

Maximizing Returns on National Investments Through Cyberinfrastructure

Daniel E. Atkins
U. S. National Science Foundation
datkins@nsf.gov
www.nsf.gov/oci

*Workshop on Advanced Collaborative Environments and
CERN Large Hadron Collider Users*

*December 11-13, 2006
International Conference Centre
Geneva, Switzerland*



Office of
Cyberinfrastructure

D. E. Atkins



The University of Michigan Upper Atmospheric Research Collaboratory (UARC)



The Initial Facility at
Sondrestrom, Greenland



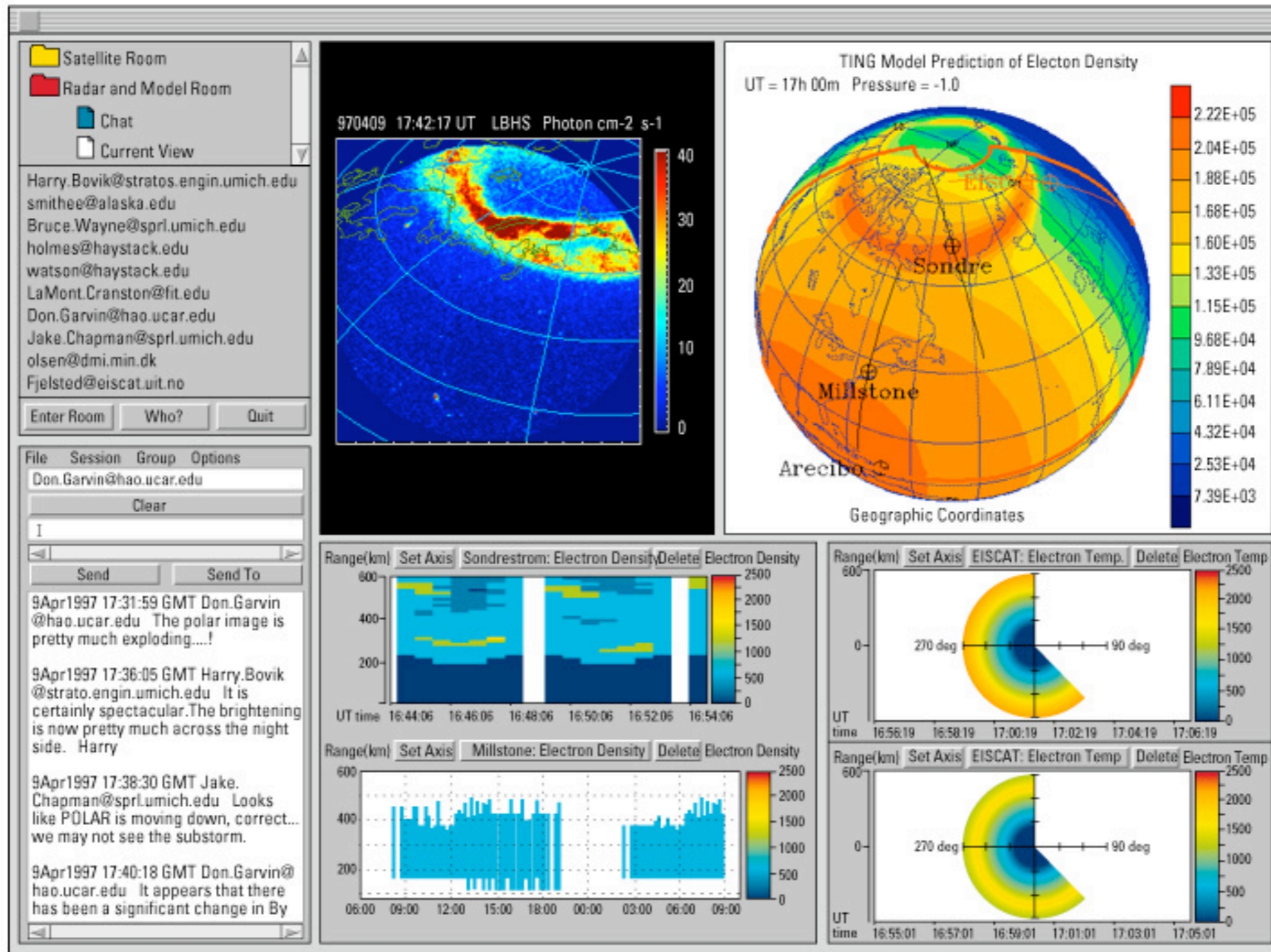
UARC Interface (circa 1988)

Real-time instruments

computational models

*dynamic
work
rooms*

*team
chat*



annotation

Session replay



Office of Cyberinfrastructure

Archival data

Journals

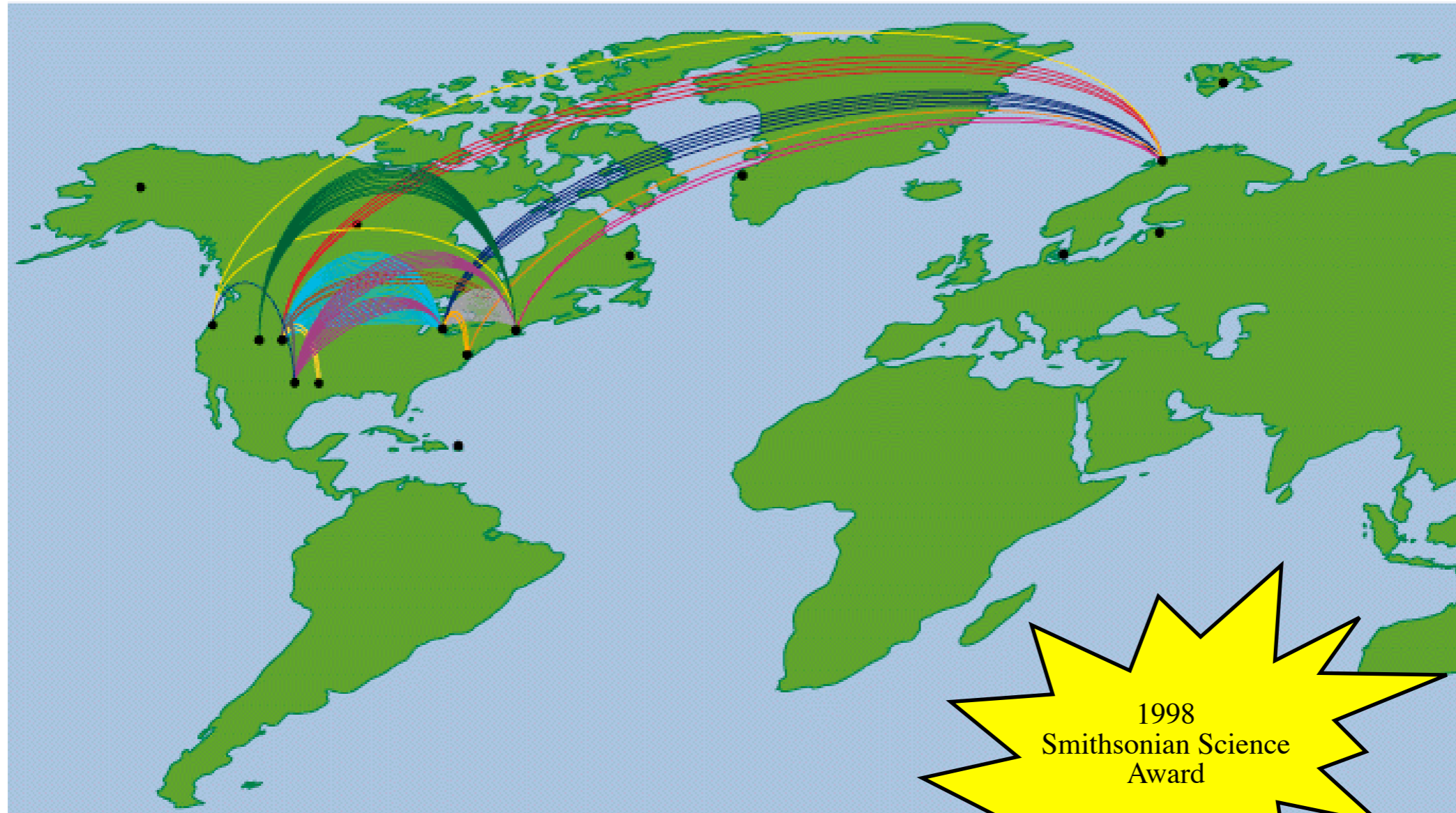
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Evolved into a Network of Instruments (one global instrument)



