Lecture 1:
Course Introduction

CSE 123: Computer Networks

Stefan Savage

Overview for today

- Class overview
  - Administrativa (who, what, where)
  - Expected outcomes
  - Structure of the course
  - Policies and procedures
- A brief overview of Computer Networking
  - High-level concepts
  - An end-to-end example

Course instructors

- Stefan Savage – Lecturer & taskmaster
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  - Office hours: Tu 4-5pm (or by appt) CSE 3106
- Alex Rasmussen – TA
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- Nima Nikzad – TA
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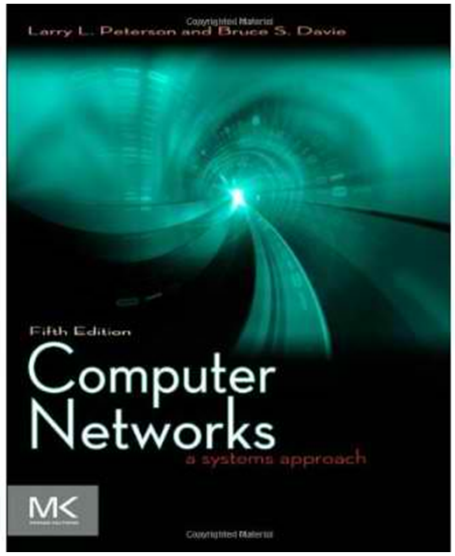
  - Office hours: TBA

About me

- I work at the … g, operating systems and …
- Research
  - Large-sca … jects
    - » Routing … ement tools
  - Large-sca … us, bots, spam) and e-crim …
- Policy
  - National S …
  - NRC's Co… unications Board
  - ISAT advis …
- Industry
  - Asta Netw … pany)
  - Netsift (UC … -> Cisco
  - Lots of co …

Course info

- Discussion section: M 1-1:50 Center 109
- There will be a discussion board (TBA)
- Course Web page
  - http://www.cse.ucsd.edu/classes/fa11/cse123-a/
- Textbook: Peterson and Davie, *Computer Networks: A systems Approach*, Morgan Kaufmann, 5th Edition, ISBN 978-0123850591



Alert!

- No discussion section this Monday
- Tuesdays class is cancelled

- **We next meet on Thursday the 29th**

Expected Outcomes

- This course *will* teach you the *fundamentals* of computer networks:
  - Layering, signaling, framing, MAC, switching, routing, naming, Internetworking, congestion control, router design, etc.
- I *will not* teach you much about signals and coding
  - Take an EE course to learn about modulation, encoding, etc. on different hardware technologies
- Similarly, we will not cover Internet apps/services
  - CSE124 covers application layer protocols, Web, etc.
  - You can also pick up much of this on your own

Prereqs

- CSE120
  - I will approve enrollment for students who have not taken it,
  - But, you will be solely responsible for concepts and experience from the class (e.g., concurrency)

- Programming experience
  - We will be assigning programming projects in C/C++
  - This course will not teach you C. The TAs will help, but you need to learn it on your own if you don't already know it.

CSE 123 Class Overview

- Course material taught through class lectures, textbook readings, and discussion sections
- Course assignments are
  - Homework questions (based on lecture and reading)
  - 3 programming projects (two significant)
- Discussion sections are a forum for asking questions
  - Lecture material and homework
  - Additional networking topics
- Discussion board (TBA)
  - The place to ask questions about lecture, hw, projects, etc.

Rules

- Written assignments are due at the ***beginning*** of class
- Regrades should be the ***exception***
  - Addition errors (happy), significant errors in grading (fine), nit picking/grade mongering (death to you)
  - We reserve the right to *completely* regrade your assignments
  - All regrades go to TAs first

- ***No Cheating***

- Cheating means not doing the assignment yourself
  - Ok to **talk** with other students about assignments outside of class
  - No copying, no Google, etc. If you're unsure, then ask

- Don't mess with the professor. He's a mean man.

Labs

- We will use the uAPE (B230) lab in the basement of the CSE/EBU3B building
  - Linux running on Intel machines
- You can also use your home machine
  - But…. we will test on uAPE machines
  - Be sure to test your projects there as well

Exams

- Midterm
  - Tentatively Tuesday, November 1st
  - Covers first half of class
- Final
  - Friday Dec 9th, 11:30-2:30
  - Covers second half of class + selected material from first part
    - » I will be explicit about the material covered
- No makeup exams
  - Unless dire circumstances
- All tests closed book with crib sheet
  - You can bring one double-sided 8.5x11” page of notes to each exam to assist you in answering the questions
  - Not a substitute for thinking

Grading

- Homeworks: 20%
  - Think of these collectively as a take-home midterm
- Midterm: 20%
- Final: 30%
- Projects: 30%

How *Not* To Pass CSE 123

- Do not come to lecture
  - It's nice out, class is early, the slides are online, and the material is in the book anyway
  - Lecture material is the basis for exams and directly relates to the projects
  - I guarantee you I'm more fun than the textbook
- Do not do the homework
  - It's only 20% of the grade
  - Excellent practice for the exams, and some homework problems are exercises for helping with the project
  - 20% is actually a significant fraction of your grade (difference between an A and a C)

How *Not* To Pass (2)

- Do not ask questions in lecture, office hours, or email
  - Professor is scary, I don't want to embarrass myself
  - Asking questions is the best way to clarify lecture material at the time it is being presented
  - Office hours and email will help with homeworks, projects

