

Internet History

Charles Severance



<https://www.coursera.org/course/insidetheinternet>

Coursera

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High Level Phases

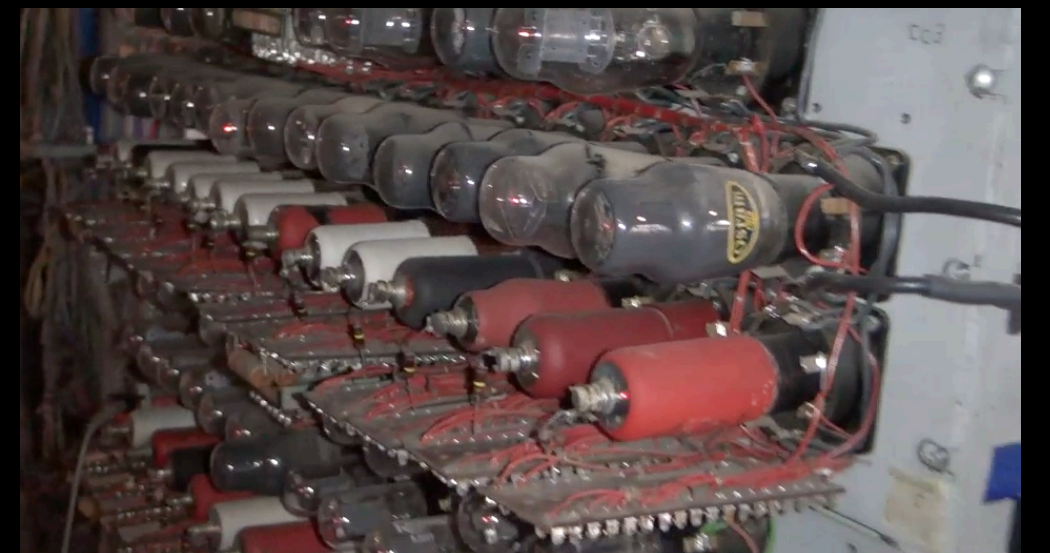
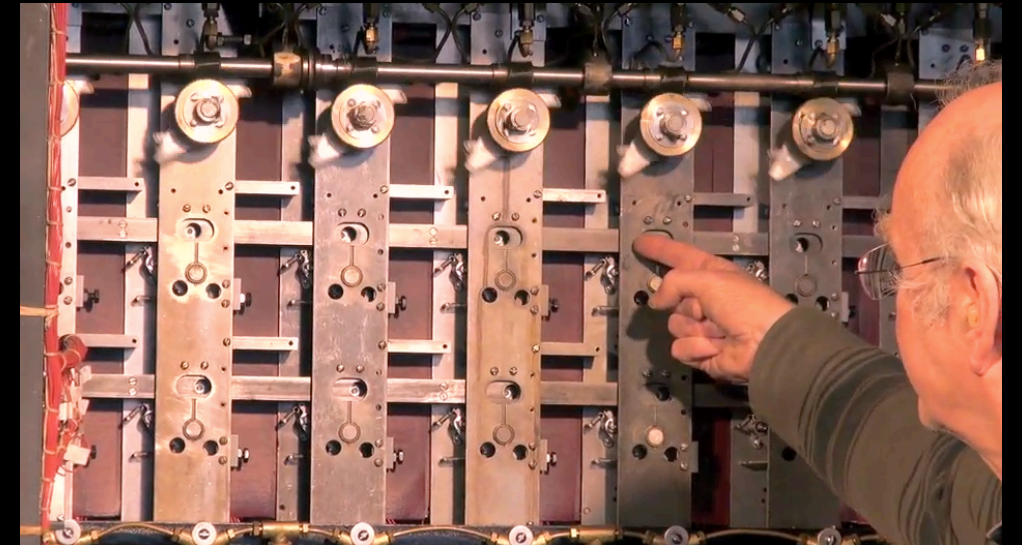
- Dawn of Electronic Computing
- Pre-Internet Communication
- Research Networks - 1960s - 1970's
- The First "Internet" - Mid 1980's
- The Web Makes it Easy - Early 1990's
- Ubiquity of the Internet - 1996 and beyond

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>

Alan Turing and Bletchley Park

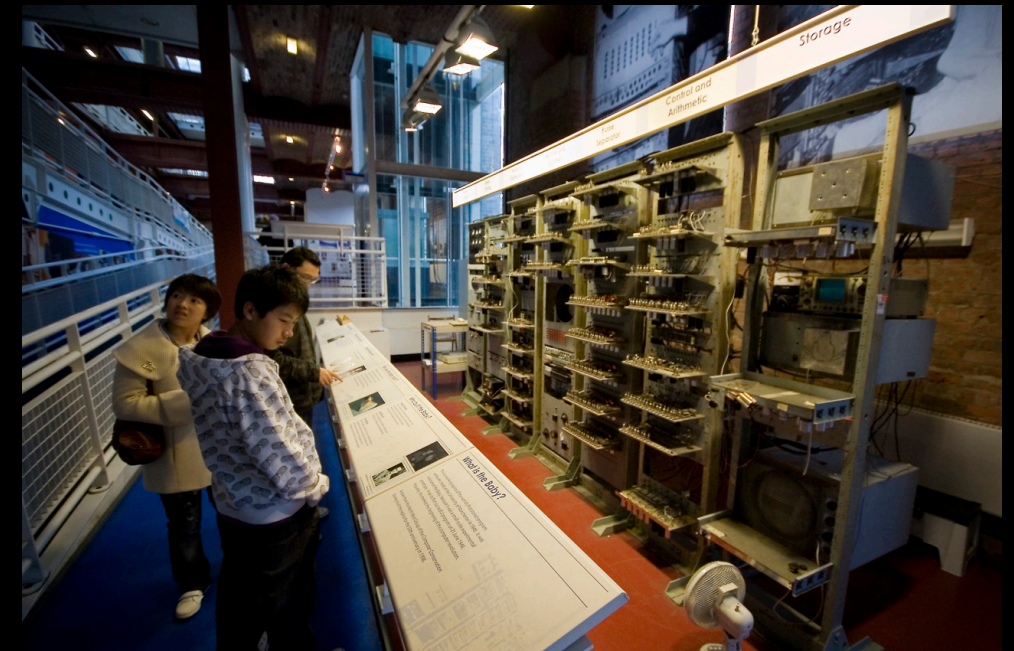
- Top secret code breaking effort
- 10,000 people at the peak (team effort)
- BOMBE: Mechanical Computer
- Colossus: Electronic Computer



http://www.youtube.com/watch?v=5nK_ft0LfIs

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

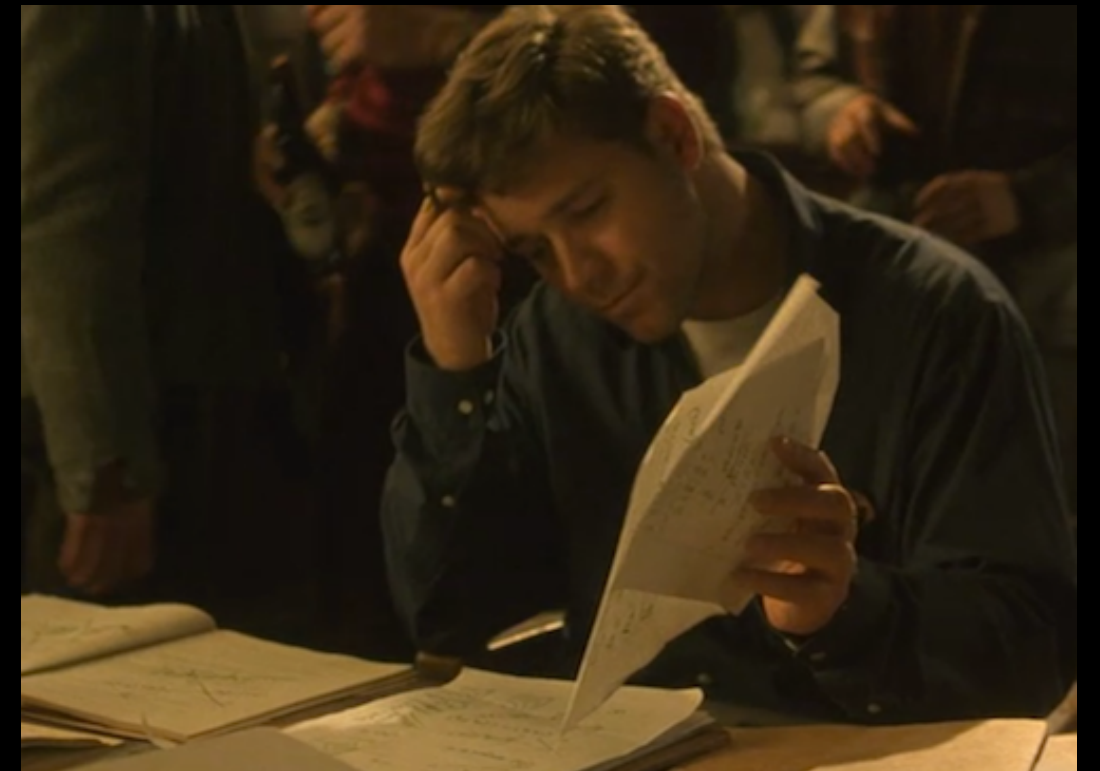


http://upload.wikimedia.org/wikipedia/commons/b/bb/SSEM_Manchester_museum.jpg

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
- Mathematicians 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>

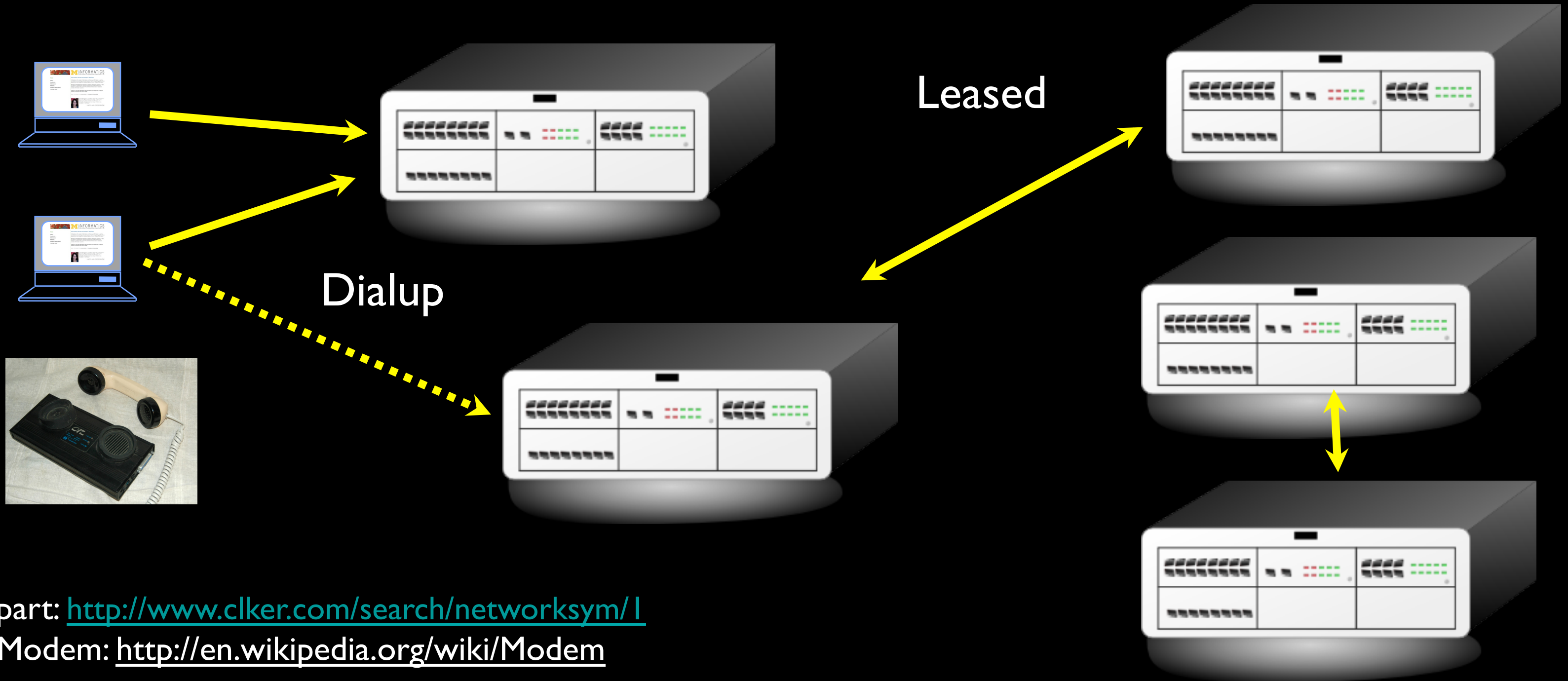
John Forbes Nash

- 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



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)

