Jonathan McKinsey

The Beauty and Joy of Computing

Lecture #13
Internet I

Jon's Recipe for Success in College (and Beyond)

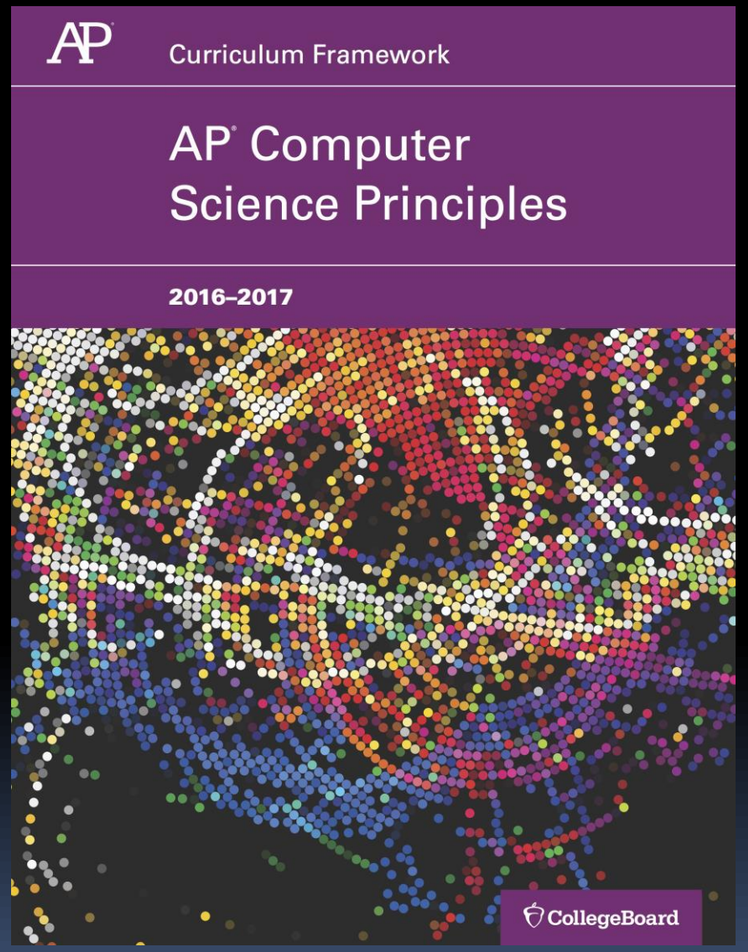
- Form study groups. Learn from and teach your peers.
- Get a github account and start building your portfolio.
- Learn the difference between confidence and arrogance.
- Be thinker and not a drone.
- Exercise and eat right.
- Stay up-to-date in your field. Join professional societies.
- Give back to the community.

Internet History

(AP) Computer Science Principles

7 Big Ideas

- Creativity
- Abstraction
- Data and Information
- Algorithms
- Programming
- The Internet
- Global Impact



