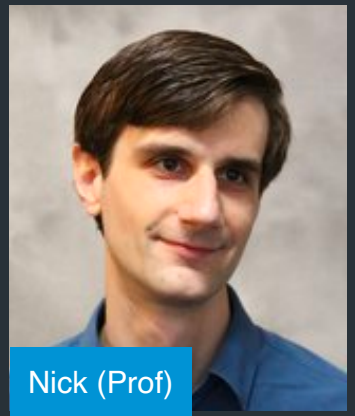
CSCI 1680: Computer Networks

Nick DeMarinis

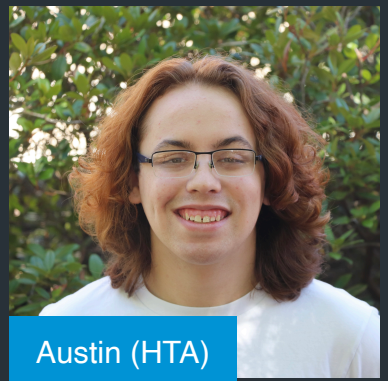
https://cs.brown.edu/courses/cs1680

Based partly on lecture notes by Rodrigo Fonseca, David Mazières, Phil Levis, John Jannotti, Peterson & Davie

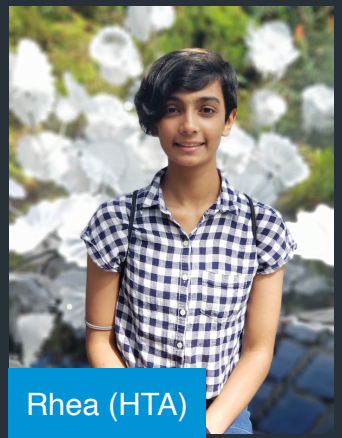
Cast



Nick (Prof)



Austin (HTA)



Rhea (HTA)

Richard (HTA)

Brandon (UTA)

Kenta (UTA/STA)

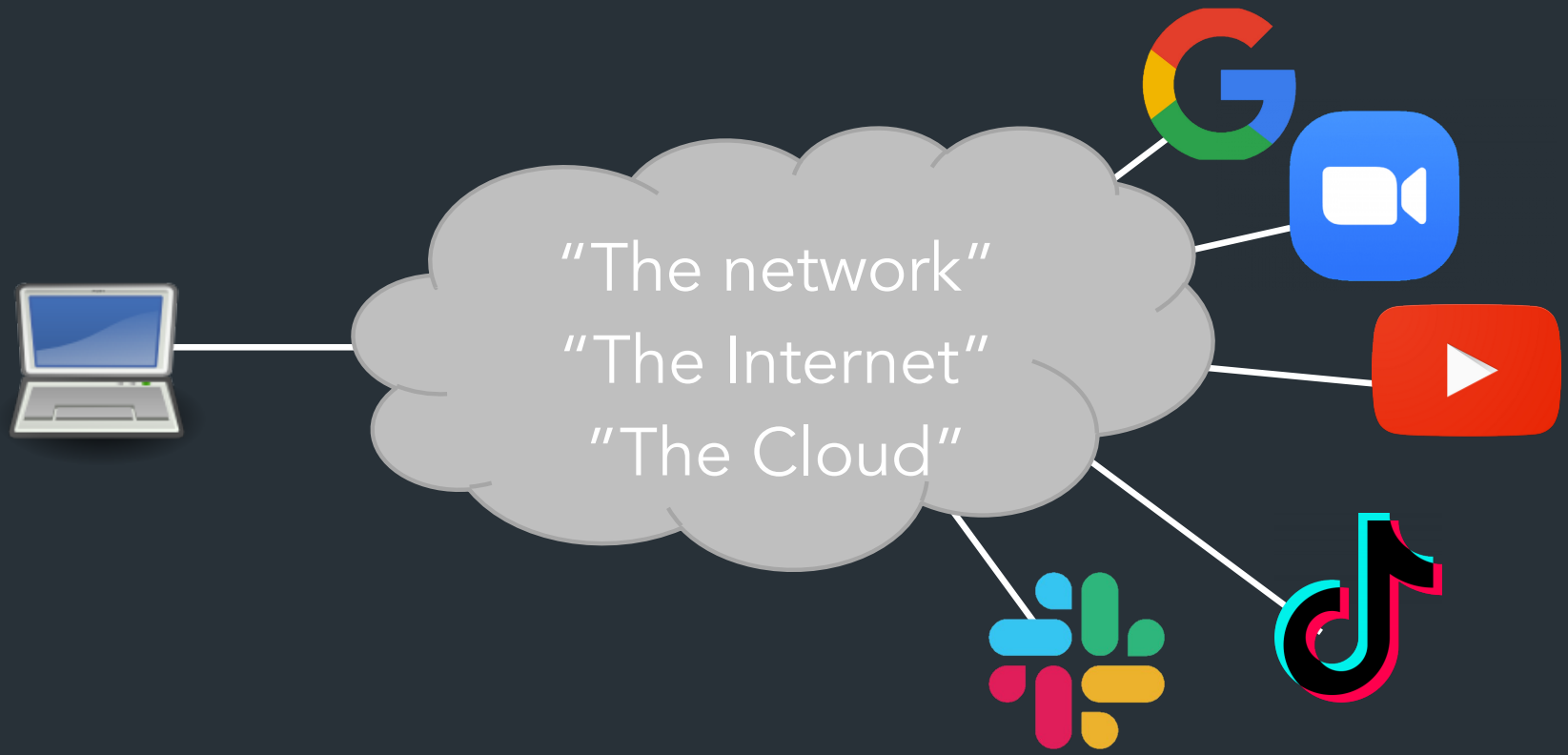
Alex (UTA)