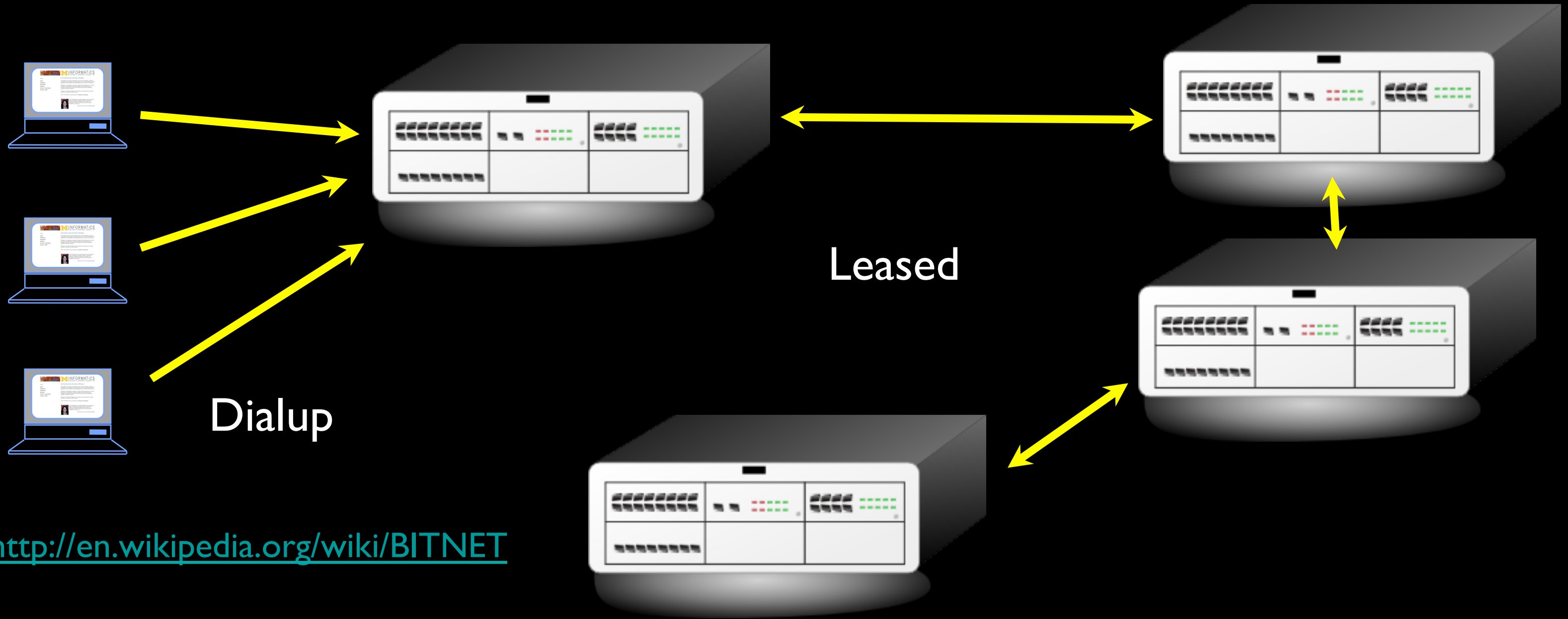
6:00

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

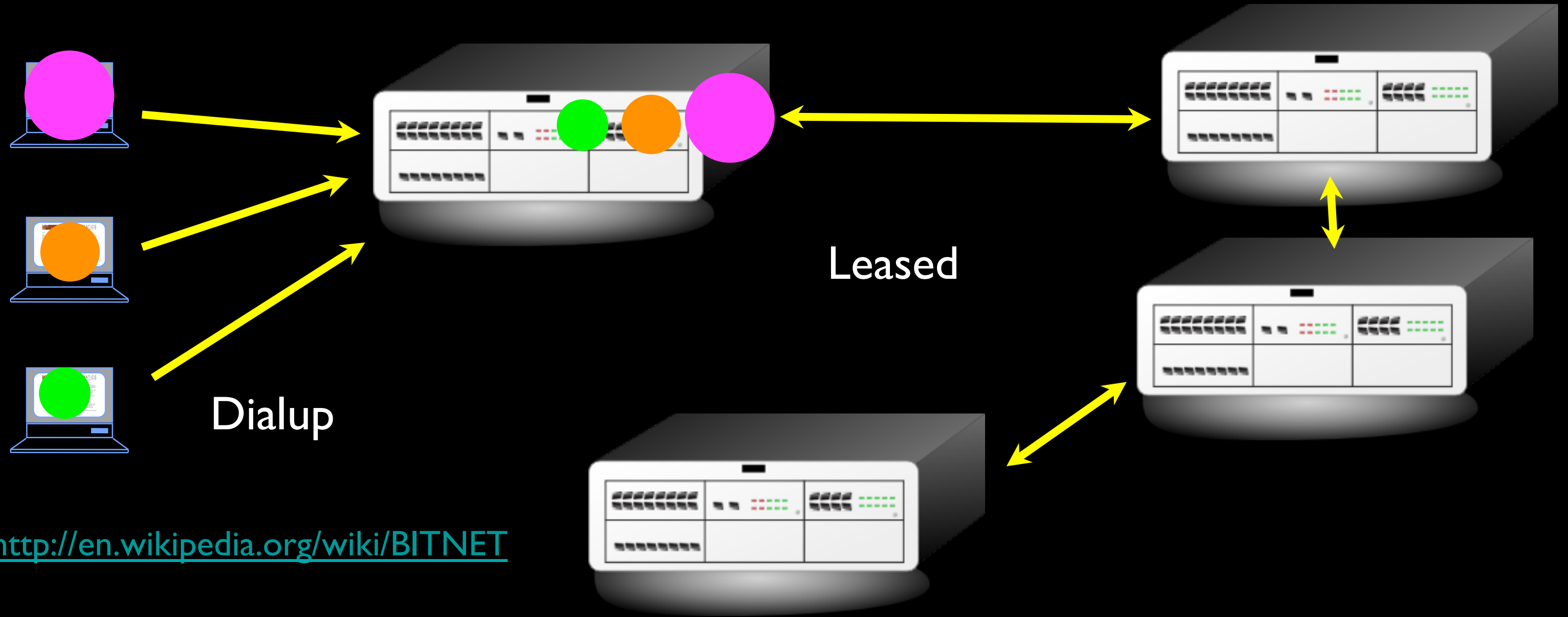
Store and Forward Networking



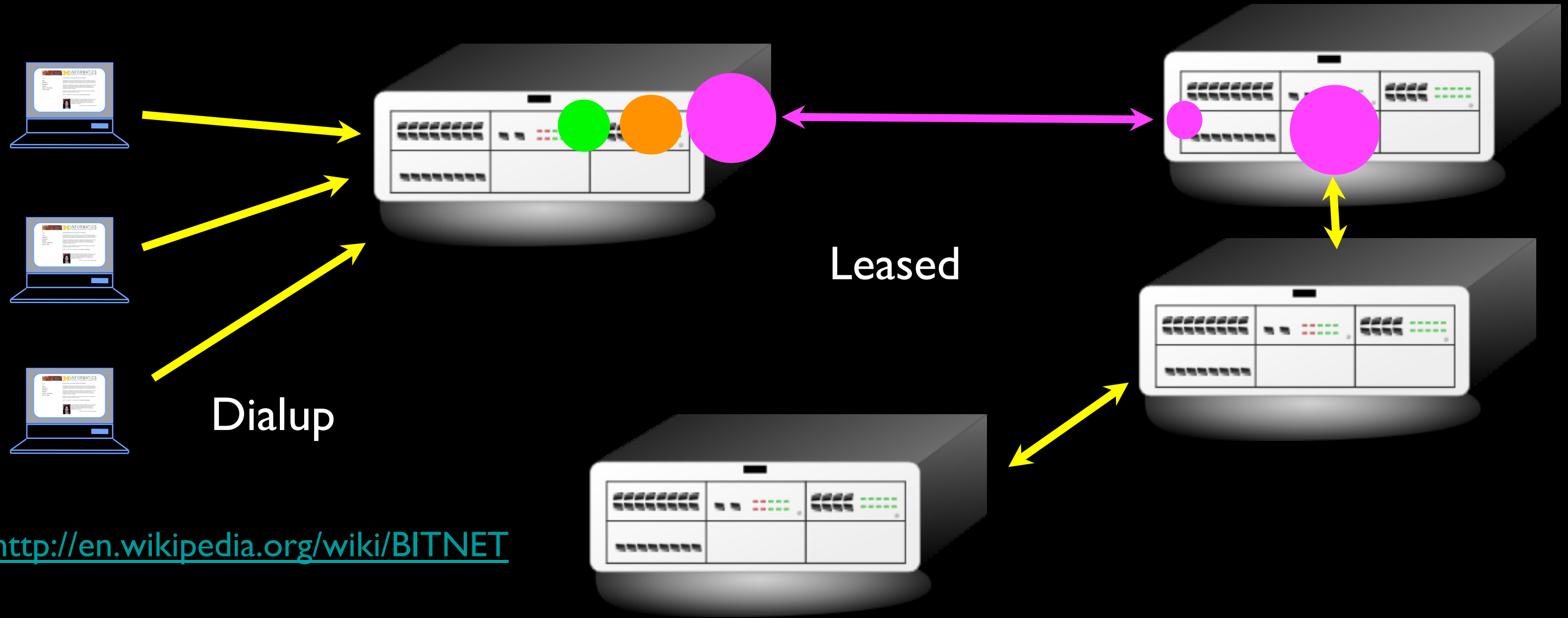
<http://en.wikipedia.org/wiki/BITNET>

Clipart: <http://www.clker.com/search/networksym/>

Store and Forward Networking



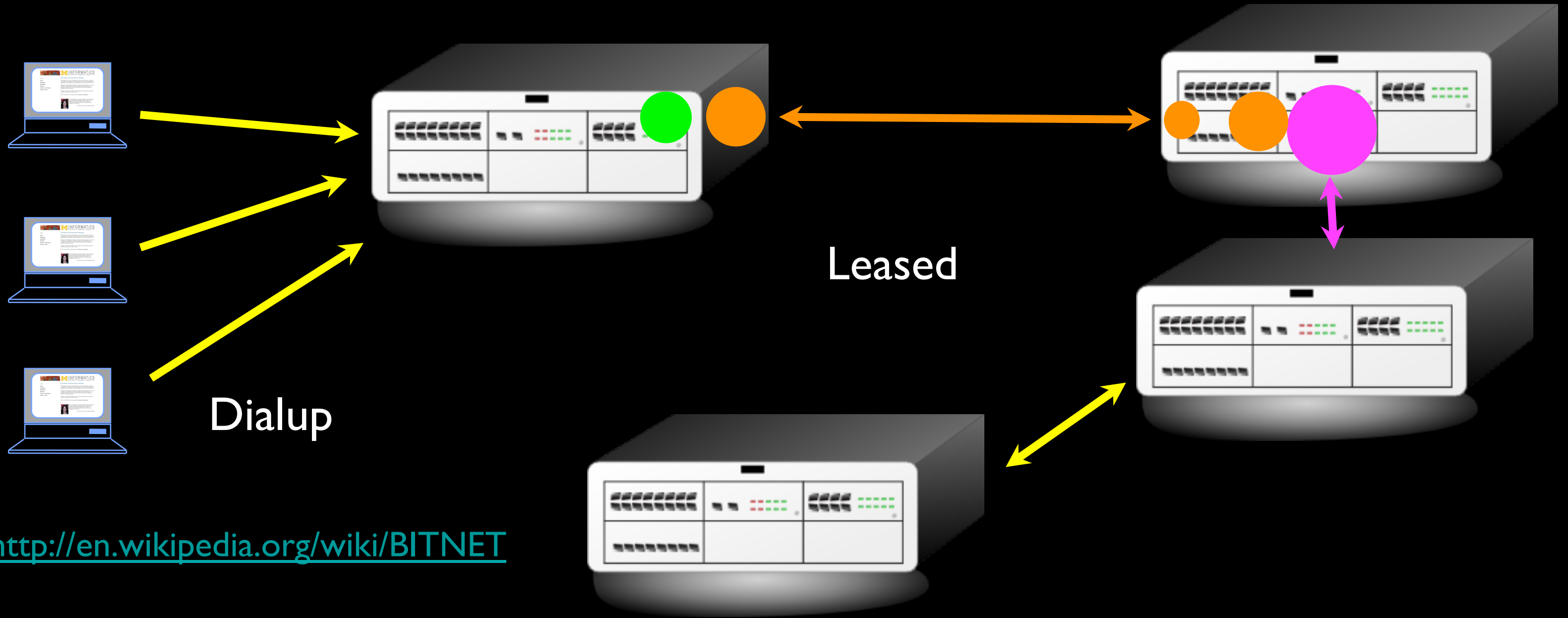
Store and Forward Networking



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

Clipart: <http://www.clker.com/search/networksym/>

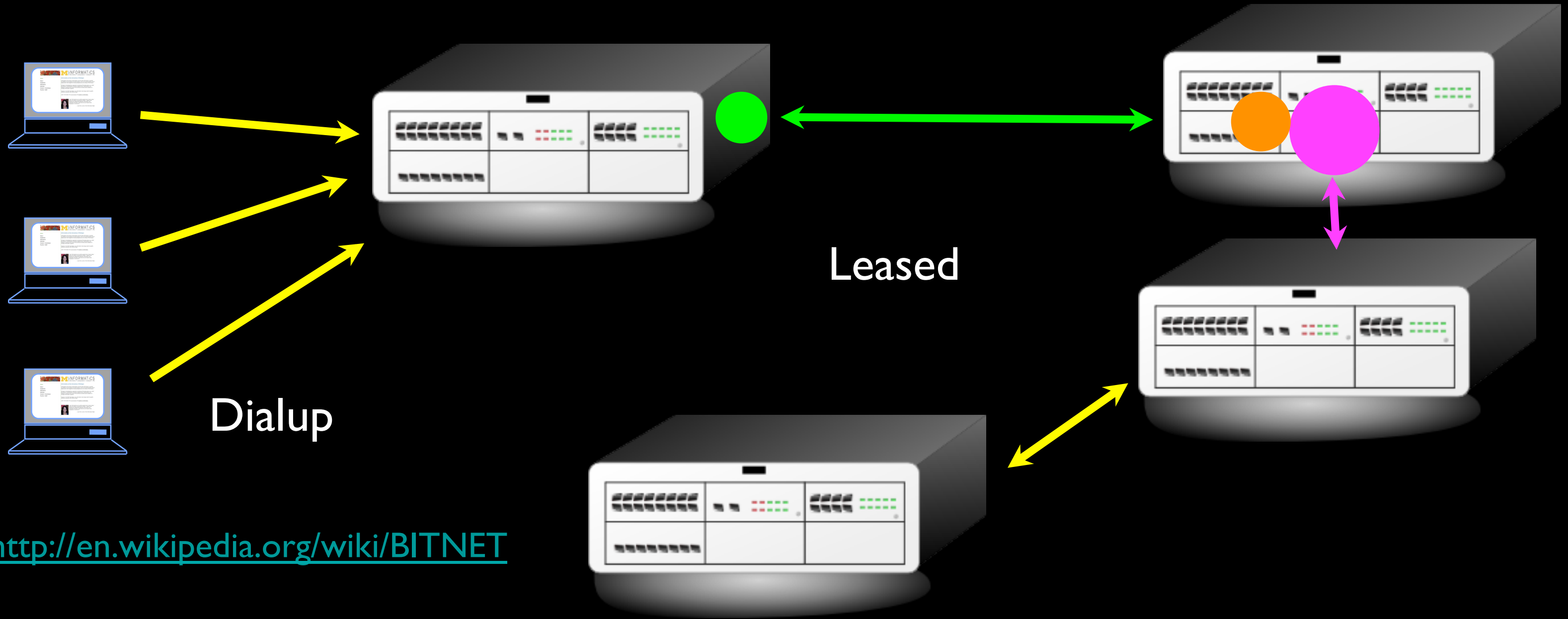
Store and Forward Networking



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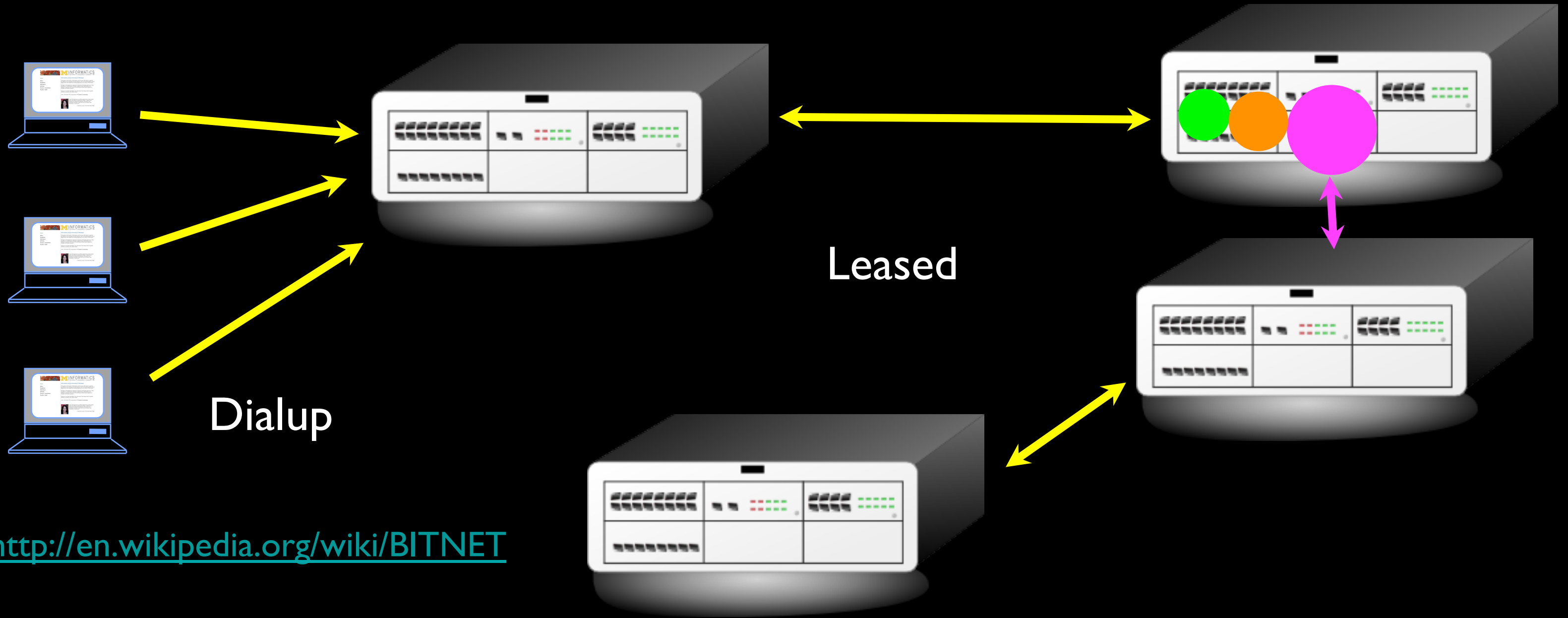
Store and Forward Networking



