

Announcements

- Pair Programming Begins Today ... more later

Connected computers are better! How's it done?

Networking ...

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Networks...

Computers are useful alone, but are better when connected (networked)

- Access more information and software than is stored locally
- Help users to communicate, exchange information...changing ideas about social interaction
- Perform other services—printing, Web, email, texting, mobile, etc.

Today's Message: Internet is NOT really a bunch of tubes!

Network Structure

Networks are structured differently based (mostly) on distance between computers:

- Local area network (LAN)
 - Small area: room or building
 - Either wired (Cu or fiber) or wireless
- Wide area networks (WAN)
 - Large area: more than 1 km
 - Fiber-optic, copper transmission lines, μ -wave, satellite
- Metropolitan area networks (MAN)
 - Neighborhood or several blocks of business district
 - Private service provider owns network

Protocol Rules!

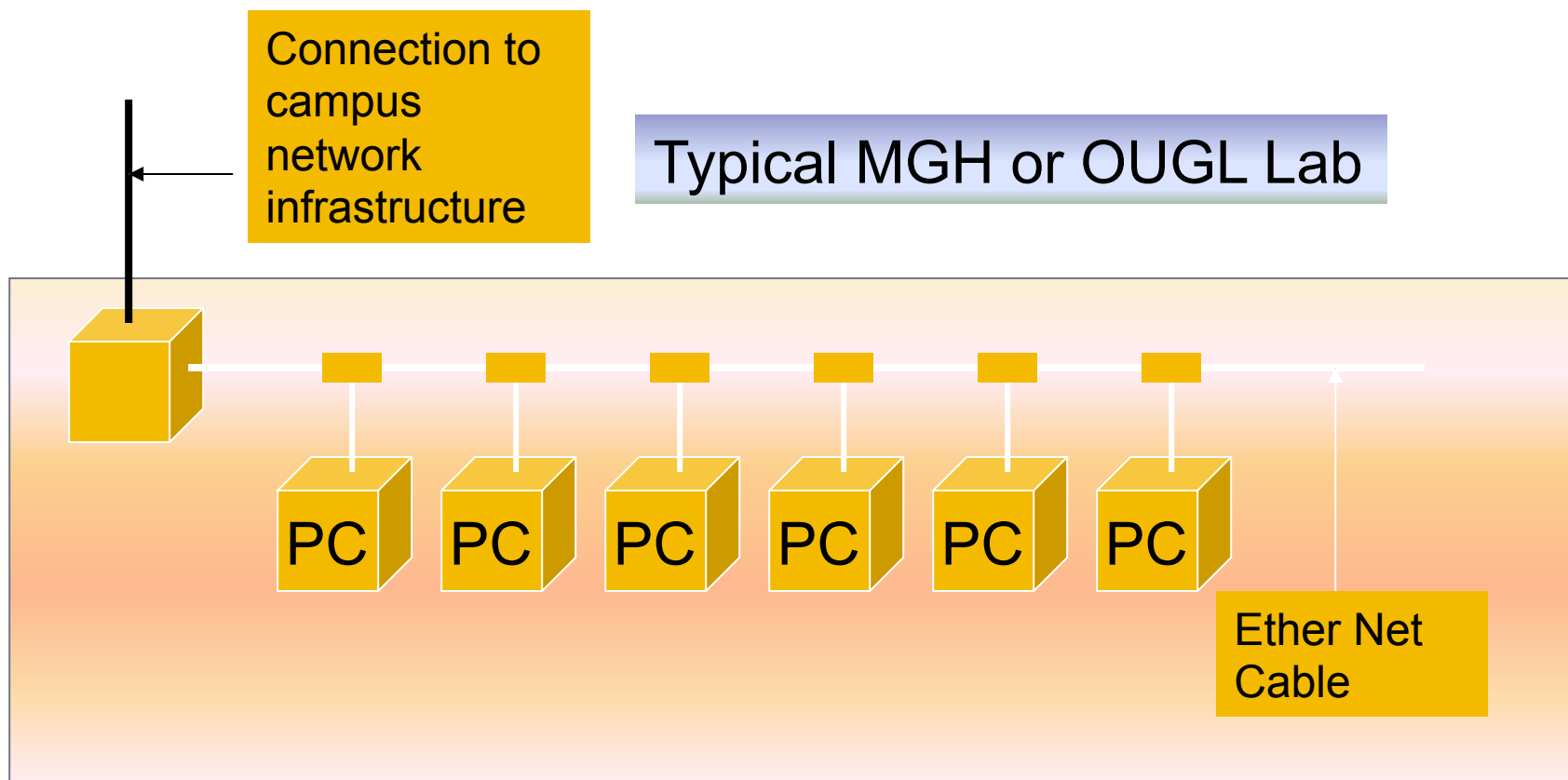
To communicate computers need to know how to set up the info to be sent and interpret the info received