UARC Patterns of Communication

Pattern of Communication, UARC Campaign, April 9, 1997



Vignettes from UARC/SPARC

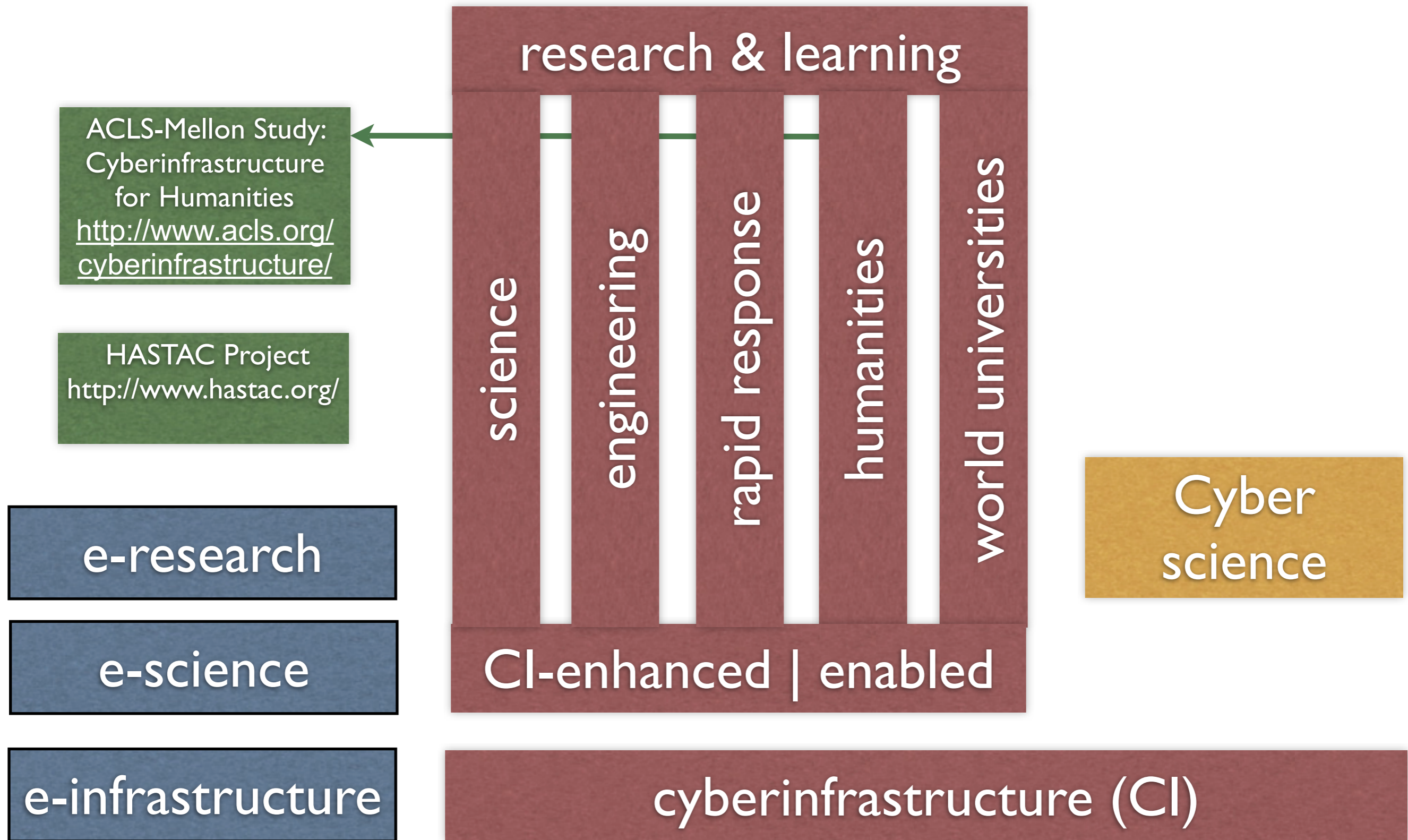
- Shared, tele-instruments, multiple eyes & complementary expertise.
- Rapid response, opportunistic campaigns.
- Isolated instruments became a global instrument chain.
- Cross-mentoring/training.
- New & earlier opportunities/exposure for grad students.
- Enhanced participation. Legitimate peripheral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



- 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 and capture of process/provenance.
- Data-theory closure.
- A “living specification”. Experiencing the new.



Current Nomenclature



Dualities

cyberinfrastructure

enables

research &
development

CI is both an object and means for R&D

collaboration

enables

CI
environments

Multi-stakeholder collaboration required to create, provision, and apply CI; CI supports collaborations across time and distance (geographic, disciplinary, institutional)

learning | education

enables

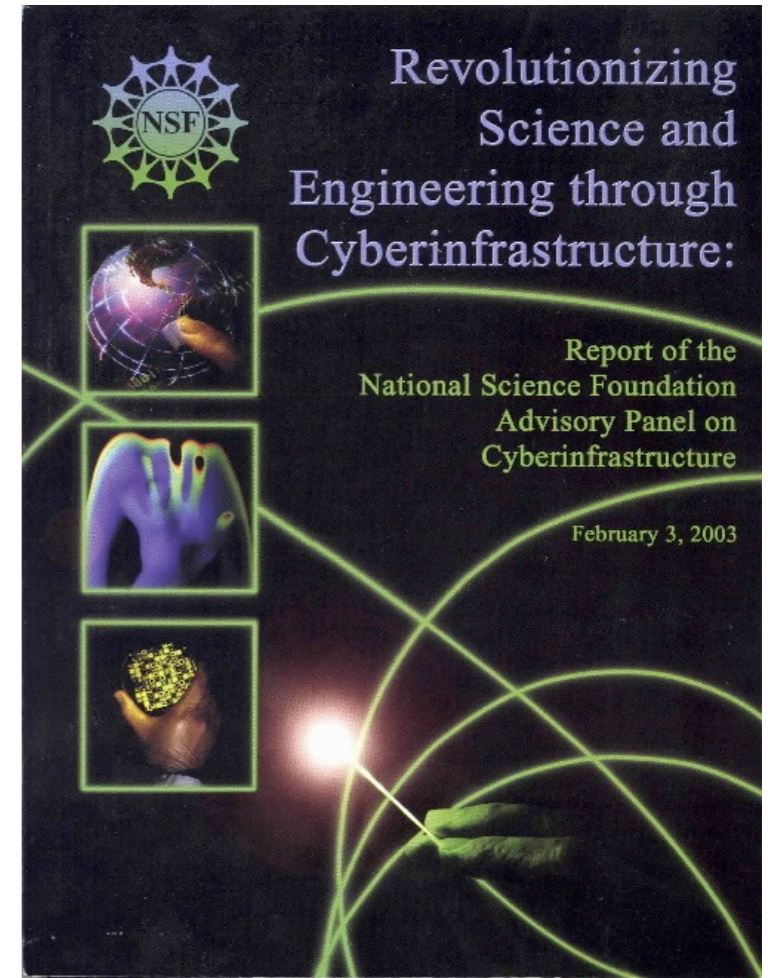
CI
environments

Learning and workforce development initiatives required to create and use CI; CI enables/enhances learning/education

NSF Blue Ribbon Advisory Panel on Cyberinfrastructure

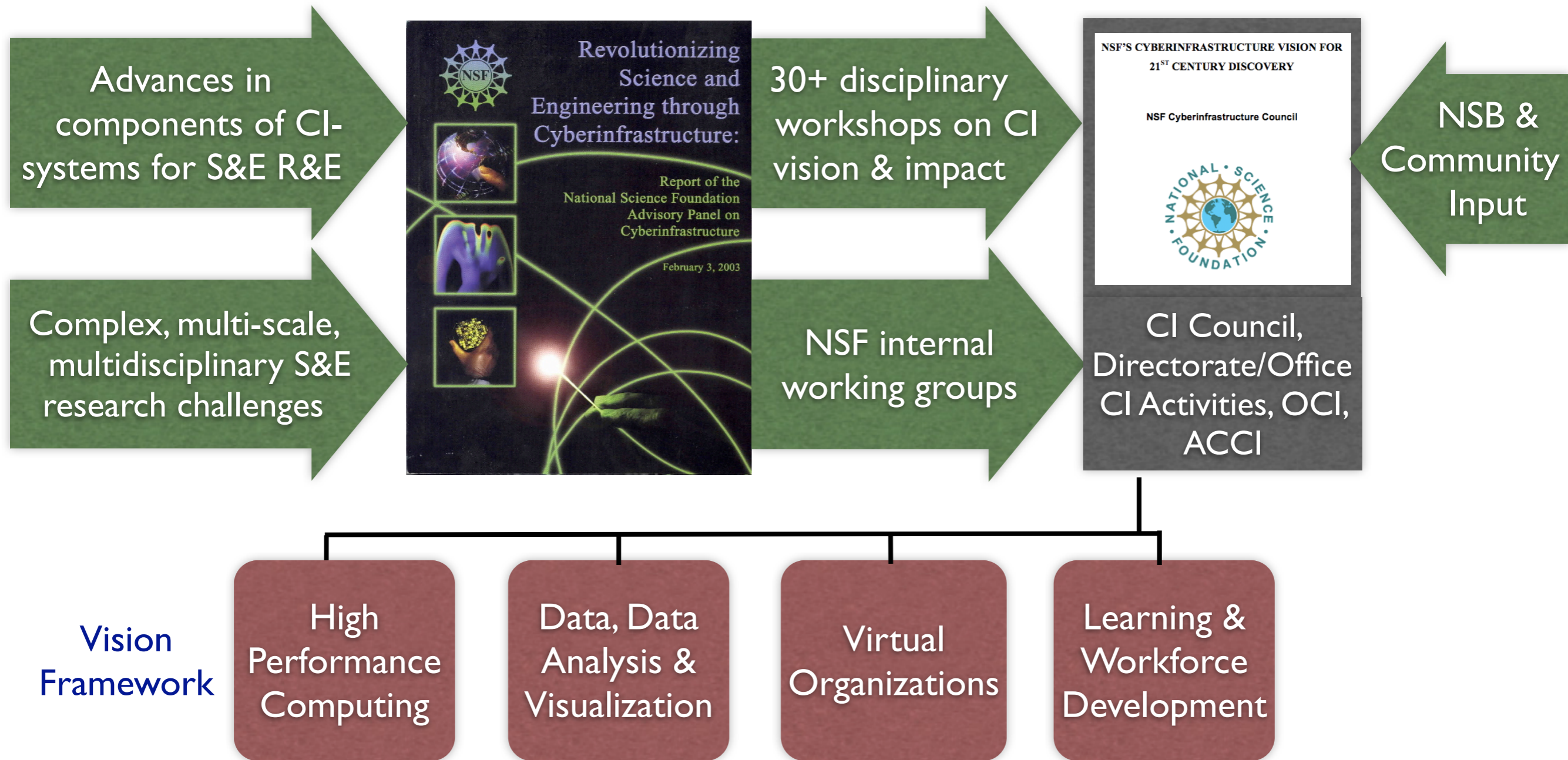
“a new age has dawned in scientific and engineering research, pushed by continuing progress in computing, information, and communication technology, and pulled by the expanding complexity, scope, and scale of today’s challenges. The capacity of this technology has crossed thresholds that now make possible a comprehensive Text “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/od/oci/reports/toc.jsp>



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


Vision and Activities Based on Broad and Diverse Community Engagement



- All directorates and offices support cyberinfrastructure.
- Science-driven partnerships between creation, provisioning and use of CI
- Supports integrated research and education and broadened access and participation.



