Announcements

- Pair Programming Begins Today … more later
- *Blown To Bits*

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!

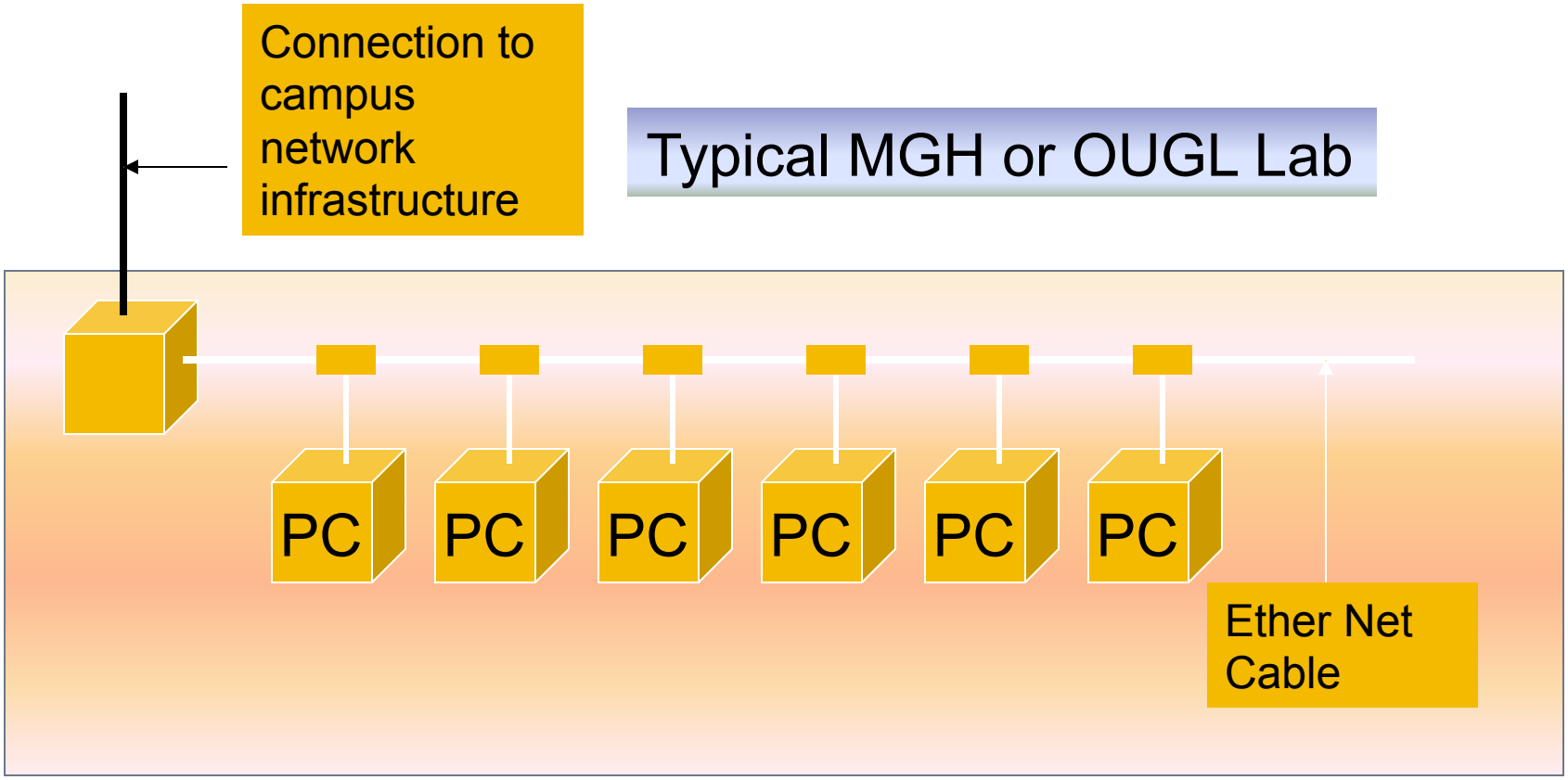
To communicate computers need to know how to set up the info to be sent and interpret the info received

