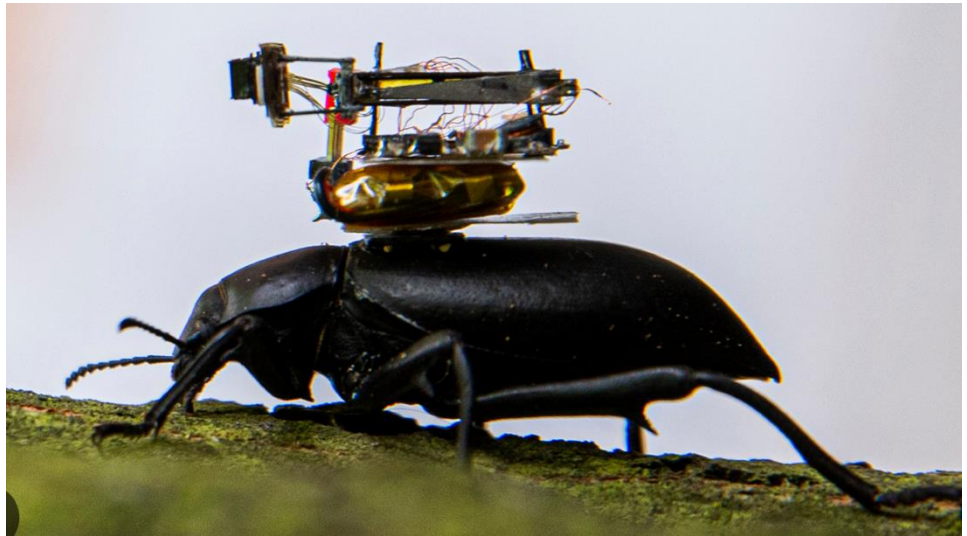
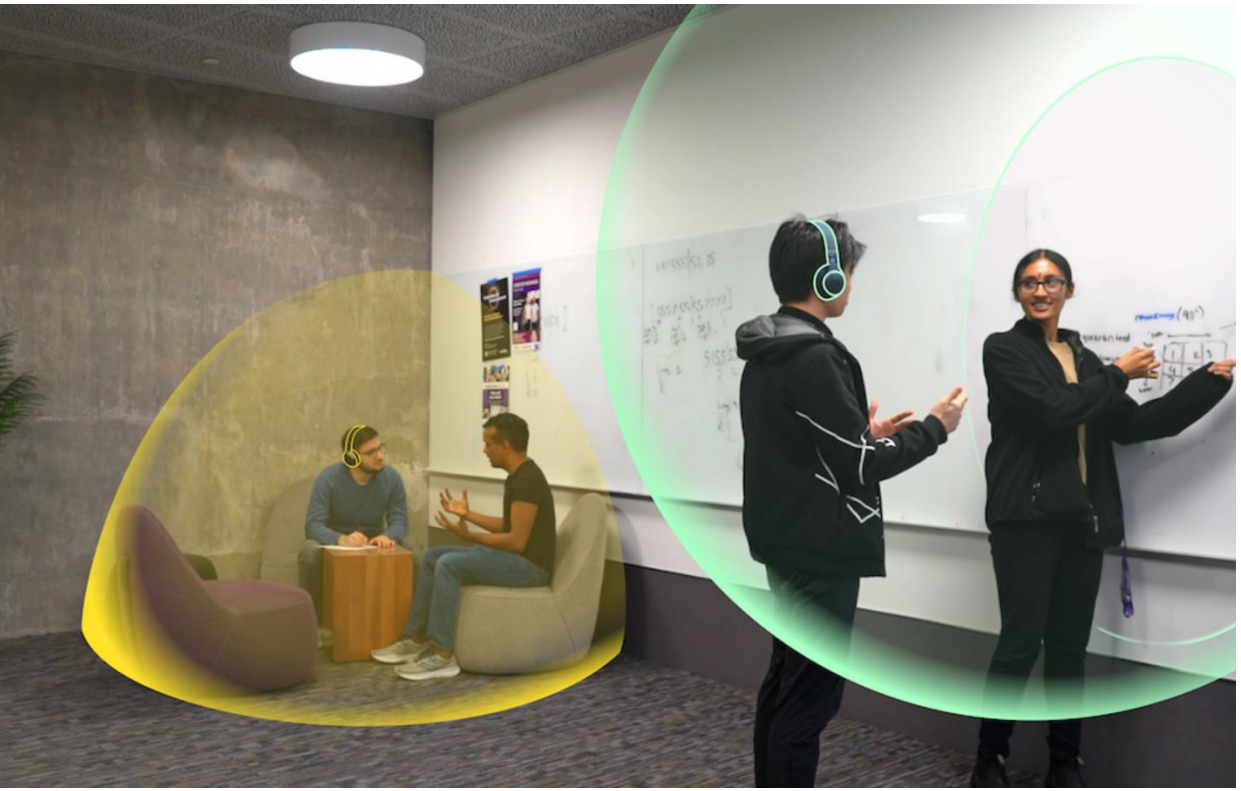
CSE 461: Computer Networks

