CSE 461:
Computer Networks

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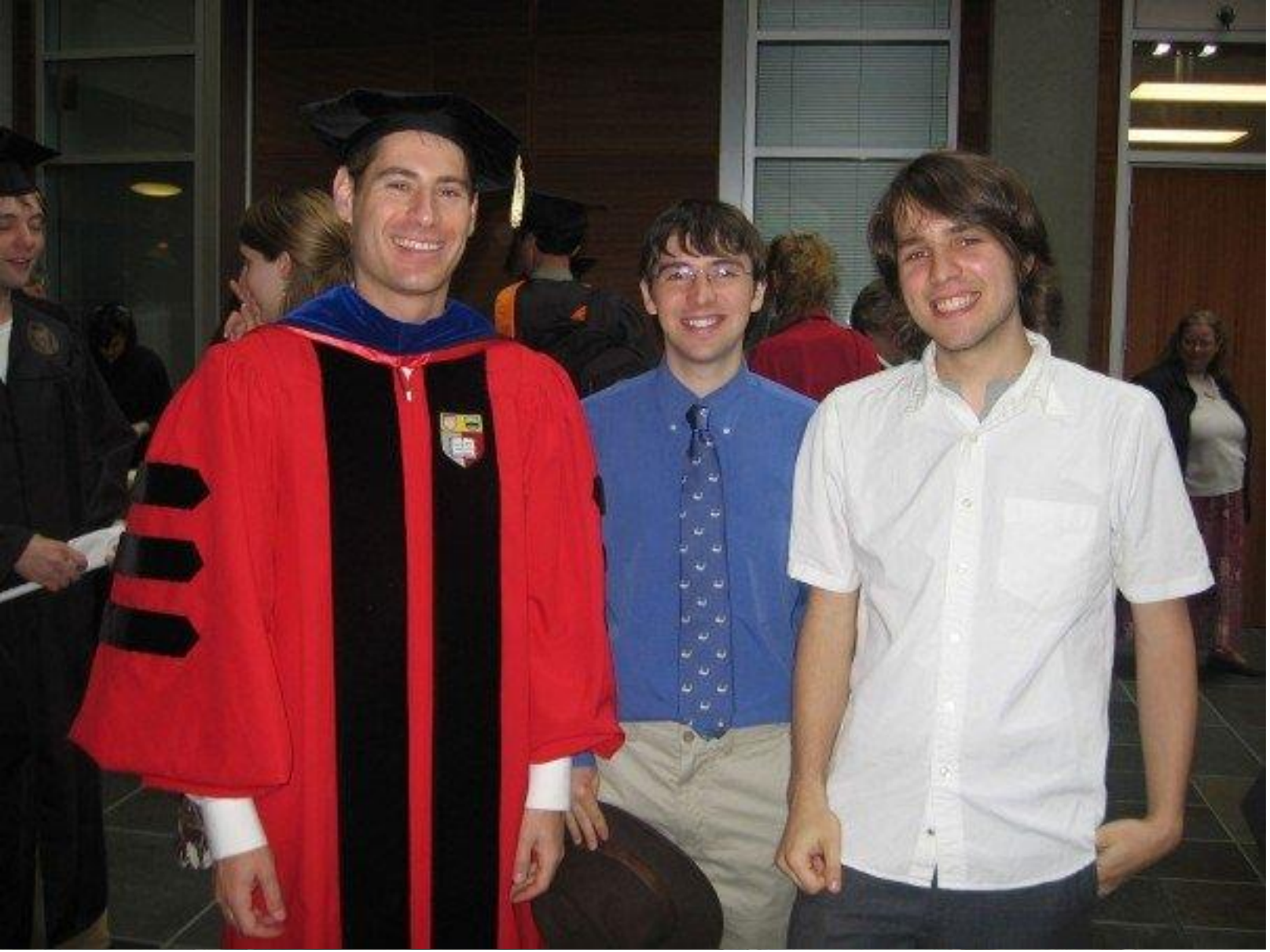
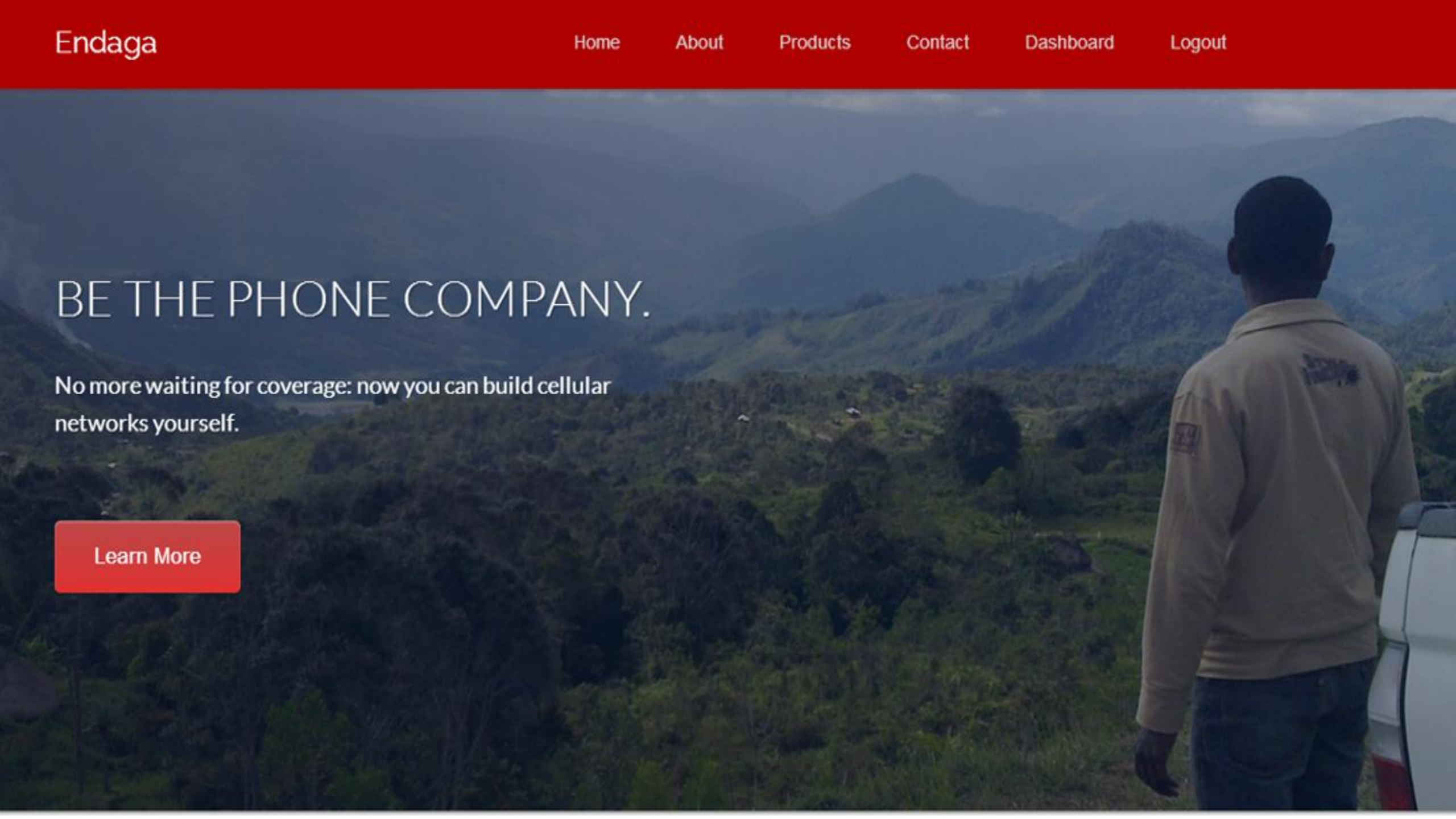
Rithik Duggempudi - rrd3@cs
Kyle Yan- kyleyan@cs
Dao Yi - daoyee@cs
Jeff Zhao - zhaox27@cs

