INDIANACTSI
Clinical and Translational Sciences Institute
Accelerating Clinical and Translational Research

a PTEC project
PHARMAHUB
COLLABORATION FOR PHARMACEUTICAL ENGINEERING AND SCIENCE

nanoHUB.org
an NCN project
ONLINE SIMULATION AND MORE FOR NANOTECHNOLOGY

C3Bio

CUAHD
Communities and Universities Addressing Health Disparities

catalyzeCARE
transforming healthcare delivery

VHUB
Collaborative volcano research and risk mitigation

NEEShub
George E. Brown, Jr. Network for Earthquake Engineering Simulation

hpc2
Improved Simulation Through Collaboration
Rensselaer Polytechnic Institute • Stony Brook University • University at Buffalo • Brookhaven National Laboratory • NYSERNet

iemHUB
a CIEM project
INTEGRATED ENVIRONMENTAL MODELING
A community center for developing and sharing knowledge and tools for environmental systems anal

trustHUB

CLEERHUB
Collaboratory for Engineering Education Research

VSCSE
VIRTUAL SCHOOL OF COMPUTATIONAL SCIENCE AND ENGINEERING

MEMSHUB

cceHUB
cancercareengineering

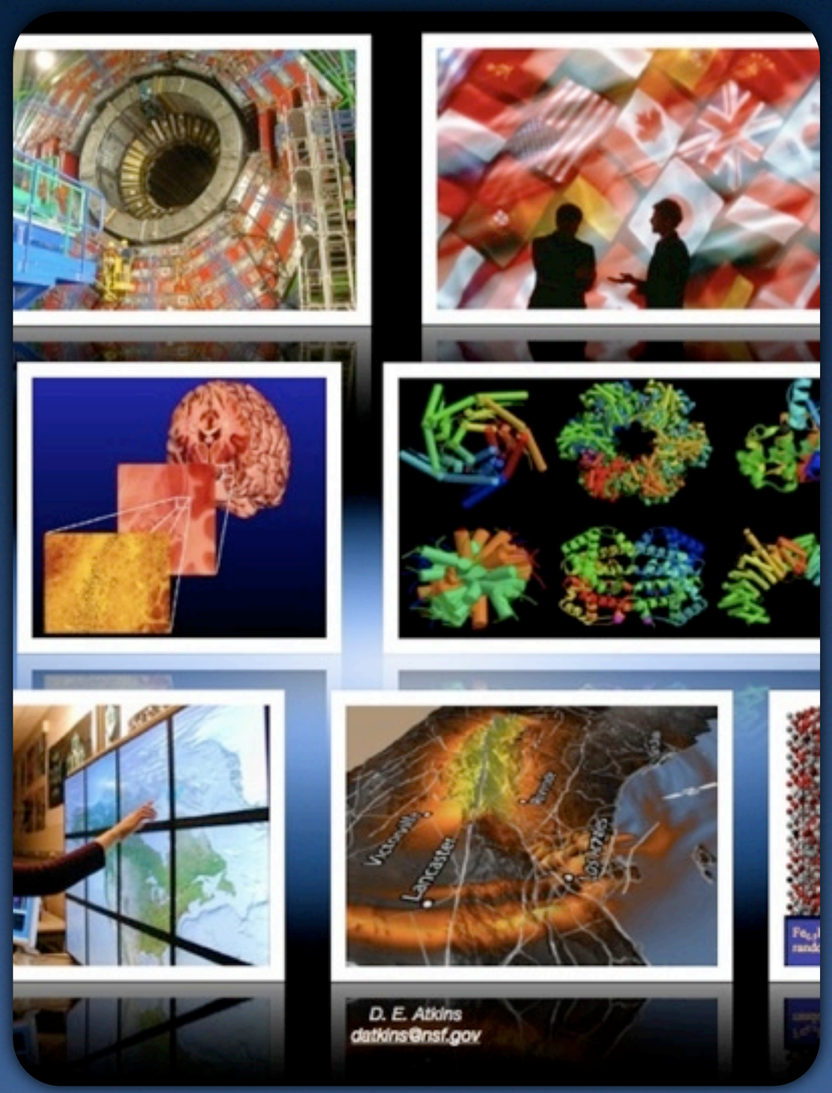
Science of Information
NSF Science and Technology Center

thermalHUB

CAT
CENTER FOR ASSISTIVE TECHNOLOGY
CONNECTING ASSISTIVE TECHNOLOGY CONSUMERS PROFESSIONALS, INNOVATORS, AND PROVIDERS

MANUFACTURINGHUB

GLOBALHUB
Advancing Global Engineering



The Greatest and Best Use of Cyberinfrastructure: High-Performance Collaboration

HUB BUB 2011
the HUBzero conference

Daniel E. Atkins
W.K. Kellogg Professor of Community Informatics,
Professor of EECS,
Associate VP for Research Cyberinfrastructure
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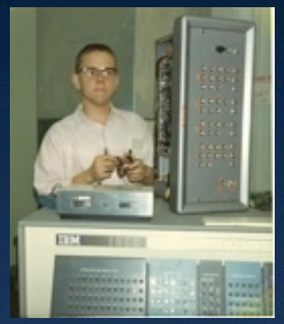
HUBzero

- In a larger historical context;
- as an object of celebration;
- as a system for future development.

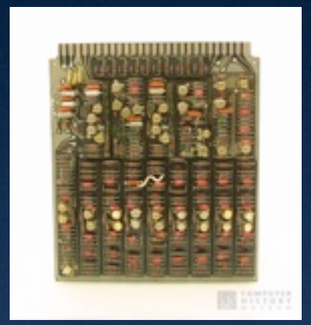
Personal Privilege and Amazement: From Digiclock to Petascale Grid Communities



