Internet History

Charles Severance

https://www.coursera.org/course/insidetheinternet Coursera

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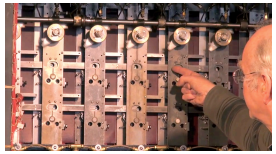
- Thanks to IEEE Computer for permisison to use IEEE Computer magazine articles associated with the videos
- Thanks to Richard Wiggins for the use of his video material
- Thanks to Dave Malicke and Open Michigan (open.umich.edu) for help with copyright review of these materials

High Level Phases

- Dawn of Electronic Computing
- Pre-Internet Communication
- Research Networks - 1960s - 1970's
- The First "Internet" - Mid 1980's
- The Web Makes it Easy - Early 1990's
- Ubiquity of the Internet - 1996 and beyond

Alan Turing and Bletchley Park

- Top secret code breaking effort
- 10,000 people at the peak (team effort)
- BOMBE: Mechanical Computer
- Colossus: Electronic Computer



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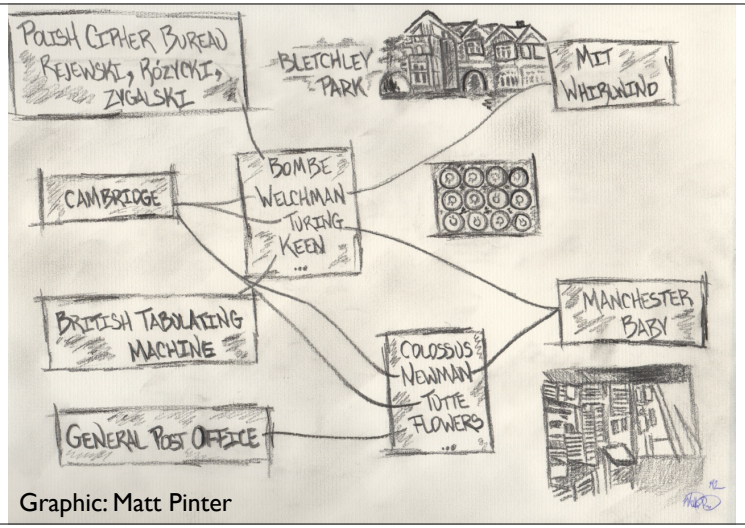
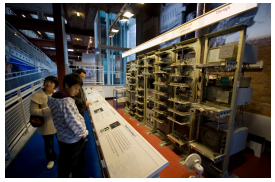


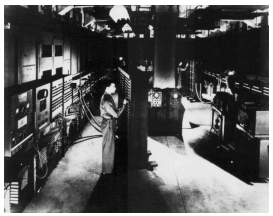
Graphic: Matt Pinter

24:50

Post-War (1940s)

- Alumni of the US and UK codebreaking efforts and other started building general purpose computers
  - Manchester Baby
  - Ferranti Mark I
  - Harvard Mark I
  - US Army ENIAC

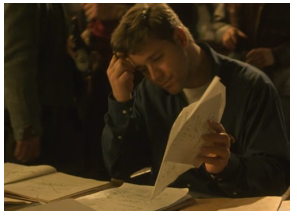




http://upload.wikimedia.org/wikipedia/commons/b/bb/SSEM_Manchester_museum.jpg
http://en.wikipedia.org/wiki/File:Classic_shot_of_the_ENIAC.jpg

Post-War (1950s)

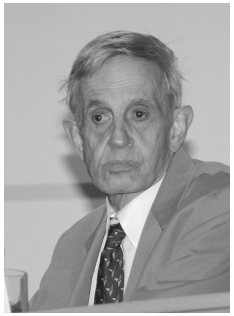
- Math / Science "Won the war"
- Broad-based investment in maintaining the US/West intellectual lead
- Mathemeticians were valued, recruited, brilliant, arrogant, and quirky
- "A Beautiful Mind" gives a sense of the culture of the time



