Lecture 1: Course Introduction

CSE 222A: Computer Communication Networks

Alex C. Snoeren

Lecture 1 Overview

- Class overview
  - Expected outcomes
  - Structure of the course
  - Policies and procedures
- A brief review of undergrad networking
  - High-level concepts
  - An end-to-end example

Logistics

- Instructor: Alex C. Snoeren
  - Office hours Tuesdays 11-12pm or by appointment
  - EBU3B 3114
- TA: Siva Radhakrishnan
  - Office hours Wed 1-3pm EBU3B B240A
- Course Web page:
  - http://www.cs.ucsd.edu/classes/wi13/cse222A-a/
  - Piazza is *only* for Q&A

Prereqs

- Undergrad networking course (e.g., CSE123)
  - You are welcome to take the course without prior background,
  - But, several parts of the course will be especially challenging
    - » You are responsible for doing the extra reading on your own
    - » Peterson & Davie are your friends—our undergrad textbook
- Systems programming experience
  - The term project will likely require significant implementation
  - This course will not teach you systems programming. The TA will help, but you need to learn it on your own if you don't already know it.

Expected Outcomes

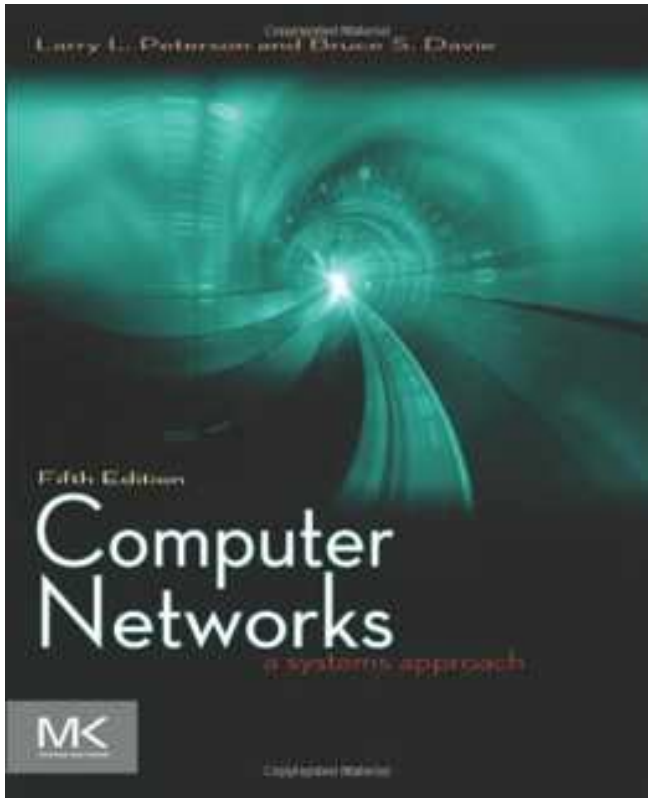
- This course *will* teach you about network architecture
  - We will cover some classic literature for background
  - Focus mostly on recent developments in the field
- This course *will not* teach you the fundamentals
  - Layering, signaling, framing, MAC, switching, routing, naming, Internetworking, congestion control, router design, etc.
  - Take the undergrad course for the basics
- Similarly, we will not cover Web/Cloud services
  - CSE223B covers distributed systems design, the “cloud,” etc.
  - You *will be able to* pick this up on your own with Google

CSE 222A Class Overview

- Course material taught through class lectures, paper readings, and term project
  - Lectures are *interactive*—attendance is crucial to success
- Course grade based upon:
  - Daily paper reviews
  - In-class quiz at end of term (based on lectures/readings)
  - Term project with paper and presentation
- Piazza discussion forums
  - The place to ask questions about lecture, papers, project, etc.
  - My first time using it, so please let me know if it's broken!

Textbook

- Peterson and Davie, *Computer Networks: A systems Approach*, Morgan Kaufmann, 5th Edition, ISBN 978-0-12-385059-1



Paper reviews

- Written critique of each assigned reading
  - Submitted in advance of each class through an automated conference review system (HotCRP)
  - What are the biggest contributions of the paper?
  - What are the main shortcomings/issues with the work?
  - What are the implications of the described work?
- You should read others' reviews
  - Help you see other points of view
  - Available *after* you submit your review
- Graded on a 3-point scale
  - Our expectations will go up as the term progresses

Term Project

- Group project; teams of 2-3 people
  - Your chance to explore what networking research is like
  - The very best projects can—and do—result in publications
- List of project ideas on course Website
  - Will be posted shortly
- Several milestones to keep you on track
  - Topics of interest due Jan 22nd.
  - Teams formed January 24th.
  - Project proposal due February 5th.
- Final exam period will be a mini conference
  - You will prepare a report and a presentation

Grading

- Paper reviews: 15%
- Quiz: 35%
- Project: 40%
- Participation: 10%
  - Attendance and engagement in class discussion is crucial

Questions

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

Networking in One Slide

- Protocols & Layering
  - Manage complexity by decomposing the tasks
  - Standardizing syntax and semantics to support interoperability
- Naming
  - Agreeing on how to describe a host, application, network, etc.
- Switching & Routing
  - Deciding how to get from here to there
  - Forwarding messages across multiple physical components
- Resource Allocation
  - Figuring out how to share finite bandwidth, memory, etc.

