The Beauty and Joy of Computing

Lecture #12
Internet I

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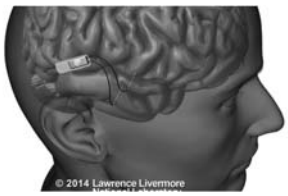
MEMORY IMPLANT

DARPA is investing millions to help develop brain implants to help with memory particularly for people suffering disabilities. However, this research may still be theoretical as disconcerting scientists on the project state, "The first challenge is understanding how memory really works."



`http://www.latimes.com/science/sciencenow/la-sci-sn-pentagon-neural-prosthetic-memory-20140709-story.html`

Quick Question I

In the last 3 years, what was the longest time stretch you have ever been without Internet?

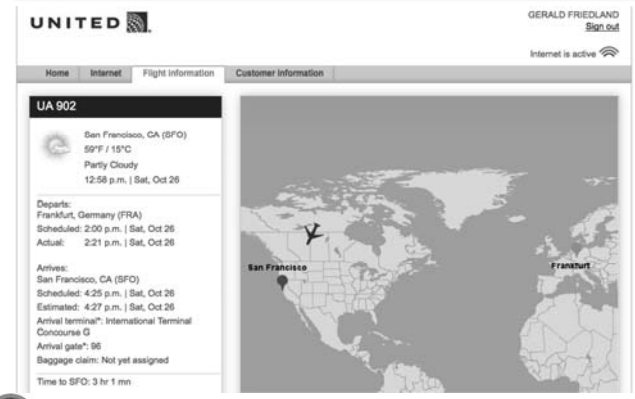
a) Several hours
b) 1-2 days
c) More than 2 days
d) Several weeks
e) More than several weeks

Quick Question II

What was the reasons for not having access to the Internet?

a) Technical interruption
b) In an area with no Internet
c) Voluntary break
d) Didn't bother having access
e) Other

Internet is pretty much everywhere!



`www.computerhistory.org/internet_history`

The Internet (1962)

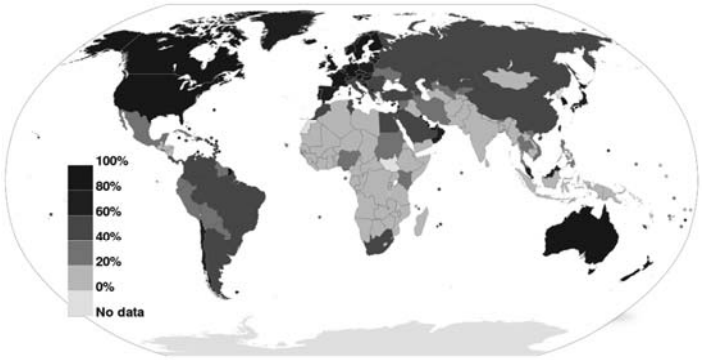
- Founders
  - JCR Licklider, as head of ARPA, writes on "intergalactic network"
  - 1963 : ASCII becomes first universal computer standard
  - 1969 : Defense Advanced Research Projects Agency (DARPA) deploys 4 "nodes" @ UCLA, SRI, Utah, & UCSB
  - 1973 Robert Kahn & Vint Cerf invent TCP, now part of the Internet Protocol Suite
- Internet growth rates
  - Exponential since start!

`www.greatachievements.org/?id=3736`
`en.wikipedia.org/wiki/Internet_Protocol_Suite`

The basics of the basics

`http://youtu.be/7_LPdttKXPc`

The Internet Today



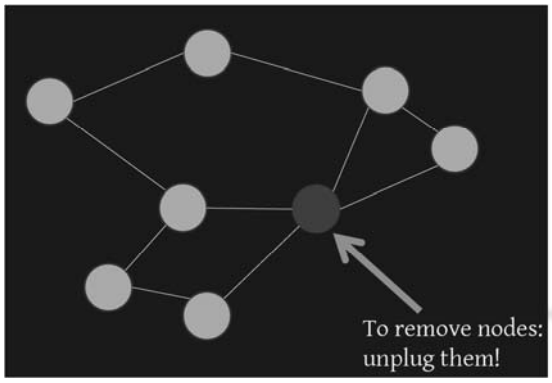
Internet Usage as a Percentage of Population (2012)

Source: Wikimedia Commons

Growth of the Internet

- The major point in building networks is agreement.
- The Internet was build
  - using a decentralized architecture
  - using open protocols