cs.washington.edu/461

Mobile Intelligence Lab



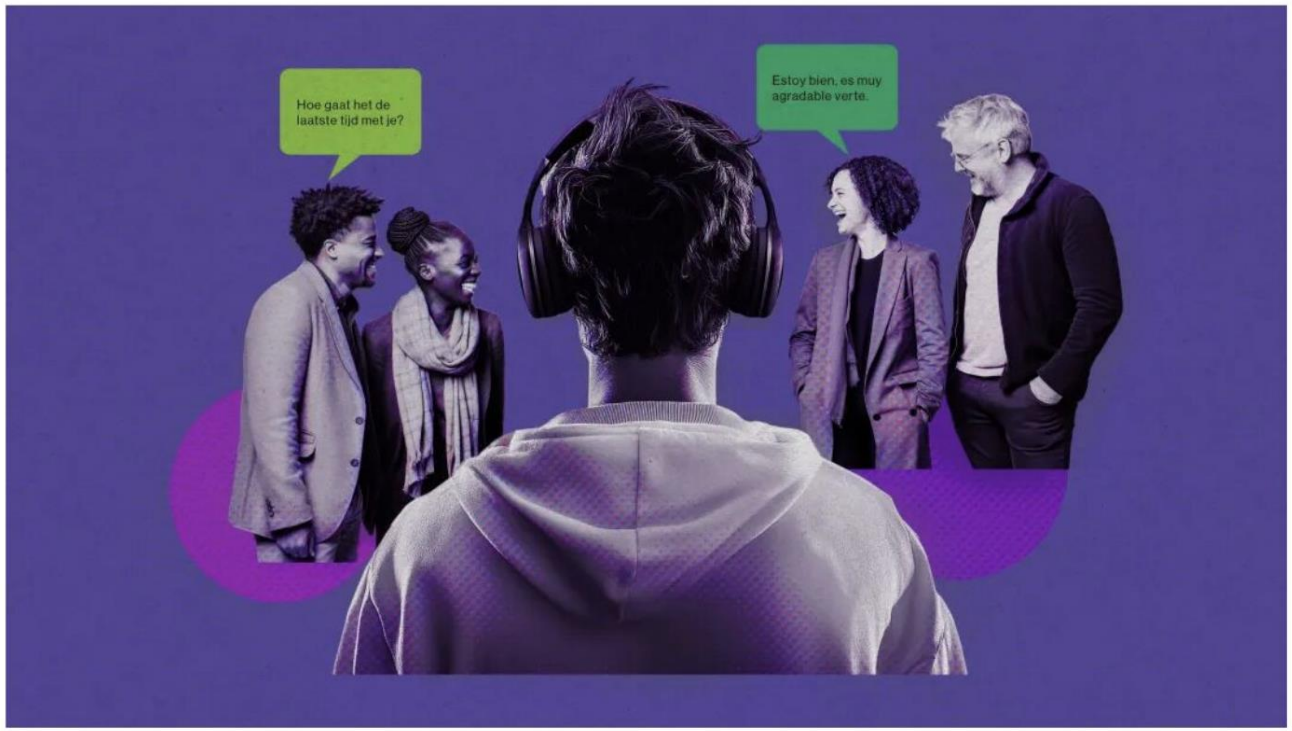

9x
Arrangement



New Artificial intelligence 19 hours

A new AI translation system for headphones clones multiple voices simultaneously

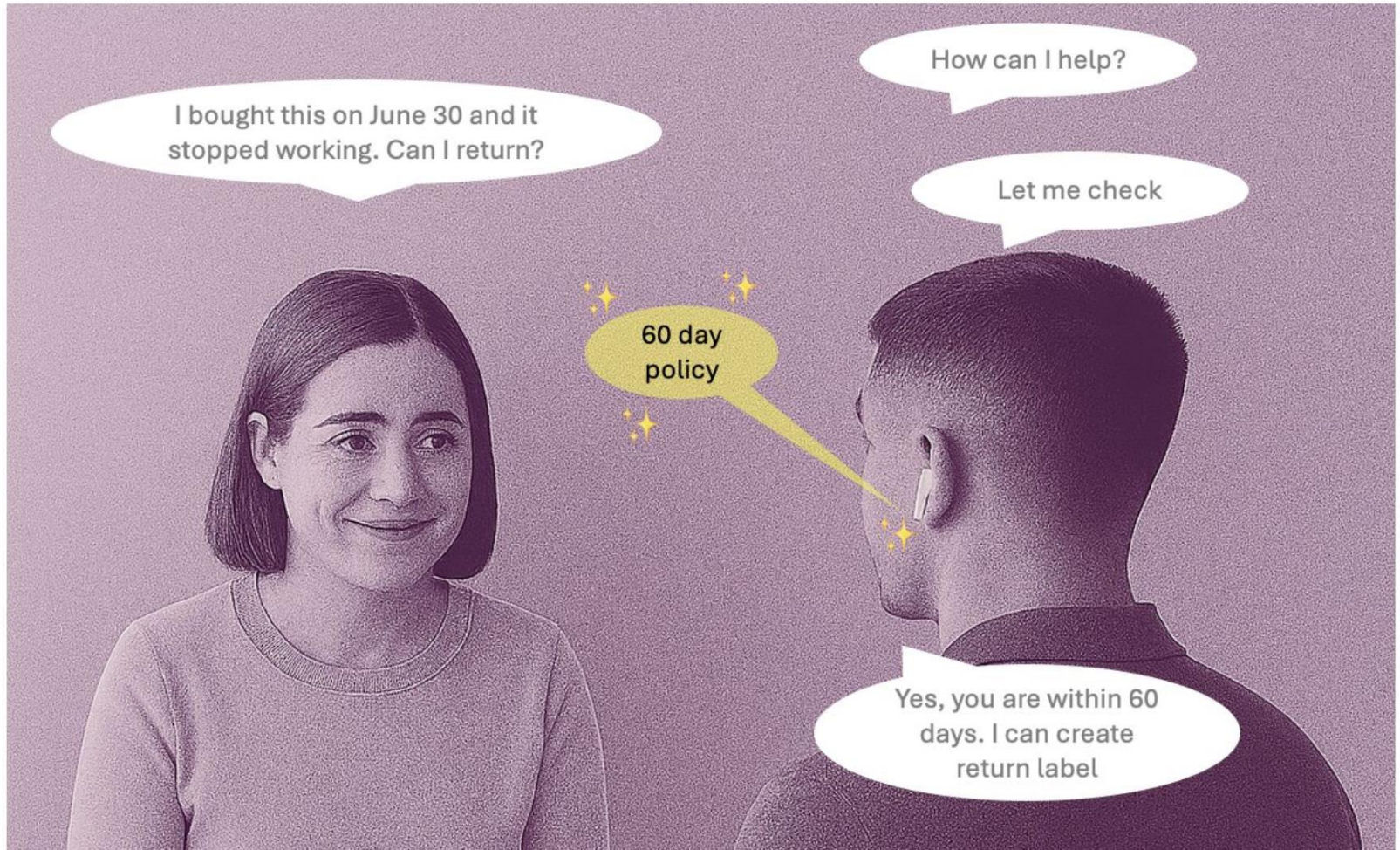
Spatial Speech Translation addresses one of automatic translation's biggest challenges: lots of people speaking at the same time.



