

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!

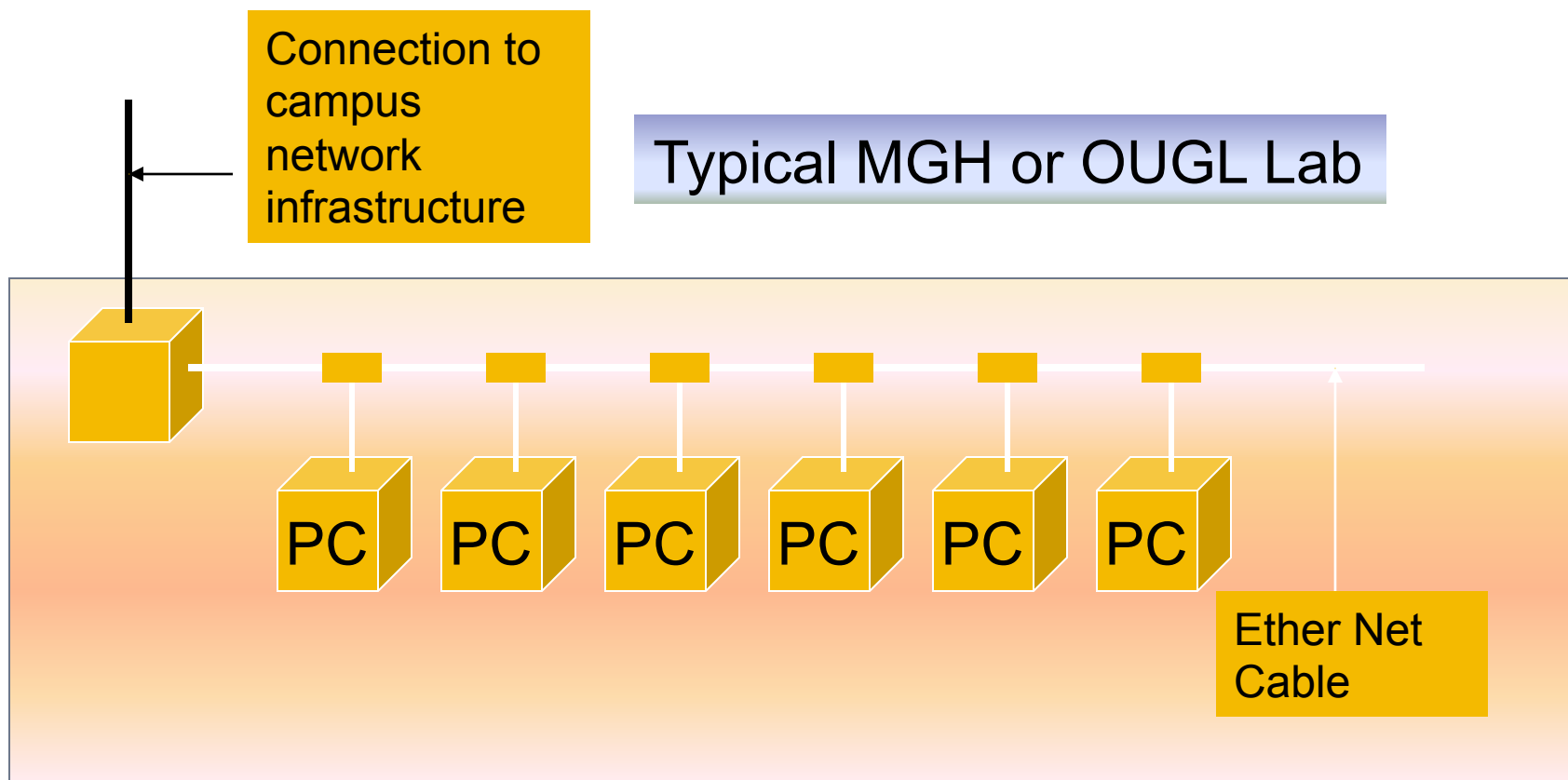
To communicate computers need to know how to set up the info to be sent and interpret the info received