- 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

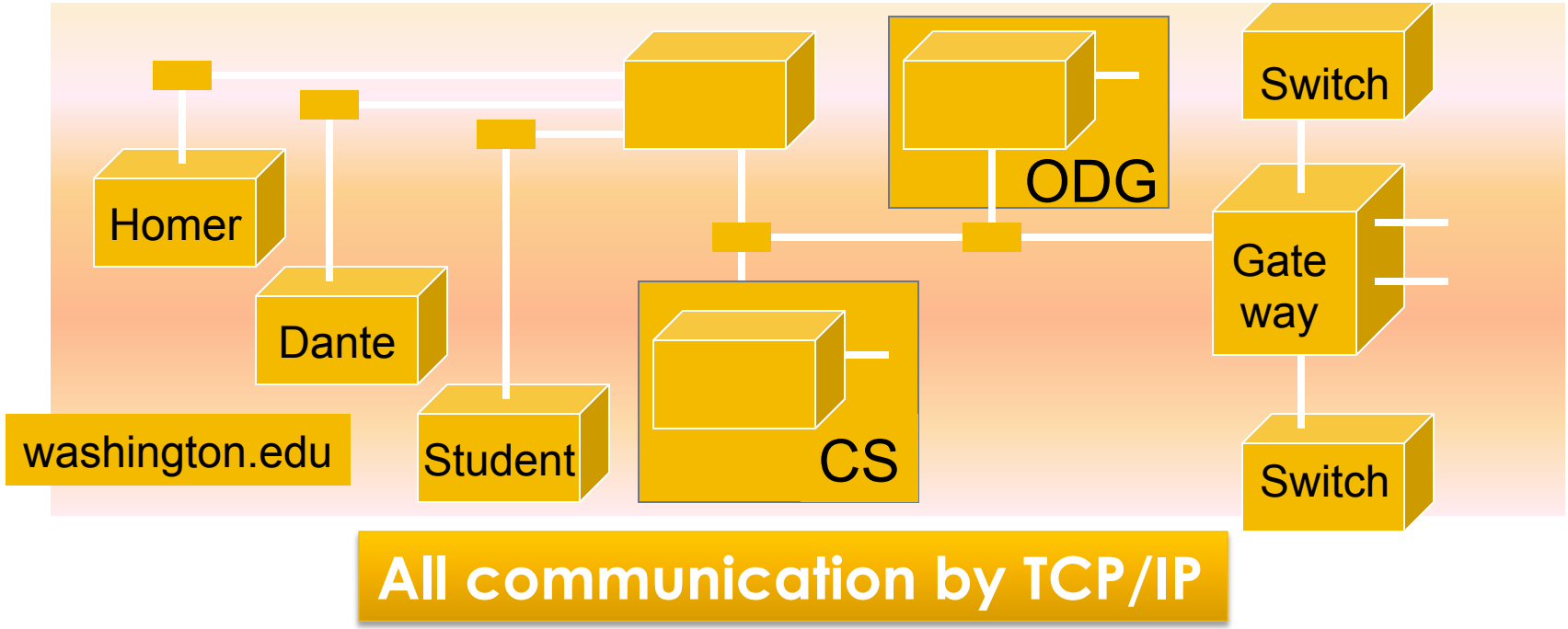
EtherNet is a popular LAN protocol

- It uses a "party" protocol