A "Simple" Task

- Send information from one computer to another

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

Host **Host**

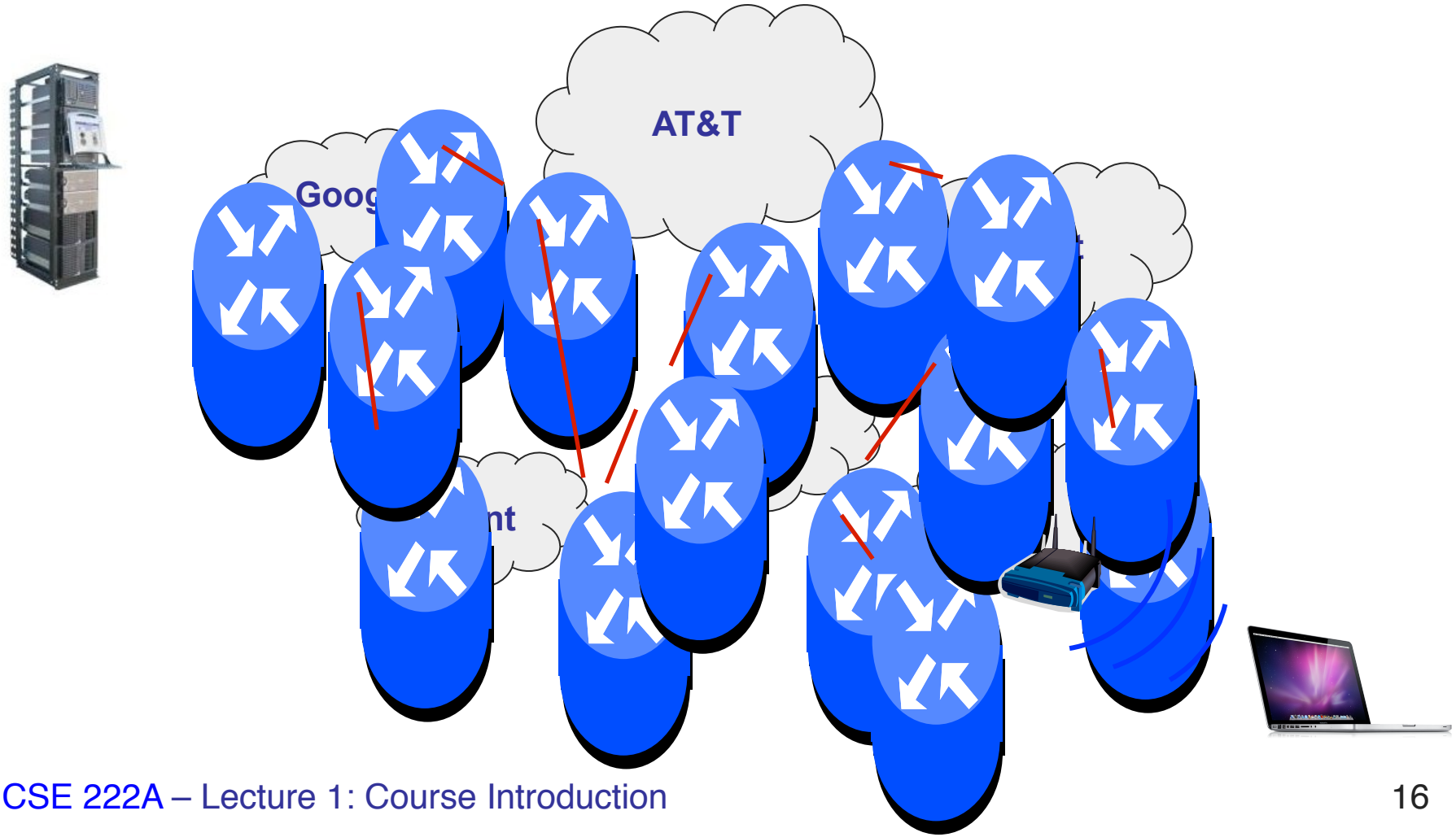
Measures of success

- 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
- How efficiently?
  - Overhead measured in bits or seconds or cycles or…
- Any mistakes?
  - Error rate measured in terms of probability of flipped bit

How long to send a message?

- Transmit time T = M/R + D
  - 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”