1964 - Digiklok

1949-62 Illiac I

1956-68 Illiac II

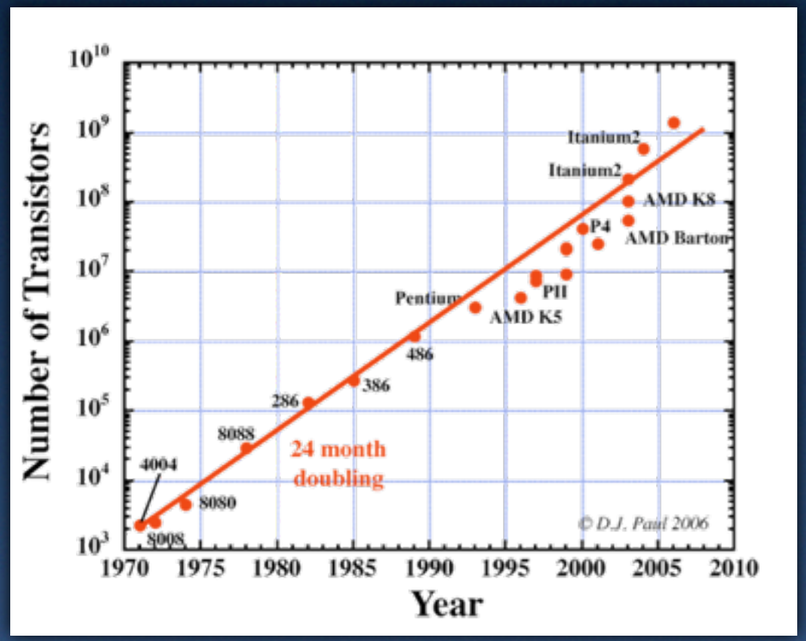


1960-68 Illiac III

1956-68 Illiac IV

1972-82 - Exp. Machines

The Marriage of Computing and Communication



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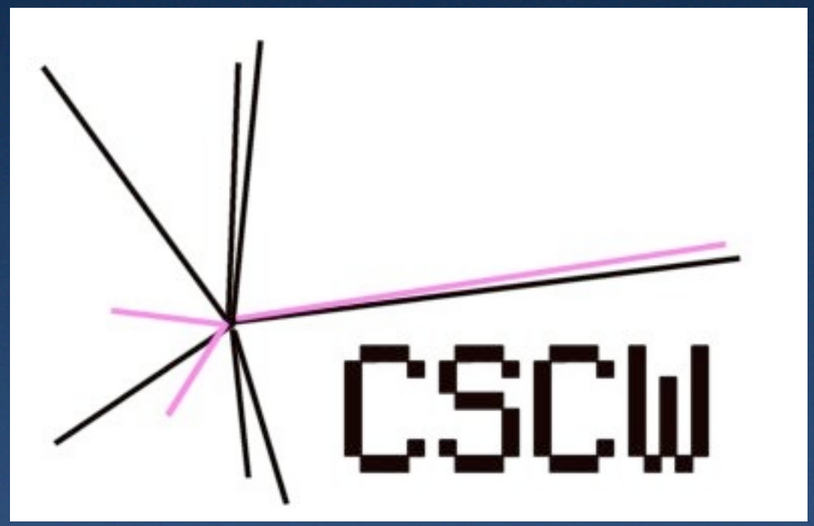
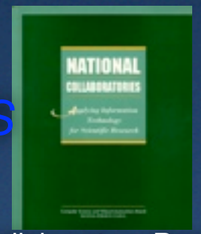
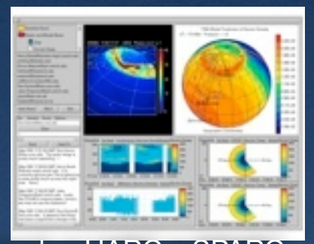


Personal Privilege and Amazement: From Digiclock to Petascale Grid Communities

1983- CAEN

EXPRES





1983- Collaboratory Research • UARC • SPARC

1990- UM Digital Lib Project

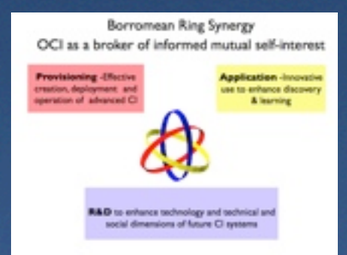
1993-School of Information

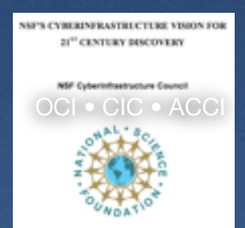
1997- Kellogg ACT

Information School Movement

2001-03 CI Adv. Panel

CI Convergence

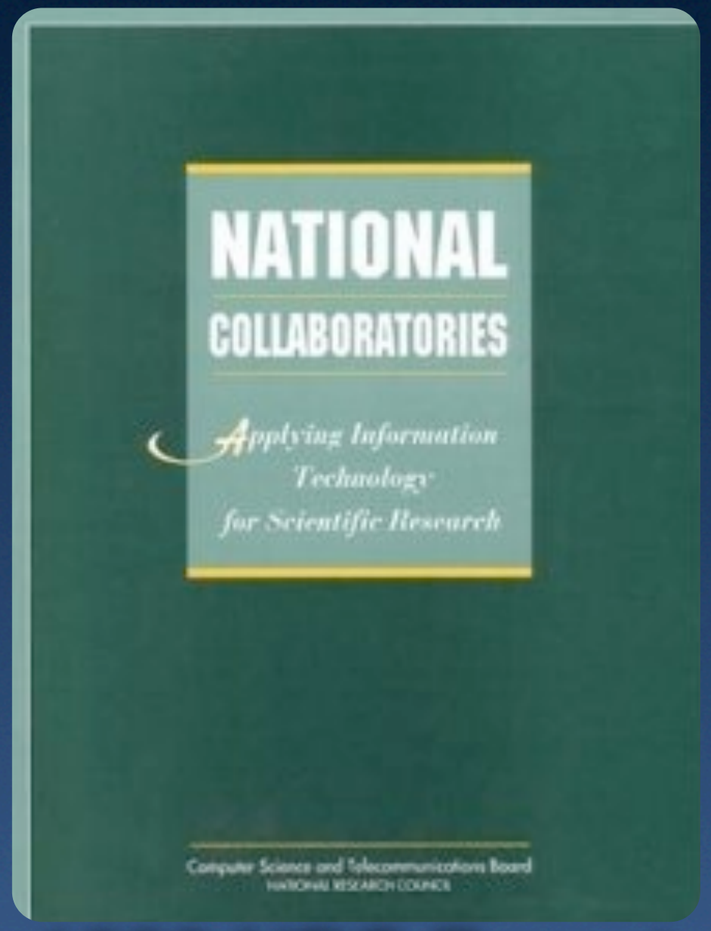




2006- NSF Office of Cyberinfrastructure

Towards a National Collaboratory

An Invitational Workshop at the Rockefeller University
March 17-18, 1989
http://ai.eecs.umich.edu/people/conway/CSE/CollabTech/CollabTechWorkshop.html



1993 NRC Report

http://www.amazon.com/National-Collaboratories-Information-Technology-Scientific/dp/0309048486

From Executive Summary of National Collaboratories...

The fusion of computers and electronic communications has the potential to dramatically enhance the output and productivity of U.S. researchers. A major step toward realizing that potential can come from combining the interests of the scientific community at large with those of the computer science and engineering community to create integrated, tool-oriented computing and communications systems to support scientific collaboration. Such systems can be called "collaboratories."