Campus & The World

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



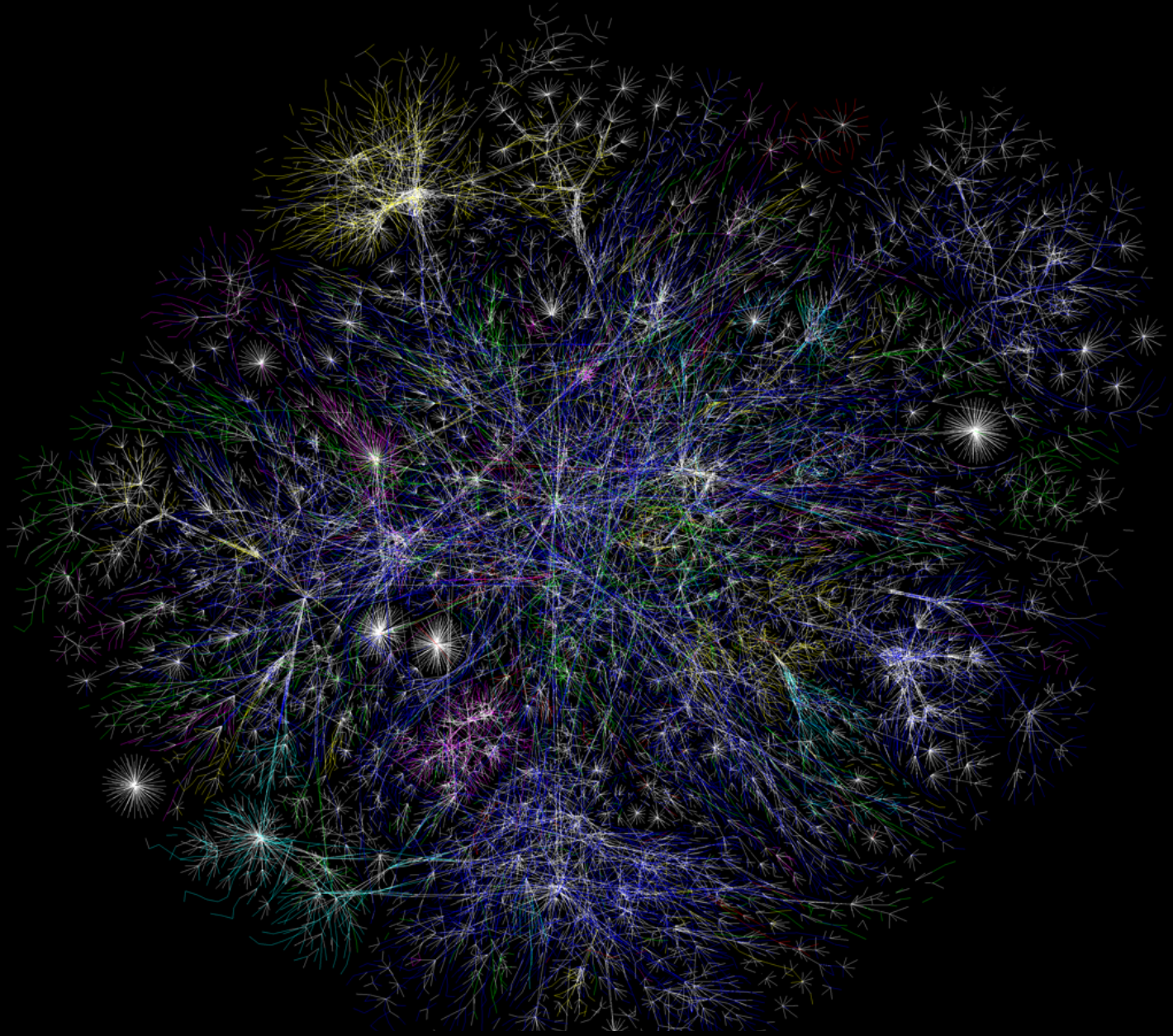
IP—Like Using Postcards

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

