Test Your Tech

A local area network is:

A. An exclusive social club.
B. A group of computers, usually in a single building, connected by cables.
C. Local television affiliates of the big networks.
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Special Guests

- Scott Barker, Director of IT and Chair of the Informatics program for the Information School (iSchool)
- Marshall Bjerke, Senior, Informatics
Announcements

- Deadlines at noon today
  * HW1 and Lab 2
- Watch for your grades on MyUW’s Student tab in the CS pane
- Last week’s quiz:
  * Students who answered that RAM is measured in MB or GB will receive credit for that question.
Announcements

• Videocasts of the course are available within a couple hours after each lecture
  * Linked at top of Calendar on the course Web site
Announcements

• Office hours
  * Listed on course Web site’s Home page
  * Maps to our offices for office hours

• In addition to office hours
  * Drop-in labs
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
Networking Changes Life

The Internet is making fundamental changes

1. Nowhere is remote—access to info is no longer bound to a place
2. Connecting with others—email is great
3. Revised human relationships—too much time spent online could be bad
4. English becoming a universal language
5. Enhanced freedom of speech, assembly

Can you think of others?
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
### Basic Types of Networks

<table>
<thead>
<tr>
<th>Network Type</th>
<th>Differentiating Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peer-to-Peer</strong></td>
<td>* No computer running server software</td>
</tr>
<tr>
<td><strong>Server-Based Networks</strong></td>
<td>* Computer running server software manages network traffic</td>
</tr>
<tr>
<td>• Local Area Network (LAN)</td>
<td>* Limited geographical area</td>
</tr>
<tr>
<td></td>
<td>* One-time capital cost (wire or fiber optics cable installation)</td>
</tr>
<tr>
<td>• Wide Area Network (WAN)</td>
<td>* Across town or across the globe</td>
</tr>
<tr>
<td></td>
<td>* Third-party service provider (monthly $$)</td>
</tr>
<tr>
<td></td>
<td>* More bandwidth = more expense</td>
</tr>
<tr>
<td></td>
<td>* Connects to LANs with a router</td>
</tr>
<tr>
<td>• Campus Network</td>
<td>* One-time capital expense</td>
</tr>
<tr>
<td></td>
<td>* Buildings in close proximity</td>
</tr>
<tr>
<td>• Metropolitan Area Network (MAN)</td>
<td>* Clusters of buildings in close proximity</td>
</tr>
<tr>
<td></td>
<td>* Separated from other clusters</td>
</tr>
<tr>
<td></td>
<td>* Third-party service provider (monthly $$)</td>
</tr>
</tbody>
</table>
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

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
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>
<thead>
<tr>
<th>Hop</th>
<th>IP Address</th>
<th>Node Name</th>
<th>Location</th>
<th>ms</th>
<th>Network</th>
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<td>IP allocation for GEANT network</td>
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<td>IP allocation for GEANT network</td>
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<td></td>
</tr>
</tbody>
</table>

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

Packet-Switching Animation
Check Internet Hops

Interested?

* Find software called Visual Routes (personal evaluation copies are free) at http://www.visualroute.com
* 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
- .ischool.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.
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
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
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;

<table>
<thead>
<tr>
<th>protocol</th>
<th>= http://</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web server</td>
<td>= www</td>
</tr>
<tr>
<td>domain</td>
<td>= .cs.washington.edu</td>
</tr>
<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>
</tr>
</tbody>
</table>
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