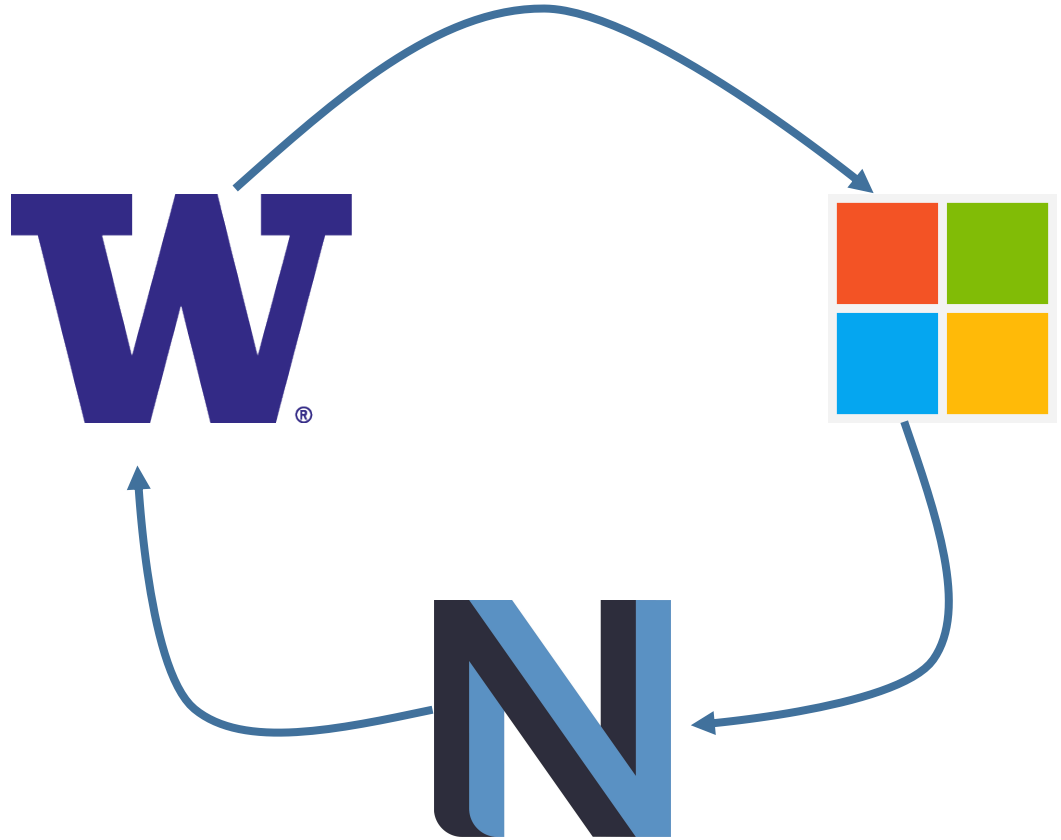
CSE 461: Computer Networks

Ratul Mahajan

Will Bigelow, Brad Chen, Mark Guan
Daniel Starikov, John Taggart, Kyle Yan

Who we are

Ratul

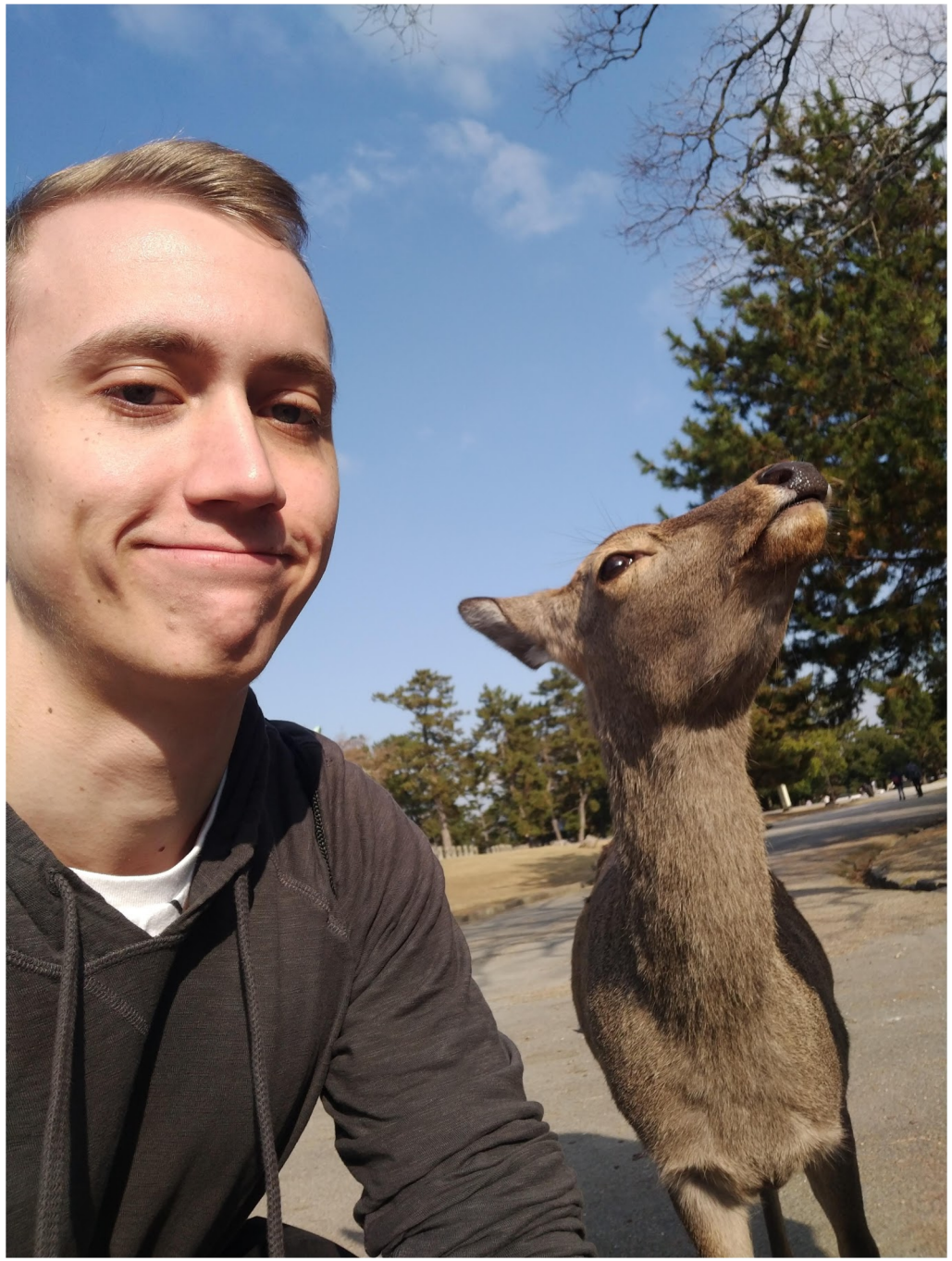


Brad Chen

- Hometown: Oakland, CA
- Year: Senior, B.S. Computational Sciencing
- Incoming SWE at Convoy, if it still exists after COVID-19
- Some fun facts about me:
  - Total tennis aficionado
  - My favorite movie is the The Last Airbender by M. Night Shyamalan
  - In my free time, I make TikToks
  - You can catch me at r/WallStreetBets
  - Once failed the 30 McNugget challenge
  - Has an ongoing relationship with the London Police

Will Bigelow

- Hometown: Berkeley, California
- Year: SENIOR, B.S. Computers
- Incoming Software Engineer at Airbnb, if it still exists after COVID-19
- Some fun facts about me:
  - The amazing head chef of his residence
    - Makes the meanest quiche on the West Coast
    - Also has a secret taco recipe that he will not tell Brad about
  - Life goal is to become a 5 star Airbnb superhost
  - “Stonks only go up”
  - Slightly fazed when presented with leetcode easy problems
  - Somewhat understands Border Gateway Protocol



Mark Guan

- From Acton, Massachusetts: home of the rabid deer
- 4th year Computer Science AND Engineering