http://www.youtube.com/watch?v=CemLiSI5ox8

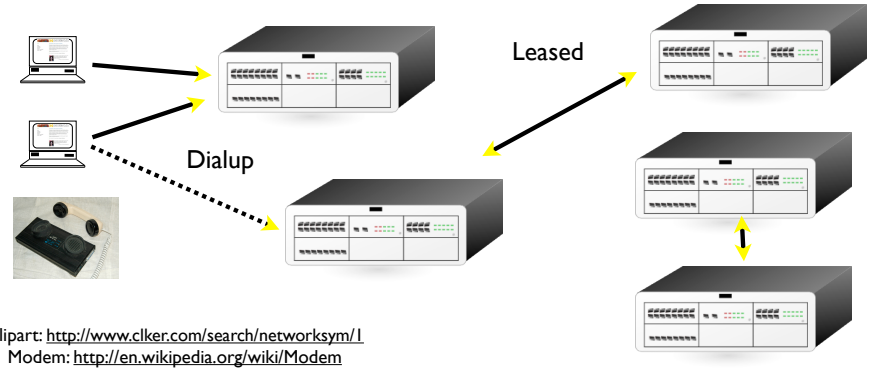
John Forbes Nash

- Received his Phd. Mathematics at Princeton in 1950 at 22 years old
- Mathematics faculty at MIT - 1951 - 1958
- Schizophrenia 1959 - 1995
- Nobel Prize in Economic Sciences - 1994



http://en.wikipedia.org/wiki/John_Forbes_Nash

Phone Line Networking



Clipart: http://www.clker.com/search/networksym/1
Modem: http://en.wikipedia.org/wiki/Modem

Dial-Up Access

- You were happy to connect to one computer without having to walk across campus
- You could 'call' other computers long distance
- The characters were encoded as sound
- Pretty Common in the 1970's

http://deepblue.lib.umich.edu/handle/2027.42/79576 (1969)

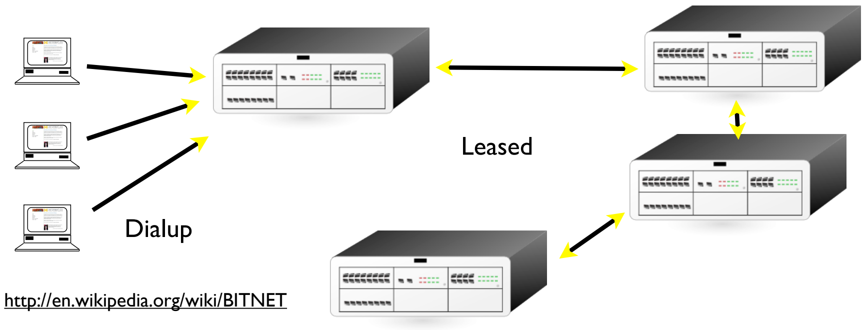
6:00

Data Transfer with Leased Lines

- You could get a dedicated connection between two points from the phone company
- No dialing was needed leased lines are always connected
- Reserved dedicated phone wires and permanent connections
- Expensive because of limited copper - cost was based on distance
- Think bank branch offices and other places where cost is significant

http://en.wikipedia.org/wiki/Leased_line

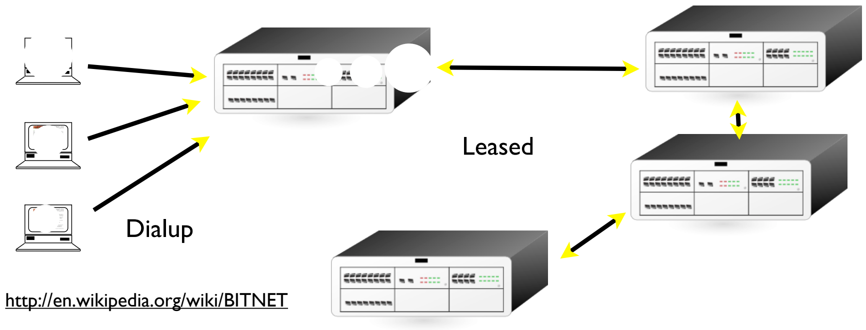
Store and Forward Networking



http://en.wikipedia.org/wiki/BITNET

Clipart: http://www.clker.com/search/networksym/1

Store and Forward Networking



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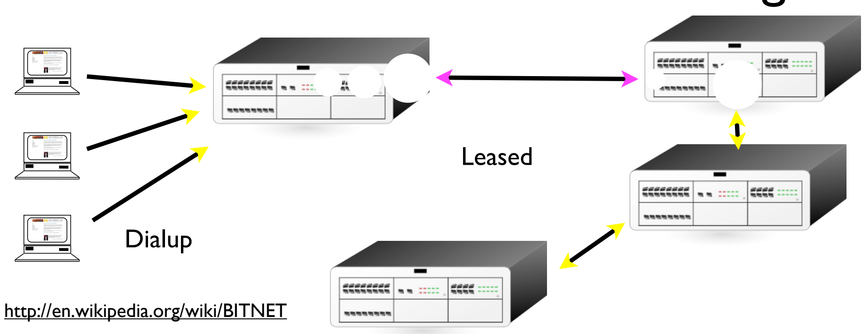