HOME | FUNDING | AWARDS | DISCOVERIES | NEWS | PUBLICATIONS | STATISTICS | ABOUT | FastLane

 National Science Foundation
OFFICE OF
Cyberinfrastructure

SEARCH
NSF Web Site

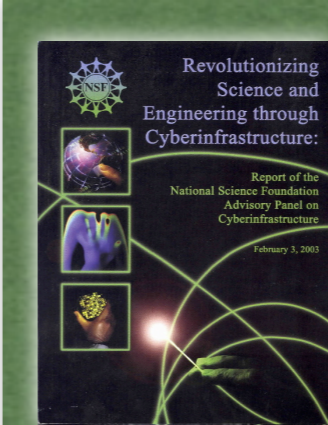
OCI Home | OCI Funding | OCI Awards | OCI Discoveries | OCI News | About OCI

Cyberinfrastructure - stimulating advances in 21st century science and engineering

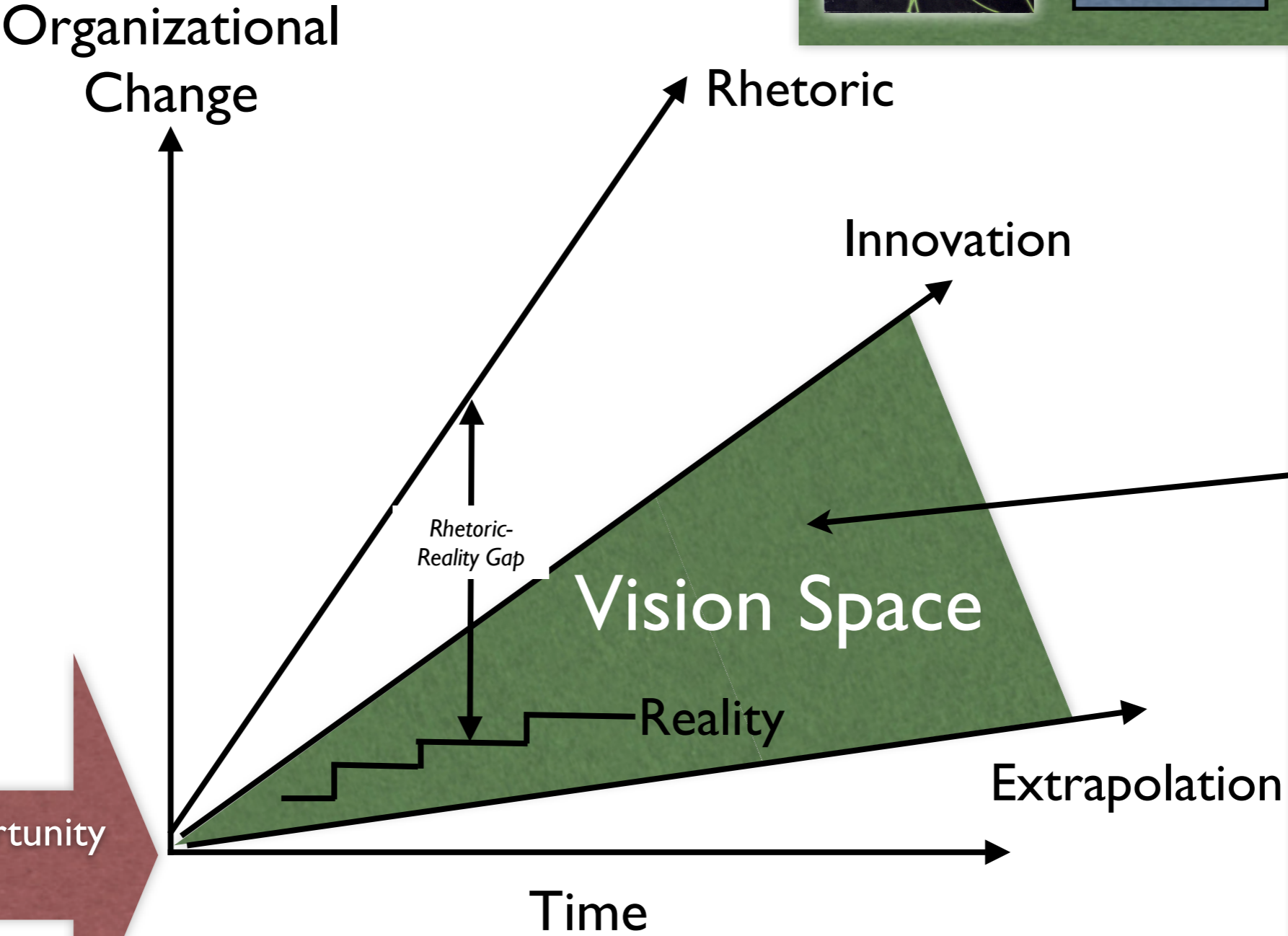
About OCI	Special Announcements	Quick Links
<p>View OCI Staff Directory Search OCI Staff Directory <input type="text"/> </p> <p>General Information About OCI Career Opportunities Advisory Committee Budget Excerpt</p>	<ul style="list-style-type: none">• Career Opportunities - Dear Colleague Letter The Office of Cyberinfrastructure (OCI) announces a nationwide search to fill a number of Program Director positions. For more information, click on the link http://www.nsf.gov/publications/vacancy.jsp?org=OCI&nsf_org=OCI• Petascale Acquisition Forum, Mar 24, '06 NSF Invites Prospective Proposing Institutions and Vendors to a Discussion of Plans for a Petascale HPC Acquisition As indicated in the President's FY 2007 Budget Request, NSF is planning for the acquisition of a petascale high-performance computing (HPC) system. Subject to the availability of funds, NSF expects to begin funding the resulting multi-year acquisition project in FY07. The petascale HPC system to be acquired will permit science and engineering communities to address some of their most computationally challenging research needs. HPC system vendors and potential resource provider organizations (organizations who, either separately or in collaboration with others, wish to propose to manage the development, deployment, and operation of a petascale system on behalf of the science and engineering research community) are invited to meet with each other and with NSF staff to discuss the time-line and strategy for this petascale system acquisition on Friday, March 24, 2006, from 9:00a.m. - 11:00a.m., at the National Science Foundation, 4201 Wilson Blvd., Arlington, VA, 22230. Those interested in attending this meeting should send email with their name and affiliation to HPC-Input@nsf.gov, no later than March, 20, 2006. Space is	<p>Reports and Workshops Relating to Cyberinfrastructure and Its Impacts</p> <p>Publications See All</p> <p>Report of Blue-Ribbon Advisory Panel on Cyberinfrastructure</p> <p>Other Site Features Special Reports Research Overviews Multimedia Gallery Classroom Resources NSF-Wide Investments</p>



OCI to help the NSF community define and occupy the upper reaches of the “CI vision space”



Other “Blue Ribbon” Reports



Director's Talks



Adopted from John Anderson, formerly of EuroPARC.



Some Science Drivers

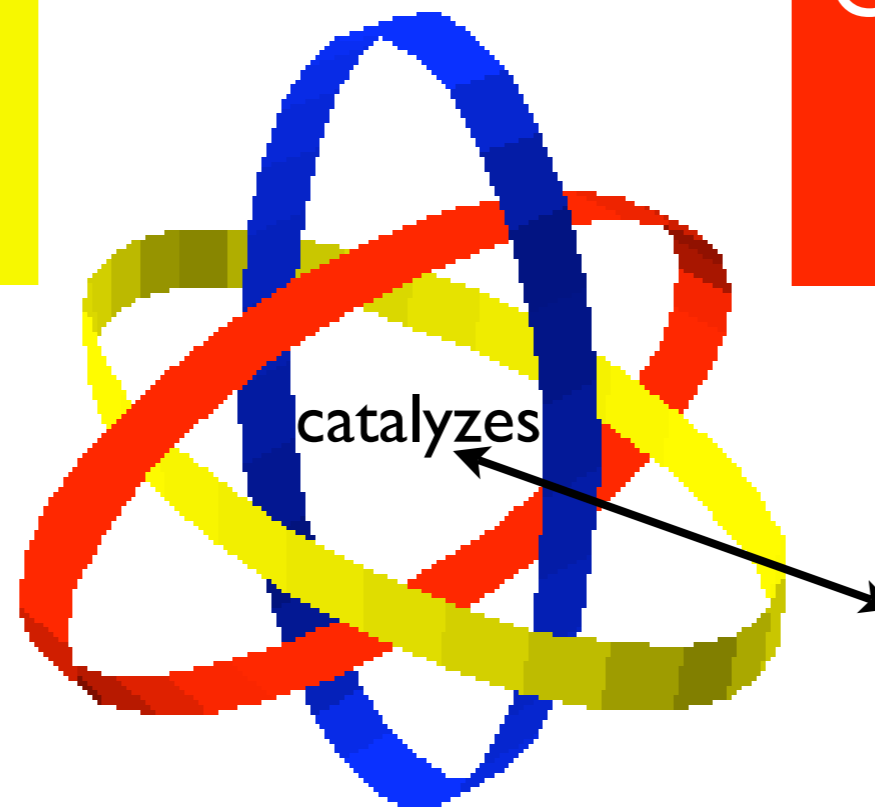
- Inherent **complexity and multi-scale** nature of today's frontier science challenges.
- Requirement for **multi-disciplinary, multi-investigator, multi-institutional** approach (often international).
- High **data intensity** from simulations, digital instruments, sensor nets, observatories.
- Increased value of data and demand for data **curation & preservation** of access.
- Exploiting infrastructure **sharing** to achieve better stewardship of research funding.
- Strategic need for **engaging more students** in high quality, authentic science and engineering education.