Madhav (UTA/STA)

Vignesh (UTA)

Nathan (UTA)

Why are we here?



You (the user)

Applications

Why should you care?

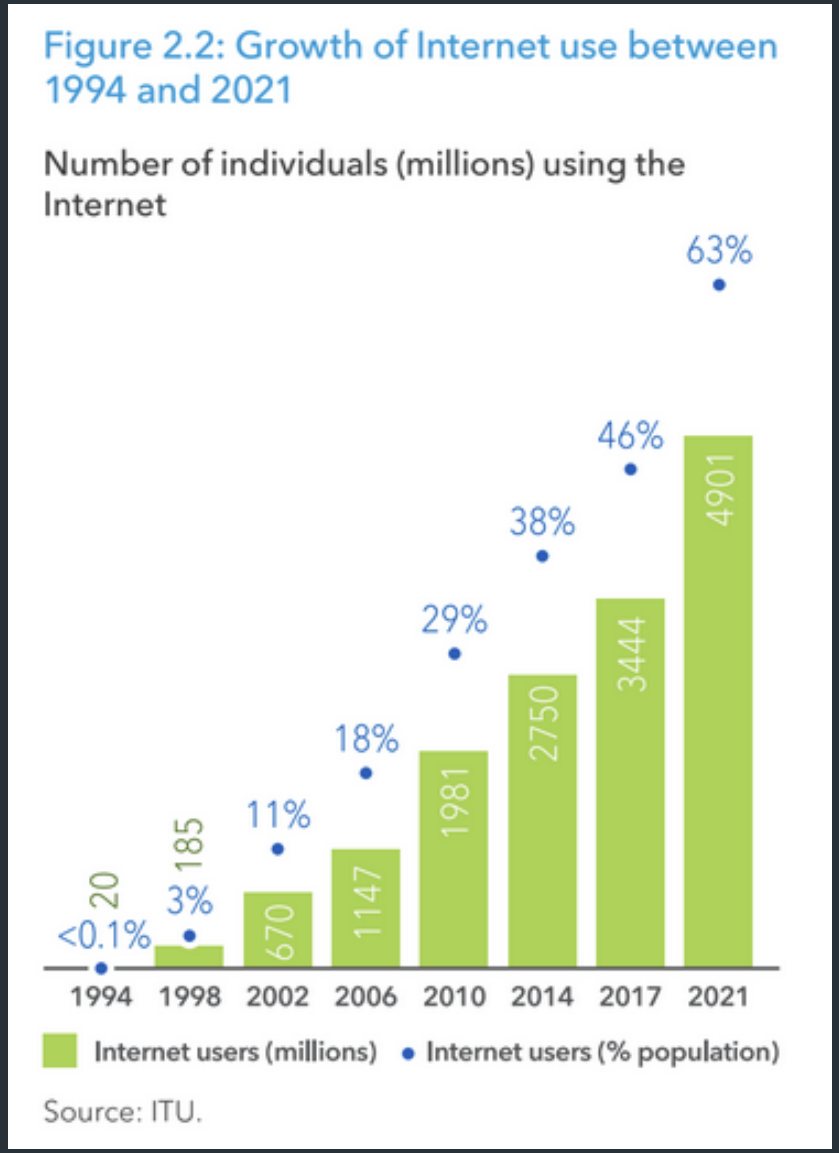
Networks have mostly disappeared...

