CS 43: Computer Networks
Course Introduction

Kevin Webb
Swarthmore College
September 5, 2017

Please sit towards the front, next to other students!

What This Class Is About

- How networks (focus on the internet) work
- How applications that use networks work
  - HTTP, DNS, Email, etc.
- How to write programs that communicate over networks
- How different protocols, policies, and mechanisms interact to provide an effective communication medium

Instructor: Kevin Webb

- http://www.cs.swarthmore.edu/~kwebb/
- Please call me Kevin (or Professor Webb)
- Research: Control platforms for networks

Instructor: Kevin Webb

Office Hours

- Wednesday 11:00 AM – Noon
- Thursday Noon – 2:00
  - NOTE: Faculty dept. meeting at 4:15 on Thursdays
- By appointment
- 255 Science Center

Resources

- Piazza Q&A Forum, Github Enterprise
  - https://piazza.com/swarthmore/fall2017/cs43/home
  - https://github.swarthmore.edu
- Slides & audio recordings on course website
- Lab sections:
  - Science Center 256
  - Friday 2:15-3:45, Friday 4:00-5:30

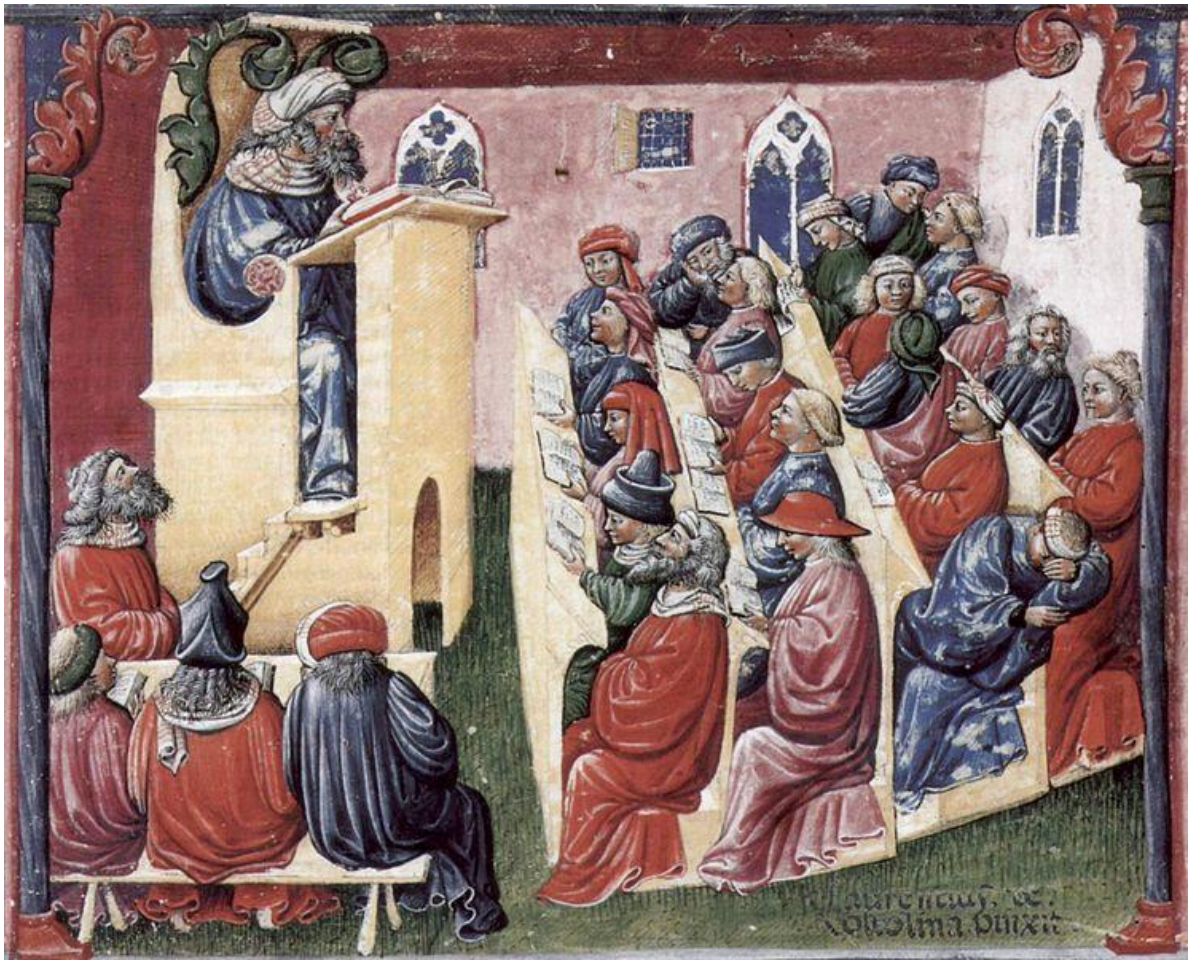
Email Policy

- For public questions: use Piazza!
  - Your classmates benefit from your questions
  - Your classmates can answer your questions
  - I will check the forum frequently
- For private questions: use email (kwebb@cs)
- I will attempt to respond to within 24 hours

How does this class work?