Achieving the NSF CI (e-science) Vision requires synergy between 3 types of activities

Transformative Application - to enhance discovery & learning

Borromean Ring: The three rings taken together are inseparable, but remove any one ring and the other two fall apart. See www.liv.ac.uk/~spm02/rings/



Provisioning - Creation, deployment and operation of advanced CI

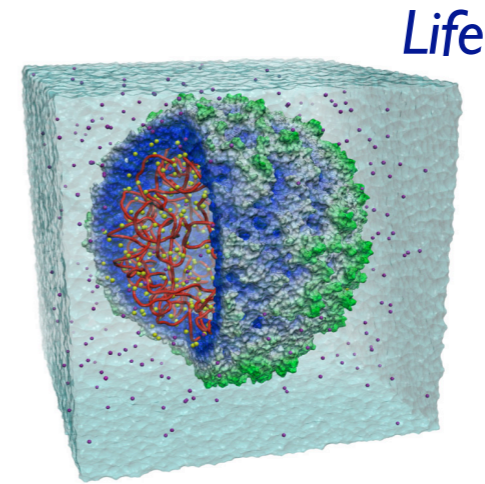
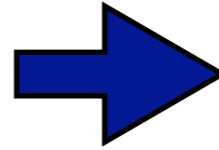
provides shared and connecting CI

Office of Cyberinfrastructure

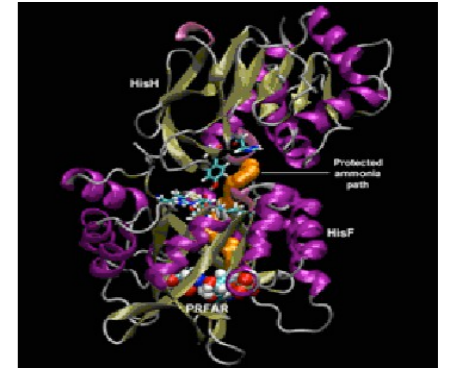
R&D to enhance technical and *social* effectiveness of future CI environments

High Performance Computing

increasingly important tool for understanding



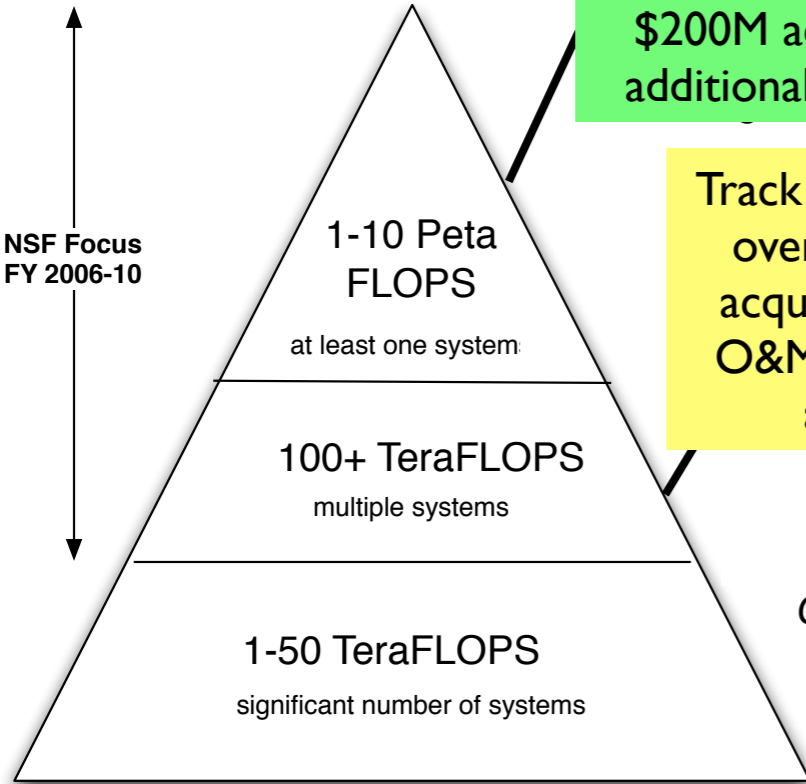
Life



Satellite tobacco mosaic virus, P. Freddolino et al.

Aldehyde dehydrogenase, T. Wymore and S. Brown

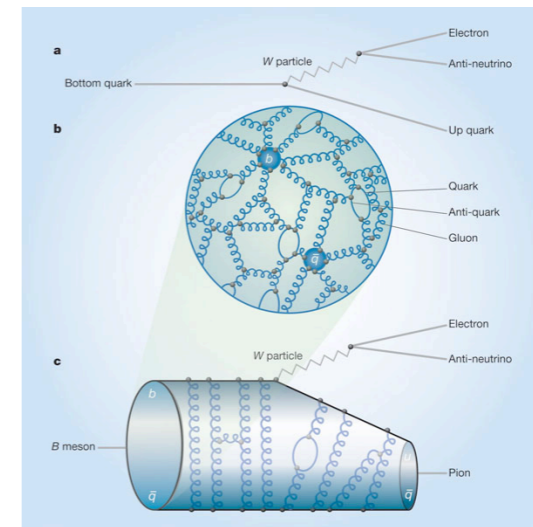
NSF Focus FY 2006-10



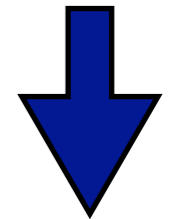
Track 1: One solicitation funded over 4 years: \$200M acquisition + additional O&M cost.

Track 2: Four solicitations over 4 years: \$30M/yr acquisition + additional O&M cost. First track 1 approved 8-07

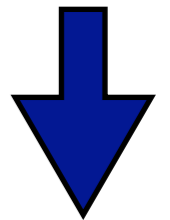
Campus Level



I. Shipsey

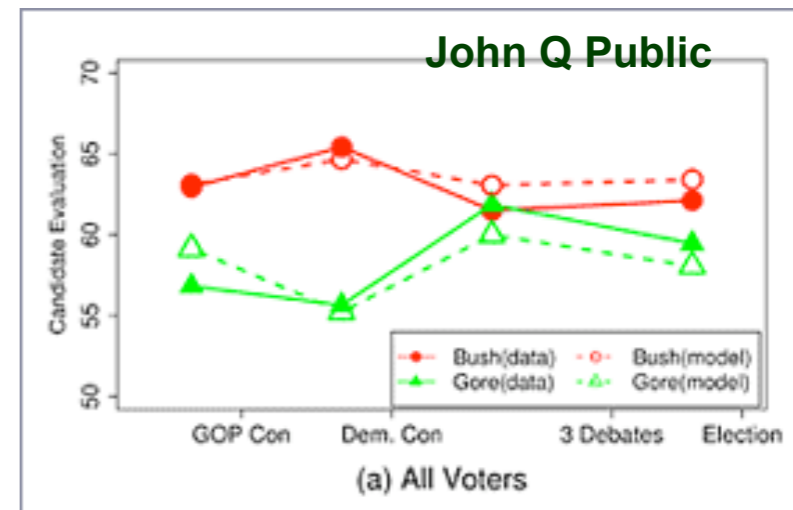
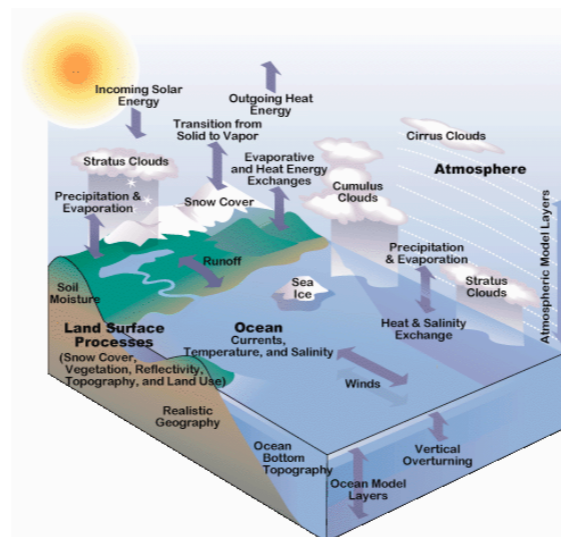
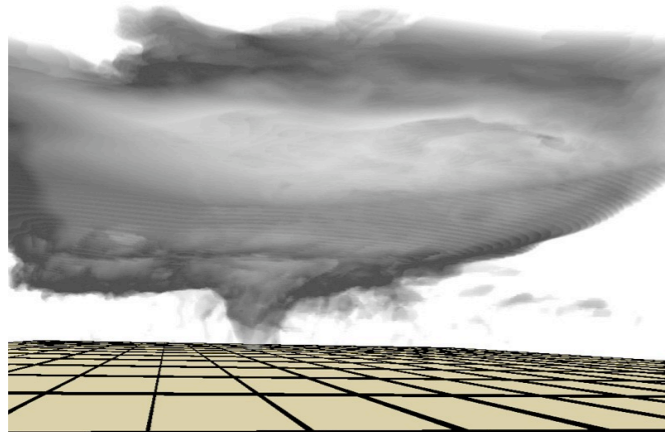
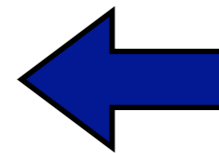