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

Clipart: <http://www.clker.com/search/networksym/>

Store and Forward Networking

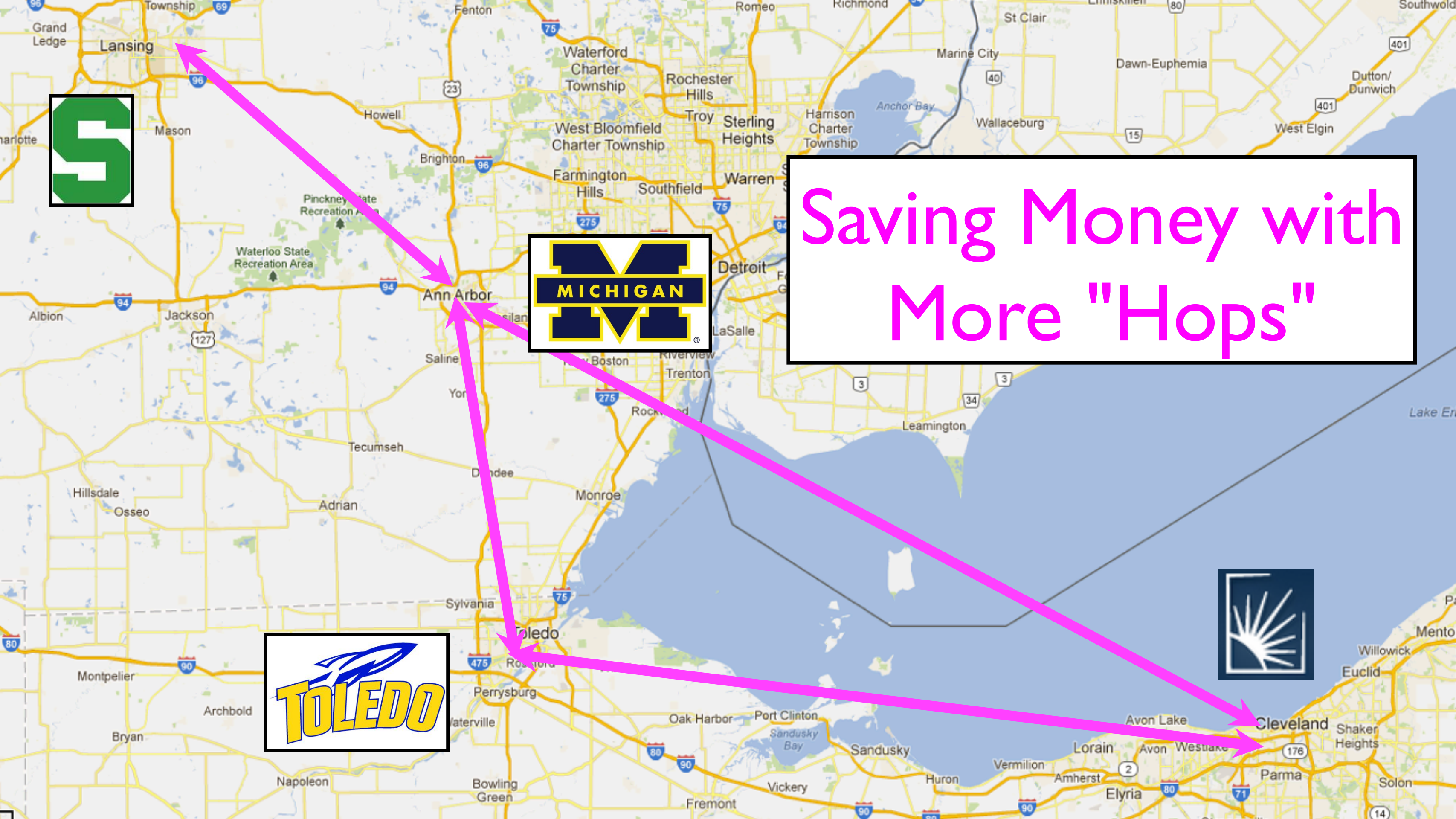


<http://en.wikipedia.org/wiki/BITNET>

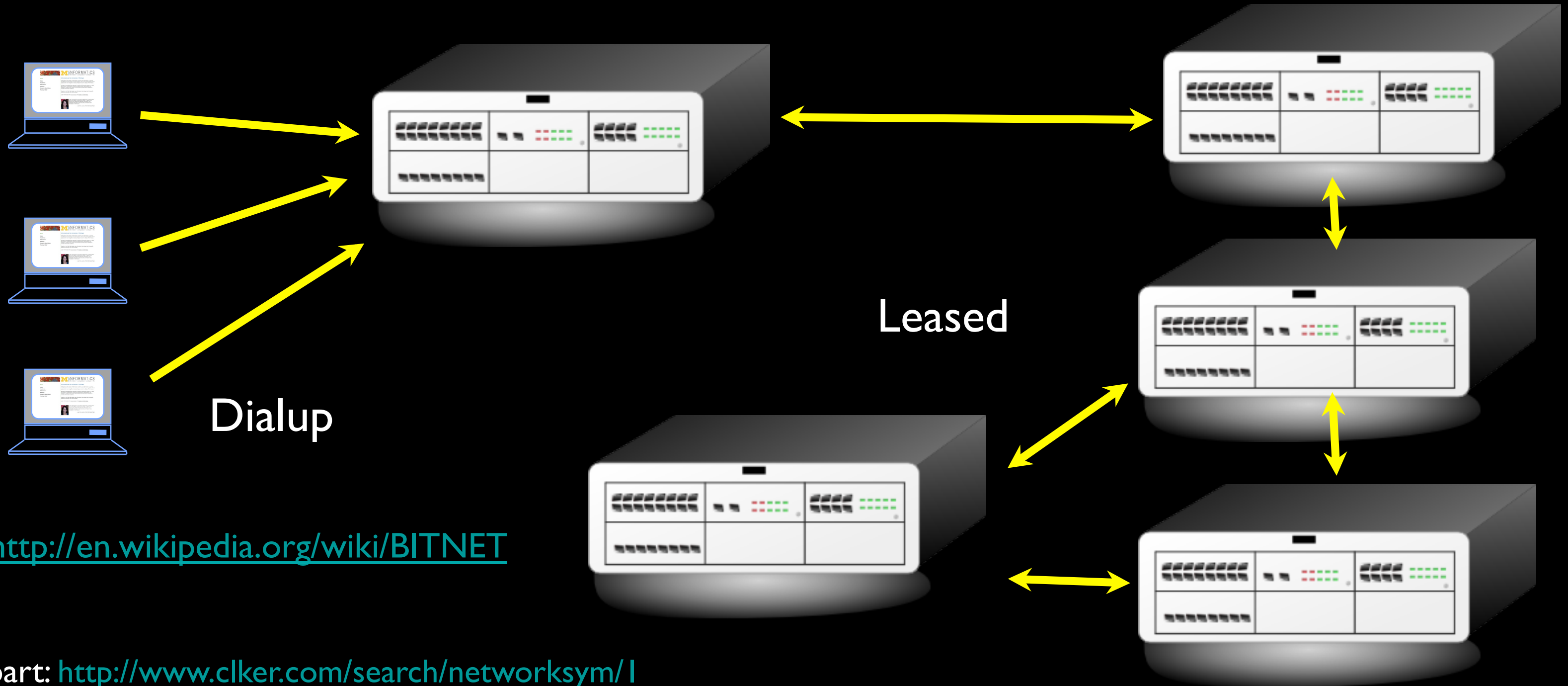
Clipart: <http://www.clker.com/search/networksym/>



Saving Money with
More "Hops"



Saving Money with More "Hops"



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

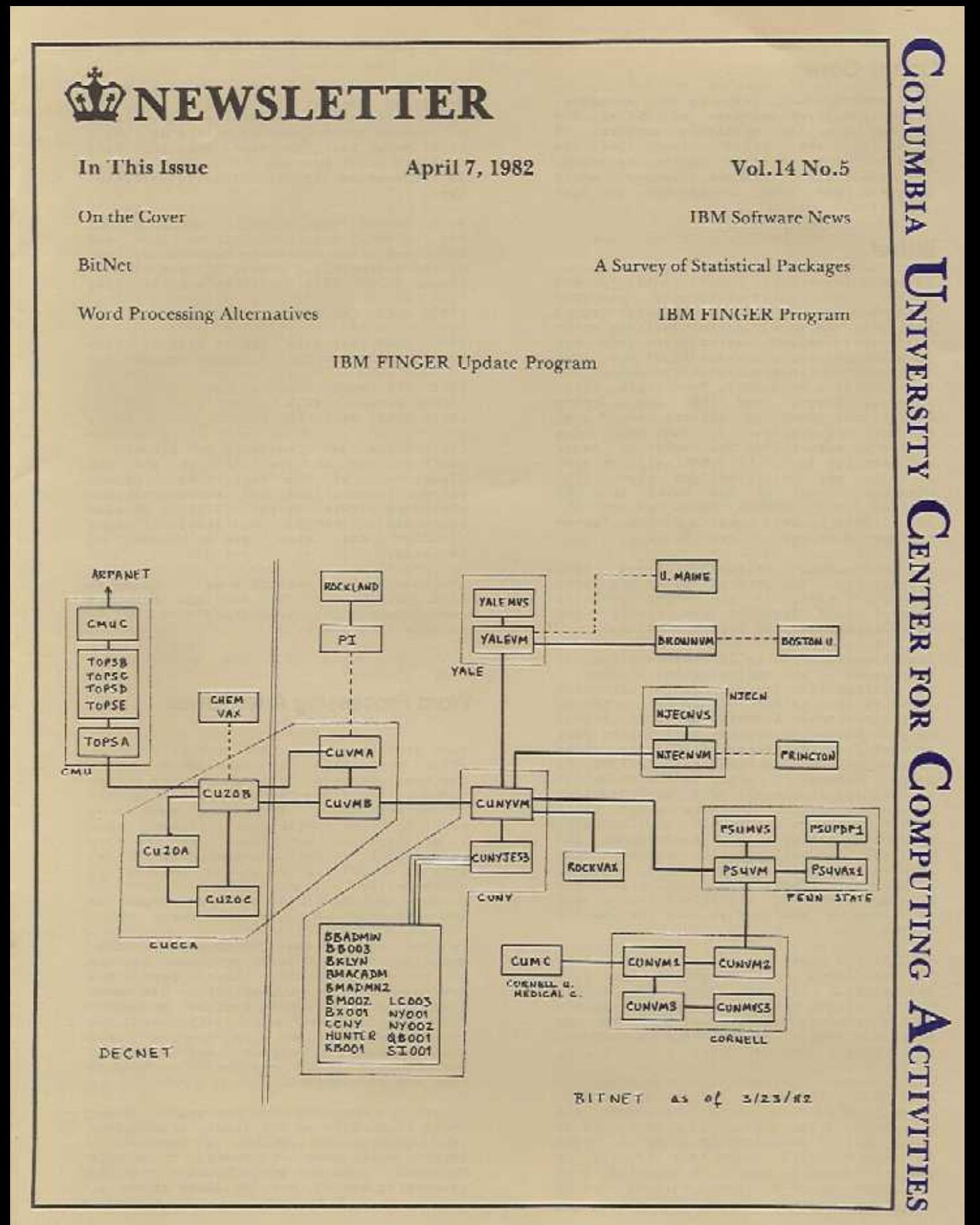


http://en.wikipedia.org/wiki/IBM_3270

BITNET

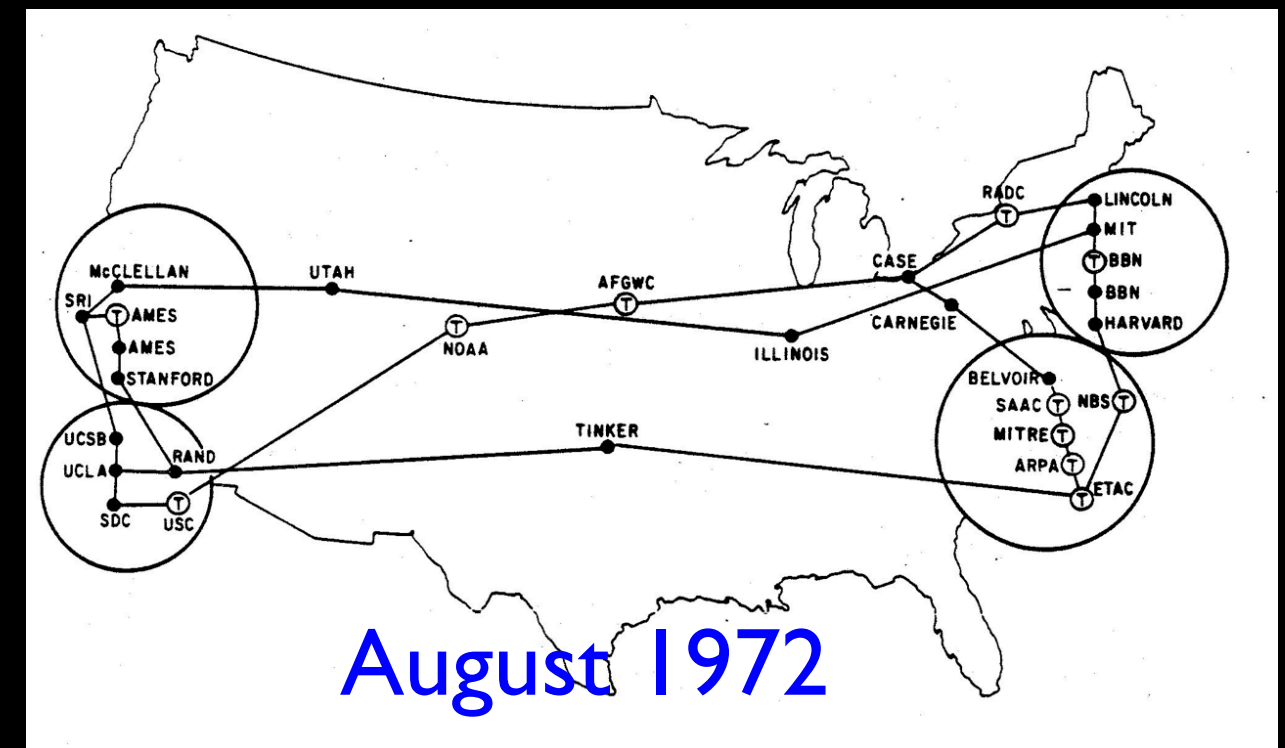
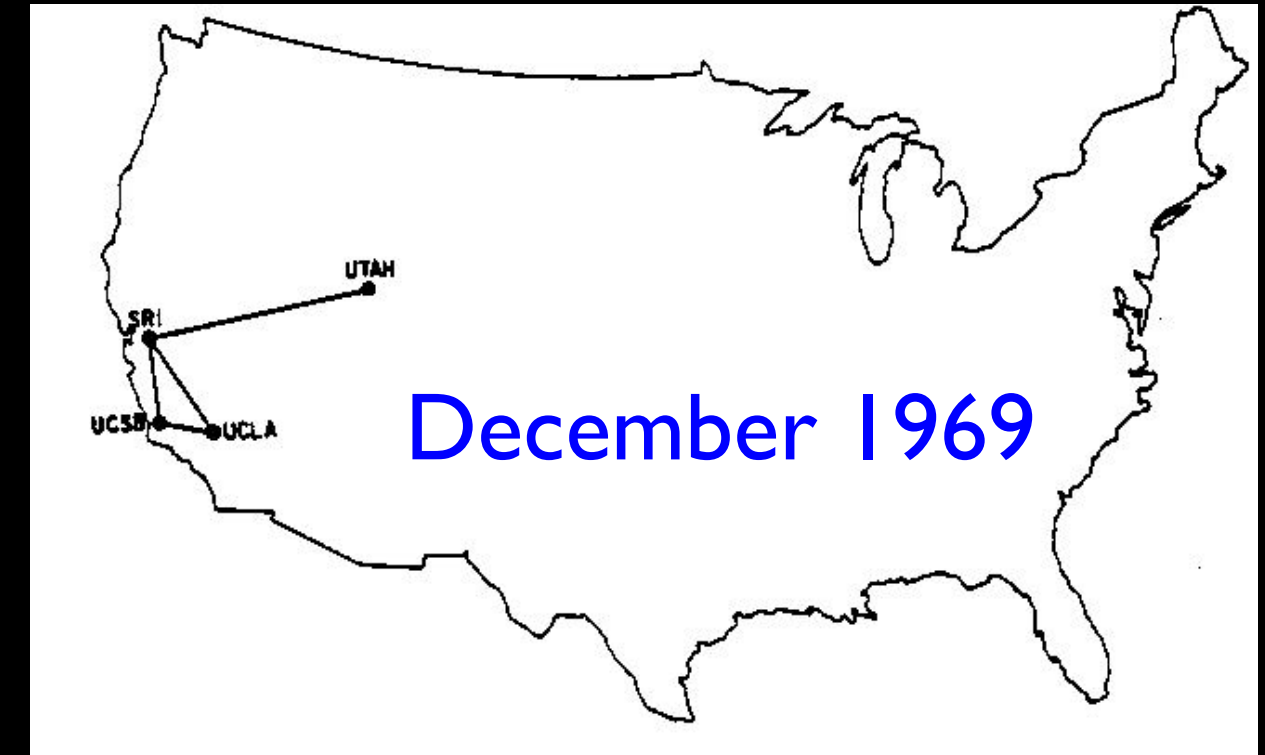
- Typically specialized in Mail
- E-Mail could make it across the country in 6-hours to about 2 days
- You generally focused your life on one computer
- Academic network in the 1980's

