“Digital Culture and the Future Internet”

Digital Humanities Initiative
CUNY Graduate Center
New York, NY
October 30, 2013

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Director, California Institute for Telecommunications and Information Technology
Harry E. Gruber Professor,
Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD
http://lsmarr.calit2.net

Birth of the Internet in Early 1970s Led to Forty Years of Exponential Growth

But This is What Vint and Bob Looked Like When they Did It

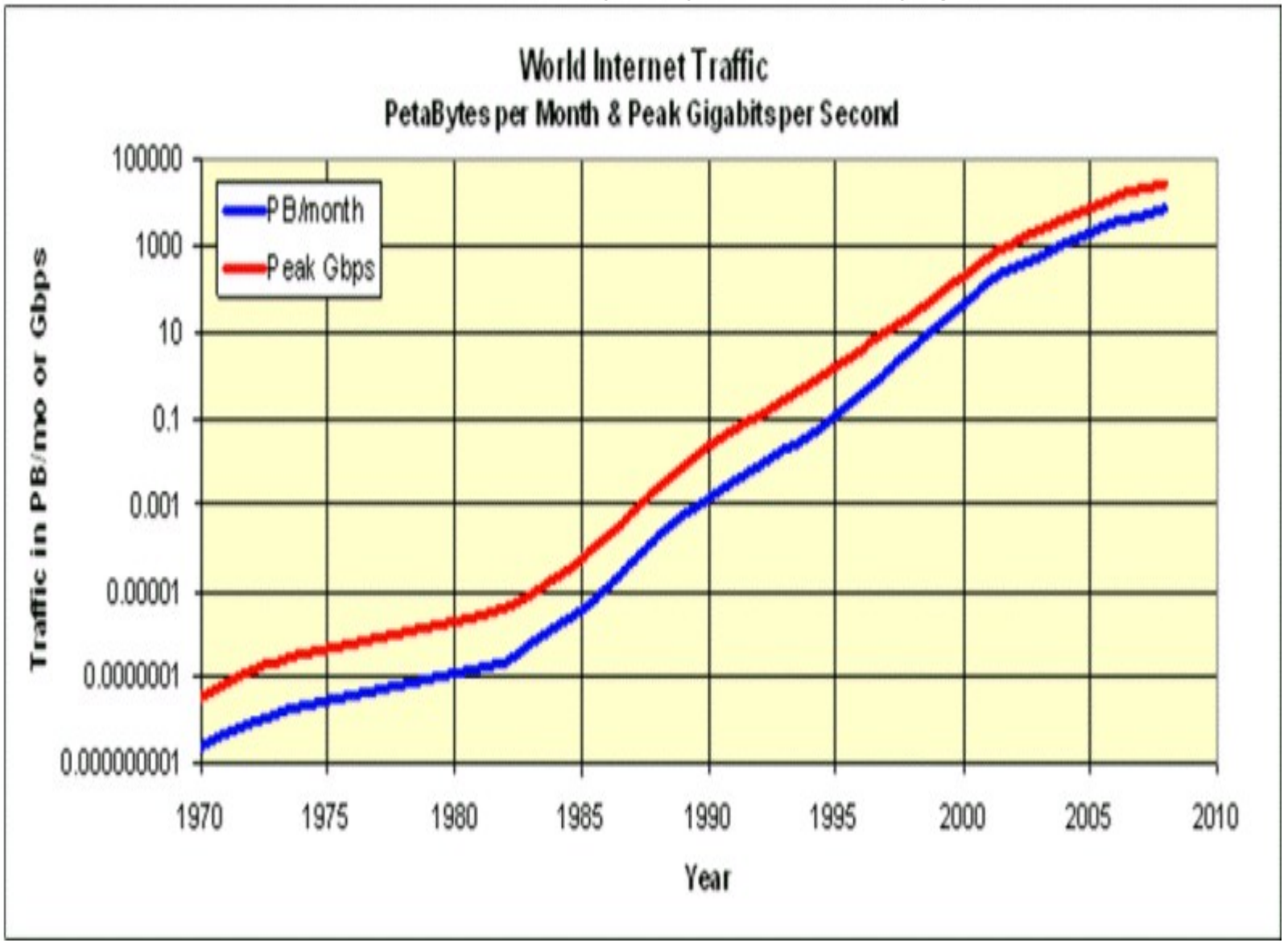




http://www.uclabruin.com/30anniv.htm

The Forty Year Exponential Growth in Traffic on the Internet

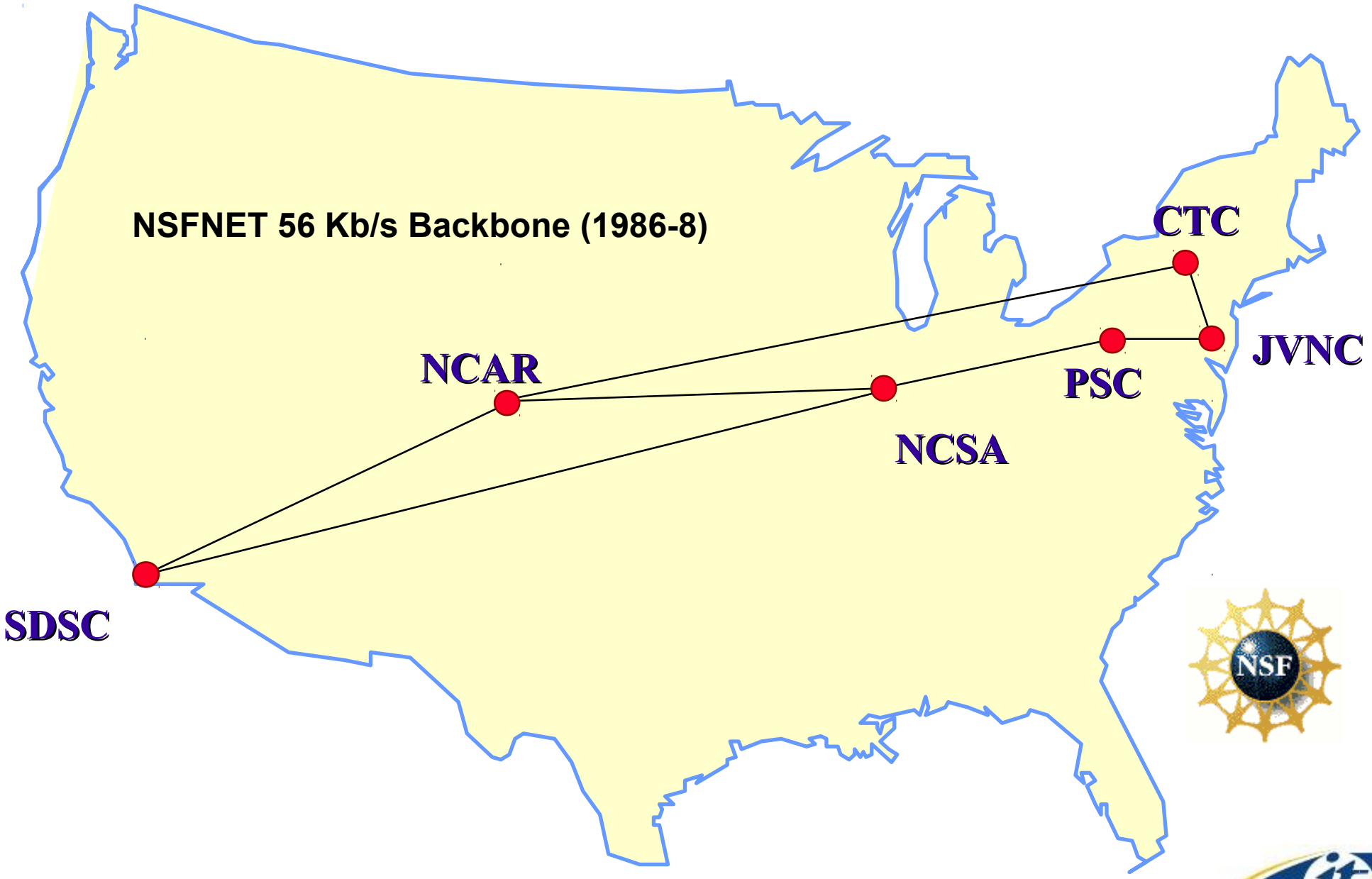
Data Collected by Larry Roberts Copyright 2009 L.G. Roberts



One Trillion Fold Increase!

www.packet.cc/Traffic.html

The First NSFnet Backbone:
The National Shared Bandwidth = a Dial-Up Modem!



Slides from 1994 © CSC Vanguard Meeting with Larry Smarr.

NCSA Mosaic Home Page





Eric Bina (left) and Marc Andreessen (right)

***NCSA Mosaic* of Marc Andreessen and Eric Bina**

NCSA Mosaic Home Page

NCSA Mosaic Home

URL : http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/NCSAMosaicHome.html

N C S A

MOSAIC

X Window System • Microsoft Windows • Macintosh

Welcome to NCSA Mosaic, an Internet information browser and World Wide Web client. NCSA Mosaic was developed at the National Center for Supercomputing Applications at the University of Illinois in Urbana-Champaign .