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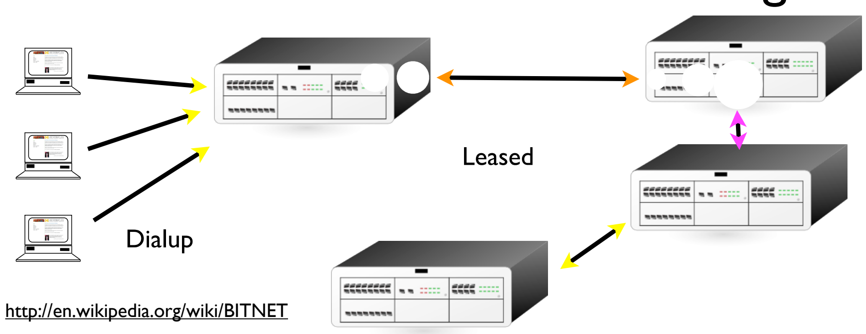

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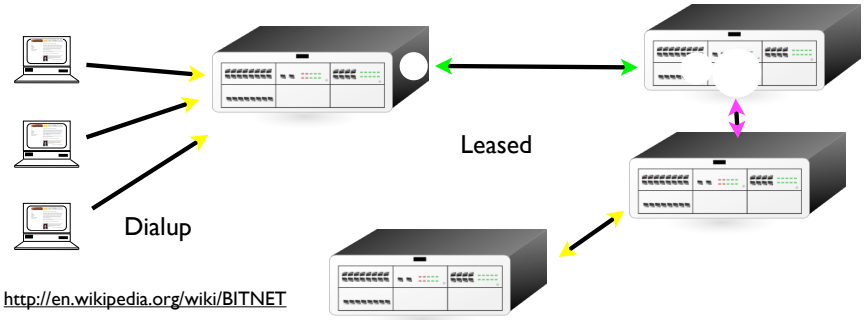

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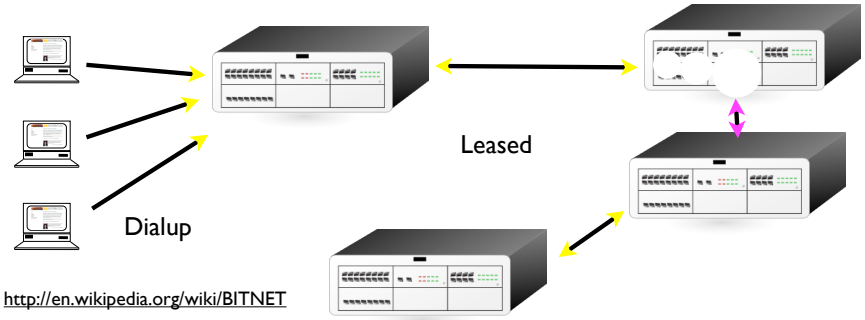

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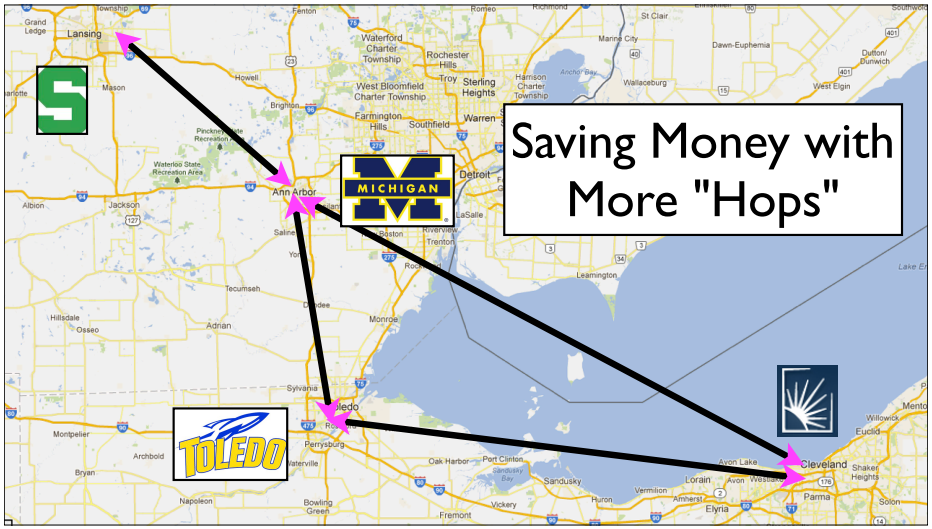