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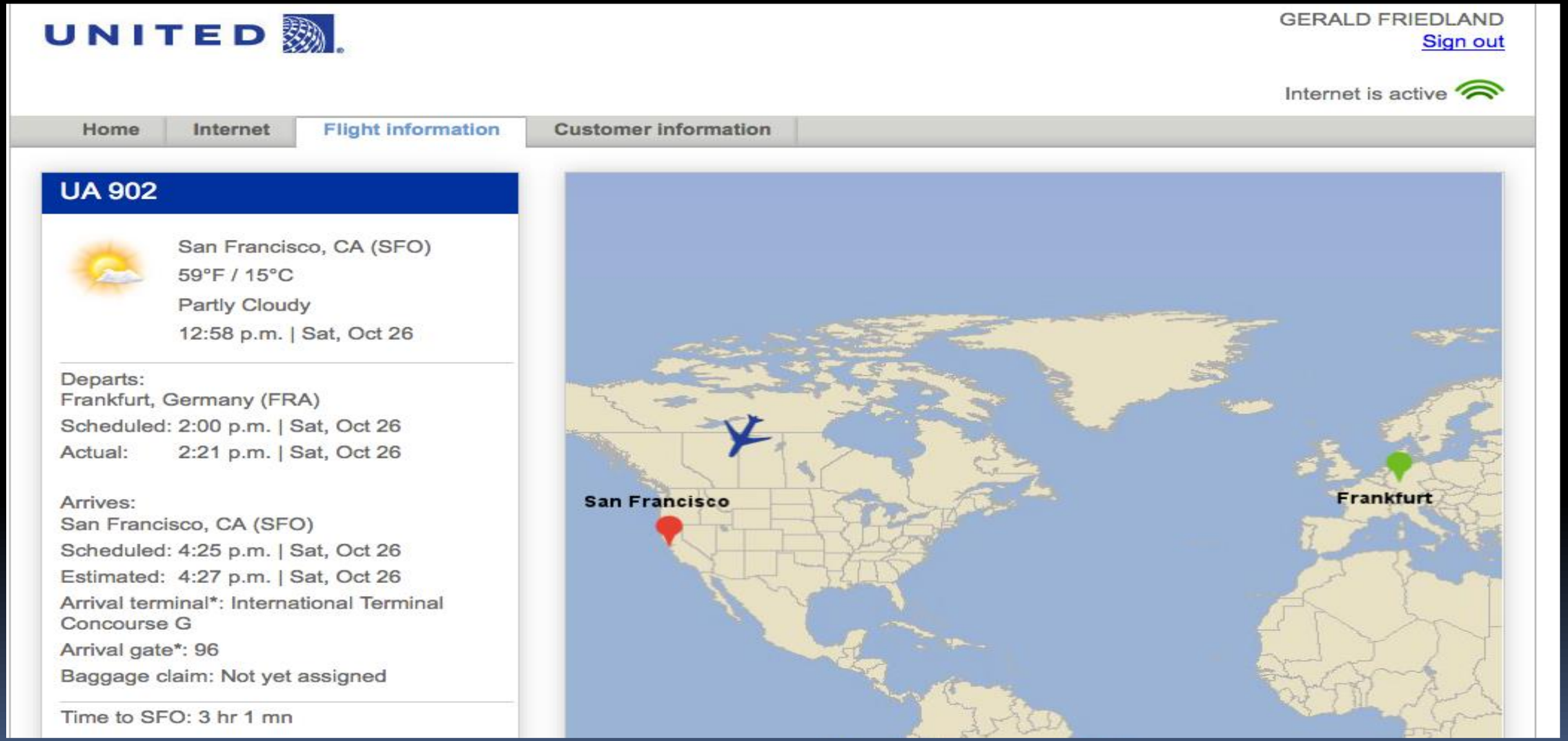
Internet is pretty much everywhere! (1/2)



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Internet is pretty much everywhere! (2/2)

