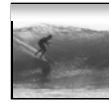




Networking

More than just a social interaction

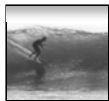


Networks...

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,...

UW's networks move more than trillion bytes per day



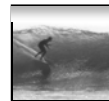
Network Structure

Networks are structured differently based (mostly) on how far apart the computers are

- * Local area network (LAN) -- a small area such as a room or building
- * Wide area networks (WAN) -- large area, e.g. distance is more than 1 Km

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

3



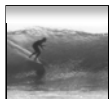
Protocol Rules!

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 -- transmission control protocol / internet protocol -- for Internet
- HTTP -- hypertext transfer protocol -- for Web

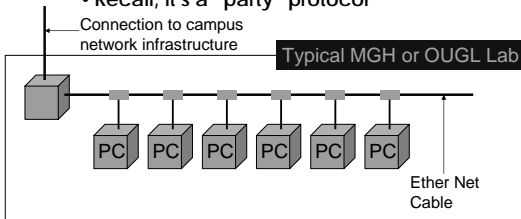
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LAN in the Lab

EtherNet is a popular LAN protocol

- Recall, it's a "party" protocol

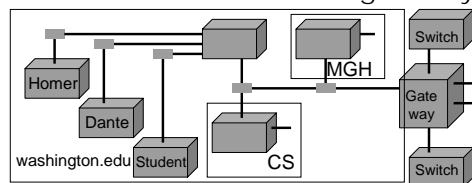


5



Campus & The World

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



6



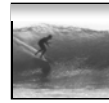
IP -- Like Using Postcards

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

Taking separate routes lets packets by-pass congestion and out-of-service switches

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A Trip to Switzerland

A packet sent from UW to ETH (Swiss Fed. Tech. University) took 21 hops

Hop	IP Address	Node Name	Location	ms	Network
0	128.95.1.207	ispff.cse.washington.edu			University of Washington W&E-HBOT0N
1	128.95.1.100	ispff.cse.washington.edu			University of Washington W&E-HBOT0N
2	143.142.150.1	under2-oed-1.cac.washington.edu	UW Gateway		University of Washington UW-SEA
3	198.107.150.1	trnsfp1-wes-gs-0-0-0-gm-gigapac.net		17	Verio, Inc. V900-198-100
4	198.48.91.75	abilene-gene-gm-gigapac.net		15	University of Washington UW-SEA29
5	198.32.11.121	etbing-ab.abilene.ucaid.edu		0	Exchange Point Blocks NET-EP-1
6	198.32.105.0	gene-eth.abilene.ucaid.edu		25	Exchange Point Blocks NET-EP-1
7	198.32.11.111			27	Exchange Point Blocks NET-EP-1
8	198.32.14.4	ksy-dmtr.abilene.ucaid.edu		40	Exchange Point Blocks NET-EP-1
9	198.32.11.111	ksy-cmp.abilene.ucaid.edu		34	Exchange Point Blocks NET-EP-1
10	198.32.0.80	isping-ksy.abilene.ucaid.edu		201	Exchange Point Blocks NET-EP-1
11	198.32.176.6	chrmg-spsr.abilene.ucaid.edu		52	Exchange Point Blocks NET-EP-1
12	198.32.0.83	ry-cmpg-chrmg.abilene.ucaid.edu		72	Exchange Point Blocks NET-EP-1
13	198.32.146.6	nyem-wash.abilene.ucaid.edu		96	Exchange Point Blocks NET-EP-1
14	62.40.103.25	abilene-gbm-0k7.de.geant.net	United Kingdom	185	IP allocation for GEANT network
15	62.40.98.82	de-01.geant.net	United Kingdom	171	IP allocation for GEANT network
16	62.40.98.33	de-01.ch.geant.net	United Kingdom	183	IP allocation for GEANT network
17	62.40.103.18	swi02-PB-1.switch.ch	United Kingdom	178	IP allocation for GEANT network
18	129.95.18.42	swi02-O2-2.switch.ch	Switzerland	187	SWITCH Teleinformatics Services SWITCH-LAN
19	192.23.92.1	rou-eth-switch-1-giga-to-switch.ethz.ch	Switzerland	192	Swiss Federal Institute of Technology ETH-NET
20	129.132.98.10	ispwip-1-mega-kernid-2.ethz.ch	Switzerland	188	Swiss Federal Institute of Technology ETH-NET
21	129.132.1.95	ethz.ch	Switzerland	192	Swiss Federal Institute of Technology ETH-NET