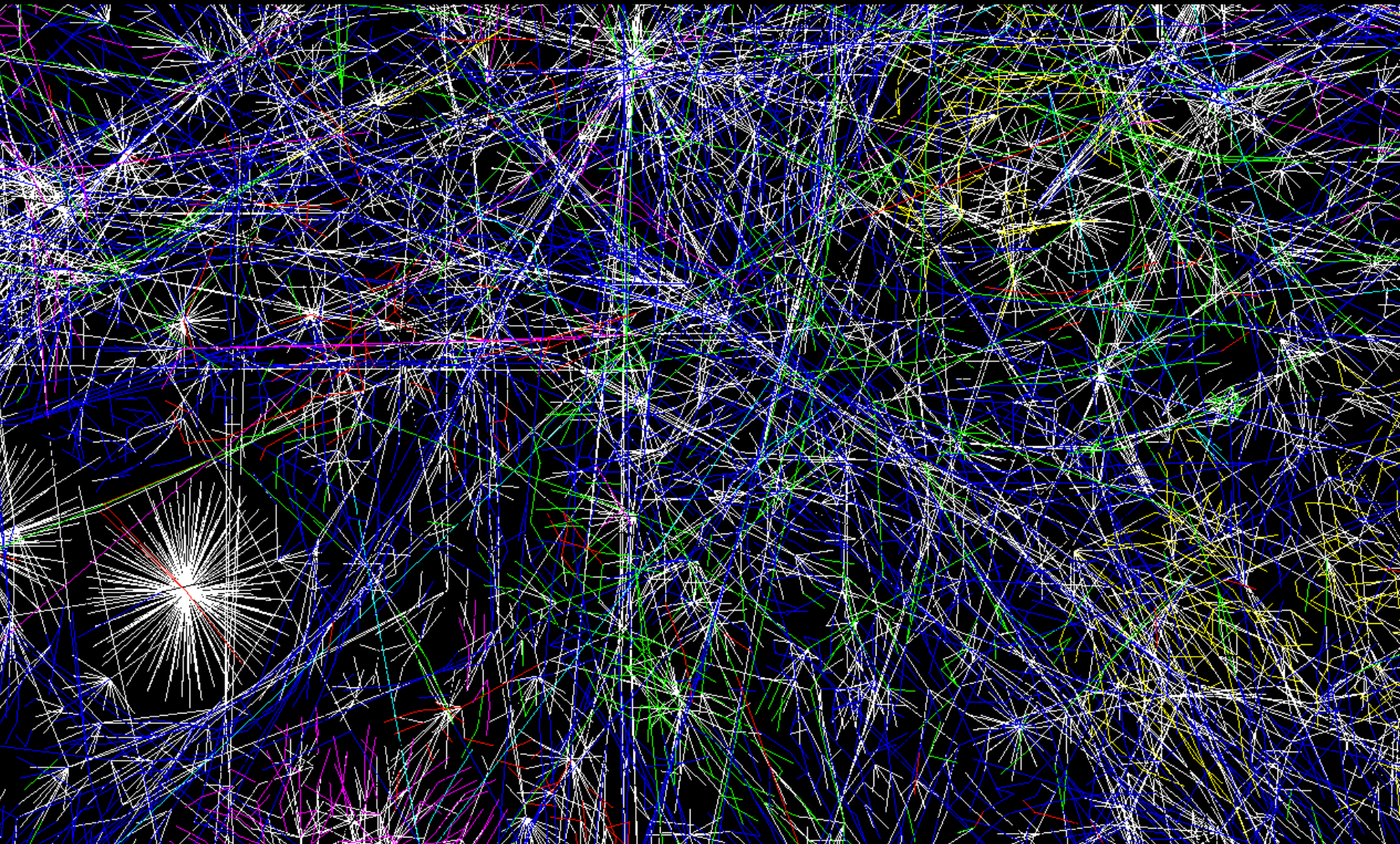
- Each makes its way separately to destination, possibly taking different routes
- Reassembled at destination forming msg

