The Internet Defined

- The Internet (always I) is exactly that:
  - A network Internetworking networks
  - Using the same set of common protocols
  - Interconnected in many places & ways
  - Not really owned or operated by anyone
  - Engineered by volunteers, managed ad-hoc
  - Built from a 1960’s cold-war experiment
  - Expanded beyond anyone’s imagination
Problem statement

1969 - four “ARPA NETWORK” nodes
- UC Los Angeles
- UC Santa Barbara
- University of Utah
- Stanford Research Institute, Palo Alto

Nationwide by September 1971
- Including a satellite link to London
Internet Physical Topology . . .

Internet Access

- Dial-Up access
  - 2,400 bps at first, much later at 33,600 bps
- xDSL access, “always on”
  - Approaching 1.5 Mbps, some areas better
- Cable TV modem access “always on”
  - One TV channel 6 MHz, many Mbps
- Satellite TV modem access “always on”
  - Similar to cable TV, but satellite latency

Internet Access . . .

- Verizon’s FiOS (Triple Play)
  - Fiber direct to the premises
  - Speeds up to 20 Mbps
- AT&T’s U-verse (Triple Play)
  - Fiber/copper hybrid near the premises
  - Speeds up to 20 Mbps (10 Mbps offered)
    - Requires mini-DSLAMs (52B boxes)
- Cable DOCSIS 3.0 (Triple Play)
  - 160 Mbps future capability
### Internet Access

- Dedicated access
  - Leased lines: frac. T1, T1, frac. T3, etc
  - Primarily business, education, gov't
- Wireless access
  - WiFi “hot spots”, both free and “fee”
  - Cellular 802.20 Mobile Broadband Wireless
  - WiMAX 802.16 (US version)
  - HiperMAN (European version)

### Internet Standards & Admin.

- The Internet is:
  - Not owned by any company or government
  - Not controlled by any official world body
  - Not run by any communications company
  - Not regulated by laws (a few exceptions)
  - Available to almost anyone to connect
    - To offer resources, content and services
    - To access those resources, content & services
  - Autonomous and almost anarchistic

### Internet Standards & Admin.

- Administrative & support organizations
  - The Internet Society: ISOC
  - Internet Architecture Board: IAB
  - Internet Engineering Task Force: IETF
  - Internet Engineering Steering Group: ISEG
  - Internet Research Task Force: IRTF
  - I Corp. Assigned Names & Numbers: ICANN
  - Internet Assigned Numbers Authority: IANA
Internet Standards . . .
- IETF issues Requests for Comments: RFCs
  - Since earliest days, RFCs control the 'net
  - There are currently over 5,400 RFCs
    - Many obsolete prior RFCs
  - However, there are only 58 STDs
    - Some dating back to 1980
    - STD1 (frequently updated) lists the standards
- RFCs are the real "standards" of the 'net
  - Although they are not recognized by gov'ts

Internet Standards & Admin.
- Core Internet numbers and names
  - Internet Protocol (IP) addresses
    - Globally unique addresses (whois)
    - Private network addresses
  - TCP "well known" service port numbers
    - Most are for application services
  - Domain Name Service (DNS) names
    - Globally unique names (whois)
    - Translated to IP addresses by DNS servers

Global Addressing . . .
- Internet Protocol addresses globally unique
  - IPv4 addresses are 32 bits long
    - Example IP address: 163.122.34.153
      - 10100011.01111010.00100010.10011001
  - IPv6 addresses are 128 bits long
    - Example: 2001:db8:85a3::8a2e:370:7334
  - Details will be examined later in this class
  - IPs addresses are assigned at configuration
    - Network Administrators assign to each device
    - No two addresses can be the same (ex. Private)
Global Addressing . . .
- Dotted Decimal Number System
  - A way to talk about 32 bit binary IPv4 address numbers that we break into four 8 bit groups
  - A typical IPv4 Address:
    - 10000001 00000000 00000000 00001000
  - In dotted decimal we can call it:
    - 129.0.0.8
  - We still convert, but it's easier to say

Global Addressing . . .
- Private network addresses (RCF 1918)
- Private nets exist behind address translators
- All use a common set of private addresses
- The following are reserved for private nets
  - 10.0.0.0 to 10.255.255.255
  - 172.16.0.0 to 172.31.255.255
  - 192.168.0.0 to 192.168.255.255
- Hidden from the Internet, many exist
  - Corporations, schools, individuals, etc.

TCP Well-Known Port Numbers
- “Well-Known Ports” pre-assigned numbers
  - 20 FTP -- Data
  - 21 FTP -- Control
  - 23 Telnet
  - 25 Simple Mail Transfer Protocol
  - 37 Time (NTP)
  - 53 Domain Name System (DNS)
  - 80 HTTP
Domain Name System

- Numbers: good for PCs, hard for people
- DNS assigns globally unique names
- DNS servers translate the names to IP #s
- Domains are built from:
  - gTLDs: classic generic top level domains
    - .com, .edu, .org, .net, .gov, .mil, .int
  - Organizations reserve the next levels
    - cnn.com, pace.edu, care.org, loc.gov

Domain Name System . . .

- Among current gTLDs now available:
  - (country codes) .us, .ca, .fr, .es, .ch, etc.
  - .biz – business, .info – informational
  - .museum – museums
  - .name – personal domains
  - .coop – cooperatives, .aero – aeronautics
  - Additionally, gTLDs in other languages are now under consideration by ICANN

Domain Name System . . .

- How it actually works . . .
  - An application points to www.pace.edu
  - TCP/IP stack requests translation to IP
  - DNS server hierarchy returns IP address
  - Application sends request to the IP address
  - Server returns reply to application by IP
  - TCP/IP stack “caches” IP addresses
  - Repeat requests are handled without DNS
Some Internet Protocols

- At network layer 3:
  - IPv4, IPv6, ICMP
- At transmission layer 4:
  - TCP, UDP
- At application layer 7:
  - Email(SMTP), Web(HTTP & HTTPS), FTP, SNMP, Time(NTP), Telnet, etc.

Some Internet Applications

- Email: SMTP, POP3 Mailboxes
- FTP: file transfer, web site updating, etc.
- WWW: http (normal), https (secure)
- SNMP: Simple Network Mgmt Protocol
- Video: streaming videos, clips, films
- Radio: streaming radio (global)
- VoIP: Internet telephony Skype, Gizmo

Internet2

- Internet 2 PowerPoint Presentation
World Wide Web (WWW)

- Invented in 1989 by Tim Berners-Lee
  - At CERN, a way to share information
  - A client server architecture using the Internet
- First URI, http, html specs published in 1990
- By January 1993, 50 web site worldwide
- Mosaic browser (client) debuts in 1993
  - 1 million copies downloaded by December 1993
  - Mosaic becomes Netscape, eventually Firefox
- Sir Tim-Berners-Lee now heads W3C.ORG

Linear text vs. hyperlinks

World Wide Web (WWW) . . .
World Wide Web (WWW) . . .

- Intranets and Extranets
- Internet Security
  - Encryption, Authentication, Authorization
    - Captcha
- Use, misuse & content
  - Google, Yahoo and MSN . . .
  - YouTube, Flickr, Snapfish . . .
  - Facebook, MySpace, Twitter, Blogs . . .
  - Hulu, Netflix, MovieFlix . . .

Week 9 Summary

- The Internet Defined & Physical Topology
- Internet Access
- Internet Standards, Admin. and Regulation
- IP Addressing & Domain Name System (DNS)
- Internet Protocols & Applications
- Internet2
- World Wide Web (WWW)
  - Intranets and Extranets
  - Internet Security, Use, Misuse and Content