Is Not Really So Simple



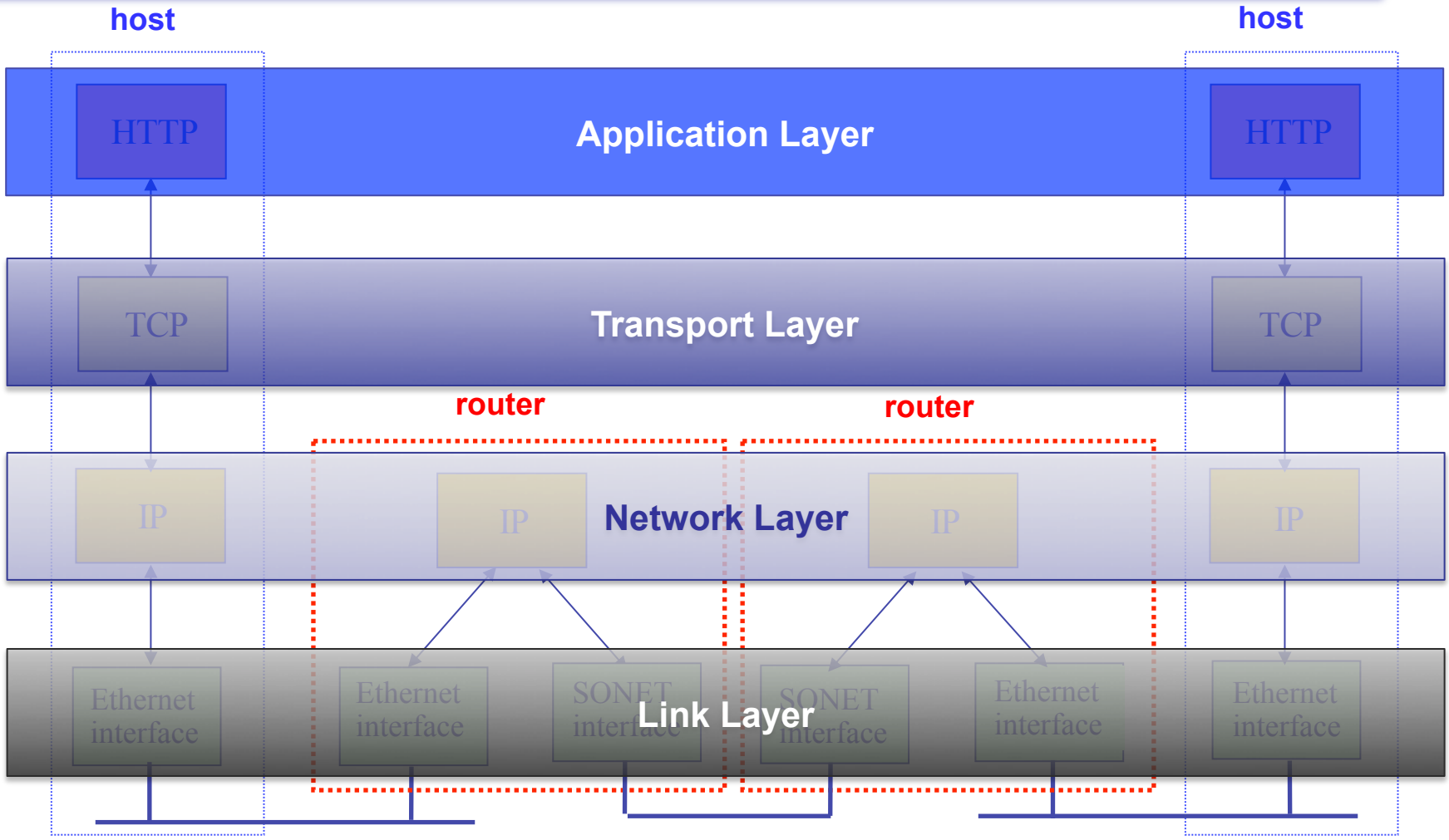
Layering: A Modular Approach

- Sub-divide the problem
  - 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