The University of Michigan Upper Atmospheric Research Collaboratory (UARC)

http://www.crew.umich.edu/research/research_uarc.html

The Initial Facility at Sondrestrom, Greenland

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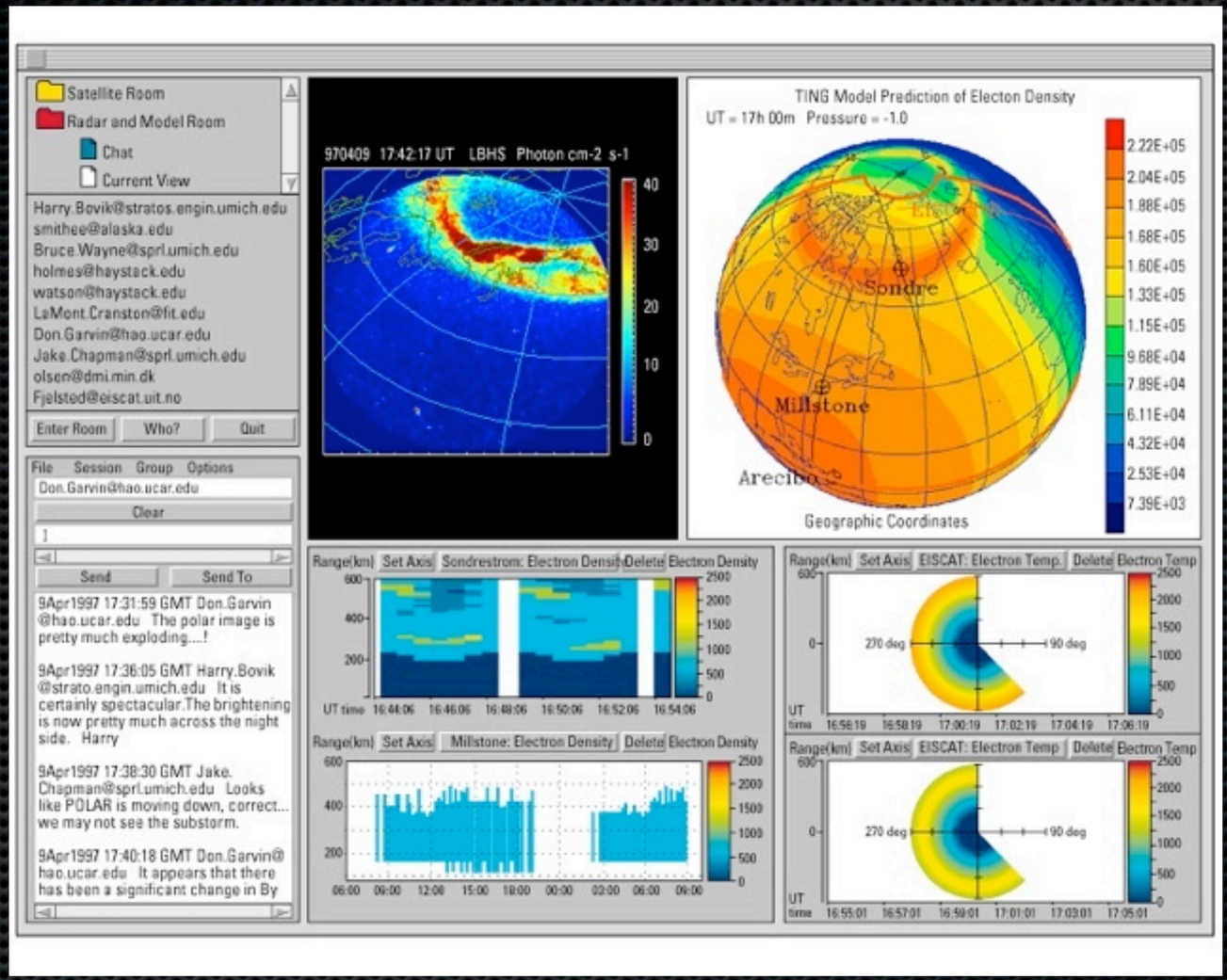
UARC Interface

Real-time instruments ***computational models***

dynamic work rooms

team chat



annotation

Session replay

Archival data ***Journals***

Evolved into a Network of Instruments (one global instrument)

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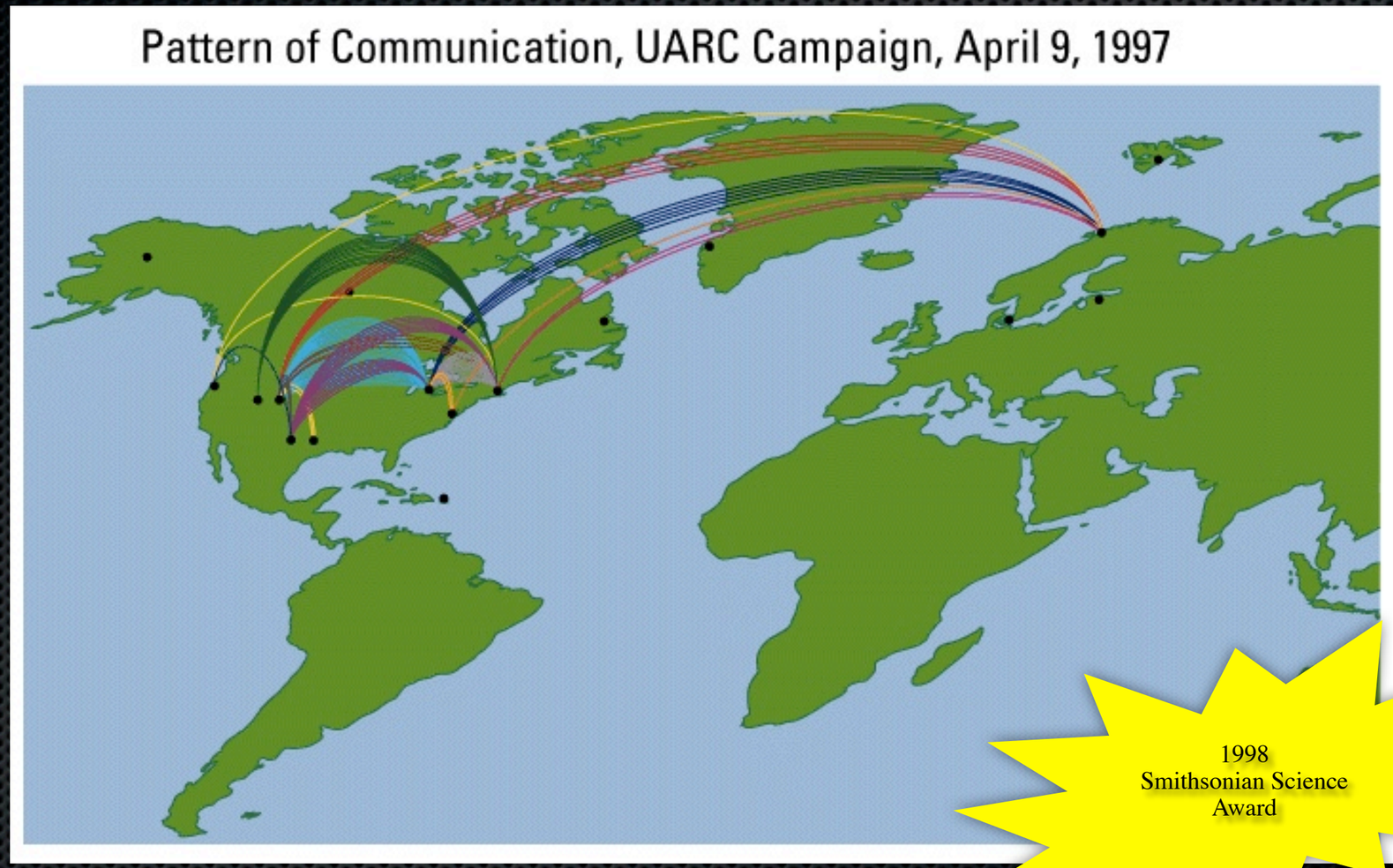
UARC Patterns of Communication