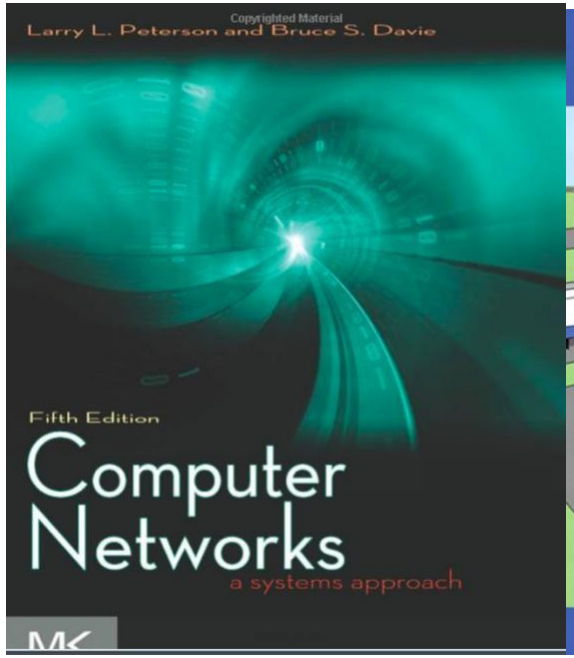
New Artificial intelligence

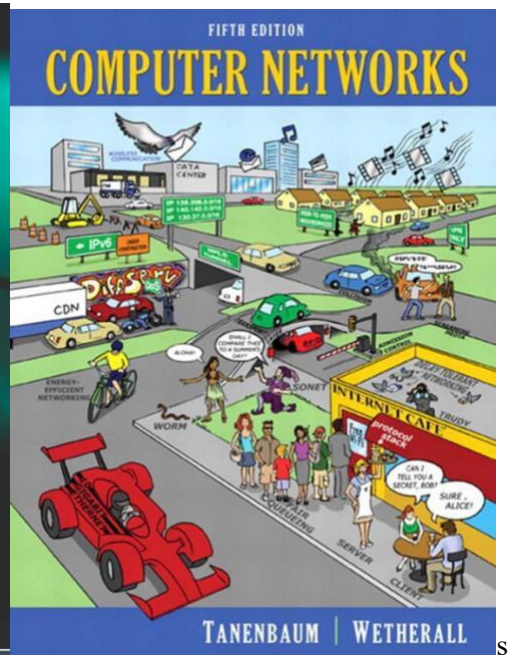
Meet LlamaPIE: Your in-ear AI co-pilot

Unlike today's AI assistants that wait for users to ask questions, LlamaPIE proactively determines when to assist and enhances human conversations via concise guidance (1-3 words) delivered by earphones.



