The Computing Continuum

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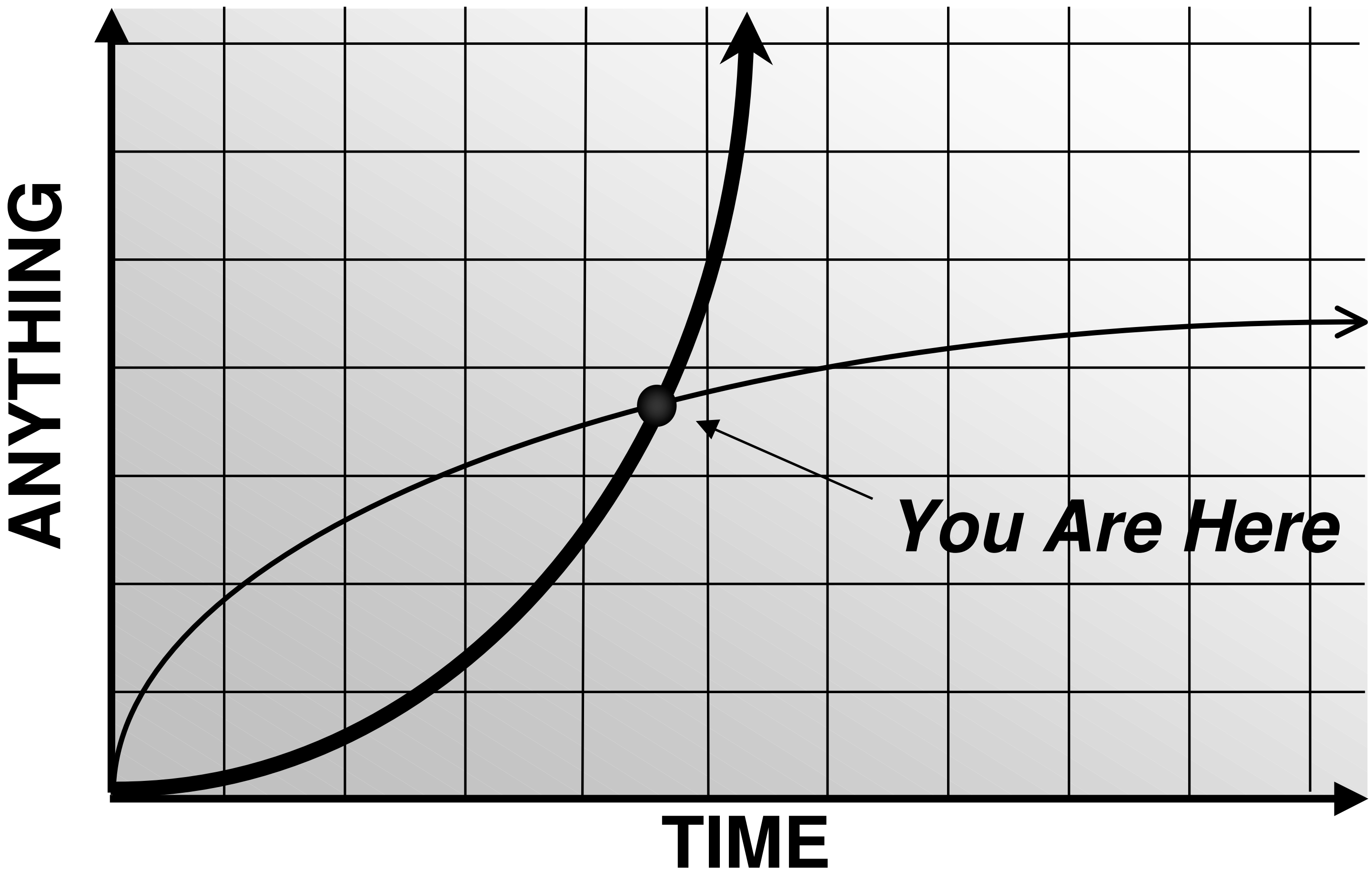
USA