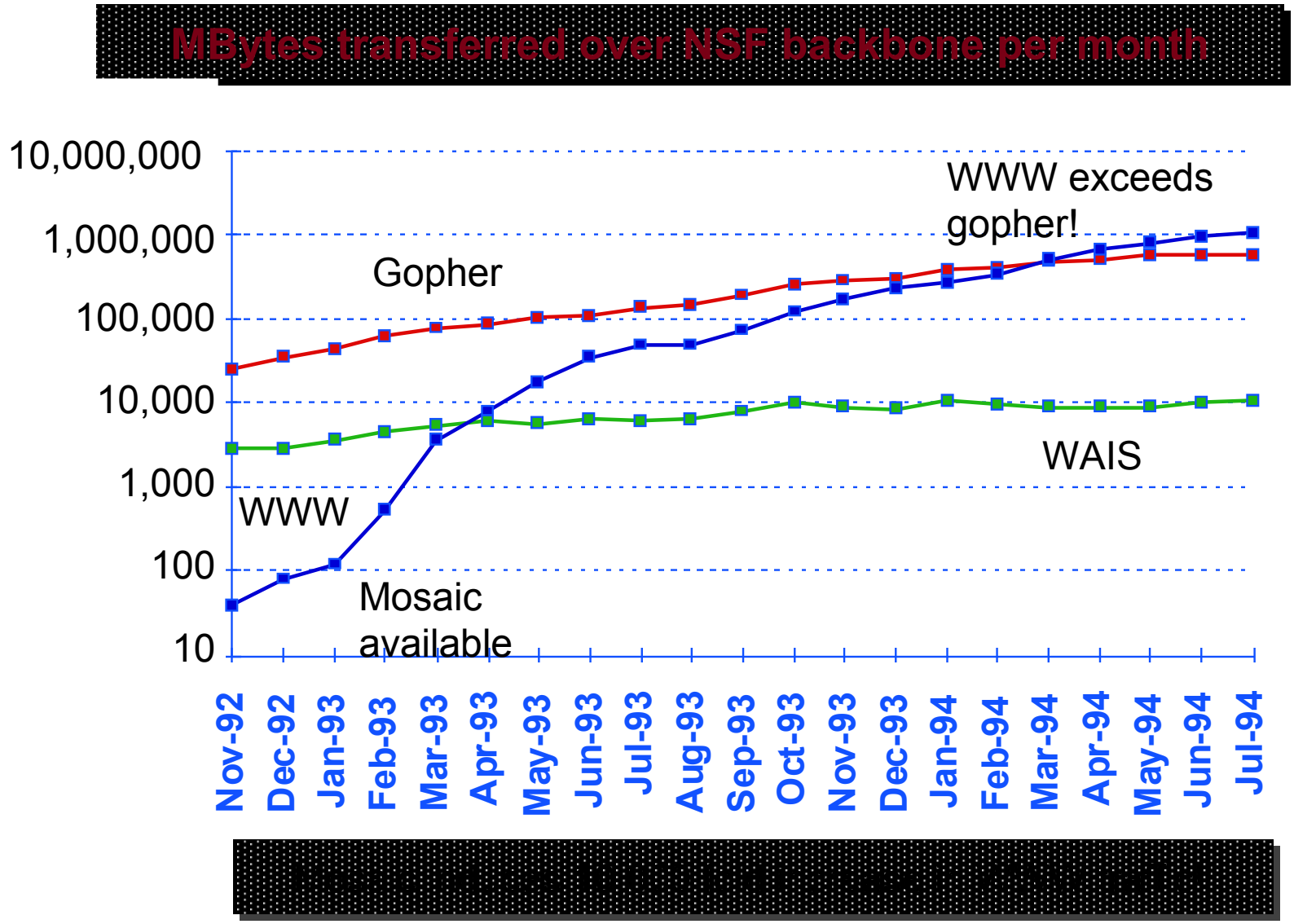
Each highlighted phrase (in color or underlined) is a hyperlink to another document or information resource somewhere on the Internet. *Single click* on any highlighted phrase to follow the link.

The following resources are available to help introduce you to cyberspace and keep track of its growth:

- What's New with NCSA Mosaic and the Internet
- Internet Resources Meta-Index at NCSA

Slides from 1994 © CSC Vanguard Meeting with Larry Smarr.

Exponential Growth of Clients Coupling to Servers



Source: Data from Merit; Graph by Larry Smarr

Slides from 1994 © CSC Vanguard Meeting with Larry Smarr.

NCSA Mosaic
Led to the Modern Web World



Licensing

SPYGLASS

100 Commercial Licensees

NCSA Programmers





1993

NCSA Collage

1992

CERN 1990

The world's largest particle physics laboratory ... where the web was born!

NCSA HTTPd

Open Source



Mac OS X Server



IBM WebSphere Software



Source: Larry Smarr

NSFnet Upgraded Backbone Bandwidth: 1.5 -> 45 Mb/s Backbone (1988-94)

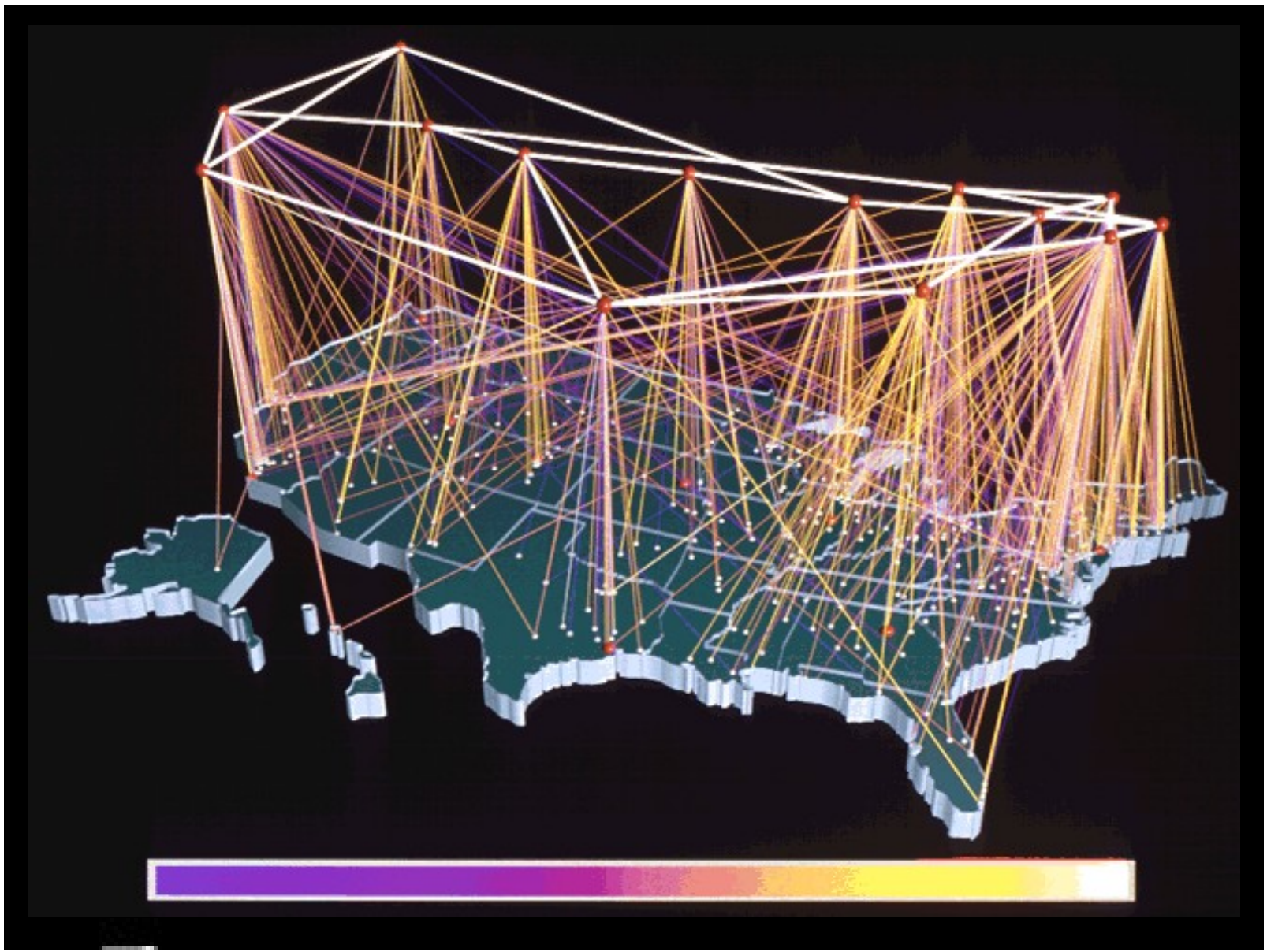
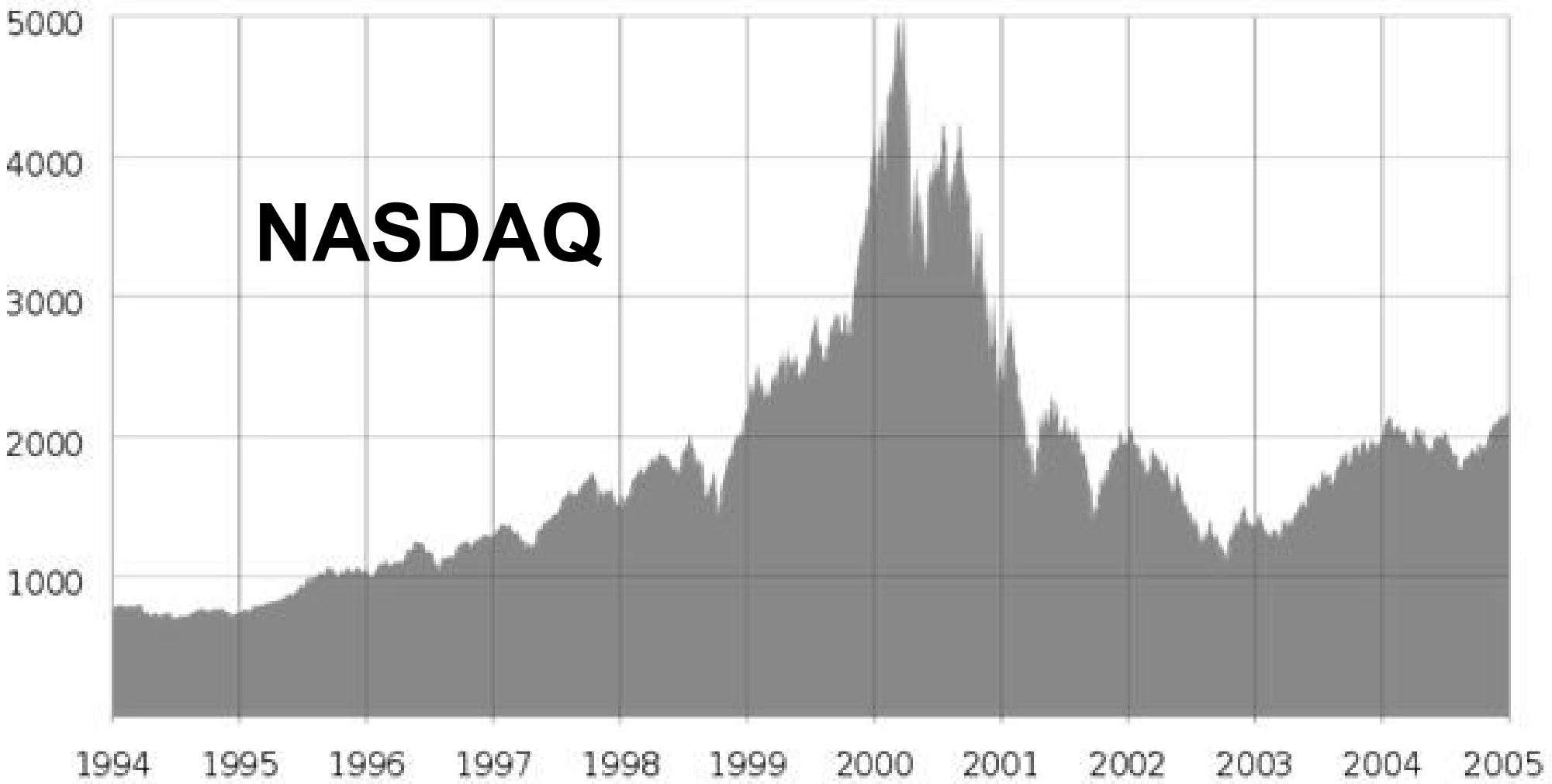
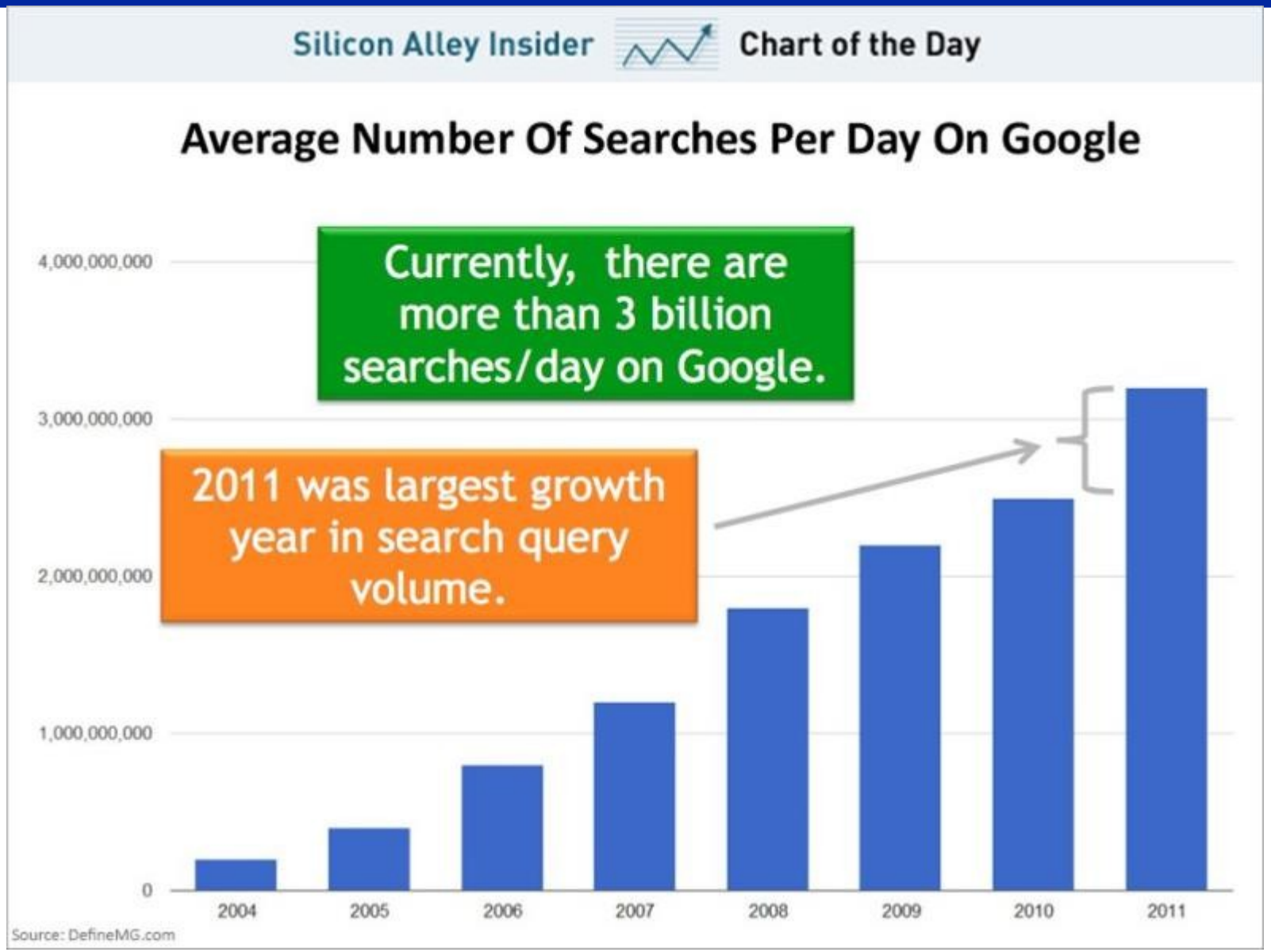