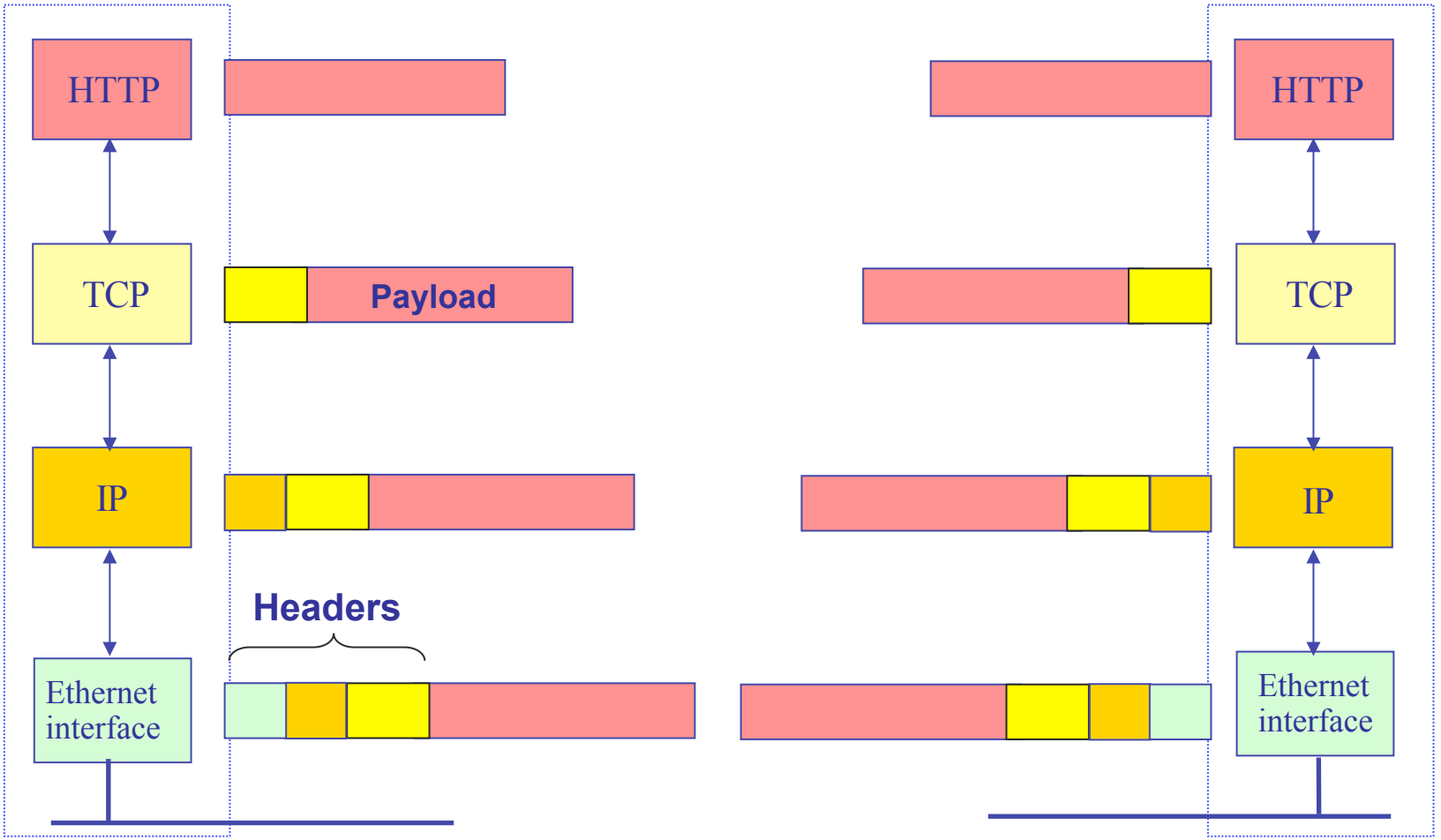
Protocol Standardization

- Communicating hosts speaking the same protocol
  - Standardization to enable multiple implementations
  - Or, the same folks have to write all the software
- Internet Engineering Task Force
  - Based on working groups that focus on specific issues
  - Produces “Request For Comments” (RFCs)
    - » Rough consensus and running code
    - » After enough time passes, promoted to Internet Standards
- Other standards bodies exist
  - ISO, ITU, IEEE, etc.