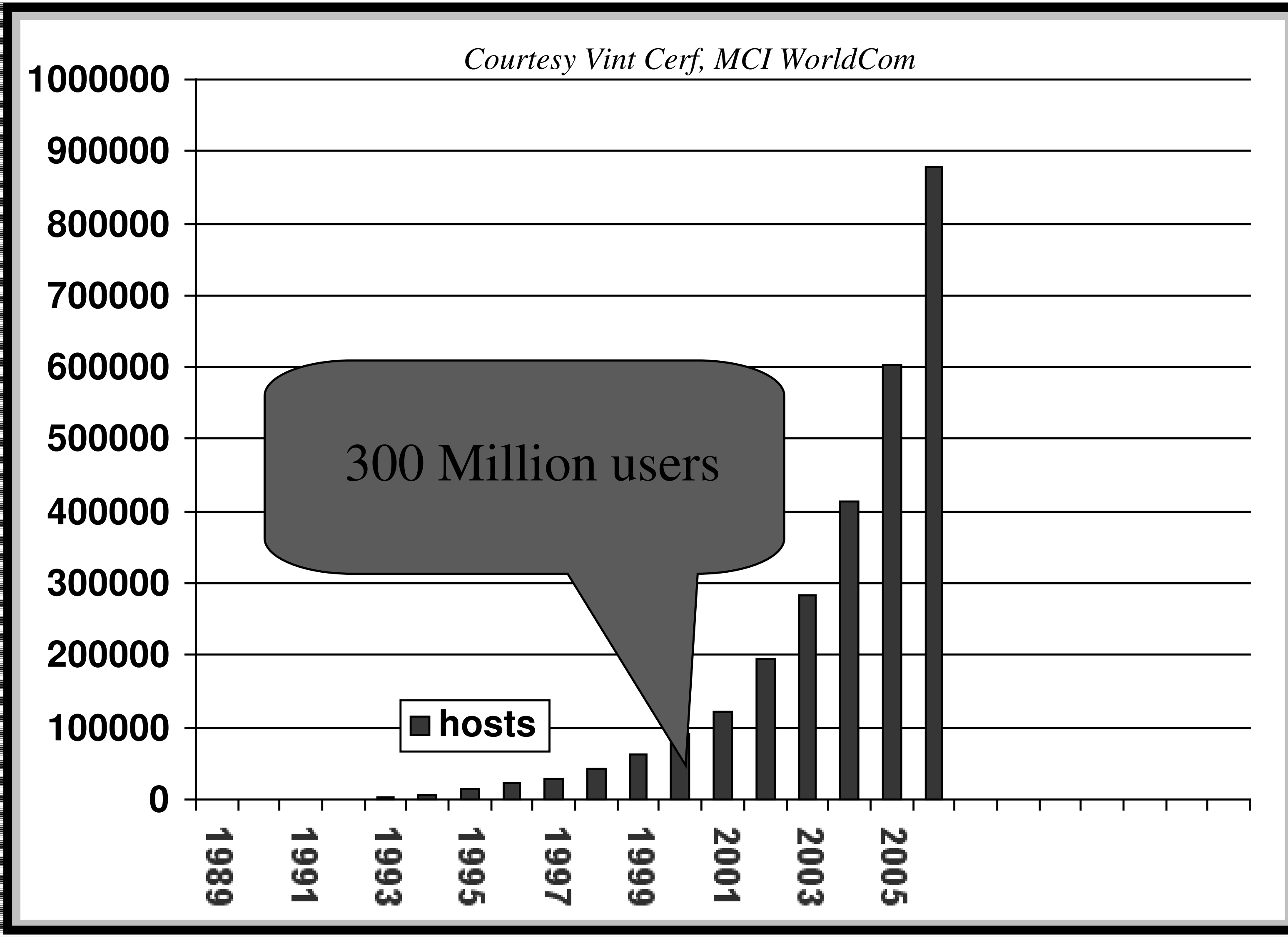
Sid Karin
skarin@sdsc.edu

"The thing about change is that things will be different afterwards."