- 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

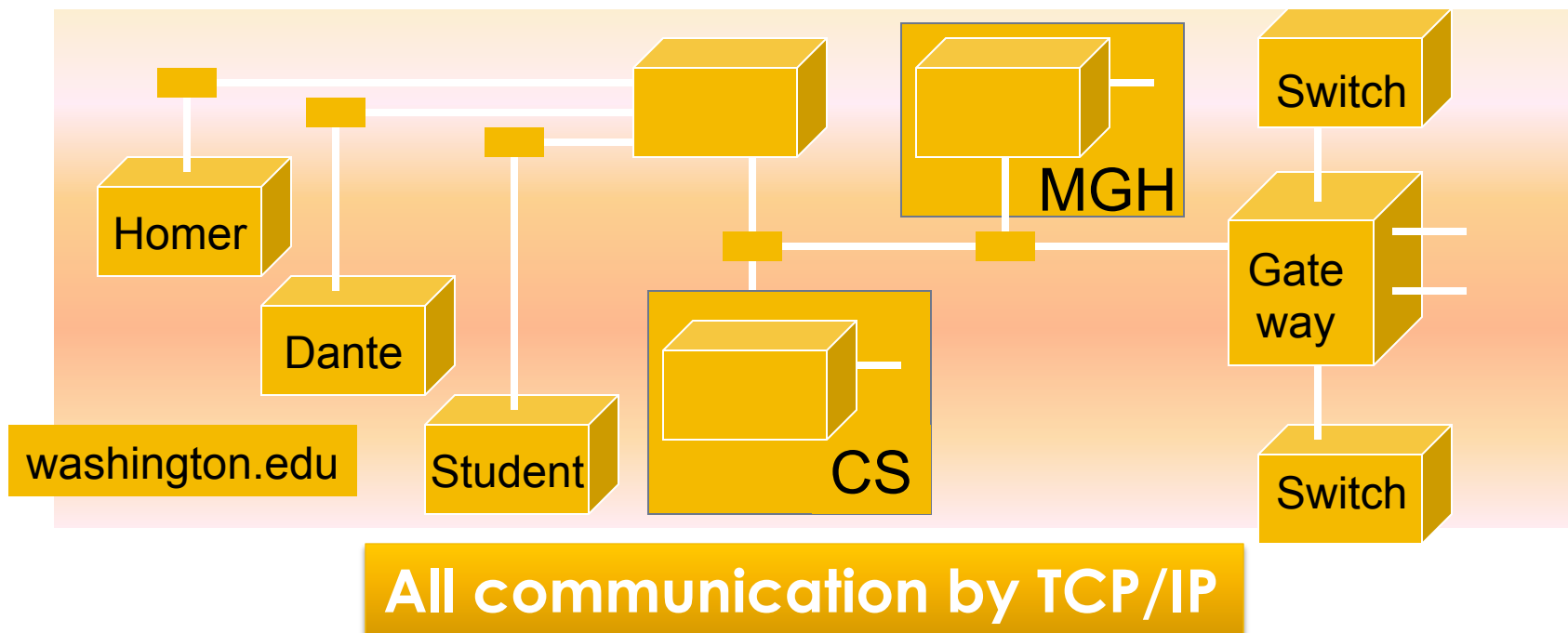
EtherNet is a popular LAN protocol

- 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

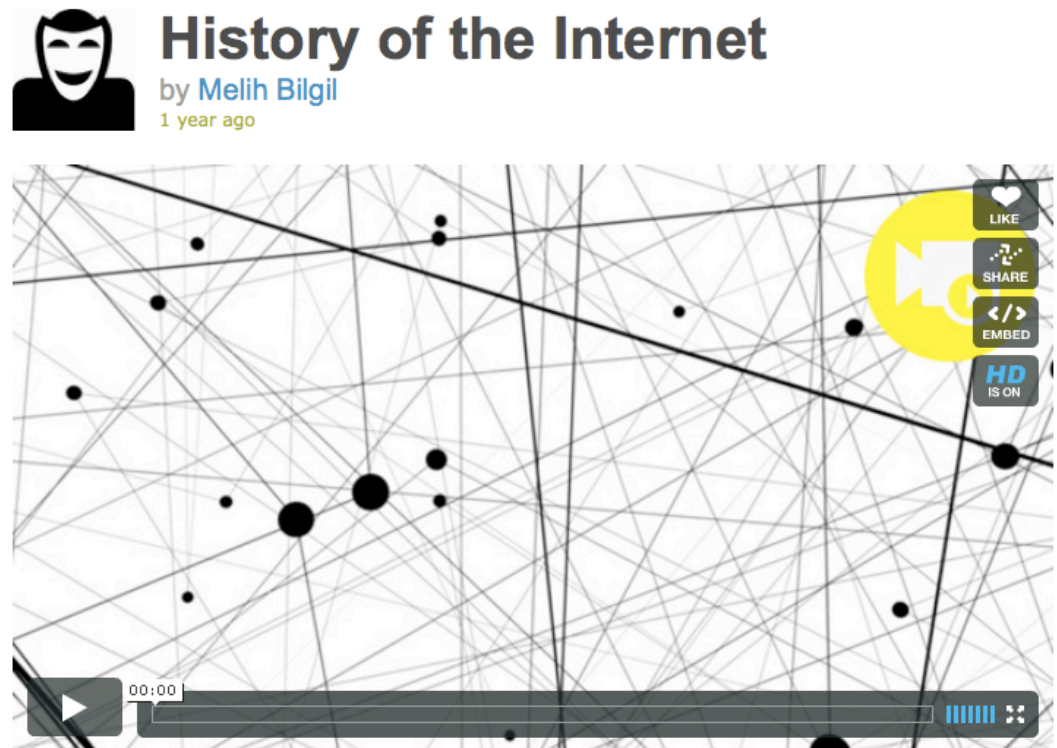
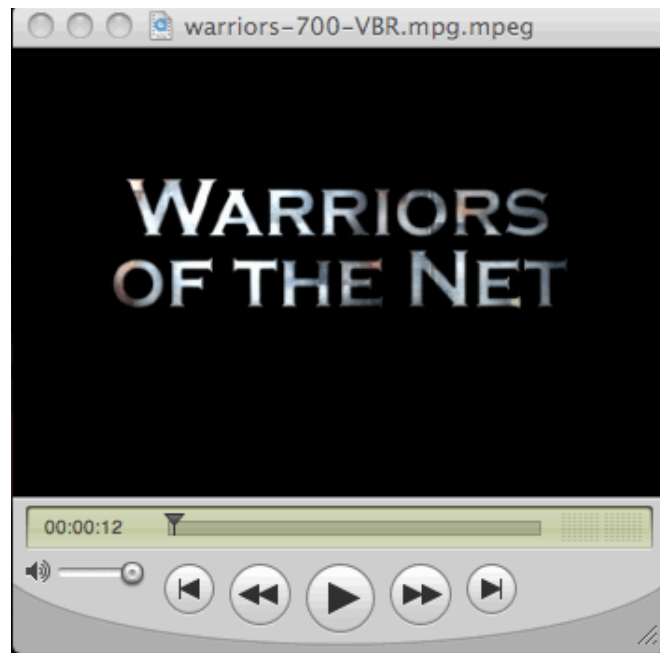
- Break message into fixed size units
- Form IP packets with destination address, sequence number and content
- Each makes its way separately to destination, possibly taking different routes
- Reassembled at destination forming msg