- Wait until the last couple of days to start a project
  - We'll have to do the crunch anyways, why do it early?
  - The projects cannot be done in the last couple of days

Class Web Page

http://www.cs.ucsd.edu/classes/fa11/cse123-a/

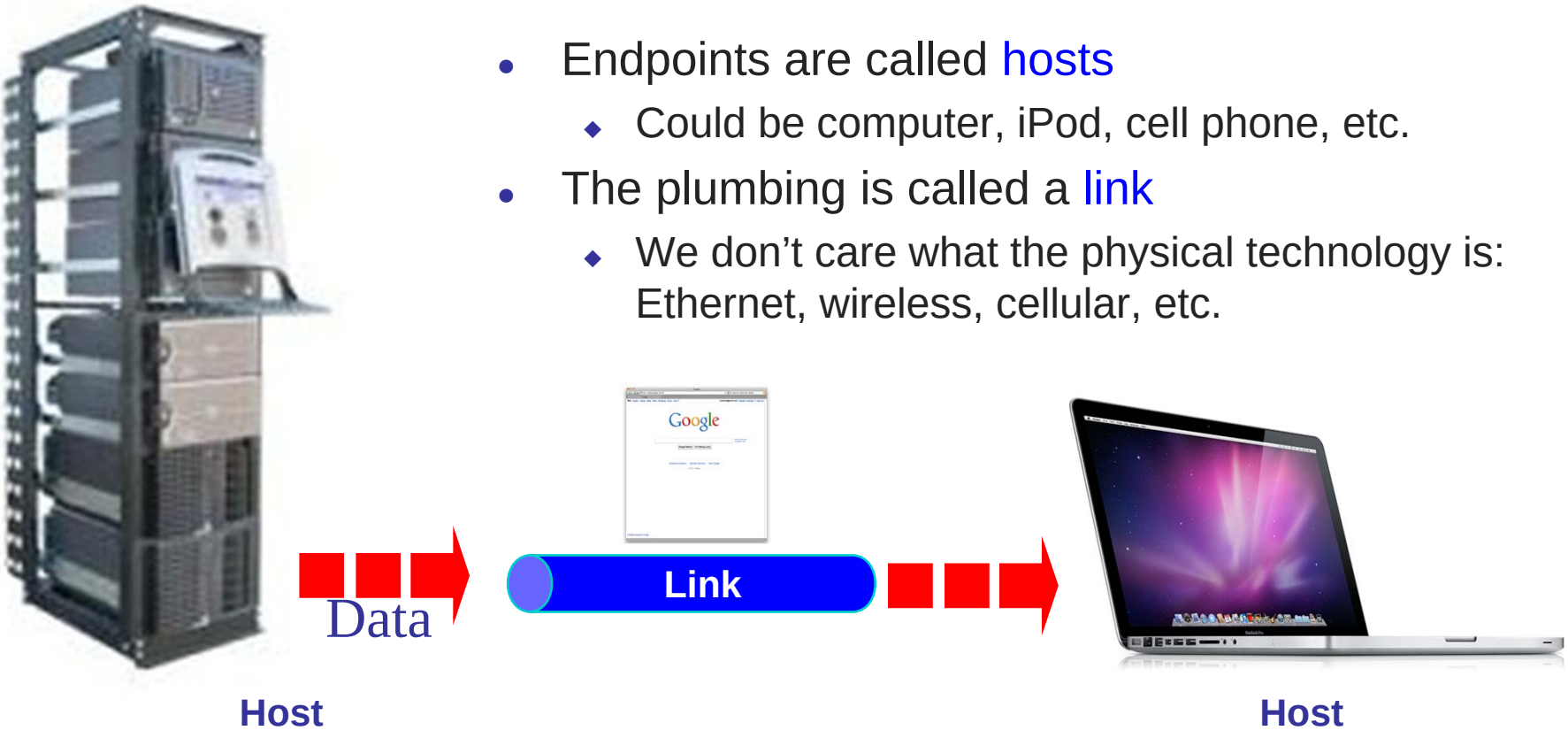
- Will serves many roles…
  - Course syllabus and schedule (updated as quarter progresses)
    - » Lecture slides
  - Announcements
  - Homework handouts
  - Project information

Questions

- Before we start the material, any questions about the class structure, contents, etc.?

