

Announcements

- Handouts (reminder from last time)
 - class syllabus (on web page)
 - programming assignment #1 (also on web page)
- Enrollment
 - Now 8 on the waitlist

Project #1 Notes

- **Small bug in the sample code (PDF handout)**
 - on pg. 12, 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**

Physical Layer

- Goal: Raw bits over a communication channel
- Sample Issues:
 - how to encode a 0 vs. 1?
 - what voltage should be used?
 - how long does a bit need to be signaled?
 - what does the cable, plug, antenna, etc. look like?
- Examples:
 - modems
 - “knock once for yes, twice for no”

Data Link Layer

- Goal: transmit error free frames over the physical link
- Sample Issues:
 - how big is a frame?
 - can I detect an error in sending the frame?
 - what demarks the end of the frame?
 - how to control access to a shared channel?
- Examples:
 - Ethernet framing

The Network Layer

- Goal: controlling operations of the subnet
- Sample Issues:
 - how route packets that have to travel several hops?
 - control congestion - too many messages at once
 - accounting - charge for use of the network
 - fragment or combine packets depending on rules of link layer
- Examples:
 - IP

The Transport Layer

- Goal: accurately transport session data in order
 - end points are the sending and receiving machines
- Sample Issues:
 - how to order messages and detect duplicates
 - error detection (corrupt packets) and retransmission
- Examples:
 - TCP

The Session & Presentation Layers

- Goal: common services shared by several applications
- Sample Issues:
 - network representation of bytes, ints, floats, etc.
 - encryption?? (this point is subject to lots of debate)
 - synchronization
- Examples:
 - eXternal Data Representation (XDR)

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