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

Check Out the Vids

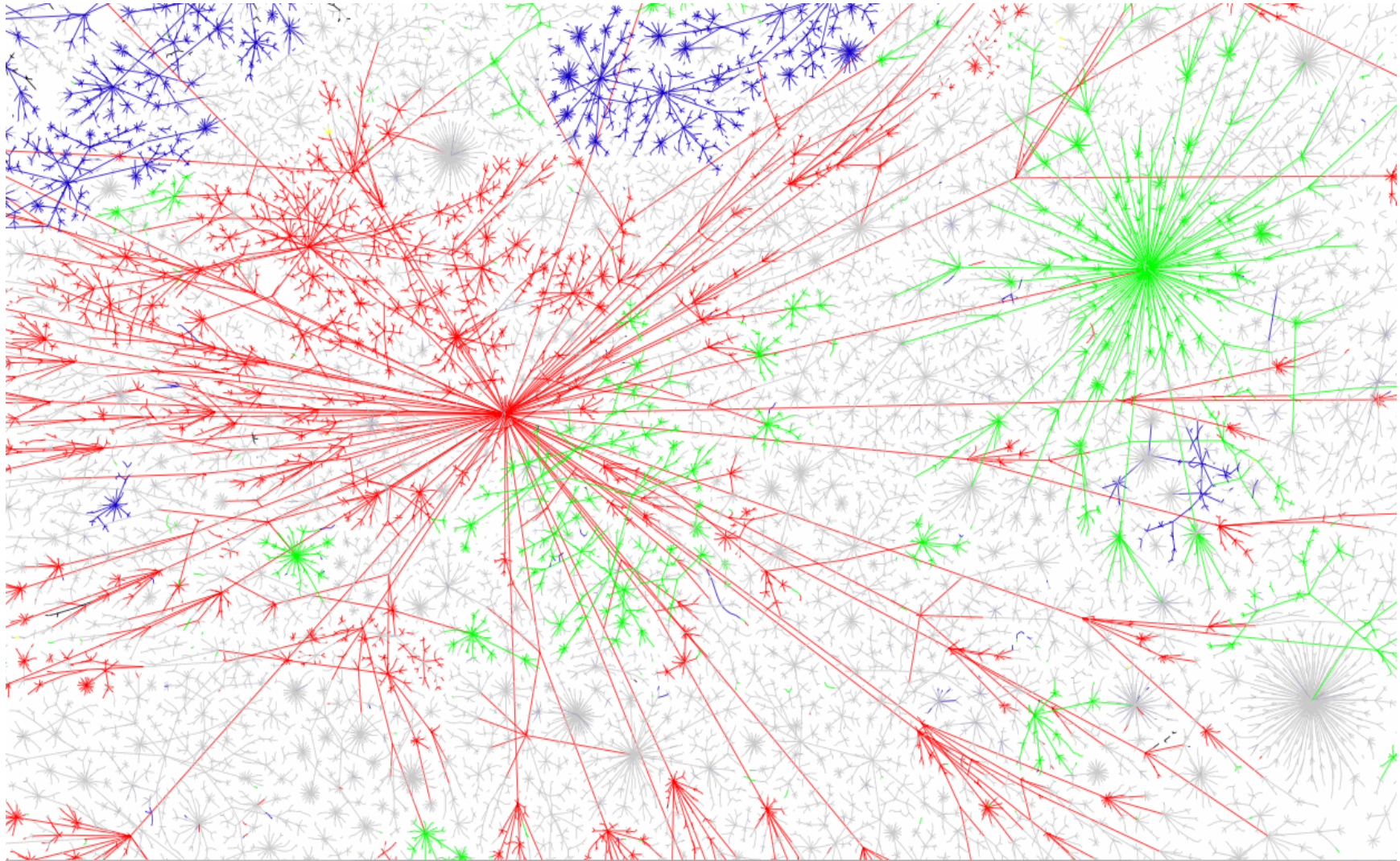
- Two videos are linked from the calendar ... please check them out