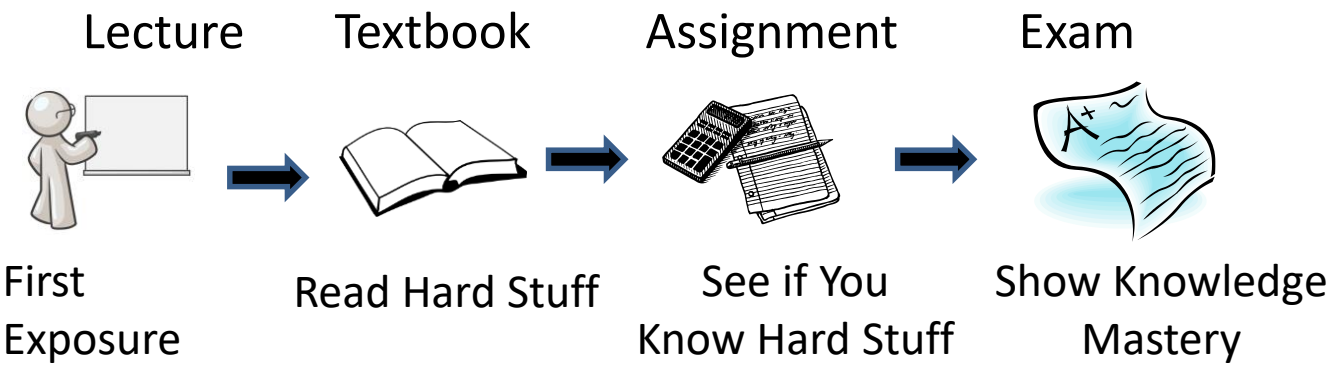
- This class is designed a bit differently from what you might normally be used to
  - Class will be centered around you
  - Requires your participation
- Ever considered why we have lectures?

Traditional Lectures:



- Roughly one millenium old

Traditional Lectures:



- Little opportunity for expert feedback
- Might as well skip class and watch video lectures!
  - (I am not actually suggesting this. Please attend your classes!)

Interactive Classes with Peer Instruction

- You do the “easy” part before class.

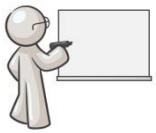
Textbook, videos, website

First Exposure

In class quiz

Gauge understanding

Instruction



Fill in gaps,
Explore details,
Add context,
Provide feedback

Exam

Show Knowledge Mastery

- Class is reserved for interactive, customized experiences
- Research on how people learn:
  - Everyone constructs their own understanding
  - To learn, YOU must actively work with a problem and construct your own understanding of it

Clickers!

- Lets you vote on questions in real time.
- Like pub trivia, but the subject is always networks.
- You NEED one of these for the course!

Peer Instruction

- Short quiz at the beginning of class
- During class: pose carefully designed questions
  - Solo vote: Think for yourself and select answer
  - Discuss: Analyze problem in teams of 3
    - Practice analyzing, talking about challenging concepts
    - Reach consensus
    - If you have questions, raise your hand and I'll come over
  - Group vote: Everyone in group votes
    - You must all vote the same to get your point
  - Class wide discussion:
    - Led by YOU (students) – tell us what you talked about in discussion that everyone should know!

Why Peer Instruction?

- You get a chance to think.
- I get feedback as to what you understand.
- It’s less boring!
- Research shows it promotes more learning than traditional lecture.

Giving out Candy

- To people willing to
  - Ask a question
  - Share an explanation
  - Summarize what their group talked about

- Your explanations are CRITICAL for fellow students' learning

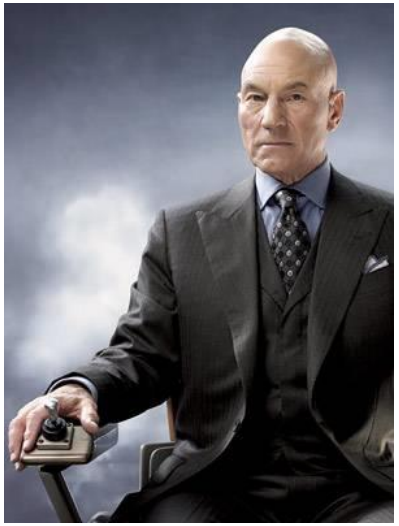
Example Question

- Individual vote
- Group discussion / group vote
  - Room should be LOUD
- Class discussion

The most useful super power for a college student would be:

A
Invisibility

B
Lots of $$$



C
Telepathy

D
Weather

E: Some other power (be prepared to discuss)

Grading

- 5% Reading Quizzes
- 5% Class participation
- 25% Midterm Exam
- 30% Final Exam
- 35% Programming Assignments

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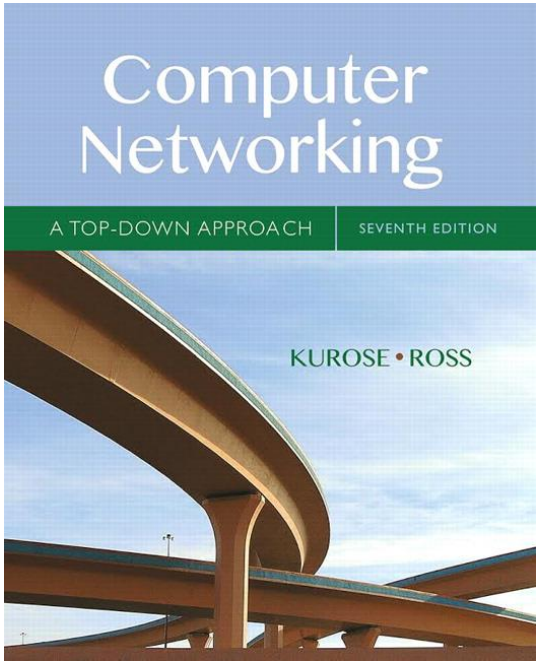
- I will drop your three lowest quizzes/no-shows.