...by being everywhere!

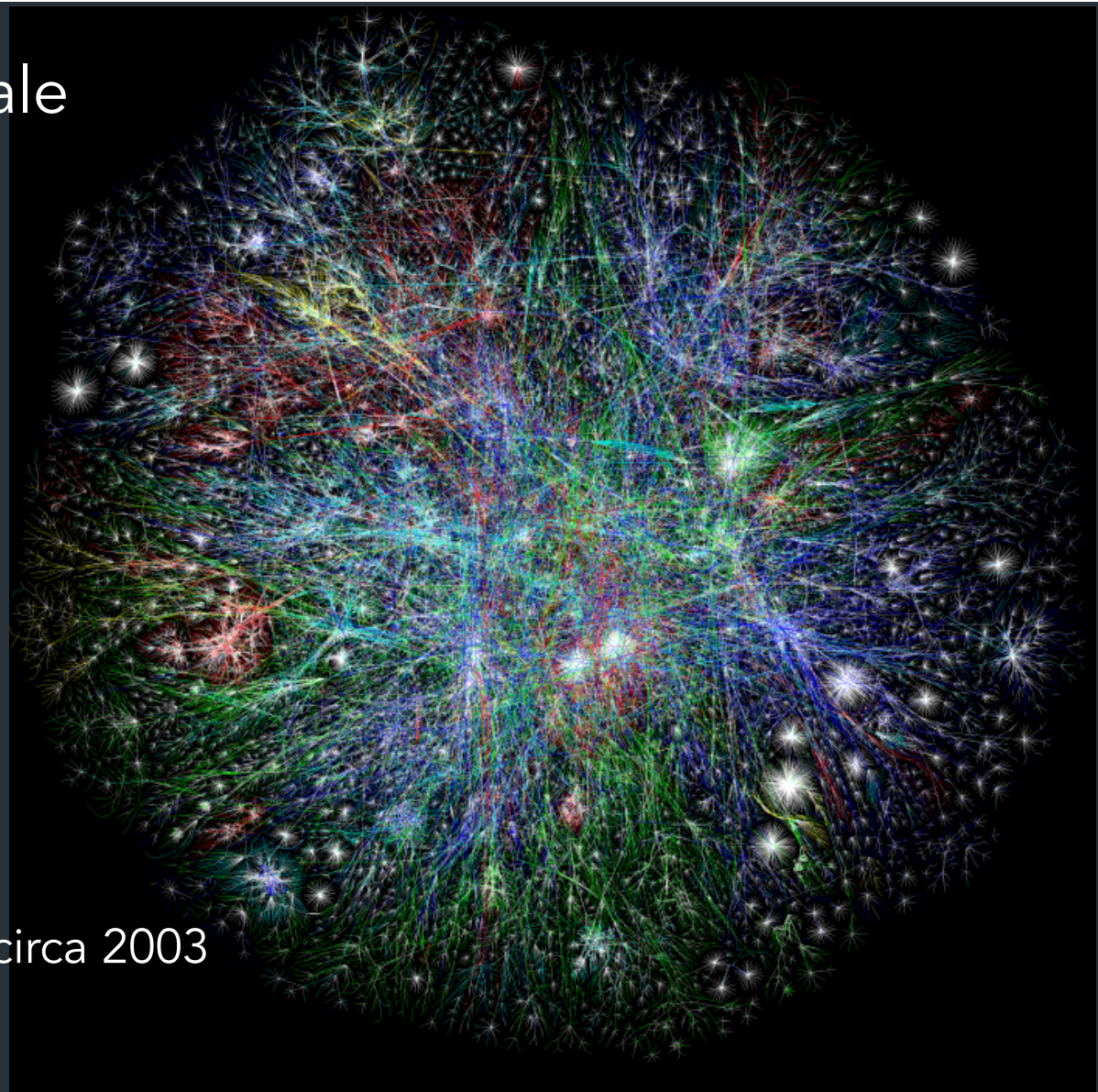
Almost all applications are cloud-based => new challenges in system and software design