Store and Forward Networking

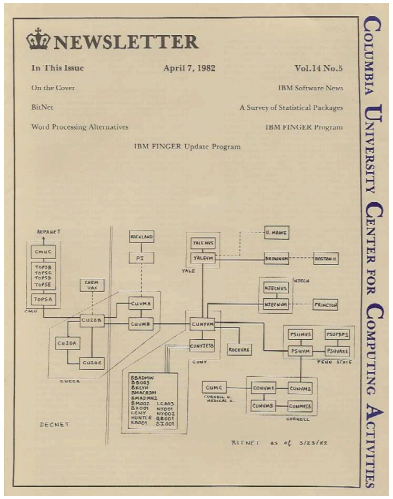
- Typically specialized in Mail
- E-Mail could make it across the country in six hours to about 2 days
- You generally focused your life on one computer
- Early 1980's

http://en.wikipedia.org/wiki/IBM_3270

BITNET

- Typically specialized in Mail
- E-Mail could make it across the country in 6-hours to about 2 days
- You generally focused your life on one computer
- Academic network in the 1980's

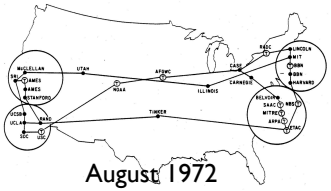
http://www.columbia.edu/acis/history/bitnet.jpg



Research Networks 1960-1980's

- How can we avoid having a direct connection between all pairs of computers or long snake-like connections?
- How can we dynamically handle outages switching between multiple paths?
- How to transport many messages simultaneously and efficiently?

December 1969



August 1972

http://som.csudh.edu/fac/lpress/history/arpamaps/

Efficient Message Transmission: Packet Switching

- Challenge: in a simple approach, like store-and-forward, large messages block small ones
- Break each message into packets
- Can allow the packets from a single message to travel over different paths, dynamically adjusting for use
- Use special-purpose computers, called routers, for the traffic control

Packet Switching - Postcards

Hello there, have a nice day.

Hello ther (1, csev, daphne)

e, have a (2, csev, daphne)

nice day. (3, csev, daphne)

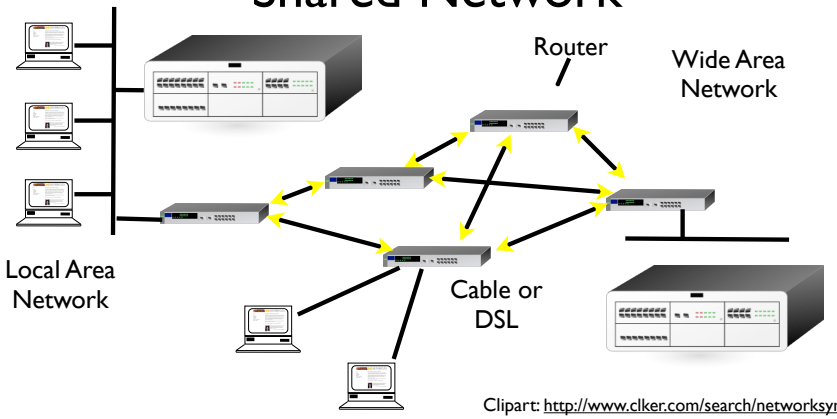
http://www.flickr.com/photos/stephoto/1519649375/

Packet Switching - Postcards

http://www.flickr.com/photos/stephoto/1519649375/

Hello there, have a nice day.