Textbook



- *Computer Networking: A Top-Down Approach (7th Edition)*
- You need this book!

Policies

- Collaboration
  - You may discuss approaches, not solutions
  - You must submit your own work
  - Exams will include questions on programming
- Cheating
  - Zero tolerance for cheating, don't do it!
- Lab Lateness
  - 2 days of extra (at the granularity of days)
  - Let me know when you've submitted

Tentative Schedule

- Midterm – October 26, in class
- Final - TBD
- Labs
  - Out on Fridays (lab section)
  - Due on Thursdays
  - First lab: solo, others in pairs

Administrative Questions?

- All of this info (should be) on class website
- Feel free to ask on Piazza discussion board

Clicker Registration

- https://cs.swarthmore.edu/clickers/

- Please register ASAP

What is the goal of a network?

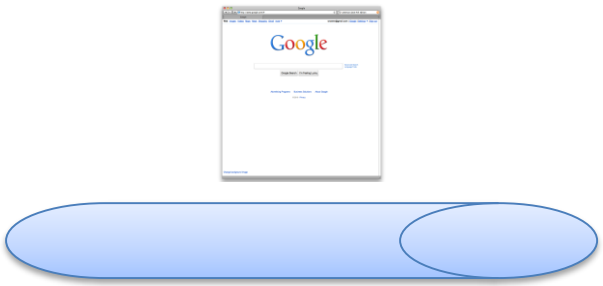
- Allow devices communicate with one another and coordinate their actions to work together.

- Piece of cake, right?

A “Simple” Task

- Send information from one computer to another
- Endpoints are called hosts
  - Could be computer, iPod, cell phone, etc.
- The plumbing is called a link
  - Many different physical technologies: Ethernet, wireless, cellular, etc.

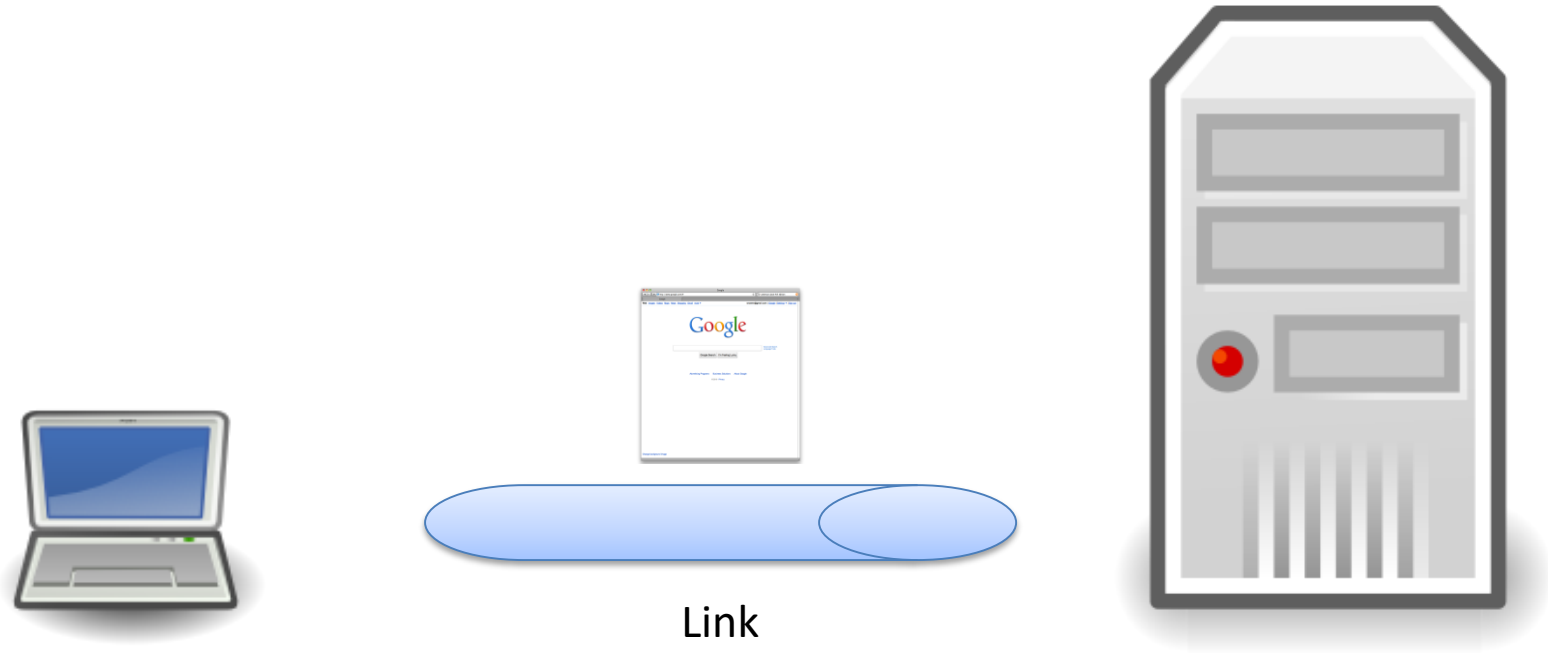
Host
(PC)