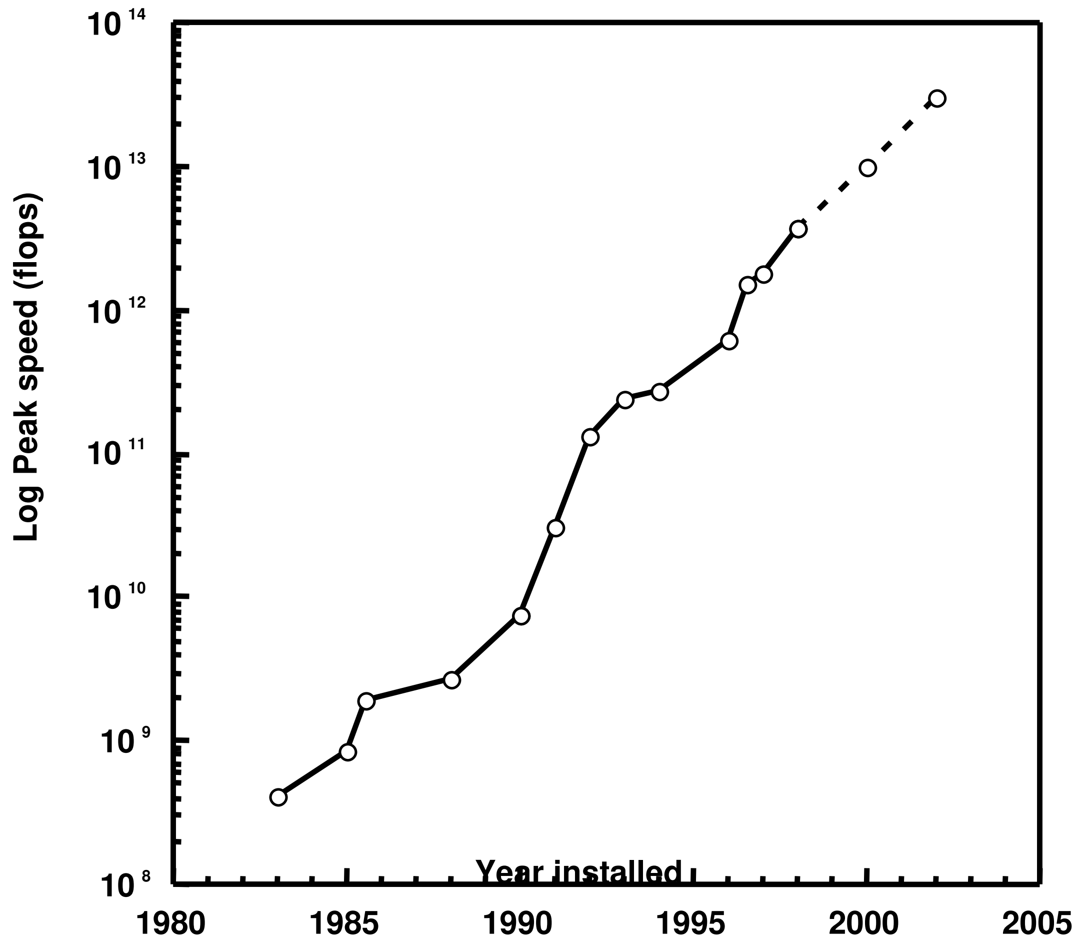
— Alan McMahon



Internet Hosts (000s) 1989-2006



Peak Speed of the World's Fastest Supercomputers



A Continuum is Emerging

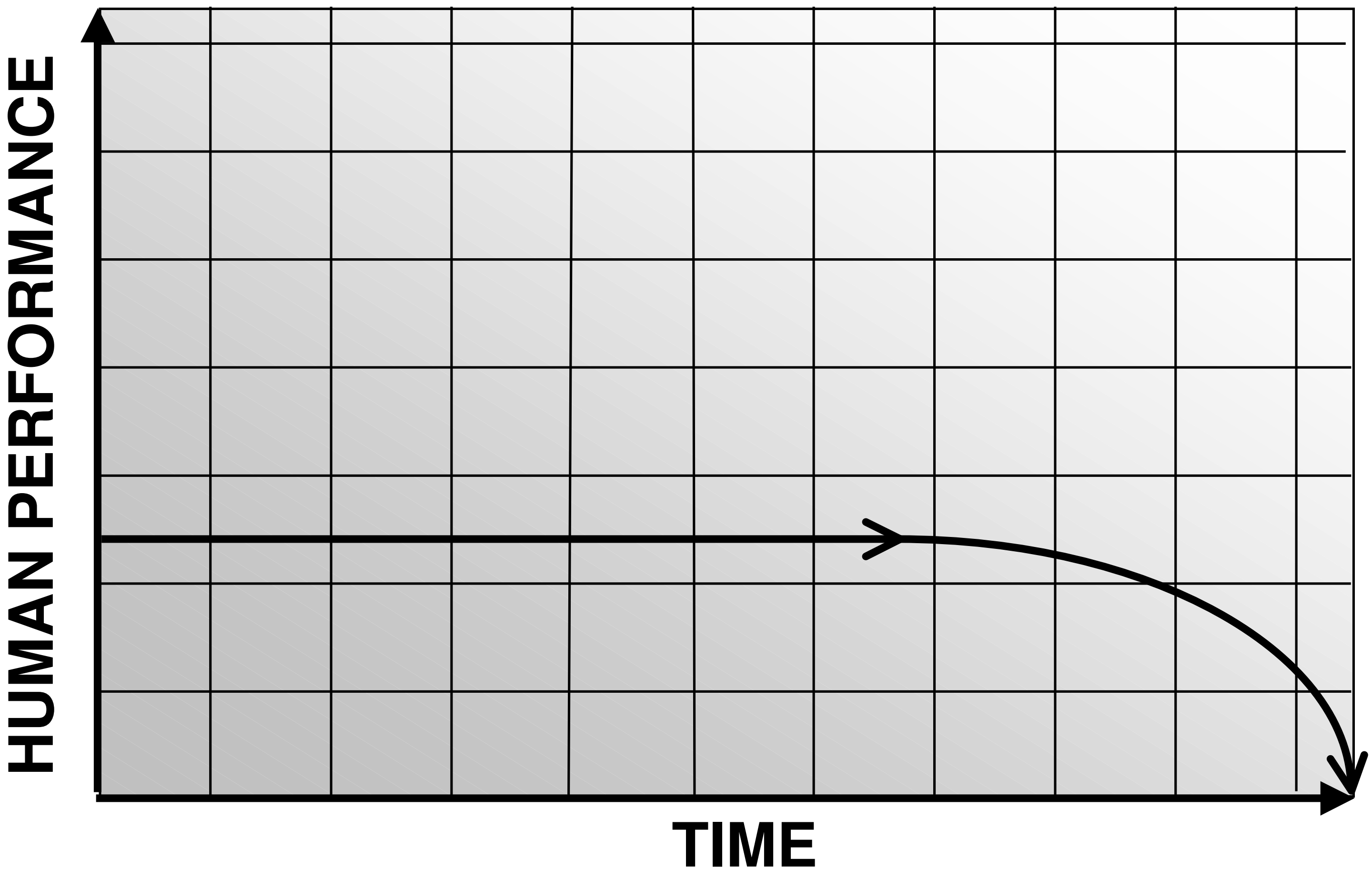
- All information is becoming *digital*
- Computing is becoming
  - Ubiquitous *used everywhere*
  - Continuous *interconnected*
  - Pervasive *invisible to the user*