- Communication rules are a *protocol*
- Example protocols
 - EtherNet—for physical connection in a LAN
 - TCP/IP—for Internet—transmission control protocol / internet protocol
 - HTTP—for Web—hypertext transfer protocol

LAN in the Lab

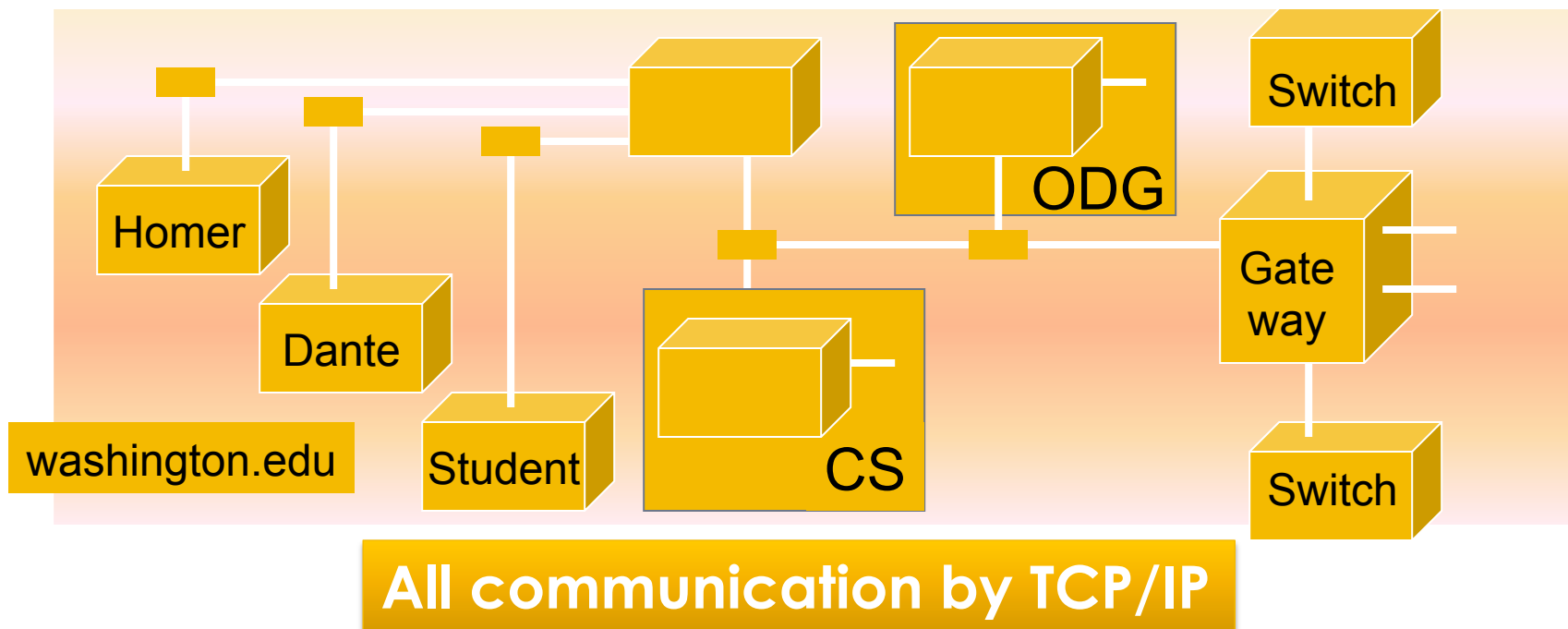
EtherNet is a popular LAN protocol

- It uses a “party” protocol



Campus & The World

The campus subnetworks interconnect computers of the UW domain which connects to Internet via a gateway