1998
Smithsonian Science
Award

University of Michigan

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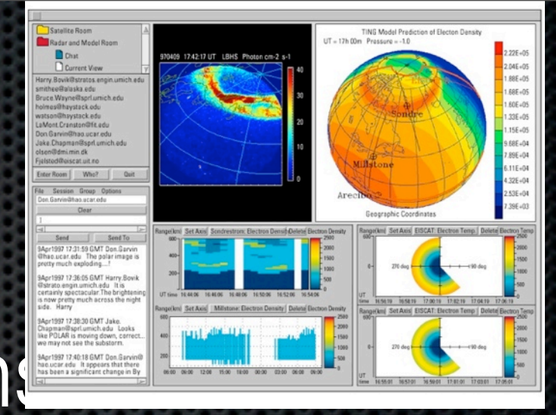
Vignettes from UARC/SPARC



- Shared, tele-instruments & expertise.
- Rapid response, opportunistic campaigns
- Multi-eyes, complementary expertise. Isolated instruments became a global instrument chain.
- Cross-mentoring/training.
- New & earlier opportunities/exposure for grad students.
- Enhanced participation. Legitimate peripheral participation.

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- Support for authentic, inquiry-based learning at UG and pre-college level.
- Distributed workshops for post-campaign data analysis.
- Session re-play for delayed participation.
- Data-theory closure.

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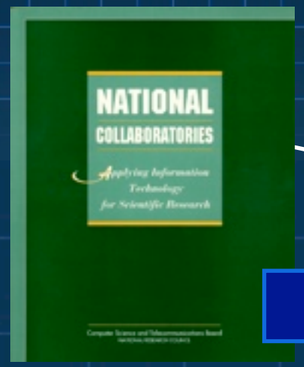
Cyberinfrastructure Genealogy & Movement



Collaboratories

KDI

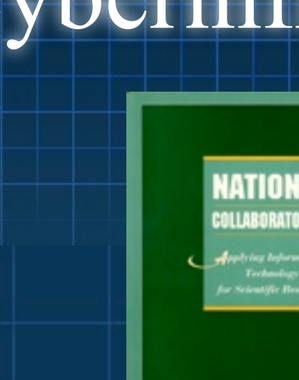
PACI

HPCC

Digital Libraries

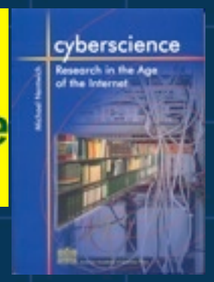
GRIDS

ITR

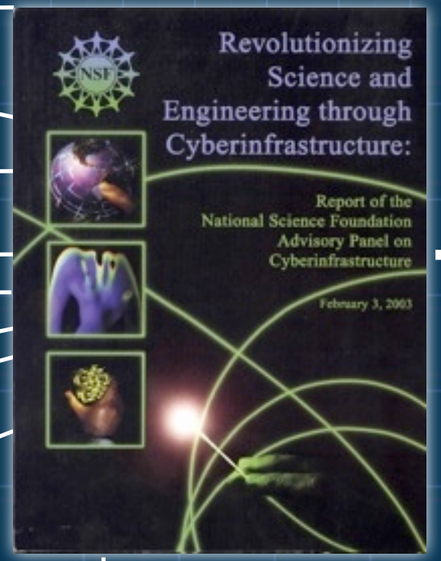


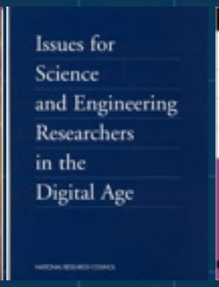
2nd Edition
www.mkp.com/grid2

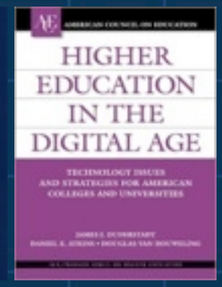
E-science



Cyberscience





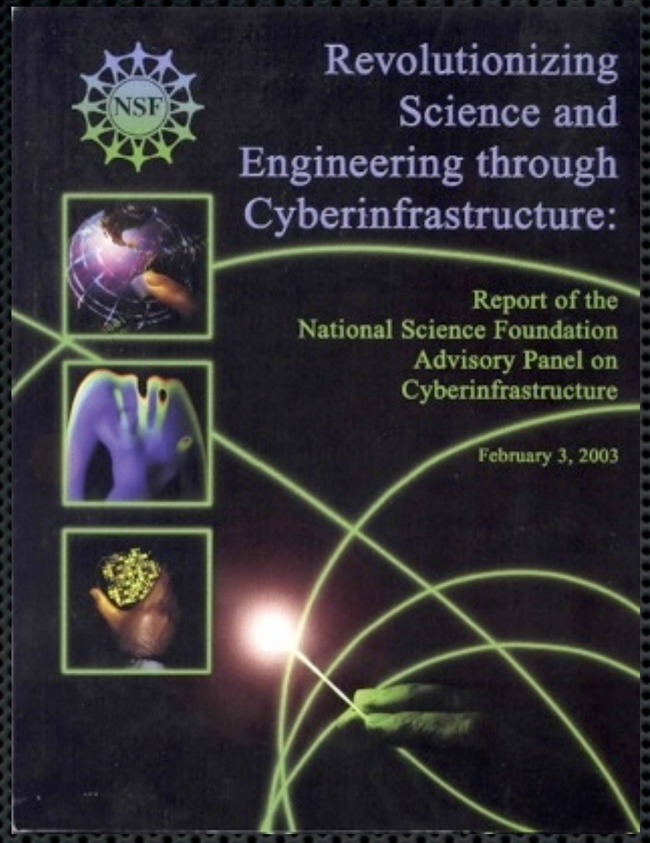


IT & Future of Higher Education

D. E. Atkins • University of Michigan • atkins@umich.edu

NSF Blue Ribbon Advisory Panel on Cyberinfrastructure

Daniel E. Atkins, Chair
University of Michigan
Kelvin K. Droegemeier
University of Oklahoma
Stuart I. Feldman
IBM
Hector Garcia-Molina
Stanford University
Michael L. Klein
University of Pennsylvania
David G. Messerschmitt
University of California at Berkeley
Paul Messina
California Institute of Technology
Jeremiah P. Ostriker
Princeton University
Margaret H. Wright
New York University