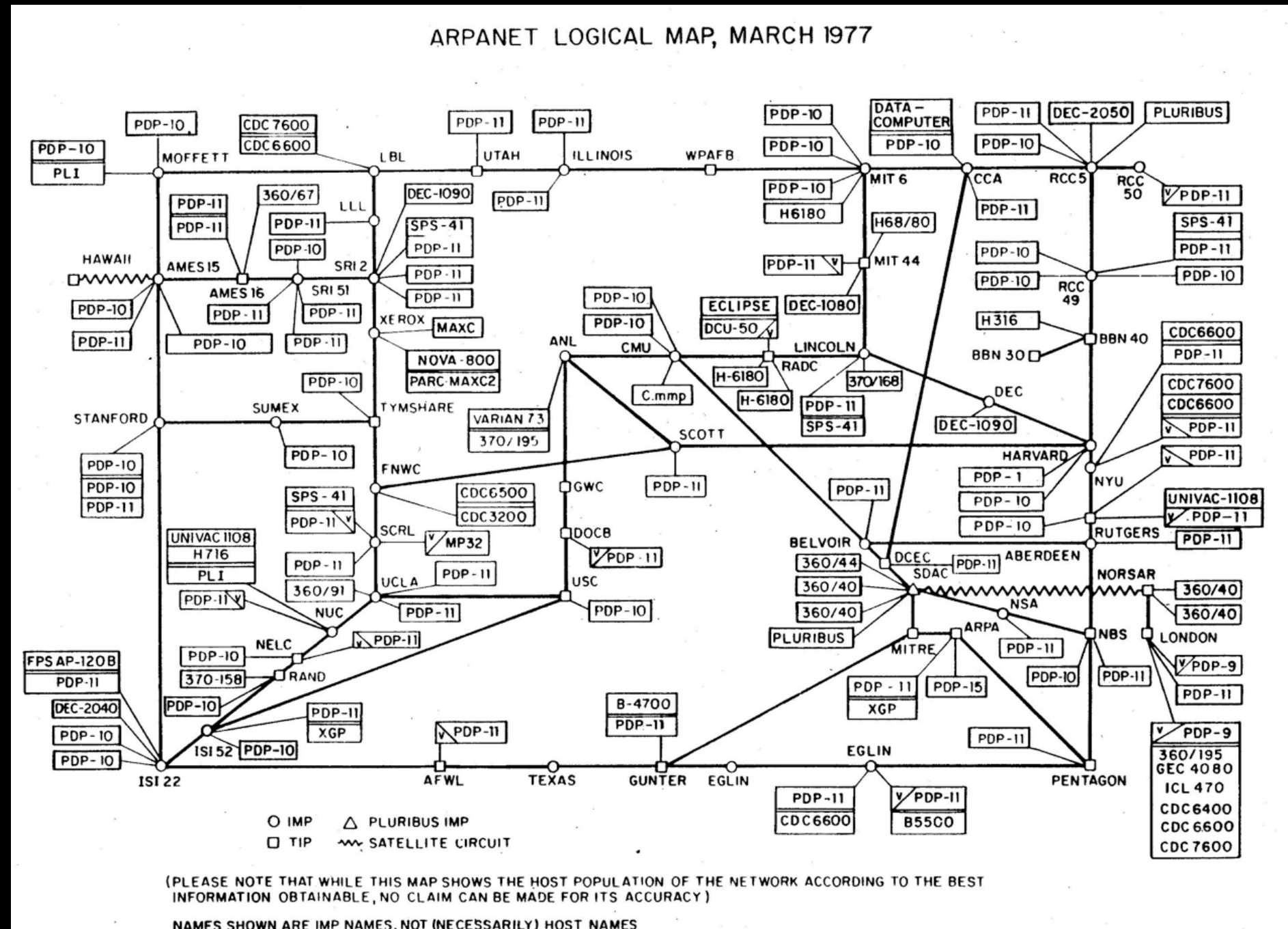
<http://www.columbia.edu/acis/history/bitnet.jpg>



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?





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/arpametmar77.jpg](http://som.csudh.edu/fac/lpress/history/arpamaps/arpametmar77.jpg)

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, glenn)

e, have a (2, csev, glenn)

nice day. (3, csev, glenn)



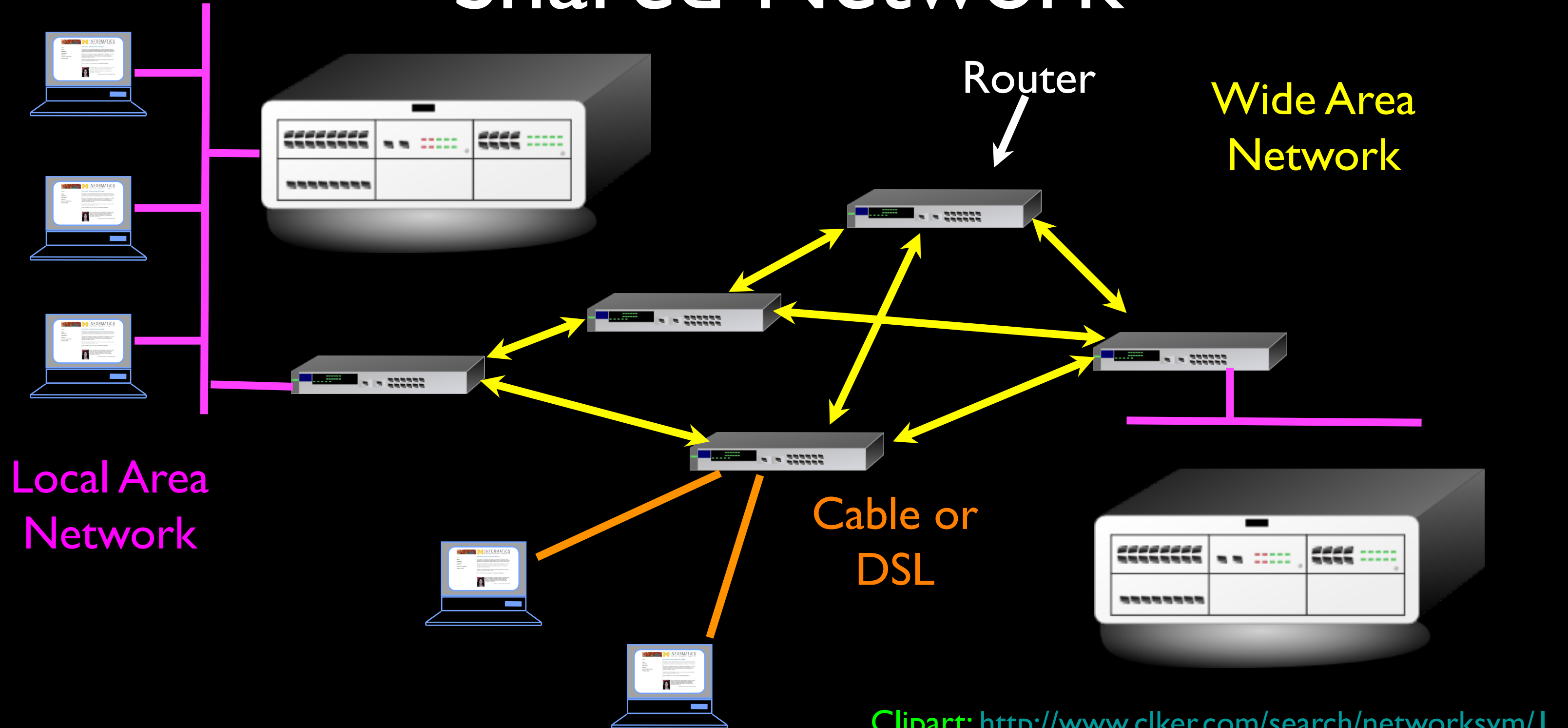
Packet Switching - Postcards



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

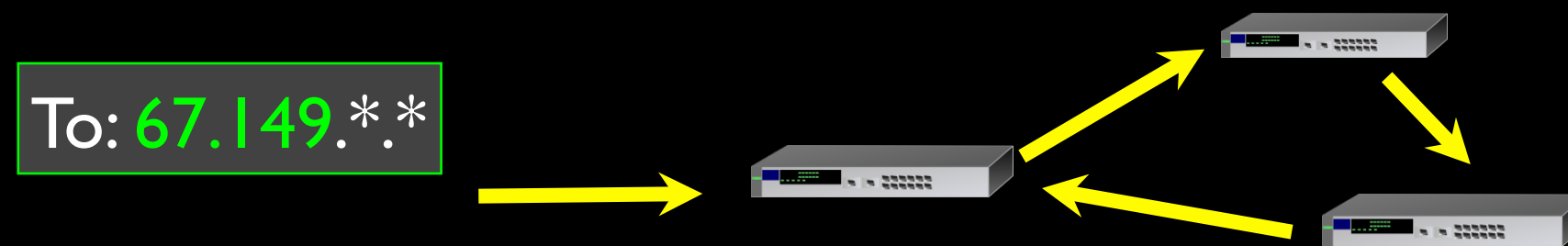
Hello there, have a nice day.

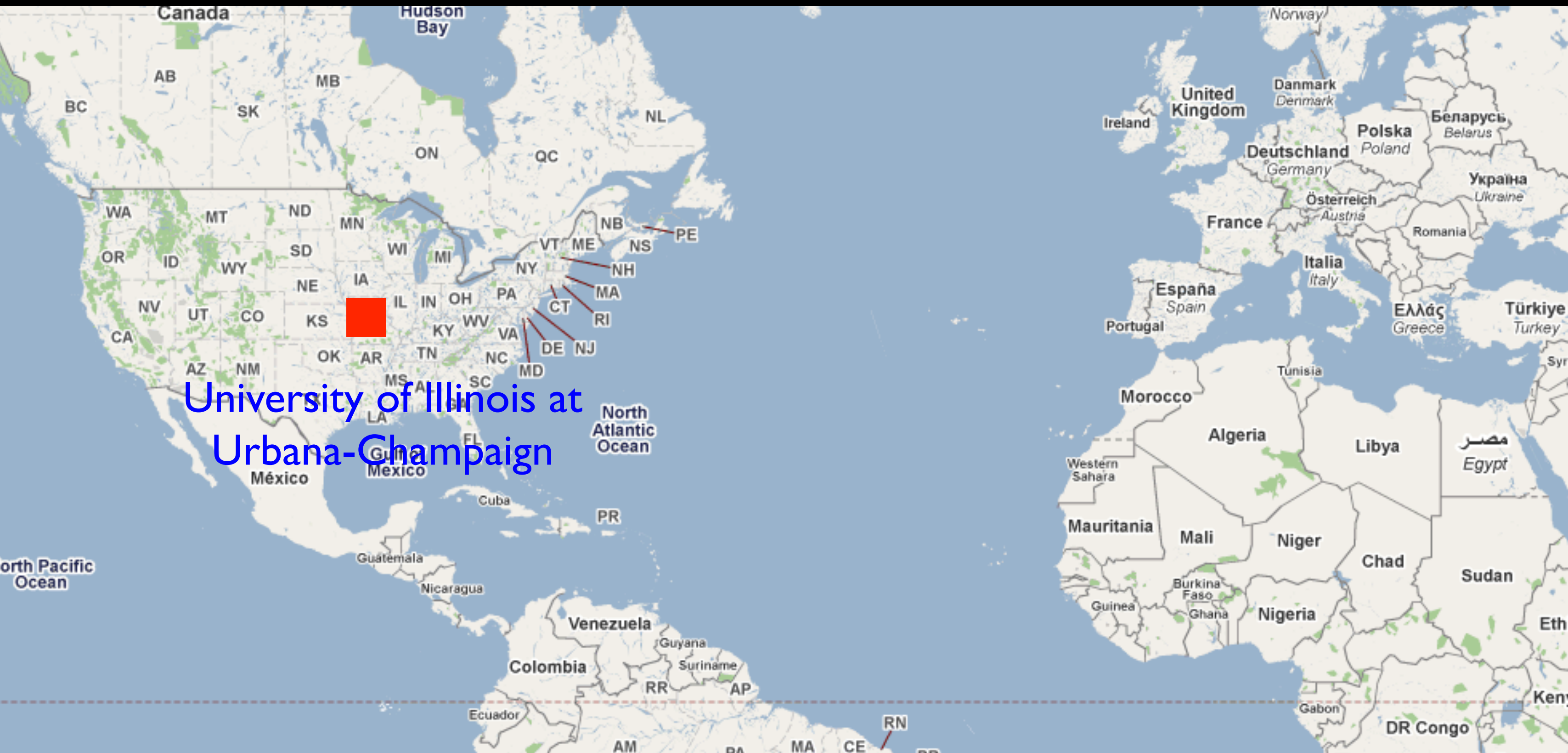
Shared Network



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"?





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?”