Astronaut using the Internet on the International Space Station

Source: NASA

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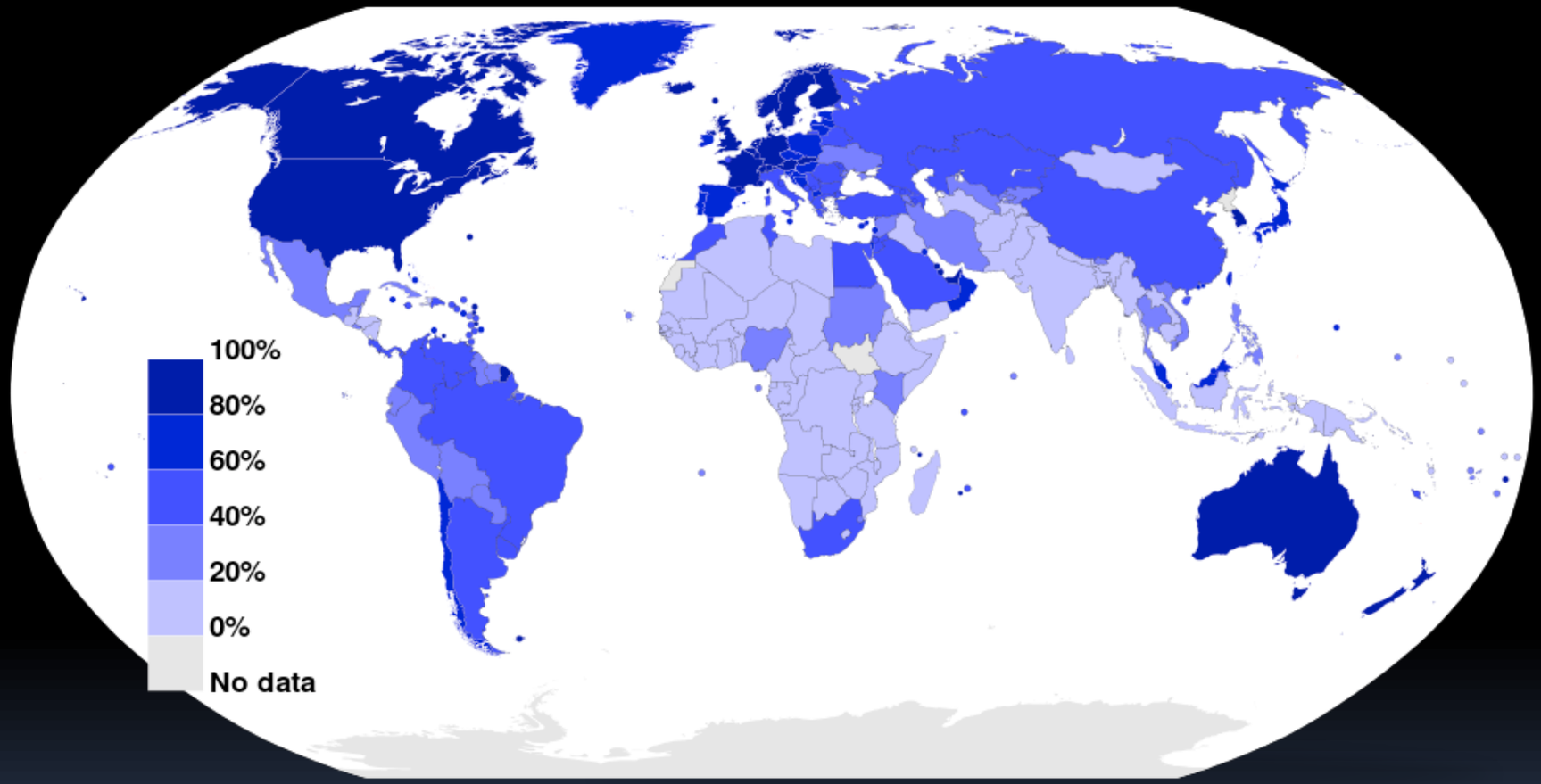
The Internet Today



Internet Usage as a Percentage of Population (2012)

Source: Wikimedia Commons

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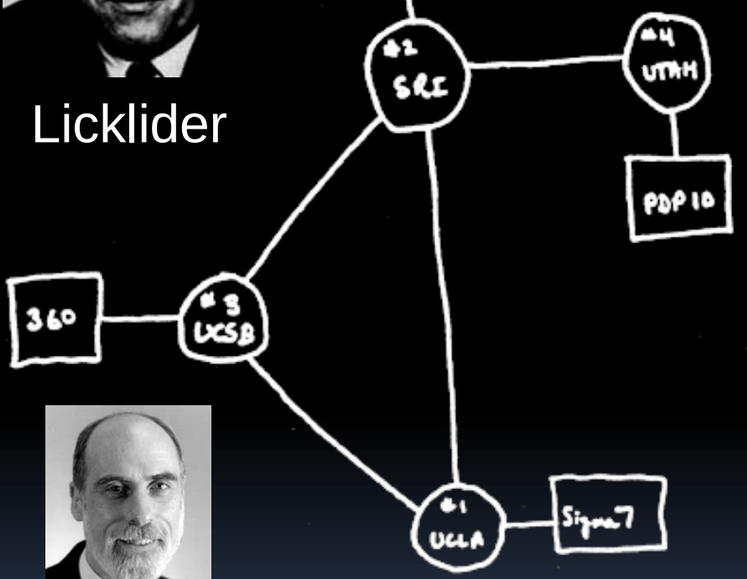
en.wikipedia.org/wiki/Internet_Protocol_Suite
www.computerhistory.org/internet_history
www.greatachievements.org/?id=3736