A “Simple” Task

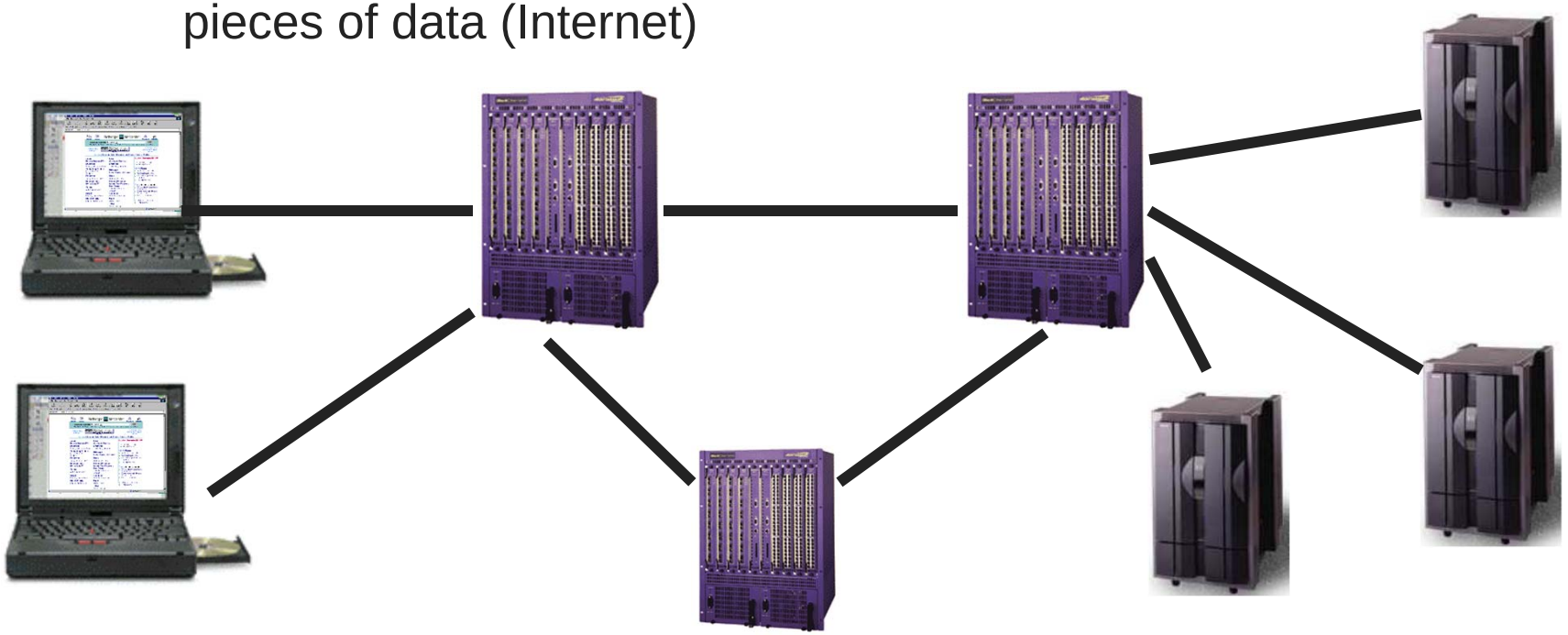
- Send information from one computer to another



- Endpoints are called hosts
  - Could be computer, iPod, cell phone, etc.
- The plumbing is called a link
  - We don’t care what the physical technology is: Ethernet, wireless, cellular, etc.

What if hosts aren't directly connected?

- **Routers/Switches**: moves bits between links
  - *Circuit switching*: guaranteed channel for a session (Telephone system)
  - *Packet switching*: statistical multiplexing of independent pieces of data (Internet)



Measures of success

- How fast?
  - Bandwidth measured in bits per second
  - Often talk about KBps or Mbps – Bytes vs bits
- How long was the wait?
  - Delay (one-way or round trip) measured in seconds (typically milliseconds)
- How efficiently?
  - Overhead measured in bits or seconds or cycles or…
- Any mistakes?
  - Error rate measured in terms of probability of a flipped bit (or corrupted packet)

How long to send a message?

- Transmit time T = M/R + D
  - M = message size, R= bandwidth, D= Delay
  - 10 Mbps Ethernet LAN (M=1KB)
    - » M/R=1ms, D ~=5us
  - 155 Mbps cross country ATM link (M=1KB)
    - » M/R = 50us, D ~= 40-100ms
- Where are the bits in the mean time?
  - In transit inside the network
- R*D is called the bandwidth delay product
  - How many bits can be “stored” be stored in transit
  - Colloquially, we say “fill the pipe”