Image: Donna Cox, Bob Patterson, NCSA

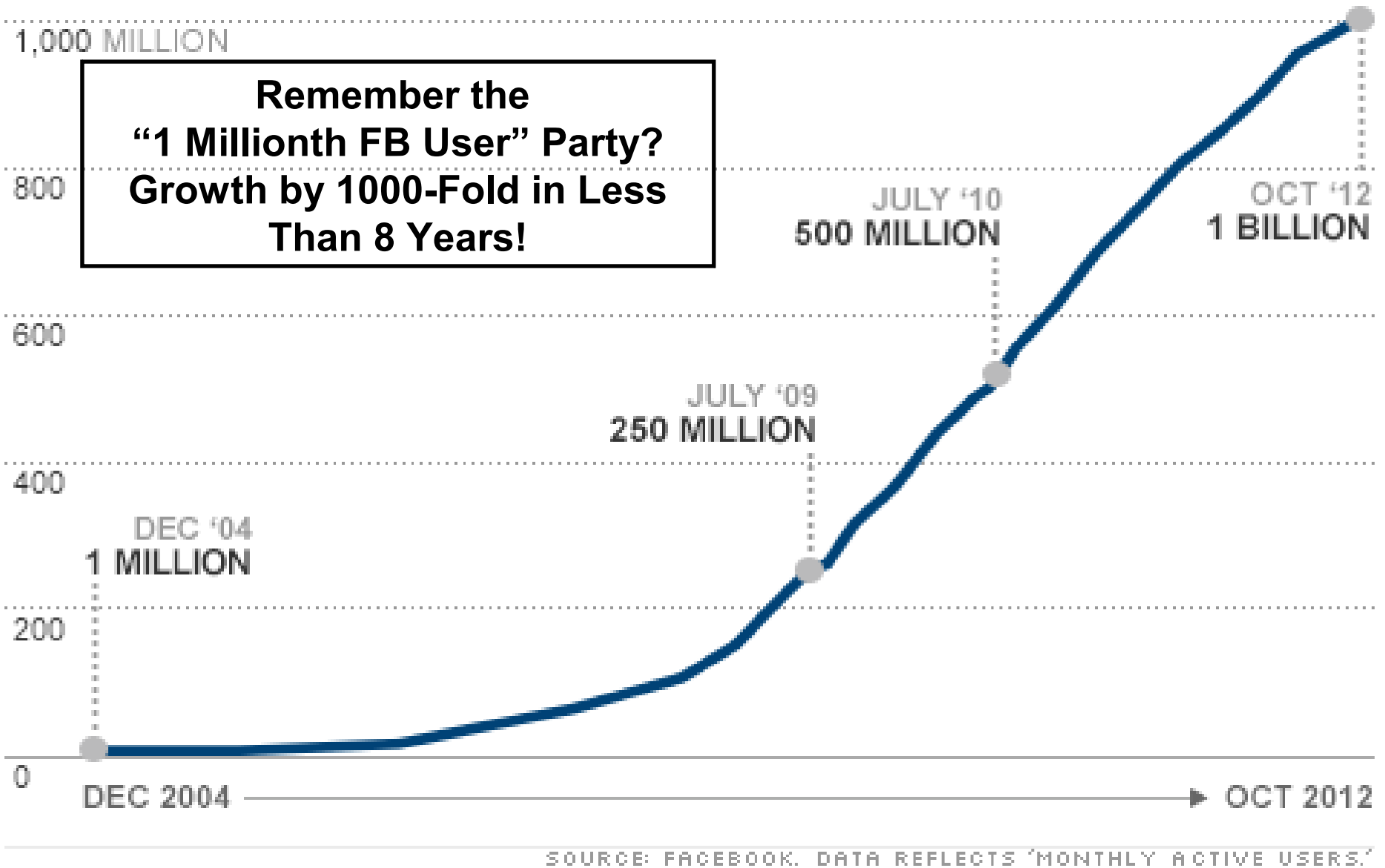
Then Came the Dot-Com Crash - Creative Destruction of Capitalism



Out of the Rubble
Google Brings Search to the Web



Over the Same Period
Facebook Leads the Rise of the Social Web



The Scale of the Web Today: "You Know What's Cool?-a Billion"

- **Facebook**
  - One Billion Active Users
- **YouTube**
  - 4 Billion Hours of Video Watched Each Month
- **Google**
  - Over One Billion Searches Every Day
- **Apple**
  - 15 Billion Apps Downloaded Per Year
- **Smartphones**
  - 1 Billion Active Users

The Unrelenting Computing Exponential

The Computing Power to Make a Single Google Search Is More Than Was Used In Space & On Earth For the 11 Year, 17 Flight Apollo Program!

http://insidesearch.blogspot.com/2012/08/the-power-of-apollo-missions-in-single.html

Four Trends of the Future Web

- Being There
- Cultural Heritage
- Virtual Rooms
- Telepresence
- Intelligent Cities