Matter



Society

The Environment

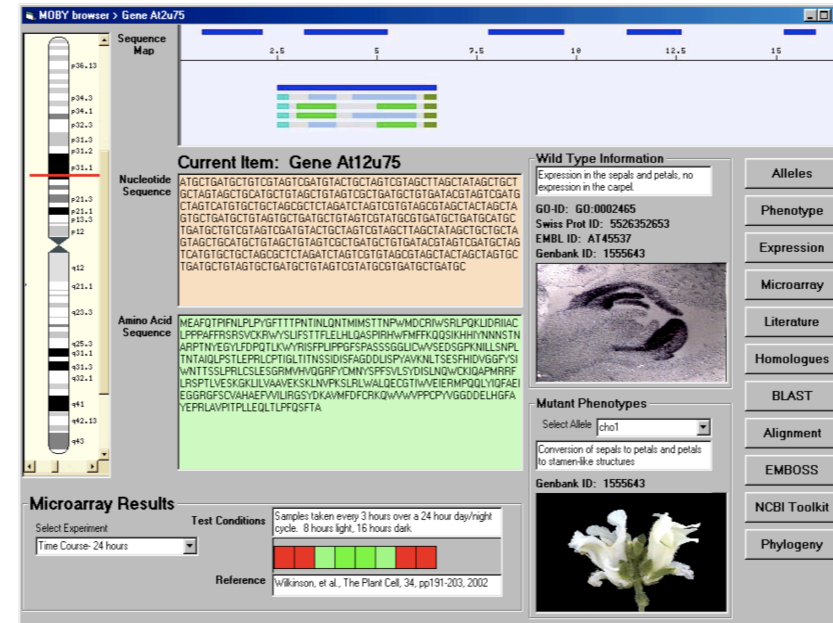
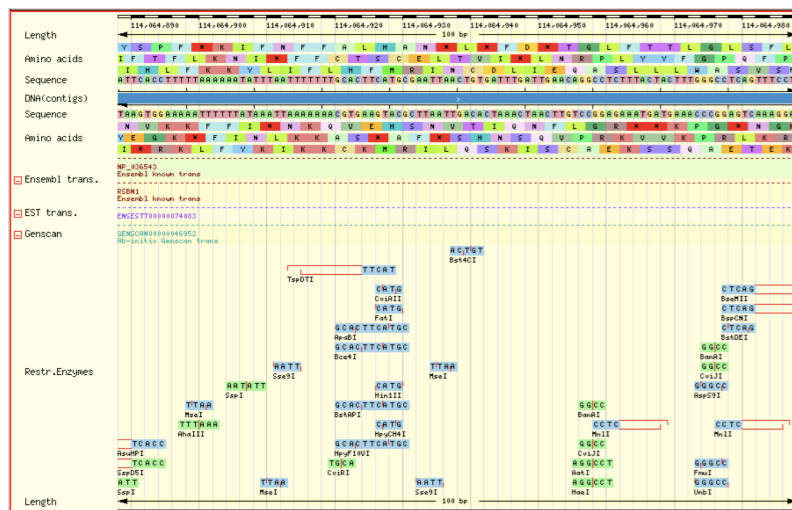
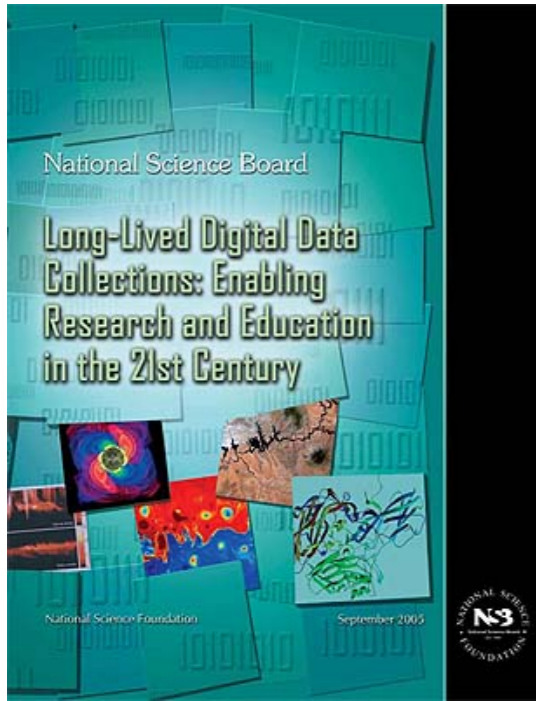


S.-Y. Kim, M. Lodge, C. Taber.

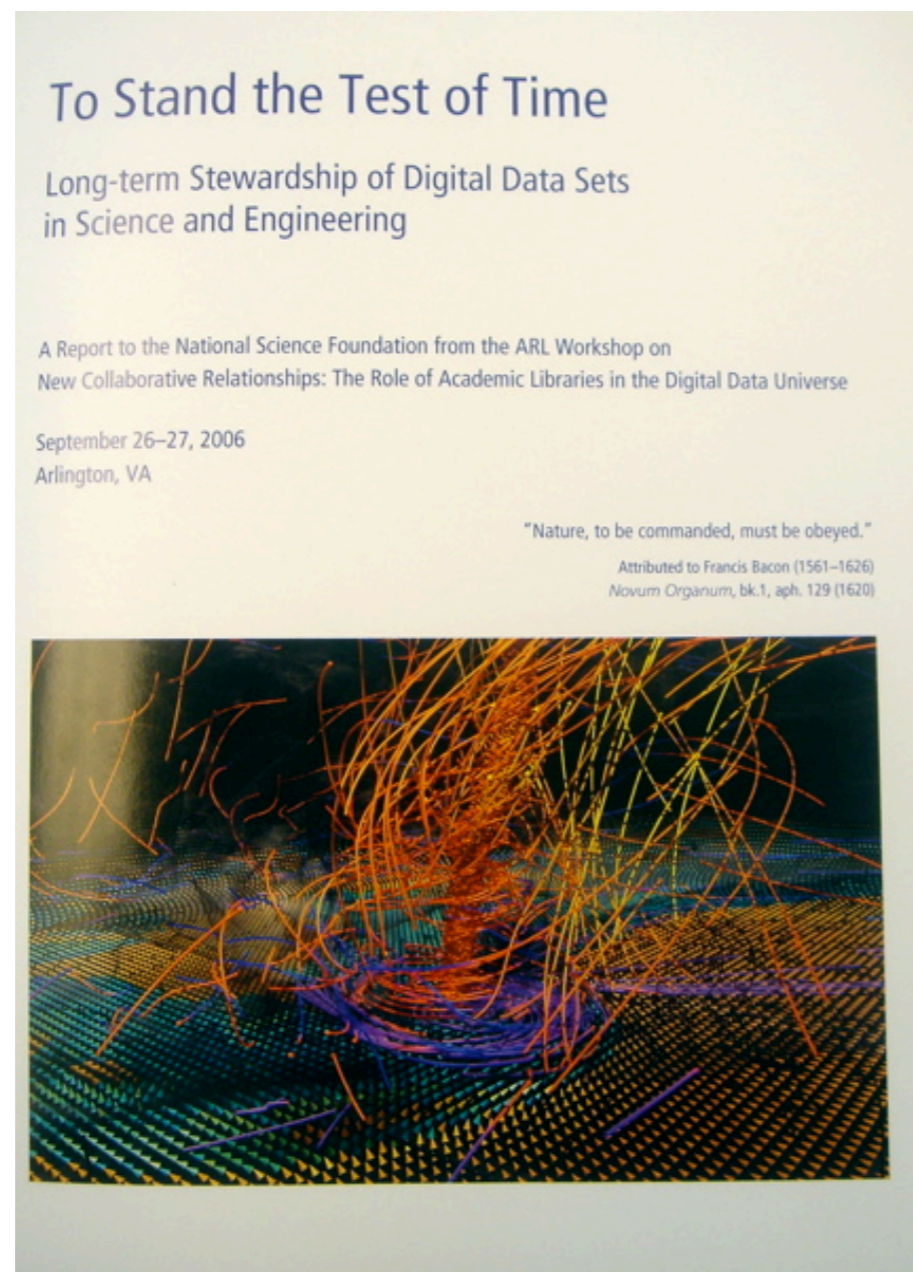


Data, Data Analysis & Visualization

- Challenges: **increased scale, heterogeneity, and re-use value** of digital scientific information and data. Inadequate digital preservation strategy of long-lived data.
- Taking initial steps to **catalyze the development** of a federated, global system of science and engineering data collections that is open, extensible, evolvable, (and appropriately curated and long-lived.)
- Complemented by a **new generation of tools** and services to facilitate data mining, integration, analysis, visualization essential to transforming data into knowledge.
- NSF Leadership for OSTP/Interagency Working Group on Digital Data



New Report: *To Stand the Test of Time*



Available online at <http://www.arl.org/info/events/digdatarpt.pdf>

Lead NSF Program Officer for Data Initiatives, Chris Greer is at this meeting.



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Virtual Organizations

- To catalyze the development, implementation and evolution of a national cyberinfrastructure that integrates both physical and cyberinfrastructure assets and services.
- To promote and support the establishment of world-class VOs that are secure, efficient, reliable, accessible, usable, pervasive, persistent and interoperable, and that are able to exploit the full range of research and education tools available at any given time
- To support the development of common cyberinfrastructure resources, services, and tools that enable the effective, efficient creation and operation of end-to-end cyberinfrastructure systems for and across all science and engineering fields, nationally and internationally.



NVO



LEAD



iVDgL



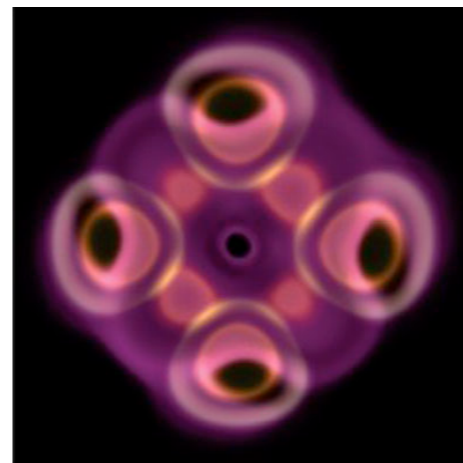
TeraGrid



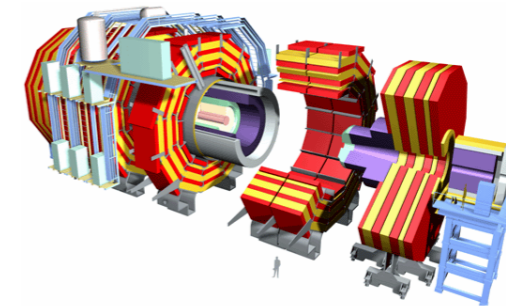
Open Science Grid



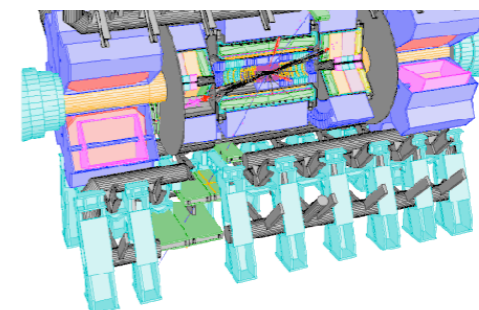
NEES



NanoHub



CMS



ATLAS



Instances of Virtual Organizations (VOs)

People*

People*

People*

Interfaces for interaction, workflow, visualization and collaboration for distributed teams in domain/project specific and potentially functionally-complete VOs.