But there's more to networking than sending bits…

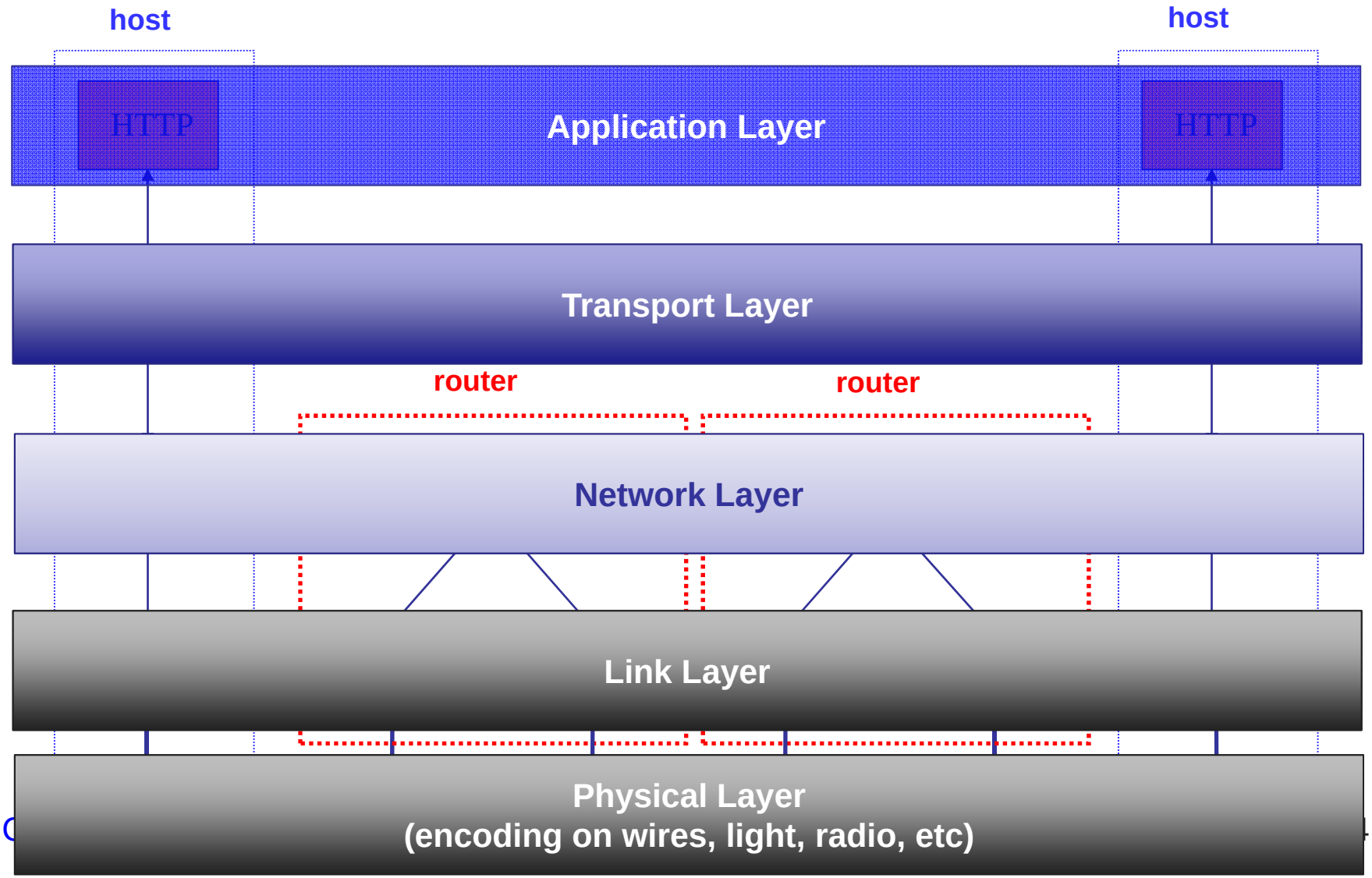
- Like what?

- Sending bits to a *particular* destination among many
- Sending a **long** message to a particular destination
- Detecting if there was an error
- Fixing the error
- Deciding how fast to send
- Making sure the message is kept private
- Etc, etc, etc…