The Internet is Moving Throughout the Physical World



Source: Deborah Estrin



High Performance Wireless Research and Education Network

http://hpwren.ucsd.edu/

National Science Foundation awards 0087344, 0426879 and 0944131

HPWREN

UCSD

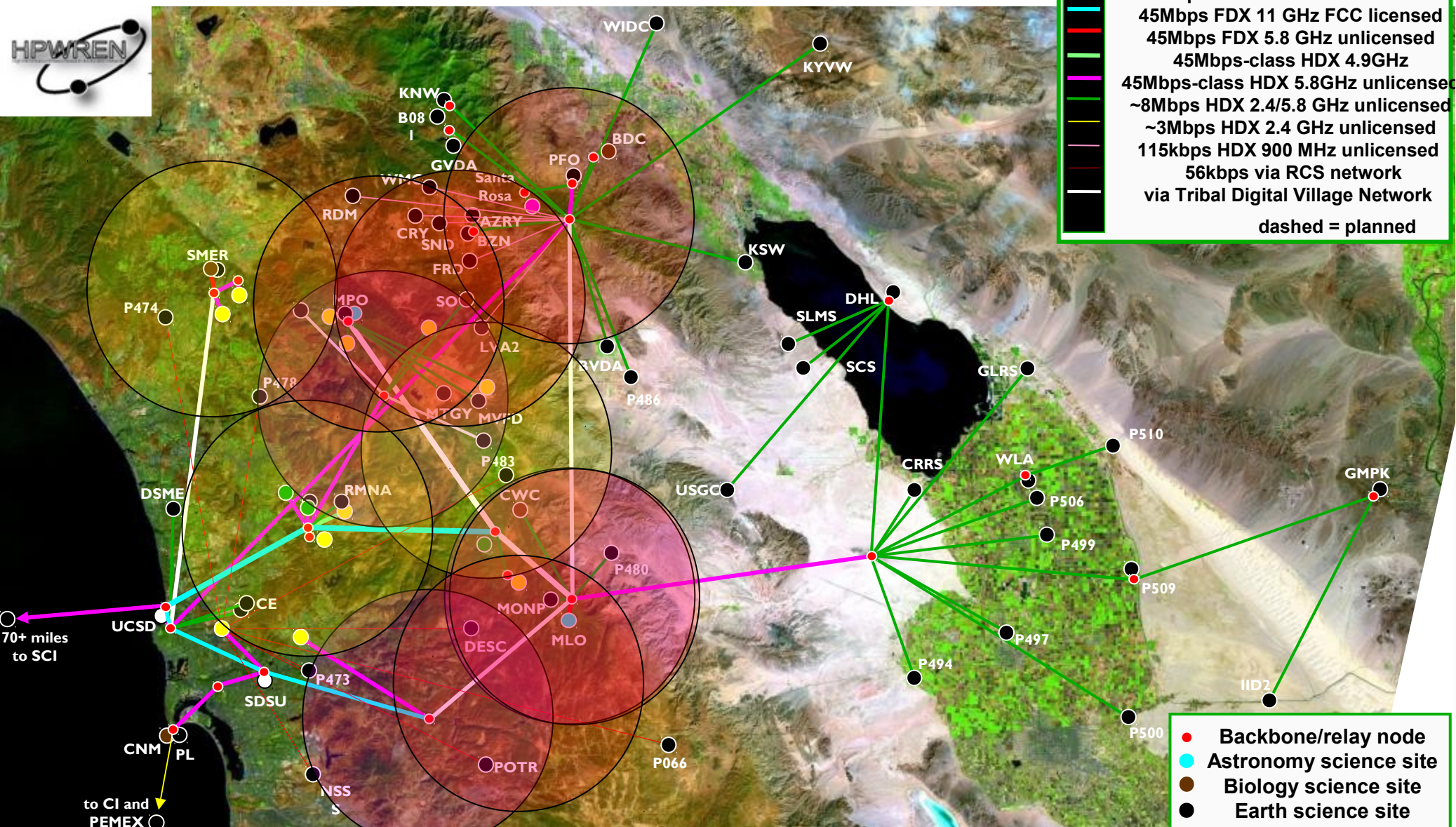
SDSC
SAN DIEGO SUPERCOMPUTER CENTER

it²

SAN DIEGO STATE UNIVERSITY

NATIONAL SCIENCE FOUNDATION

San Diego and Imperial Counties Are Densely Covered with Environmental Sensornets



Red circles: HPWREN supplied cameras

Yellow circles: SD County supplied cameras

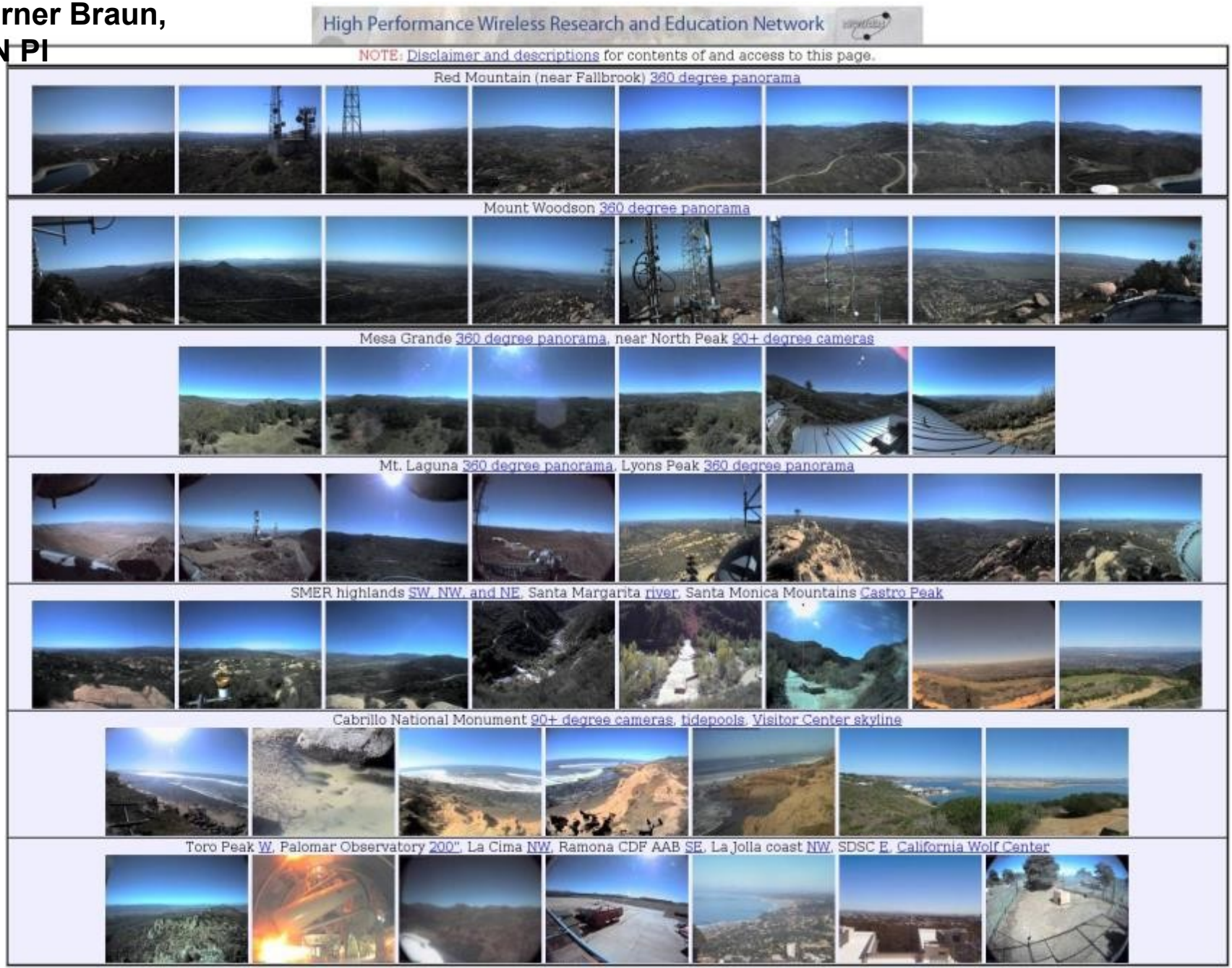
approximately 50 miles:

Source: Hans Werner Braun, HPWREN PI

Note: locations are approximate

Continuous Environmental Monitoring Enabled by HPWREN Cameras

Source: Hans Werner Braun, HPWREN PI



Wireless Remote Cameras Capture Unseen Moments of Nature









HPWREN


GREECE
TURKEY
CYPRUS
SYRIA
LEBANON
JORDAN
ISRAEL
IRAQ
IRAN
JORDAN
KUWAIT
PERSIAN
EGYPT
SAUDI ARABIA
QATAR
SAUDI ARABIA
U.A.E.
OMAN
RED SEA
SUDAN
YEMEN
ARABIAN SEA
UCSD
CYBER-ARCHAEOLOGY
EXPEDITIONS


Calit2
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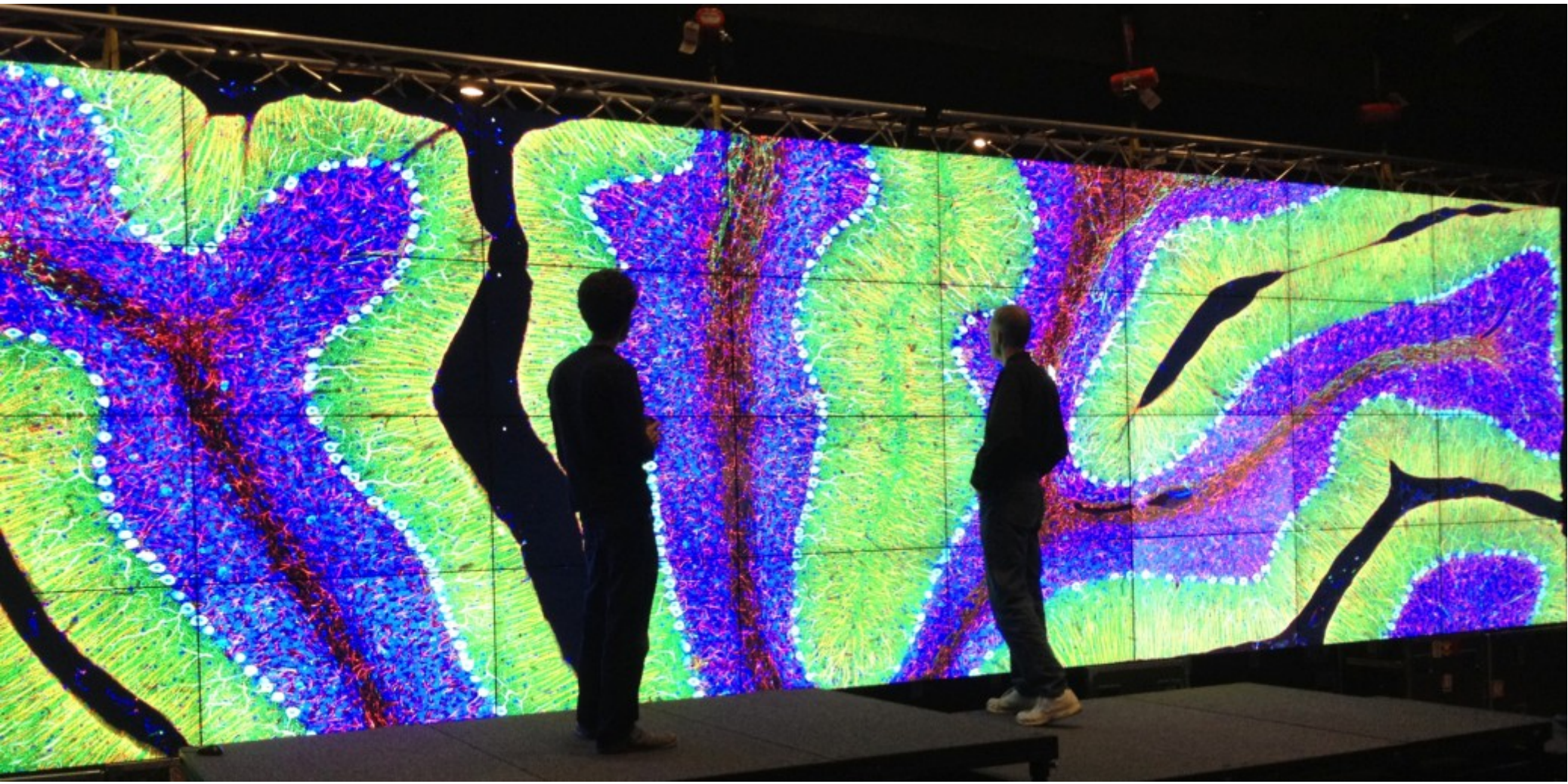
Egypt’s Luxor in the StarCAVE