Mechanisms for flexible secure, coordinated resource/services sharing among dynamic collections of individuals, institutions, and resources (the Grid or service layer problem)

Distributed, heterogeneous services for:

Computation

Data,
information
management

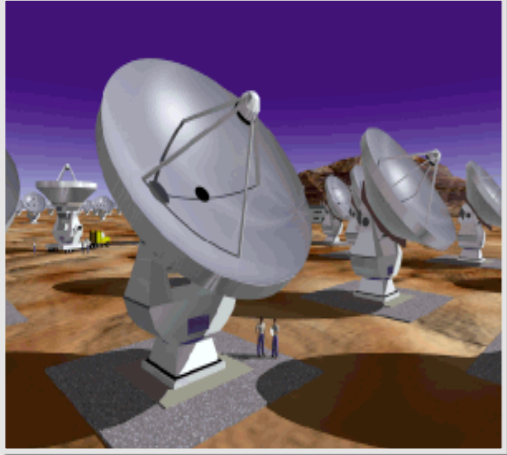
Sensing,
observation,
activation in
the world

Alternate Names for Instances of VOs:

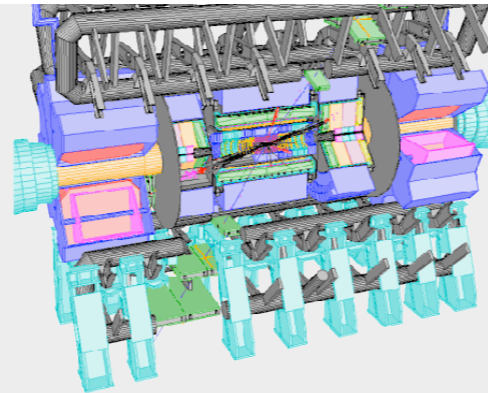
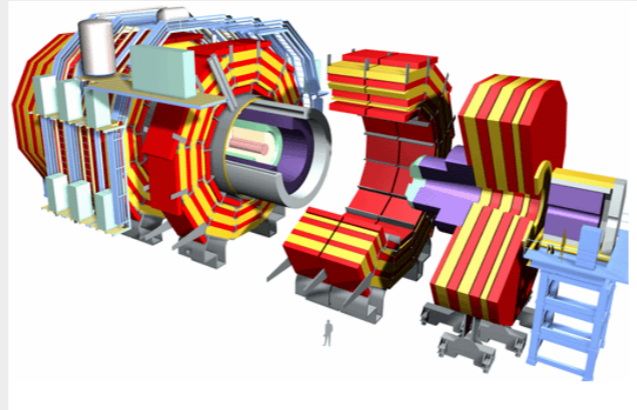
- Co-laboratory
- Collaboratory
- Grid (community)
- Network
- Portal
- Gateway
- Hub
- Virtual Research Environment (VRE)
- Cyberinfrastructure Collaborative



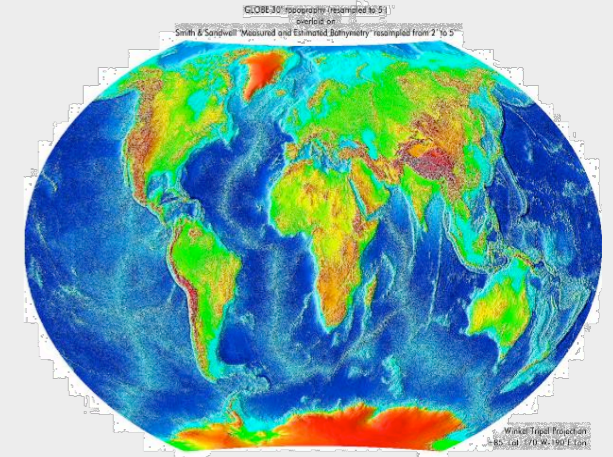
CIVO Enabled Science



NVO and ALMA



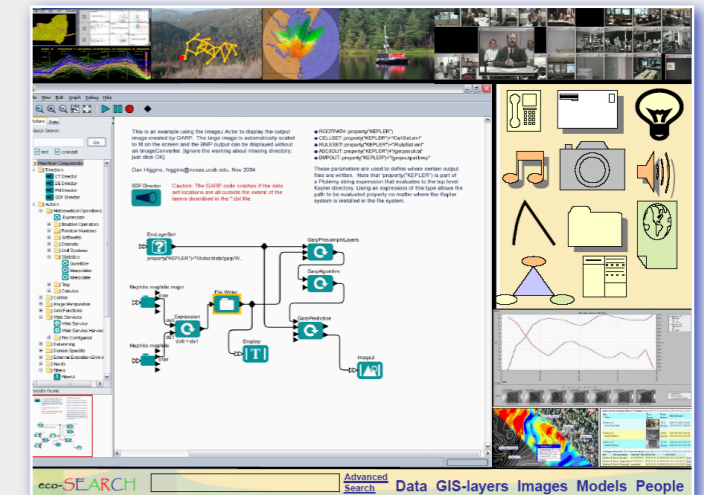
ATLAS and CMS



Climate Change



LIGO



NEON

The number of international-scale projects is growing rapidly!

Alternate Generic Names for *Virtual Organizations*

- Distributed Knowledge Communities
- Virtually-augmented Communities
- Participation Environments built upon Participation Architectures
- Learning and Discovery Ecosystems



Virtually Augmented Organizations offer additional modes of interaction between People, Information, and Facilities

		Time	
		Same (synchronous)	Different (asynchronous)
Geographic Place	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

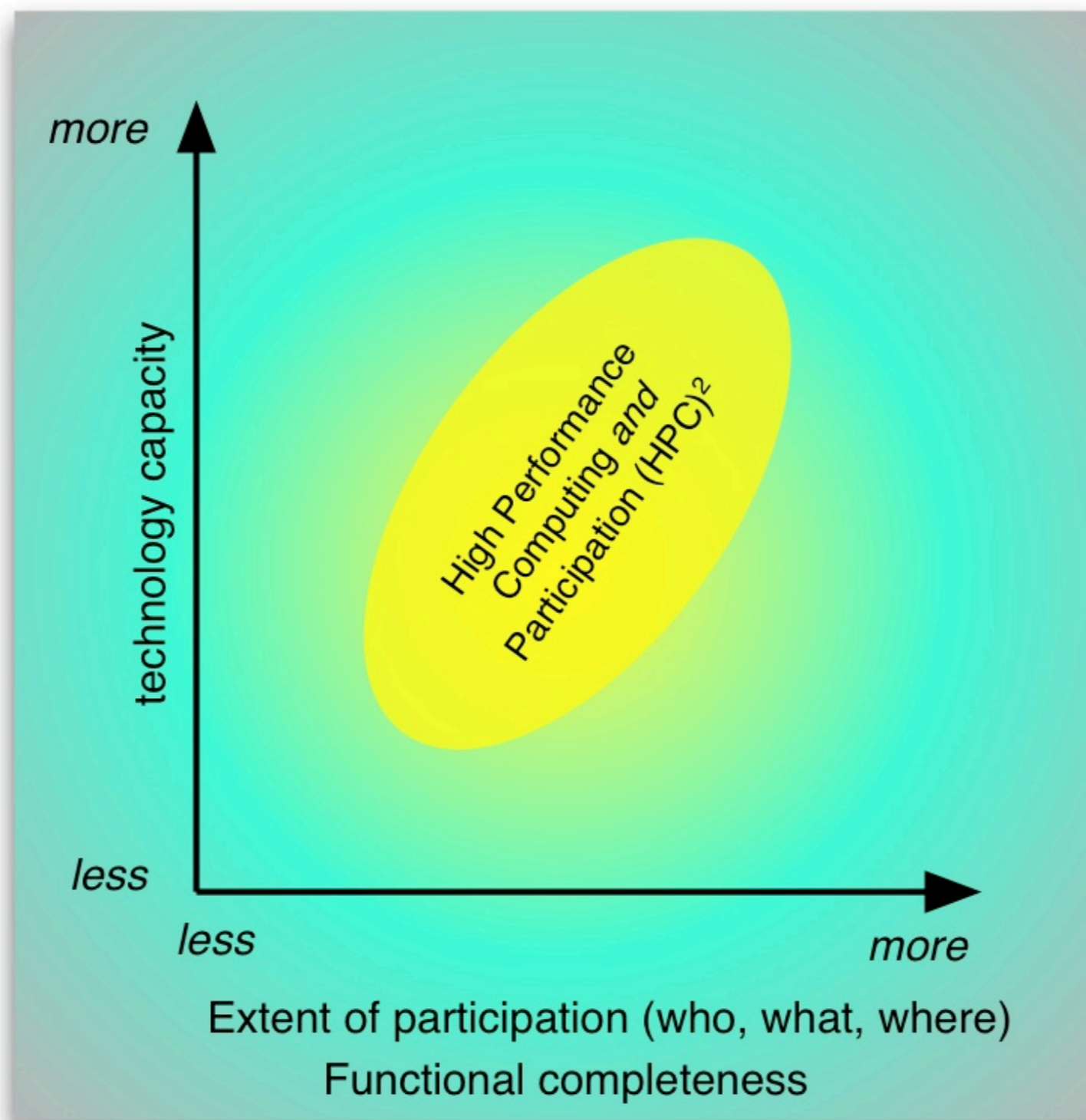
P: people, **I:** information, **F:** facilities, instruments

Need a socio-technical approach: Realizing the potential of e- | cyber science to support effective VOs requires attention to *institutional infrastructure*

- Need more than good ICT systems and tools for individuals and organizations. (Technology determinism alone is not enough).
- No less important is the *institutional contexts* (i.e. norms of practice and rules) to facilitate collaboration within science and technical research communities.
- The institutional and organizational environment of e-science encompasses a wide and diverse array of interrelated social, economic, and legal factors that
 - create incentives for, and constraints upon individual and collective action; and
 - thereby shape the production, utilization, consumption, and governance of e-science capabilities and products.