- Incoming Software Engineer at Stripe, if it still exists after COVID-19
- Some fun facts about me:
  - Has the cleanest frisbee forehand on the west coast
  - Most cats are afraid of me
  - that one Patriots fan that everyone hates
  - 225 Bench / 315 DL / 135 Squat
  - I once had to go to the ER because I bit a fake fruit
  - Figured out Santa wasn’t real at age 5
  - Has a Boston accent in his dreams

Daniel Starikov

- Hometown: Federal Way, WA
- 5th Year M.S. in C.S., graduating December 2020.
- Works on waterjet-wielding meat-cutting robots.
- Some fun facts about me:
  - Double-majored with EE for undergrad.
  - Worked on self-driving cars at Nvidia internship last summer.
  - Loves to bomb straight down the mountain when snowboarding.
  - Has a fear of jellyfish ever since diving headfirst into one.
  - Read the Game of Thrones books in Russian.

John Taggart

- Hometown: Puyallup, WA
- Computer Science B.S., graduating June 2020.
- Set to be a Software Development Engineer at AWS after graduation.
- Some fun facts about me:
  - I once did research work in the Icelandic Highlands with some geologists.
  - I developed an iOS game from scratch as a personal project last summer.
  - My first car was an ugly-as-sin purple Toyota minivan.