Cultural Heritage Visualization in Chicago's Electronic Visualization Lab's CAVE2



Displayed is a 3D panorama of Luxor in Egypt-
Images were Created at Calit2 by Tom DeFanti and Dan Sandin

Towards Digital Wallpaper

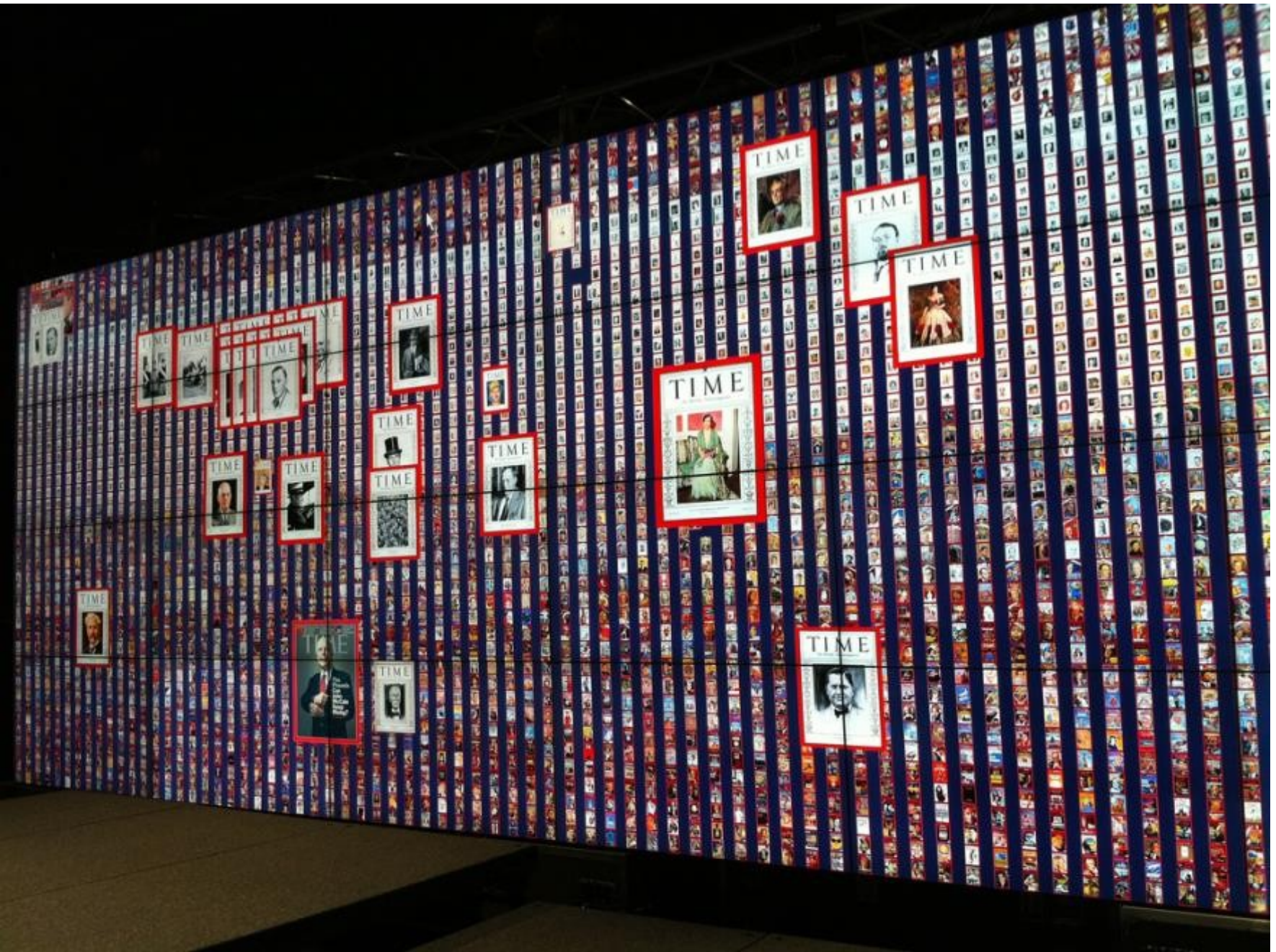




Using Calit2's VROOM to Explore
Confocal Light Microscope Collages of Rat Brains

NCMIR

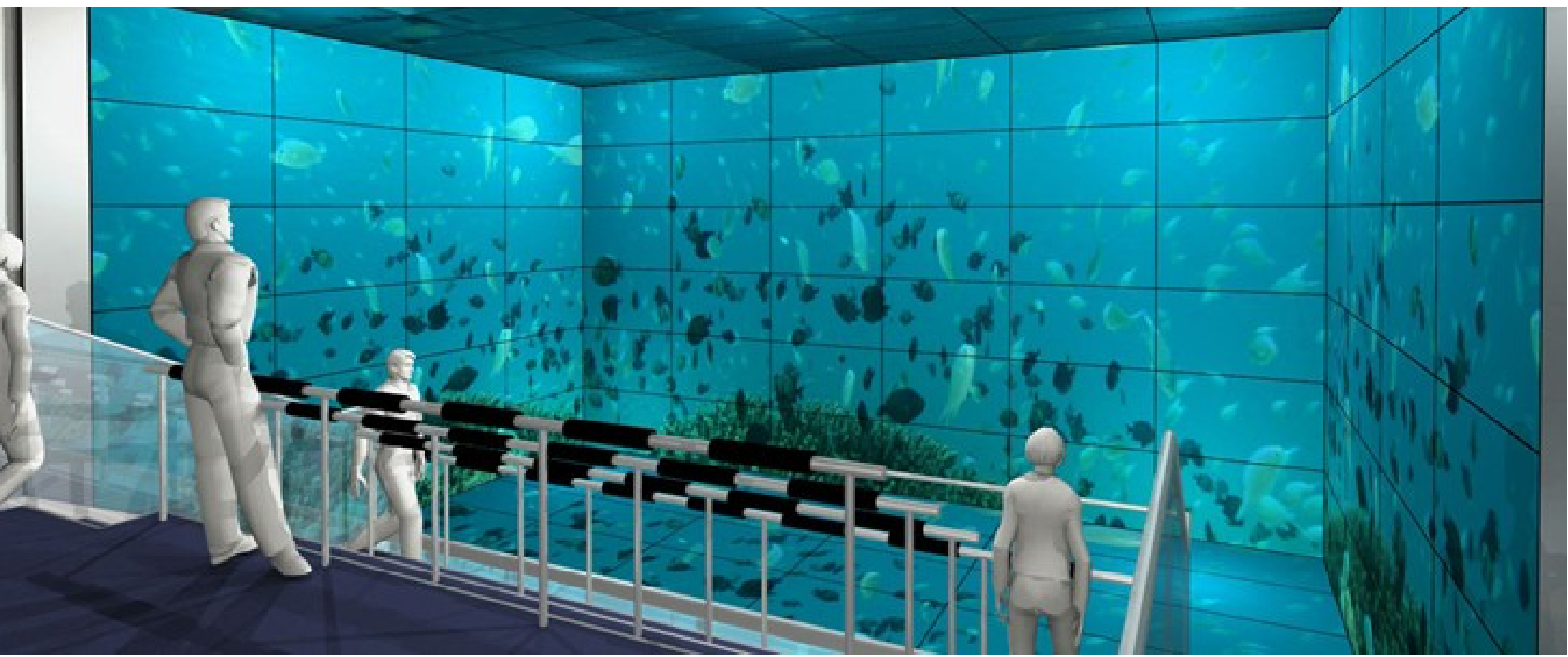
Scalable Cultural Analytics: 4535 Time magazine covers (1923-2009)



Source: Software Studies Initiative, Prof. Lev Manovich, CUNY/Calit2

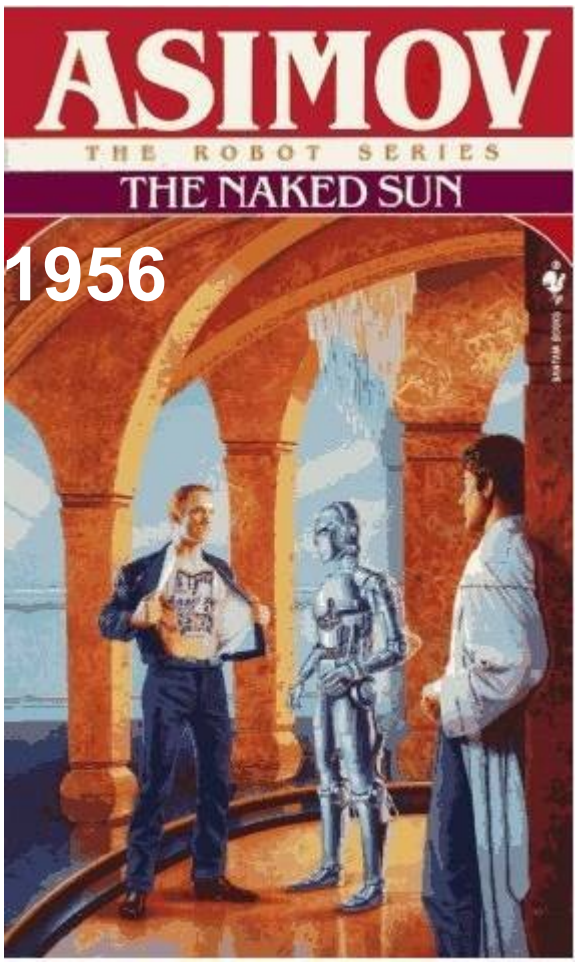
The Beginning of Virtual Rooms

Sharp Corp's 156 60"LCDs for the 5D Miracle Tour at the Hui Ten Bosch Theme Park in Nagasaki Opened April 29, 2011



http://sharp-world.com/corporate/news/110426.html

Over Fifty Years Ago, Asimov Described a World of Remote Viewing

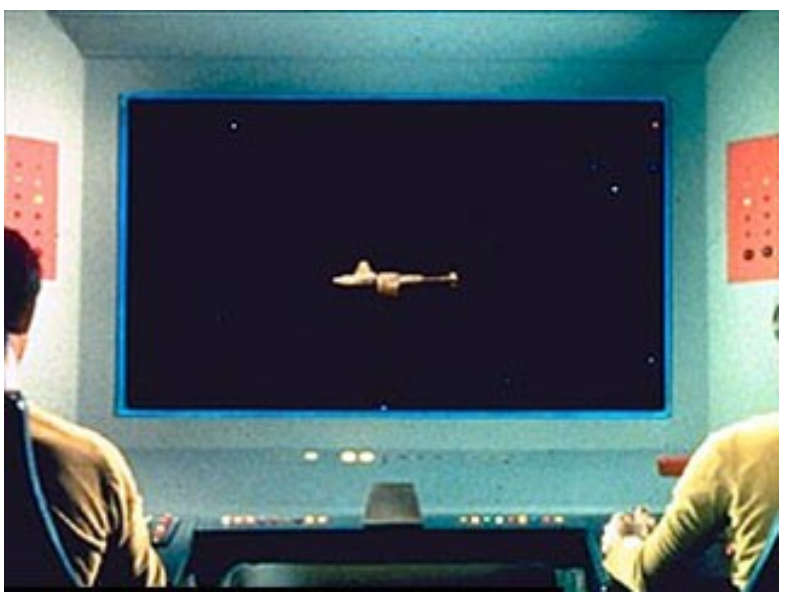


A policeman from Earth, where the population all lives underground in close quarters, is called in to investigate a murder on a distant world. This world is populated by very few humans, rarely if ever, coming into physical proximity of each other. Instead the people "View" each other with trimensional “holographic” images.