Optimizing CI Investment



The Grid Movement

TeraGrid

EMPLOYMENT SITEMAP CONTACT

ABOUT USER INFO NEWS

Search TeraGrid

For Allocated Users

User Portal

Research Briefs

Seismic Modeling and Oil Reservoir Simulations with TeraGrid

[see more Research Briefs](#)

Programs

Science Gateways

The Science Gateways program is designed to enable entire communities of users with a common scientific goal to use the TeraGrid through a common interface.

[More on Science Gateways](#)

ASTA

The Advanced Support for TeraGrid Applications (ASTA) Program aims to help ensure that the resources of TeraGrid are optimally utilized for important scientific discoveries and technological innovation.

TeraGrid Related Education Resources & Opportunities

TeraGrid offer a variety of workshops, institutes, seminars and on-line learning resources to engage the community in making effective use of TeraGrid resources. A list of these learning opportunities across all of the Resource Provider sites is posted on the Education, Outreach and Training web pages at <http://www.teragrid.org/eot/workshops.php>

We would like to bring your attention to the following workshops:

October 16-17, 2006: Introduction to & Optimization for SDSC Systems

October 29, 2006: Remote/Collaborative TeraScale Visualization on the TeraGrid

TeraGrid is Voted GRIDtoday Top Research Grid

News

10/03/2006: [Pennsylvania House of Representatives Recognizes PSC's 20th Anniversary](#)

09/28/2006: [Texas Advanced Computing Center receives \\$59 million high-performance computing award from National Science Foundation](#)

09/22/2006: [Call for Papers - The 8th LCI International Conference on High-Performance Clustered Computing](#)

09/20/2006: [RENCI Biportal Enhanced with First Workflow](#)

09/18/2006: [Katrina: After the Storm - Civic Engagement Through Arts, Humanities and Technology - September 28-30, 2006](#)

09/18/2006: [Call For Participation - What To Do With A Million Books: Chicago](#)



Search The Site:

Search **OSG at Work**:

- Home
- About the OSG
- Science on the OSG
- Getting Started
- News and Events
- Contacts
- OSG at Work

Science on the **Open Science Grid**



The ATLAS transition radiation tracker (TRT) barrel detector. Courtesy of CERN

Simulating Supersymmetry with ATLAS

One of the discoveries eagerly anticipated by particle physicists working on the world's next particle collider is that of supersymmetry, a theoretical lost symmetry of nature. Physicist Sanjay Padhi from the University of Wisconsin-Madison has used Open Science Grid resources to show that there is a good possibility of discovering supersymmetry in the first few months of operation of the new collider, if the new symmetry exists in nature.

[Read more...](#)

OSG NEWS

- [Open Science Grid Receives \\$30 Million Award to Empower Scientific Collaboration and Computation](#)
- There will be a joint EGEE/OSG session on Security at the [EGEE Conference](#), September 25-29, 2006.
- September 11, 2006 article in GRIDToday: [Running an Effective Distributed Facility](#).
- Press Release, September 7, 2006: [DOE Announces \\$60 Million in Projects to Accelerate Scientific Discovery through Advanced Computing](#).

View Live Grid Status



Tools for Collaborators

- OSG at Work**
- Virtual Data Toolkit**
- Document Database**
- Logos and Templates**
- Monitoring**
- Security**
- Support**

EGEE
Enabling Grids for E-scienceE

- ▶ EGEE PROJECT
- ▶ EGEE & INDUSTRY
- ▶ USERS AND EGEE
- ▶ EGEE EVENTS
- ▶ WORLDWIDE GRID
- ▶ NEWSROOM

NSF
Office of Cyberinfrastructure

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Welcome to EGEE (Enabling Grids for E-scienceE).

The Enabling Grids for E-scienceE project brings together scientists and engineers from more than 90 institutions in 32 countries world-wide to provide a seamless Grid infrastructure for e-Science that is available to scientists 24 hours-a-day. Conceived from the start as a four-year project, the second two-year phase started on 1 April 2006, and is funded by the European Commission.

Expanding from originally two scientific fields, high energy physics and life sciences, EGEE now integrates applications from many other scientific fields, ranging from geology to computational chemistry. Generally, the EGEE Grid infrastructure is ideal for any scientific research especially where the time and resources needed for running the applications are considered impractical when using traditional IT infrastructures.

Latest News

First EELA Bulletin - EELA News - Year 1, Issue 1 now available

[... Read more](#)

Try the GRID

[Click here](#)

Become a User

Want to become a user of the EGEE Grid? [Click here](#)

Collaborating Projects

If your project is related to EGEE, please register it [here](#)

E. Atkins

Let's look at a few real example Grid Science Gateways

(about a dozen ... many more
exist!)

These example slides courtesy of D. Gannon

NEESGrid

Realtime access to earthquake
Shake table experiments at remote sites.

CHEF (dev-local): Worksite - Microsoft Internet Explorer

Address: http://neespop.ce.unr.edu:9271/chef/portal/group/NEESgridUNR/page/default.psm/js_pane/P-f16ab04bfe-10006

NEESgrid WorkTools

My Workspace NEESgrid UNR NEESgrid Support NEESgrid All

Nov 14, 2002 05:43 pm

Video Cameras

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Discussion

Telepresence Server

Video Cameras

ENotebook

Data Browser/Viewer

NEESgrid Repository

Chat

Browse Testbed

TeleRobotic Video Camera 1

UNRCamera1 Thu Nov 14 17:43:19 2002

Select Camera: 1 2 3 4 5

(1 item remaining) http://134.197.37.119/axis-cgi/mjpg/video.cgi?resolution=fullsize&camera=1

NEESgrid WorkTools

My Workspace NEESgrid UNR NEESgrid Support NEESgrid All

Nov 14, 2002 05:40 pm

Data Viewer

Event: "core: ex2 sine1-4"

sine1	-0.062791	
sine2	-0.24869	
sine3	-0.187381	
sine4	-0.125333	

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Telepresence Server

Video Cameras

ENotebook

Data Browser/Viewer

NEESgrid Repository

Nov 14, 2002 05:42 pm

NEES Data Browser

NEES Repository @ UNR

Symbol key:

- The folder is open (click to close).
- The folder is closed (click to open).
- Download this file using GridFTP.
- Upload a file to this folder using GridFTP.
- Configure data streaming and recording for this event.
- Make this event viewable with the NEES data viewer.
- Follow a link between objects.

New Object Delete Object Move Object Copy Object Edit Object

[Server Root]

- UNR Demo
 - Bridge Shake Table Experiment
 - Data Acquisition
 - White Noise System Identification
 - White Noise System Identification Channel Configuration
 - sensor data
 - white noise
 - sensor data
 - white noise
 - sensor data
 - white noise
 - sensor data
 - 1940 Imperial Valley-El Centro 100%
 - 1940 Imperial Valley-El Centro 100% Channel Configuration

Folder "Data Acquisition"

name (string)
Data_Acquisition

lastAccessedTimestamp (timestamp)
2002-11-12 13:15:06.055

lastModifiedTimestamp (timestamp)
2002-11-12 13:15:06.055

originalVersionID (object)
Data Acquisition

versionNumber (integer)
0

creationTimestamp (timestamp)
2002-11-12 13:15:06.055

lockTimestamp (timestamp)
1969-12-31 18:00:00.0

NEESgrid

BIRN – Biomedical Information



The screenshot displays the BIRN Portal interface. At the top left is the BIRN logo with the text "BIOMEDICAL INFORMATICS RESEARCH NETWORK". To the right is a login section with "Username:" and "Password:" labels, input fields, and a "login" button. Below the logo is a navigation bar with links for "Portal Home", "BIRN Website", "Account Request", "Style", and "Help".

Login Information

BIRN Portal Login

Enter your username/password

Username:

Password:

- [Request](#) a BIRN account (must be a BIRN participant)
- [Email](#) BIRN Portal admins

Portal Requirements

You must have cookies enabled to login to the BIRN Portal, in addition, Javascript is highly recommended but not required.

The latest version of Java will be required to access *some* of the applications.

For optimal browsing please use a [Mozilla](#) based browser.