- 5th Year MS, graduating Dec. 2020
- Hometown: Shanghai, China
- Doing research in NLP, also interested in security
- Spent entire spring break implementing Raft
- Learning to make games with Unity
- Don’t like taking pictures

Class Structure

Grading

Assignments: 10%

- Reading and homework from the book

Grading

Assignments: 10%

Surprise Quizzes: 5%

- Short unannounced quizzes during the quarter
- Drop lowest

Grading

Assignments: 10%

Surprise Quizzes: 10%

3 Projects: (15 + 15 + 15)%

- 3 coding exercises:
  - Socket programming
  - Link and Network layer behavior
  - HTTP Proxy

Grading

Assignments: 10%

Surprise Quizzes: 5%

3 Projects: (15 + 15 + 15)%

Midterm: 15%

Final: 20%

Participation: 5%

Grading

Assignments: 10%
Surprise Quizzes: 5%
3 Projects: (15 + 15 + 15)%
Midterm: 15%
Final: 20%
Participation: 55

Late Policy:

- 10% penalty for each late day
- Each **person** gets three late days

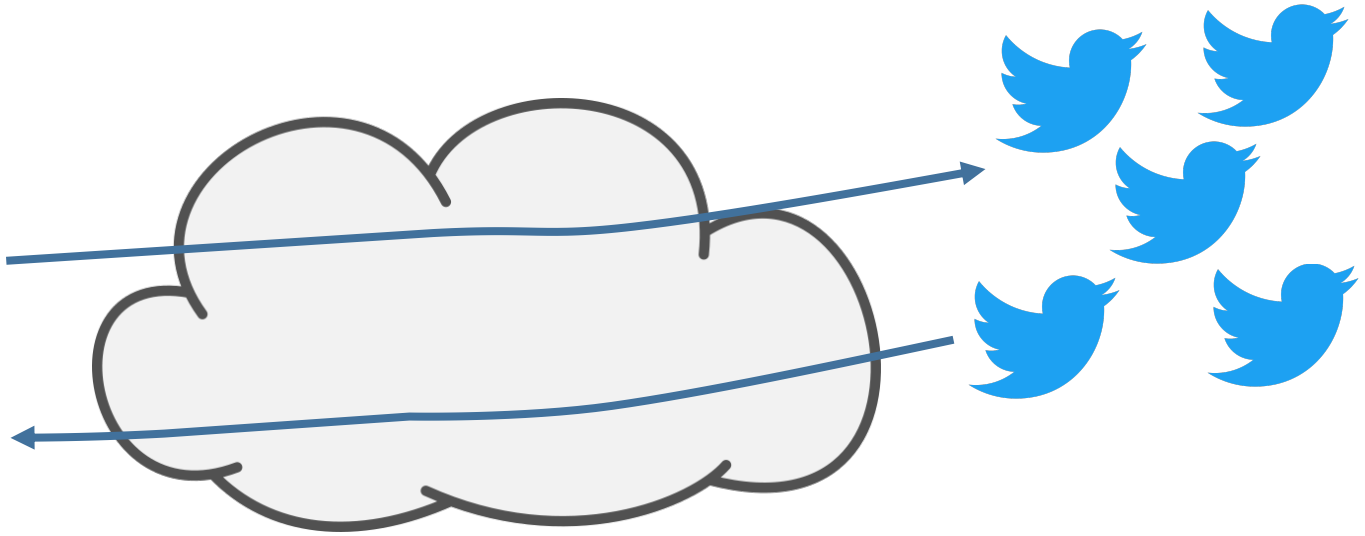
Administrivia

- Office hours
  - Opportunity to have more personal interactions with course staff.
- Tools
  - Mailing list: primary class communications
  - Canvas Assignments: Homework and projects
  - Canvas Discussion: Back and forth discussions on class content
  - Canvas Gradebook: Grades will be posted here
- Slides
  - Adapted from Kurtis Heimerl, who adapted from David Wetherall
  - I will be posting my own slides online

Questions?