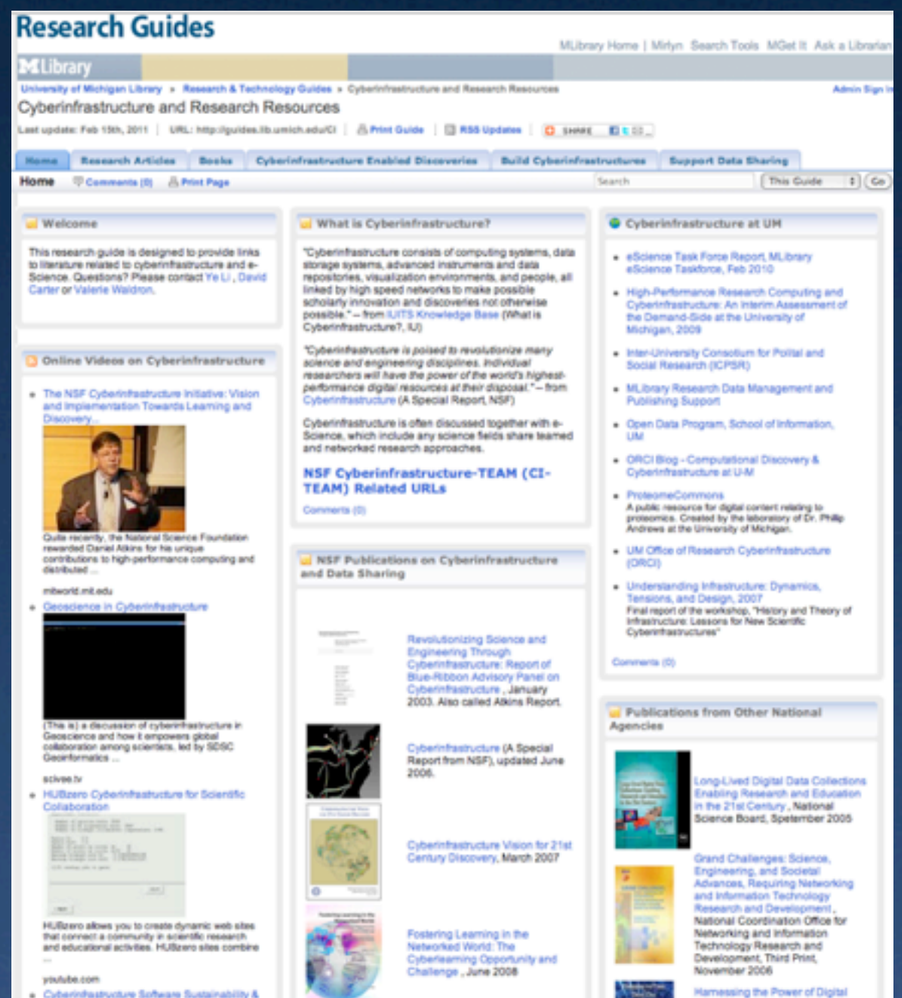


"a new age has dawned in scientific and engineering research, pushed by continuing progress in computing, information, and communication technology, and pulled by the expanding complexity, scope, and scale of today's challenges. The capacity of this technology has crossed thresholds that now make possible a comprehensive "cyberinfrastructure" on which to build new types of scientific and engineering knowledge environments and organizations and to pursue research in new ways and with increased efficacy."

http://www.nsf.gov/oci

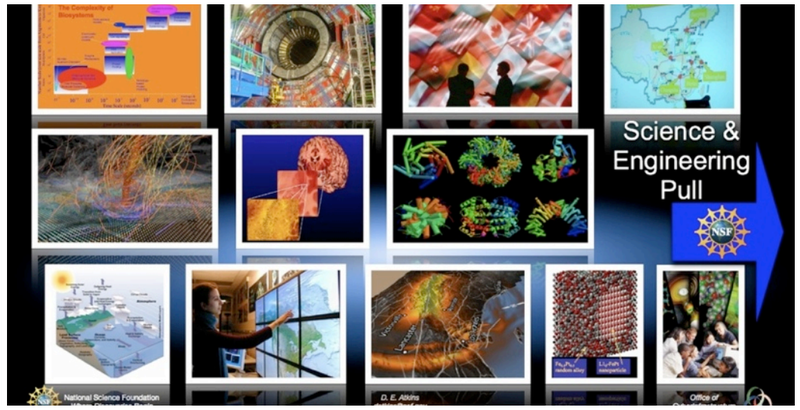
Now 100's of Reports on CI-enabled Research

http://www.nsf.gov/dir/index.jsp?org=OCI

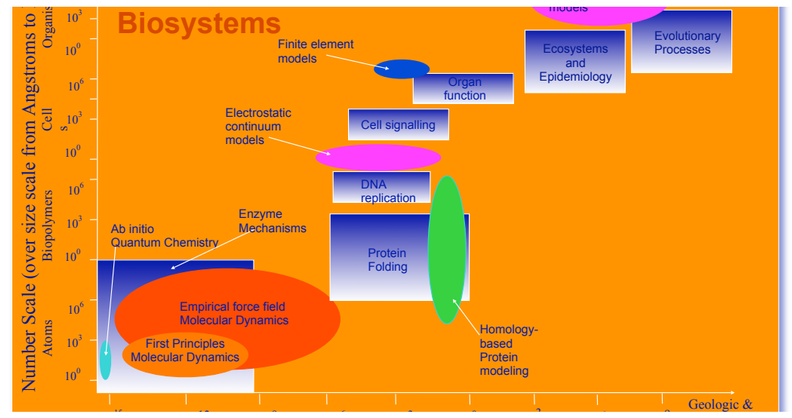


http://guides.lib.umich.edu/CI

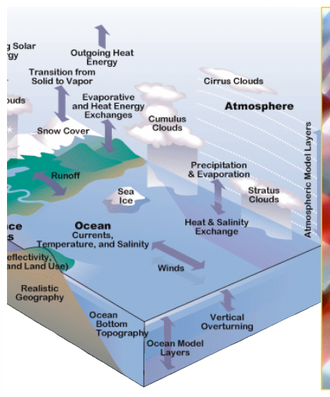
e-science (research enabled by e-infrastructure/ICT) is increasingly essential for meeting 21st century challenges in scientific discovery and learning



The inherent complexity, multi-scale, and multi-science nature of today's frontier science challenges.