The Internet (1962)

- 1962: JCR Licklider, as head of Defense Advanced Research Projects Agency (ARPA), writes on "intergalactic network" where everyone on the globe is interconnected and can access programs and data at any site from anywhere
- 1963 : ASCII (American Standard Code for Information Interchange) becomes first universal computer standard
  - 128 characters: a-z, A-Z, 0-9, space, some punctuation, and some control characters
- 1969 : Defense Advanced Research Projects Agency (DARPA) deploys 4 "nodes" @ UCLA, SRI, Utah, & UCSB that form ARPANET
- 1973 Robert Kahn & Vint Cerf invent TCP, now part of the Internet Protocol Suite

Licklider

ASCII Alphabet			
A	1000001	N	1001110
B	1000010	O	1001111
C	1000011	P	1010000
D	1000100	Q	1010001
E	1000101	R	1010010
F	1000110	S	1010011
G	1000111	T	1010100
H	1001000	U	1010101
I	1001001	V	1010110
J	1001010	W	1010111
K	1001011	X	1011000
L	1001100	Y	1011001
M	1001101	Z	1011010



Vint Cerf

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Quick Question 1

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

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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

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Internet
How it Works

youtu.be/7_LPdttKXPc

The basics of the basics

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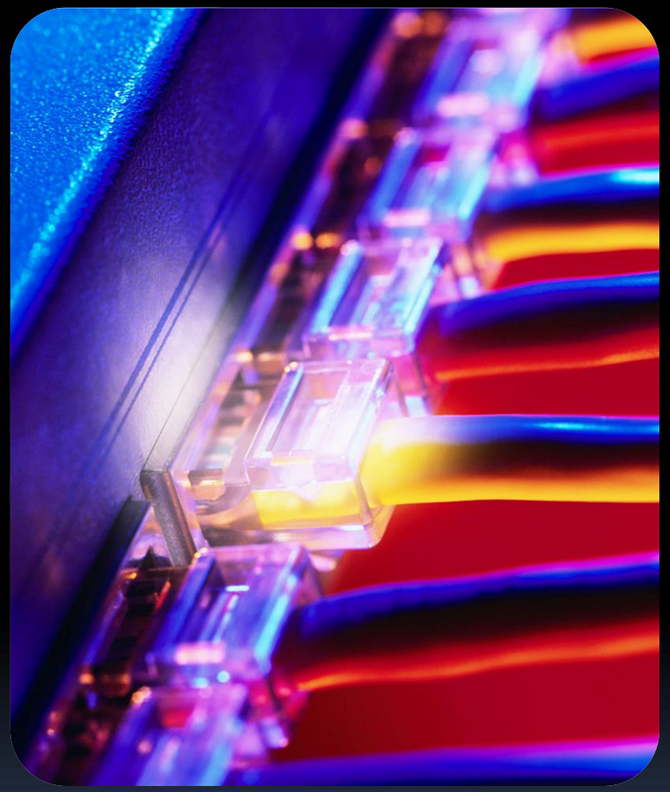
It's a Network of Autonomous Systems (1)

- The Internet and the systems built on it facilitate collaboration.
- The Internet connects devices and networks all over the world i.e. the Internet of Things.
- An end-to-end architecture facilitates connecting new devices and networks on the Internet.
  - This means all the hard work (e.g., checking if a file is corrupted) is done by the endpoints, and the middle network is "dumb", "unreliable", "dynamic"
  - Software-Defined Networking (SDN) and Cloud Computing are changing this!
- Connecting new devices to the Internet is enabled by assignment of an Internet protocol (IP) address.
- The domain name system (DNS) translates names to IP addresses.