TV and Movies of 40 Years Ago Envisioned Telepresence Displays









Source: Star Trek 1966-68; Barbarella 1968

The Bellcore VideoWindow -- A Working Telepresence Experiment

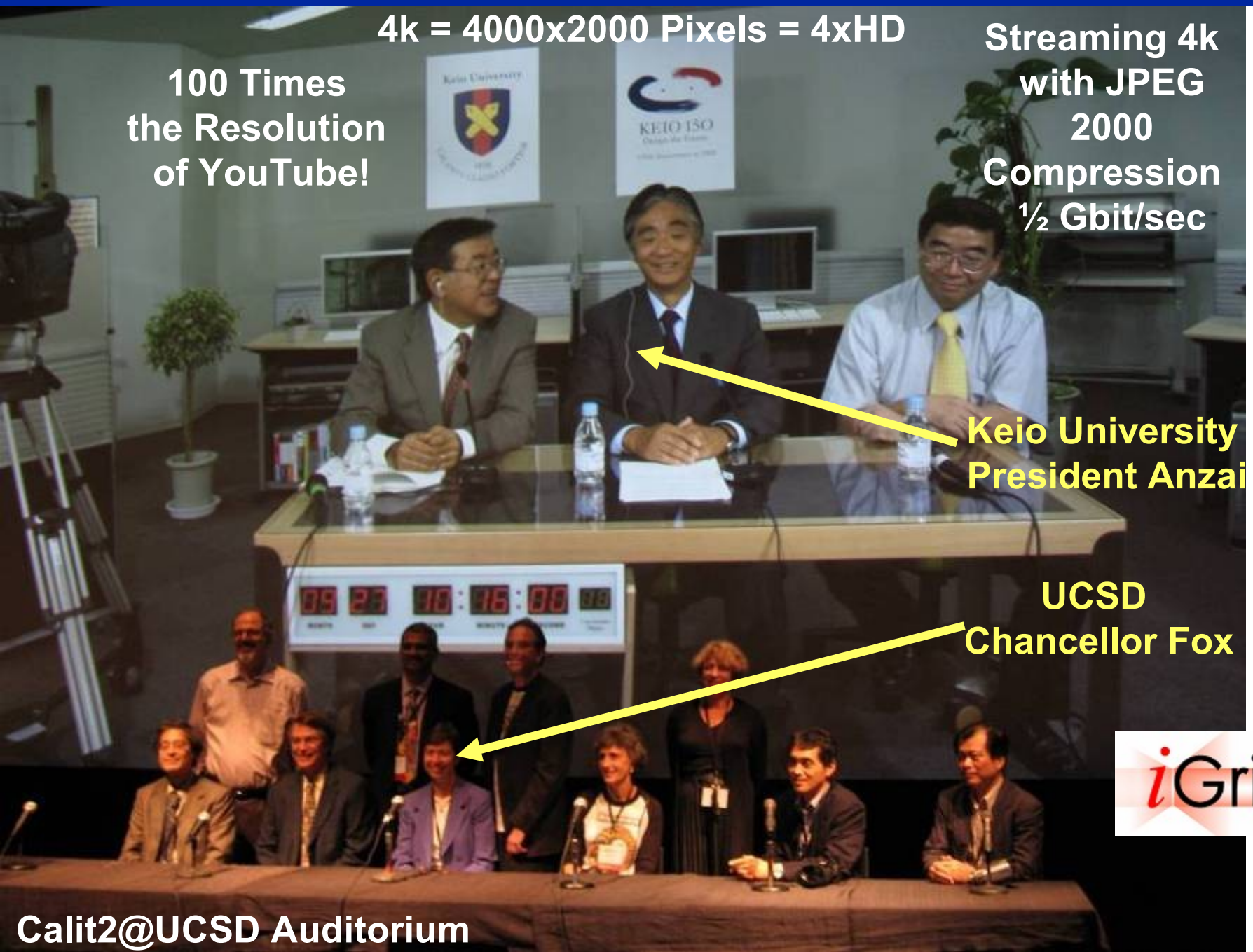


(1989)

“Imagine sitting in your work place lounge having coffee with some colleagues. Now imagine that you and your colleagues are still in the same room, but are separated by a large sheet of glass that does not interfere with your ability to carry on a clear, two-way conversation. Finally, imagine that you have split the room into two parts and moved one part 50 miles down the road, without impairing the quality of your interaction with your friends.”

Source: Fish, Kraut, and Chalfonte-CSCW 1990 Proceedings

Telepresence Meeting
Using Digital Cinema 4k Streams



CineGrid

Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

iGrid 2005

it²

Tele-Collaboration for Audio Post-Production
Realtime Picture & Sound Editing Synchronized Over IP



Skywalker Sound@Marin **Calit2@San Diego**

Collaboration Between EVL's CAVE2 and Calit2's VROOM Over 10,000Mbps Optical Fiber



Source: NTT Sponsored ON*VECTOR Workshop at Calit2 March 6, 2013

eMedia Studio: Interactive Telepresence Dance/Media Performances

http://embodied.uci.edu



Calit2@UCI



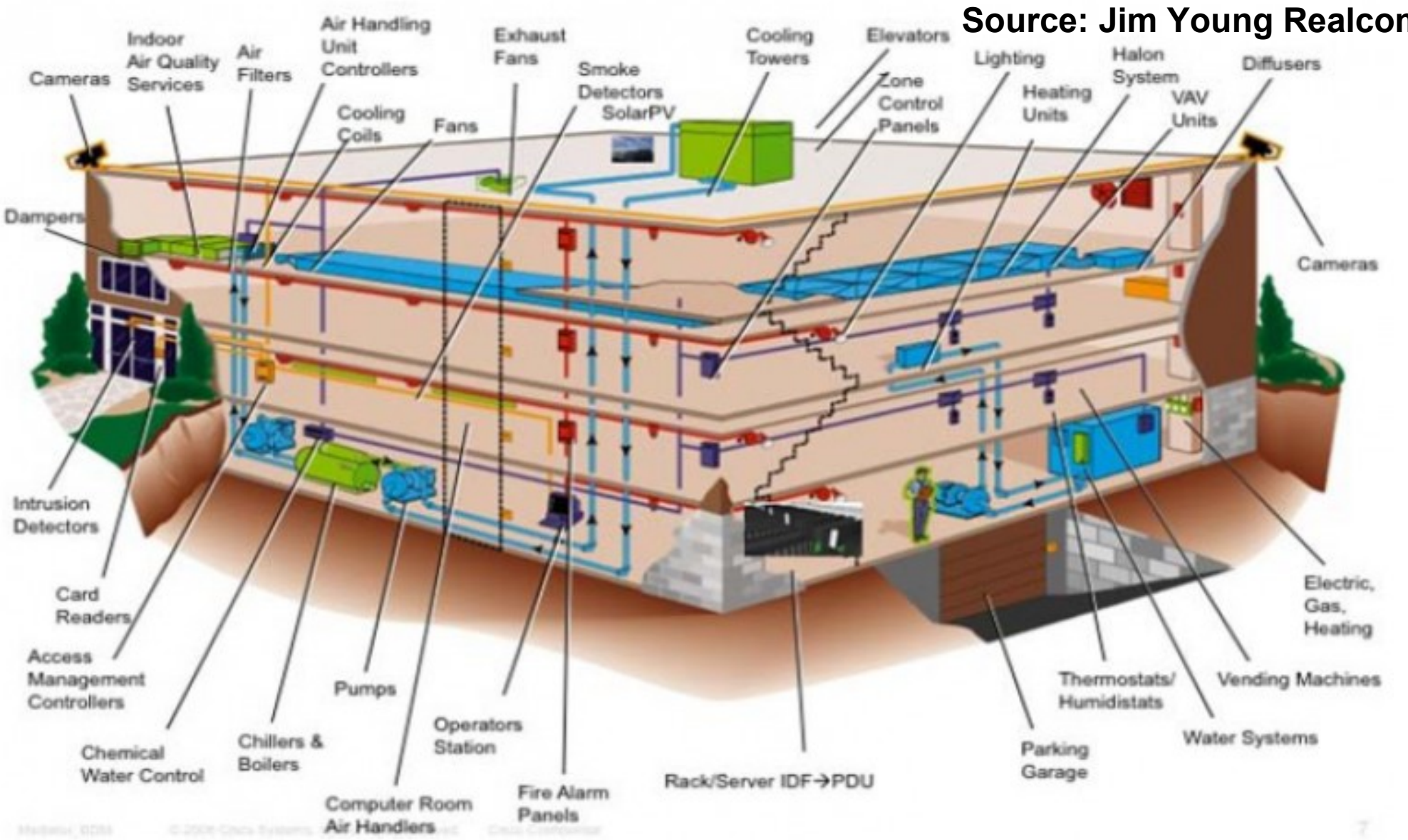
Virtual Jazz-Coupling UCI with UCSD

The Disruptive Transition to Intelligent, Secure, Low Carbon, and Climate Adaptive Infrastructure

- **The First Wave:**
  - **Infrastructure Will Gradually Become "Intelligent"**
- **The Second Wave:**
  - **From High to Low Carbon Emissions**
- **The Third Wave:**
  - **Climate Change is Now Occurring on a Time Scale Commensurate With the Lifetime of Infrastructure**

Buildings Are Becoming "Internets of Things" Key to Reducing 40% of U.S. CO2 Emissions