Shared Network

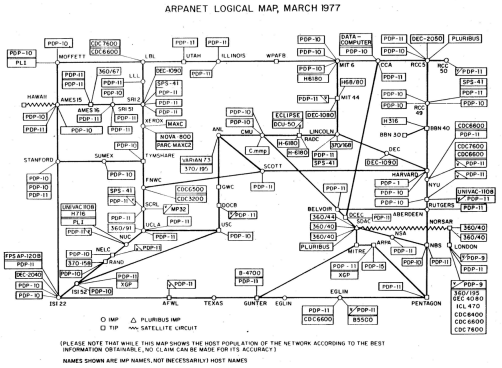


Clipart: http://www.clker.com/search/networksym/1

An Example Problem to Solve

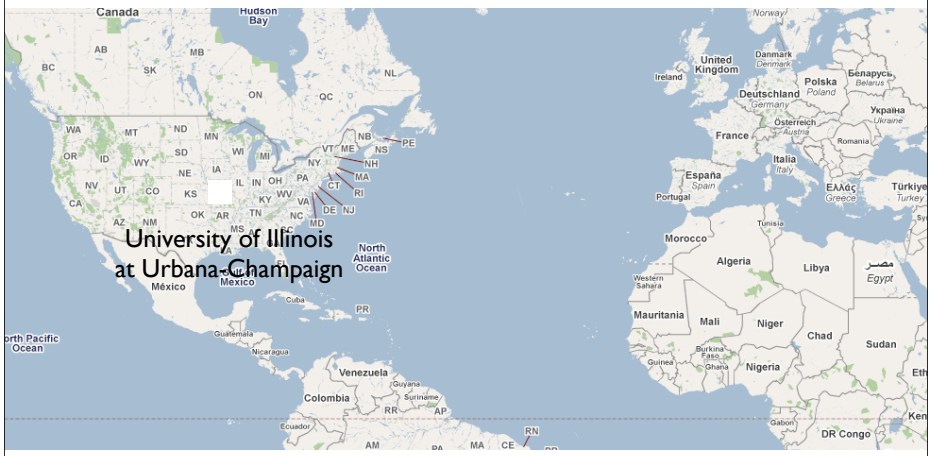
- With each router having only a local / subset knowledge of the shape of the network, how do we avoid confusion if the information is a little "messed up"?

Clipart: http://www.clker.com/search/networksym/1



Heart, F., McKenzie, A., McQuillian, J., and Walden, D., ARPANET Completion Report, Bolt, Beranek and Newman, Burlington, MA, January 4, 1978.

http://som.csudh.edu/fac/lpress/history/arpamaps/arpanetmar77.jpg



Supercomputers...

- As science needed faster and faster computers, more universities asked for their own Multimillion dollar supercomputer
- The National Science Foundation asked, "Why not buy a few supercomputers, and build up a national shared network?"

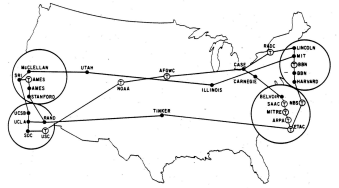
NCSA - Innovation

- We now "assume" the Internet and the Web - it was not so easy...
- A number of breakthrough innovations came from the National Center for Supercomputing Applications at Urbana-Champaign, Illinois
- High Performance Computing and the Internet were deeply linked

http://www.vimeo.com/6982439 (11:53)

NSF Net

- NSFNet was funded by the National Science Foundation
- Standardized on TCP/IP
- The first national TCP/IP network that was "inclusive"
- Initially the goal was all research universities



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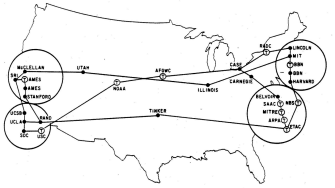


ARPANET August 1972

http://som.csudh.edu/fac/lpress/history/arpamaps/

Michigan's State-Wide Network

In 1969, Merit was one of the earliest network projects that was intended for use by an entire campus population of students, faculty, and alumni. [1]

Merit PDP-11 based Primary Communications Processor (PCP) at the University of Michigan, c. 1975

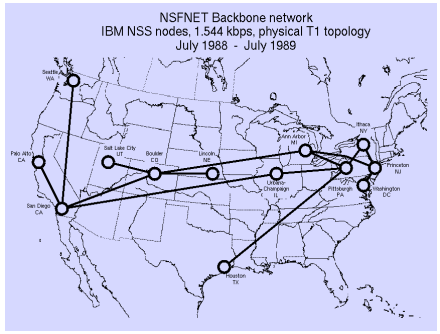
[1] http://www.zakon.org/robert/internet/timeline/