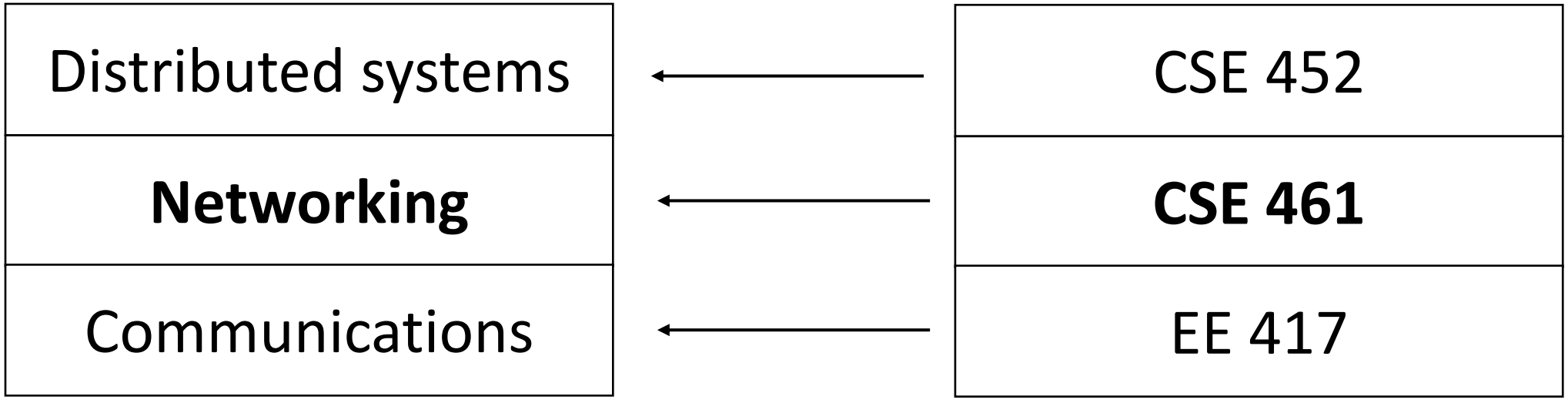
CSE 461: Computer Networks

Focus of the course



Focus of the course (2)

Three “networking” topics:



Main goals

1. 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 how and why of Internet design
   - SDN, Load Balancers, Architectures

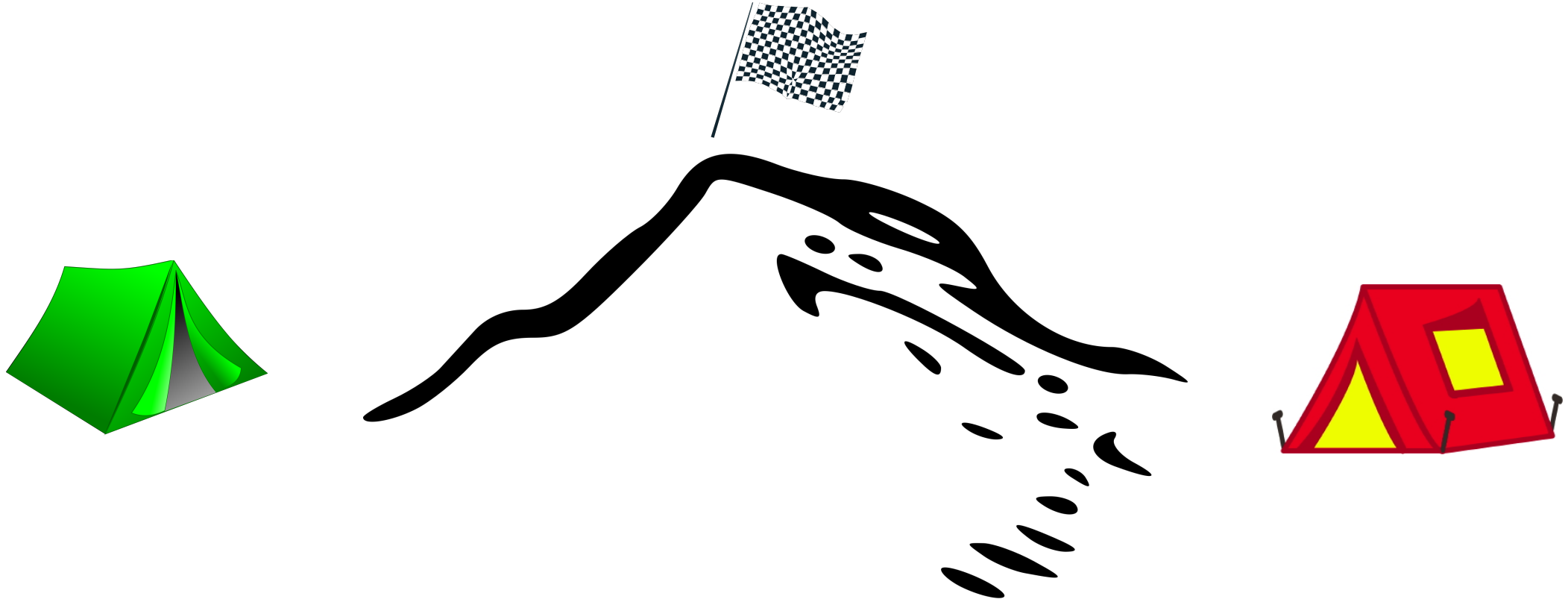
Why learn the fundamentals?

Intellectual interest

Reinvention, broad applicability

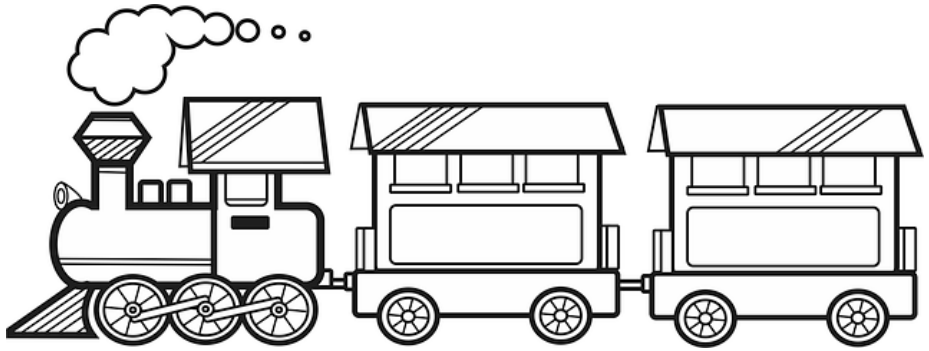
- Non-Internet networks
- Changing Internet