Source: Jim Young Realcomm



- **Microsoft Collects 500M Data Points/Day from its Campus**
- **Estimated to Become ~$200B/Year Industry by 2016**

Countries, States, and Cities are Beginning to Conceive of a New Low Carbon Future

Australian Sustainable Energy
Zero Carbon Australia
Stationary Energy Plan

ZEROCARBONBRITAIN
A NEW ENERGY STRATEGY

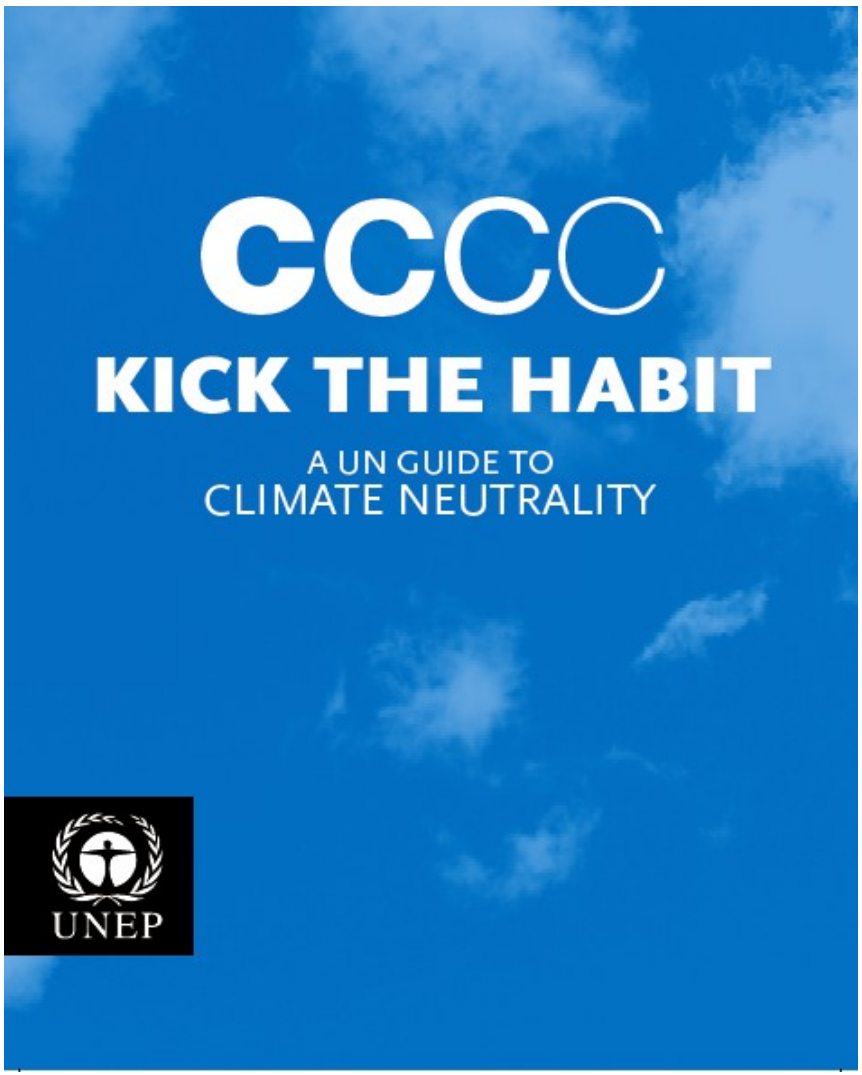
CARBON NEUTRAL BRITISH COLUMBIA

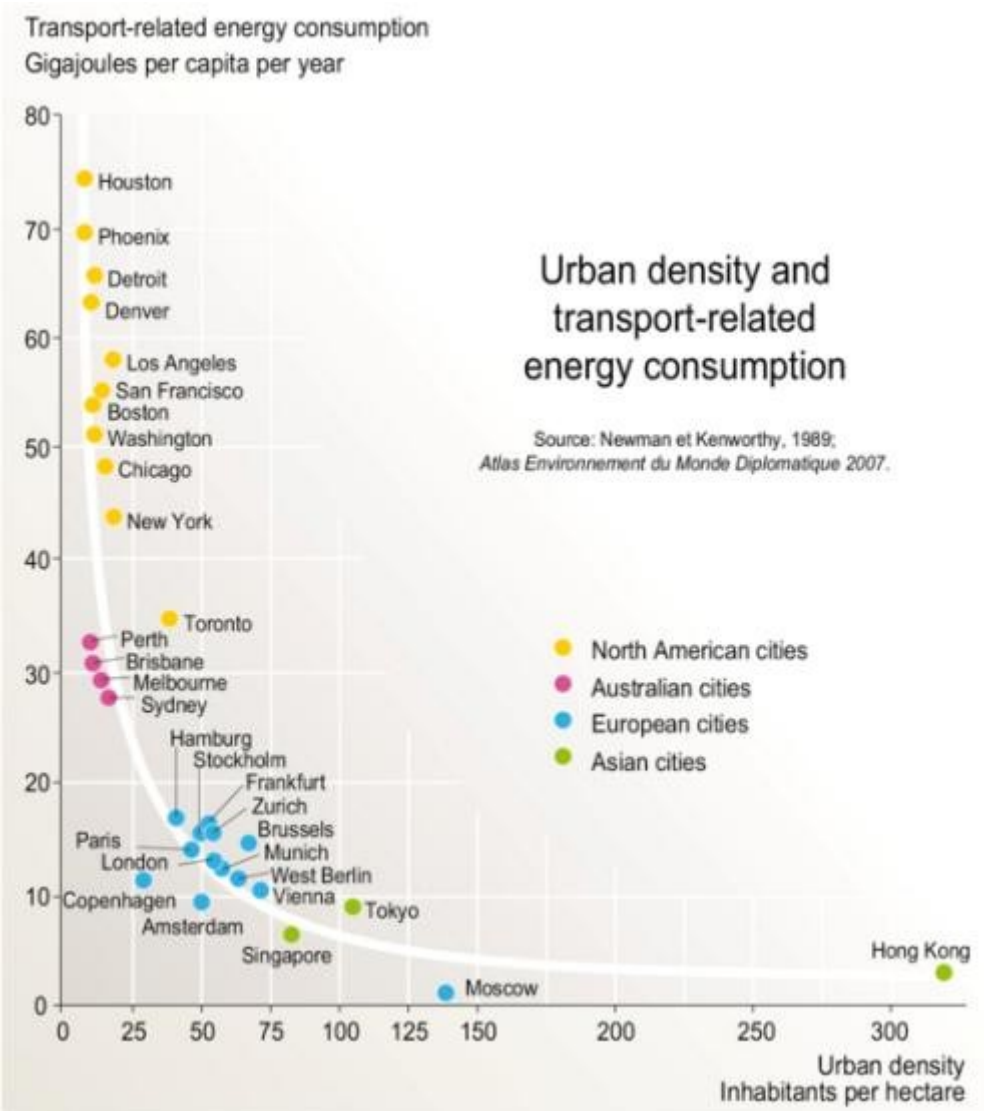
Masdar City: Zero Carbon, Zero Waste

Seattle as North America's First Carbon-Neutral City
ALEX STEFFEN, 3 DEC 09



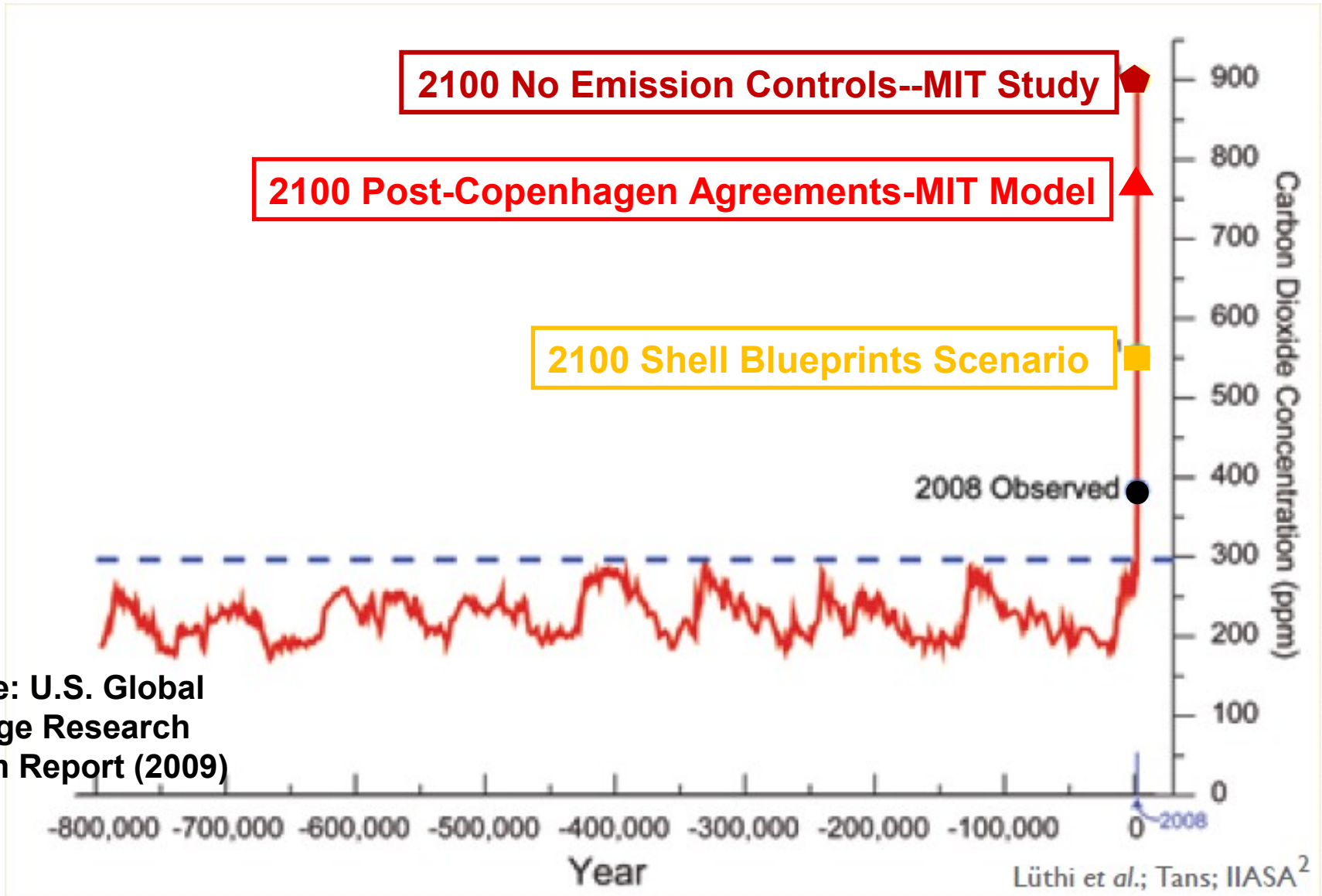
The Transition to a Low Carbon Society Requires Rethinking Our Cities Infrastructure





www.unep.org/publications/ebooks/kick-the-habit/pdfs/KickTheHabit_en_lr.pdf

Atmospheric CO_2 Levels for Last 800,000 Years and Several Projections for the 21st Century