http://www.youtube.com/watch?v=PBWhzz_Gn10

<http://www.vimeo.com/2696386>

Picture of Portion of I'net



A Quick Trip to U. Florida

Table: Traceroute to cise.ufl.edu

Hop	IP Address	Node Name	Location	ms	Network
0	10.0.1.1	-		4	[Local Network]
1	10.0.1.1	-		3	[Local Network]
2					
3	68.87.205.1	-	Mt Laurel, usa	16	[Network for 68.87.205.1]
4	68.85.240.101	be-70-ar01.burien.wa.seattle.comcast.net	Mt Laurel, usa	13	[Network for 68.85.240.101]
5	68.85.240.69	be-30-ar01.seattle.wa.seattle.comcast.net	Seattle, WA, USA	13	[Network for 68.85.240.69]
6	68.86.90.213	pos-0-5-0-0-cr01.seattle.wa.ibone.comcast.net	Seattle, WA, USA	10	[Network for 68.86.90.213]
7	68.86.85.206	pos-0-8-0-0-cr01.portland.or.ibone.comcast.net	Portland, OR, USA	16	[Network for 68.86.85.206]
8	68.86.85.197	pos-1-15-0-0-cr01.sacramento.ca.ibone.comcast.net	Sacramento, CA, USA	26	[Network for 68.86.85.197]
9	68.86.85.181	pos-0-9-0-0-cr01.sanjose.ca.ibone.comcast.net	San Jose, CA, USA	34	[Network for 68.86.85.181]
10	154.54.11.105	te3-3.mpd01.sjc04.atlas.cogentco.com	San Jose, CA, USA	45	PSINet, Inc.
11	154.54.0.177	te9-1.ccr02.sfo01.atlas.cogentco.com	San Francisco, CA, USA	33	PSINet, Inc.
12	154.54.3.137	te3-8.ccr01.lax01.atlas.cogentco.com	Los Angeles, CA, USA	62	PSINet, Inc.
13	154.54.0.226	te3-8.ccr01.iah01.atlas.cogentco.com	Houston, TX, USA	97	PSINet, Inc.
14	154.54.24.194	te3-2.ccr01.mia01.atlas.cogentco.com	Miami, FL, USA	110	PSINet, Inc.
15	154.54.1.186	te3-3.ccr01.mia03.atlas.cogentco.com	Miami, FL, USA	114	PSINet, Inc.
16	38.112.31.66	florida_lambda_rail_llc.demarc.cogentco.com	Washington, DC, USA	111	PSINet, Inc.
17	198.32.155.10	tpa-flrcore-7609-1-te21-1.net.flrnet.org	Marina del Rey, usa	124	EP.NET, LLC.
18	198.32.173.161	tlh-flrcore-7609-1-te41-1907.net.flrnet.org	Marina del Rey, usa	122	EP.NET, LLC.
19	198.32.173.162	ctx36-ewan-msfc-1-v1907-1.ns.ufl.edu	Marina del Rey, usa	203	EP.NET, LLC.
20	128.227.236.85	ctx36-nexus-msfc-1-v50-1.ns.ufl.edu	Gainesville, FL, USA	147	University of Florida
21	128.227.236.14	csev1-core-msfc-1-v41-1.ns.ufl.edu	Gainesville, FL, USA	156	University of Florida
22	128.227.254.74	-	Gainesville, FL, USA	146	University of Florida
23	128.227.205.2	cise.ufl.edu	Gainesville, FL, USA	131	University of Florida

You can find such “trace route” facilities by Googling, and then type in the IP-Addresses around the world