Link

Host
(Server)

Not Really So Simple…



Host
(PC)

Link

Host
(Server)

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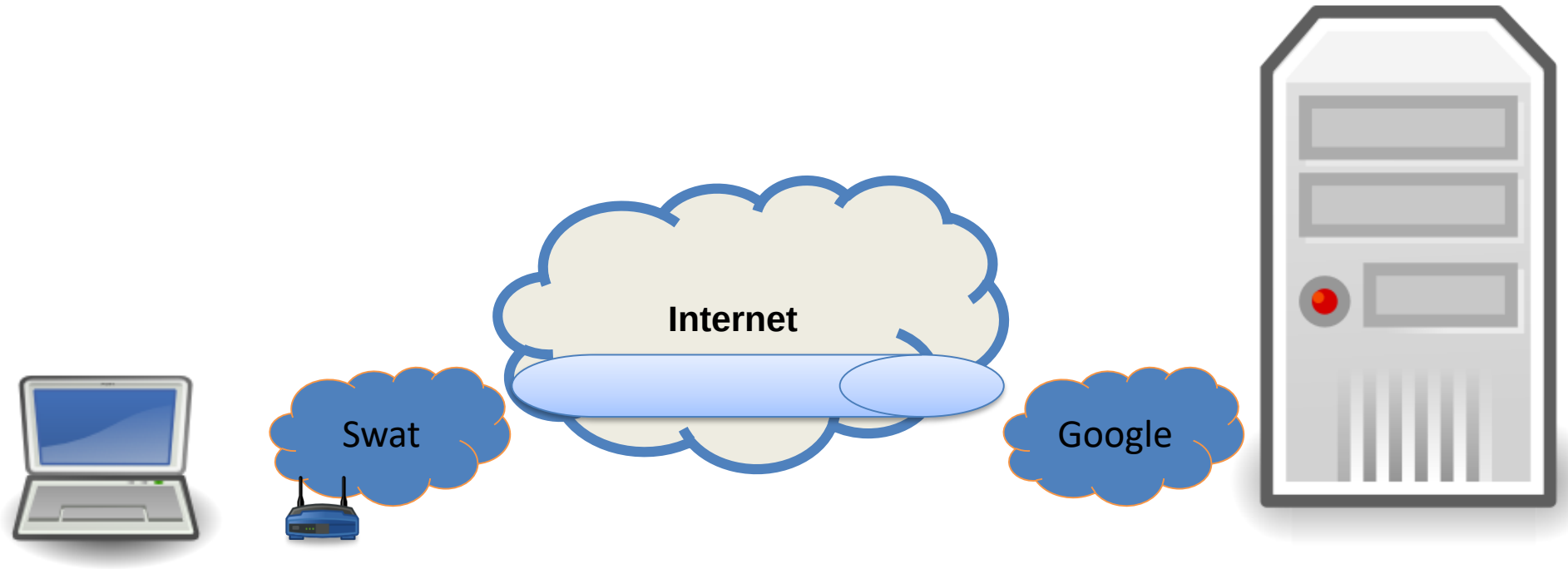