Fundamentals - Reliable communication



Fundamentals – Channel throughput

1 Gbps

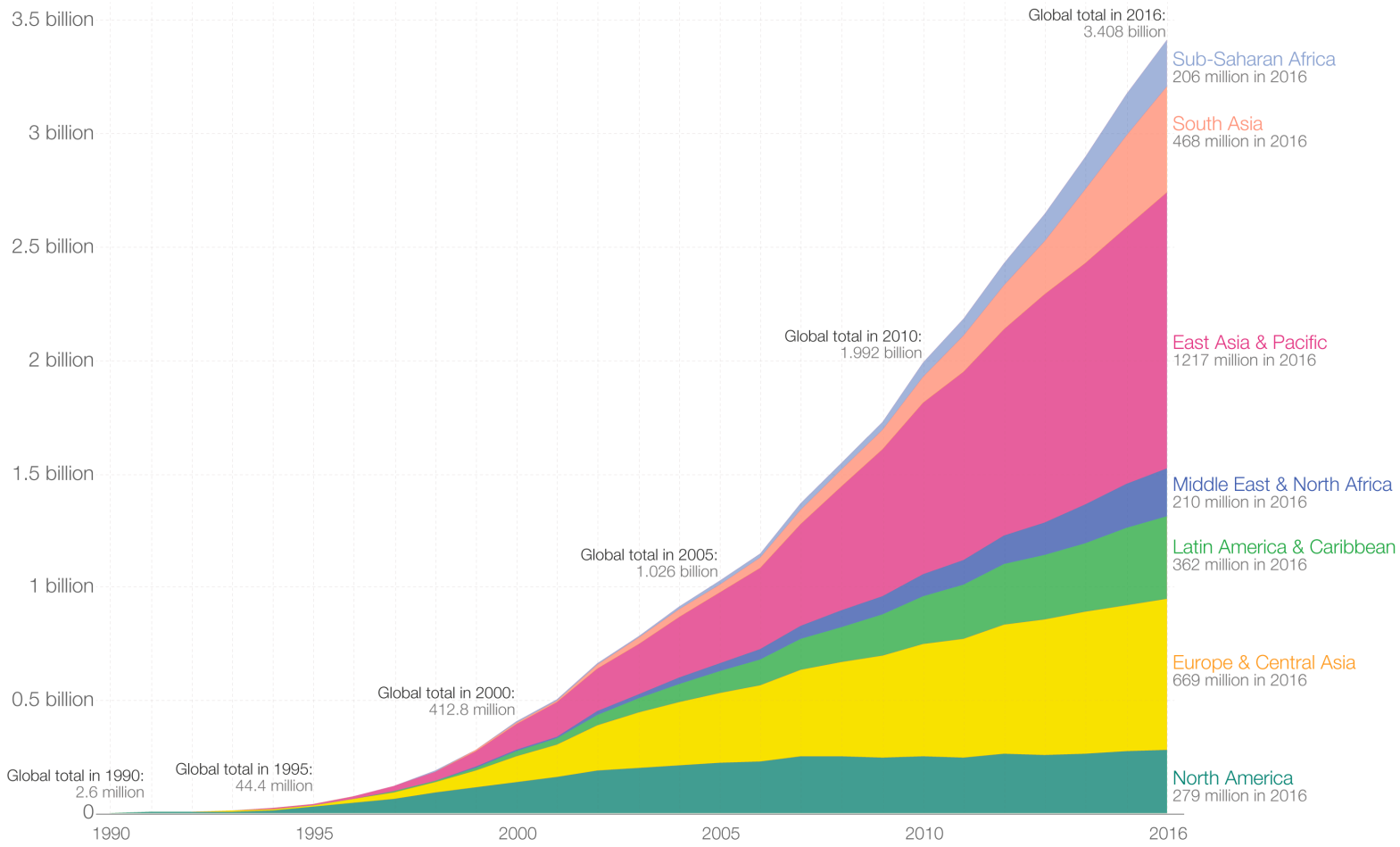


20ft container = 2,350,080 in^3 (240 x 96 x 102)
3.5in SSD = 23 in^3 (4 x 5.75 x 1)
SSDs / container = 50K (50% packing efficiency)
Container capacity = 25PB (512 GB per SSD)
Container speed = 100 mph
SEA <> NYC throughput = ~2000 Gbps

Fundamentals – Reinvention

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

Internet growth



Data source: Based on data from the World Bank and data from the International Telecommunications Union. Internet users are people with access to the worldwide network.
The interactive data visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic.