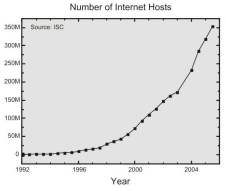
NSFNet @ University of Michigan

- University of Michigan did not get a Supercomputer Center
- Proposed a $55M high-speed network for $15M
- Partners: University of Michigan, Merit Network, IBM Corporation, MCI, and State of Michigan
- Operated from 1988-1995

http://www.vimeo.com/11044819

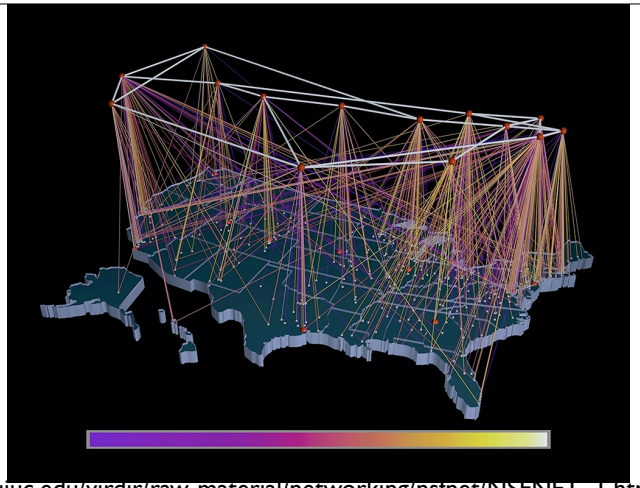
13:14





Source: http://hpwren.ucsd.edu/~hwb/NSFNET/NSFNET-20071ISummary/

NSFNET T1 Backbone and Regional Networks, 1991



http://virdir.ncsa.uiuc.edu/virdir/raw-material/networking/nsfnet/NSFNET_1.htm

NSF Net Advocacy

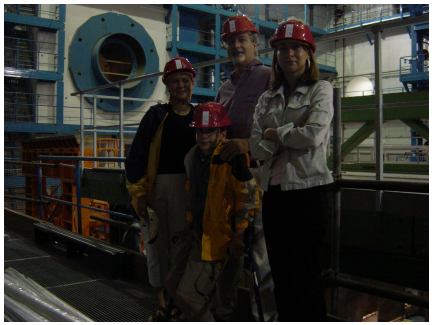
- Initially aimed at research universities
- Cleveland FreeNet and similar efforts provided indirect Internet access to the average citizen
- In about 1989-1990, the "academic-only" started being relaxed - led to Internet Service Providers making "dial-up Internet" available to the general public

CERN - High-Energy (physics)

- Brilliant physicists from all over the world
- Work on long, highly detailed projects - 15-20 years
- Have a lot of time to think..
- (And have fun)

http://musiclub.web.cern.ch/MusiClub/bands/cernettes/
http://www.youtube.com/watch?v=A1L2xODZSI4
"...You Prefer your Collider"

Visits to CERN!

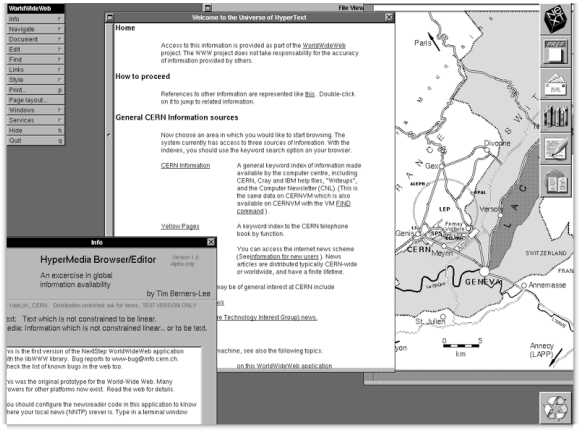


http://club-softball.web.cern.ch/club-softball/Canettes/
http://www.youtube.com/watch?v=f90ysF9BenI

The Beginning of the Web: CERN

- The Internet was infrastructure - the web gave the Internet a "user interface and URLs
- The Web was invented at CERN by Tim Berners-Lee and Robert Cailliau
- CERN developed browsers and servers - with a goal of worldwide hyperlinked documents

http://www.youtube.com/watch?v=x2GyILq59rI (9:42)



http://info.cern.ch/images/NextEditorBW.gif

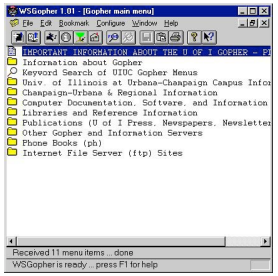
The First Web Server in America

- The first web server in America was at the Stanford Linear Accellerator (SLAC)
- It was a database of 300,000 research papers
- Dr. Paul Kunz
- December 12, 1991

http://www.youtube.com/watch?v=IOgqP2yoKwc (5:30)