Class Structure





https://github.com/SystemsApproach/book

Grading

- **Assignments: 10%**
  - Reading from the books

Grading

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

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- **3 Projects: (12 + 15 + 18)%**
  - Use Edstem (feel free to start making groups now)
  - 3 coding exercises

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (12 + 15 + 18)%
- **Midterm: 20%**
- **Final: 20%**

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (12 + 15 + 18)%
- Midterm: 20%
- 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 and Ed: Primary class announcements
  - Canvas Assignments: Homework and projects
  - Ed Discussion: Back and forth discussions on class content
  - Canvas Gradebook: Grades will be posted here

Administrivia (2)

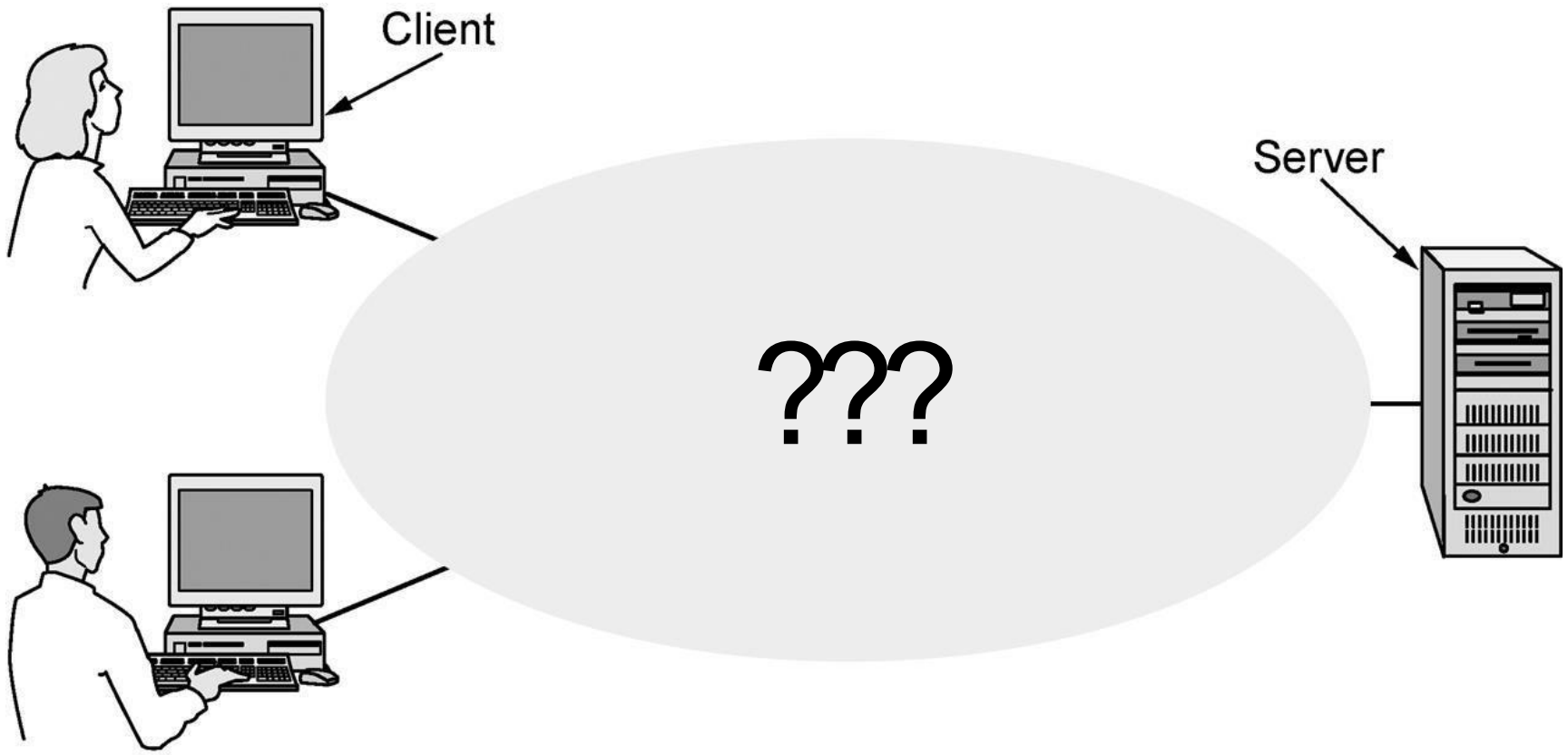
- Slides
  - Adapted from David Wetherall
  - I will be posting class slides right before lecture as well

Questions?

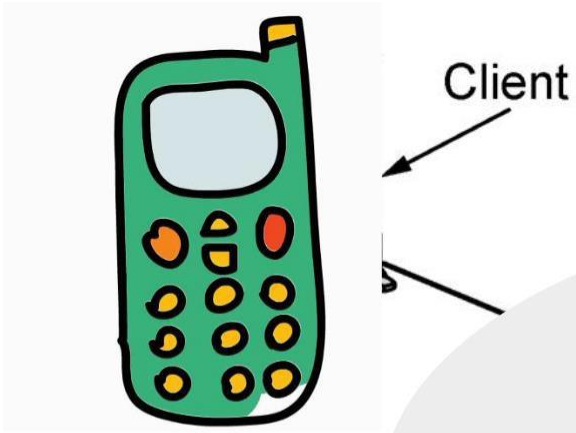
5 Minute Activity!