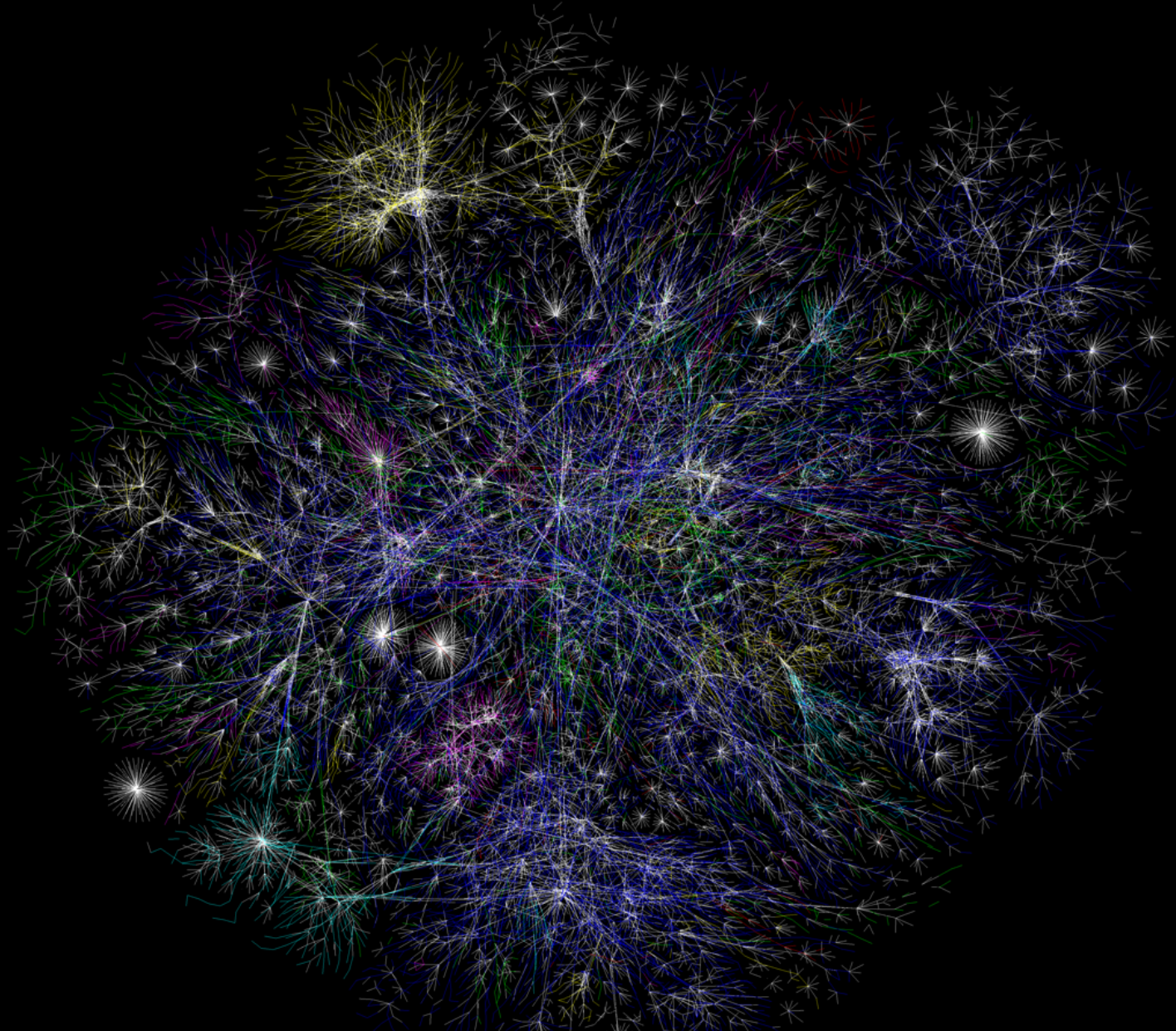
IP—Like Using Postcards

Information is sent across the Internet using IP—Cerf uses postcard analogy

- Break message into fixed size units
- Form IP packets with destination address, sequence number and content
- Each makes its way separately to destination, possibly taking different routes
- Reassembled at destination forming msg