Example upheavals

Change	**Enabling Technology**
Emergence of Web	Content Distribution Networks
Piracy	Peer-to-peer file sharing
Internet of Things	IPv6
Mobile Devices	Wireless, High bandwidth cellular
Cloud computing	Virtualization
Crypto currencies	Blockchains
….	….

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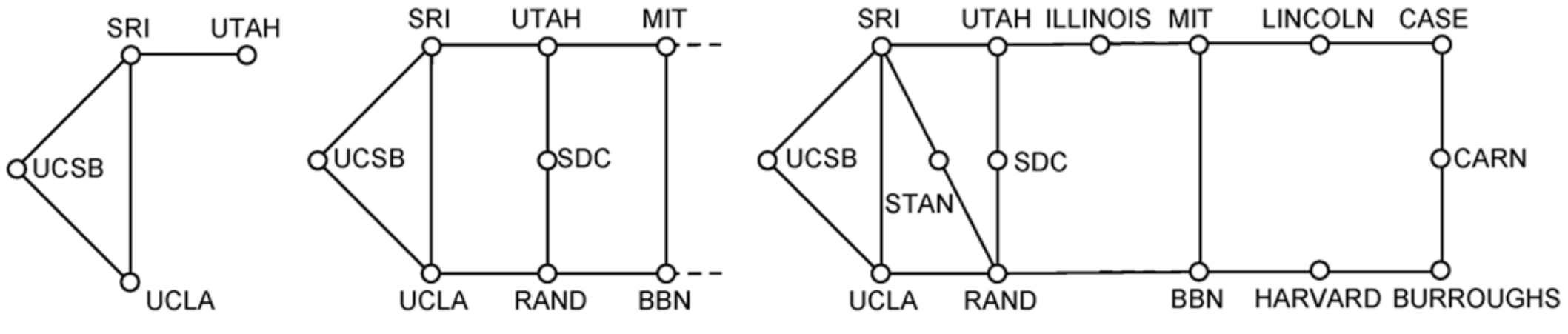
Who cares about the internet?

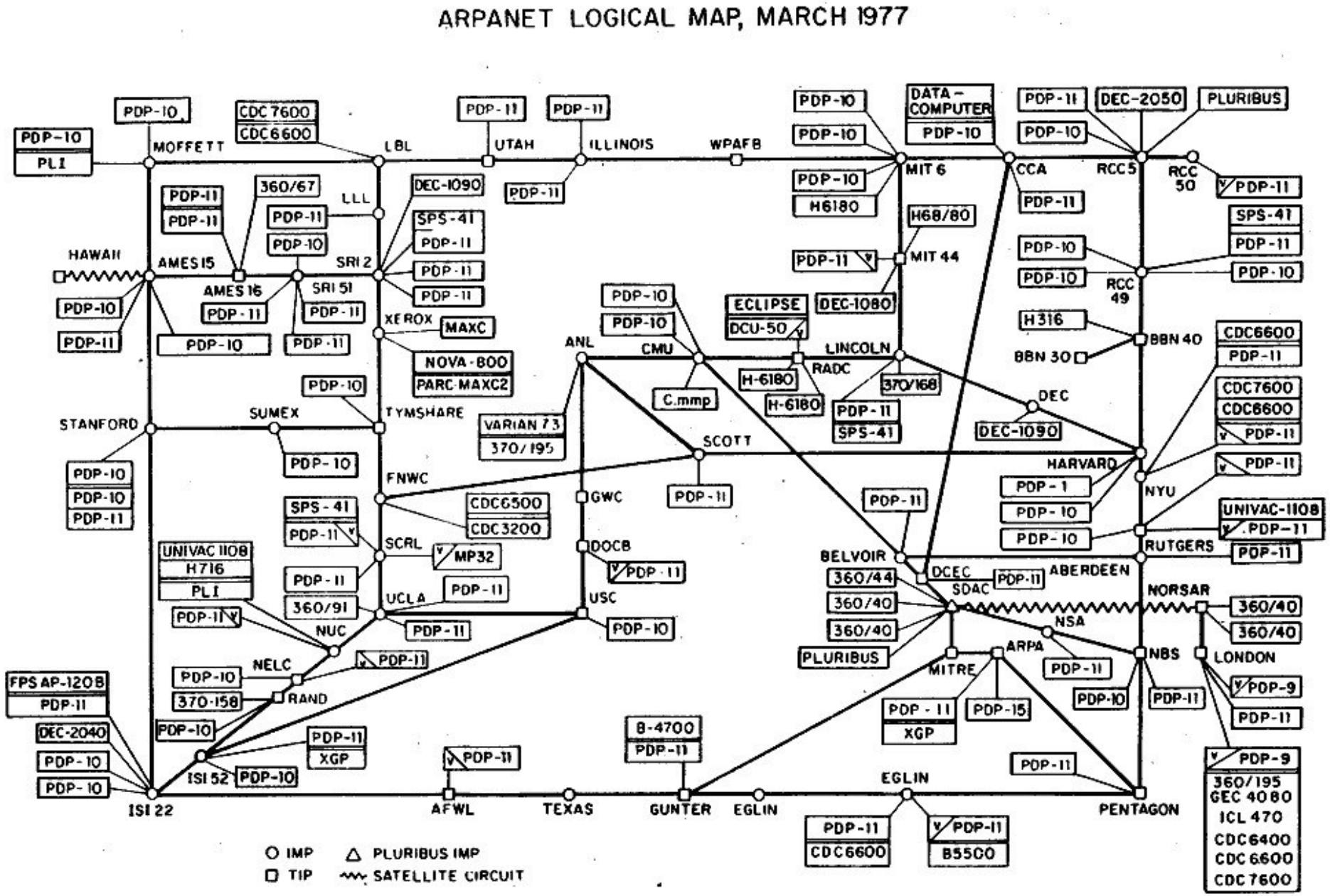
1. Curiosity
2. Impact on our world
3. Job prospects!