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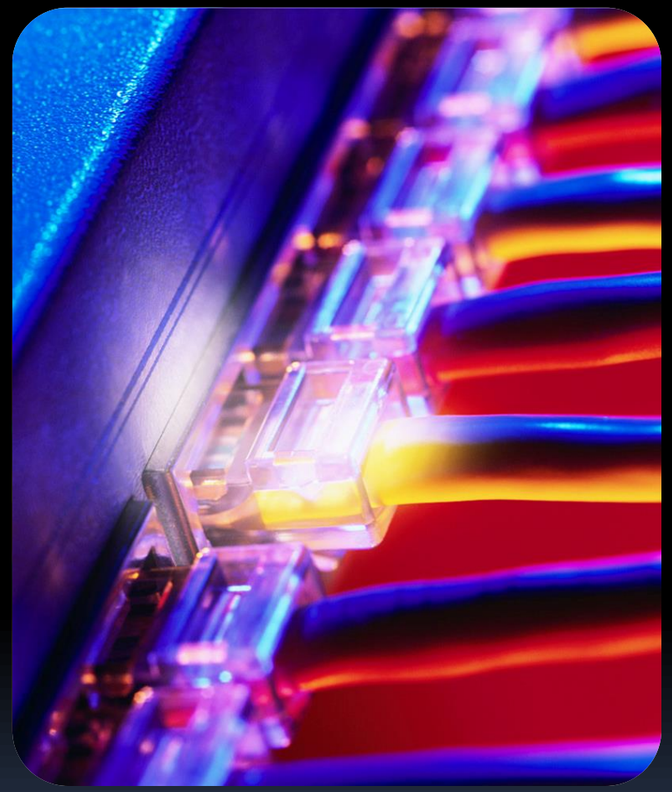
It's a Network of Autonomous Systems (2)

- The Internet is built on evolving standards, including those for addresses and names.
  - We'll see how IP has changed, new "top-level" domain names added!
- Devices & networks that make up the Internet are connected and communicate using addresses and protocols.
  - Protocols = agreements on standards
- Standards such as hypertext transfer protocol (HTTP), IP, and simple mail transfer protocol (SMTP) are developed and overseen by the Internet Engineering Task Force (IETF).