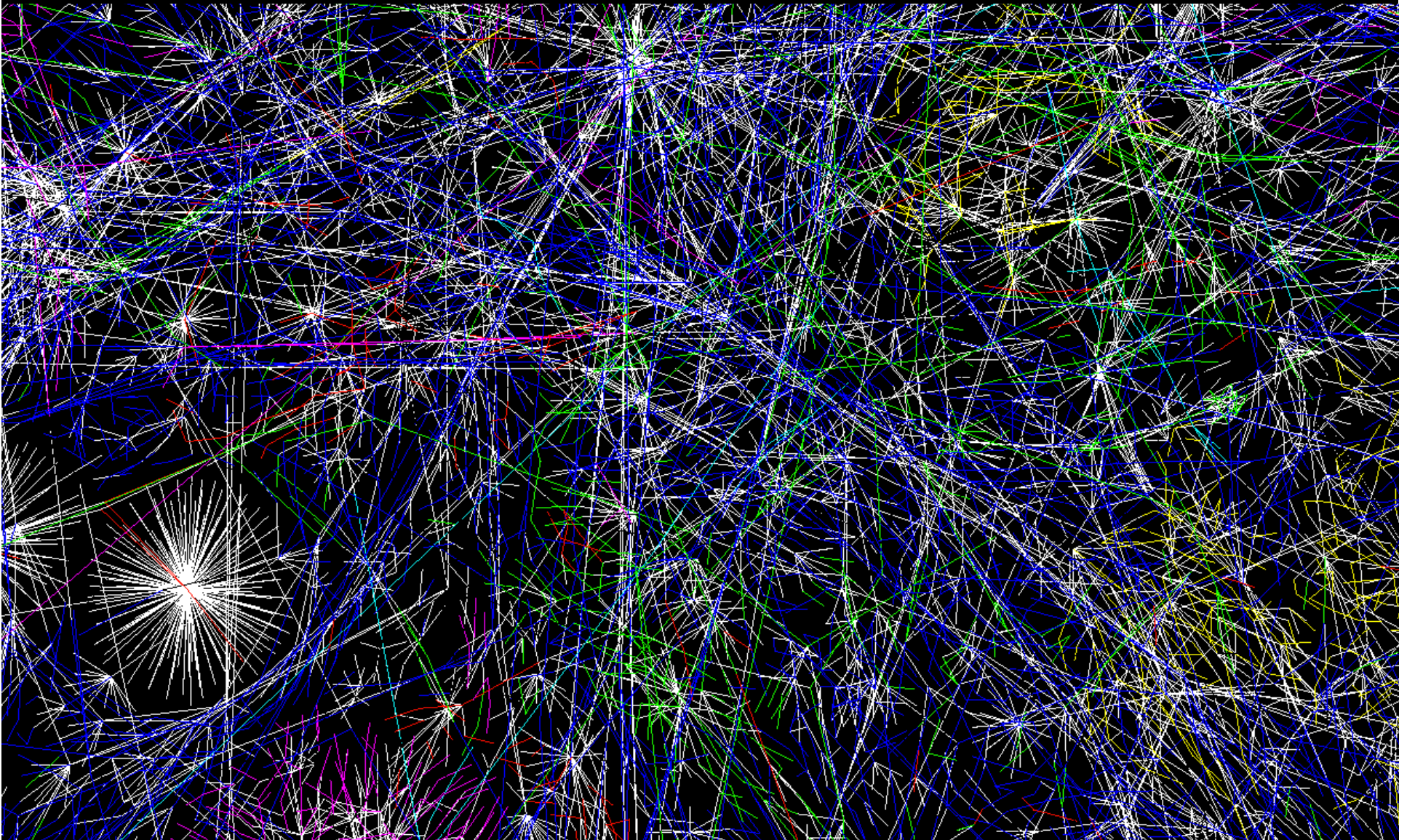
addr # data

Key Point: Taking separate routes lets packets by-pass congestion and out-of-service switches; packet reassembly discovers lost packets; ask for resend



net, ca, us com, org mil, gov, edu
jp, cn, tw, au de, uk, it, pl, fr br, kr, nl unknown