<u>Human</u> Performance is Finite

An individual can absorb about one gigabyte of information per second (1 GB/s).

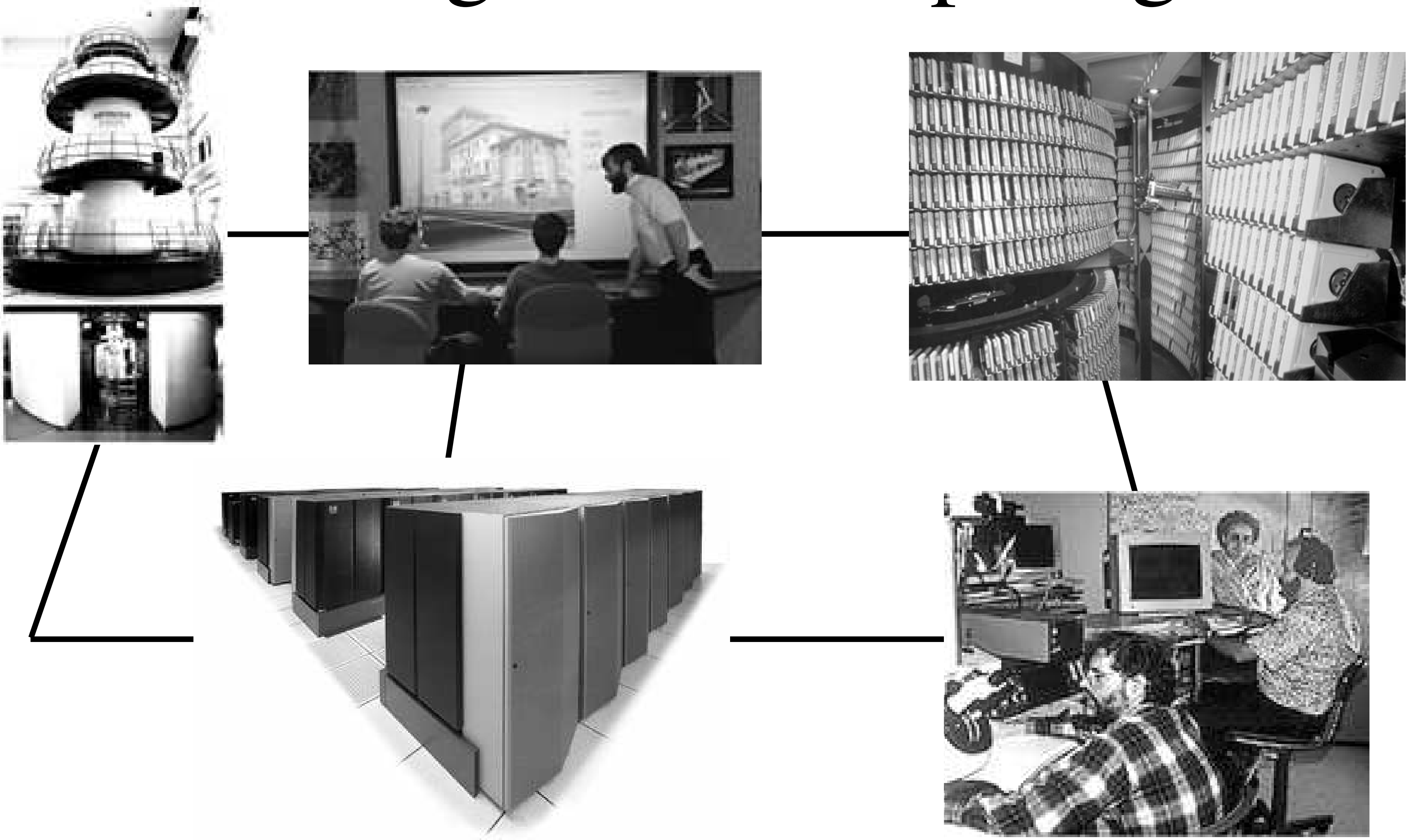
Most of this information is visual.