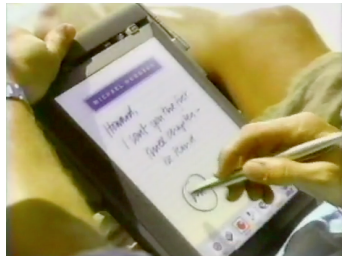
1993: Gopher is Dominant

- Internet Engineering Task Force (IETF) Meeting
  - March 29-April 2, 1993 - Columbus, Ohio, USA (638 attendees)
  - Gopher BOF - 200 attendees
  - World-Wide Web BOF - 15 attendees including Tim Berners-Lee
- P.S. DVD is invented this year

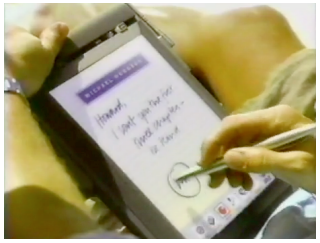


http://www.ietf.org/proceedings/26.pdf

What industry was thinking in 1993...



http://www.youtube.com/watch?v=sYNUcFMCIzw 0:30

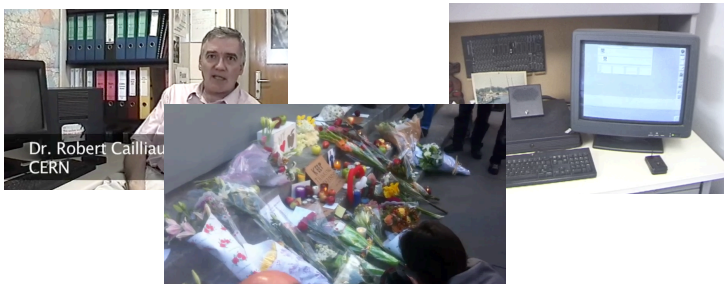


0:30

Steve Jobs and the World-Wide-Web?

- For several years the primary web browser and web server were built as NeXT applications
- Apple computers provided far superior graphics that allowed the development of Mosaic

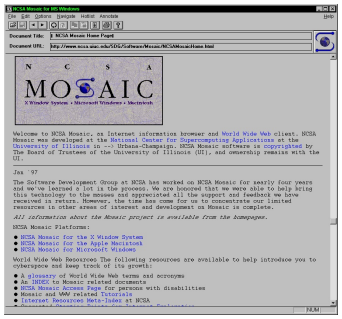
http://www.youtube.com/watch?v=W9rPUFW6czc



12:23

The Explosive Growth of the Web

- The web was invented in the early 1990's
- Growing in Academia 1993
- Growing everywhere 1994 - 1995
- Cable Modems to the home started in the mid 1990's



http://gladiator.ncsa.uiuc.edu/Images/press-images/mosaic.1.0.tif

Mosaic - Netscape - Mozilla - Firefox

- Mosaic was the first "consumer" web browser developed at NCSA
- NCSA created the httpd web server which is the basic for the Apache web server
- While most of the NCSA programmers formed Netscape and made their fortunes, NCSA released their browser for free and focused on building standards to keep the web open

http://www.vimeo.com/7053726 9:01

1994: Year of the Web

- Netscape Founded - April 4, 1994
- WWW Conf: May 25-26-27 1994, CERN, Geneva (Switzerland)
- WWW Conf: October 17-19, 1994, Chicago, IL
- October 1994, Tim Berners-Lee founded the (W3C) at MIT
- November 8, 1994 - Windows 95 beta 2 - With a vengance!

11:59

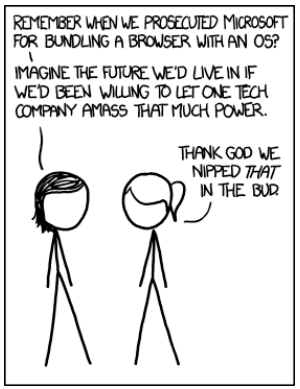
Netscape, JavaScript and FireFox

- As Microsoft worked to suffocate Netscape::
  - JavaScript was invented to compete with Visual Basic (1995)
  - Netscape slowly leaked out into Open Source as Mozilla - which later became FireFox (late 1990's)
- FireFox's search box gave the small Mozilla Foundation millions of dollars of revenue

http://www.youtube.com/watch?v=IPxQ9kEaF8c

Did Microsoft Save the World-Wide Web?