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


Endaga
Home
About
Products
Contact
Dashboard
Logout
BE THE PHONE COMPANY.
No more waiting for coverage: now you can build cellular networks yourself.
Learn More

26
3
10
Photo
Facebook

TAs Now!

Pat Kosakanchit

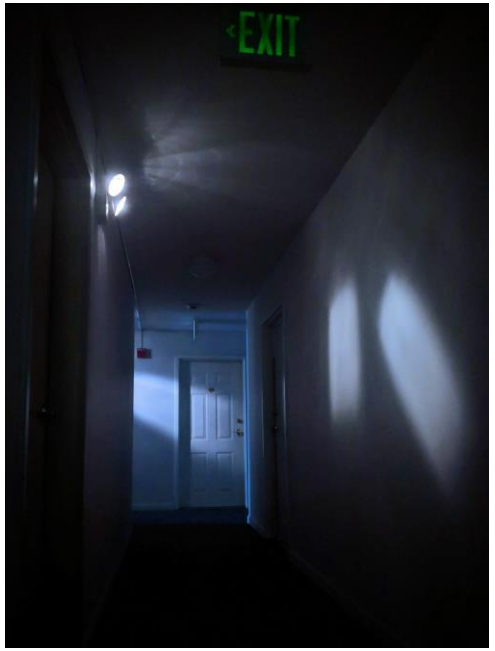
- BS/MS student
- Currently located in Thailand (15 hours ahead of Seattle)
- Did undergraduate research at ICTD lab on Community LTE Networks
- Love street photography and Thai food