Picture of Portion of I'net 2005



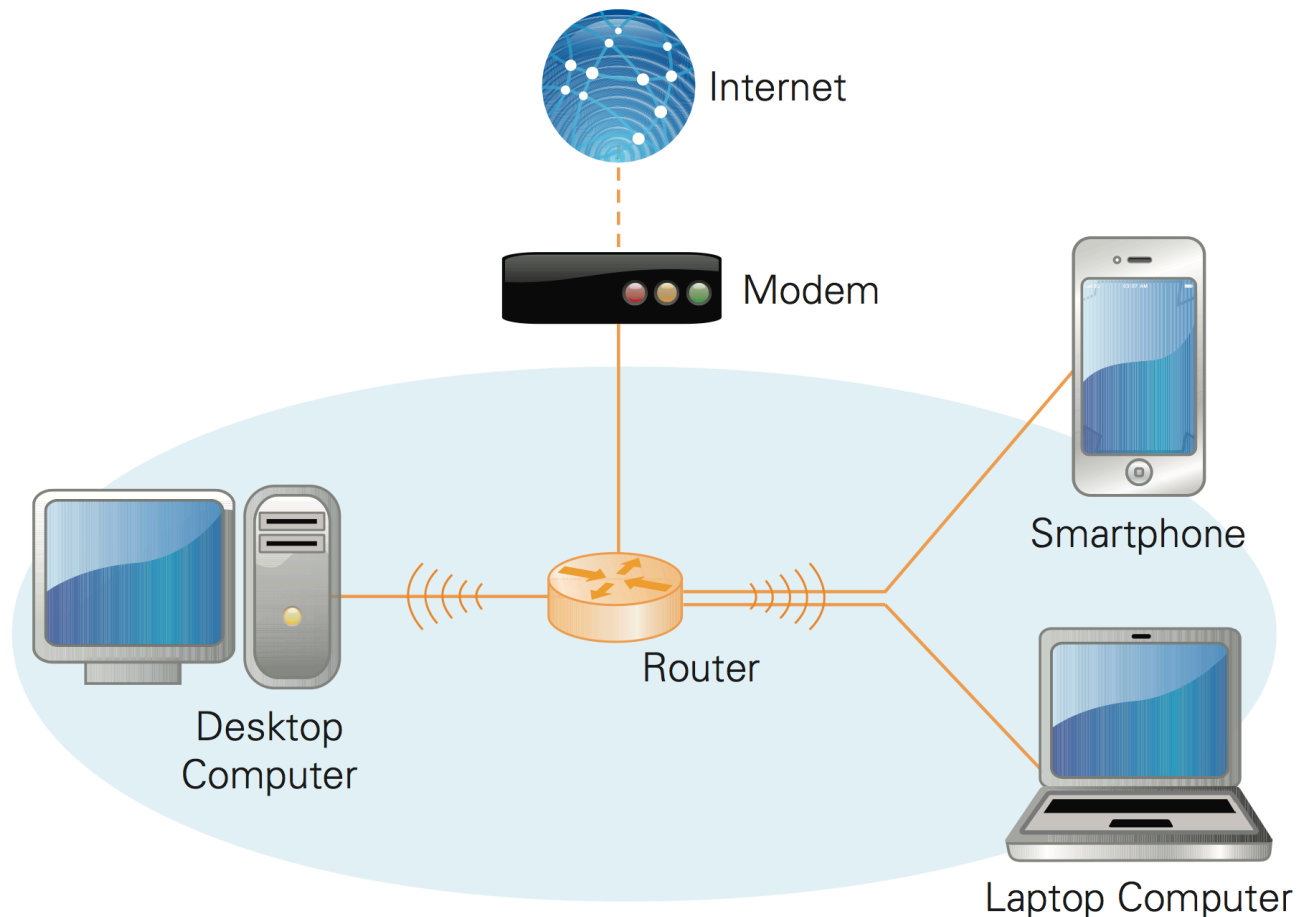
A Quick Trip to Switzerland

Hop	Time	Host	IP-addresses
1	0.687	10.0.0.1	10.0.0.1
2	3.117	10.20.62.254	10.20.62.254
3	7.209	r2-l3tca-cr2.nextweb.net	216.237.3.33
4	5.551	ge-6-15.car2.Tustin1.Level3.net	4.79.142.41
5	168.978	vl-3202-ve-134.ebr2.Tustin1.Level3.net	4.69.160.17
6	168.314	ae-7-7.ebr3.LosAngeles1.Level3.net	4.69.153.225
7	166.494	ae-12-12.ebr1.Washington1.Level3.net	4.69.132.82
8	164.907	ae-81-81.csw3.Washington1.Level3.net	4.69.134.138
9	163.503	ae-82-82.ebr2.Washington1.Level3.net	4.69.134.153
10	163.304	ae-44-44.ebr2.Paris1.Level3.net	4.69.137.61
11	161.167	ae-9-9.car1.Lyon1.Level3.net	4.69.134.49
12	197.768	ae-5-5.car1.Geneva1.Level3.net	4.69.137.81
13	165.424	DANTE.car1.Geneva1.Level3.net	213.242.73.74
14	162.997	swiEL2-10GE-1-3.switch.ch	130.59.37.66
15	166.81	swiLS2-10GE-1-2.switch.ch	130.59.36.69
16	172.19	swiEZ2-10GE-1-1.switch.ch	130.59.36.206
17	182.814	rou-gw-rz-tengig-to-switch.ethz.ch	192.33.92.1
18	172.375	rou-fw-rz-rz-gw.ethz.ch	192.33.92.169
21	N/A	ns1.ethz.ch	129.132.98.8

whatismyipaddress.com/traceroute-tool

Wireless is a LAN technology

- As with “wired Ethernet,” all computers in range can hear the radio signals of the others



Naming Computers—Take 1

People name computers by a domain name

- a hierarchical scheme that groups like computers
 - `.edu` All educational computers, a TLD
 - `.washington.edu` All computers at UW
 - `dante.washington.edu` A UW computer
 - `.ischool.washington.edu` iSchool computers
 - `.cs.washington.edu` CSE computers
 - `spiff.cs.washington.edu` A CSE computer

Domains begin with a “dot” and get “larger” going right

Naming Computers—Take 2

Computers are named by IP address, four numbers in the range 0-255

cse.washington.edu: 128.95.1.4

ischool.washington.edu: 128.208.100.150

- Remembering IP addresses would be brutal for humans, so we use domains
- Computers find the IP address for a domain name from the *Domain Name System*—an IP address-book computer

A computer needs to know IP address of DNS server!

Domains

.edu .com .mil .gov .org .net domains are “top level domains” for the US

- Recently, new TLD names added
- Each country has a top level domain name:
 - .ca (Canada)
 - .es (Spain)
 - .de (Germany)
 - .au (Australia)
 - .at (Austria)
 - .us (US)

Do you know sites like:
bit.ly
www.nba.tv
del.icio.us
... they exploit TLDs

Logical vs Physical

View the Internet in two ways:

1. Humans see a hierarchy of domains relating computers—**logical network**
2. Computers see groups of four number IP addresses—**physical network** (my computer: 128.208.3.136)

Both are ideal for the “user's” needs

- The Domain Name System (DNS) relates the logical network to the physical network by translating domains to IP addresses