- Netscape wanted to make the web browser, web server, and web protocols propritary and owned by them
- The web browser would be $50-$100 and sold separately
- This threatened to make the desktop operating system irrelevant



http://xkcd.com/1118/

World-Wide-Web Consortium

- The W3C was formed in October 1994 (www.w3c.org)
- Led by Tim Berners-Lee who moved from CERN to MIT
- Goal was to develop standards for the web and avoid proprietary balkanization of the Web
- Many large companies (Microsoft, IBM, etc) joined quickly

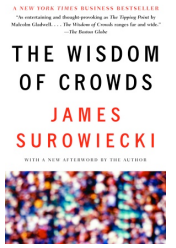
http://en.wikipedia.org/wiki/World_Wide_Web_Consortium

When You Can Assume the Web

Internet: TCI Show 08
http://www.vimeo.com/4275919

December 11-14, 1995
http://www.w3.org/Conferences/WWW4/

- Larry Smarr wanted to make supercomputers available to physicists
- Unversity of Michigan sneaked in 1.54Mb/sec instead of 56kb/sec backbone for their NSFNet proposal
- Tim Berners-Less and Robert Cailliau were building a system for network hosted documentation
- Paul Kunz was trying to make his article database easier to use
- Joseph Hardin wanted to make supercomputers more user friendly
- Mitchell Baker - Just wanted us to have a free and open source browser



The Web Land Rush...

- In the late 1990's there were many fortunes to be made - simply by being first in a market
- Everything was "novel" when it was re-invented on the web
- New brands were quickly established and became dominant

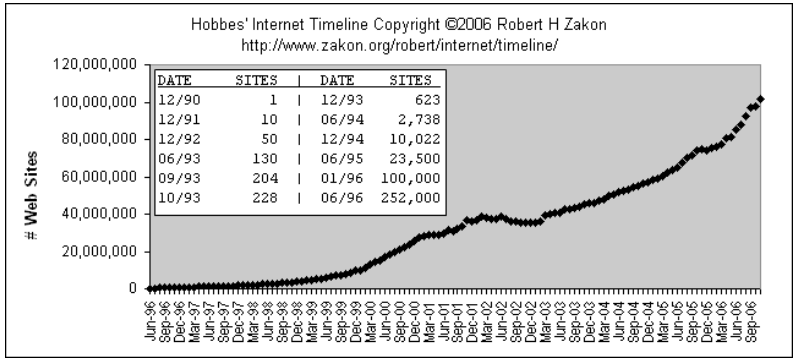
http://www.vimeo.com/7048422

5:39

The Modern Internet

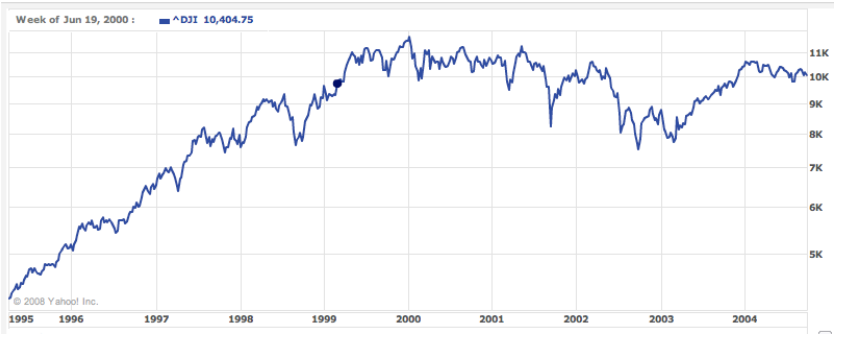
- In the late 1990's in the boom there was a great deal of Fiber optic that was installed in the US
- High speed and long distance were cheap and common
- Many national backbone networks emerged - commercial, government, academic, etc
- These networks swap data at "peering points" so we see one seamless Internet - after about 1999 - this was all pretty boring - it just worked

http://en.wikipedia.org/wiki/Internet_Exchange_Point



http://www.zakon.org/robert/internet/timeline/

The "Web Effect"



A History of Open Source ....

http://www.vimeo.com/7307422

http://www.vimeo.com/3800796

http://www.vimeo.com/6215179

Other Resources

- Hobbes Internet Timeline
  - http://www.zakon.org/robert/internet/timeline/
- A Brief History of the Internet. Barry M. Leiner, et al. 2009. SIGCOMM Comput. Commun. Rev. 39, 5 (October 2009), 22-31. DOI=10.1145/1629607.1629613
  - http://doi.acm.org.proxy.lib.umich.edu/10.1145/1629607.1629613

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