Route Across the US

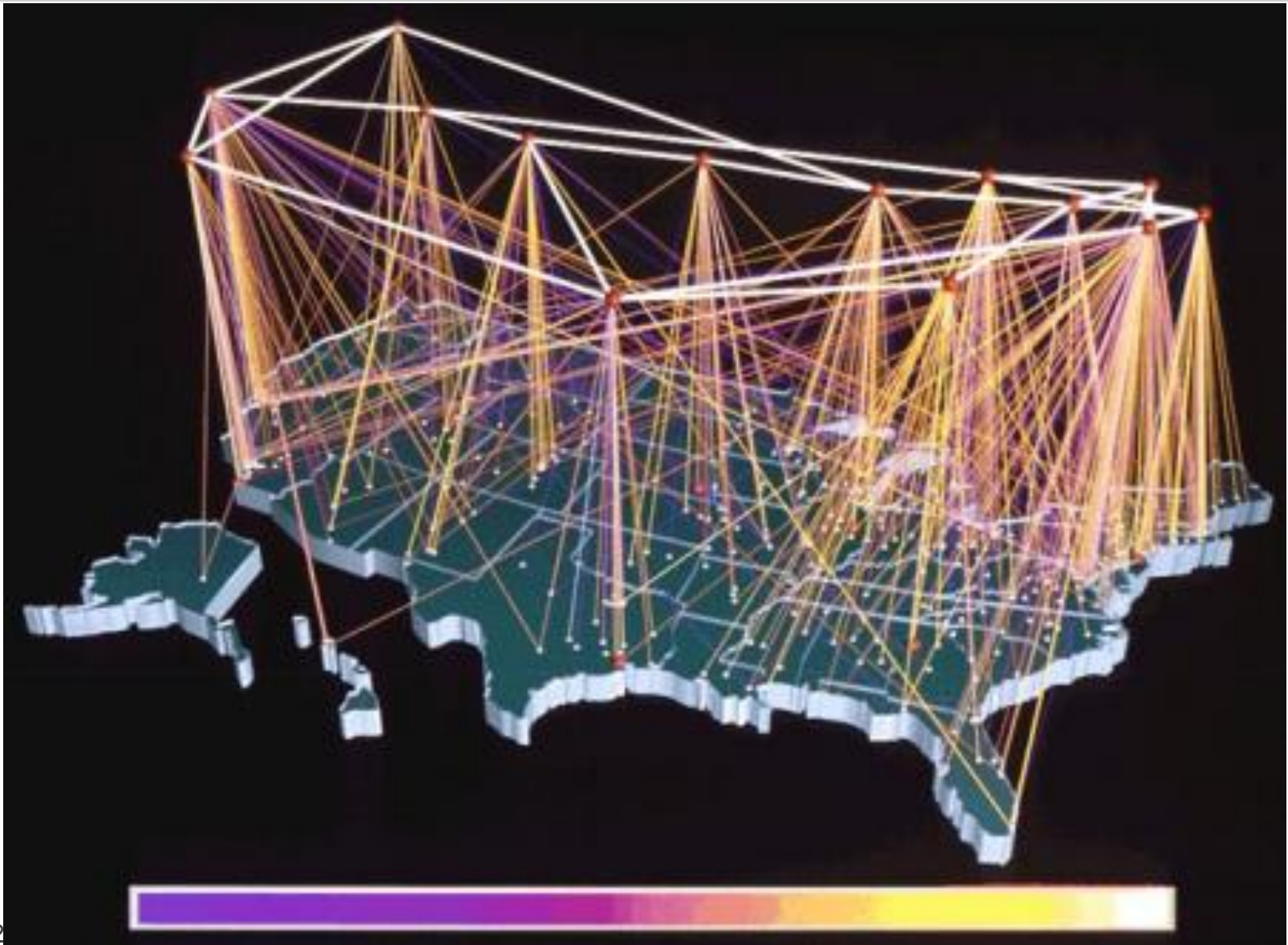
- The route
 - Starts with my ISP moving packet through MAN
 - Next, the packet enters a regional WAN
 - Next, the packet crosses the backbone
 - Arriving at another regional WAN
 - Next arriving on campus in a LAN
 - Delivered to the destination computer

Regional Network

- The Watchtower regional network of Eastern MA
- Every state/region has one or a few