From this experimental network (~1970)…



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

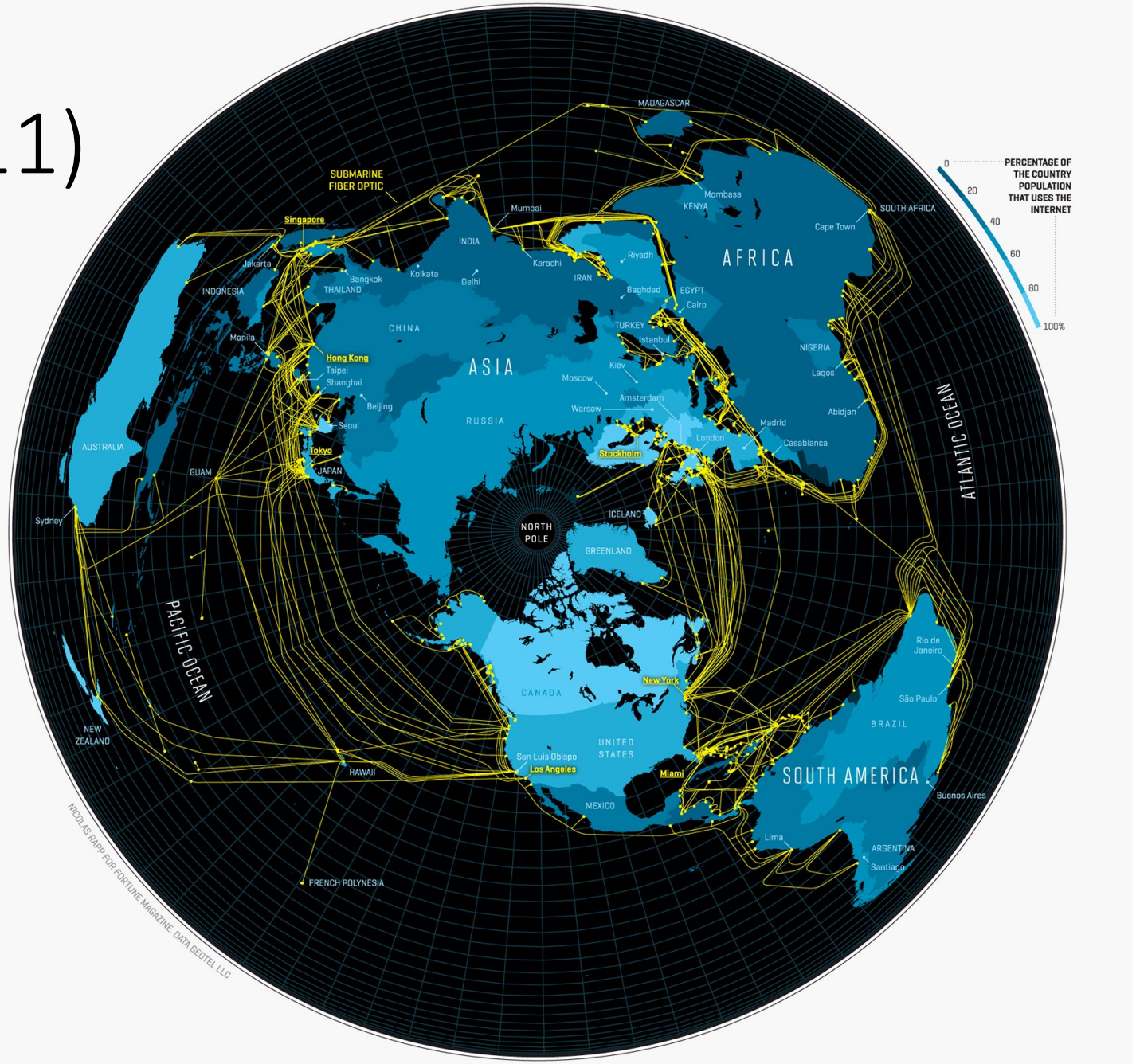
To this…



(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)