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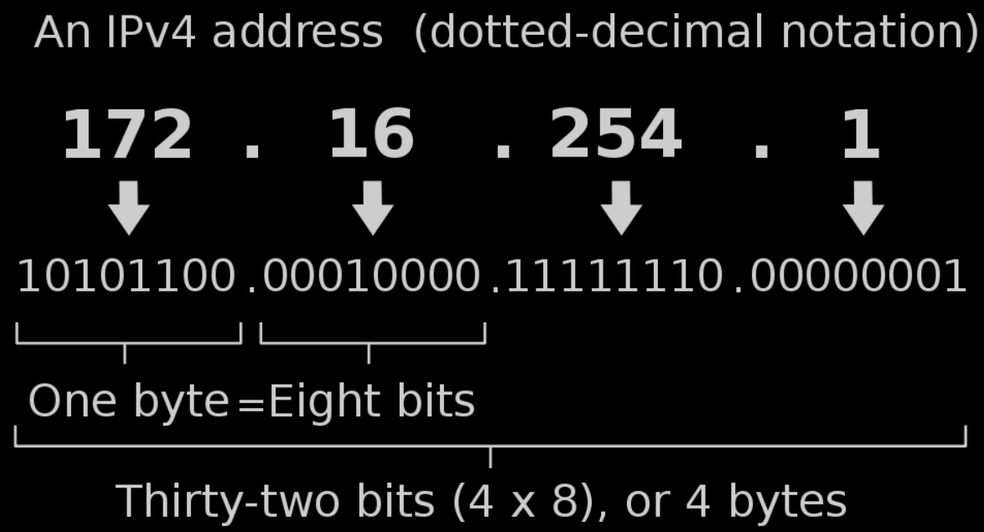
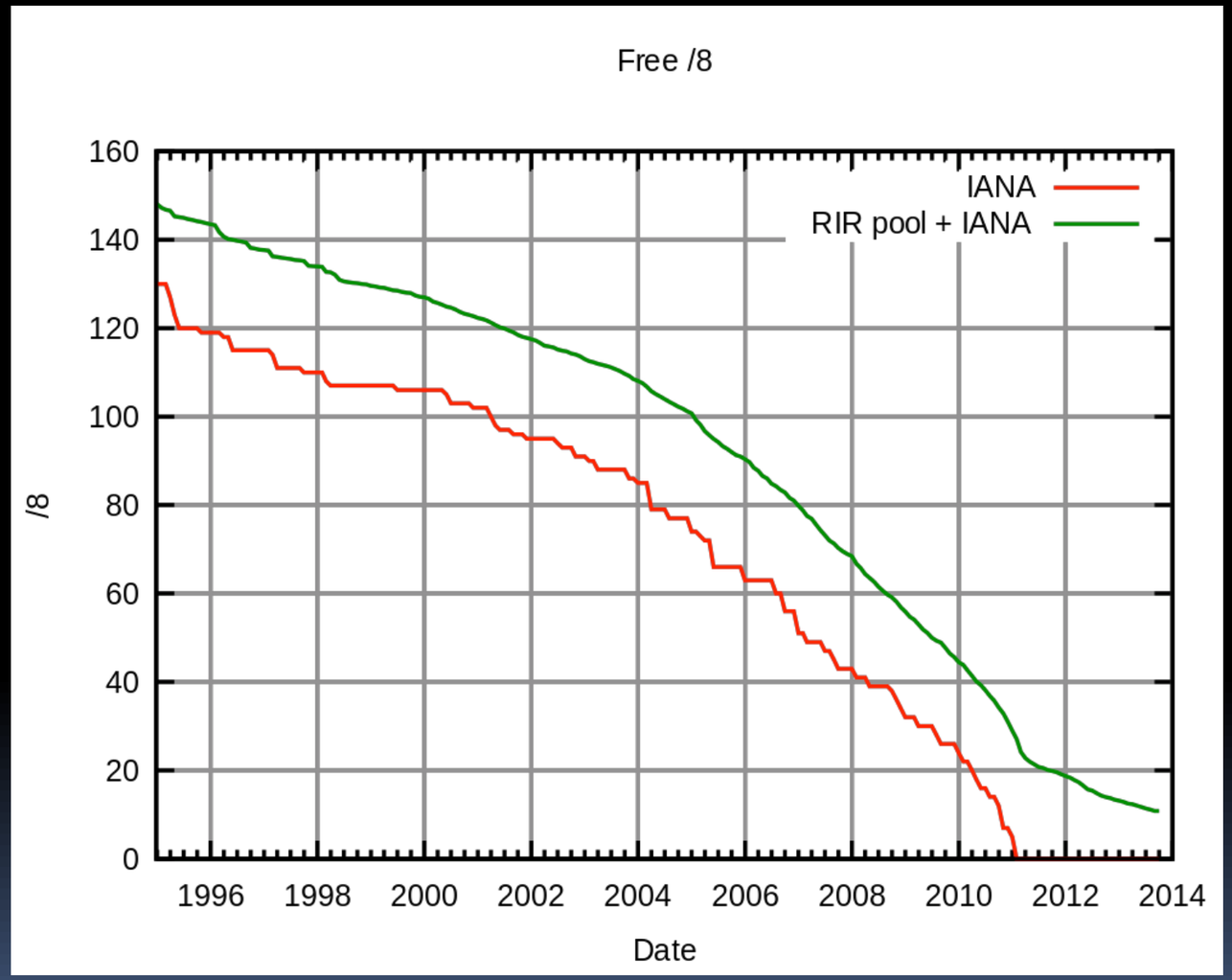
IP Addresses (this one is called IPv4)



- 2^{32} = ~4 billion unique numbers (world population 7 billion)

Problem: No more IP addresses left…

- 1 global Internet Assigned Numbers Authority (IANA)
- 5 regional Internet registries (RIR)