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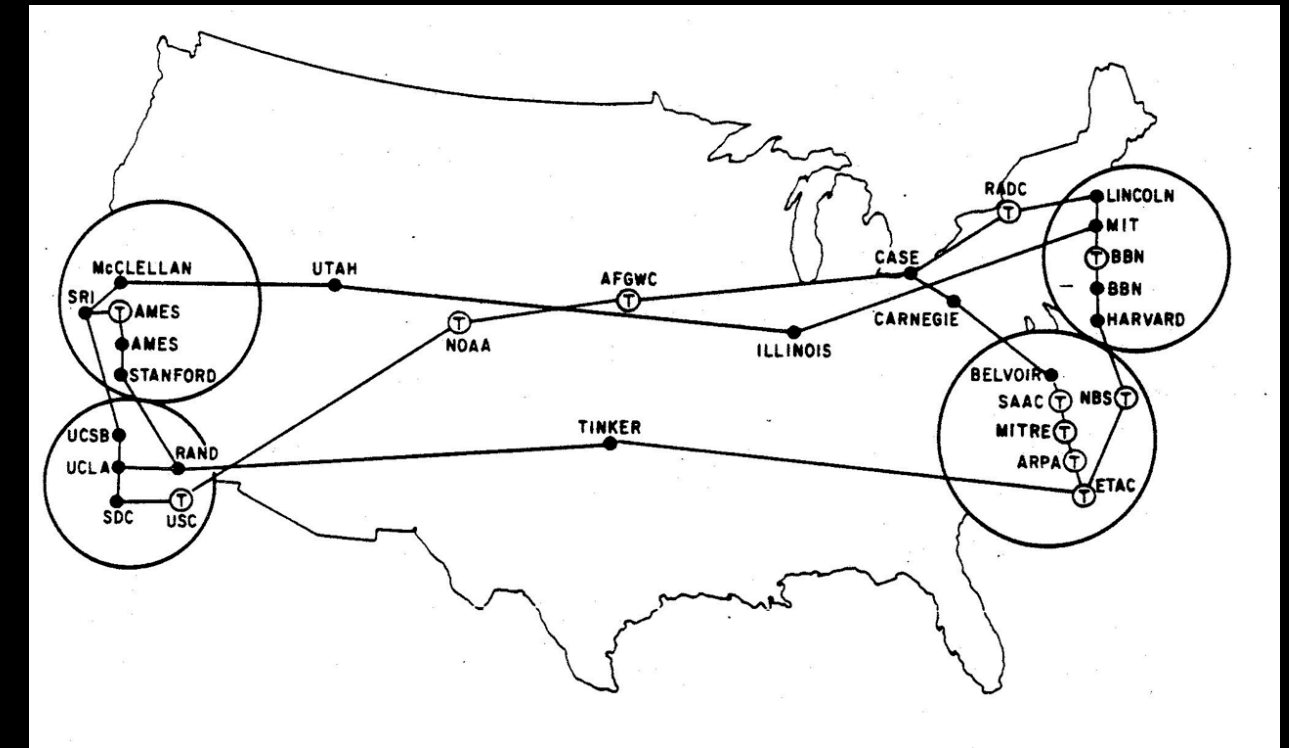
NCSA - Innovation

- 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

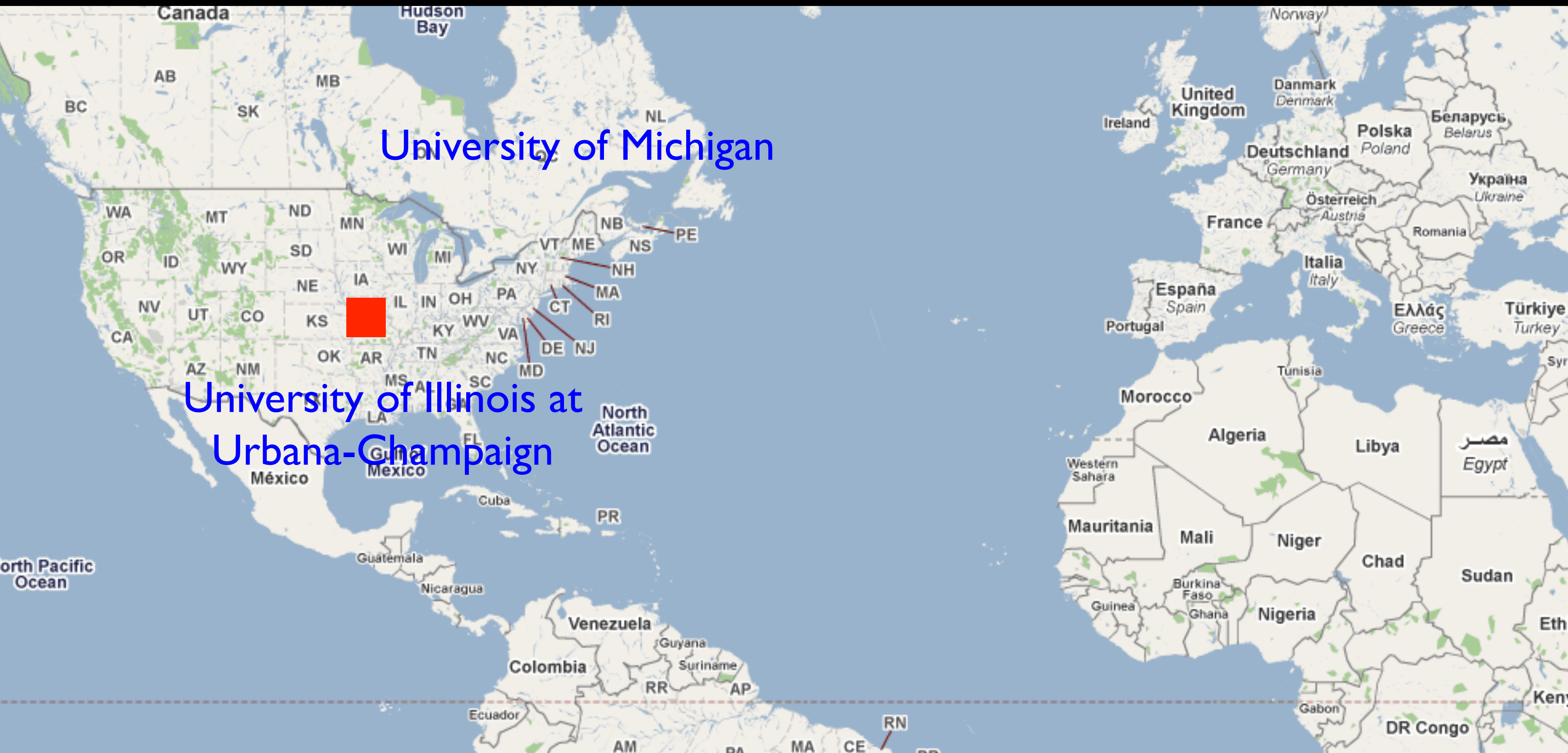


NSF Net

- 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



ARPANET August 1972



University of Michigan

University of Illinois at
Urbana-Champaign

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]

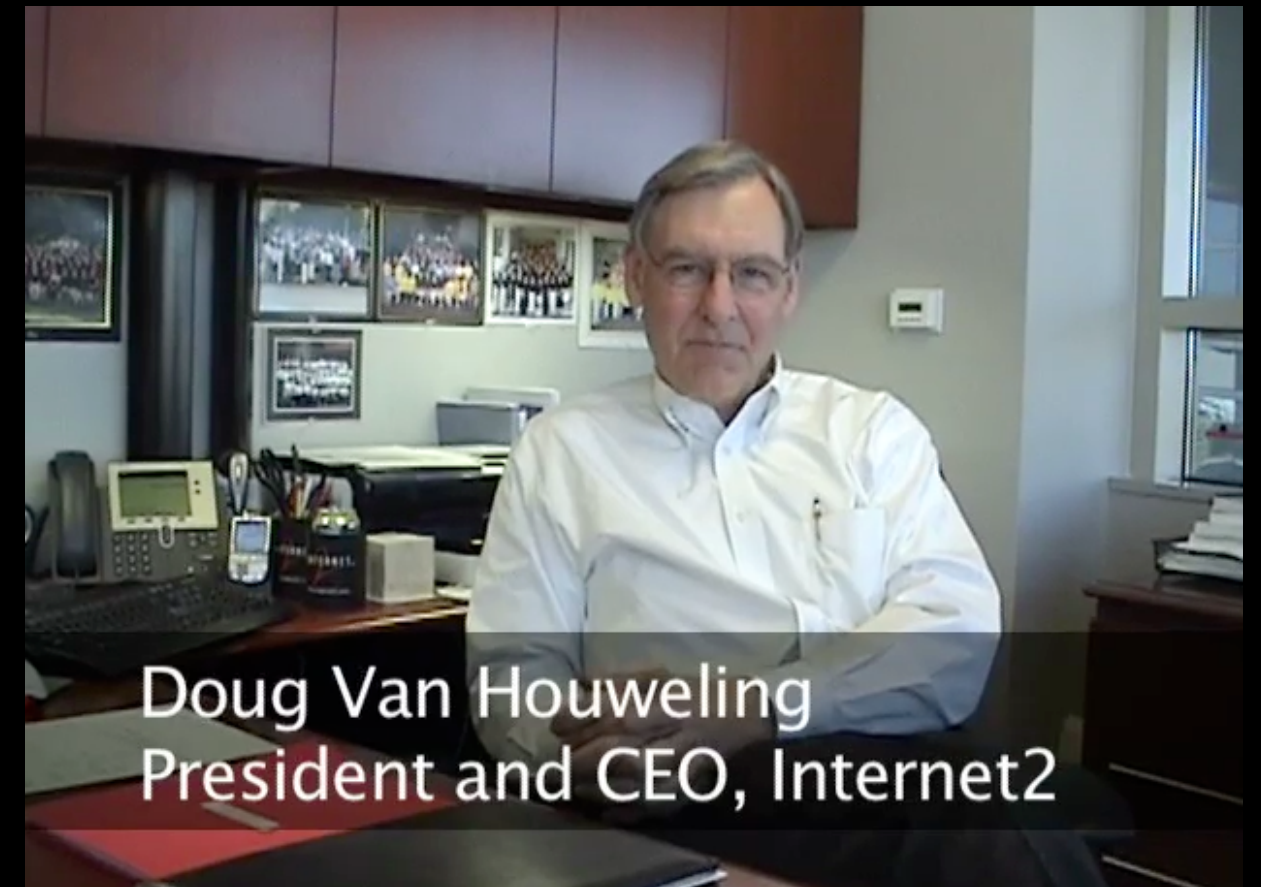
[1] <http://www.zakon.org/robert/internet/timeline/>



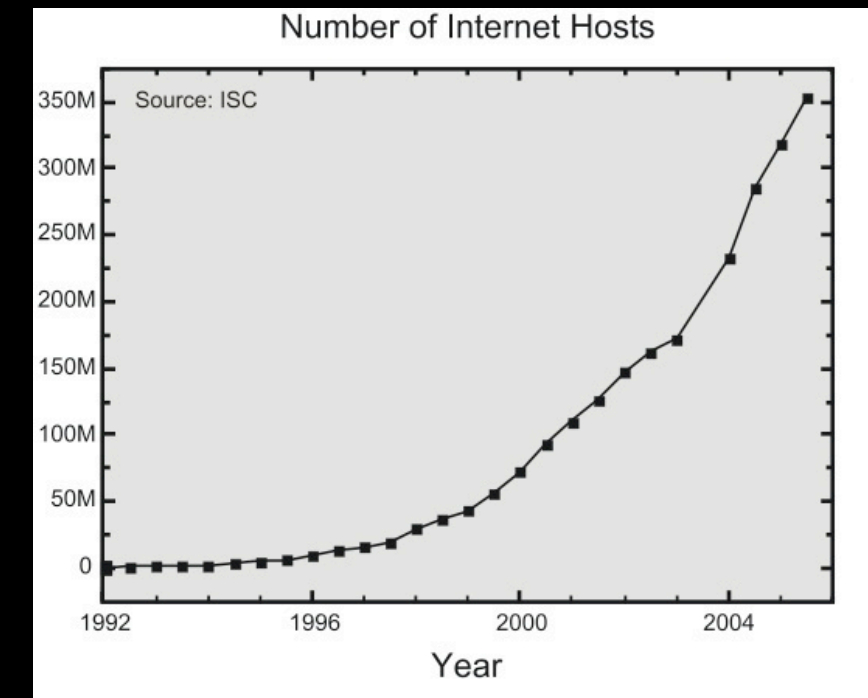
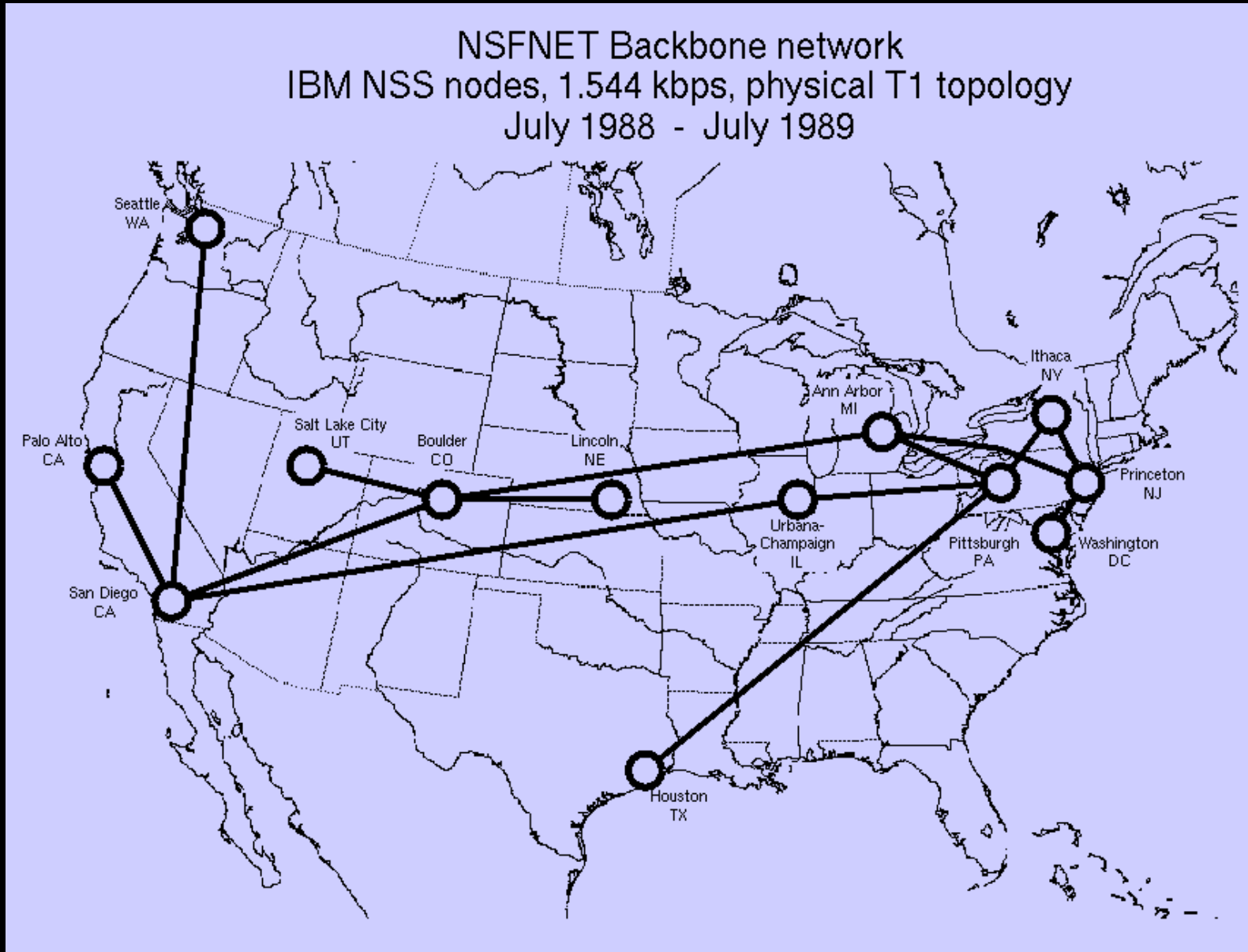
Merit PDP-11 based Primary Communications Processor (PCP) at the University of Michigan, c. 1975