Kyle Yan

- BS/MS student; still here in PST
- Doing research in NLP
- Miss traveling; plan to visit NYC and Japan once quarantine ends
- Miss eating out; favorite Seattle restaurant: Ishoni Yakiniku
- Miss campus; favorite campus spot: the Alberg Terrace (on 6th floor of CSE1)

Dao Yi

- BS/MS student
- Love cooking; except deep fry
- Miss theater; waiting Dune
- Hate corona
- Room in pandemic



Jeff Zhao

- BS/MS student, my last quarter at UW
- Computer Security & Networks
- Big fan of *A Song of Ice and Fire*
- Spring in Vienna, 2017

Rithik Duggempudi

- Senior, last quarter at UW
- 2nd time TAing Computer Networks
- Love anything Sci-fi
- Trying to improve cooking skills due to the pandemic

Class Structure

Grading

- **Assignments: 10%**
  - Reading from the book (Peterson OSS textbook)
  - Canvas homework (try as many times as you want)

Grading

- Assignments: 10%
- **Surprise Quizzes: 5%**
  - Short unannounced timed quizzes during the quarter
  - Conducted on gradescope
  - Drop lowest
  - Alternative times for people off time-zone

Grading

- Assignments: 10%
- Surprise Quizzes: 10%
- **3 Projects: (15 + 15 + 15)%**
  - Use canvas groups (feel free to start making groups now)
  - 3 coding exercises:
    - Socket programming
    - Link and Network layer behavior
    - TCP Bufferbloat
      - New project!
      - May default to HTTP Proxy

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (15 + 15 + 15)%
- **Midterm: 15%**
- **Final: 25%**

Grading

- Assignments: 10%
- Surprise Quizzes: 5%
- 3 Projects: (15 + 15 + 15)%
- Midterm: 15%
- Final: 25%

Late Policy: Each **person** gets three late days. Late days will be decided at end of quarter and selected as to have the most positive impact.

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, his talks are online
  - I will be posting my own slides right before lecture as well
- No Section this week.