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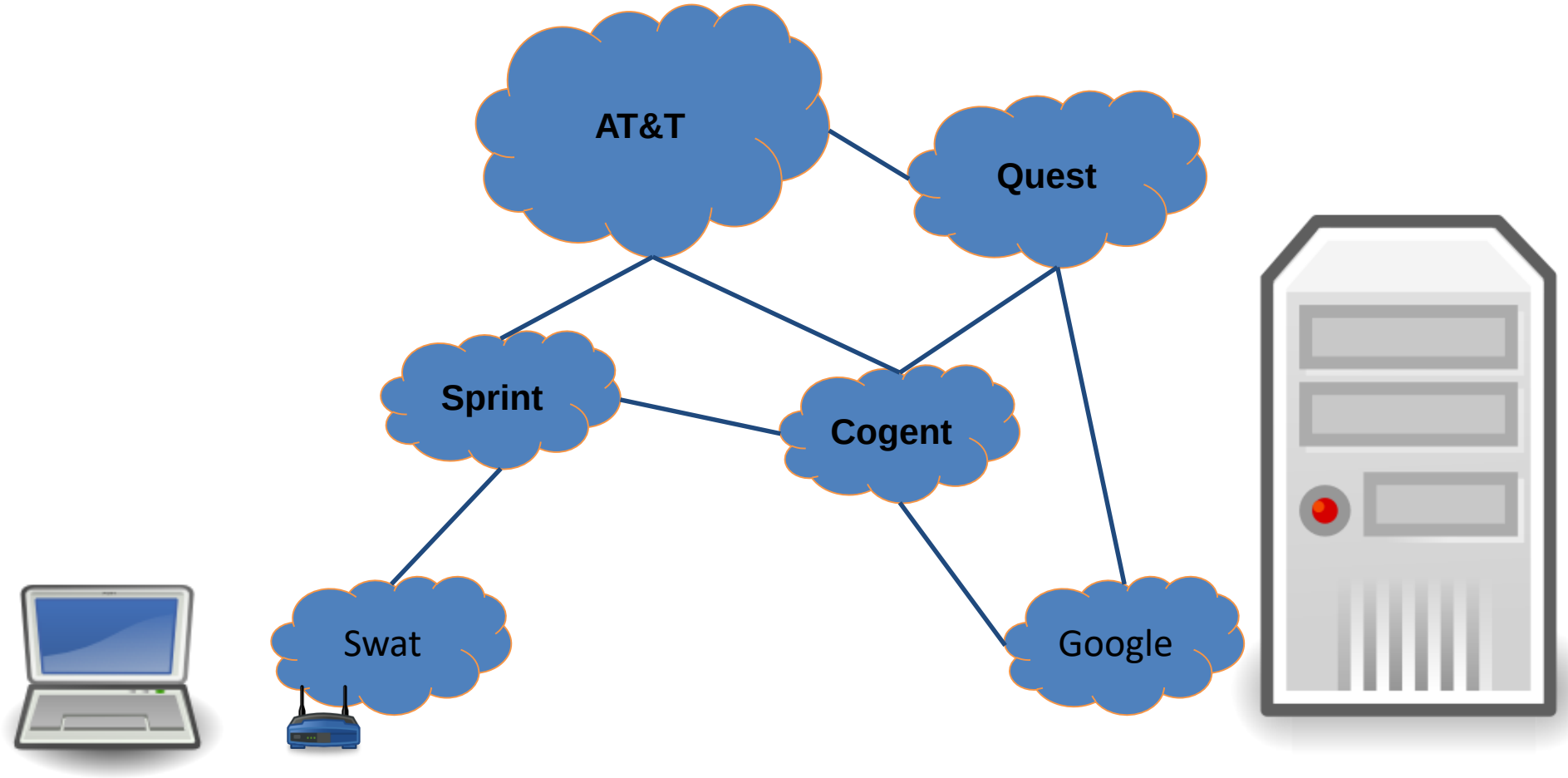

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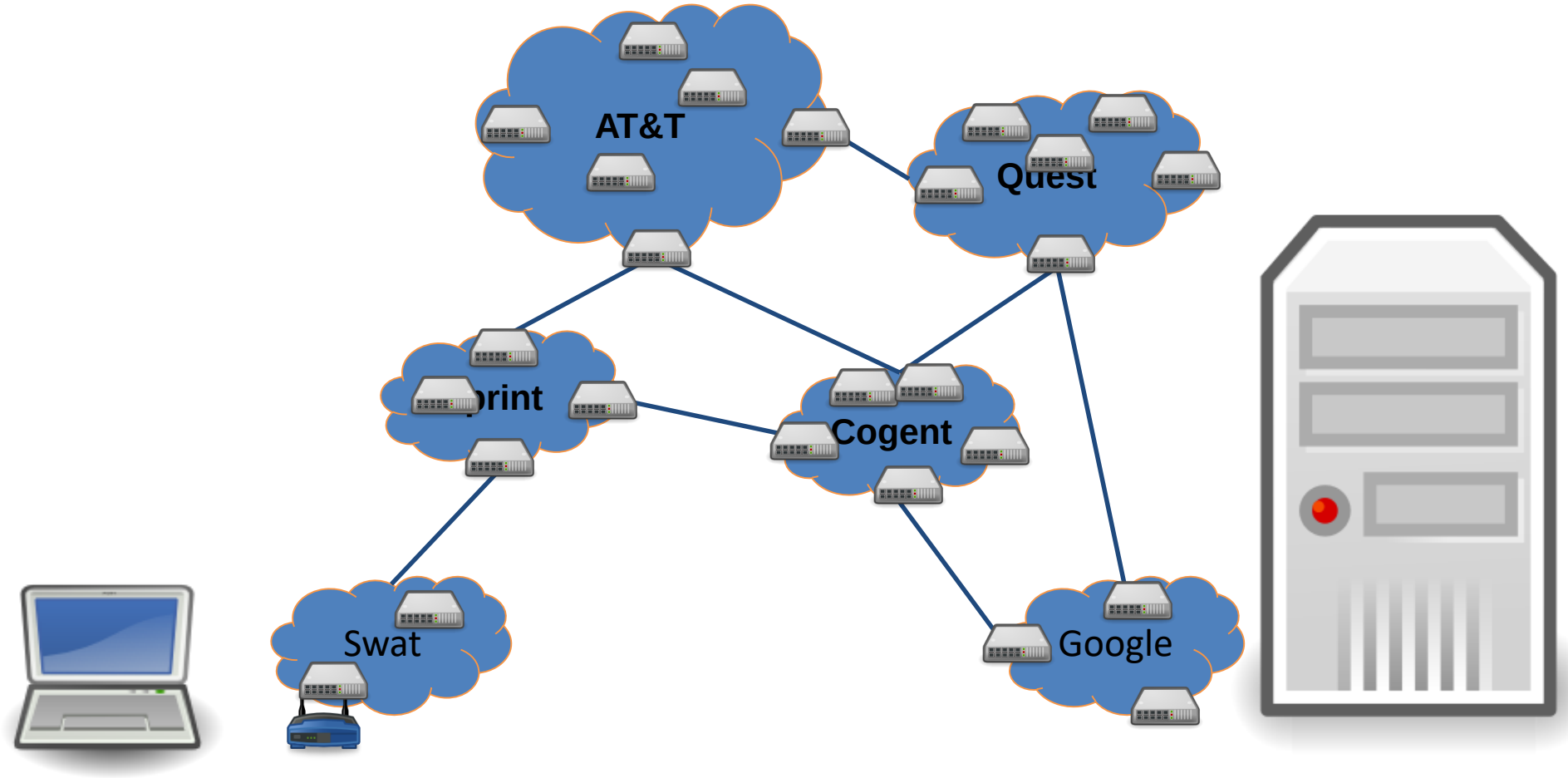