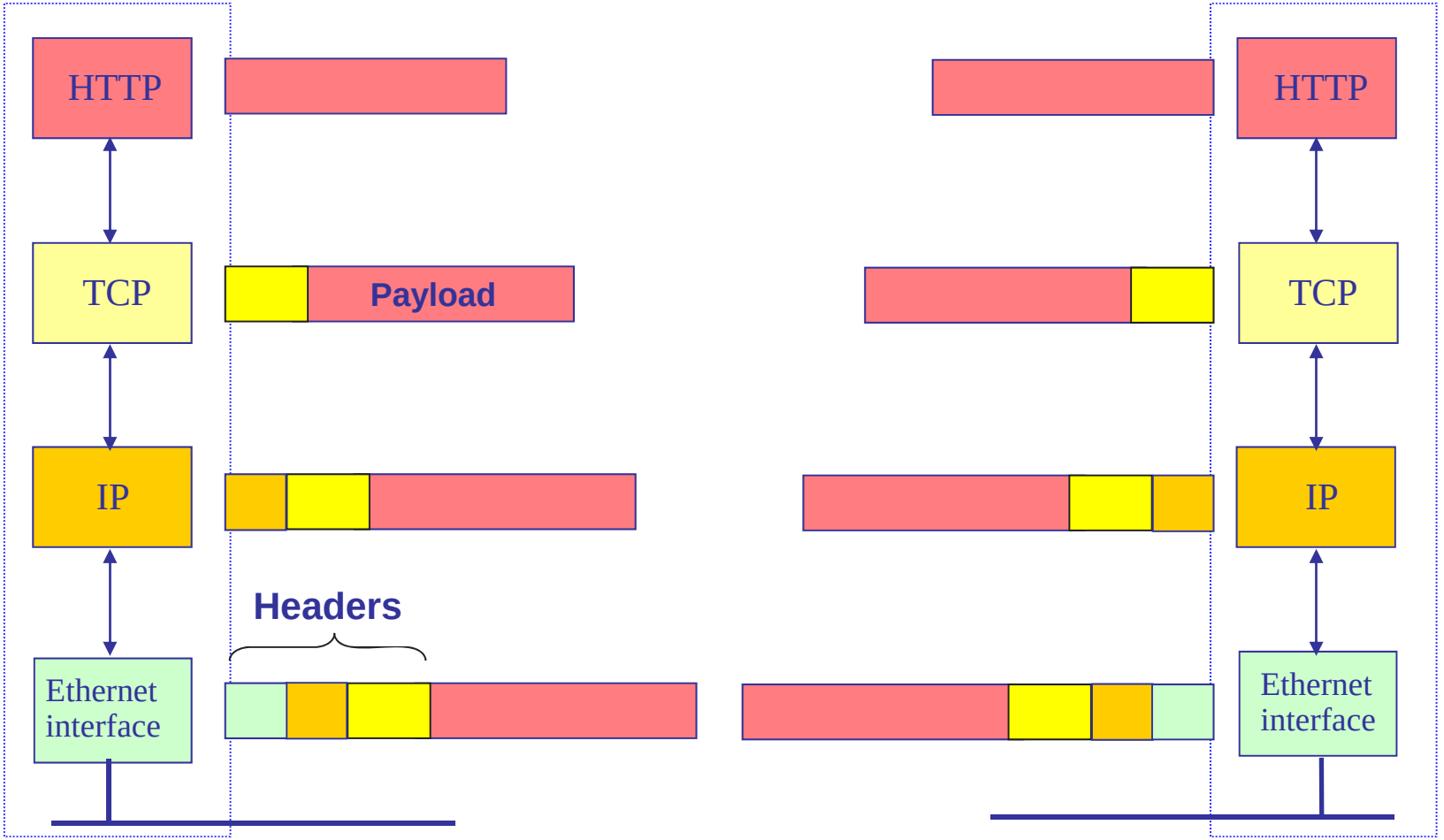
Layering: A Modular Approach

- Sub-divide the problem
  - Break up functionality into distinct services (e.g., reliable message delivery)
  - Organized services into order series of **layers**
  - Each layer relies on services from layer below
  - Each layer exports services to layer above
- Interface between layers defines interaction
  - Hides implementation details
  - Layers can change without disturbing other layers
- Interface among peers in a layer is a protocol
  - If peers speak same protocol, they can interoperate