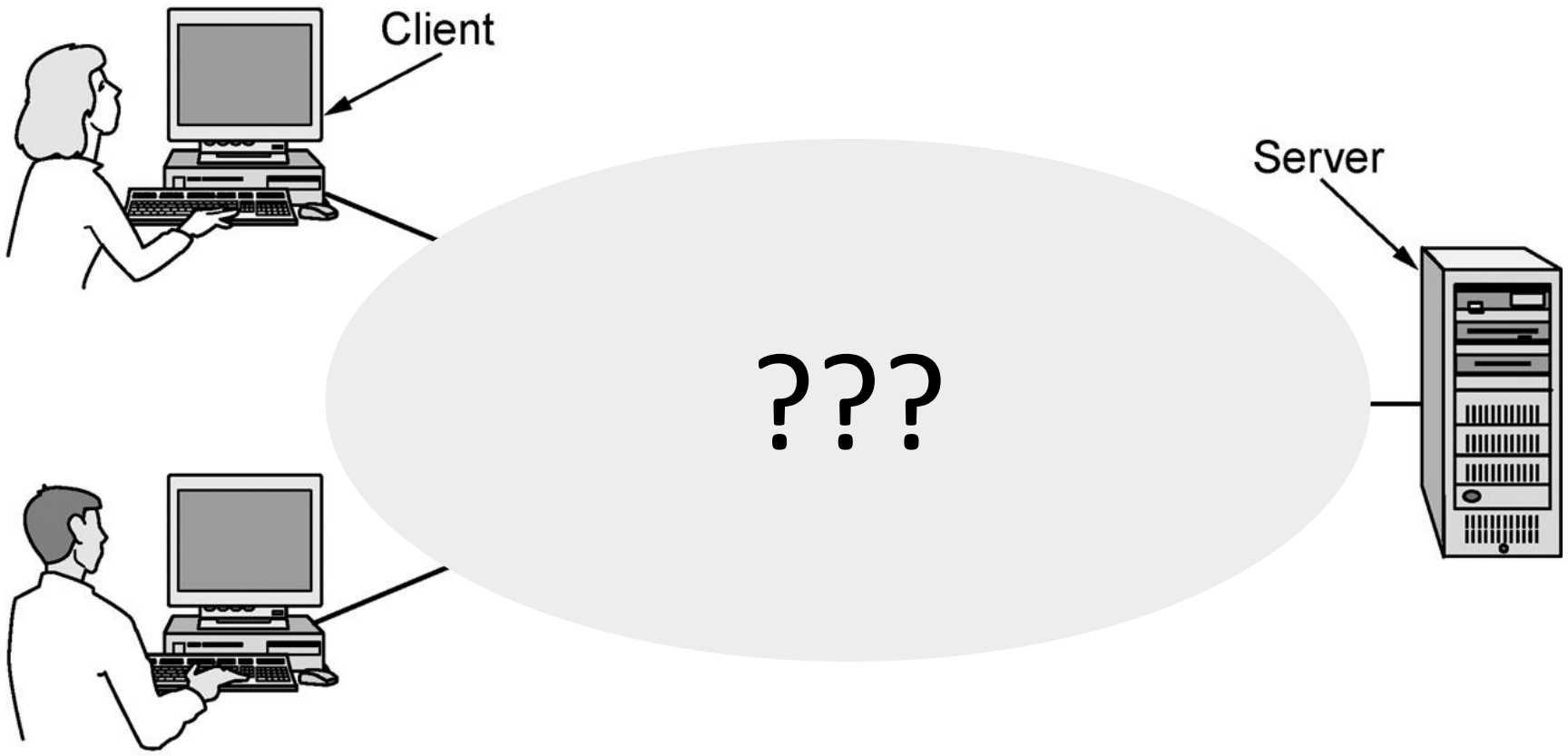
COVID Effects

- Things are hard now
- Our goal is to be generous but fair
  - Chat with us if there’s a problem in any particular direction
    - We’ll try to help
- Be generous back
  - Staff are people too
  - For instance, daycare gets cancelled

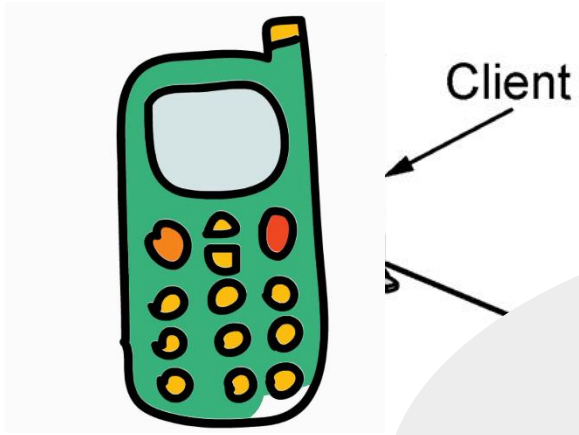
Questions?

CSE 461: Computer Networks

Focus of the course



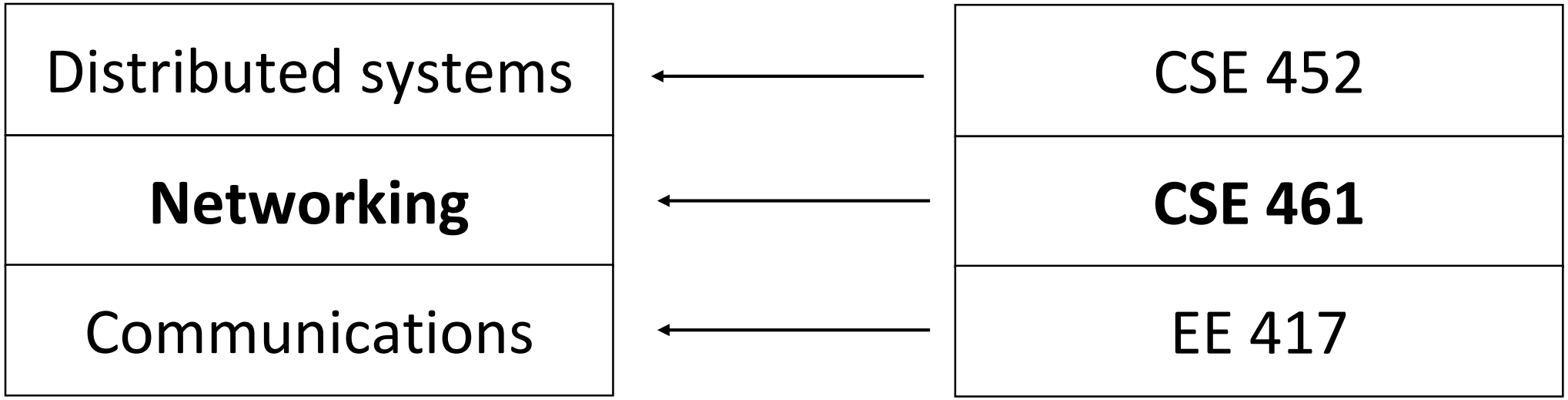
Focus of the course (in today's terms)



???