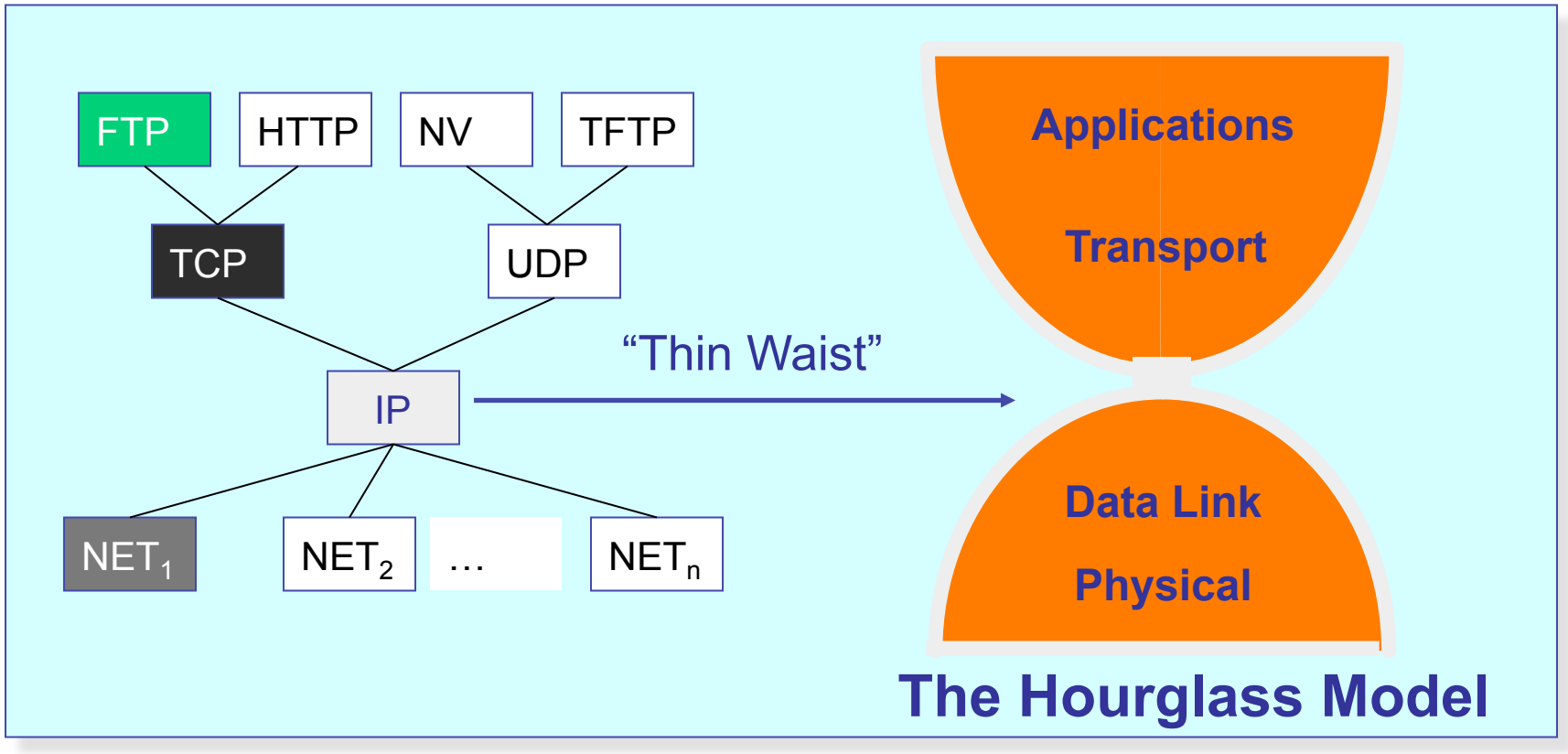
TCP/IP Protocol Stack



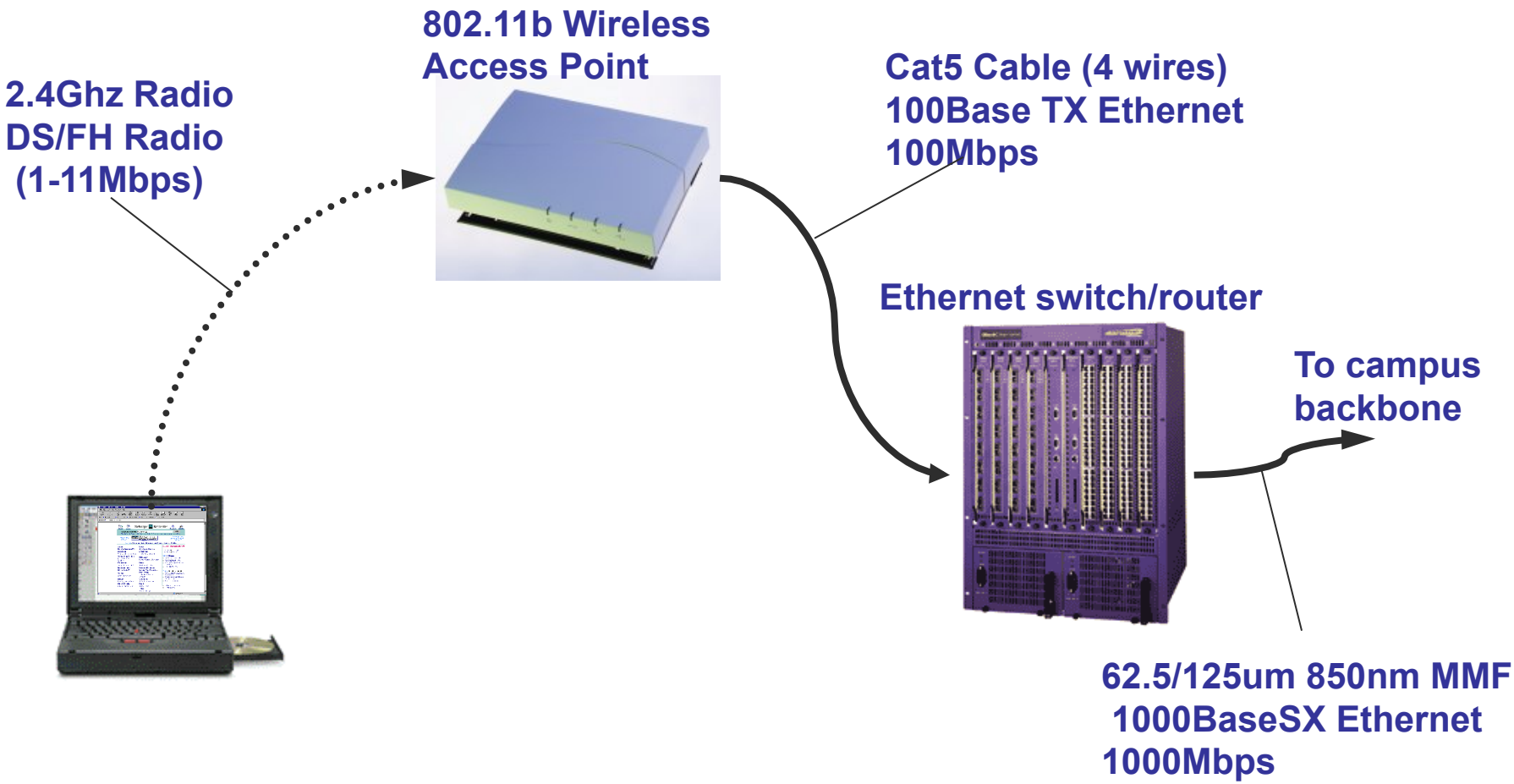
Encapsulation



Internet Protocol Suite

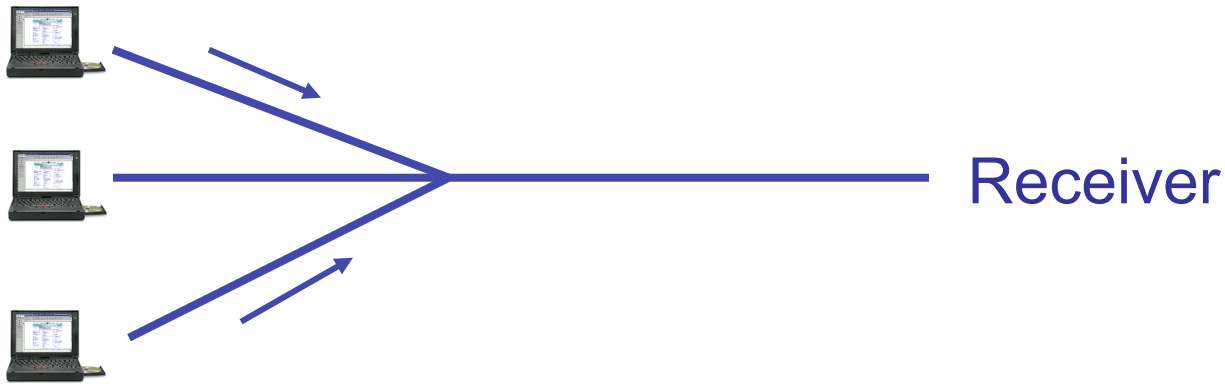


Physical layer



Link Layer (e.g. Ethernet)