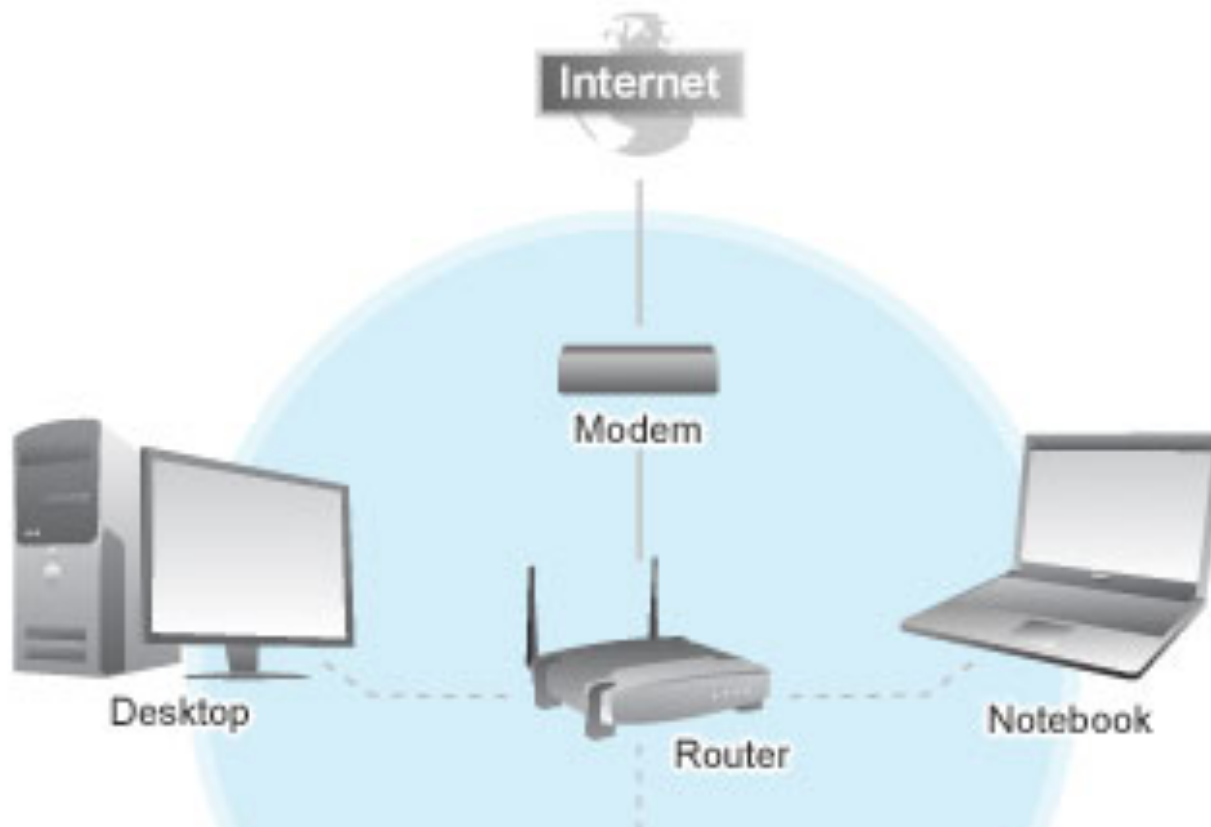


A Backbone Carrier -- NCSA



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**

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

Internet vs. World Wide Web

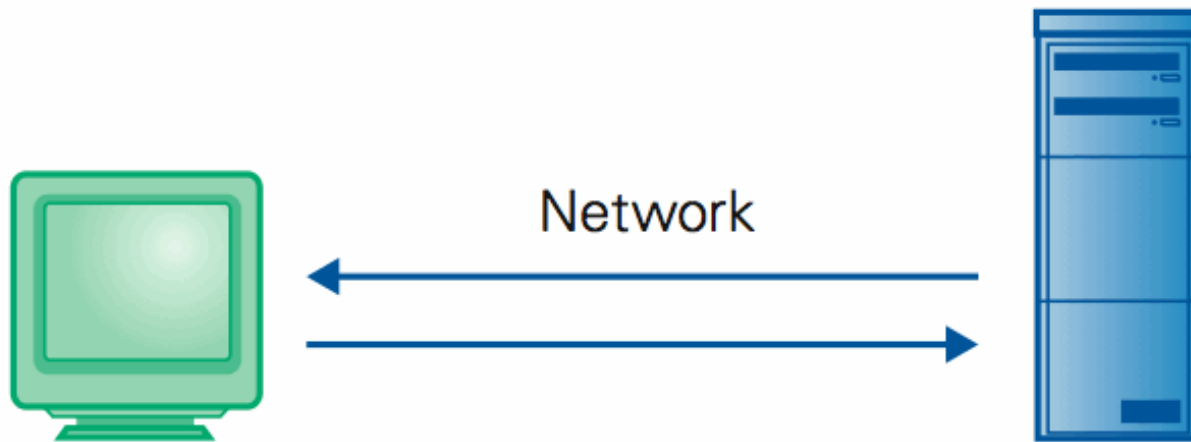
- Many people mis-use the terms “Internet” and “World Wide Web”
- Let’s get them right