<u>Human</u> Performance is Constant



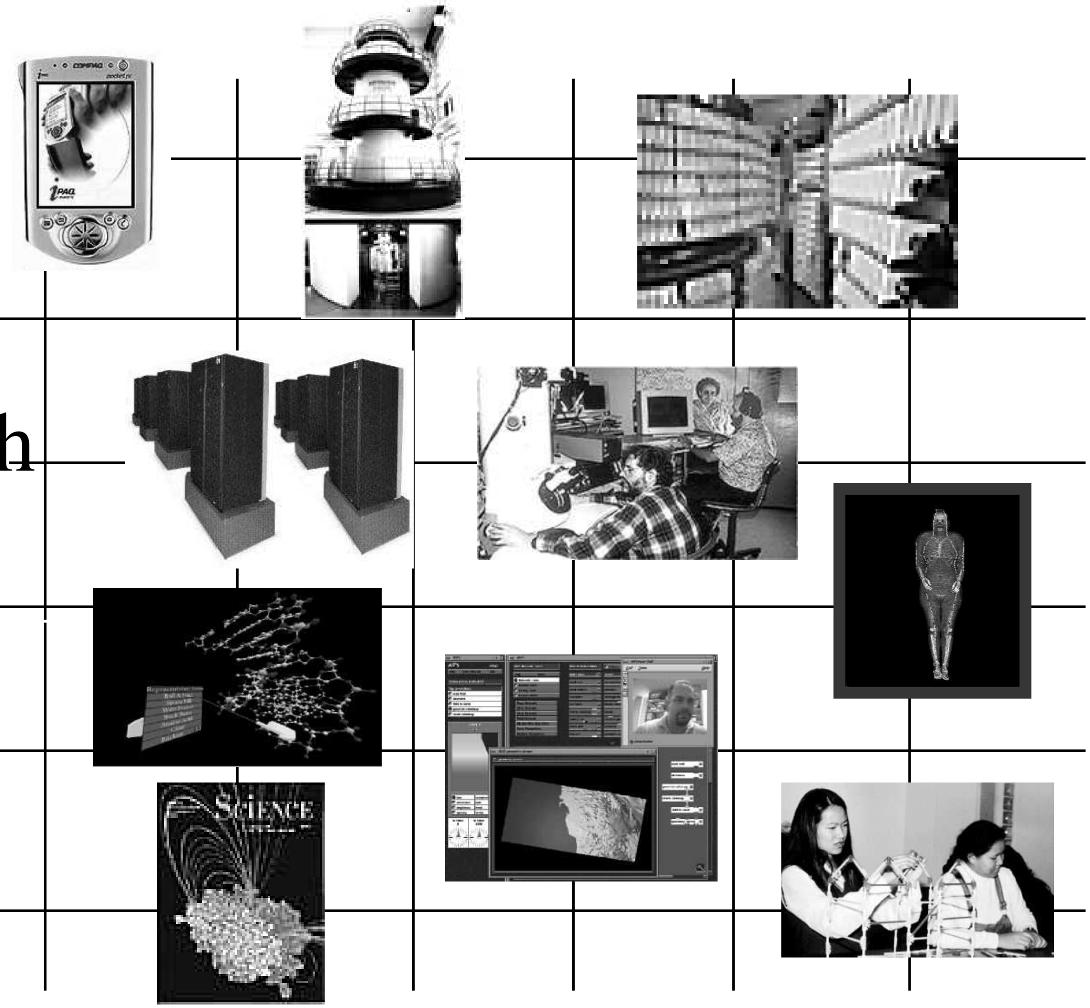
Low-End Computing...

High-end Computing



Changing How Science is Done

- Collect data from digital libraries, laboratories, and observation
- Analyze the data with models run on the *grid*
- Visualize and share data over the Web
- Publish results in a digital library



Supercomputers Give Us an Early View of the Mass Market Future

1985

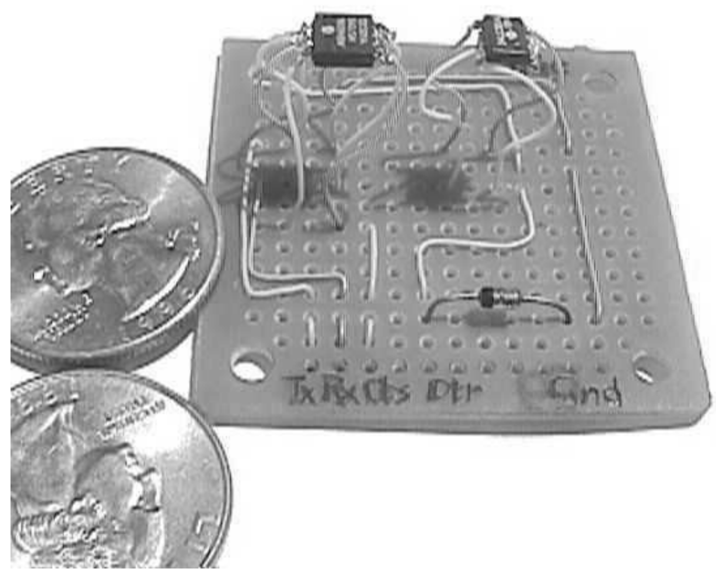
Cray X-MP Supercomputer
Located at National Center
Cost: $8,000,000
No Built in Graphics
56 kbps NSFnet Backbone