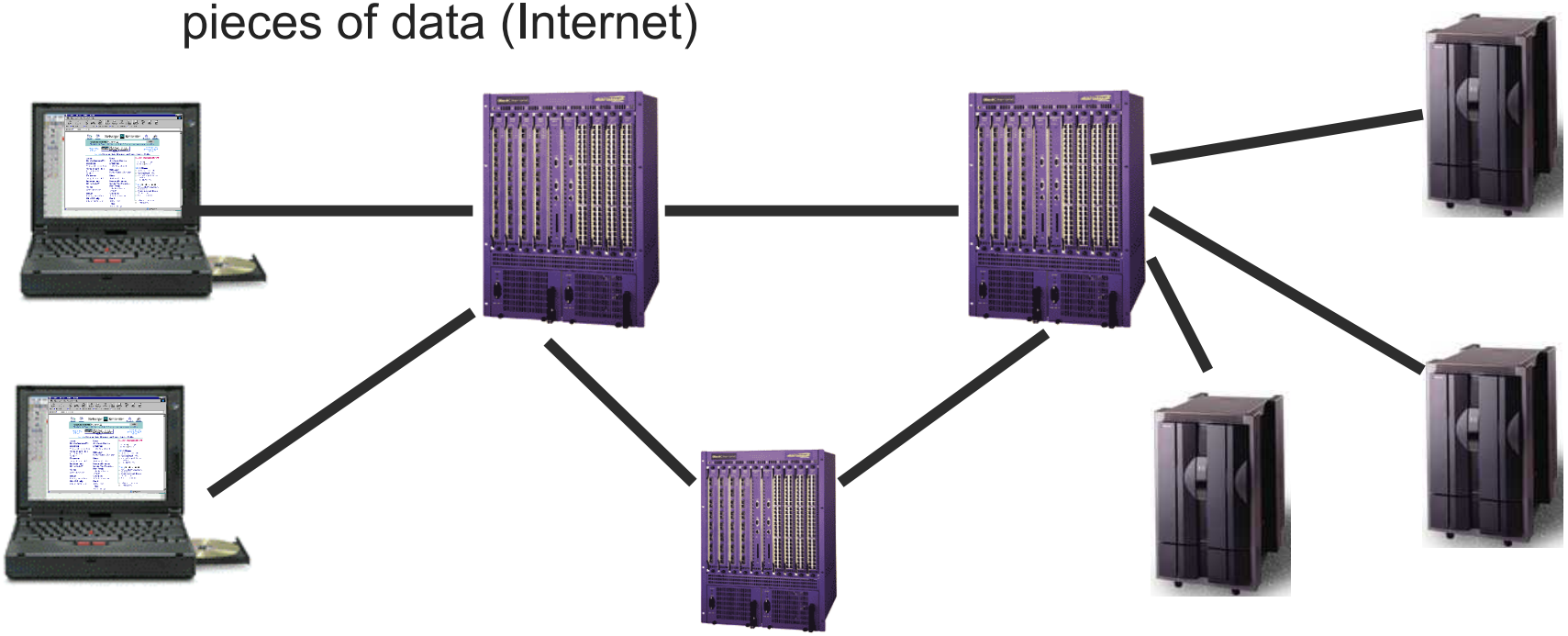
- Break message into frames
- Media Access Control (MAC)
  - Can I send now? Can I send now?



