CS 40, Lecture 1: Introduction

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Logistics

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Logistics

Course website:
http://eeclass.stanford.edu/msande40

I will maintain course materials
 (handouts, links to articles, etc.)
 at the course website.

Overview

This course explores the interplay between the *technology of the Internet,* and the *economics and policy* that will shape the future of the network.
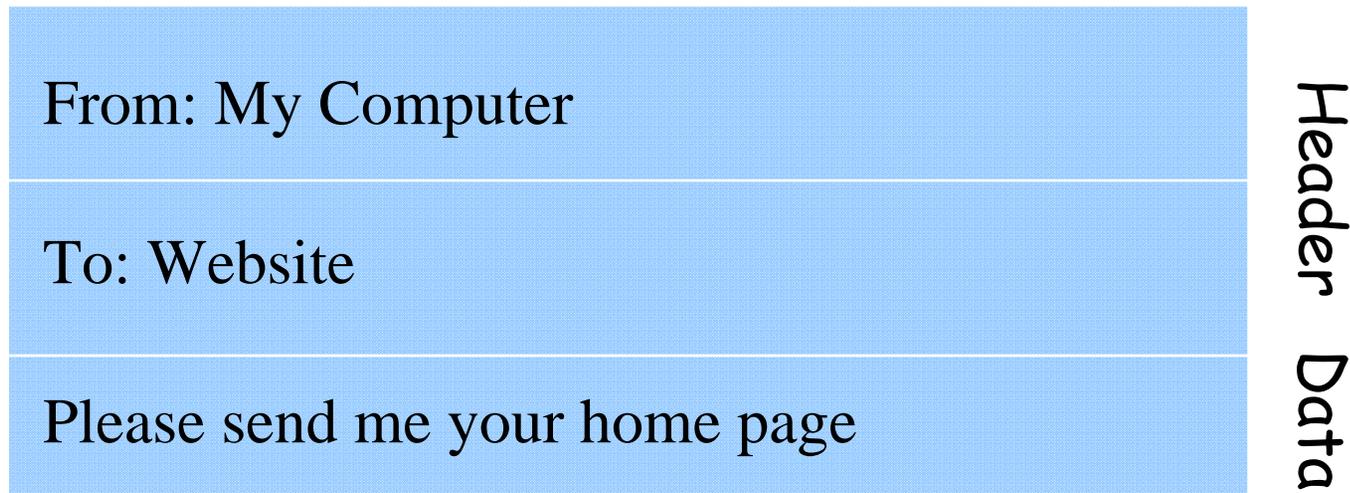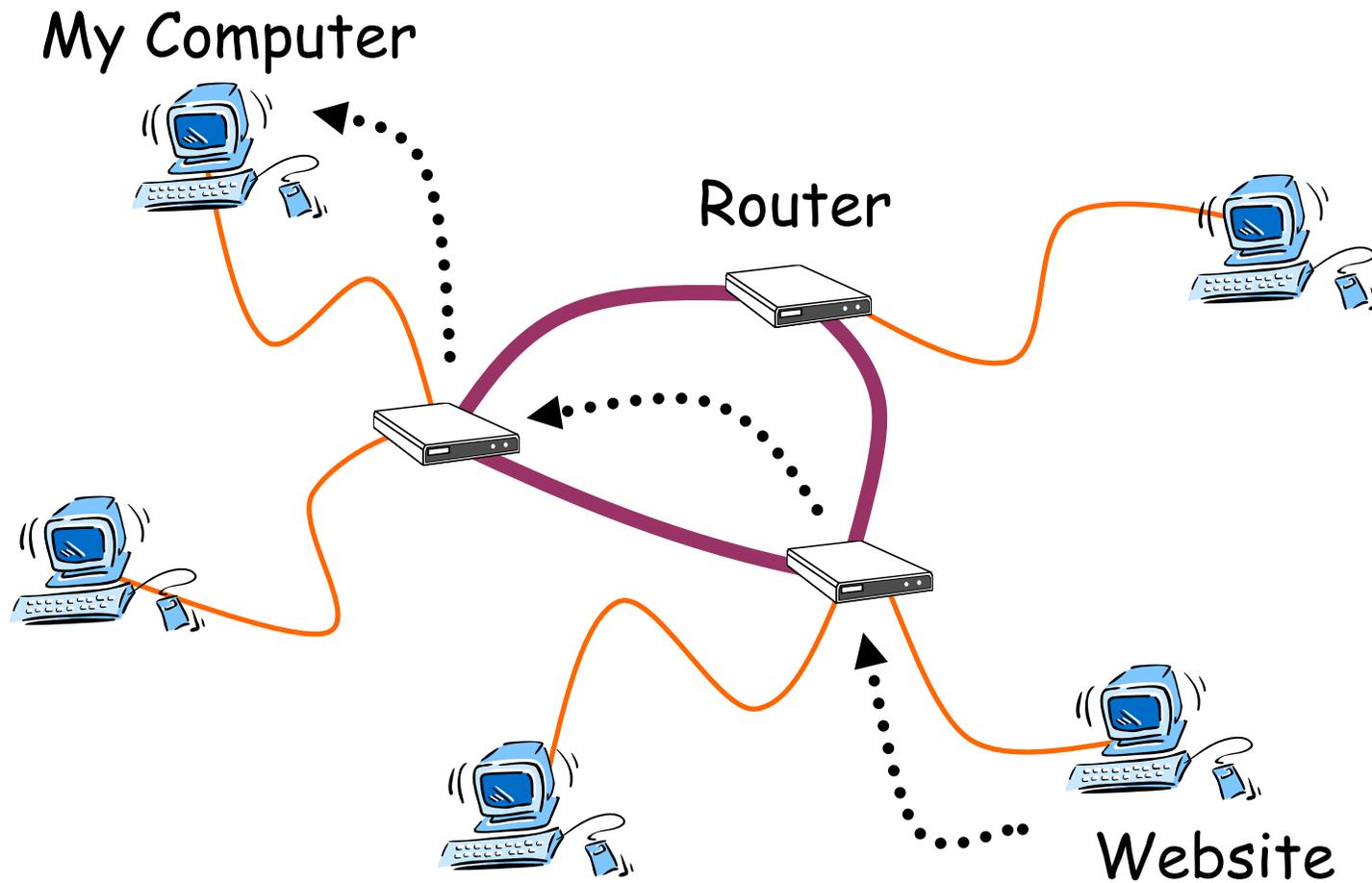
What is the Internet?