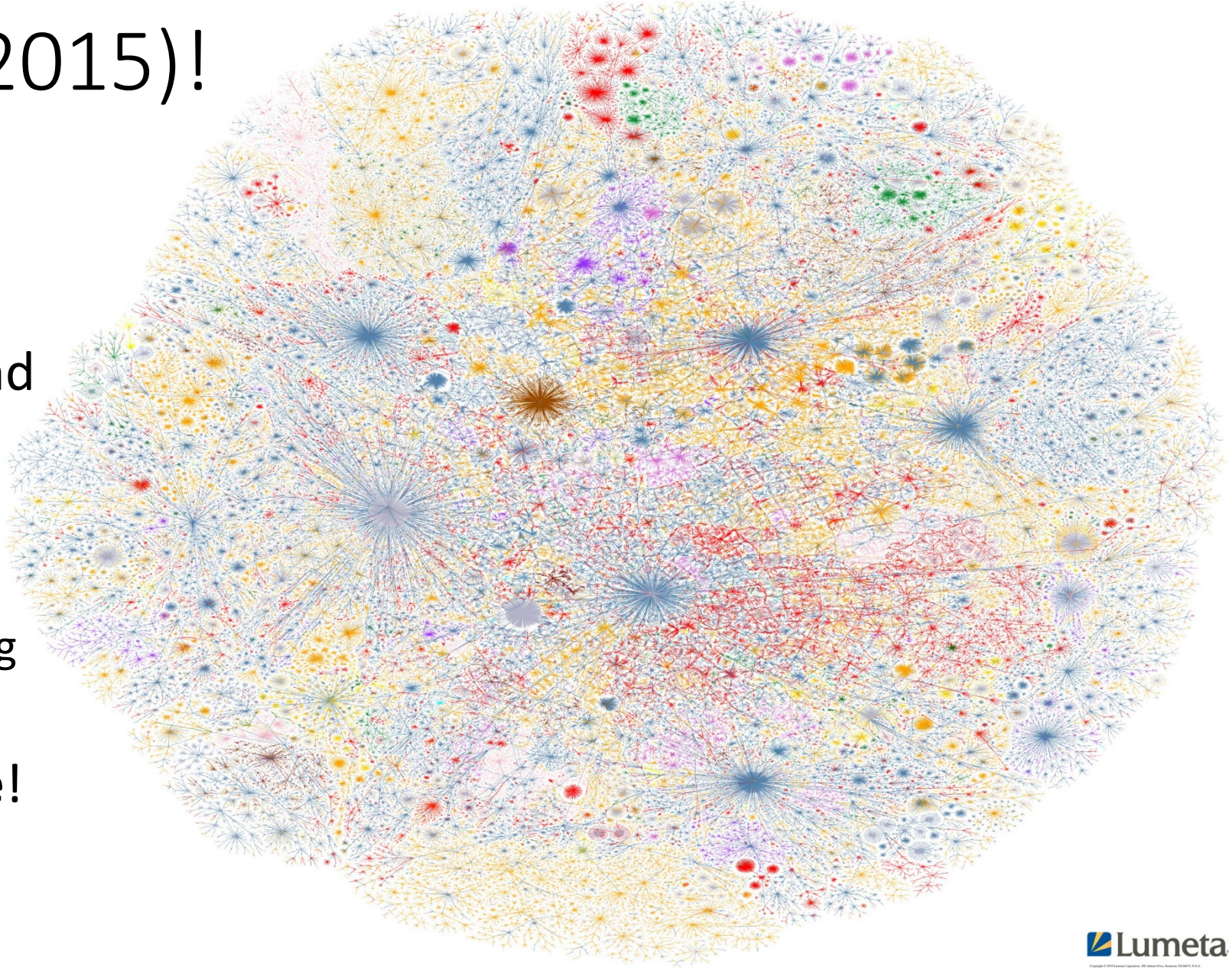
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

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
Baghdad
EGYPT
Cairo
Jakarta
Bangkok
THAILAND
Kolkata
Delhi
INDONESIA
CHINA
TURKEY
Istanbul
Manila
Hong Kong
Taipei
Shanghai
Beijing
ASIA
Kiev
Moscow
Amsterdam
Warsaw
RUSSIA
NIGERIA
Lagos
Abidjan
Madrid
London
Casablanca
Seoul
Tokyo
JAPAN
AUSTRALIA
GUAM
Stockholm
ATLANTIC OCEAN
Sydney
NORTH POLE
ICELAND
GREENLAND
PACIFIC OCEAN
Rio de Janeiro
São Paulo
BRAZIL
New York
CANADA
NEW ZEALAND
UNITED STATES
San Luis Obispo
Los Angeles
HAWAII
Miami
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 – 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

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Architectures

Lots of ways to build networks with different **tradeoffs**

- Internet -- open access
  - Flexibility++, Privacy++, Security--
- Cellular -- identity first
  - Flexibility--, Privacy --, Security++,

"On the Internet, nobody knows you're a dog."

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

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