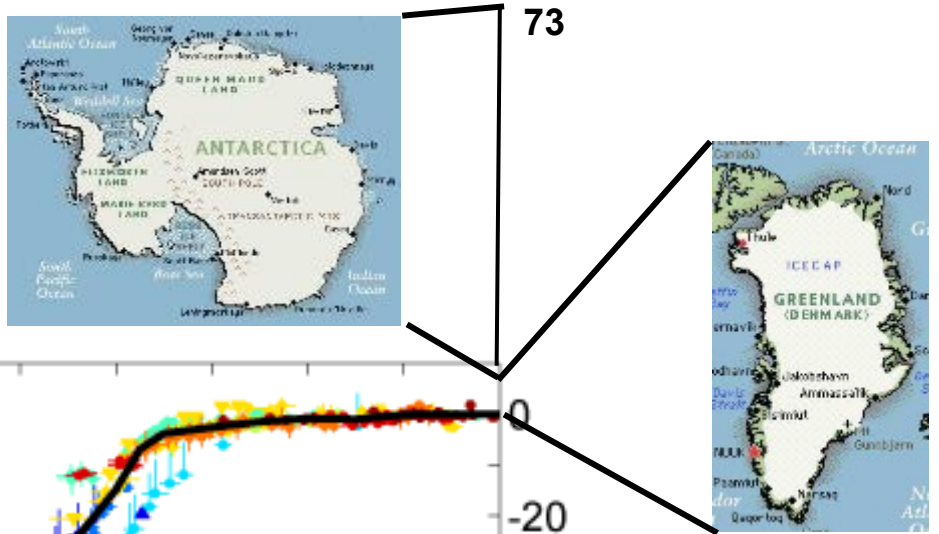


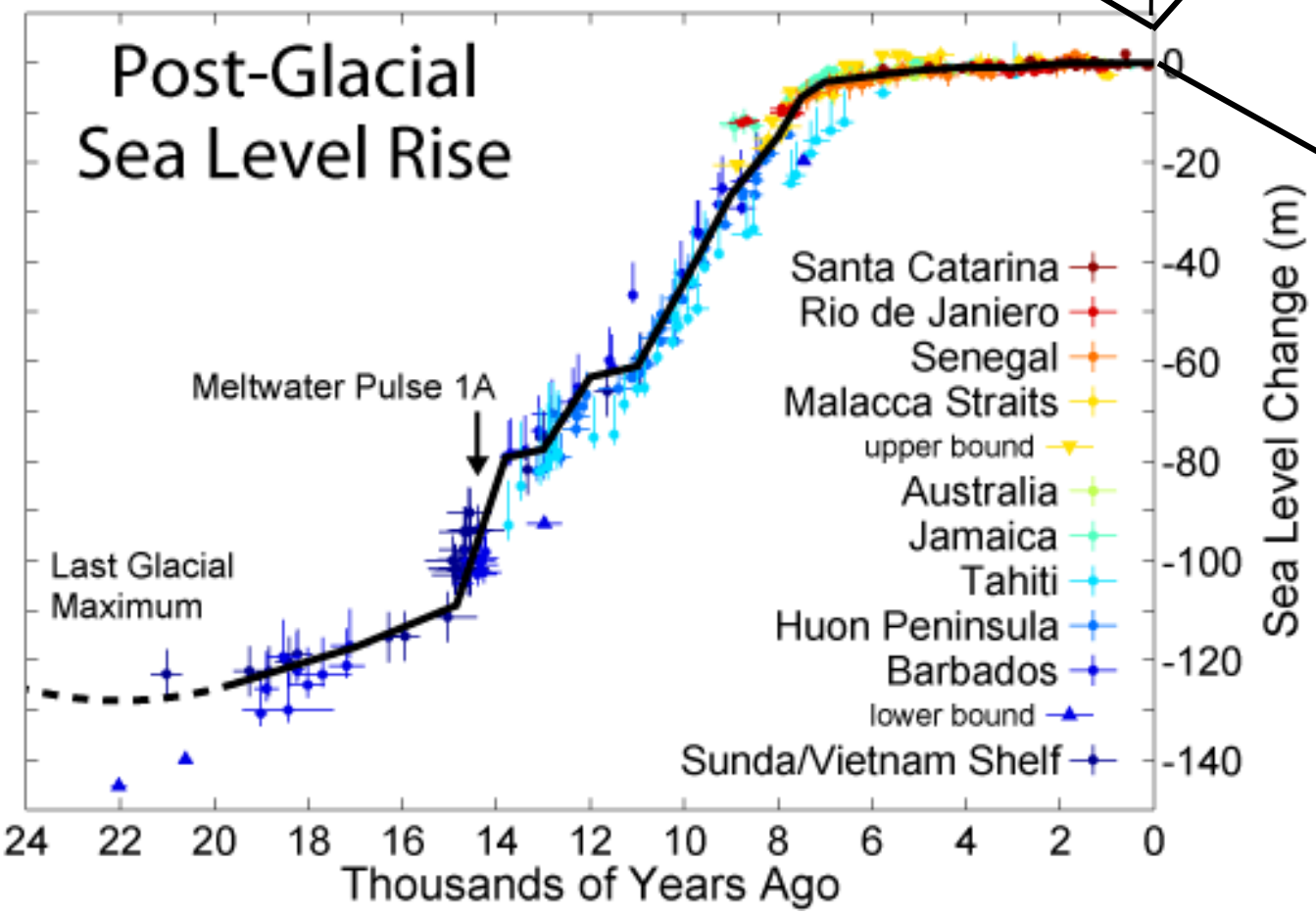
Source: U.S. Global Change Research Program Report (2009)

Graph from:
www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/download-the-report

Over the Last 20,000 Years
Humans Have Adapted to Continual Sea Level Rise

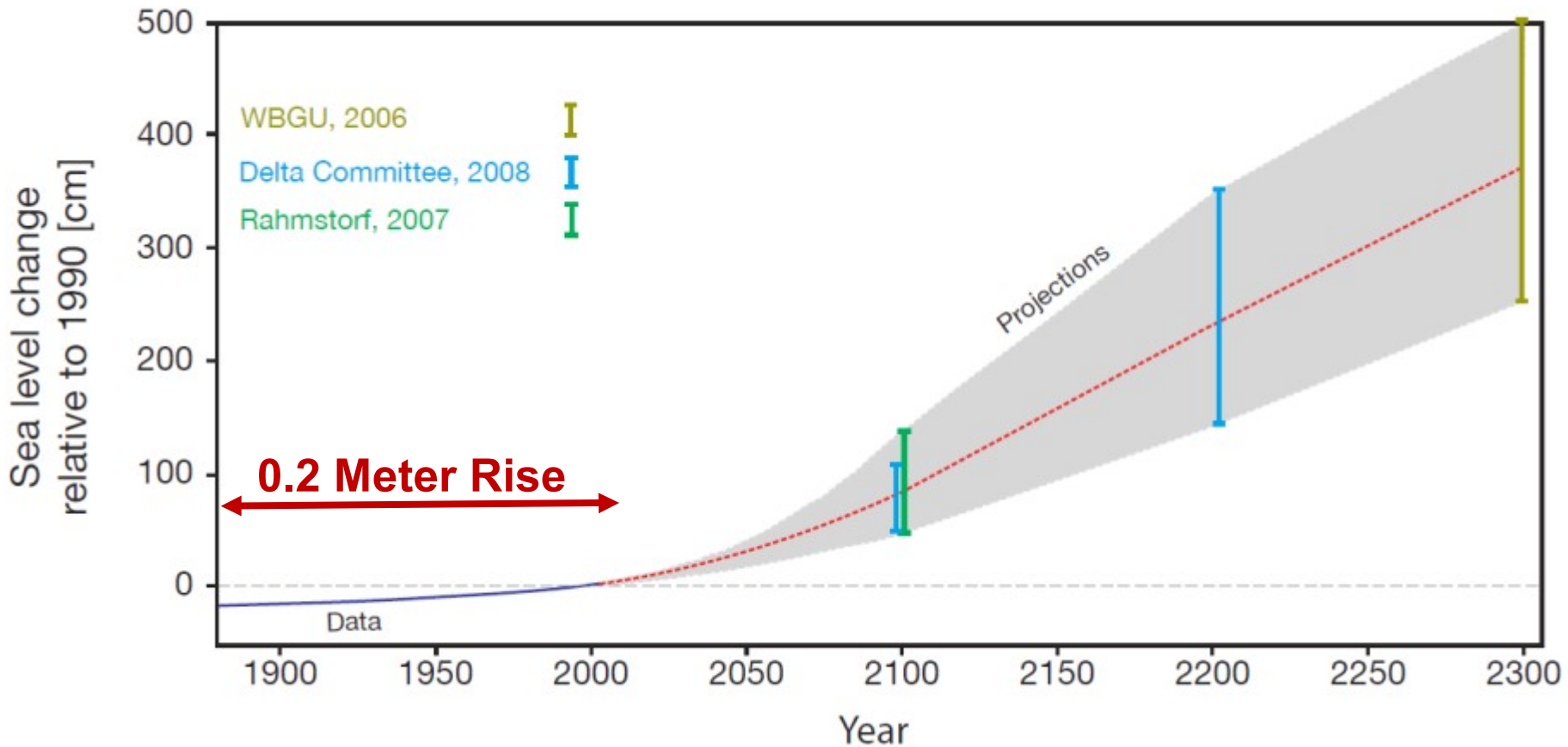
Future Potential Sea Level Rise





Human Induced Sea Level Rise Will Continue for Centuries

1 Meter will Submerge Over 2 Million sq. km of Land Where ~150 Million People Live, Mostly in Asia



Meters of Sea Level Rise

5

3

1

Source: The Copenhagen Diagnosis, Allison, et al. (2009)

The Transition to Climate Adaptive Infrastructure: "Rising Currents" 2010 Exhibit at Museum of Modern Art



New York City's Harbor & Coastline -- How it Could be Restructured to Deal with the Rising Sea Level



Visions Created By Five Interdisciplinary Architect Teams

www.moma.org/explore/inside_out/category/rising-currents#description

New York City
is Building a High Tech Future

CORNELL NYCTECH



The Seattle Times

New York Is Vying to Become Global High-Tech Hub



Newsweek

Roosevelt Island: New York's New Tech Hub