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
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
LAN in the Lab

EtherNet is a popular LAN protocol

- Recall, it's a “party” protocol

Connection to campus network infrastructure

Typical MGH or OUGL Lab

PC PC PC PC PC PC

Ether Net Cable
Campus & The World

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

All communication by TCP/IP.
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

Taking separate routes lets packets by-pass congestion and out-of-service switches
A Trip to Switzerland

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

<table>
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<tr>
<th>Hop</th>
<th>IP Address</th>
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<th>Location</th>
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</table>

Roundtrip time to eth.ch, average = 192ms, min = 187ms, max = 204ms ~ 14-Nov-02 1:39:08 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
Naming Computers

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
  - **isc.hool.washington.edu** iSchool computers
  - **cs.washington.edu** CSE computers
  - **june.cs.washington.edu** A CSE computer

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

<table>
<thead>
<tr>
<th>Protocol</th>
<th>http://</th>
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<td>Domain</td>
<td>.cs.washington.edu</td>
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<tr>
<td>Path</td>
<td>/education/courses/100/04wi/ directories (folders)</td>
</tr>
<tr>
<td>File</td>
<td>index</td>
</tr>
<tr>
<td>File extension</td>
<td>.htm</td>
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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