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)

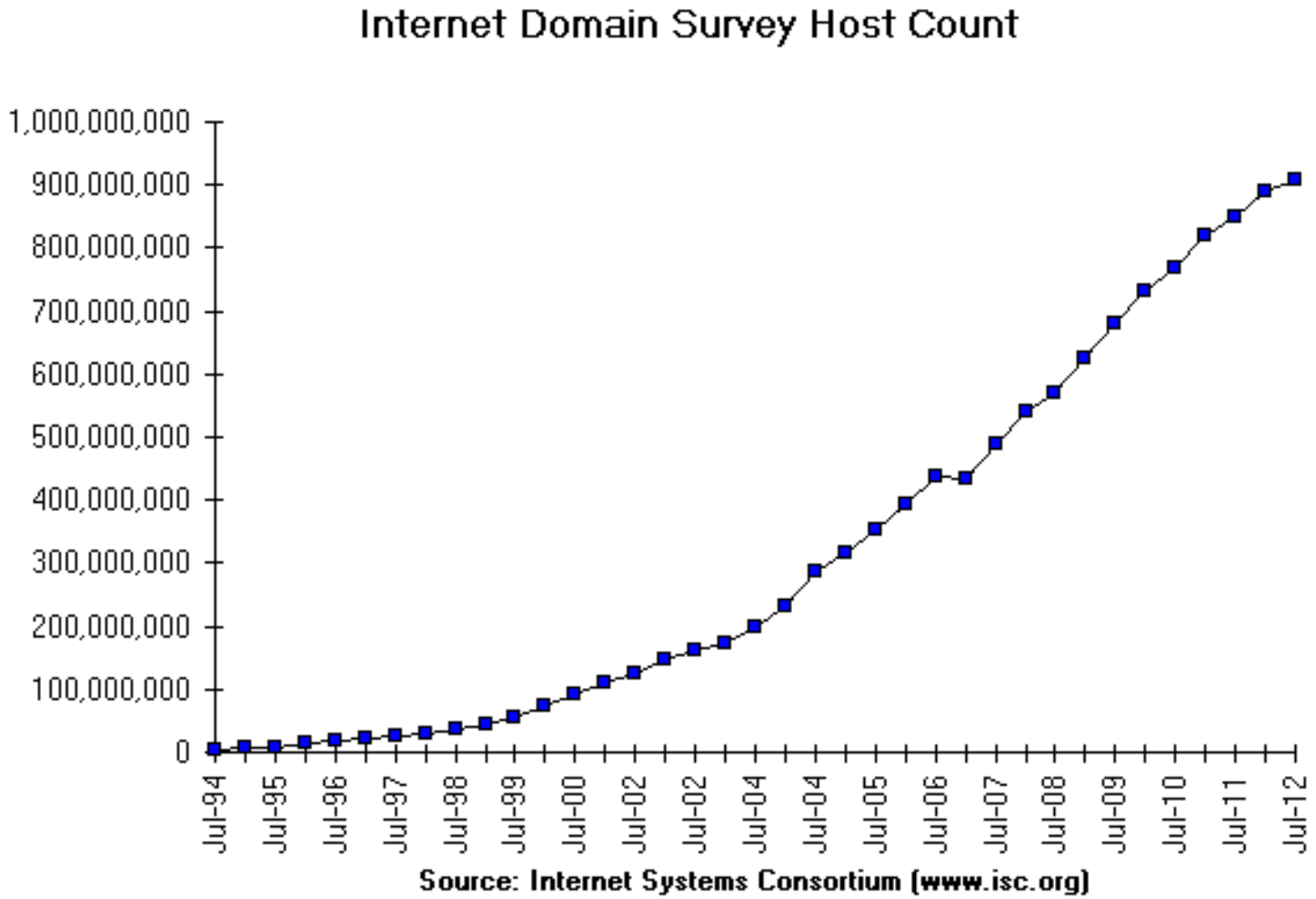
Key problem	**Example solutions**
Reliability despite failures	Codes for error detection/correction (§3.2, 3.3) Routing around failures (§5.2)
Network growth and evolution	Addressing (§5.6) and naming (§7.1) Protocol layering (§1.3)
Allocation of resources like bandwidth	Multiple access (§4.2) Congestion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



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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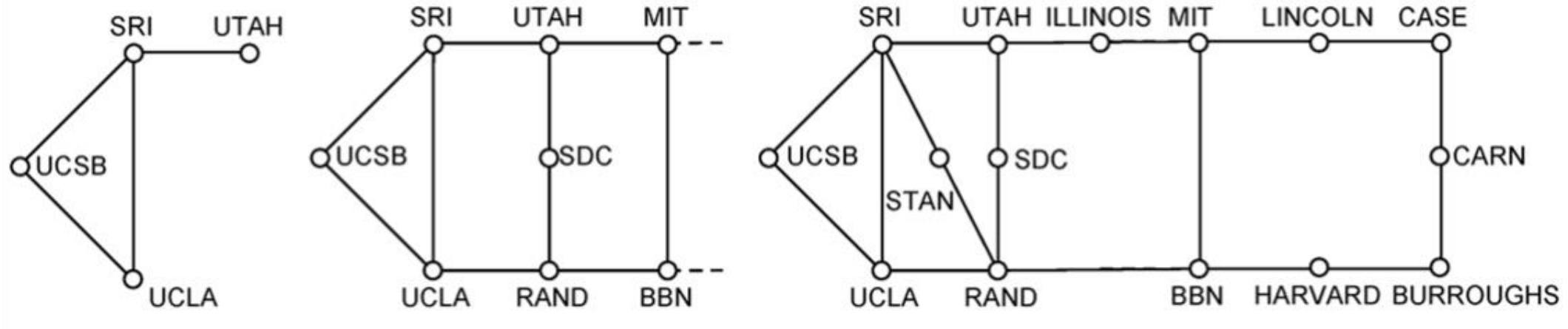
Who cares about the internet?