TCP/IP Protocol Stack

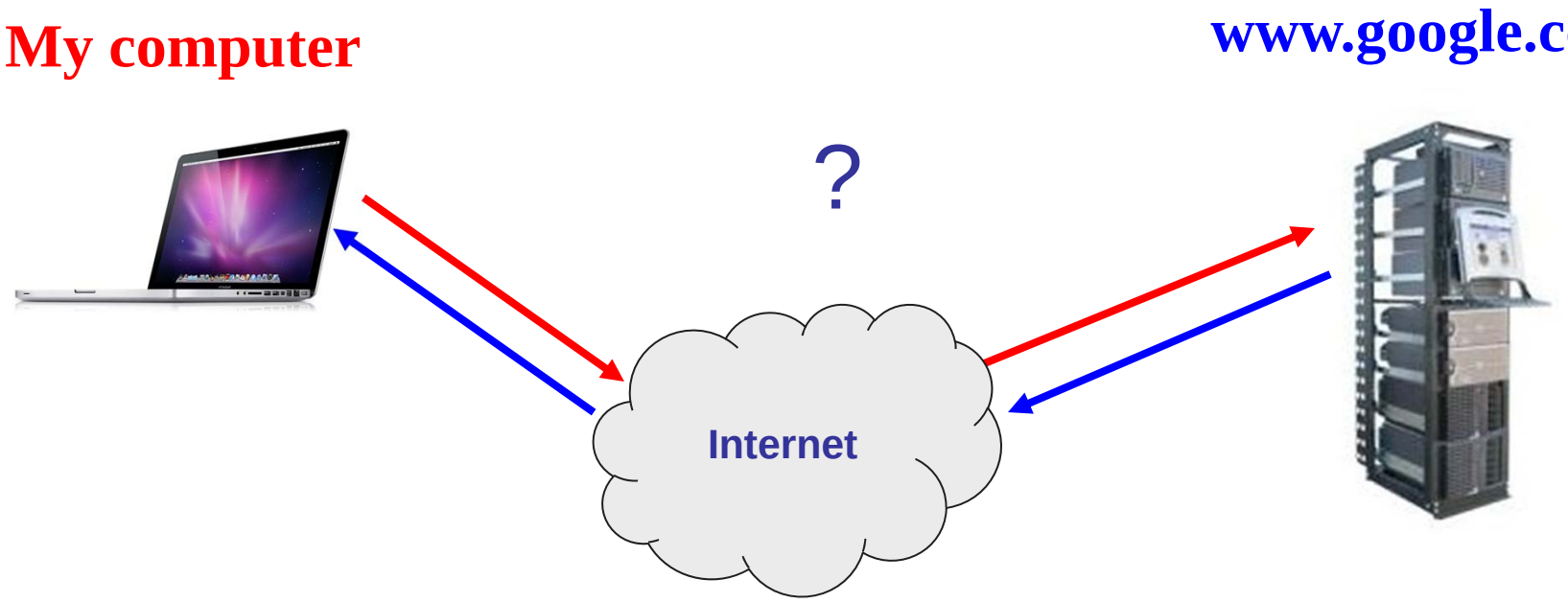


Encapsulation via packet headers

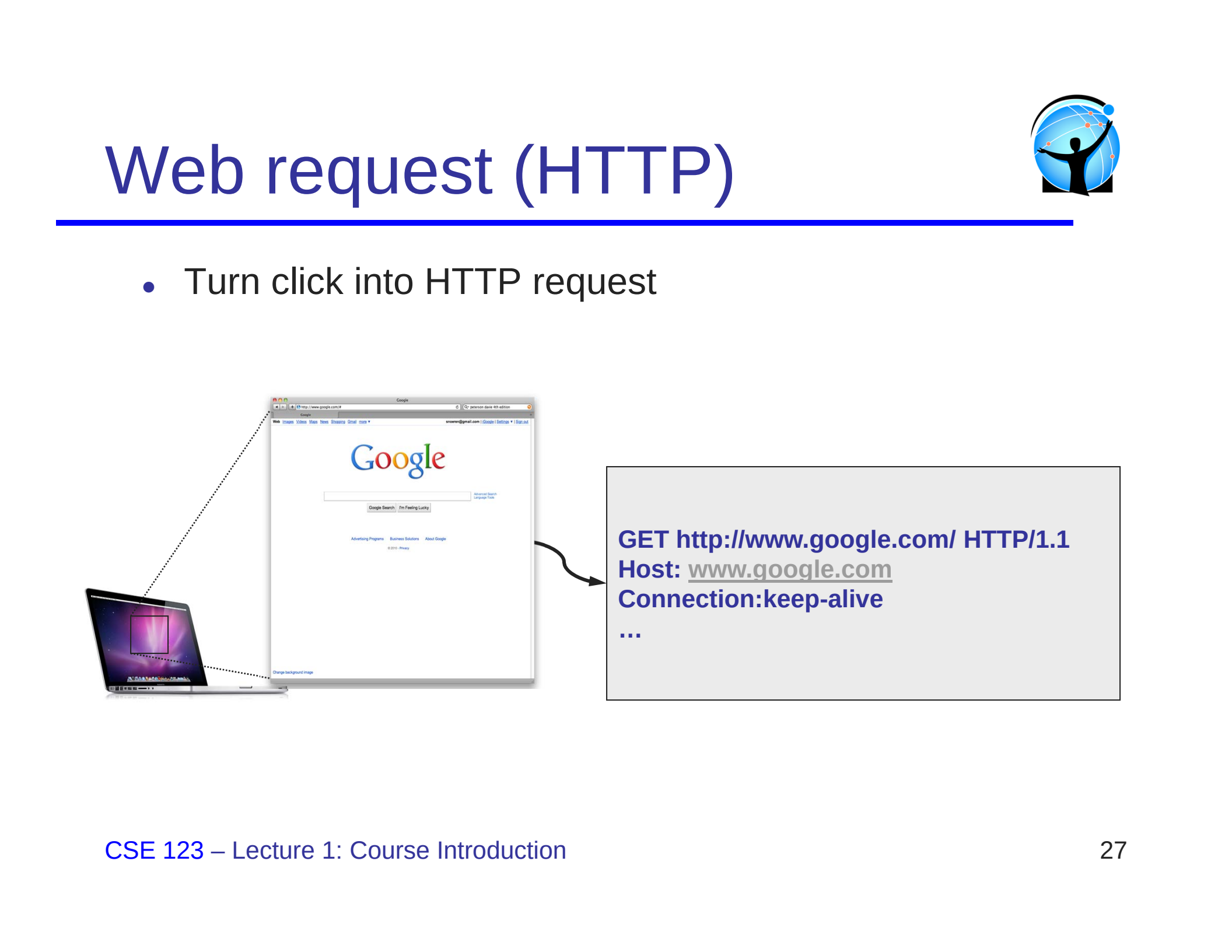


Putting this all together

- **ROUGHLY**, what happens when I click on a Web page from UCSD?



Web request (HTTP)



- Turn click into HTTP request

GET http://www.google.com/ HTTP/1.1