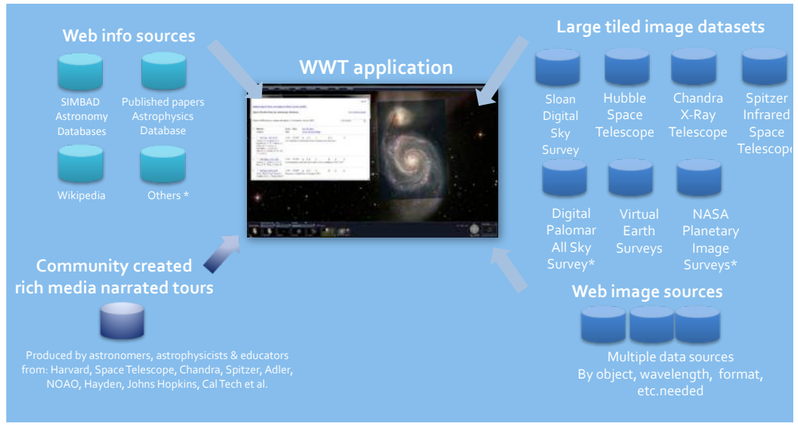


The accompanying requirement for multi-disciplinary, multi-investigator, multi-institutional approach (often international in scope).

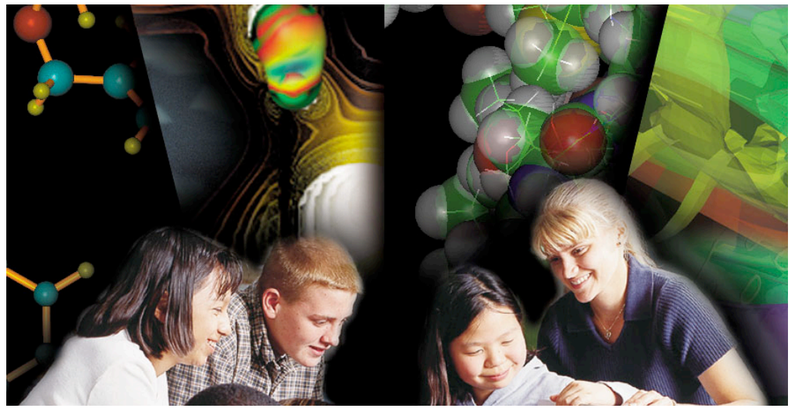


The high data intensity and heterogeneity from simulations, digital instruments, sensor nets, and observatories.

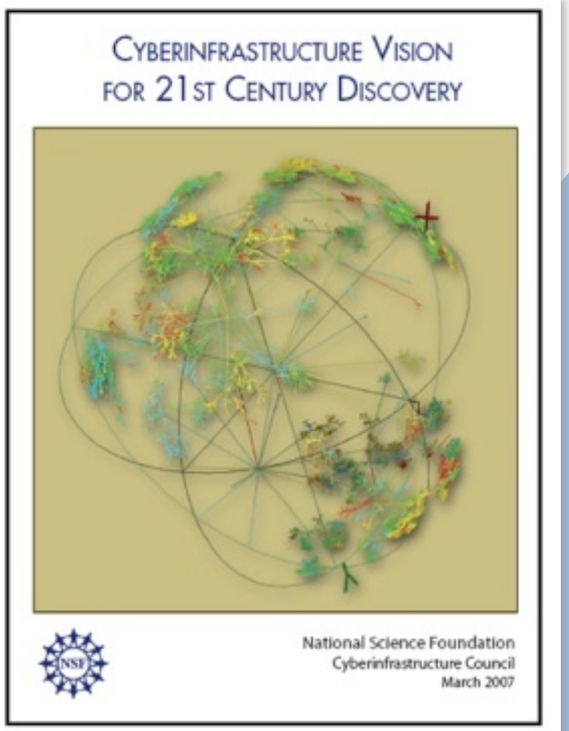
The increased scale and value of data and demand for semantic federation, active curation and long-term preservation of access.



And the need to engage more students in high quality, authentic, passion-building science and engineering education.



e-science



CI-enabled science

Community
(Virtual) Environments

High Performance Computing

Data & Visualization/ Interaction

Learning & Work Force Needs & Opportunities

Note: Many other reports on discipline-specific visions of and drivers for e-Science are available at www.nsf.gov/oci

NSF CIF-21: What we Need is a Cyberinfrastructure Ecosystem,

not just Components

Organizations

Universities, schools
Government labs, agencies
Research and Medical Centers
Libraries, Museums
Virtual Organizations
Communities

Expertise

Research and Scholarship
Education
Learning and Workforce Development
Interoperability and operations
Cyberscience

Scientific Instruments

Large Facilities, MREFCs,telescopes
Colliders, shake Tables
Sensor Arrays
- Ocean, environment, weather, buildings, climate. etc

Collaboration in Discovery & Learning

Data

Databases, Data repositories
Collections and Libraries
Data Access; storage, navigation management, mining tools, curation

Computational Resources

Supercomputers
Clouds, Grids, Clusters
Visualization
Compute services
Data Centers

Software

Applications, middleware
Software development and support
Cybersecurity: access, authorization, authentication

Networking

Campus, national, international networks
Research and experimental networks
End-to-end throughput
Cybersecurity

Maintainable, sustainable, and extensible

CIF-21 FY 12 Focus Areas

- Data-Enabled Science
- Community Research Networks
- New Computational Infrastructure
- Access and Connections to Cyberinfrastructure Facilities

CIF-21 Community Research Networks...

New cyberinfrastructure tools and changes in the research process have enabled community research networks to address complex, multi-disciplinary problems of societal concern such as competitiveness, security, economic development, and well-being. Community research networks enable people and organizations to perform everyday research functions more effectively by building on and integrating diverse resources, knowledge, and abilities. NSF has a long history of investing in community research networks such as the iPlant collaborative, the Southern California Earthquake Center, the SRS Data Enclave, and the nanoHUB. Cyberinfrastructure links these combinations of people, organizations, instrumentation, physical facilities, computers, data, and software, but few scientists know how to select and assemble these components into a functioning community research network. Focused investments in socio-technical analyses advance understanding of how to develop virtual organizations, and under what conditions they can foster innovation in science, engineering and education. Such investments are necessary to harness the full potential and promise offered by virtual organizations.

Celebrating Hubzero

- In contrast to early collaboratory projects such as UARC that were “hard-wired” for particular project, Hubzero is a platform -- a meta collaboratory -- that can be tailored to many different domain specific projects. For example:

- HUBzero is having international impact on science and engineering research and learning.

- HUBzero through a web-based portal reduces the barrier of entry to the use of high-performance computing for modeling, simulation, and prediction. It also draws upon multiple resources, both local and remote including the TeraGrid.
- HUBzero is intentionally designed to support both research and education.
- HUBzero encourages openness in sharing codes, courseware, and data (?).
- HUBzero has done better than most in financial sustainability.