- Breakouts of 4-5 people
- Introduce yourselves to each other!
  - Could be a good way to start finding project teams…
- Quickly discuss some different components (really anything relevant) of what you think the Internet is made of…
  - We'll compile/categorize once done

Focus of the course



Focus of the course (in today's terms)

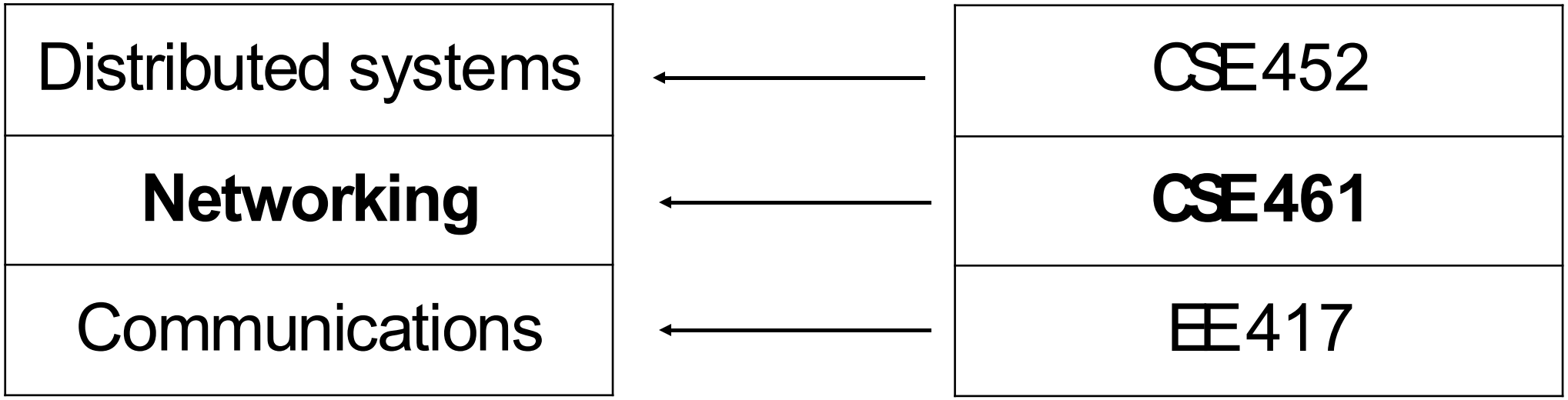


Client

???

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)

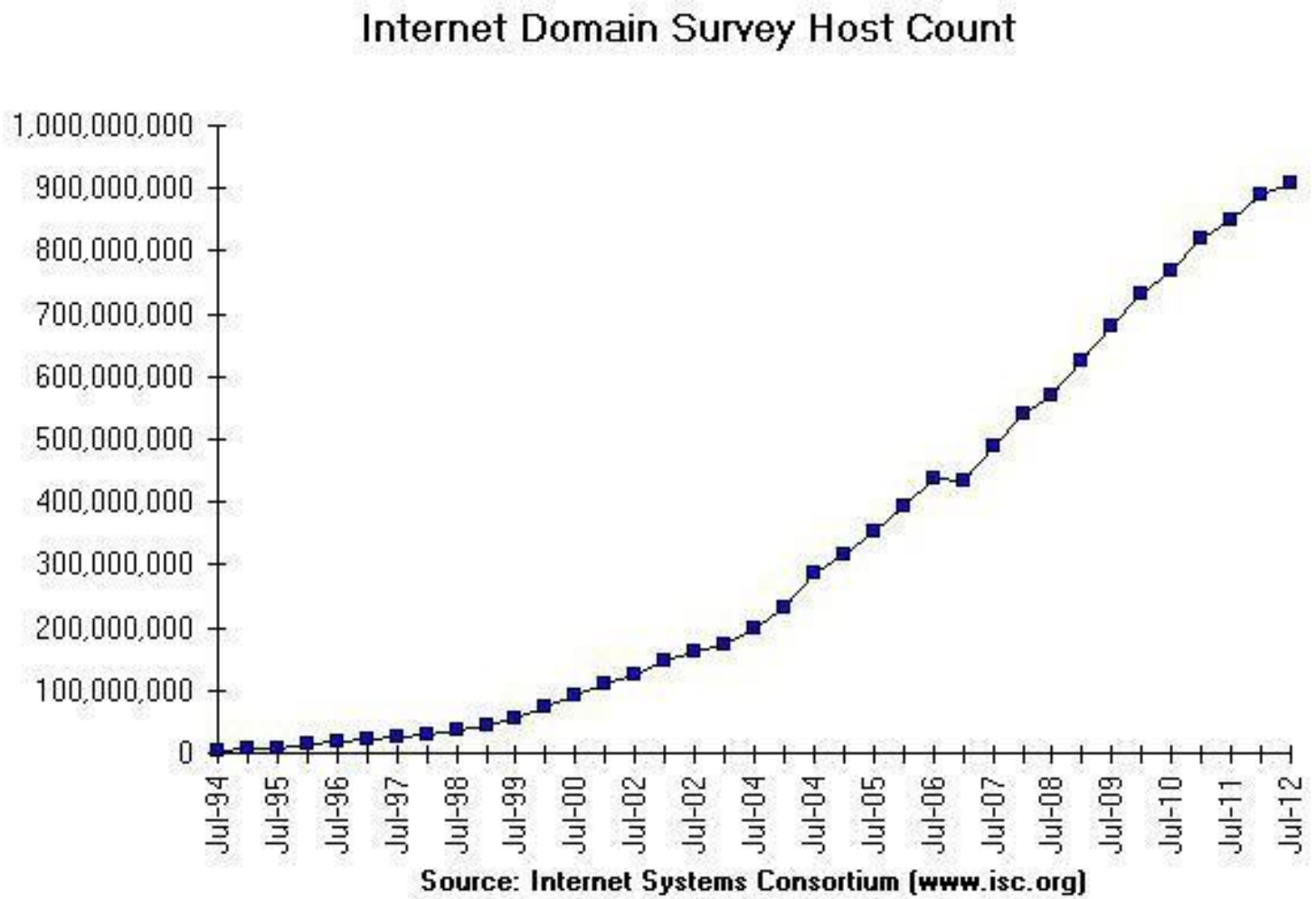
Key problem	Example solutions
Reliability despite failures	Codes for error detection/correction (§3.2, 3.3) Routing around failures (§5.2)
Network growth and evolution	Addressing (§5.6) and naming (§7.1) Protocol layering (§1.3)
Allocation of resources like bandwidth	Multiple access (§4.2) Congestion 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