Host: www.google.com
Connection:keep-alive
…

Name resolution (DNS)

- Where is www.google.com?

My computer (132.239.9.64)

Local DNS server (132.239.51.18)

What's the address for www.google.com

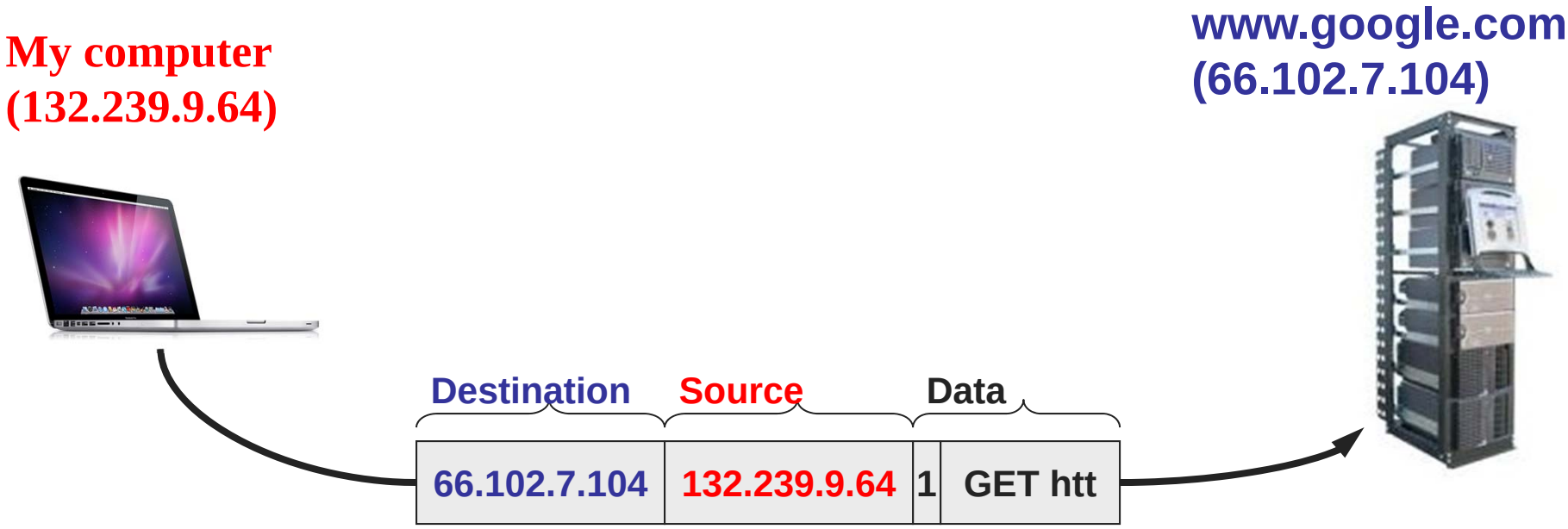
Oh, you can find it at 66.102.7.104

Data transport (TCP)

