

Announcements

- Enrollment

- priority on the waiting list for students with a C or better in 412.
- this class counts for MS but not Ph.D. comp credit.

- Changes in TA Office hours

- starting **next** week office hours will be
 - M 9-10 AM
 - Tu 2-4 PM
- AV Williams 1109 (or in 1120 - glue lab)

- Suggested problems

- Chapter 1: 4, 5, 8, 13, 22

- Reading for next week

- Chapter 2: sections 2.1-2.3

Project #1 Notes

- Small bug in the sample code (Postscript handout)
 - near line 48: `memset((void *) &server, sizeof server)`
 - should have a second argument of zero
- Use of `netstat`
 - don't forget it is installed in `/usr/sbin/netstat`
 - the “-f inet” option is useful for restricting output to IP only
- might want to look at man page for `sendto/recvfrom`

Application Layer

- Goal: common types of exchanges standardized
- Sample Issues:
 - when sending email, what demarks the subject field
 - how to represent cursor movement in a terminal
- Examples:
 - Simple Mail Transport Protocol (SMTP)
 - File Transfer Protocol (FTP)
 - Hyper-Text Transport Protocol (HTTP)
 - Simple Network Management Protocol (SNMP)
 - Network File System (NFS)
 - Network Time Protocol (NTP)
 - Net News Transport Protocol (NNTP)
 - X (X Window Protocol)

Arpanet

- First “public” wide area network
- Ideas Pioneered
 - packet switching
 - internetworking
 - radio, wire, satellite
 - build it before you standardize it!
 - many routing, congestion control, and management ideas
- Dates: 1969-1987
- How to get connected: have a DOD Arpa Contract
- Technology
 - 56 kbps dedicated links
 - custom built network switches (called IMPS)

NSFNet

- First general audience “public” wide area network
- Ideas Pioneered
 - wide area networking for the masses
 - TCP/IP Wan
 - backbone wide area network connecting regional nets
- Dates: 1984-1995
- How to get connected: be an academic site and join a regional network
- Technology
 - 448kbps - 45 Mbps
 - general purpose workstations as routers

Internet

- Ideas Pioneered
 - multi-vendor public networks
 - if you build it they will come!
- Dates: 1983- (TCP/IP protocol first used)
- How to get connected: stop by the mall, call 1-800...
- Technology
 - 9.6kbps to OC-48 (2 Gbps)
 - soon higher AND lower speeds will be supported
 - custom routers from many vendors
 - general computers for some routing

Gigabit Testbeds

- The Internet was taking, now what is next?
- A series of small projects to test new ideas
 - a “government gigabit” (622 Mbps)
- Issues:
 - the speed of light is fixed
 - round-trip coast to coast is 40msec
 - need for very high speed point-to-point connections
 - tele-medicine
 - video
 - coupling high-end computational resources

Telco Data Networks

- X.25
 - low speed (up to 64kbps) packet switched network
 - provides connection oriented services
 - call an end-point and hold the connection
- ISDN
 - slow speed (up to 128kbps) network
 - runs over a single copper pair
 - still connection oriented
- B-ISDN
 - higher speed version of ISDN
 - connection oriented

ATM

- Asynchronous Transfer Mode

- not tied to a single central clock
- proposed by telco's to replace their network

Note change
from lecture

- Fixed size packets called cells (53 bytes)

- 5 bytes for header (not big enough for end-to-end id)
 - use hop by hop Virtual Circuit Ids (VCI)
- 48 bytes for data
 - telcos wanted 32, packet switching wanted 64

- Physical Media

- copper at T-3 speeds (45 Mbps)
- fiber at OC-3 to OC-48 (155 Mbps and up)

- Designed to carry

- constant rate applications: voice and video
- variable rate applications: email, www, etc.

ATM Reference Model

OSI Layer	ATM Layer	Function
3 and 4	AAL	Segmentation Reassembly
2 and 3	ATM	Flow control Cell header Virtual circuit Cell mux/demux
1 and 2	Physical	Header sums Frame generation