2000

Personal Computer
Located on Desktops
Cost: $2,000
Interactive 3D Graphics
56 kbps Laptop Modem

UMASS Web server on a chip born 10 AM, 14 July 1999

- TCP/IP code itself fits in about 256 bytes (12-bit)
- PIC 12C509A, running at 4MHz
- 24LC256 i2c EEPROM
- HTTP 1.0 and RFC 1122 compliant
- eternity.cs.umass.edu:

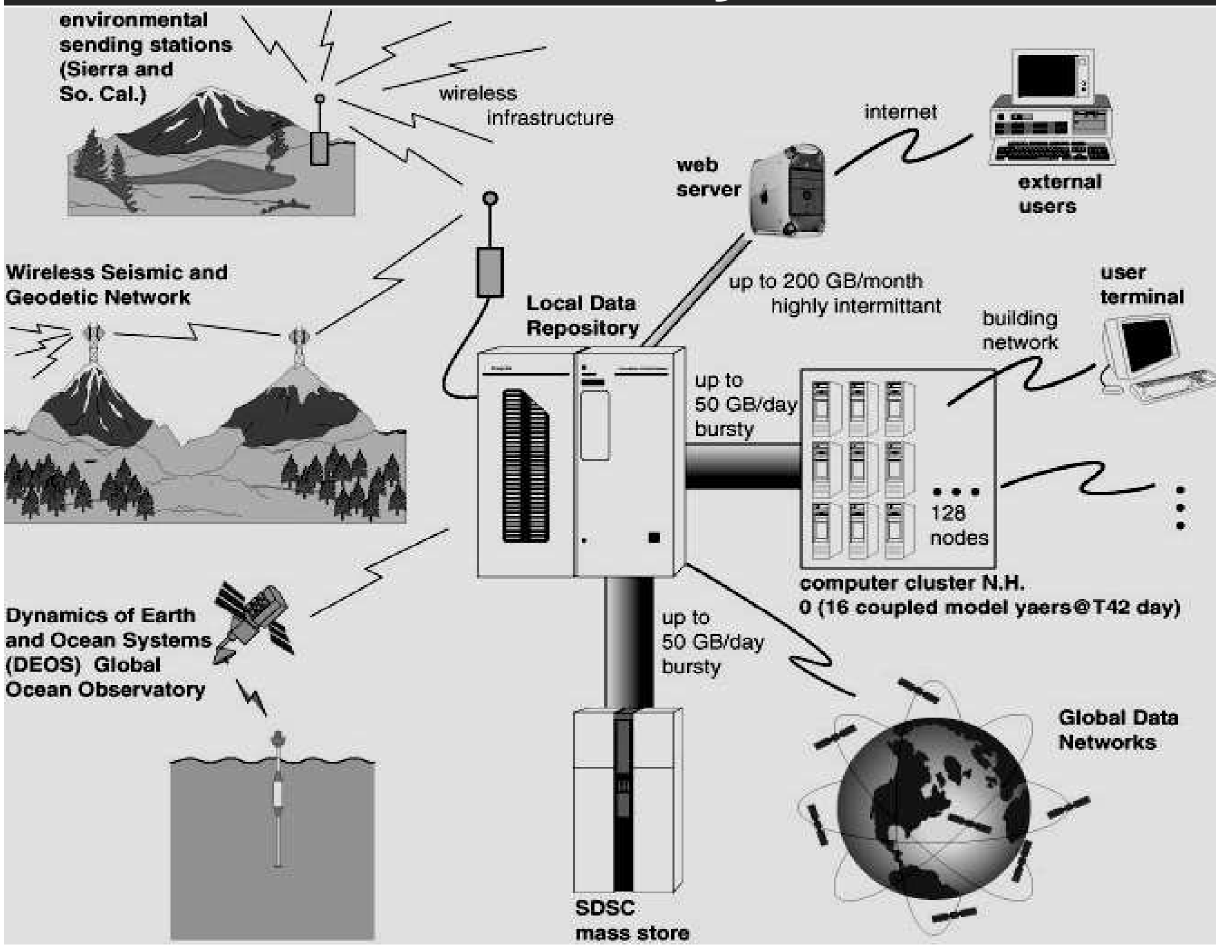


Courtesy Vint Cerf, MCI WorldCom

Gradually Our Bodies Will Move "On-Line"