- Send frame

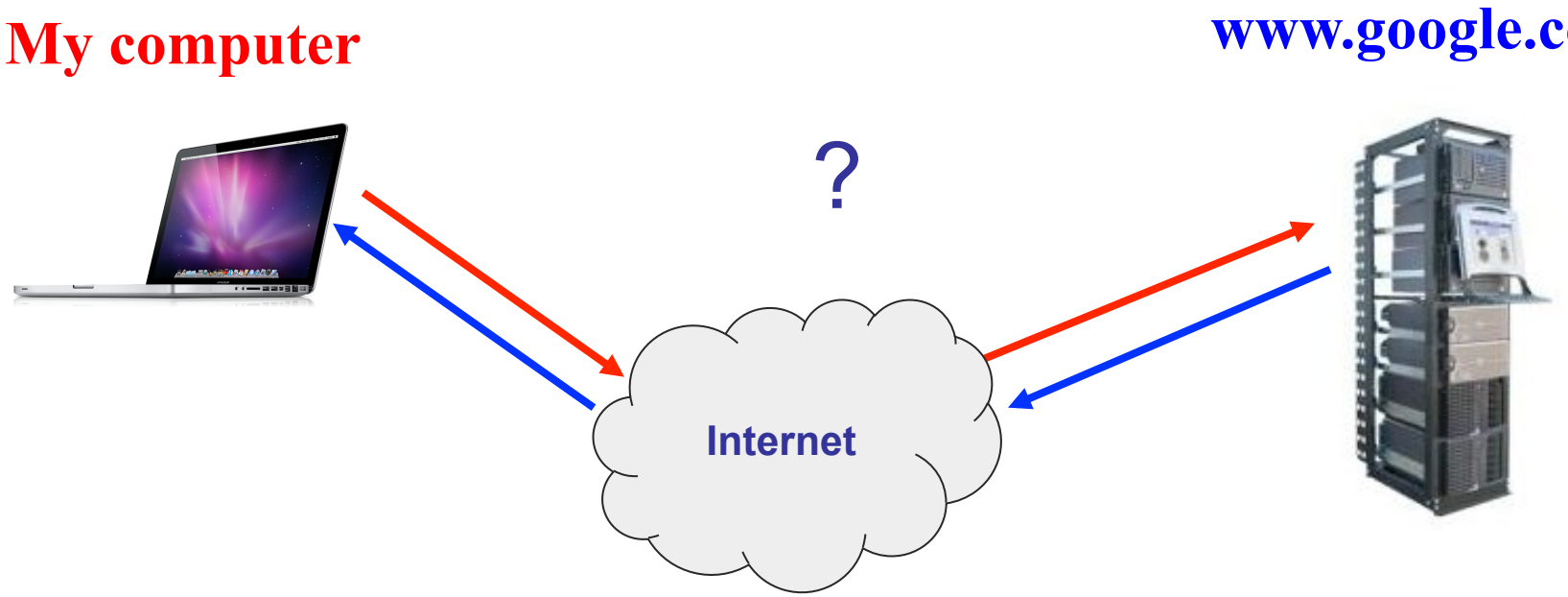
Connecting links

- **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)