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>



Source: <http://hpwren.ucsd.edu/~hwb/NSFNET/NSFNET-2007II Summary/>

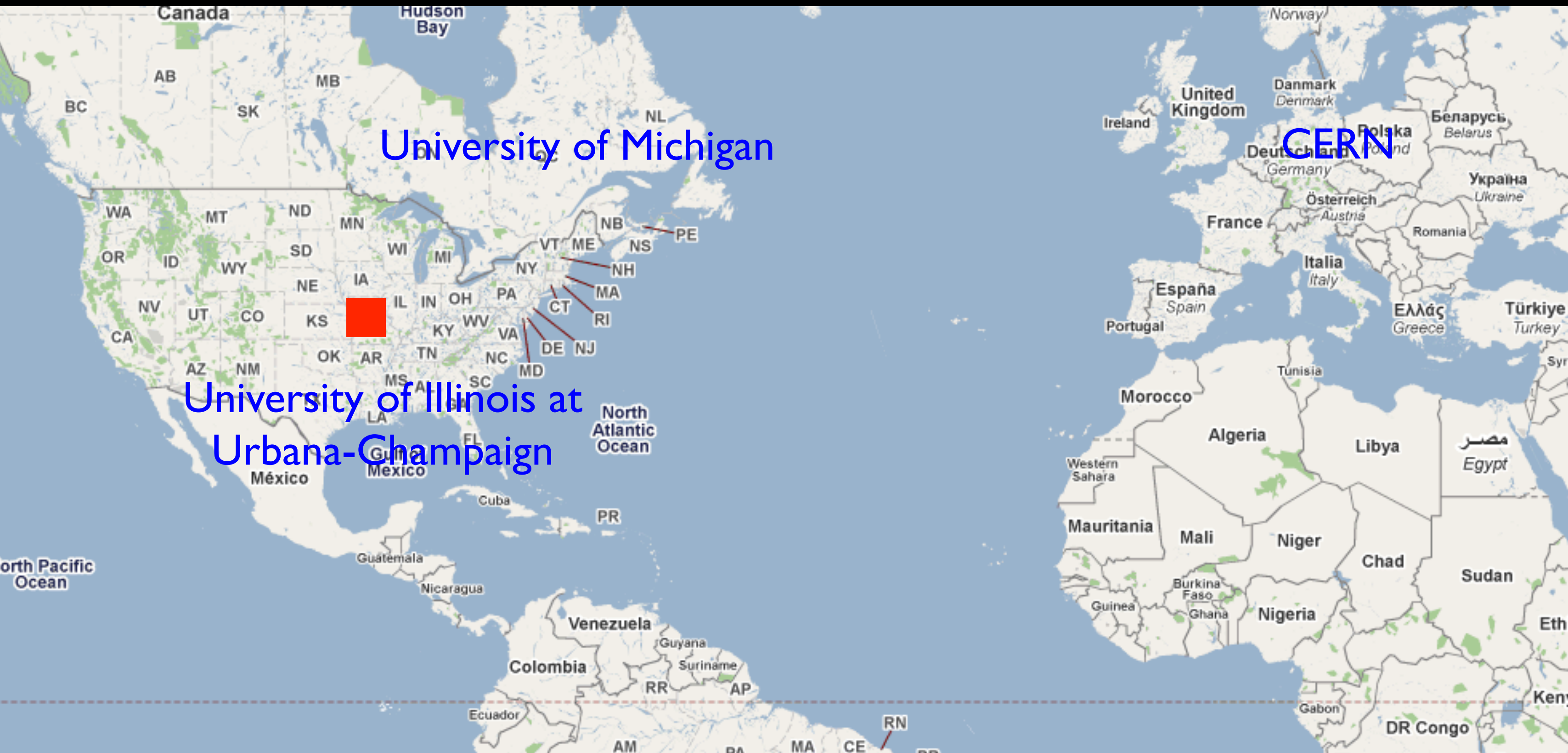
NSFNET I
Backbone and
Regional
Networks, 1991



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



University of Michigan

University of Illinois at
Urbana-Champaign

CERN

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://musicclub.web.cern.ch/MusiClub/bands/cernettes/>

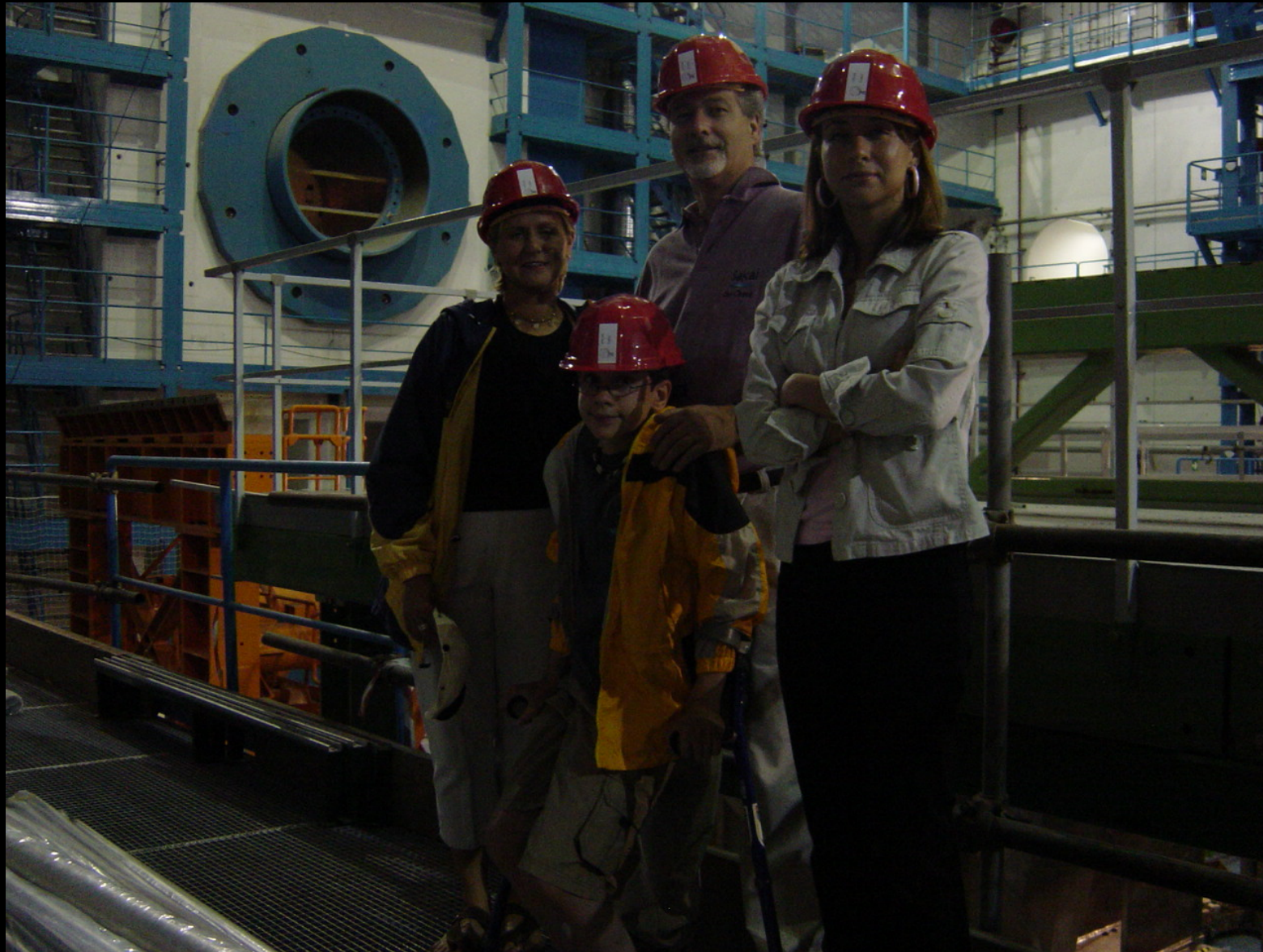
<http://www.youtube.com/watch?v=AIL2xODZSI4>

"...You Prefer your Collider"





Visits to CERN!



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



**Got My Mojo Working
Canettes Blues Band
with Dr. Chuck
Mr. Pickwick Pub**



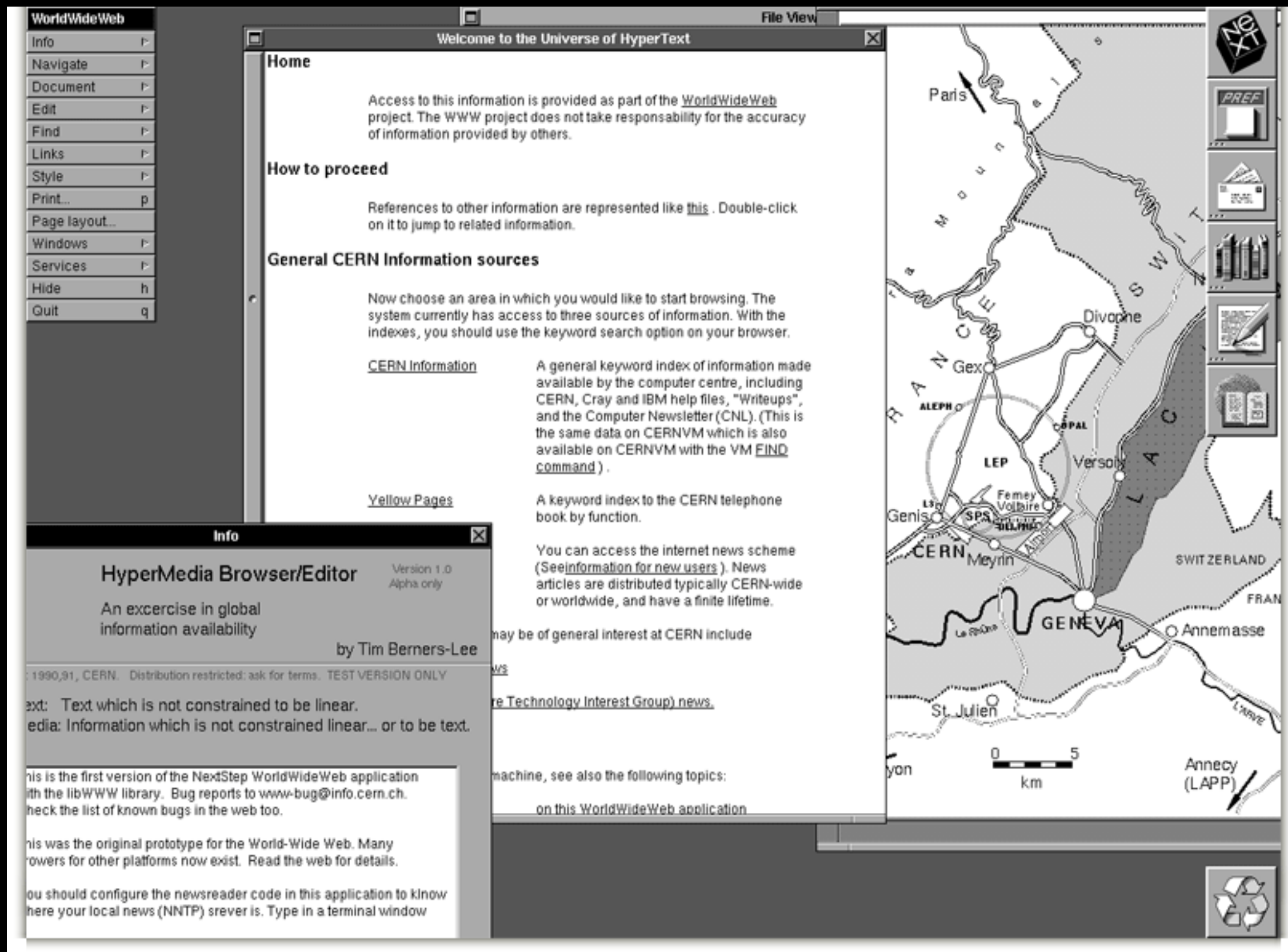
The Beginning of the Web: CERN

- 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

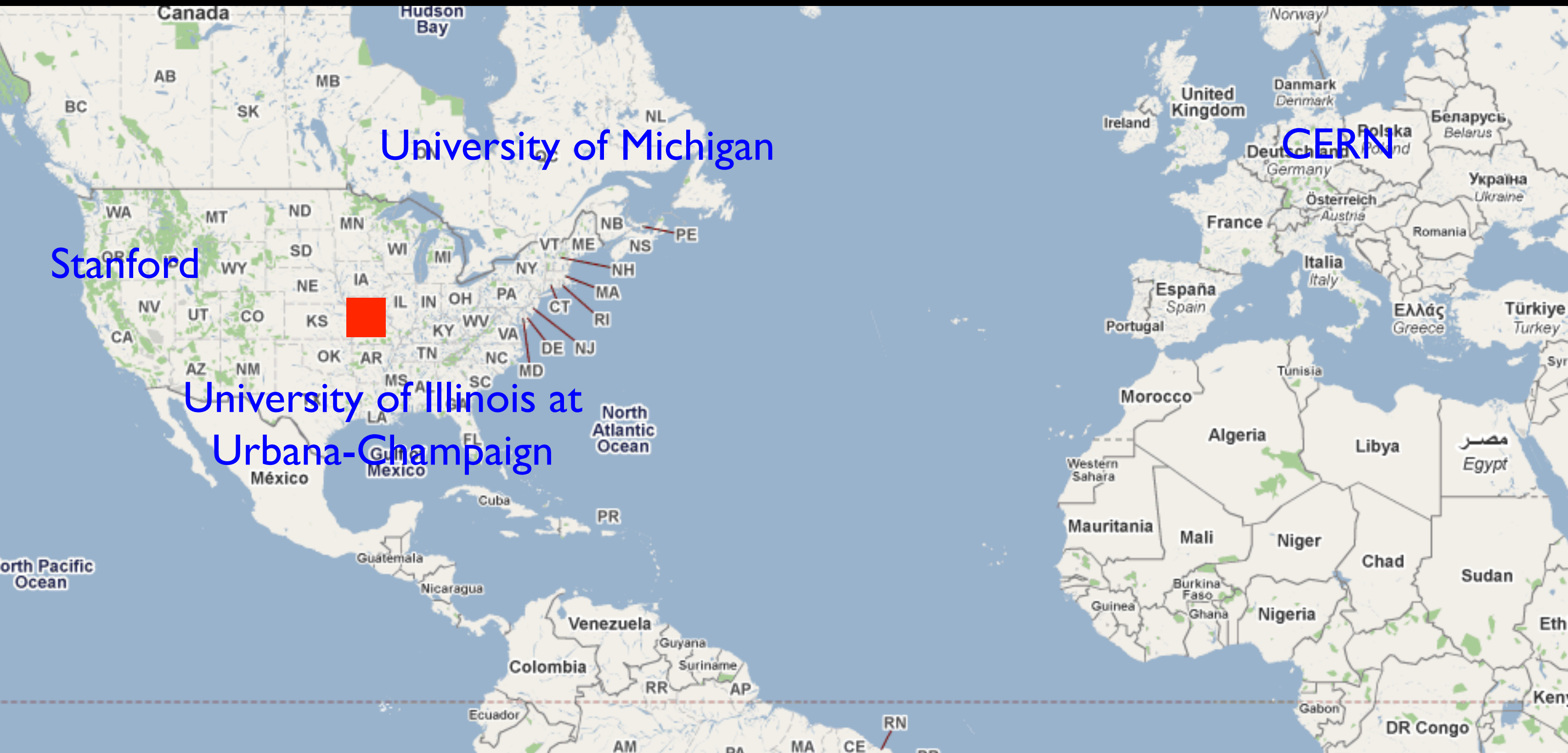


<http://www.youtube.com/watch?v=x2GylLq59rl>

(9:42)