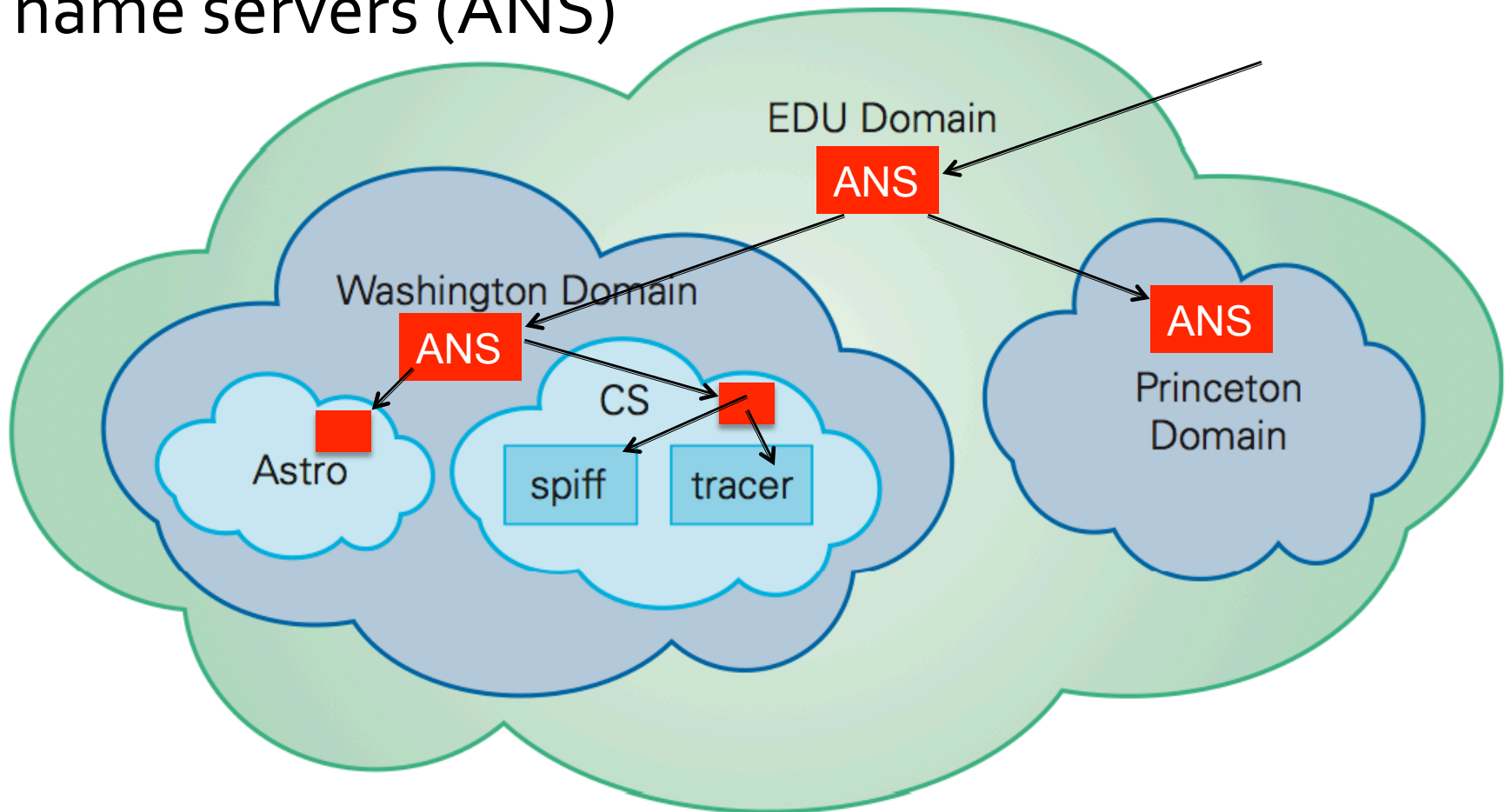
Finding A Picture ... Opportunity

www.jpl.nasa.gov/spaceimages/details.php?...