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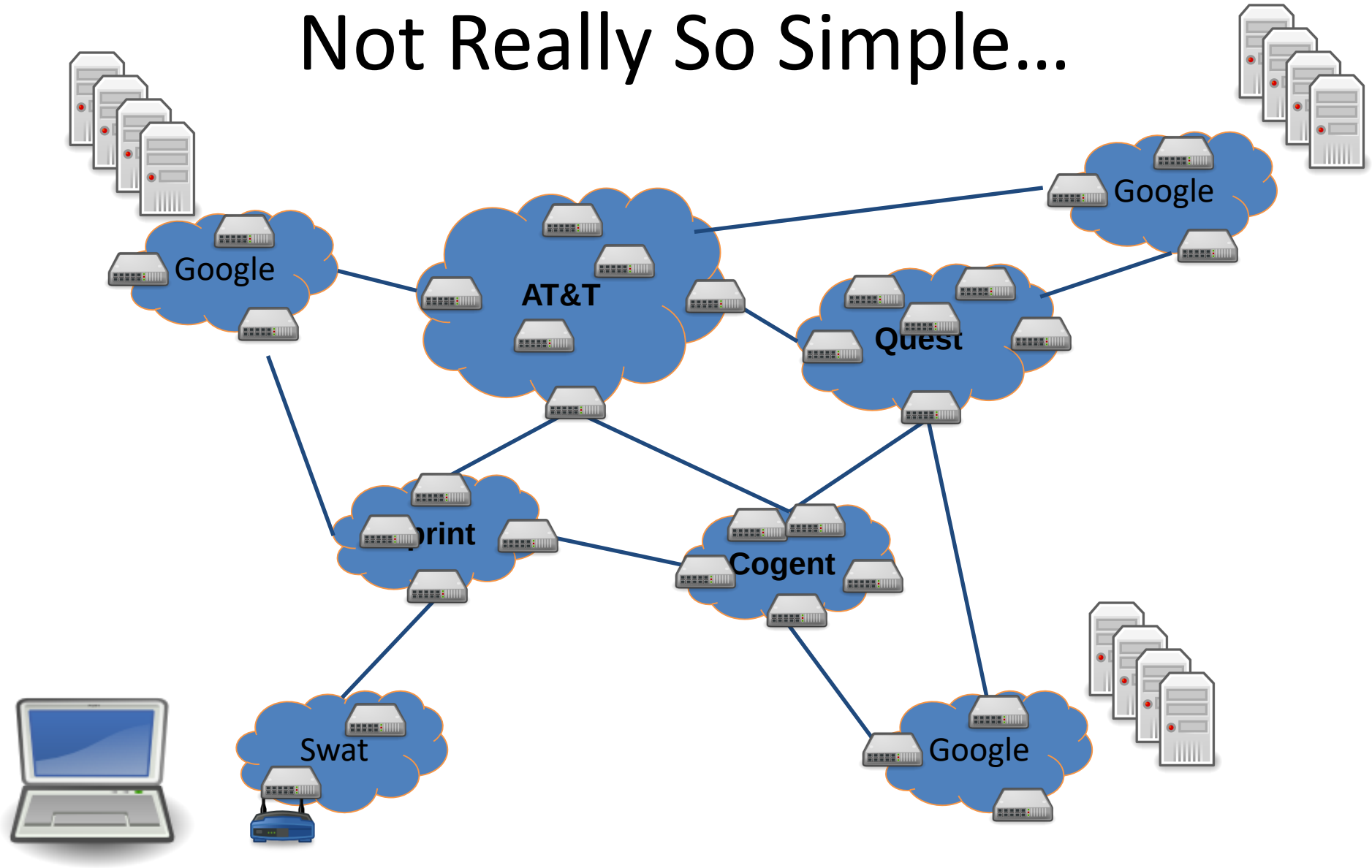


We only need…

- Manage complexity and scale up
  - Layering abstraction: divide responsibility
  - Protocols: standardize behavior for interoperability

We only need…

- Manage complexity and scale up
- Naming and addressing
  - Agreeing on how to describe/express a host, application, network, etc.

We only need…

- Manage complexity and scale up
- Naming and addressing
- Moving data to the destination
  - Routing: deciding how to get it there
  - Forwarding: copying data across devices/links

We only need…

- Manage complexity and scale up
- Naming and addressing
- Moving data to the destination
- Reliability and fault tolerance
  - (How) can we guarantee that the data arrives?
  - How do we handle link or device failures?

We only need…

- Manage complexity and scale up
- Naming and addressing
- Moving data to the destination
- Reliability and fault tolerance
- Resource allocation
  - How do we share the network's capacity?