Israeli Video Pill: Wireless Colonoscopy

The Wireless Internet Adds Bio-Chemical-Physical Sensors to the Grid



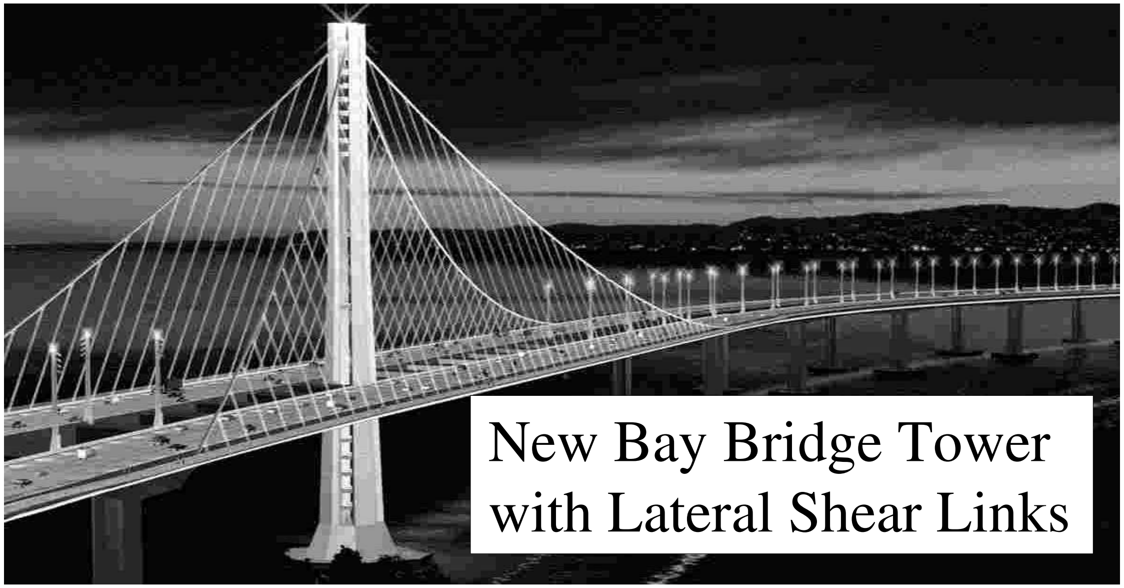
- From Experiments to Wireless Infrastructure
- Scripps Institution of Oceanography
- San Diego Supercomputer Center
- Cal-(IT)^2
- Building on Pioneering Work of Hans-Werner Braun & Frank Vernon

UCSD

Source: John Orcutt, SIO

CAL-(IT)^2

The Wireless Internet Will Improve the Safety of California's 25,000 Bridges



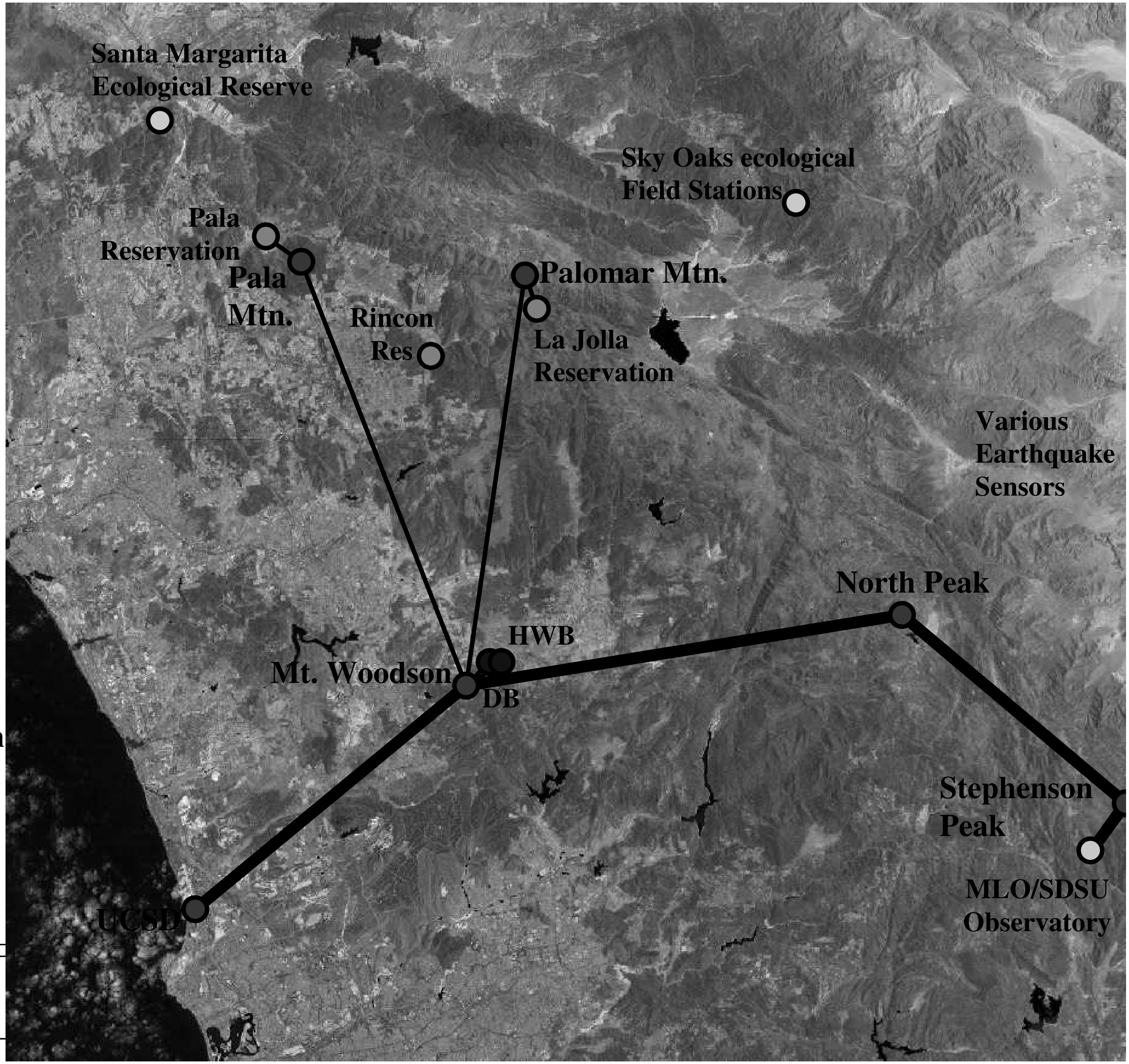
New Bay Bridge Tower with Lateral Shear Links