Finding A Picture ... Opportunity

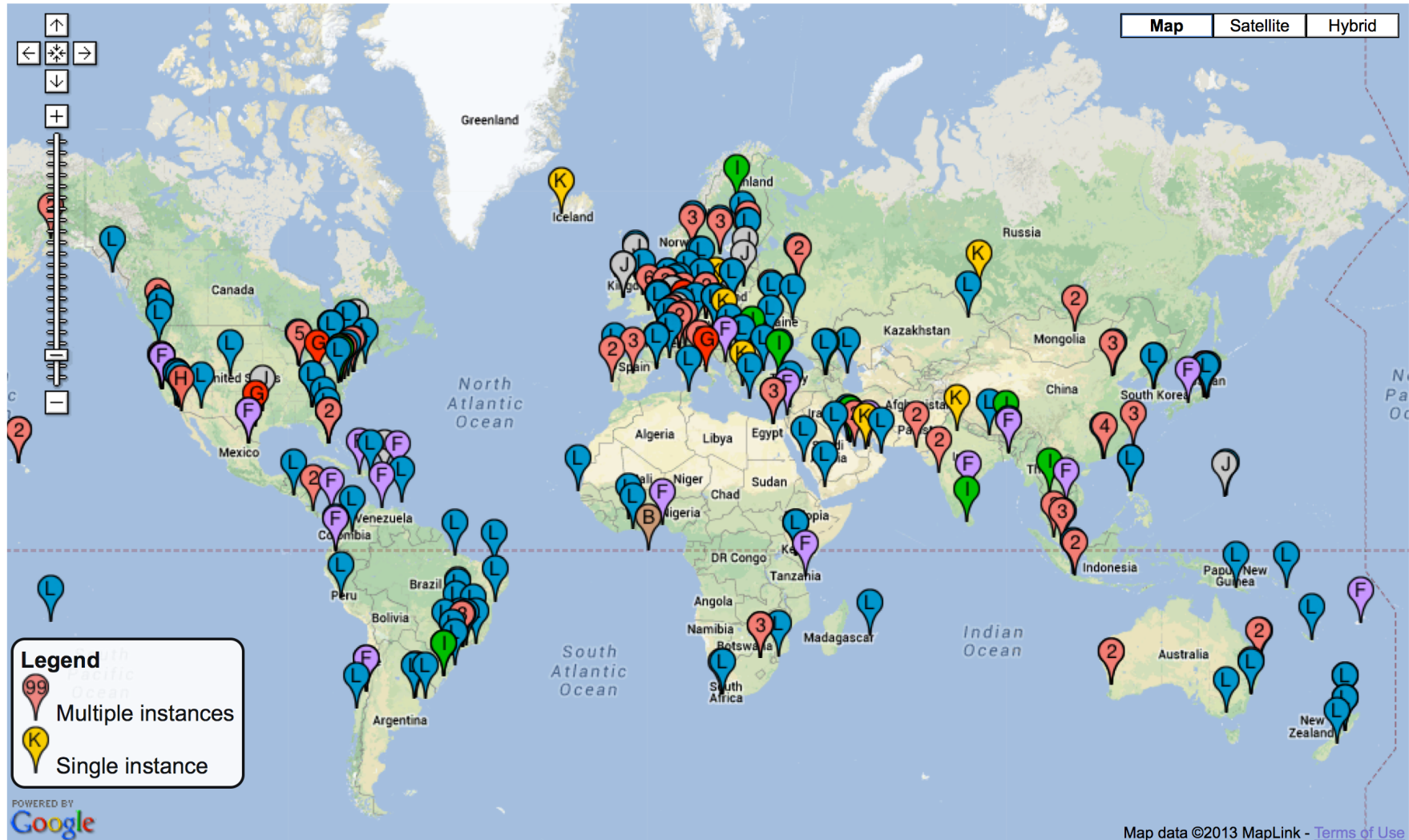
To get to www.jpl.nasa.gov use authoritative name servers (ANS)



It knows IP-Address of ANS for every Sub Domain

Finding A Picture ... Opportunity

www.jpl.nasa.gov.root



Internet vs. World Wide Web

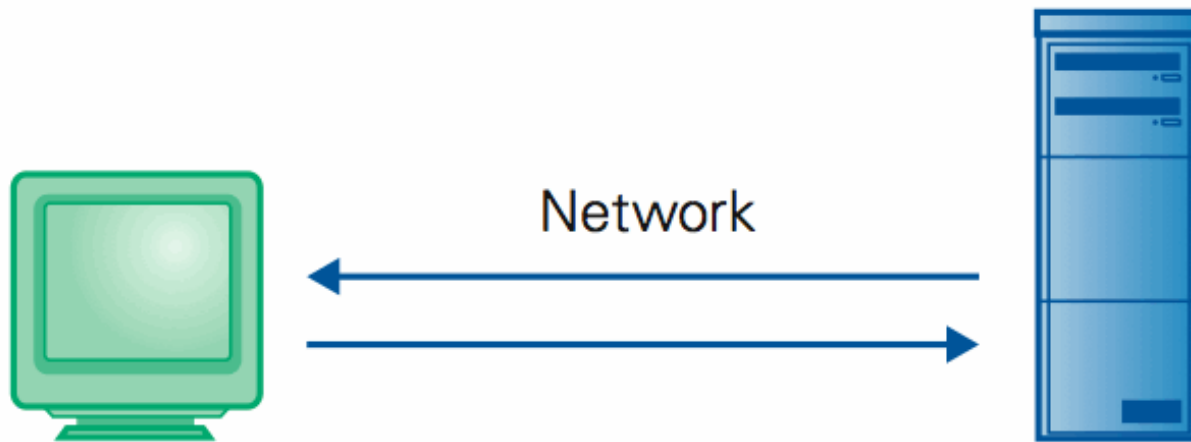
- Many people mis-use the terms “Internet” and “World Wide Web”
- Let’s get them right

Internet: all of the wires, fibers, switches, routers etc. connecting named computers

Web: That part of the Internet —web servers—that store info and serve Web pages and provide other services to client computers