The "Internet" is:

A global network of independently owned and operated networks, all using *packet switching technology* and *the TCP/IP protocol suite.*
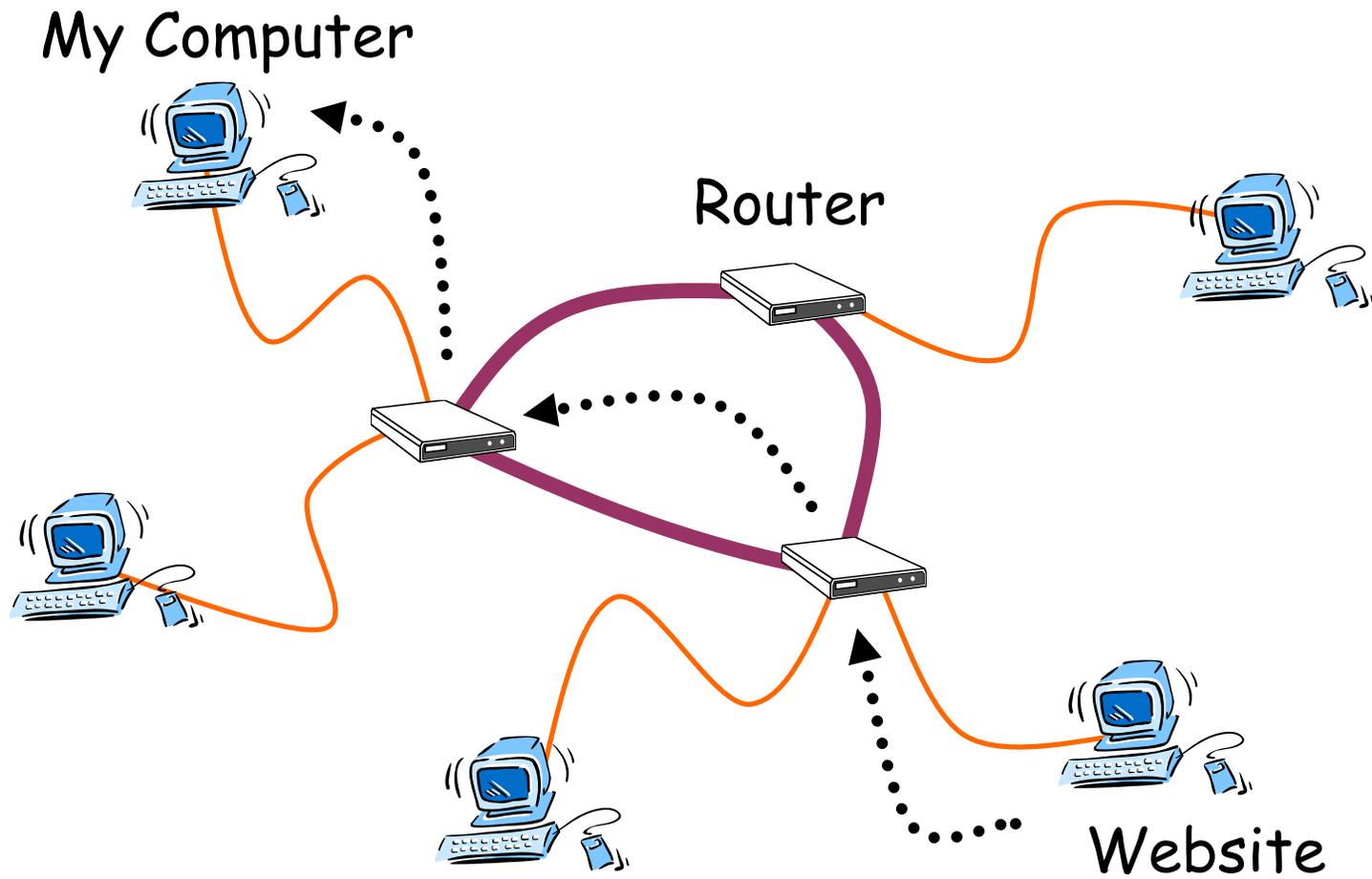
Packet switching