- How do we build robust networked applications?
- How does the "quality" of network connectivity affect users?
- What to do when networks fail?

Challenge: Scale



Challenge: Scale

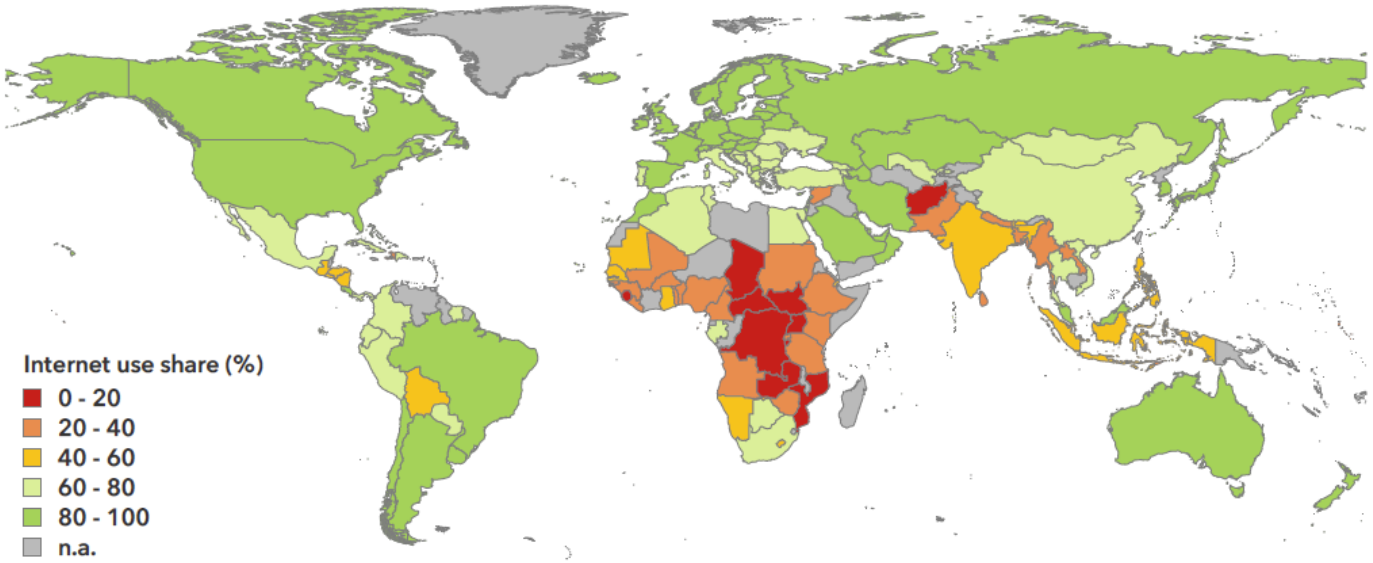


Map of the Internet, circa 2003
(via Traceroute)
OPTE project

Challenges: Access

Figure 2.5: The global digital divide

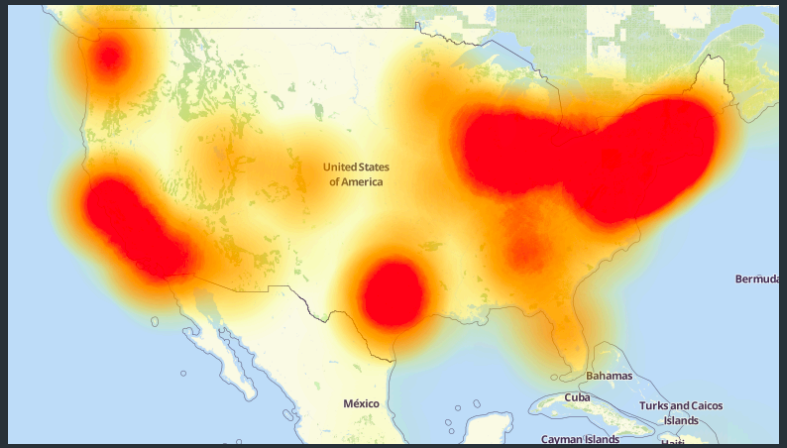
Percentage of the population using the Internet, 2020



Challenge: Security

Mirai Botnet (2016)

- Vulnerable DVRs, Home Routers, Cameras disrupted Dyn
  - DNS provider for Twitter, Netflix, Reddit, others
- Largest denial-of-service (DDoS) attack at the time, over 1TBit/s



Challenges: Politics and Oversight

DDoS attack that disrupted internet was largest of its kind in history, experts say

RYAN SINGEL SECURITY FEB 25, 2008 10:37 AM

Pakistan's Accidental YouTube Re-Routing Exposes Trust Flaw in Net

Explainer

Facebook outage: what went wrong and why did it take so long to fix after social platform went down?

TECHNOLOGY

How Was Egypt's Internet Access Shut Off?

DYLAN TWENEY BUSINESS FEB 3, 2011 9:58 AM

No Easy Fixes as Internet Runs Out of Addresses

Editors given c provid

MARVIN AMMORI OPINION JAN 18, 2014 7:00 AM

Internet Freedom Day: This Year We Go to War for Net Neutrality

How Russia Took Over Ukraine's Internet in Occupied Territories

By Adam Satariano and
Graphics by Scott Reinhard
Aug. 9, 2022

Why are we here?

Goal: learn concepts underlying networks, and their massive impact on computing and society

- How do networks work? What can one do with them?
- Gain a basic understanding of the Internet
- Gain experience writing protocols
- Tools to understand new protocols and applications
- Tackle technical and social challenges with building a global network

"From two communicating machines to the entire Internet"

How will we do this?

- 4 Programming Projects (65%)