Cal-(IT)^2 Will Develop and Install Wireless Sensor Arrays Linking Orange and San Diego County Bridges to Crisis Management Control Rooms

Combined Efforts of UCI and UCSD

HPWREN implementation and agenda

Jan 2001



Network node

Research site

Education site

Researcher location

Backbone link

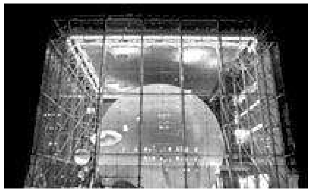
Access link

From Entertainment to Science

- Entertainment
- Education
- Communication
- Public Policy
- Business
- Engineering

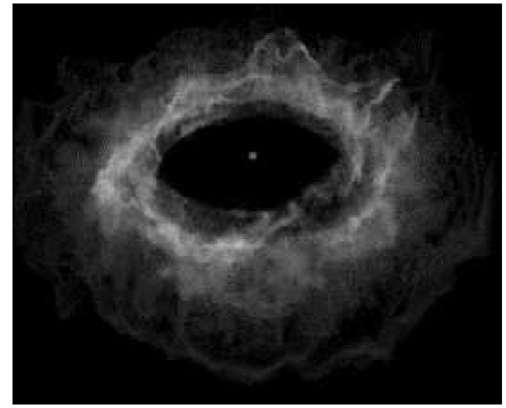
Looking out for San Diego's Regional Ecology

- Unique partnership
  - 31 federal, state, regional, and local agencies
  - John Helly, et al., SDSC
- Combines technologies and multi-agency data
  - Sensing, analysis, VRML
  - Physical, chemical, and biological data
- Web-based tool for science and public policy

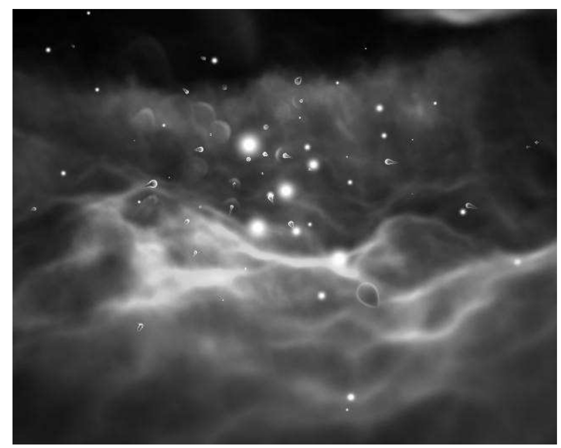


Digital Galaxy

- Collaboration with Hayden Planetarium
  - American Museum of Natural History
  - Support from NASA
- MPIRE Galaxy Renderer
  - Scalable volume visualization
  - Linked to database of astronomical objects
  - Produces translucent, filament-like objects



An artificial nebula, modeled after a planetary nebula



Viewing the Orion Nebula

How do the laws of the physical world apply to cyberspace?

Analogies

Ambiguity

Contradictions

Erroneous Assumptions

Misperceptions

Behavioral Constraints

@Lawrence Lessig

Laws

Markets

Culture

Architecture

Ethical vs. Unethical

Legal vs. Illegal

Right vs. Wrong

Moral vs. Immoral

Just vs. Unjust

Honorable vs. Dishonorable

Fair vs. Unfair

What?
Why?
How?
When?
Where?

What is the threat? What are we protecting against?

Denial of Service

Vandalism / Malicious Mischief

Theft of Service

Theft of Intellectual Property

Data Corruption

Privacy Violation

Attacks on Public Health/Safety/Morality