Assignment:

Read Chapter 1 of Kurose-Ross
Revolutions in Communications

- Telegraph (1830s)
- Telephone (1870s)
- Radio (1890s)
- Television (1930s, 40s)
  - Satellites (1960s, 70s)
  - Cable Television (1970s, 80s)
- Cellular Telephone (1980s, 90s)
- Commercialization of the Internet (1990s)
- More recently?

Revolutions can happen **FAST**
For example, in 1978 there was:

- No Facebook
- No YouTube, No Twitter
- No Google
- No World Wide Web
- No DVDs or even CDs
- No Sprint, no Verizon
- No cell phones (Aghhh!)
- Larry Page, Google co-founder, was 5 years old, in kindergarten in East Lansing.
- Microsoft had 11 (!) employees.
Internet Growth

- The Internet began in the late 1960s with the ARPANET, a U.S. DoD project
  - Development of TCP/IP protocols and some rudimentary applications (email, ftp)
- By the 1980s the network was used by
  - academia, some industry and the U.S. DoD orgs
  - but NOT by the general public
- Domain Name System not widely deployed until late 1980s. Before that???
- First dedicated transatlantic connection only in 1990!
- But then...

The World-Wide Web!

- 1989: Tim Berners-Lee (CERN - Switzerland) develops HTML, HTTP and the first (non-graphical) browser
- 1993: Marc Andreesen and Eric Bina (UIUC) develop the graphical Mosaic browser
- And the rest, as they say, is history...
  - 1993: Internet carries 1% of all telecommunications traffic in the world
  - By 2007, the Internet carries 97% (!!) of all telecom traffic in the world
The Internet Revolution

- How does the Internet Revolution differ from other technological revolutions, such as the Industrial Revolution?

Internet – the “8th Continent”

- How does the Internet Revolution differ from past revolutions in communications?
My Background

- Grew up in a (very) small town in the 1960s.
- After earning BS and MS degrees, worked at Bell Laboratories
  - Electronic switching systems, computer networks
  - Operating system kernel internals
  - High-assurance software design
- Took leave to earn PhD at University of Illinois
- Left Bell Labs and joined MSU faculty in 1990

Instruction

- I generally teach courses in “systems”
  - Ugrad: Computer networks, operating systems
  - Grad: Mobile computing, sensor networks, bio-inspired computing, Internet of Things, etc.

- My courses usually involve
  - Combination of theory and practice
  - A little history...
Past Research

- Parallel processing
- Overlay networks
- Wearable computing

Other Research

- Self-adaptive systems
- Sensor networks
- Cyber-physical systems

PlanetLab
Example: Ecosystem Monitoring

Prologue
Recent: Evolutionary Robotics

- Evolve robot body and/or controller in the computer
- 3D-print the robot body
- combine with electronics (processor, sensors, actuators)

Evolving/Fabricating Aquatic Robot
Testing Aquatic Robots

- 10’ x 15’ x 4’ tank. How much does it weigh?
- Flow Tank for swimming against current.

Robotic Fish Applications
Ongoing Research

- Air Force sponsored projects
  - high assurance software for autonomous systems
  - enable systems to identify and mitigate “unlikely-but-possible” events and situations
- Apply evolutionary algorithms to search
  - unbiased by human preconceptions
- Target platforms: rovers, drones, etc.

MSU AutoRally

- 1:5-scale truck with dual cameras, IMU, GPS, (lidar)
- Quad-core processor, 32GB RAM, 2TB SSD, and GPU
- Top speed of 60 mph!
Back to CSE 422

In this class, we will:

- Learn the *fundamentals* of computer networking
- Understand how these fundamentals are applied in real networks, in particular, the Internet
- Understand the relationship between theory and practical design
- Understand network services and layers
- Learn how distributed applications access the network
- Learn that, by their nature, networks comprise many individual solutions that must (somehow) work together and continually integrate new solutions.