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

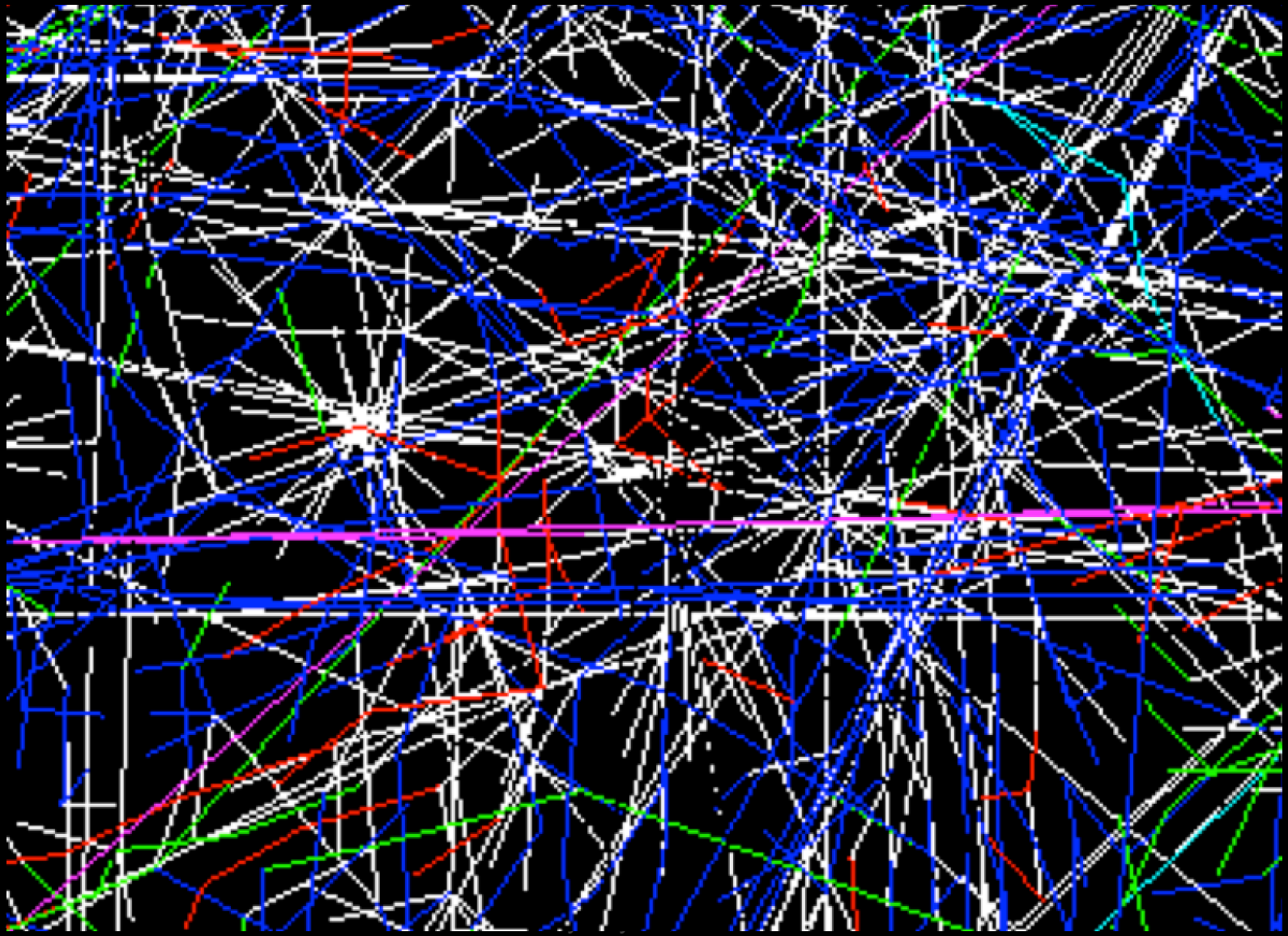


net, ca, us com, org mil, gov, edu
jp, cn, tw, au de, uk, it, pl, fr br, kr, nl unknown