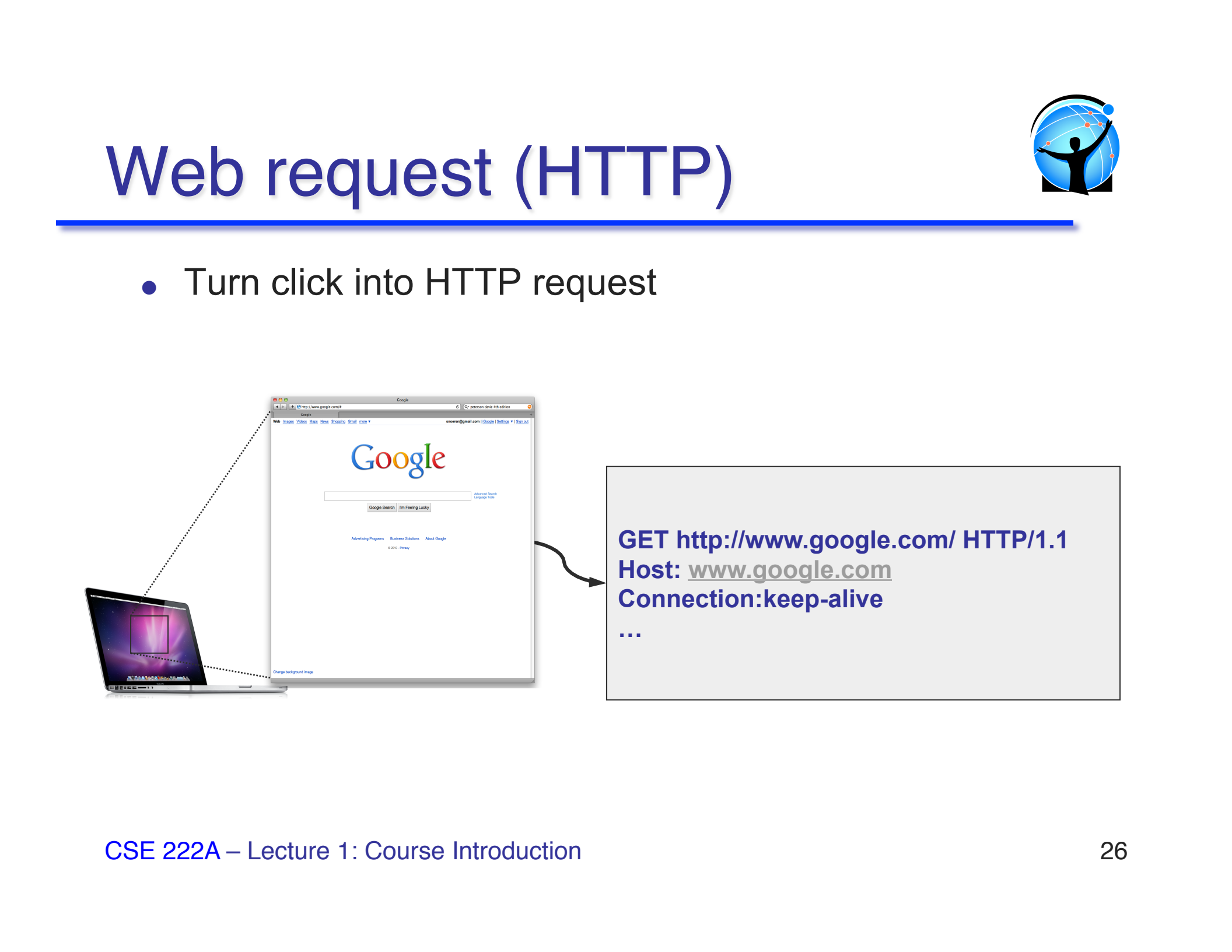


Putting this all together

- **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

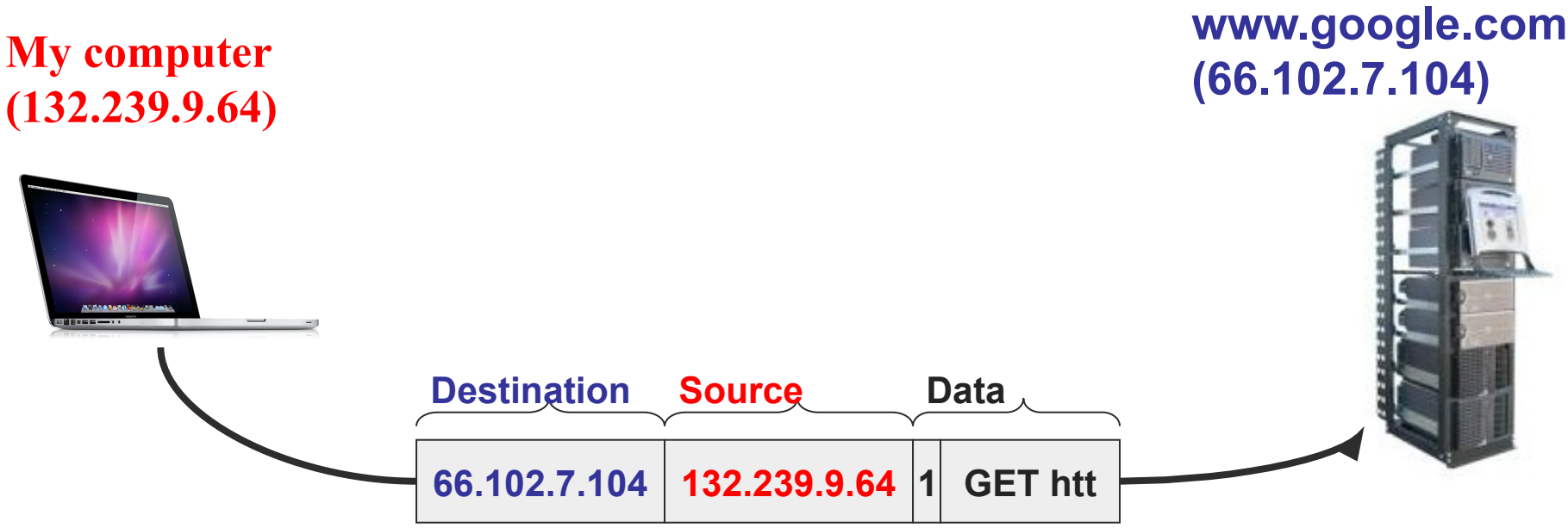
Oh, you can find it at 66.102.7.104

Data transport (TCP)

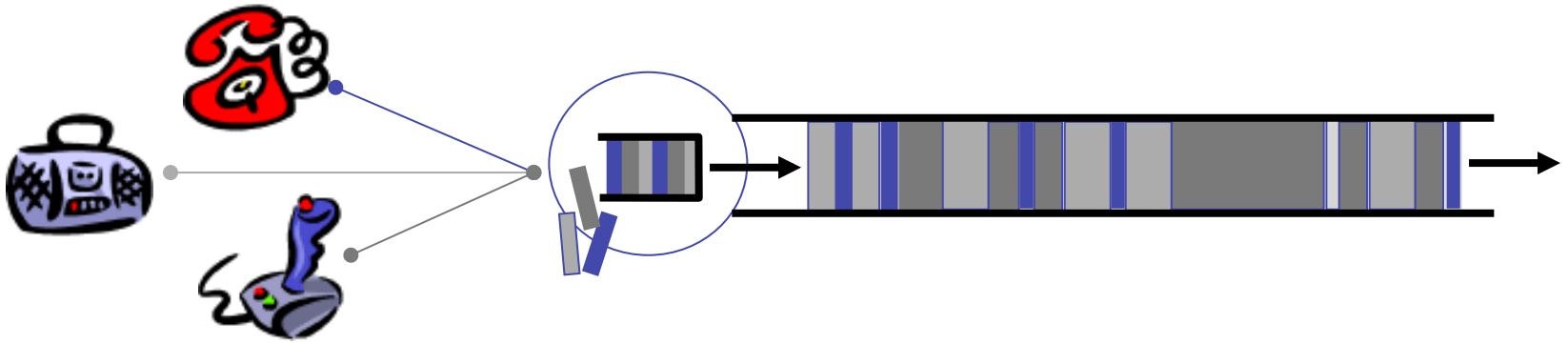
- Break message into packets (TCP segments)
- Should be delivered reliably & in-order

Global Network Addressing

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



Resource Allocation: Queues



- Sharing access to limited resources
  - E.g., a link with fixed service rate
- Simplest case: first-in-first out queue
  - Queue/serve packets in the order they arrive
  - Drop packets when the queue is full
- Anybody hear of “Network Neutrality”?

For Next Class…

- Browse the course web
  - http://www.cs.ucsd.edu/classes/sp13/cse222A-a/
- Read P&D Chapters 1 and 2
- Read and review Saltzer, Reed, and Clark ’84
  - Submit review in HotCRP – available by tomorrow
- Start thinking about term project ideas/groups
  - Suggestions available later this week