We only need…

- Manage complexity and scale up
- Naming and addressing
- Moving data to the destination
- Reliability and fault tolerance
- Resource allocation

(Lots of others too.)

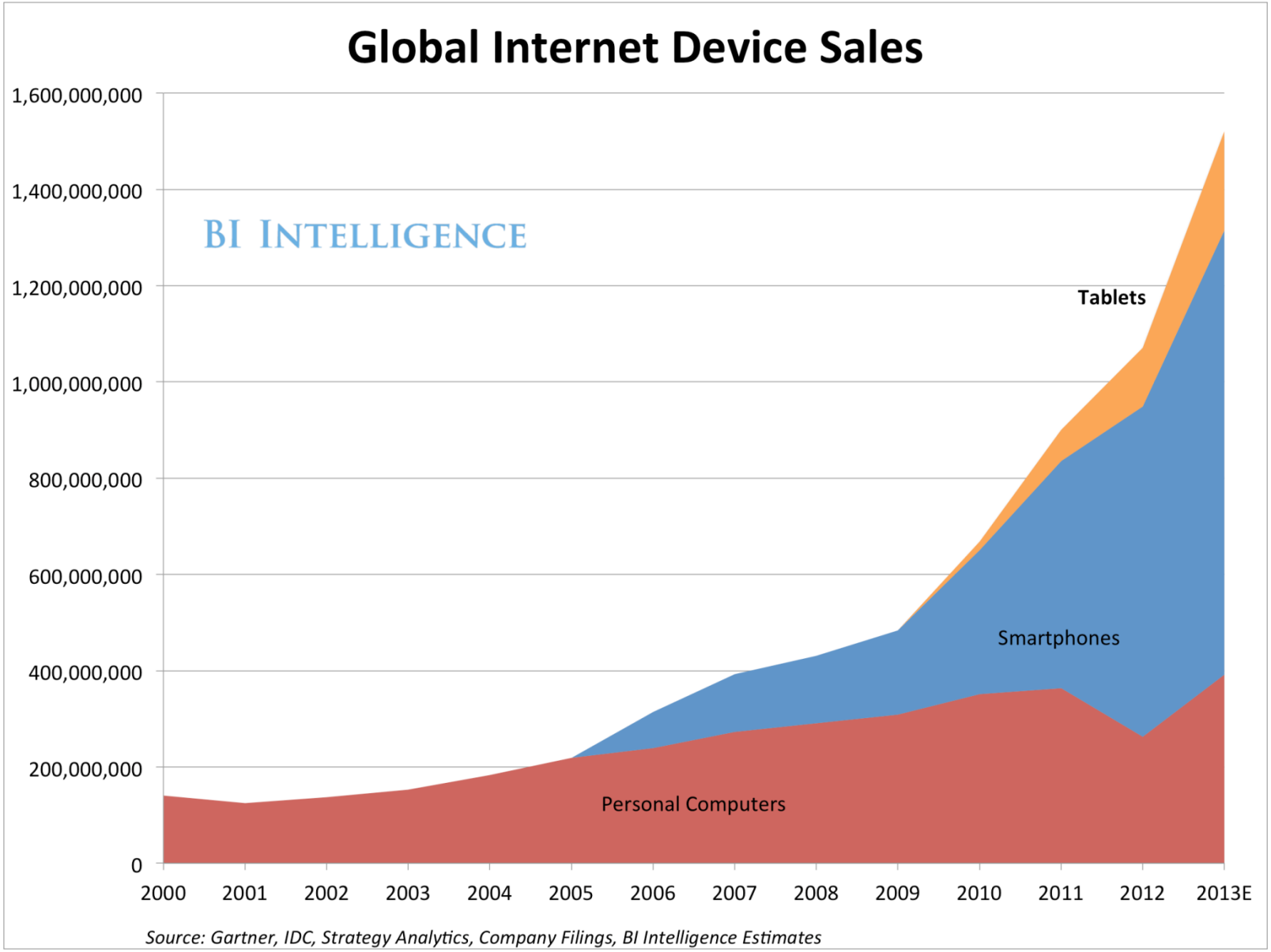
Pull back the curtain on the Internet

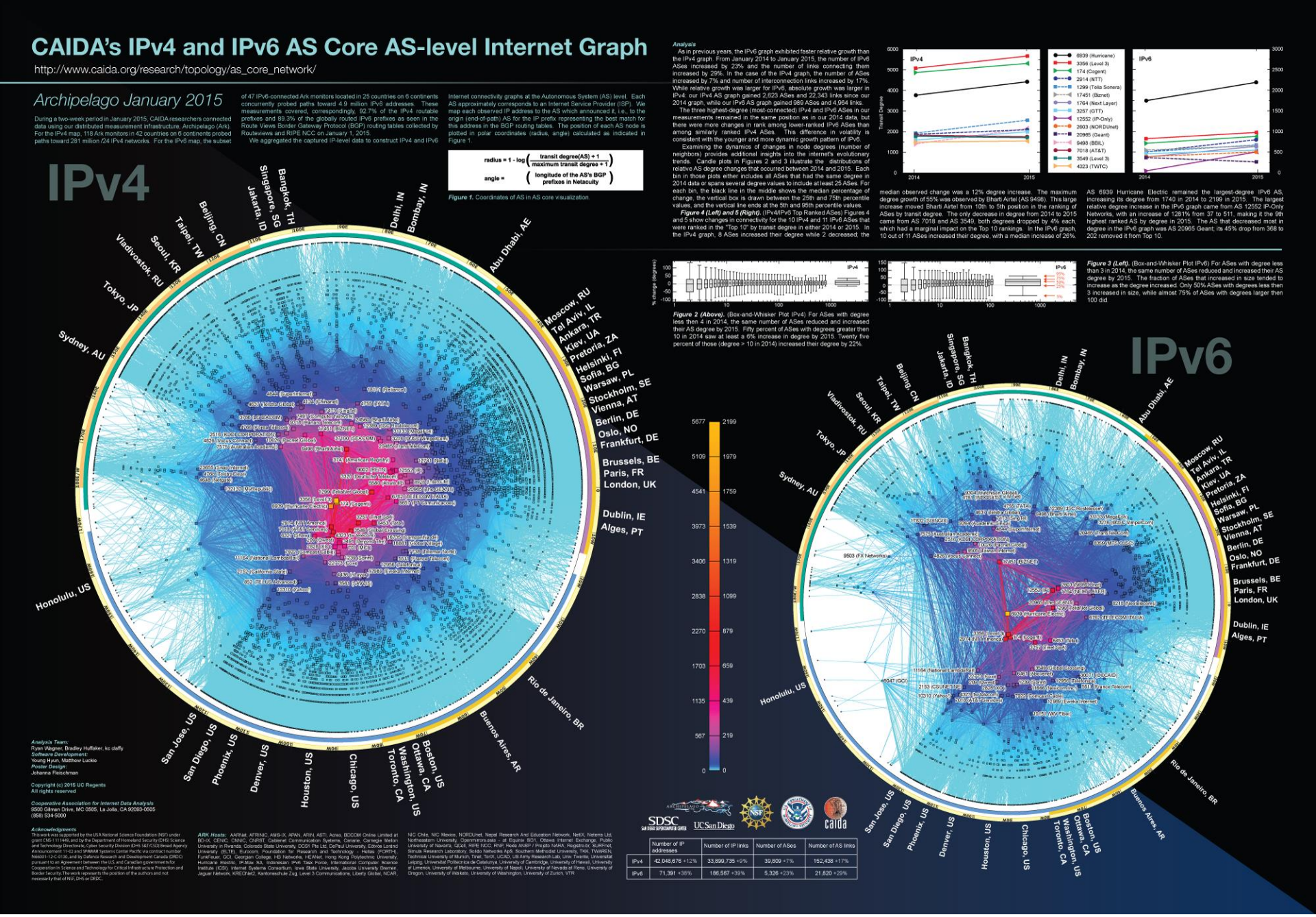
Why should you care?

- To know how the Internet works
  - What may be wrong with your networks
  - When was the last time you went 24 hours without going online?
- Network programmers get respect
  - In high demand, get paid well

The Internet is Exciting!

- Rapid growth and success.
  - 1977: 111 machines on Internet
  - 1981: 213
  - 1983: 562
  - 1986: 5000
  - 1989: 10,000
  - 1992: 1,000,000
  - 2001: 150 – 175 million
  - 2002: > 200 million
  - 2011: > 2 billion (~1B are phones/tablets)


Global Internet Device Sales
1,600,000,000
1,400,000,000
1,200,000,000
1,000,000,000
800,000,000
600,000,000
400,000,000
200,000,000
0
BI INTELLIGENCE
Tablets
Smartphones