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



University of Michigan

Stanford

University of Illinois at
Urbana-Champaign

CERN

The First Web Server in America

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

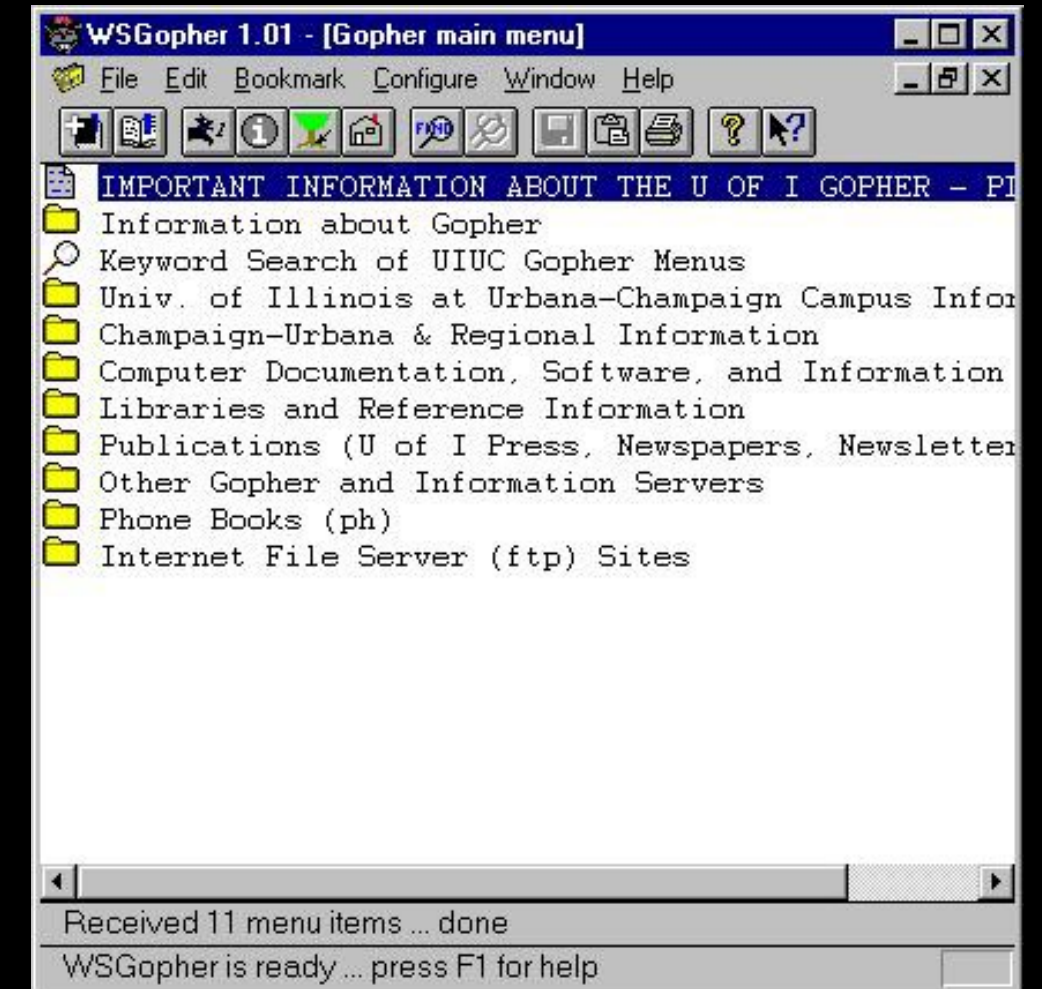


<http://www.youtube.com/watch?v=IOgqP2yoKwc>

(5:30)

1993: Gopher is Dominant

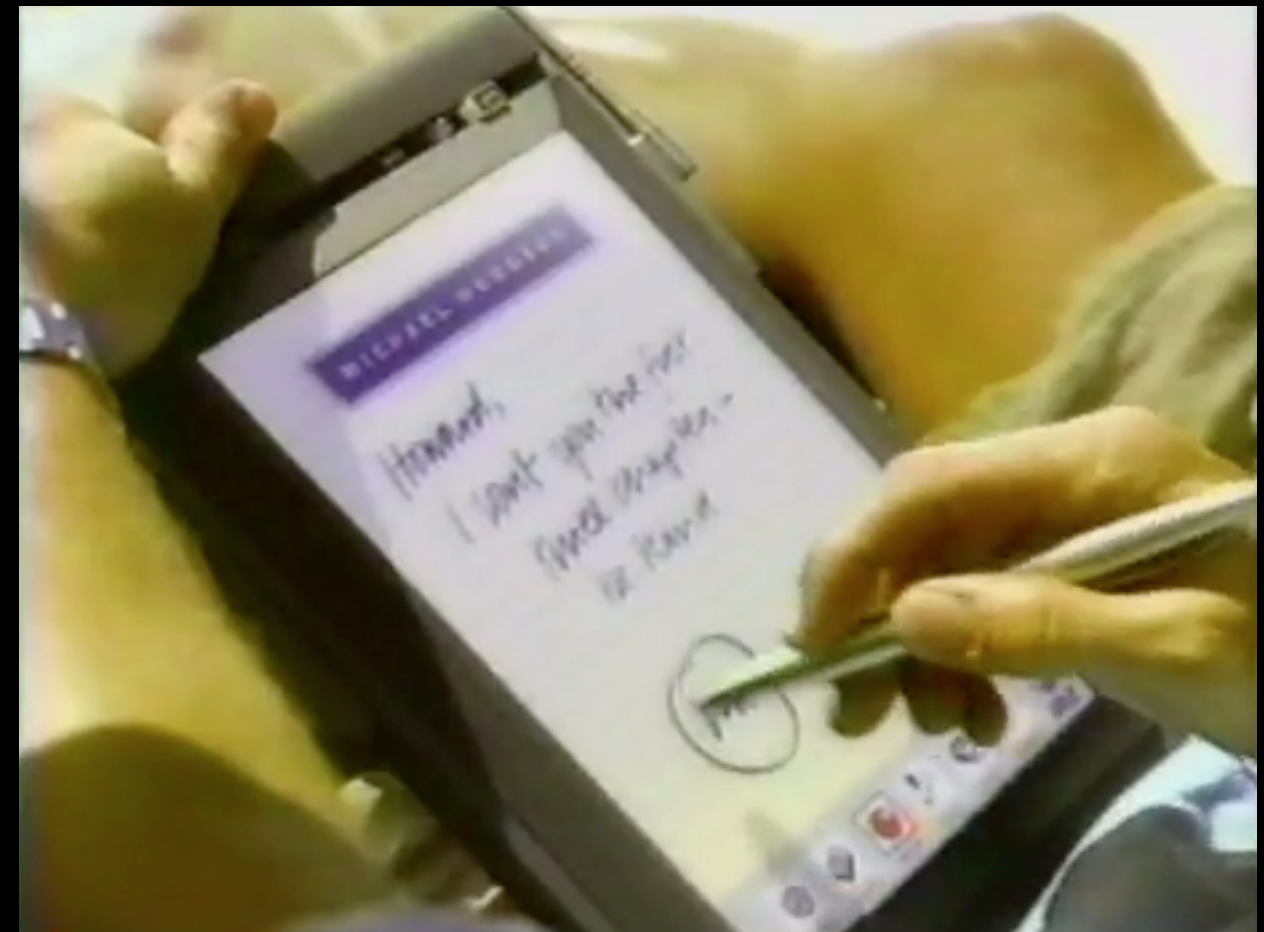
- Internet Engineering Task Force (IETF) Meeting
 - March 29-April 2, 1993 - Columbus, Ohio, USA (638 attendees)
 - Gopher BOF - 200 attendees
 - World-Wide Web BOF - 15 attendees including Tim Berners-Lee
- P.S. DVD is invented this year



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

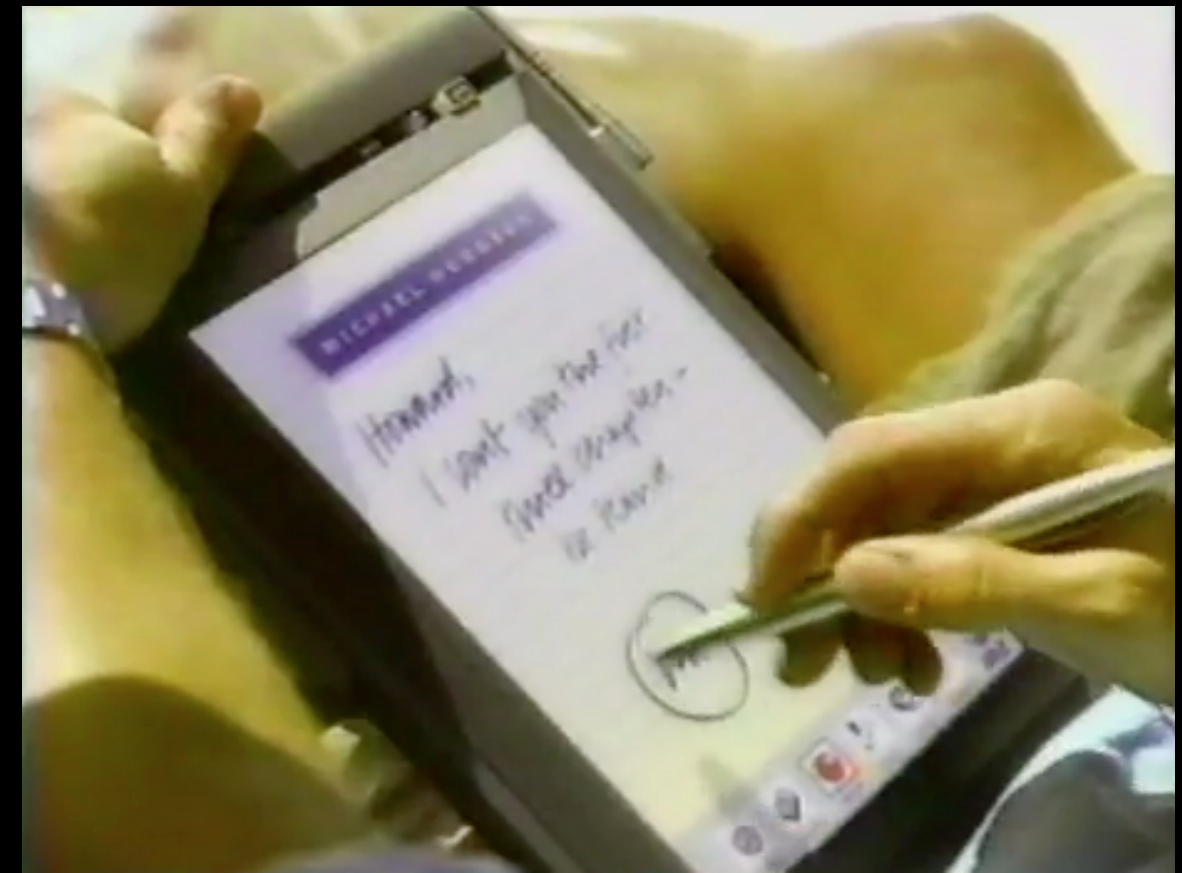


What industry was
thinking in 1993...



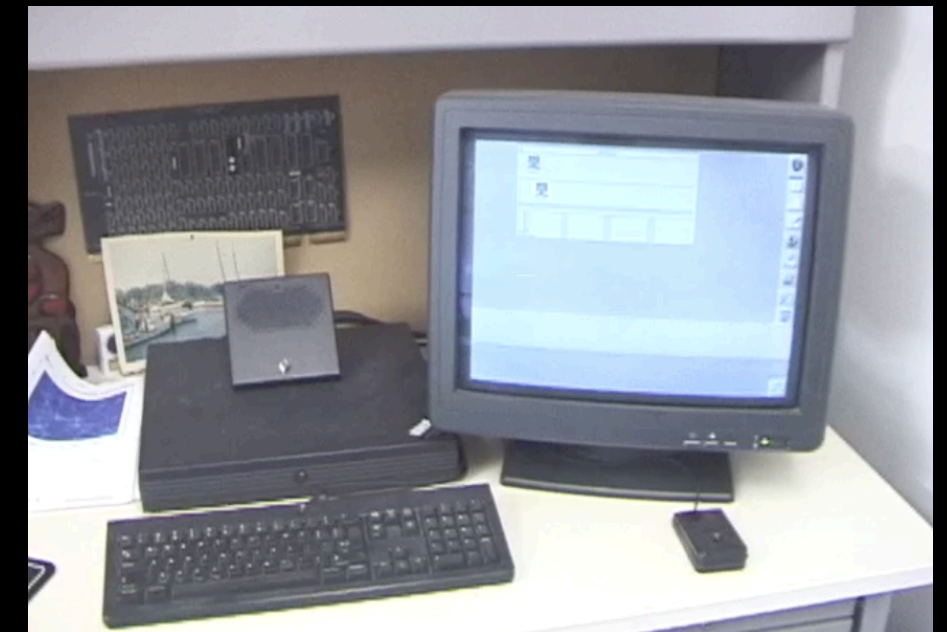
<http://www.youtube.com/watch?v=sYNUcFMClzw>

0:30



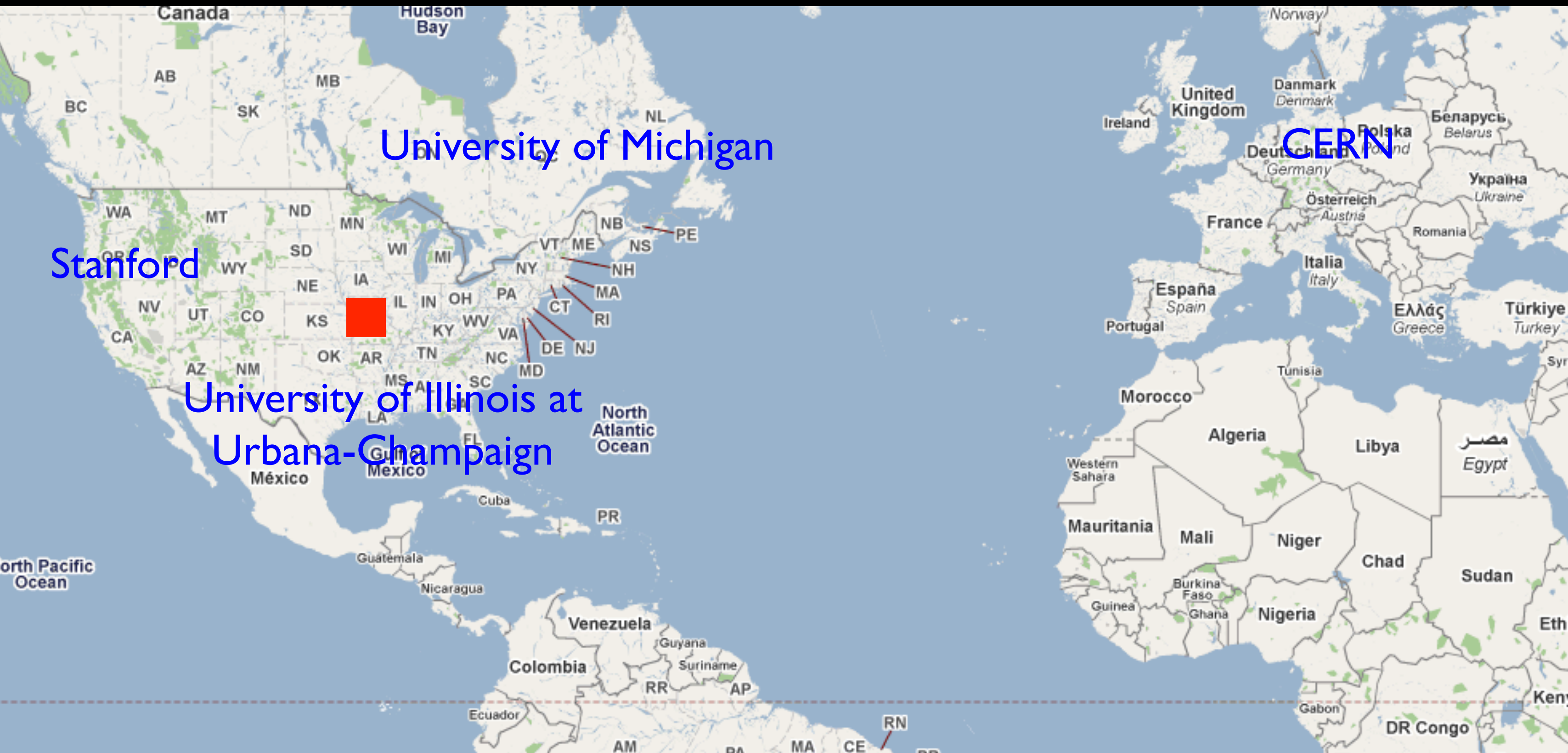
Steve Jobs and the World-Wide-Web?