One More Protocol: Client/Server

- The Web and much of the Internet services use the client server form of interaction



Client Computer

Requests services

(Sends URL for a Web page)

Server Computer

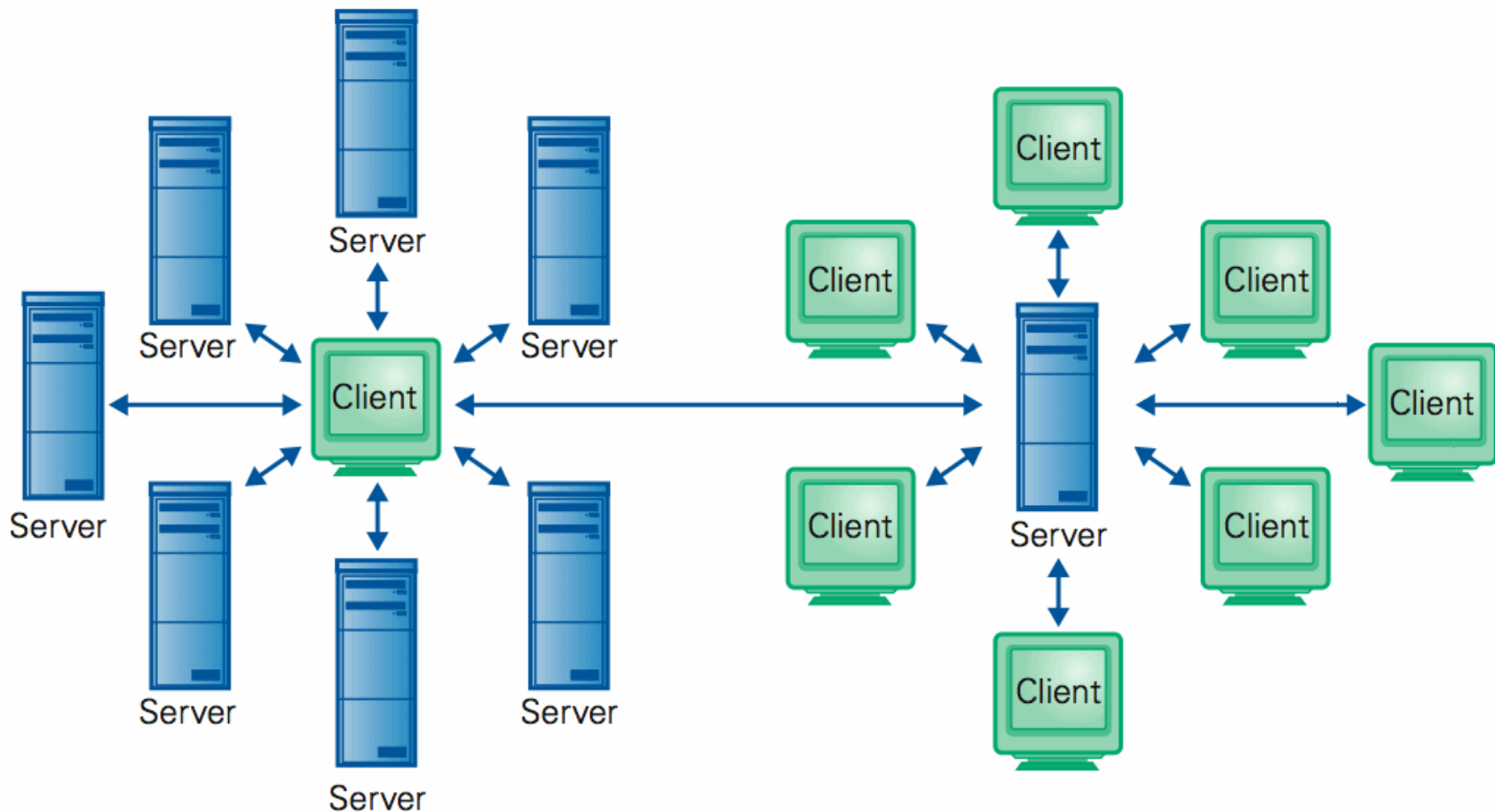
Provides services

(Returns the Web page file)

- It's a VERY BRIEF relationship

Client/Server Is Also Smart

- Clients and servers are not connected – they only exchange info ... “no commitment issues”



Summary

Networking changed the world

Internet: named computers using TCP/IP

WWW: servers providing Web pages

- Principles

- Logical network of domain names
- Physical network of IP addresses
- Protocols rule: LAN, TCP/IP, http...
- Domain Name System connects the two
- Client/Server, fleeting relationship on WWW

Pair Programming

- Pair programming – two people work side-by-side programming one problem together
 - It's thought to be more productive – fewer errors, smarter code
 - It's certainly more fun
- CSE120 Rules –
 - ALL CODING WORK ON PROJECT MUST BE DONE TOGETHER
 - Share coding duties, commenting duties
- Teams: comparable skill, compatible times