Knowledge Communities CI Model

- The key figure of merit for the application of IT in research, learning and practice should be the extent to which it enhances the effectiveness of knowledge communities engaged in learning, discovery, and practice.
- Developments in CI-enabled science now point the way to creating and nurturing cyberinfrastructure to enable groups to work together in functionally-complete, four-quadrant organizations.
- The overarching goal is “high performance collaboration” not just high performance computing.

Four Quadrant Organizations (virtual organizations) offer additional modes of interaction between People, Information, and Facilities

Time

Geographic Place	Same (synchronous)	Different (asynchronous)
Same	**ST-SP** **P**: Physical mtgs **I**: Print-on-paper books, journals **F**: Physical labs, studios, shops	**DT-SP** **P**: Shared notebook **I**: Library reserves **F**: Time-shared physical labs, ...
Different	**ST-DP** **P**: AV conference **I**: Web search **F**: Online instruments	**DT-DP** **P**: Email **I**: Knowbots **F**: Autonomous observatories

Physical + Virtual,
Not Physical vs. Virtual

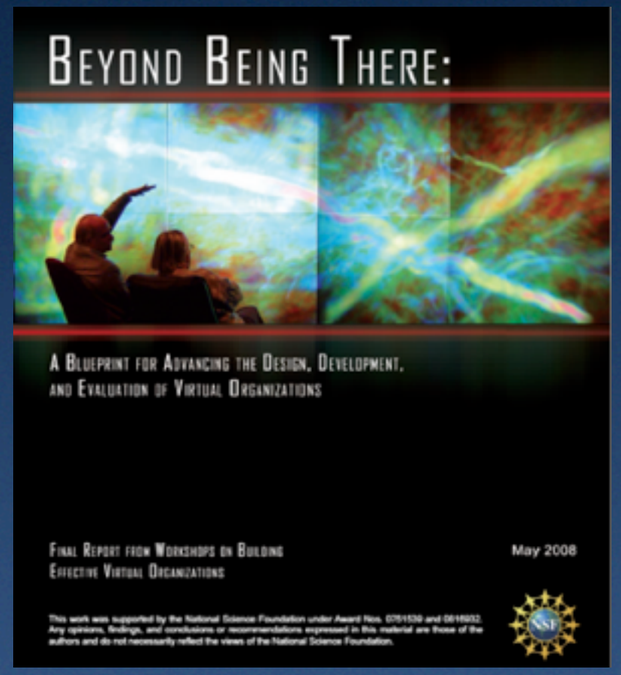
P: People
I: Information
F: Facilities, instruments

Some Attributes of 4-Quadrant Communities

- These all quadrant organizations are not just conversing *about* people and doing work, they are also sharing objects to observe, manipulate, and discuss. They therefore can incorporate **both** explicit and tacit knowledge creation and transfer.
- Conversations themselves (the collaborative sessions) can be captured and used later as an object of conversation and reflection.
- Enables engagement in open learning, exploration, and knowledge creation and to shift more from an authority-based learning model to a discovery-based learning model.
- This model does not make a sharp distinction between learning, teaching, discovery, research, and practice. These are activities all supported in blended ways within the knowledge communities model.

Game Changers

- Game-changing possibilities for “better than being there” organizational forms:
  - decreased time *to* discovery;
  - decreased time *from* discovery;
  - increased intellectual cross-section and transformational results;
  - enhanced stewardship and return on investment for research infrastructure investments;
  - multi-use: discovery, learning, rapid-response, ...
- A key to economic leadership in a global knowledge-based flat world.



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nanoHUB – nanoHUB Home

nanoHUB
online simulation and more
an NCN project

Home | My nanoHUB | Resources | Contributors | Events | About | Support

Nanotechnology 101
Introduction to nanotechnology

1 2 3 4 5 6

Nanotechnology 101 is a series of lectures designed to provide an undergraduate level introduction to nanotechnology. Our Nanotechnology 501 series offers lectures directed at the graduate student/ professional level.

Learn more

A resource for nanoscience and technology, th
development is driven by research themes in:

Nanoelectronics NEW
NEMS/Nanofluidics
Nano-Bio Devices

Simulate

Nanoelectronics
Tools for nanoelectronics

NEMS/Nanofluidics
Tools for NEMS and Nanofluidics

Nano-Bio Devices
Tools for nano-bio devices

More ›
Browse all available tools

Research

Seminars / Workshops
Cutting edge research

Collaborate
Work with your colleagues

Web Meetings
Right in your browser

User Groups
Share with your colleagues

Events

April

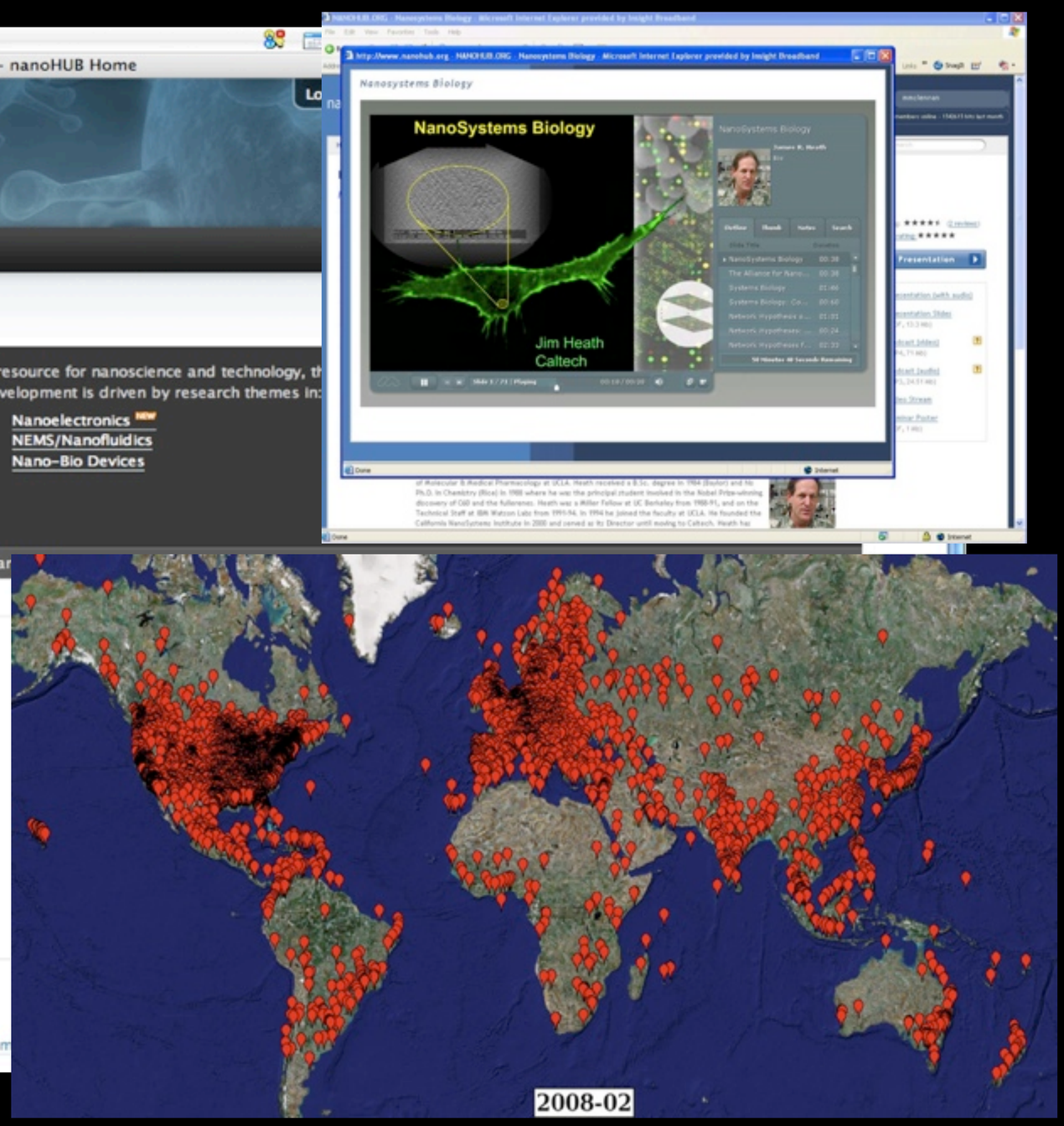
Announcements

- 2008 NCN@Purdue Summ
Bottom Up – Jul 14th

Nanosystems Biology

NanoSystems Biology

Jim Heath
Caltech



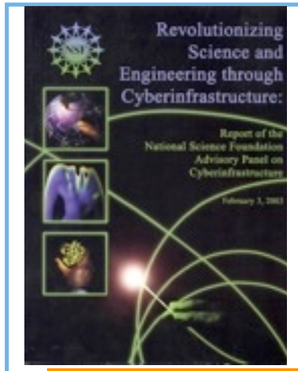
Suggestions & Questions for HUBzero Future

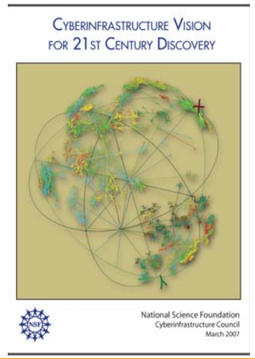
- Conceptualize HUBzero as supporting all-quadrant collaboratories with a goal to become functionally complete.
- Data-intensive scientific discovery is becoming more prominent is what some call a Fourth Paradigm for Science. What does HUBzero need to do to support this?
- View your core competency as that of enabling others to create collaboratories efficiently and effectively and the community you have builta s aprimary asset, rather than thinking of yourselves more narrowly as the creators and stewards of a particular set of software.

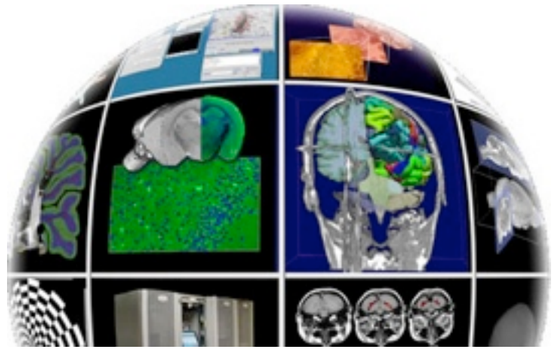
- Many universities are moving to cloud-based collaboration environments now offered by Google and emerging from Microsoft. With this and the previous point in mind, can HUBzero find ways to link with and leverage the Google Apps environment?
- The Sakai Foundation is now embarked on creating an open source platform called Sakai 3 that will be a platform for an Open Academic Environments that are built to provide functions need in the university but not as a monolithic system but rather as one that leverages cloud-based services available from others. Might HUBzero be part of this?

- Be more intentional about the positive impact of HUBzero on STEM education, especially on blended forms of formal and informal learning. Explore, for example, how HUBzero can contribute to visions and directions articulated in the new National Education Technology Policy, the NSF report on Cyberlearning, and the MacArthur Foundation initiatives on Connected Learning.
- Work with the Creative Commons, now with new leadership, to promote appropriate open licensing for codes, data, and scholarly communications.

- What is your plan to provide long-term access to (preservation of) all of the the digital objects in your Hubs? This is important for many reasons, perhaps most profoundly to preserve the reproducibility of research results so fundamental to science.
- What are metrics of impact of HUBzero built environments and can you establish more data gathering and research to explore these metrics? Could you demonstrate quantitative payoff from investments in the Hubs.

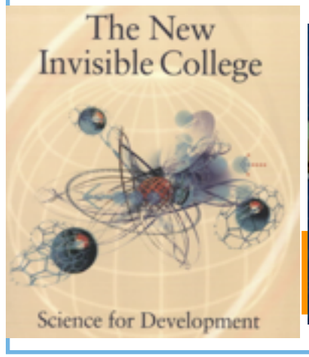


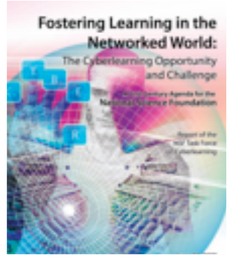




e-Science

e-Humanities & Arts



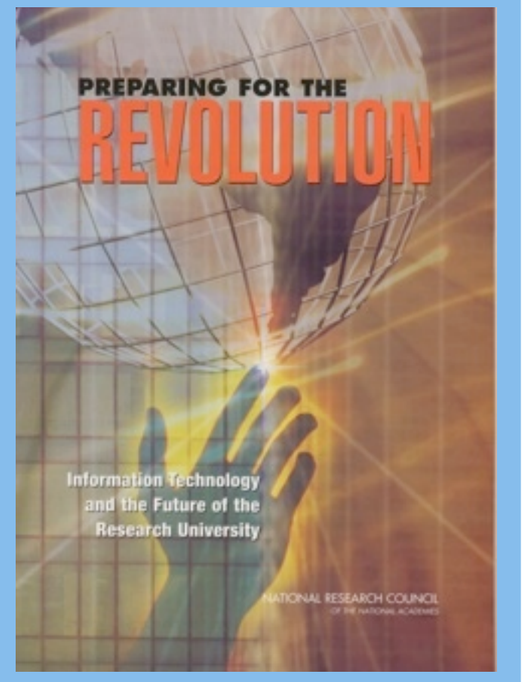


e-Learning

Transforming American Education:
Learning
Powered by Technology

e-Development

The Research University in the Digital Age



Questions & Discussion