- 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>





University of Michigan

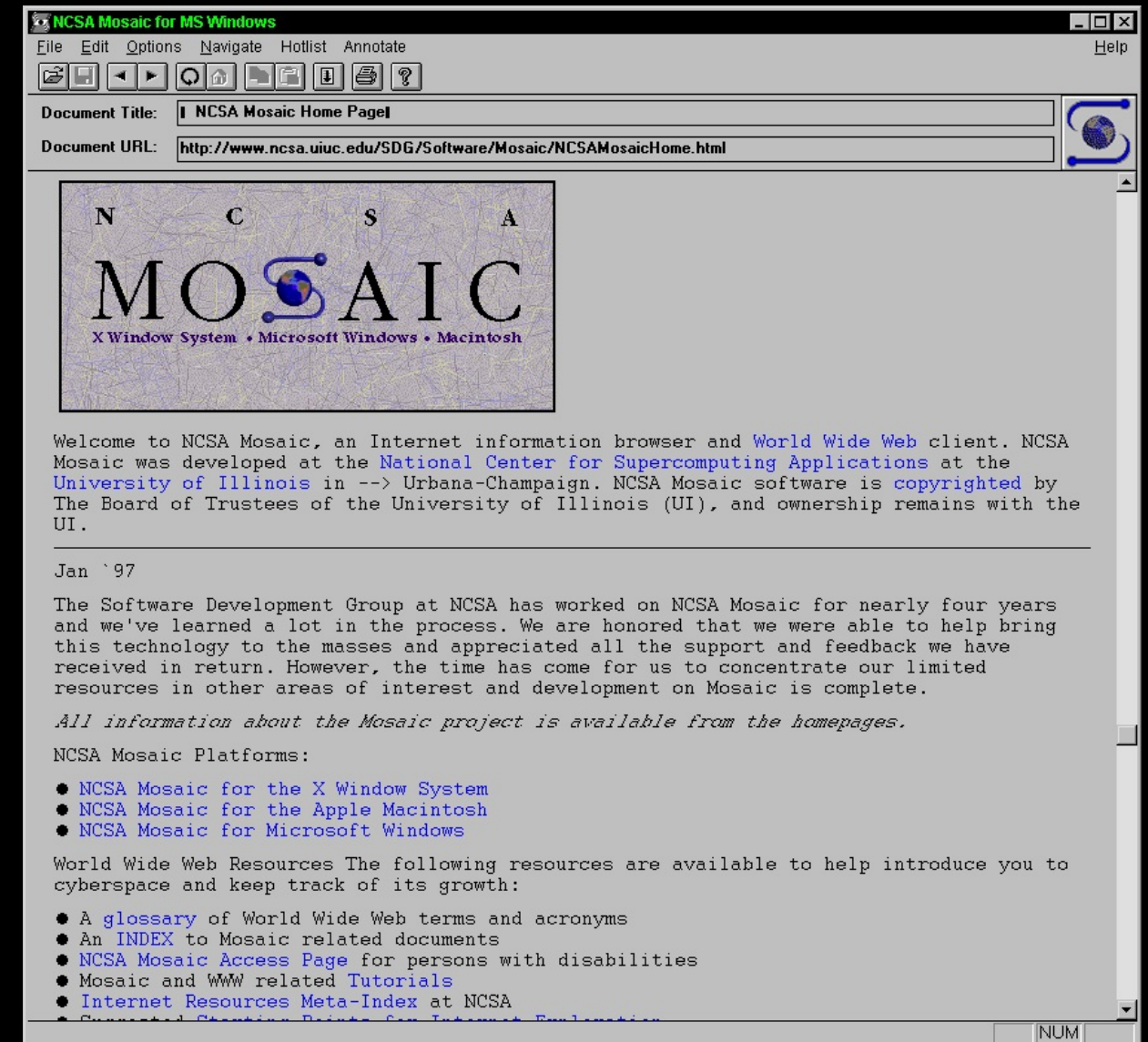
Stanford

University of Illinois at
Urbana-Champaign

CERN

The Explosive Growth of the Web

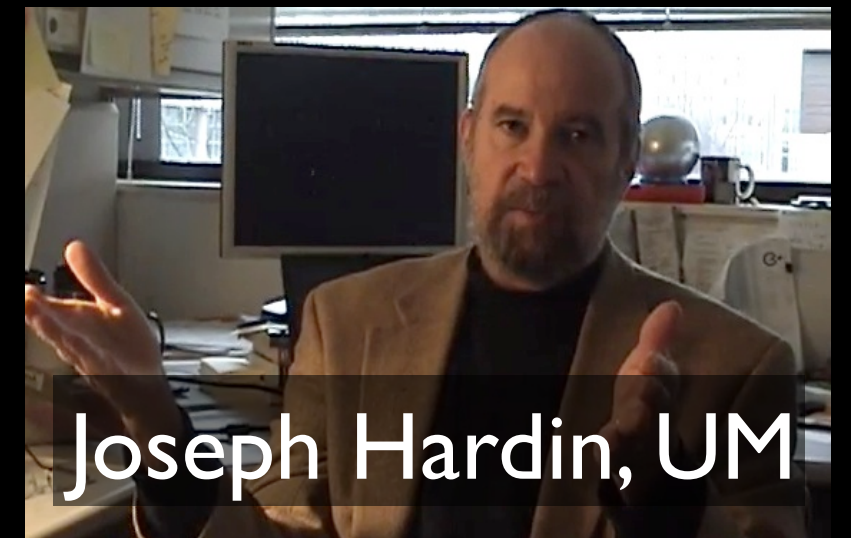
- The web was invented in the early 1990's
- Growing in Academia 1993
- Growing everywhere 1994 - 1995
- Cable Modems to the home started in the mid 1990's



<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



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 vengeance!

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



Brendan Eich
CTO, Mozilla Foundation



Mitchell Baker
CEO Mozilla

[http://en.wikipedia.org/wiki/
File:Mitchell_Baker.jpg](http://en.wikipedia.org/wiki/File:Mitchell_Baker.jpg)

<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 proprietary and owned by them
- The web browser would be \$50-\$100 and sold separately
- This threatened to make the desktop operating system irrelevant

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](http://en.wikipedia.org/wiki/World_Wide_Web_Consortium)

When You Can Assume the Web

Internet: TCI Show 08

<http://www.vimeo.com/4275919>

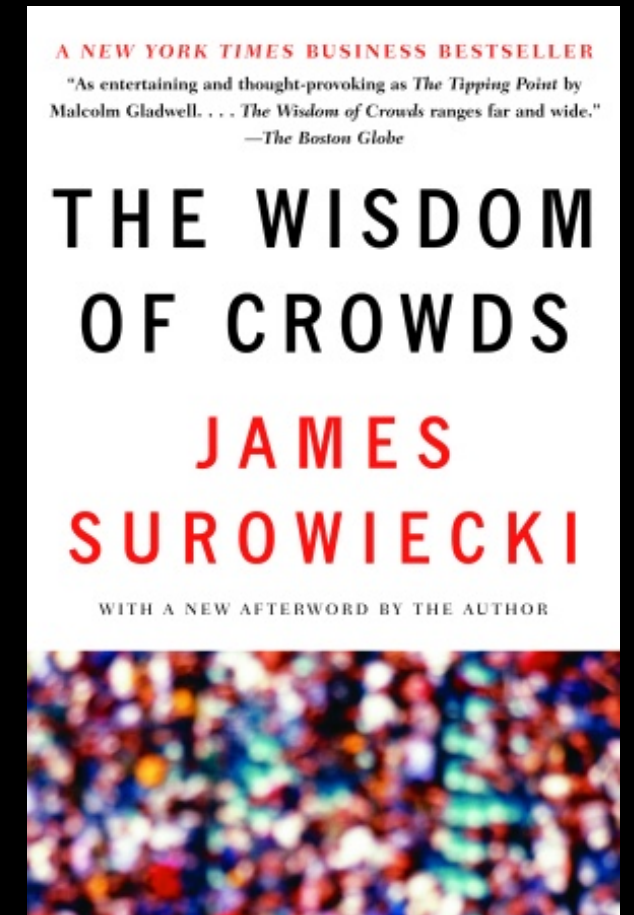
December 11-14, 1995

<http://www.w3.org/Conferences/WWW4/>



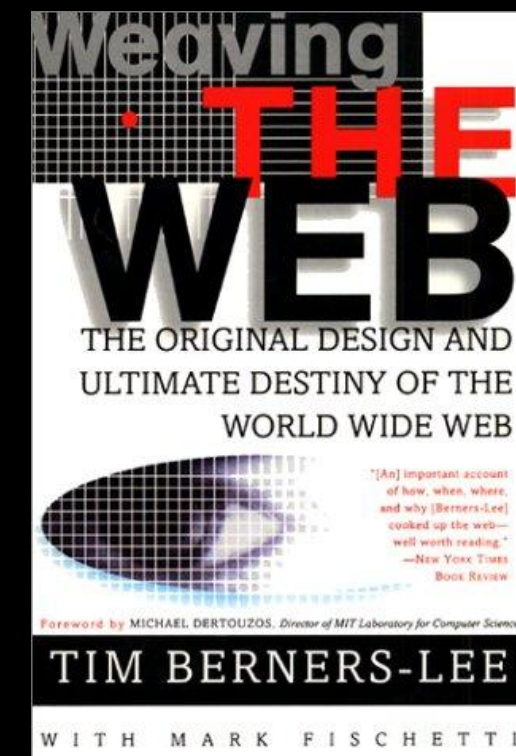
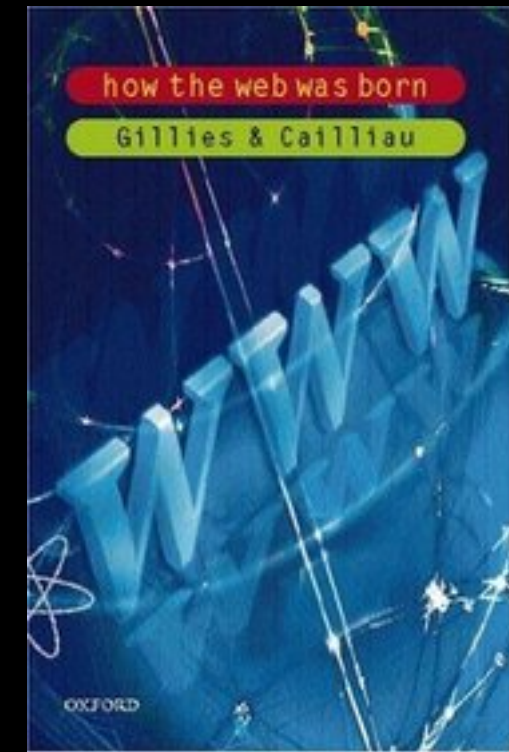
1:22

- Larry Smarr wanted to make supercomputers available to physicists
- University 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



Some Great Books

- How the Web was Born: The Story of the World Wide Web, [James Gillies](#) , [Robert Cailliau](#)
- Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web, [Tim Berners-Lee](#)



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>

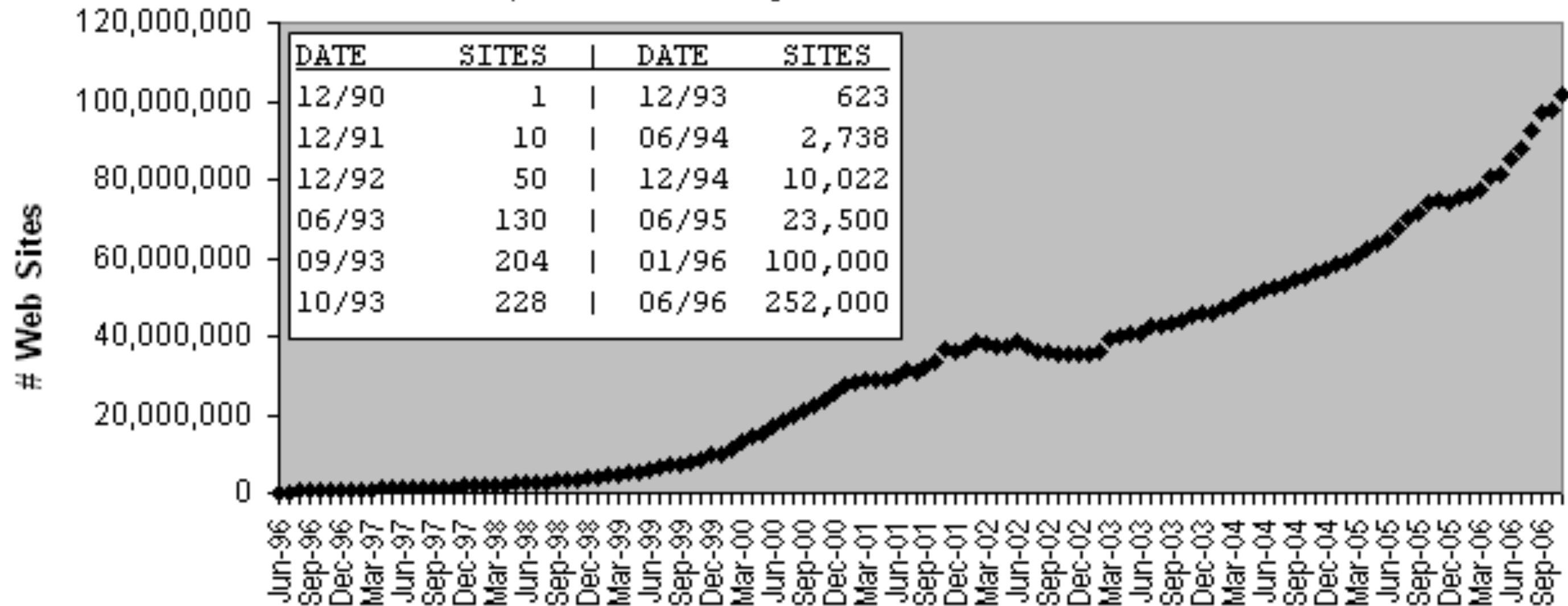
The Modern Internet

- 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

Hobbes' Internet Timeline Copyright ©2006 Robert H Zakon

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



<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>



Additional Source Information

- TuringBombeBletchleyPark: Sarah Hartwell, Wikimedia Commons, <http://upload.wikimedia.org/wikipedia/commons/2/23/TuringBombeBletchleyPark.jpg>. CC: BY-SA, <http://creativecommons.org/licenses/by-sa/3.0/deed.en>
- SSEM Manchester museum: Parrot of Doom, Wikimedia Commons, http://commons.wikimedia.org/wiki/File:SSEM_Manchester_museum.jpg, CC: BY-SA, <http://creativecommons.org/licenses/by-sa/3.0/deed.en>
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