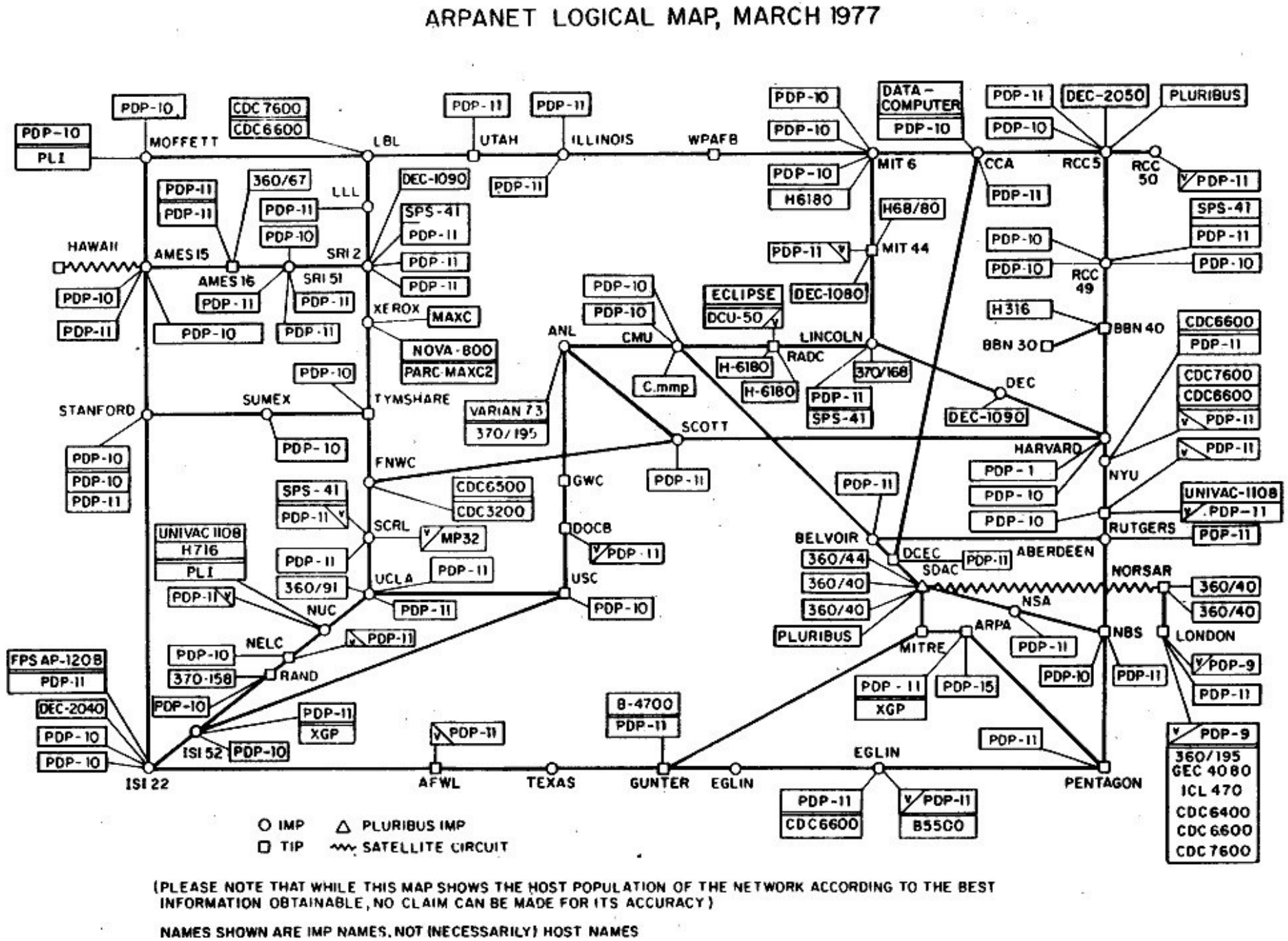
1. Curiosity
2. Impact on our world
3. Job prospects!