Recording time to ethz.ch, average: 197ms, min: 187ms, max: 204ms - 14 Nov 02 12:09 PM



Check Internet Hops

Interested?

- * Find software using Google: Search on "traceroutes"
- * Download a copy of the software
- * Install software and type in foreign URLs
 - Switzerland eth.ch
 - Australia www.usyd.edu.au
 - Japan kyoto-u.ac.jp
 - South Africa www.uct.ac.za

Use Google to find foreign computers

9



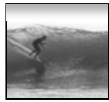
Naming Computers I

People name computers by a domain name -- a hierarchical scheme that groups like computers

- .edu All educational computers
- .washington.edu All computers at UW
- dante.washington.edu A UW computer
- .ischool.washington.edu iSchool computers
- .cs.washington.edu CSE computers
- june.cs.washington.edu A CSE computer

Peers

Domains begin with a "dot" and get "larger" going right



Naming Computers II

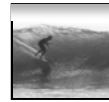
Computers are named by IP address, four numbers in the range 0-255

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

The FIT book contains the complete list

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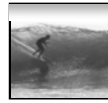


Logical vs Physical

There are 2 ways to view the Internet

- Humans see a hierarchy of domains relating computers -- logical network
- Computers see groups of four number IP addresses -- physical network
- Both are ideal for the "users" needs
- The Domain Name System (DNS) relates the logical network to the physical network by translating domains to IP addresses

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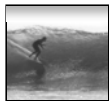


Client/Server Structure

The Internet computers rely on the client/server protocol: servers provide services, clients use them

- Sample servers: *email server, web server, ...*
- UW servers: *dante, courses, www, student, ...*
- Frequently, a "server" is actually many computers acting as one, e.g. *dante* is a group of more than 50 servers

Protocol: Client packages a request, and sends it to a server; Server does the service and sends a reply

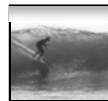


World Wide Web

World Wide Web is the collection of servers (subset of Internet computers) & the information they give access to

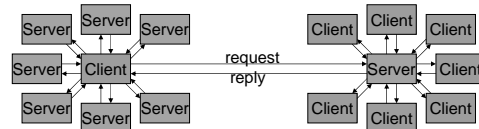
- Clearly, WWW ≠ Internet
- The "server" is the web site computer and the "client" is the surfer's browser
- Many Web server's domain names begin with *www* by tradition, but any name is OK
- Often multiple server names map to the same site: *MoMA.org* and *www.MoMA.org*

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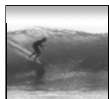


Client/Server Interaction

For Web pages, the client requests a page, the server returns it: there's no connection, just two transmissions



Servers serve many clients; clients visit many servers



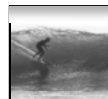
Dissecting a URL

Web addresses are URLs, *uniform resource locator*, an IP address+path

- URLs are often *redirected* to other places; e.g. *http://www.cs.washington.edu/100/* goes to

http://www.cs.washington.edu/education/courses/100/04wi/index.htm

protocol	= http://	
Web server	= www	
domain	= .cs.washington.edu	
path	= /education/courses/100/04wi/	<i>directories (folders)</i>
file	= index	
file extension	= .htm	<i>hypertext markup language</i>



Summary

Networking is changing the world

Internet: named computers using TCP/IP

WWW: servers providing access to info

* 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

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