- Break message into packets (TCP segments)
- Should be delivered reliably & in-order

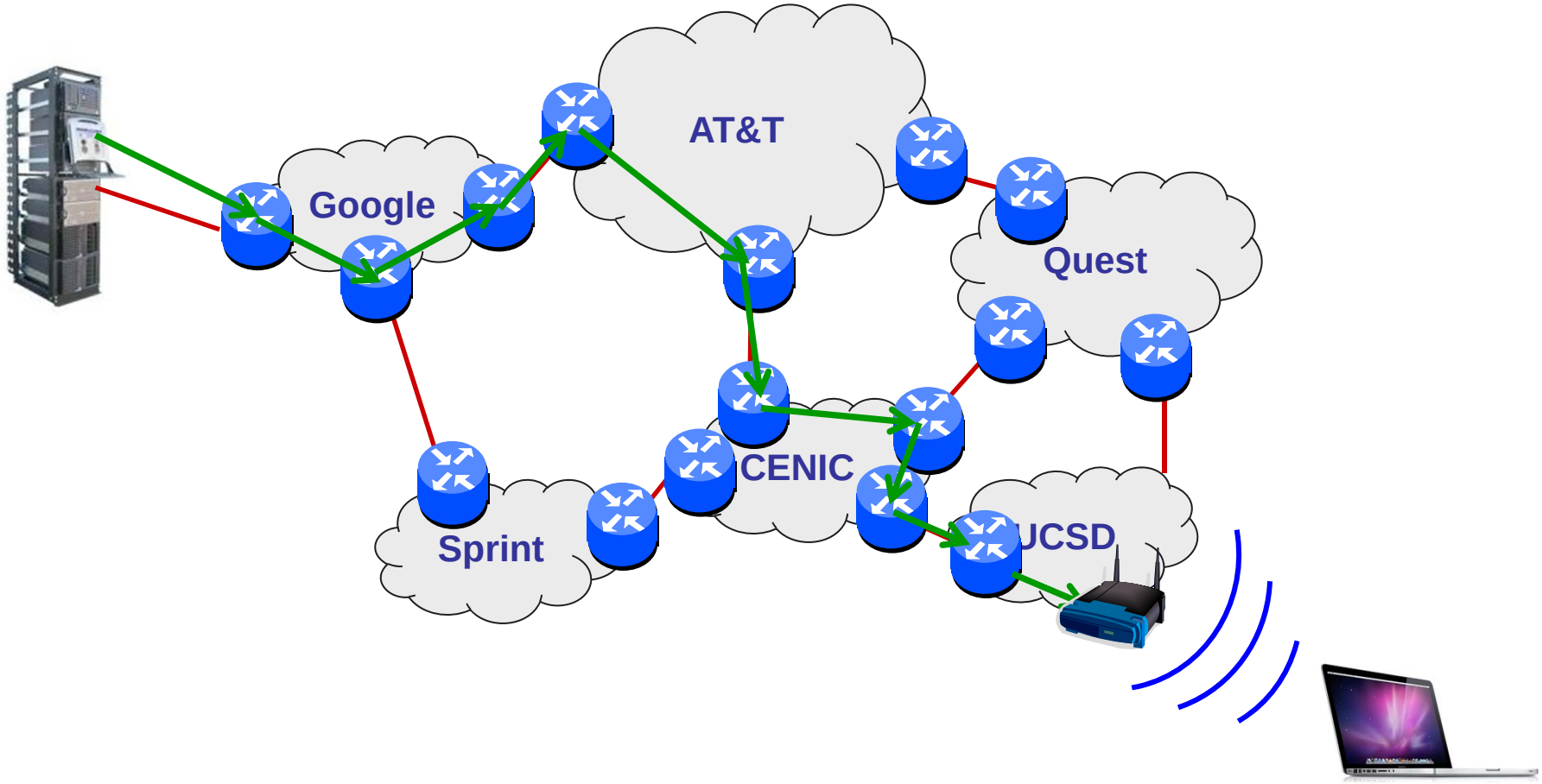
Network Layer: Global Addressing

- Address each packet so it can traverse network and arrive at host



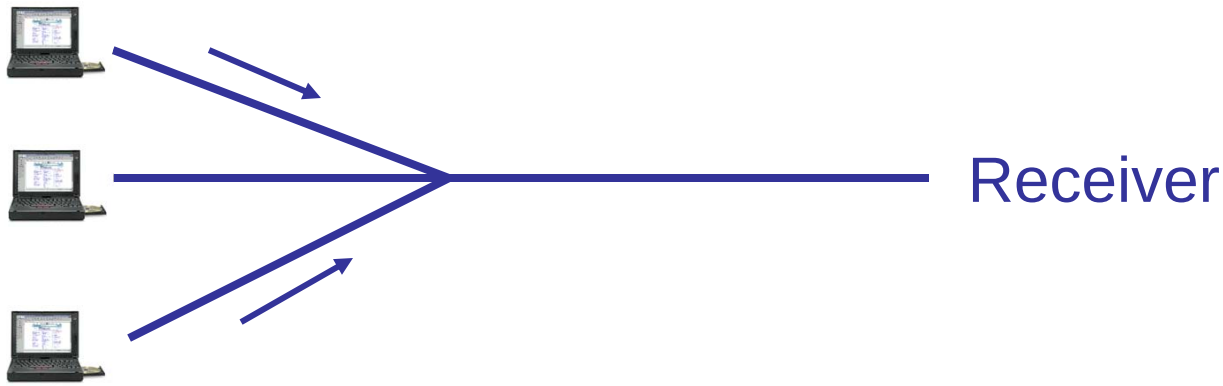
Network layer: packet routing

- **Each router forwards packet towards destination**



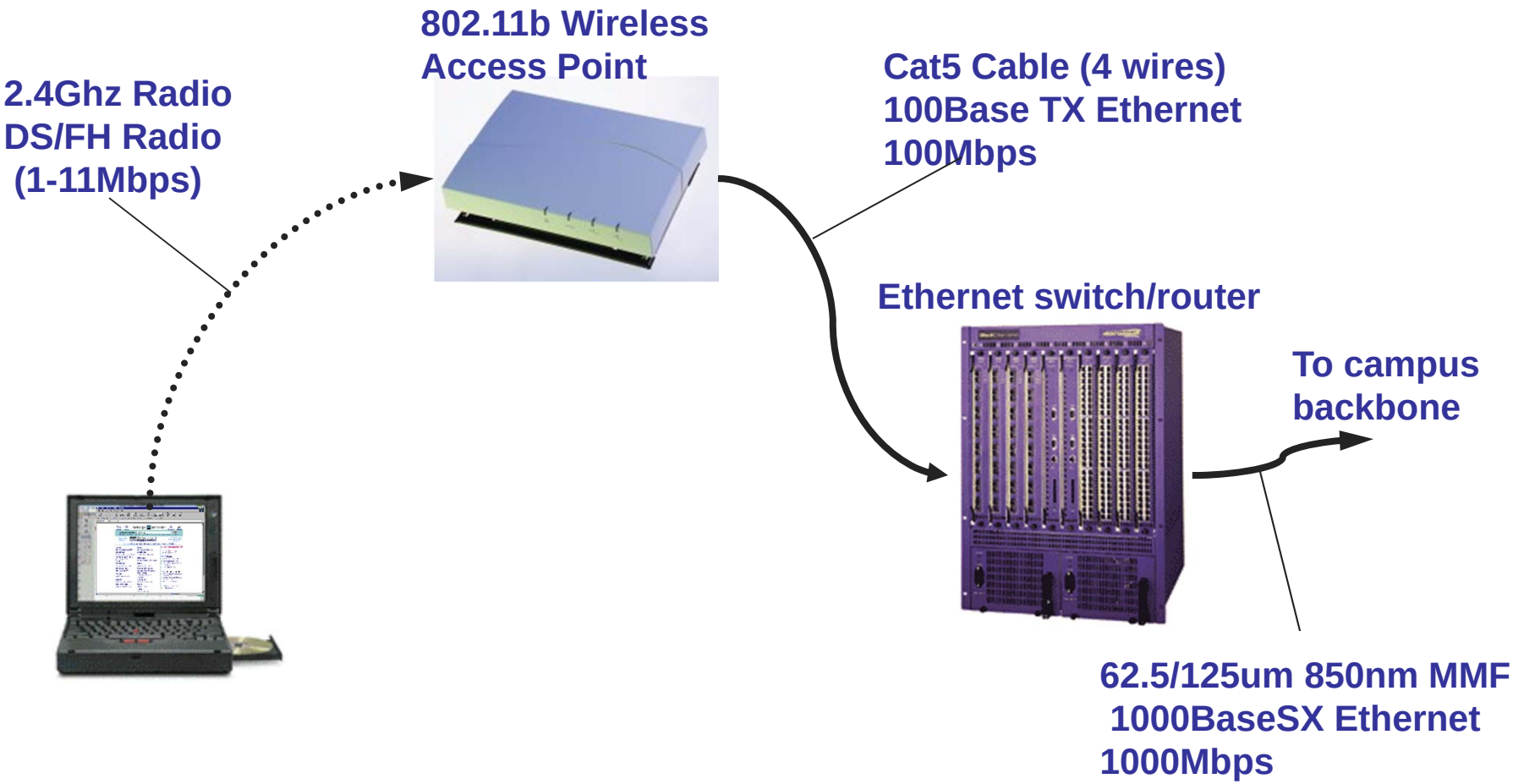
Link Layer (e.g. Ethernet)

- Break larger network message into individual frames
- Media Access Control (MAC)
  - Can I send now? Can I send now?



- Send frame

Physical layer



For Next Class…

- Reminder
  - No discussion section this Monday
  - Tuesdays class is cancelled
  - **We next meet on Thursday the 29th**
- Read Chapter 1 (excepting 1.4)
- Go bookmark the Web page
- Drop now or plan to stick it out!
- Have a great weekend!