Properties of the Internet: Decentralization



Source: BJC Spring 12, Lecture 17

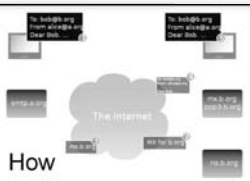
Properties of the Internet: Open Standards

- Internet Engineering Task Force (IETF):
  - Request for Comments (RFC)
- World Wide Web Consortium (W3C)
  - HTML
- International Standards Organization (ISO)
  - JPEG, MPEG
- Institute of Electrical and Electronics Engineers (IEEE)
  - WiFi

Email (1965)

en.wikipedia.org/wiki/Email

- Fundamentally changed the way people interact!
- 1965: MIT's CTSS
  - Compatible Time-Sharing Sys
- Exchange of digital info
  - Model: "Store and Forward"
  - "Push" technology
- Pros
  - Solves logistics (where) & synchronization (when)
- Cons
  - "Email Fatigue"
  - Information Overload
  - Loss of Context



- How
  - Alice composes email to bob@b.org
  - Domain Name System looks up where b.org is
  - DNS server with the mail exchange server for b.org
  - Mail is sent to mx.b.org
  - Bob reads email from there

The World Wide Web (1989)

en.wikipedia.org/wiki/History_of_the_World_Wide_Web

- "System of interlinked hypertext documents on the Internet"
- History
  - 1945: Vannevar Bush describes hypertext system called "memex" in article
  - 1989: Tim Berners-Lee proposes, gets system up '90
  - ~2000 Dot-com entrepreneurs rushed in, 2001 bubble burst
- Wayback Machine
  - Snapshots of web over time
- Today : Access anywhere!

Tim Berners-Lee

World's First web server in 1990

en.wikipedia.org/wiki/History_of_the_web_browser

WWW Search & Browser (1993)

- Browser
  - Marc L. Andreesen and Eric J. Bina @ NCSA create Mosaic, 1st popular WWW browser
    - First Internet "Killer App"
    - Later: Netscape Navigator
  - Winning? Unclear?
- Search
  - Before engines, there was a complete list of all servers!
  - 1993 Martijn Koster Aliweb is 1st web search engine
  - 1997 Stanford Sergey Brin and Larry Page develop Google's search, based on PageRank (each: $16 Billion)

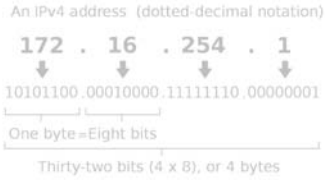
en.wikipedia.org/wiki/Web_2.0

Web 2.0 : The Social Network (2004)

- "…web development & design that facilitates interactive information sharing, interoperability, user-centered design and collaboration on WWW"
  - Users change content via "architecture of participation"
- Examples
  - Web communities, apps, social networks, video & photo sharing, wikis, blogs, tweets, …
- "Take back the web!"

"You" – Time's 2006 Person of the Year

IP Addresses



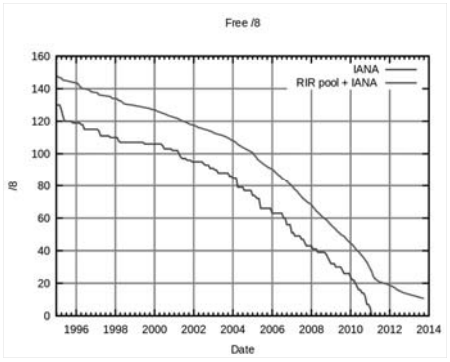
- Split: First part network, second part computer indicated by /bits: e.g. 192.168.1.103/16
- 2^{32} = 4 billion unique numbers (world population 7 billion)

Count

Take a moment and count: How many Internet-connected devices do you own?

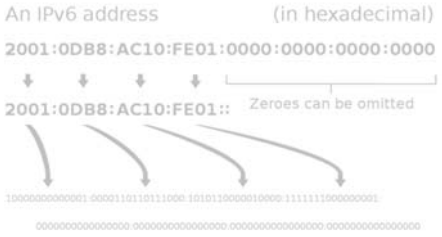
a) 0
b) 1
c) 2-5
d) 5-10
e) More than 10

Problem: No more IP addresses left…



Source: Wikimedia Commons

Solution: IPv6



- 2^{128} = 3.403 x 10^{38} unique addresses
- Issue: Adoption still in progress
- Workaround exists: NAT (Network Address Translation)

Summary and Outlook

- The Internet is setup for growth using open standards
- It is highly failure tolerant due to decentralization
- However, issues arise with trying to improve it.

Internet II:

- Routers
- Internet Protocols
- Vulnerabilities of the Internet
- More on Social Implications