Personal Computers
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013E
Source: Gartner, IDC, Strategy Analytics, Company Filings, BI Intelligence Estimates



Cooperative Association for Internet Data Analysis (CAIDA)

The Internet is Exciting!

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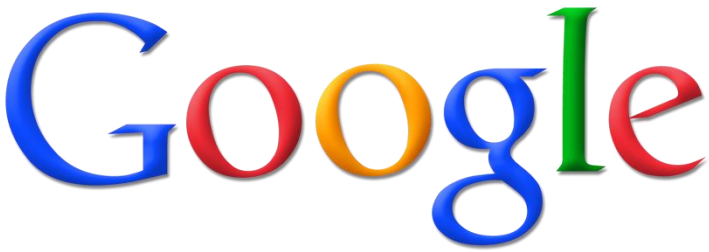
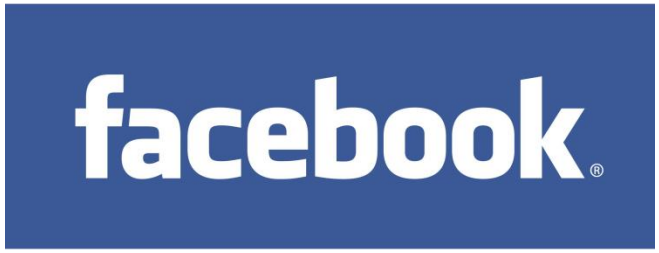
The Internet is Exciting!

- Rapid growth and success.

- We're here at the beginning.
  - Most of the growth happened in our lifetime.
  - Still TONS of untapped potential.



Founded 1998



Founded 2004

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- Communication is empowering.

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(Late 60s)

TODO List

- Reading: Protocols
  - Sections 1.1, 1.5
- Sign up on Piazza!
- Register your clicker!
- Please let me know about:
  - Your preferred name/pronouns, if different than roster information
  - Academic accommodations