Picture of Portion of I'net 2005



More Enlargement



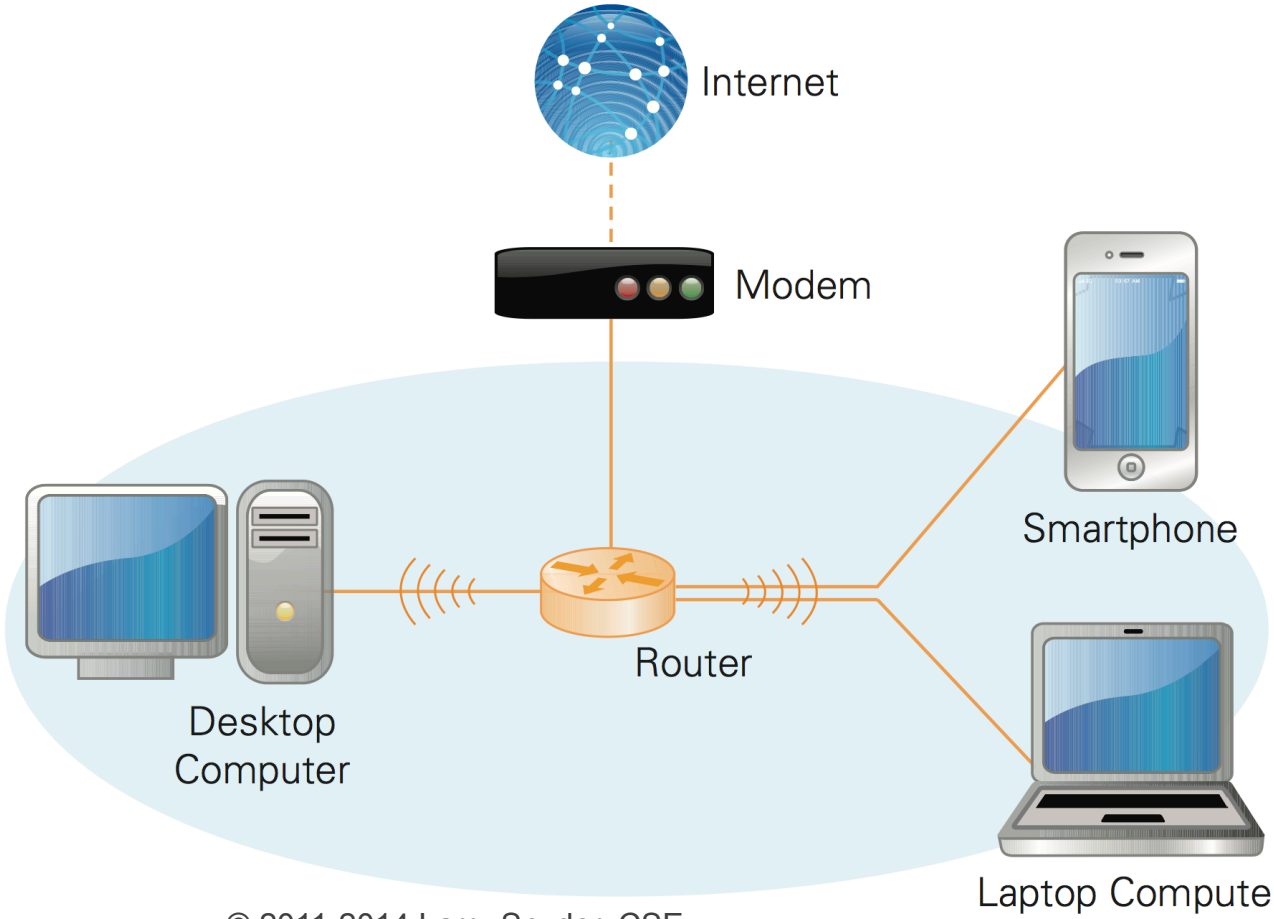
A Quick Trip to Switzerland

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

To try this: Search (traceroute) & and use SW provided

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
- DNS is an automatic directory search. It's huge

A computer needs to know IP address of DNS server!

Domains

.edu .com .mil .gov .org .net domains are original "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
- AUTOMATICALLY, ADAPTIVELY, RELIABLY, EFFICIENTLY == second big idea of Internet