All data transmitted on the Internet is first broken into units called *packets*.

From: My Computer	Header
To: Website	
Please send me your home page	Data

Packet switching

My Computer

Router

Website

Packet switching

My Computer

Router

Website

Packet vs. circuit switching

Packet switching is like *the mail system:*

> There is no guarantee of when,
> or in what order, packets will arrive.

Circuit switching is like *the phone system:*

> A physical connection is created between
> sender and receiver, for the duration
> of a call.

TCP/IP

The TCP/IP suite is built on two pillars:

- TCP: The Transmission Control Protocol
  (for end-to-end reliability)

- IP: The Internet Protocol
  (for packet routing)

These protocols provide the core
functionality of the Internet.

We will return later to TCP/IP in
more detail.

A brief history of the Internet

- 1969: ARPANET (packet switching)
- 1972: Internetworking
- 1983: DARPA adopts TCP/IP
- 1985: NSF adopts TCP/IP for NSFNET
- 1990: ARPANET decommissioned
- 1995: NSF ceases NSFNET backbone funding

Today's Internet

The Internet is a federation of thousands of independently owned and operated networks.

We refer to these networks as *autonomous systems* (ASes).

(Note: The same service provider may have several AS numbers, e.g., one in Europe and one in the U.S.; but we ignore this distinction.)

Autonomous systems

Autonomous systems are linked to each other through a system of *bilateral contracts.*

Example:

When you buy service from Comcast, their other contracts are responsible for making sure you can reach the rest of the Internet.

(More on this next lecture.)

Autonomous systems

An AS can be more than you think!

- Network service provider
- Content provider
- Content delivery network
- Enterprise networks

Network service providers

- *Tier 1:* AT&T, Sprint, Level3, Cogent, etc. Backbone providers that provide global connectivity
- *Tier 2:* Regional service providers
- *Tier 3:* Comcast, AOL, etc.

  "Access providers" that sell access to the Internet

Content providers

- Google
- Yahoo!
- Amazon
- eBay
- CNN, New York Times, etc.

All of these have significant networks; and they interconnect with other ASes.

Content delivery networks

A *content delivery network* replicates content at many locations around the Internet, to improve download times.

- Akamai
- Limelight

Internet exchanges

An *Internet exchange* is a facility where many buyers and sellers of network service are simultaneously connected.

- Equinix
- Palo Alto IX, Amsterdam IX, London IX, etc.
- Packet Clearing House

The future of the Internet

There is a vigorous debate taking place about *the ownership of the Internet.*

All of the players we just discussed are stakeholders in this debate, with widely varying views about the future of the network.

Other players

- End users
- Hardware manufacturers
- Governmental agencies
- Standards organizations
- Academia

Our goal

Our goal in this course is to develop a framework to evaluate the positions of the key players in the debate over the future of the Internet.

Examples:

How should Comcast address peer-to-peer filesharing?

What will it cost for Netflix to deliver video over the Internet?

Organization of the course

- Part I: Internet routing, congestion control, and TCP/IP
- Part II: The economics of Internet contracts and interdomain routing
- Part III: The "application" layer
- Part IV: The network neutrality debate