- ~6 Written homeworks (35%)
- No exams!

Mechanics: Resources

- Lecture slides/notes: authoritative content
- Tools
  - Course website (notes, handouts, guides): https://cs.brown.edu/courses/csci1680/f23
  - Discussions: **Ed**
  - You are responsible for checking Ed for announcements/updates

Complete HW0 (on website) ASAP so we can add you to resources!

Prerequisites

- CS33/CS1330, CS300/CS1310 (or equivalent)
- You should have seen systems programming and basic OS concepts before
  - Threads, processes, Kernel vs. Userspace
  - Bits and bytes, memory management, synchronization, …
- Remote section: if you need it, please fill out the form

If you aren't sure if the course is right for you, please talk to us!

Lectures

- T/Th 9-10:20am, CIT368
- Recorded and streamed live on zoom
- Lots of live demos, time for discussion, etc.

I encourage you to attend synchronously, but I won't think less of you if you don't

Mechanics: Homeworks

- Conceptual problems based on lecture material
- Maybe a few network experiments
- Format subject to change, depending on workload
  - Upper bound: 3-4 short-answer problems over 2wks
  - Lower bound: 1-2 very short problems over 1wk

More updates on this after enrollment settles

Mechanics: Projects

- Build fundamental protocols and client/server apps from the ground up
- 4 Programming projects
  - Snowcast: streaming music server
  - IP: build your own networking library
  - TCP: extending your IP
  - Final (short, TBD)
- First project is individual, others in groups of 2

You get: lots of freedom to design your own system

Mechanics: Projects

- This is where you will spend most of your time

- Learn how to design big systems… that happen to use the network
  - No stencil code! You get to design everything
  - We will provide lots of examples and meetings to help

What this means

nick: no stencil code

everyone:

How we support you on projects

- Lots of posted code examples
- Live demos during class
- "Warmup" tutorials to get you started with mechanics
- Gearups at least once per project
  - When scheduled: Thursdays 5-7pm in CIT368 (+ Zoom, recording)
- Milestone meetings with TA to check in about design
- Interactive grading => more partial credit

Most of our time is spent here too

Brief history of this class

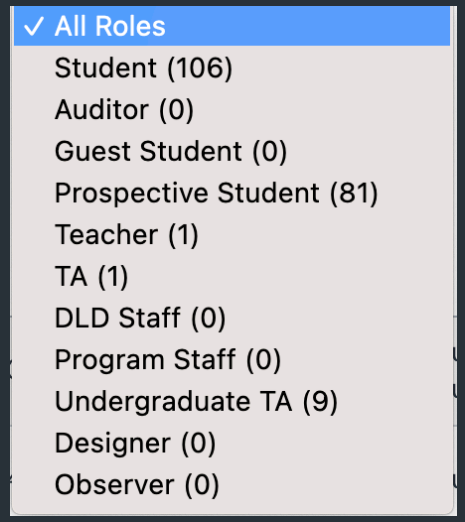
Fall 2019: ~35 students

Spring 2022:* Nick joins as instructor (Cap at 40 students)
(+ demos, examples, tutorials, dev environment)

Fall 2022: Second new offering (Cap at 40 students)
(+ warmups/tutorials)

Fall 2023: Uncapped!
(+ Gearups)

* THIS WAS A ONE-TIME THING. CS1680 IS USUALLY ONLY OFFERED IN THE FALL.



Our course is now more stable, but we're still evolving and learning how to scale.

We may adjust course content/policies over time, paying equal attention to:

- Making sure we provide support for everyone
- Managing TA workloads

We value your feedback! (Ed, email, anonymous form, …)

Asking for help

- Collaboration: work with your peers!
  - Collaboration policy on course website
  - I encourage you to collaborate, **so long as the code you write down is your own**

- Your health is most important
  - If you have concerns, feel free to talk to us

Why should you listen to me?

- My background
  - Received my PhD from Brown in 2021
  - My areas: software security, networking, network security
  - My second year as Lecturer, was a long-time TA before that

- No one knows everything about networks, and I am no exception!

Feedback

- Post on Ed, Anonymous feedback form on website, come to hours, …

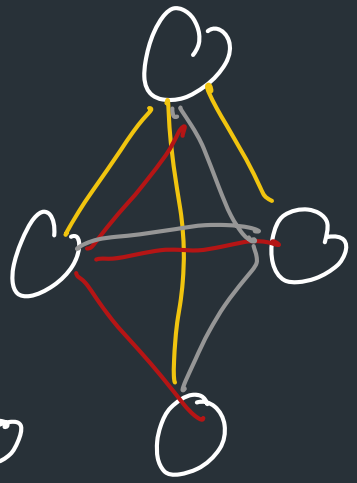
- Please tell us how we can improve the course!
  - Clarity of assignments
  - Improving accessibility
  - Concerns about presentation of content, interactions with staff

We are always looking for ways to improve support

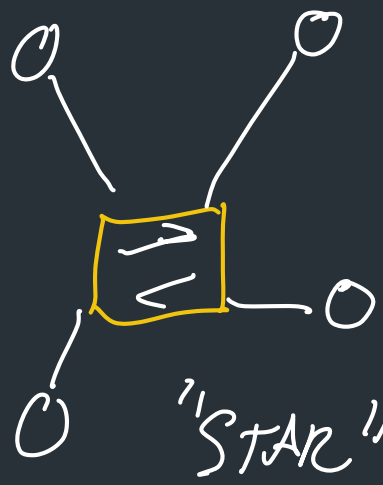
Building Blocks

- Nodes: Computers (hosts), dedicated routers, …
- Links: Coax, twisted pair, fiber, radio, …

How to connect more nodes?