Finding A Picture …

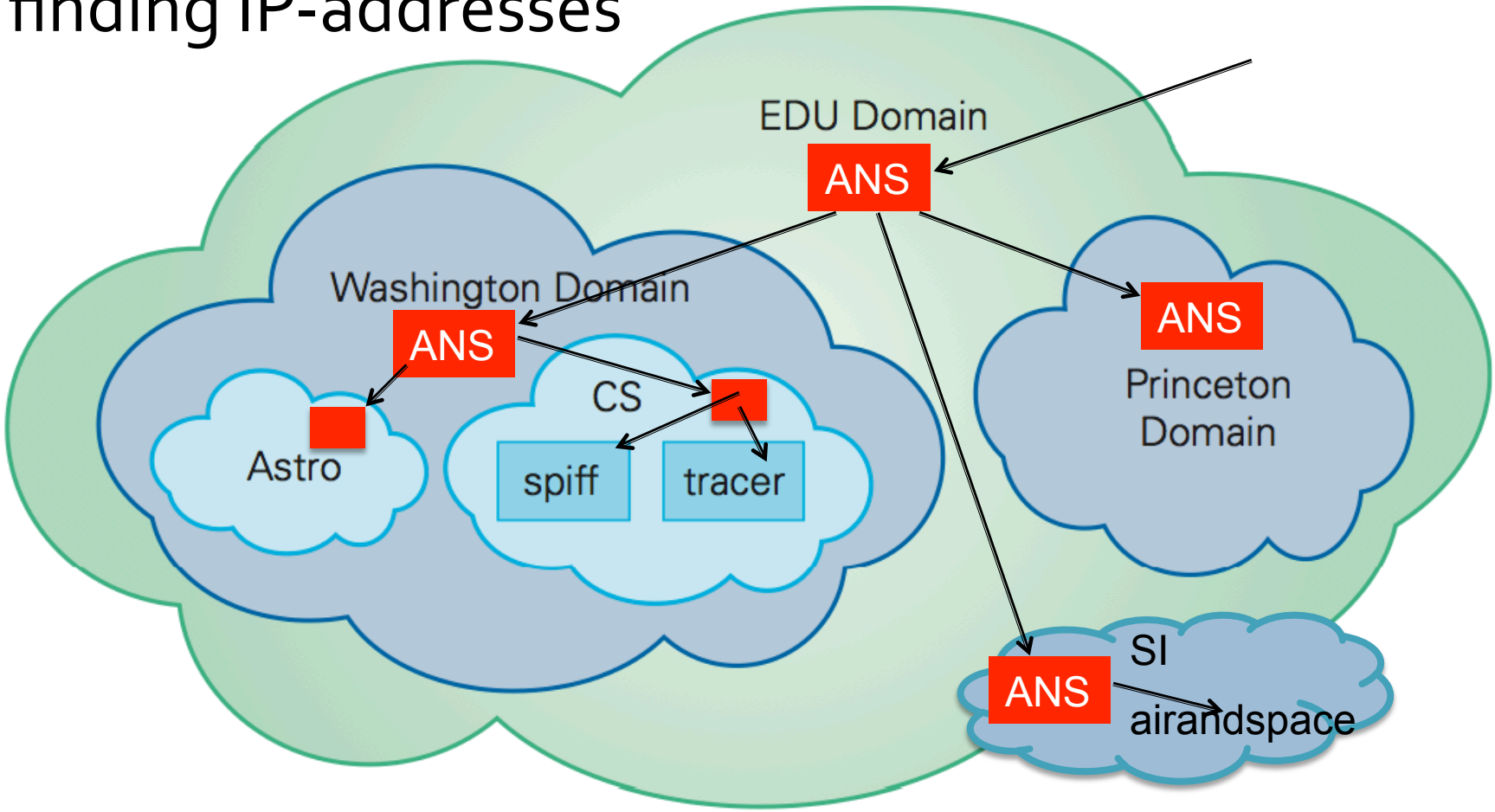
Someone sends a link to a picture you should see

Your browser needs an IPaddr for this domain

airandspace.si.edu/…

Finding An IP-address

Authoritative name servers (ANS) assist DNS in finding IP-addresses



An ANS knows IP-Address of machines in its Domain & ANS of all subdomains

Finding the TLD "edu"

airandspace.si.edu == 160.111.252.58

Internet vs. World Wide Web

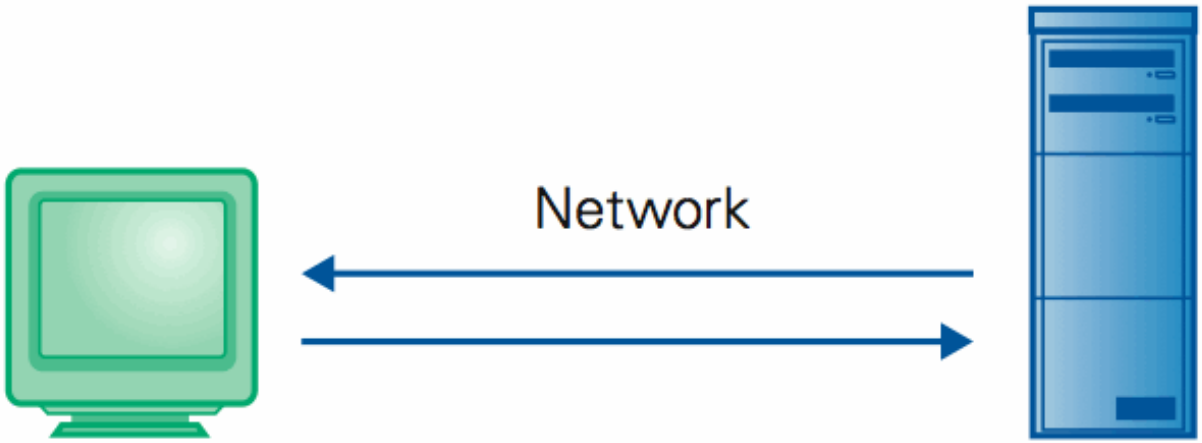
- Many people mis-use the terms "Internet" and "World Wide Web"
- Lets get them right