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

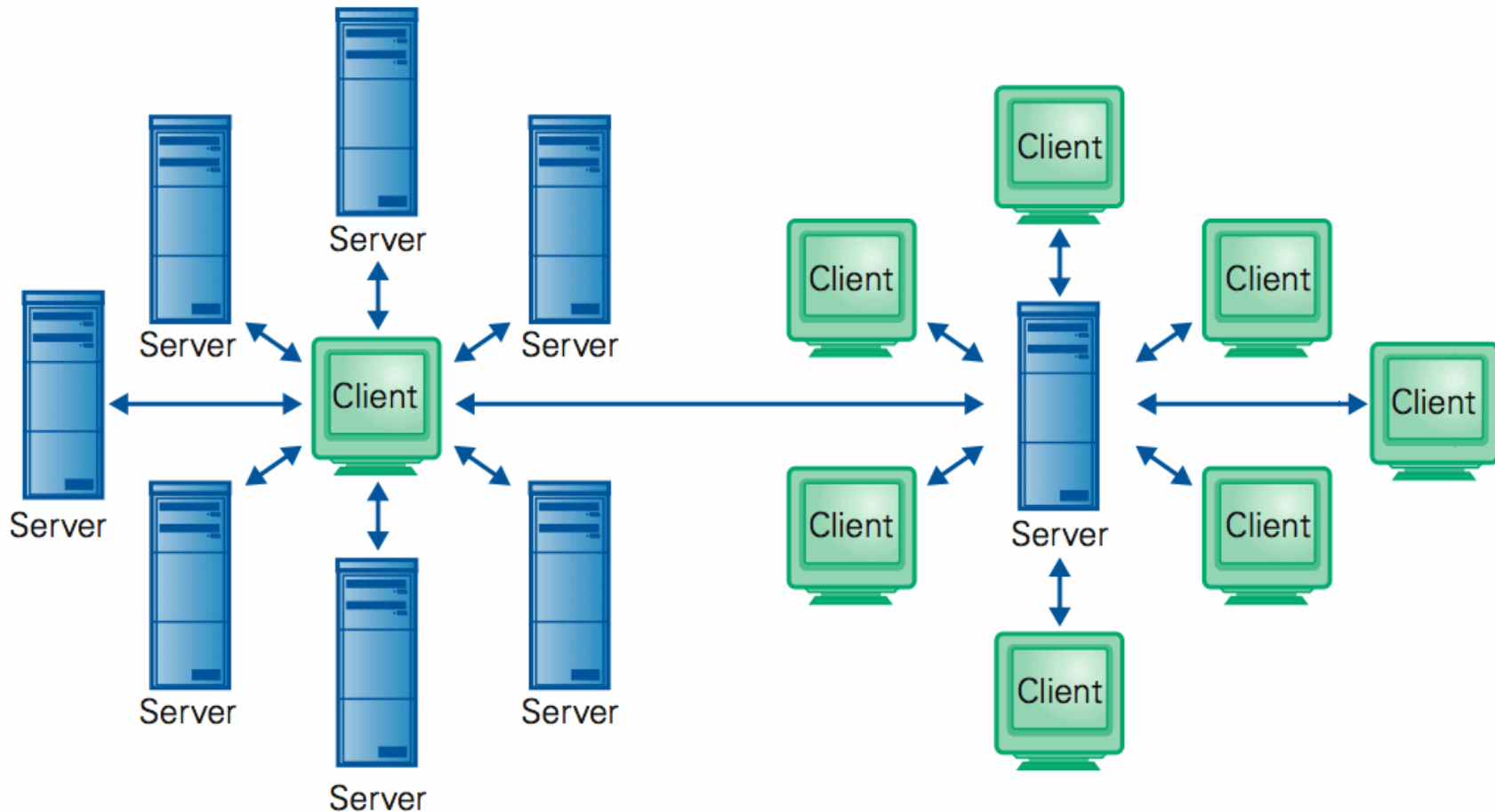
Provides services

(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 WORK ON PROJECT MUST BE DONE TOGETHER
 - Share coding duties, commenting duties
- Teams: comparable skill, compatible times