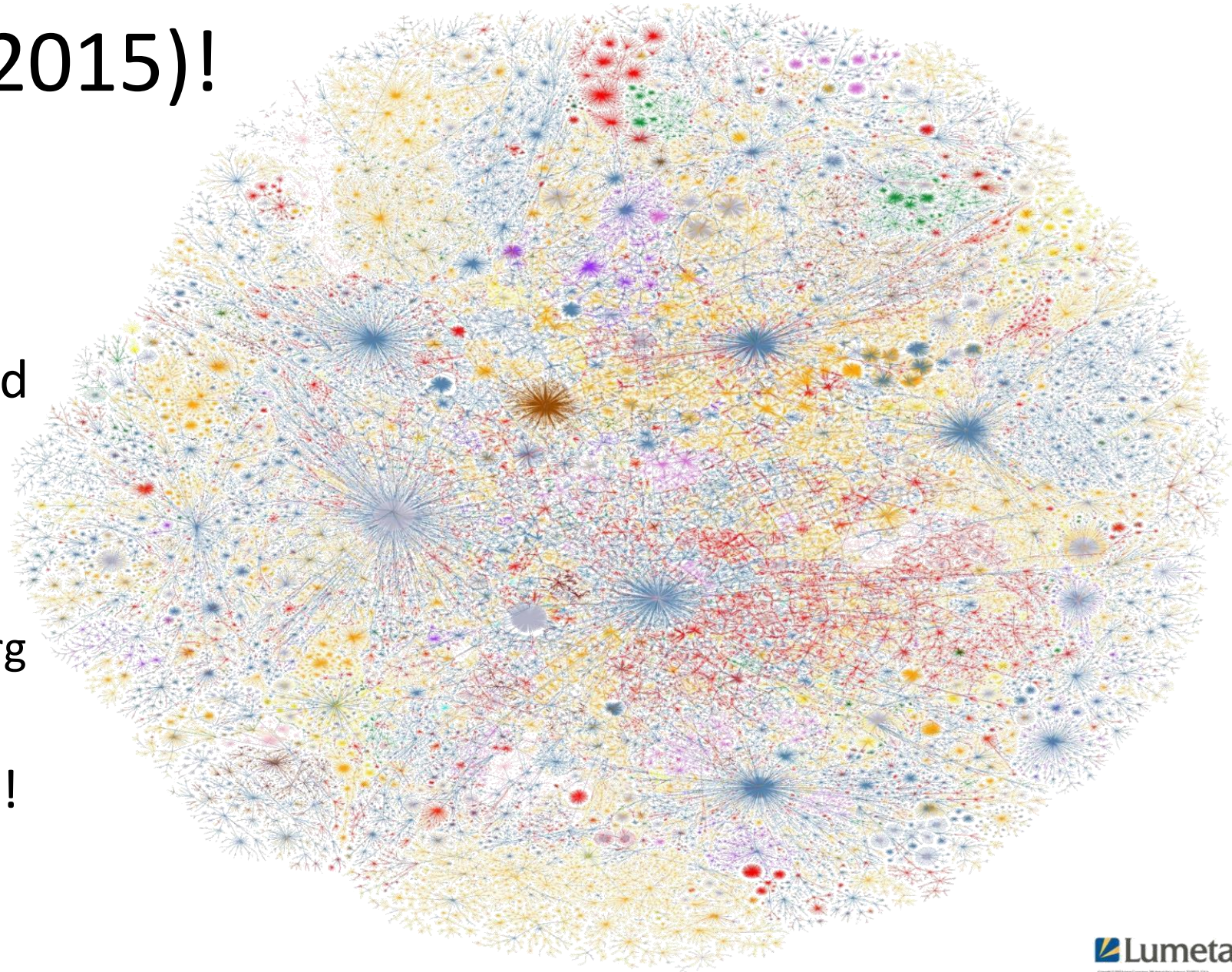
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

To this! (2011)



And this (2015)!

- An everyday institution used at work, home, and on-the-go
- Visualization contains millions of servers
 - Red = .com, Yellow= .org
- Network now contains literally 3 billion **people!**



Internet – Economic impact

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

The Google logo, featuring the word "Google" in its characteristic multi-colored font (blue, red, yellow, blue, green, red).The Facebook logo, consisting of the word "facebook" in white lowercase letters on a dark blue rectangular background.The eBay logo, featuring the word "eBay" in a stylized font where each letter is a different color (e: red, b: blue, a: yellow, y: green).The Craigslist logo, featuring the word "craigslist" in a purple, lowercase, serif font.

Internet – Societal Impact

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



WIKIPEDIA

amazon

tinder

Tor

The Main Point

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Architectures

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

Thanks!