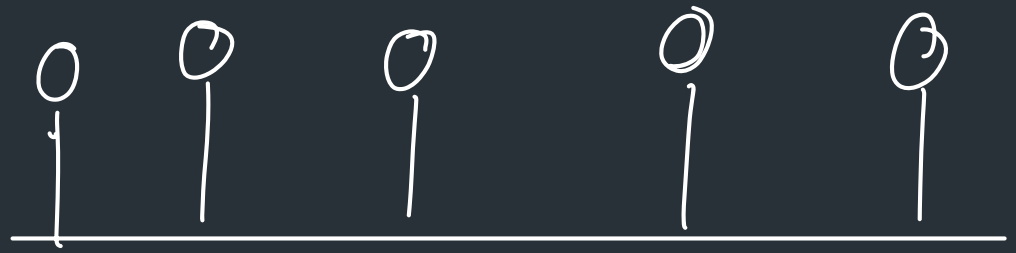


MULTIPLE LINKS



"STAR"

SHARED MEDIUM



NEED DIFF WAYS TO SHARE RESOURCES

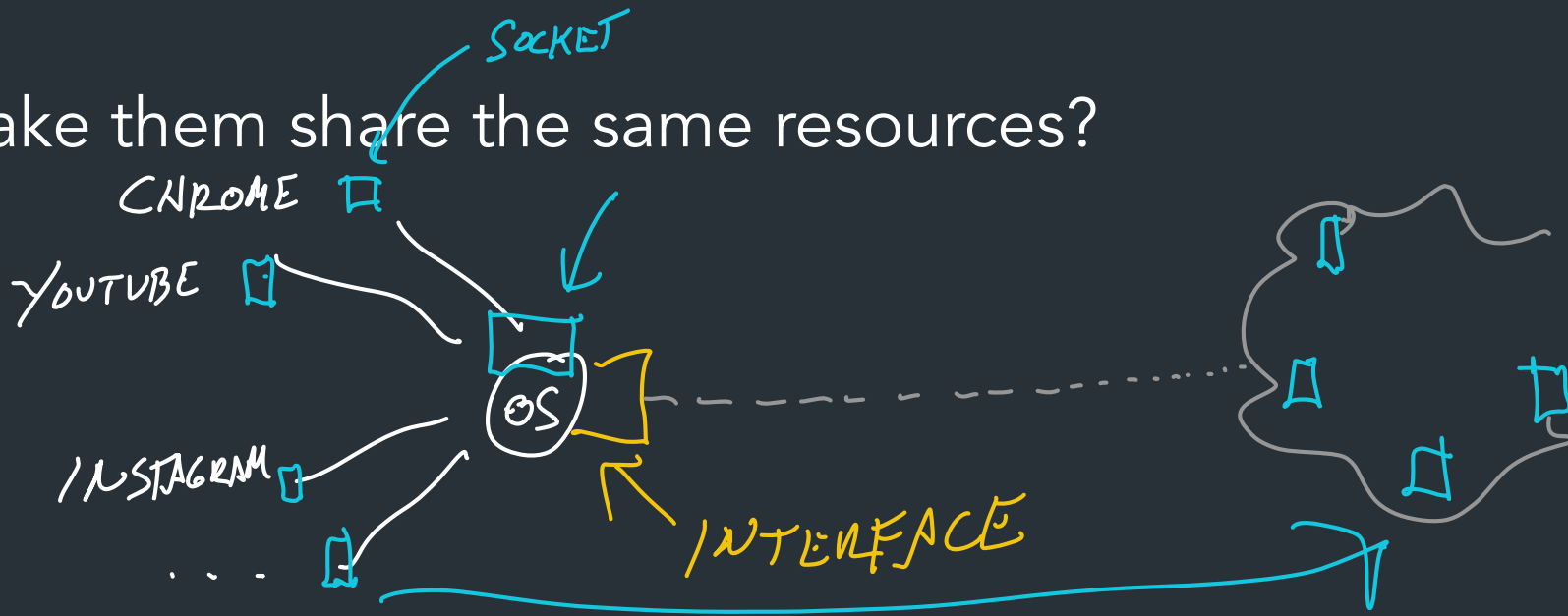
Multiplexing

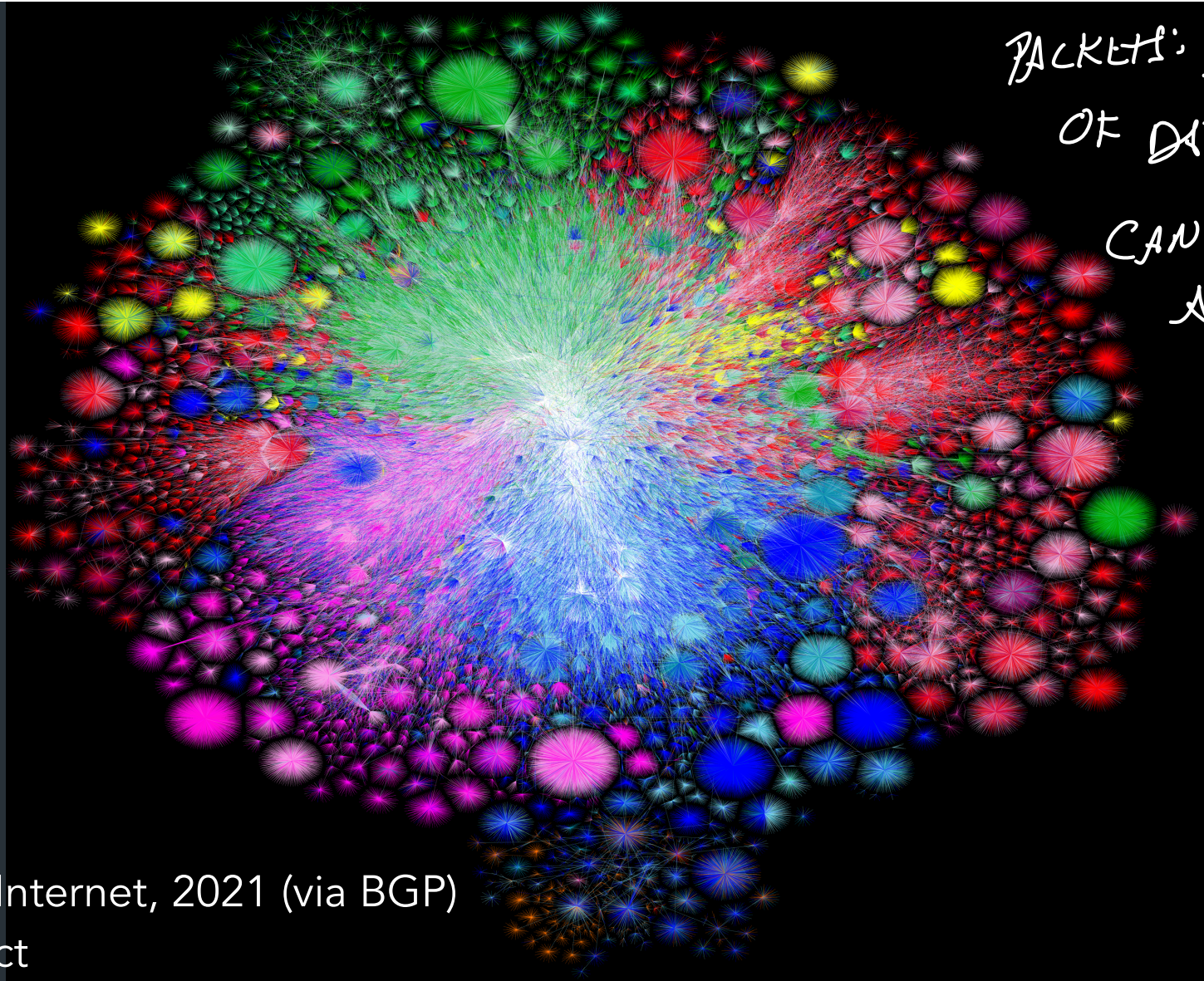
- Mechanisms for simultaneous communication on the same channel / MEDIUM
  - (or at least nearly simultaneous)

- Lots of different methods, depending on the medium and abstraction

How do you connect apps?

- Your computer runs multiple applications
- How to make them share the same resources?





Map of the Internet, 2021 (via BGP)
OPTE project

For next class

- HW0: Survey (please fill out ASAP)
- Project 0: dev environment setup (due next Thursday)
- Project 1: out on Tuesday
  - Gearup: Thursday, Sept 14, 5-7pm in CIT368 (+ Zoom, recorded)