From this experimental network (~1970)…

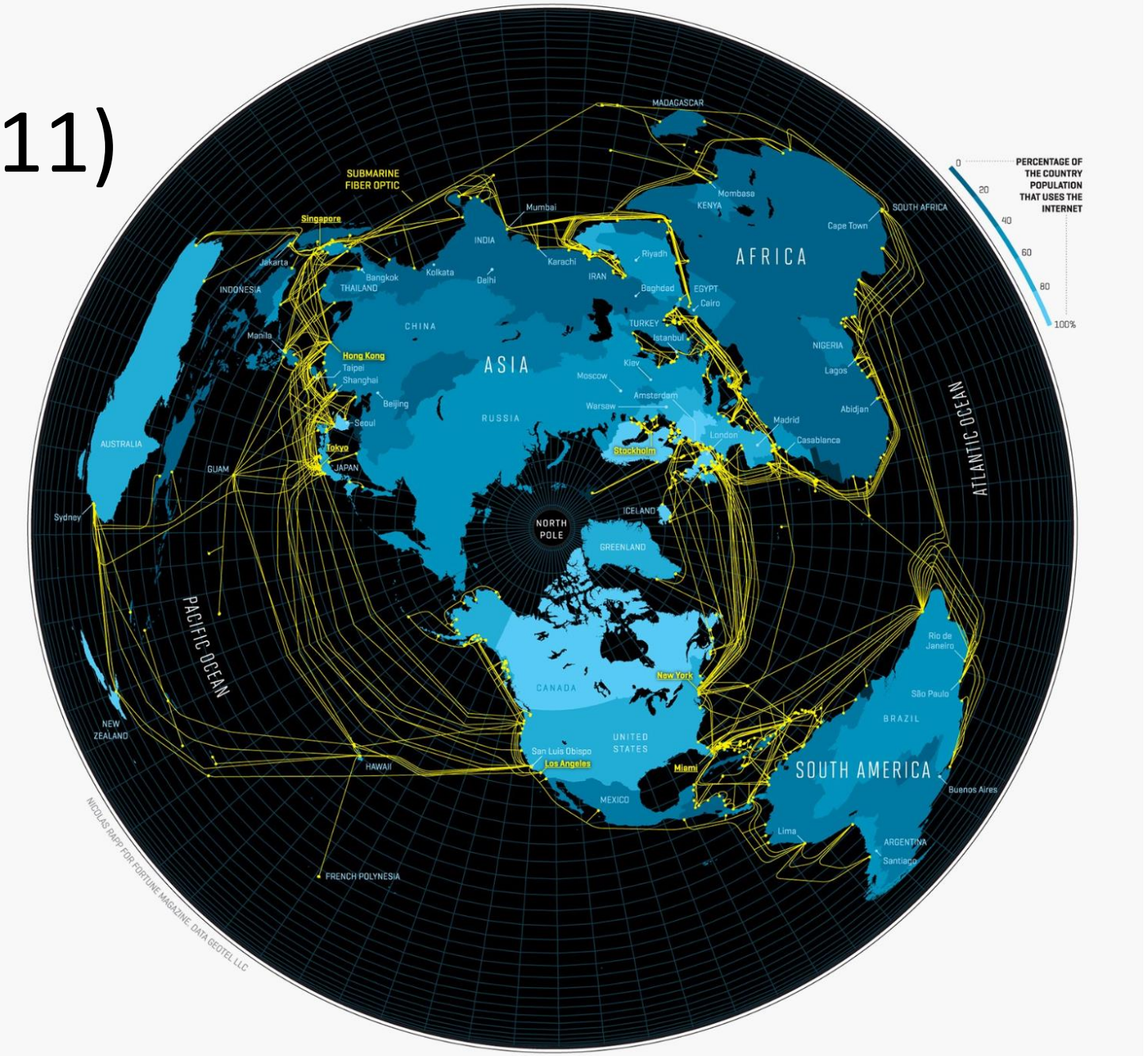


(a) Dec. 1969. (b) July 1970. (c) March 1971.