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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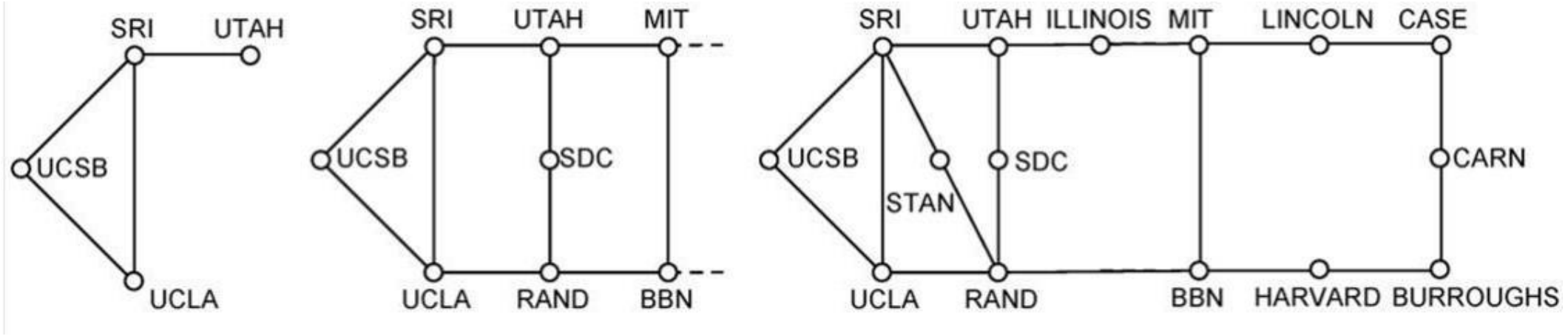
Who cares about the internet?

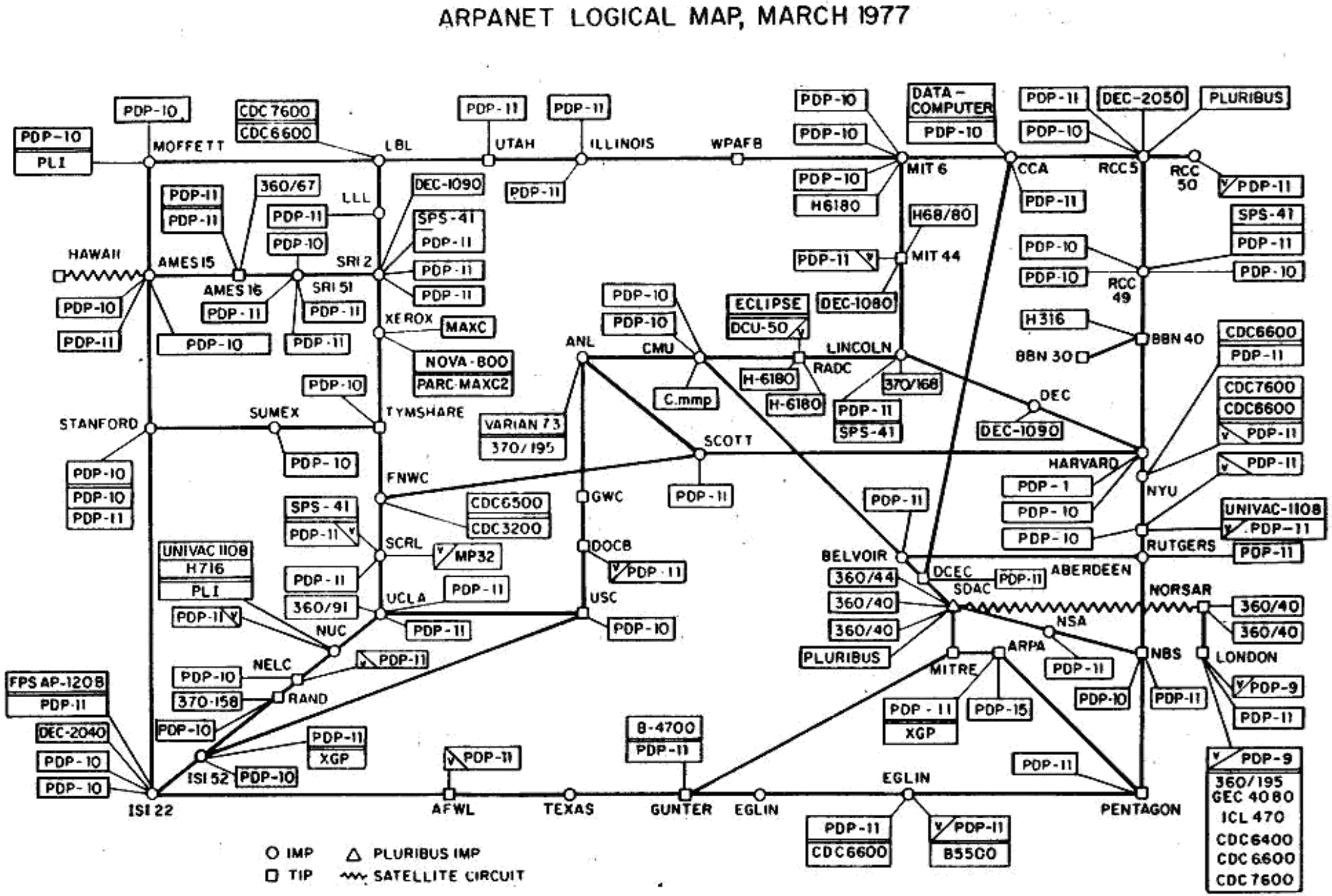
1. Curiosity
2. Impact on our world
3. Job prospects!