Source: Wikimedia Commons

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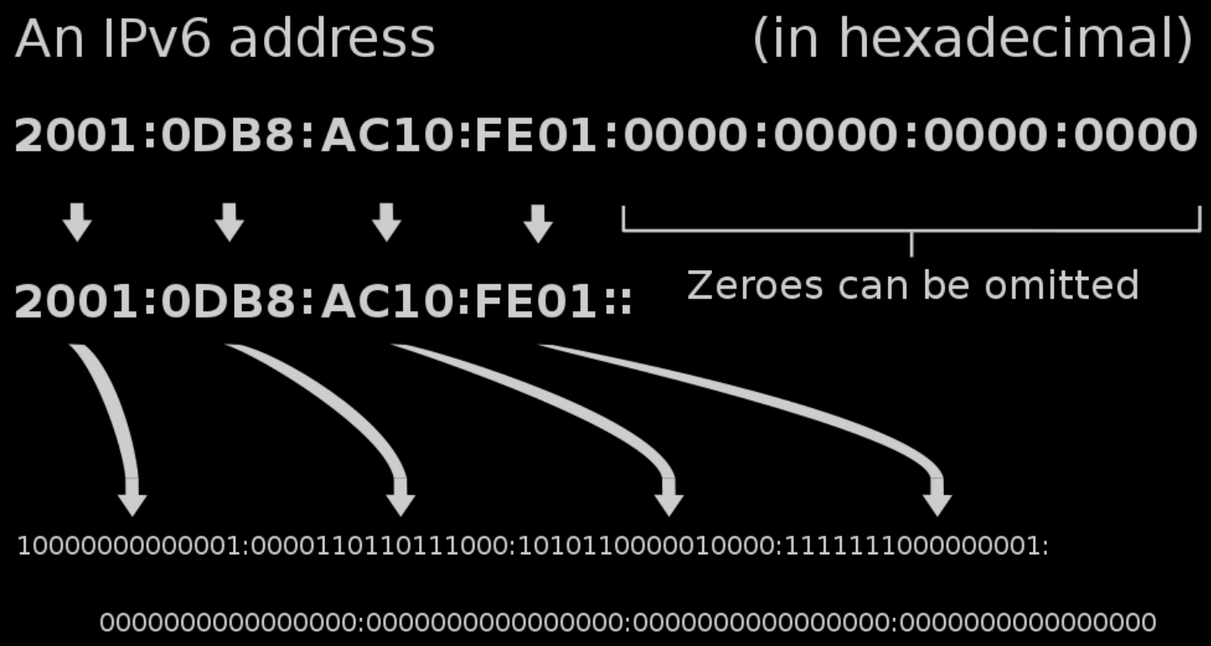
Solution: IPv6

en.wikipedia.org/wiki/IPv6



- $2^{128} = 3.403 \times 10^{38}$ unique addresses
- Issue: Adoption still in progress
- Band-aid fix: Network Address Translation

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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

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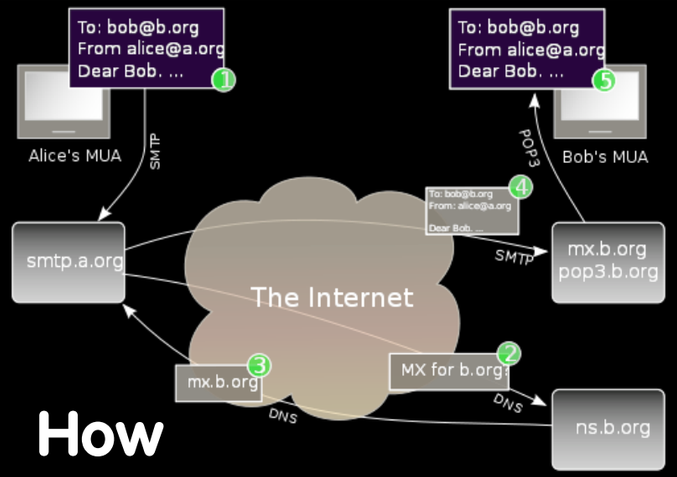
Internet Applications

Email (1965)