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



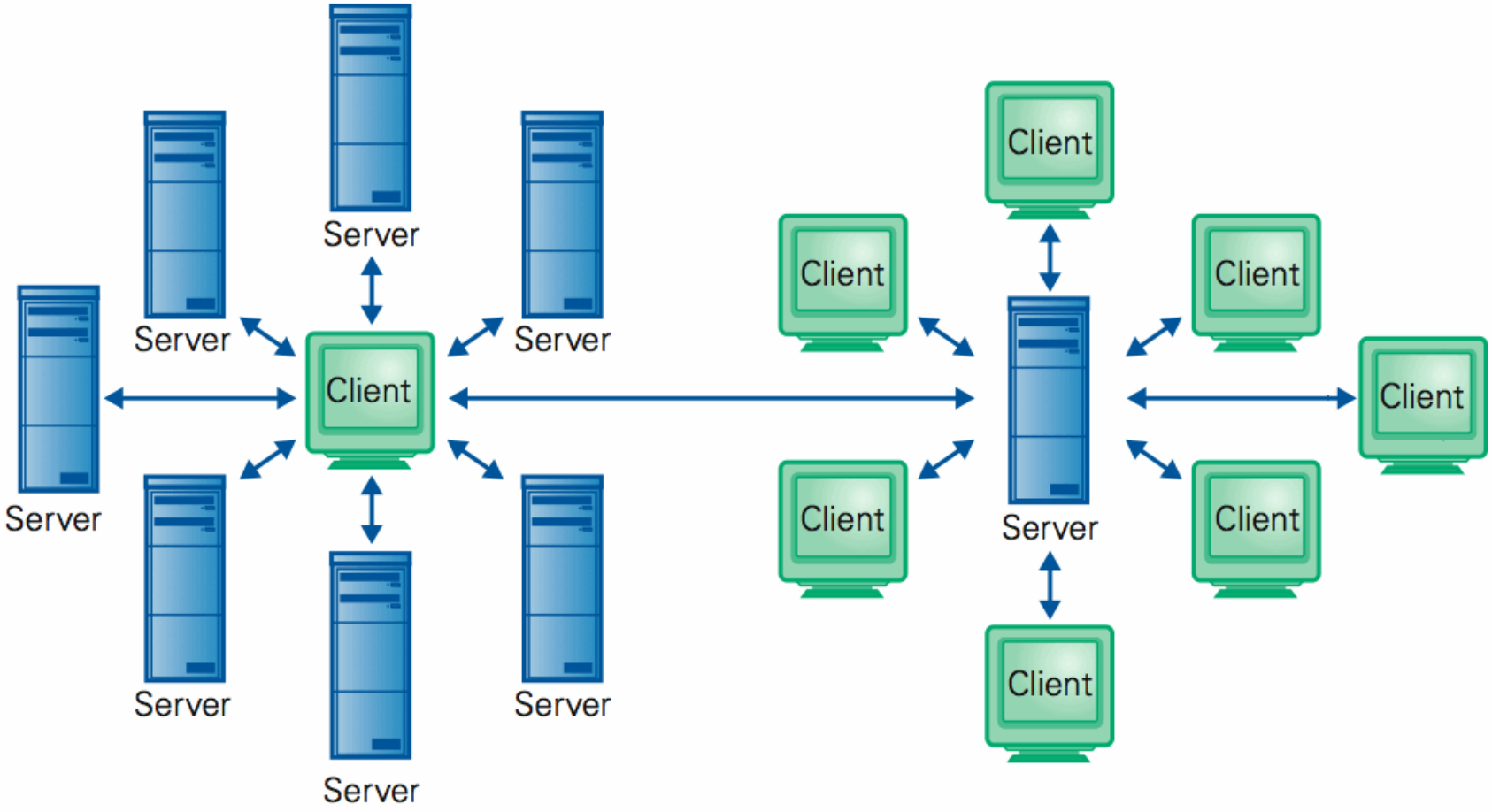
Client Computer
Requests services
(Sends URL for a Web page)

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 - Collaborate

- 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

Pair Programming, Continued

- Meet – if you don't know your partner
  - Send email and set up a meeting
  - Thursday's lab will take roll – everyone raises hand
- Think about what sort of project to do
- Sketch out project
  - What's the purpose
  - What are the "phases"
  - What does the screen look like for each
  - How does the Interaction go?
- Meet with LS or TAs and get "signed off"