From this experimental network (~1970)…



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

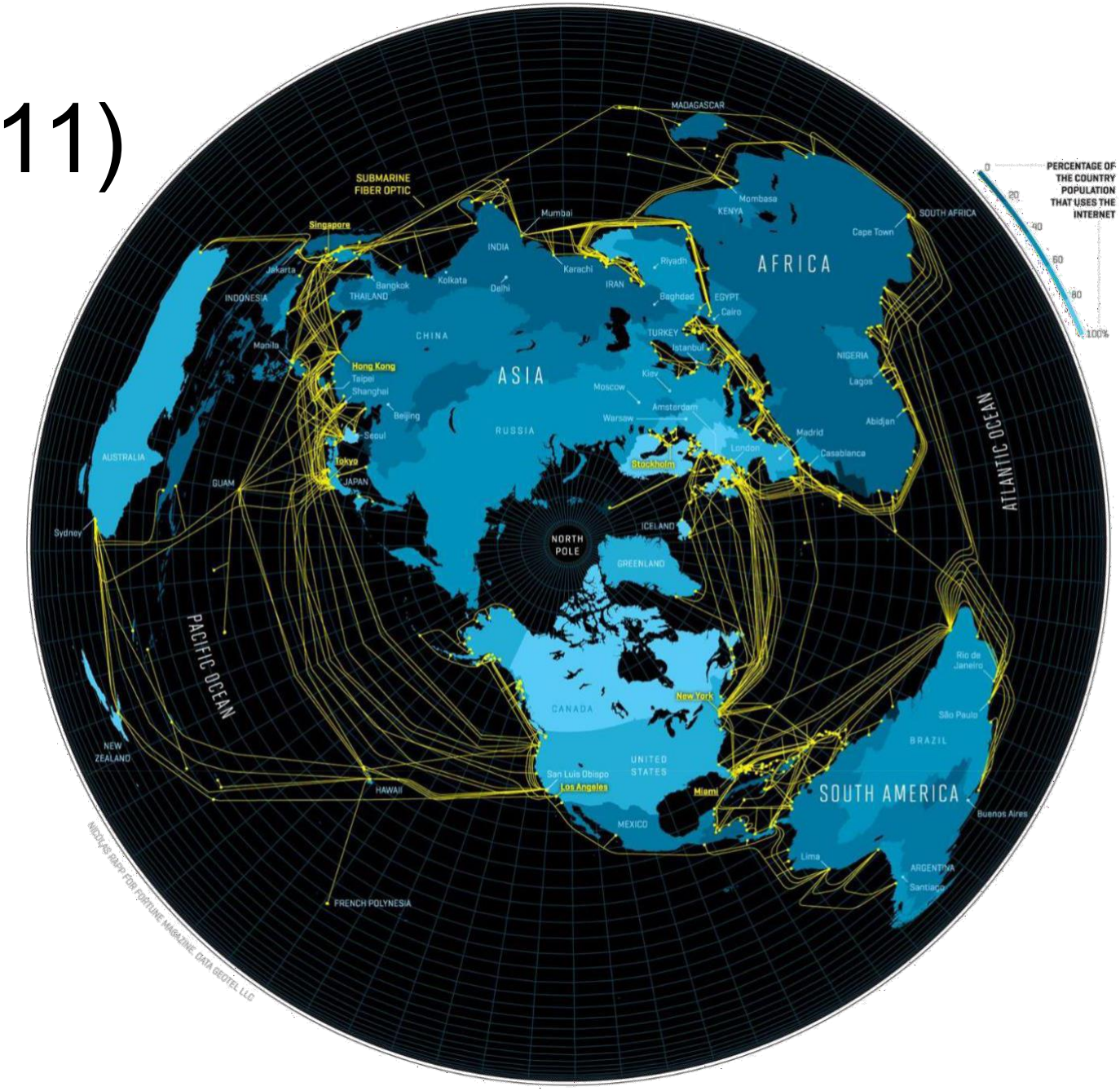
To this…



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

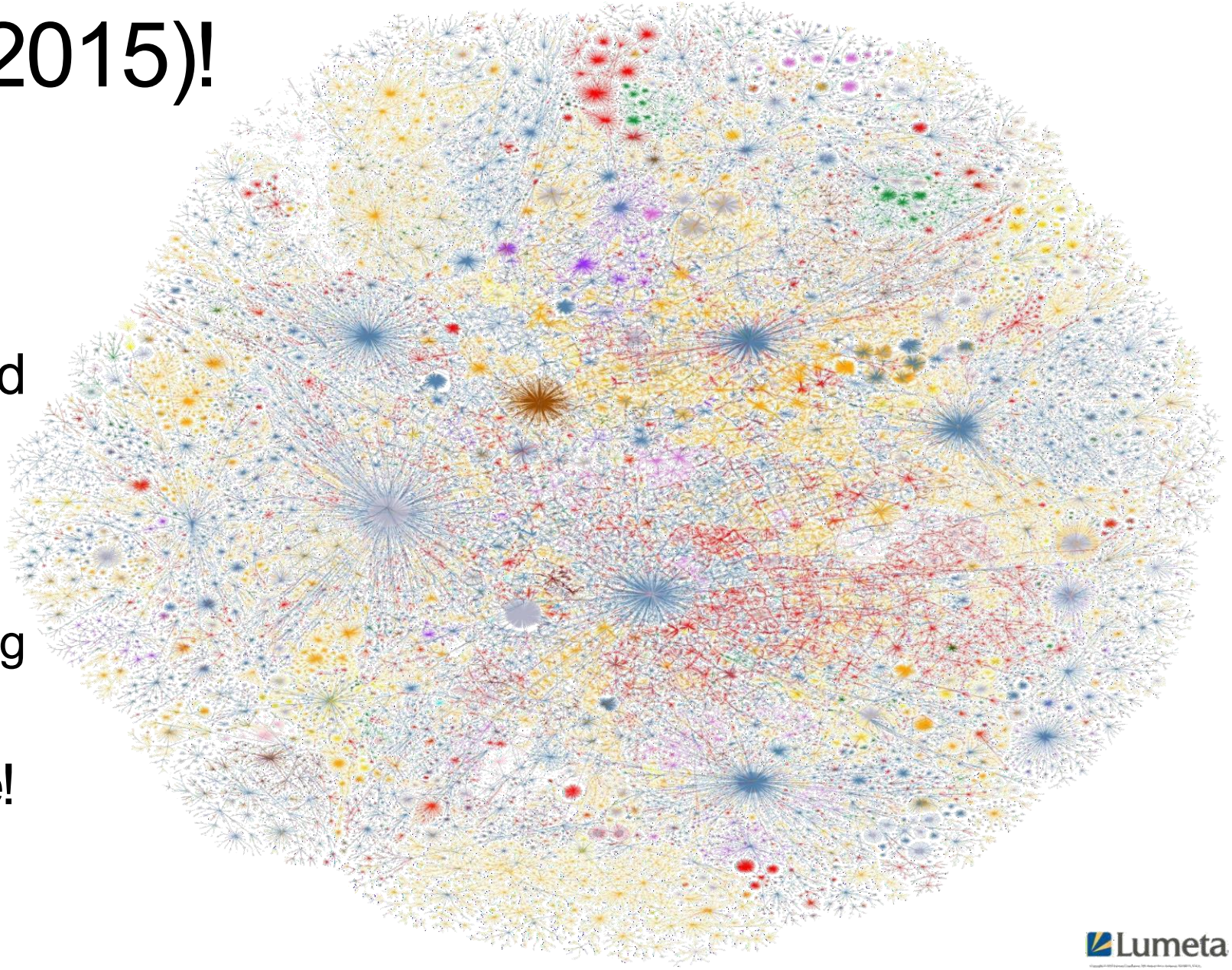
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

To this! (2011)


SUBMARINE FIBER OPTIC
PERCENTAGE OF THE COUNTRY POPULATION THAT USES THE INTERNET
0
20
40
60
80
100%
MADAGASCAR
Mombasa
KENYA
SOUTH AFRICA
Cape Town
AFRICA
Singapore
Mumbai
INDIA
Karachi
Riyadh
IRAN
Jakarta
Bangkok
THAILAND
Kolkata
Delhi
Baghdad
EGYPT
Cairo
INDONESIA
CHINA
TURKEY
Istanbul
Manila
Hong Kong
Taipei
Shanghai
ASIA
Kiev
Moscow
NIGERIA
Lagos
Beijing
Amsterdam
Warsaw
Abidjan
RUSSIA
Seoul
Madrid
London
Casablanca
AUSTRALIA
Tokyo
JAPAN
Stockholm
GUAM
ATLANTIC OCEAN
ICELAND
Sydney
NORTH POLE
GREENLAND
PACIFIC OCEAN
Rio de Janeiro
New York
CANADA
São Paulo
BRAZIL
NEW ZEALAND
UNITED STATES
San Luis Obispo
Los Angeles
Miami
HAWAII
SOUTH AMERICA
Buenos Aires
MEXICO
Lima
ARGENTINA
Santiago
FRENCH POLYNESIA
NICOLAS RAPP FOR FORTUNE MAGAZINE. DATA GEOTEL LLC

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**!



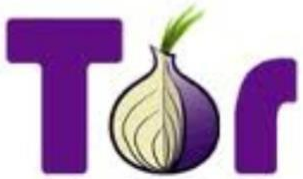
Lumeta

Internet – Economic impact

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

Internet – Societal Impact

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



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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++

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!