- 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

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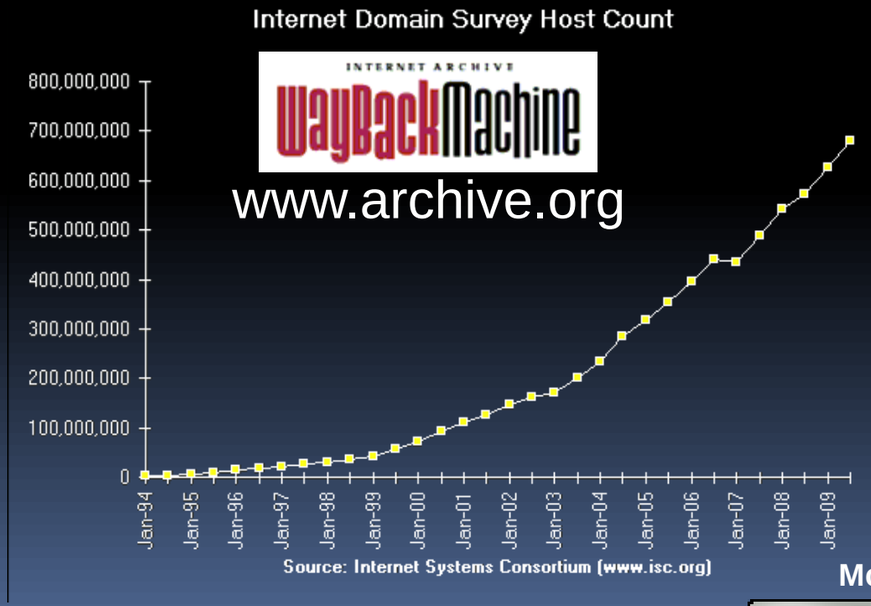
The World Wide Web (1989)

- "System of interlinked Internet hypertext documents"
- 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



INTERNET ARCHIVE WayBackMachine

www.archive.org

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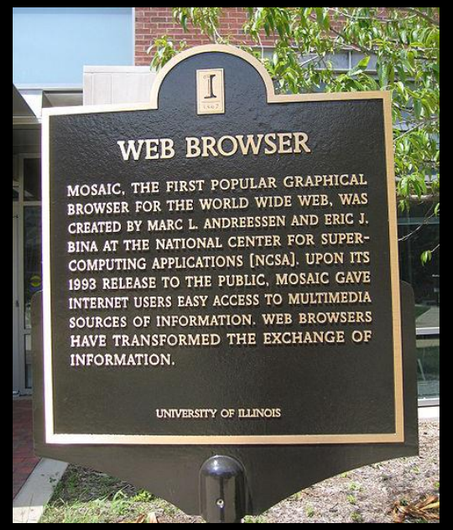
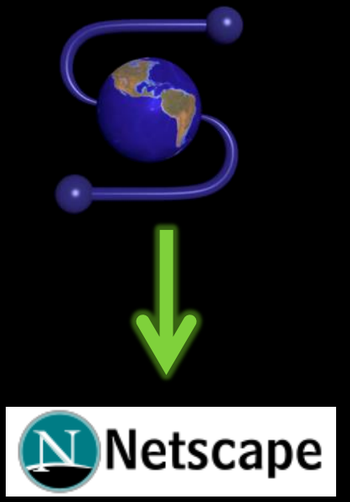
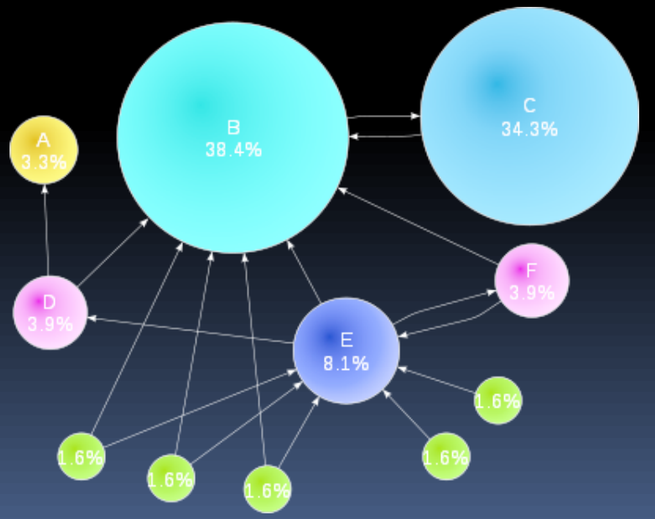
WWW Search & Browser (1993)

- Browser
  - Marc L. Andreesen and Eric J. Bina @ NCSA create Mosaic, 1st popular WWW browser
    - First Internet "Killer App"
    - Later: Netscape Navigator
  - Now Chrome, IE, Firefox, Safari, Opera, etc
- 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







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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 partipation"
- Examples
  - Web communities, apps, social networks, video & photo sharing, wikis, blogs, tweets, …
- "Take back the web!"

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

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