Acknowledgments: Some of the slides are fully or partially obtained from other sources. Reference is noted on the bottom of each slide, when the content is fully obtained from another source. Otherwise a full list of references is provided on the last slide.
What happens when you click on a URL?
What happens when you click on a URL?

• When you click on a URL, 17 messages are exchanged on the internet
What happens when you click on a URL?

- When you click on a URL, 17 messages are exchanged on the internet
  - 6 message to translate the server name to IP address
  - 3 messages to setup a TCP connection
  - 4 messages for your browser to send the HTTP “get” request, and server response (assuming the page itself fits in one message)
  - 4 messages to tear down the connection
History
Early communication over Long Distance

• Between human beings

• Letter and messenger
  • Information carried by physical objects
  • Speed limited by transportation means: horse, bird, train, car
  • Bandwidth? Distance? Security?

• Fire
  • Early optical communication
  • Speed of light
  • Bandwidth? Distance? Security?
Communication Using Electrons

- 1827 (1206) Ohm’s Law
- 1837 (1216) “Workable” telegraph invented by Samuel Morse
- 1838 (1217) demonstration over 16 kilometers at 10 w.p.m.
- 1851 (1230) Western Union founded
- 1868 (1247) Transatlantic cable laid
- 1876 (1255) Alexander Bell invented the telephone
- 1885 (1264) AT&T formed
- 1892 (1271) First automated commercial telephone switch

[Zhang07]
Age of Telephones

- 1903 (1282) 3 million phones in the U.S.
- 1915 (1294) First transcontinental telephone line
- 1948 (1327) Transistor invented by Bell scientists
- 1963 (1342) Digital transmission introduced
- 1965 (1344) 1ESS central office switch introduced
- **1969 (1348) Arpanet was born**
- 1985 (1364) Last telegraph circuit closed down
- 1999 (1378) Last 4ESS install in ATT network
1969 (1348) ARPANET was born. 4 nodes were inter-connected: UCLA, SRI, UCSB, U. of Utah. Charley Kline from UCLA sent 1st packet.
1970 (1349) ARPANET used NCP (Network Control Protocol), first end-to-end protocol
1971 (1350)
15 nodes were connected.
Ray Tomlinson of BBN invented email program.
1972 (1351) @ was chosen by Ray Tomlinson to separate the userid and hostname. First computer-to-computer chat program at UCLA.
1973 (1352) Ethernet was invented by Bob Metcalfe's (Harvard PhD Thesis)
TCP (Transmission Control Protocol) was invented by Vint Cerf and Bob Kahn.
1975 (1354)
First mailing list was created by Steve Walker.
Internet Hosts

1978 (1357)
TCP split into TCP and IP.
3Com was co-founded by Bob Metcalfe.
1982 (1361) DoD used TCP/IP to inter-connect networks. Thus, the Internet!!!
1983 (1362) NCP → TCP/IP. ARPANET was split into ARPANET and MILNET. BSD included TCP/IP.
1984 (1363) DNS (Domain Name System) was introduced.

> 1000 hosts.
1987 (1366) > 10,000 hosts.
1988 (1367) First Internet Worm released by Morris. CERT (Computer Emergency Response Team) was formed as a result. IRC was created.
Internet Hosts

1989 (1368) > 100,000 hosts
1990 (1369) ARPANET ceased. AOL, CompuServe provided dial-up service.
1991 (1370)
WWW was created by Tim Berners-Lee from CERN.
Linux was released by Linus Torvalds.
1992
> 1,000,000 hosts.
1993
Network Solution, Inc was chosen to provide domain name registration.
Mosaic was created.
1995

Realaudio started.
Win95 released.
Bob Metcalfe predicted the Internet would collapse.
1996
Browser war (Netscape vs. IE) began.
tv.com sold to CNET for $15,000.
1998
2M domain names registered.
Compaq bought altavista.com for $3.3M.
Google founded.
1999
First online banking.
business.com sold for $7.5B
Napster released.
2000 Millennium bug.
Internet Hosts

2001 Wikipedia launched.
2006
> 439M hosts.
10 new computers joined the Internet every second.
2008
Google valued at 138 billion dollars.
* Source: Bill Cheswick, Mapping the Internet and Intranets. NJIT, 10 March 2005
Colored by distance from scanning host

* Source: Bill Cheswick, Mapping the Internet and Intranets. NJIT, 10 March 2005
Today’s Networks

• What are common applications?
  • Web
  • Email
  • Video Streaming
  • file sharing (p2p)
  • Gaming
  • e-commerce
  • VoIP
Details on the Course
Administrivia

- Website:
  - sharif.edu/~kharrazi/courses/40443-911/
  - You are expected to check the website regularly
- Textbook:
- Prerequisites: 40-181 Probability and Statistics
- Corequisites: 40-424 Operating Systems
- You must also take, 40-416 with 40-443
Administrivia

• TAs
  • Behnam Momeni
  • Mehdi Ahmadinejad
  • Kamyar Allahverdi
  • Sajjad Fouladi
  • AliMohammad Rabbani
  • Rahmtin Rotabi
  • Roozbeh Ketabi

• Grading
  • 10% quiz
  • 40% homework
  • 20% midterm
Policies

- Late Homework
  - One day late will cost you 25%, two days 50%, and three days 75%.
  - No homework will be accepted after the third day.
- Cell phones
  - Please turn them off before entering class.
- Cheating and Copying
  - First time you are caught you will get a zero for the task at hand.
  - Second time you are caught you will fail the course.
  - Providing your assignment to someone else is considered cheating on your behalf.
Acknowledgments/References


• [Zhang07] Hui Zhang, 15-441 Networking, Fall 2007, School of computer science, CMU.