To this…

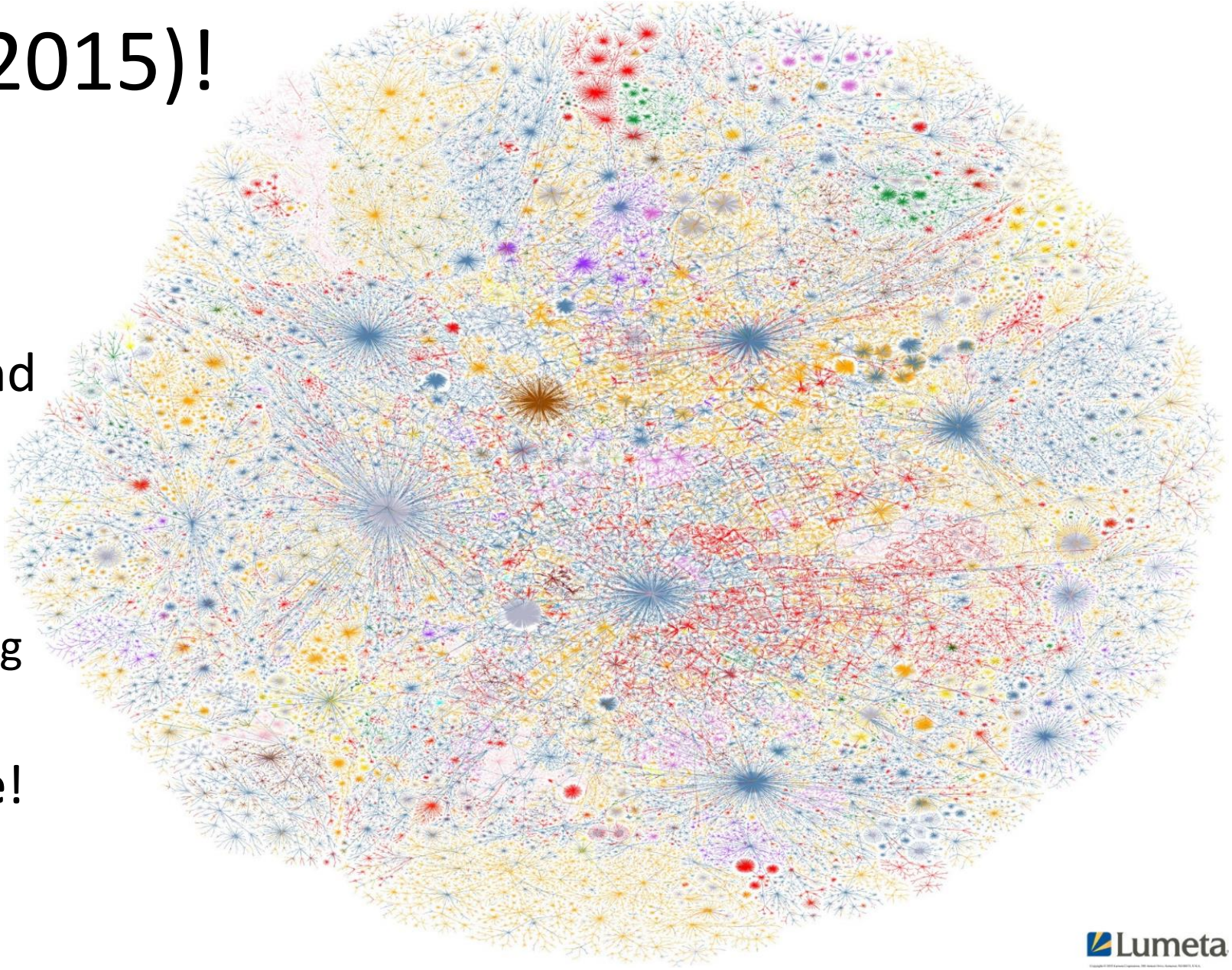

ARPANET LOGICAL MAP, MARCH 1977
MOFFETT
LBL
UTAH
ILLINOIS
WPAFB
MIT 6
CCA
RCC 5
RCC 50
HAWAII
AMES 15
AMES 16
SRI 2
SRI 51
LLL
XEROX
MAXC
NOVA-800
PARC-MAXC2
STANFORD
SUMEX
TYMSHARE
FNWC
SCRL
UCLA
NUC
NELC
RAND
ISI 52
ISI 22
AFWL
TEXAS
GUNTER
EGLIN
ANL
CMU
C.mmp
VARIAN 73
370/195
SCOTT
GWC
DOCB
USC
ECLIPSE
DCU-50
RADC
LINCOLN
MIT 44
H68/80
H6180
DEC-1080
370/168
DEC
DEC-1090
H316
BBN 30
BBN 40
RCC 49
CDC6600
CDC7600
HARVARD
NYU
RUTGERS
ABERDEEN
BELVOIR
DCEC
SDAC
NORSAR
NSA
ARPA
MITRE
NBS
LONDON
PENTAGON
UNIVAC 1108
H716
PLI
360/91
360/67
360/44
360/40
370-158
DEC-2040
FPS AP-120B
XGP
B-4700
B5500
PLURIBUS
DATA-COMPUTER
DEC-2050
PDP-10
PDP-11
PDP-1
PDP-9
PDP-15
360/195
GEC 4080
ICL 470
CDC6400
CDC 6600
CDC 7600
CDC 7600
CDC6600
CDC6500
CDC3200
MP32
SPS-41
DEC-1090
H-6180
H-6180
H6180
PLI
IMP
TIP
PLURIBUS IMP
SATELLITE CIRCUIT
(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
Jakarta
INDONESIA
Mumbai
INDIA
Karachi
Riyadh
IRAN
Baghdad
EGYPT
Cairo
Bangkok
THAILAND
Kolkata
Delhi
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 – 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++

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!

Let’s have a good remote learning quarter together.