Older versions of Safari will experience

Welcome to the BIRN Portal

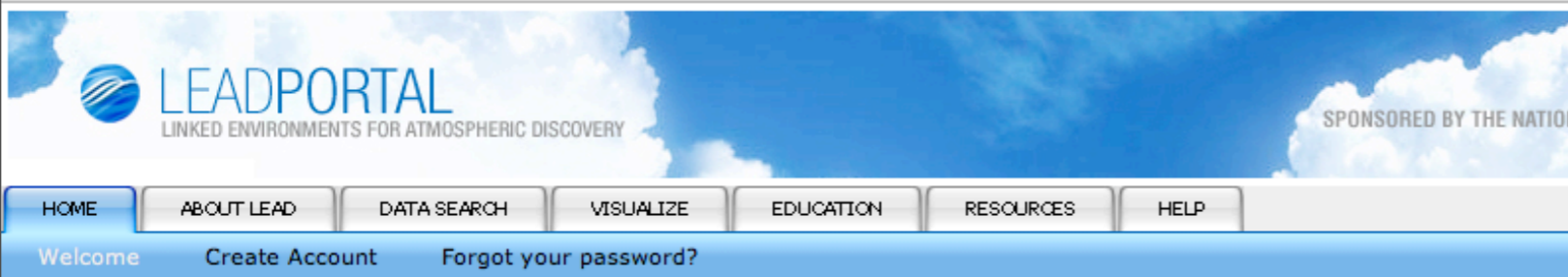
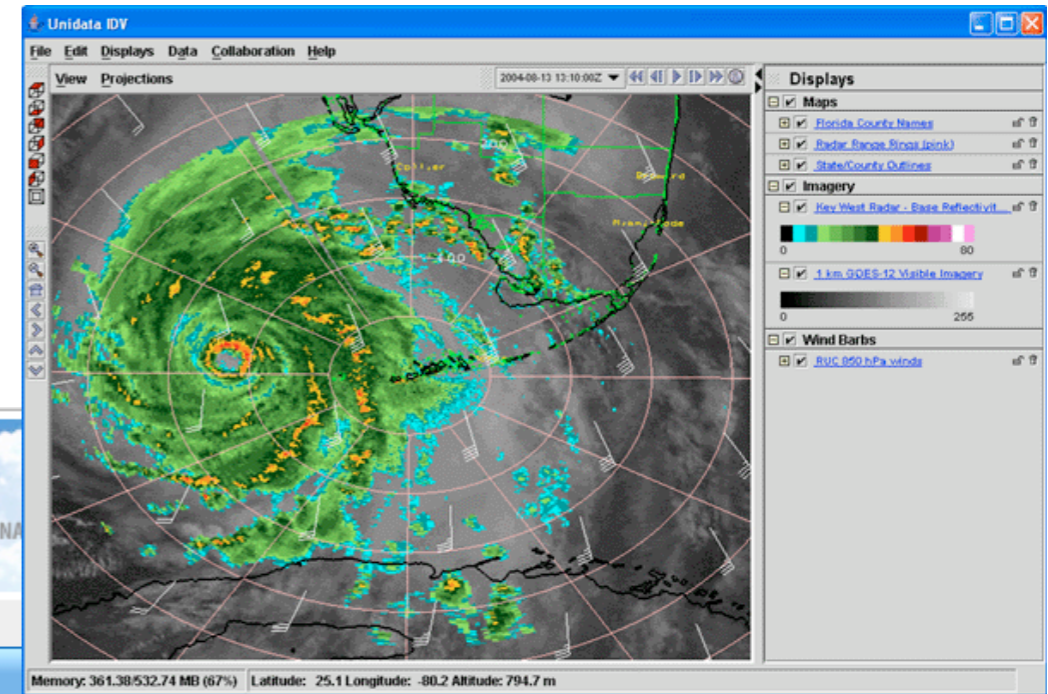
The Biomedical Informatics Research Network (BIRN) Portal provides BIRN members with a single sign on web portal to access data grid files, computation grid resources, and a variety of collaboration tools to facilitate the scientific needs of BIRN researchers. Non-BIRN participants may access the portal through a guest registration.



Mesoscale Meteorology

NSF LEAD project - making the tools that are needed to make accurate predictions of tornados and hurricanes.

- Data exploration and Grid workflow



WELCOME TO THE LEAD PORTAL



Linked Environments for Atmospheric Discovery (LEAD) makes meteorological data, forecast models, and analysis and visualization tools available to anyone who wants to interactively explore the weather as it evolves. The LEAD Portal brings together all the necessary resources at one convenient access point ... [read more](#)

FEATURES FOR ANYONE INTERESTED IN THE WEATHER

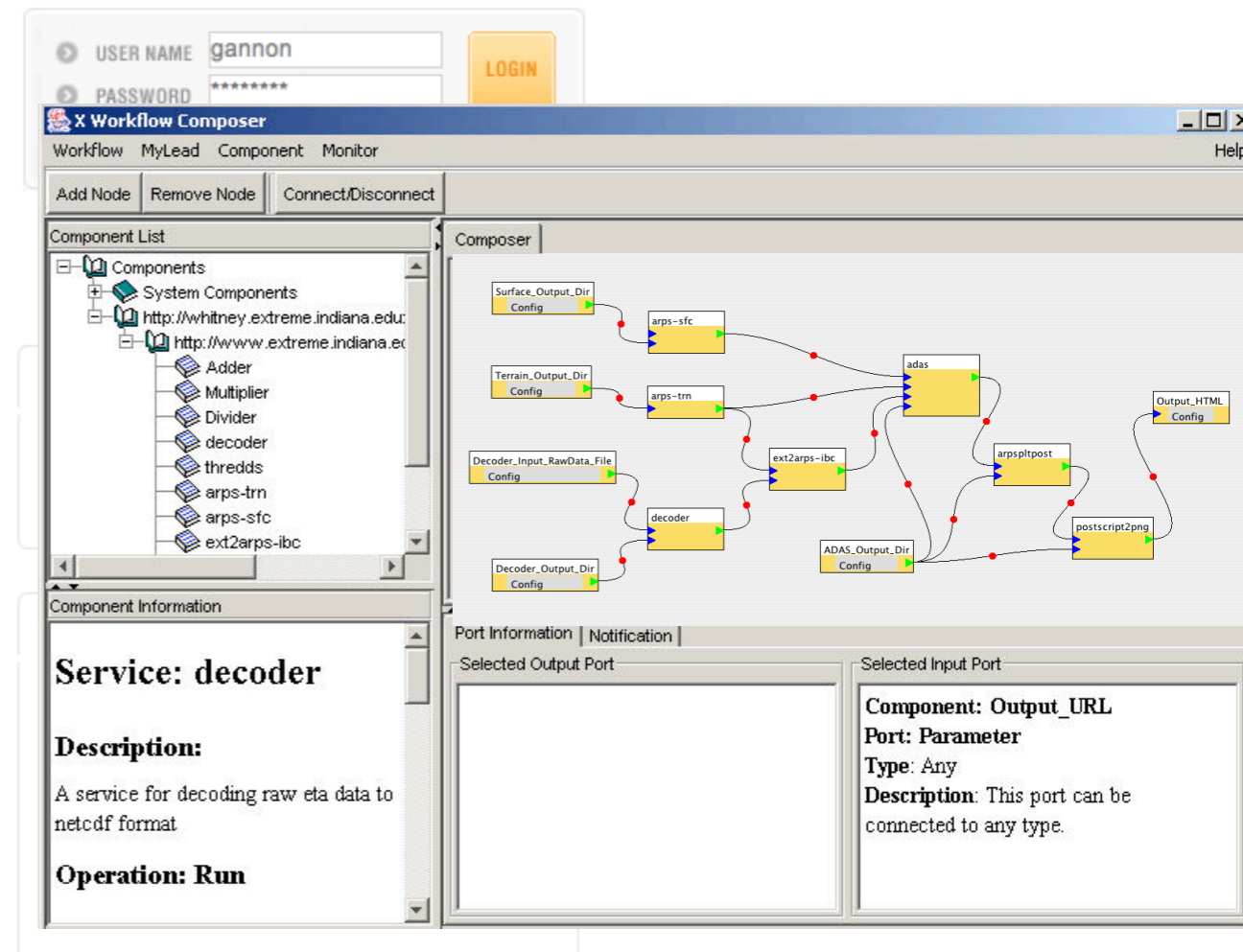
Researchers	With university, government, or industry affiliations	GET FEATURES
Educators	At college and university level, high school, or middle schools	GET FEATURES
Students	At graduate, undergraduate, middle and high school levels	GET FEATURES
Visitors	Newcomers and the curious	GET FEATURES

POPULAR TOOLS

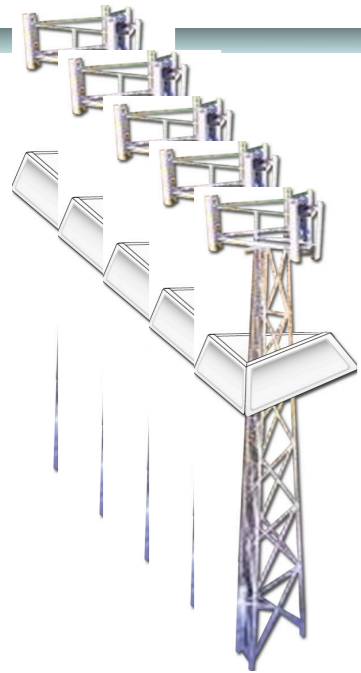
Visualize Weather Data
[Integrated Data Viewer](#) | MORE >

Make a Forecast or Analysis
[Experiment Builder](#) | MORE >

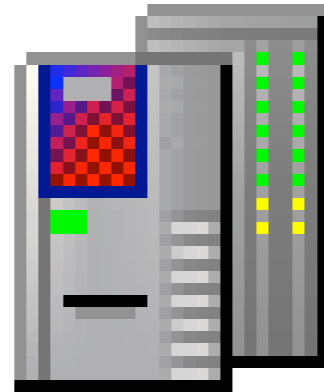
Access Weather Data
[Geographic Region Search](#) | MORE >



The LEAD Vision: Adaptive Cyberinfrastructure

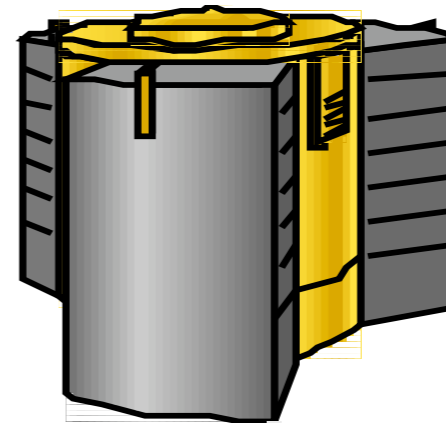


DYNAMIC OBSERVATIONS



Analysis/Assimilation

Quality Control
Retrieval of Unobserved
Quantities
Creation of Gridded Fields



Prediction/Detection

PCs to Teraflop Systems



**Product Generation,
Display,
Dissemination**



End Users

NWS
Private Companies
Students

Models and Algorithms Driving Sensors

The CS challenge: Build cyberinfrastructure services that provide adaptability, scalability, availability, useability, and real-time response.

From D. Gannon

Nanohub - nanotechnology

The image shows a screenshot of the Nanohub website as viewed in Microsoft Internet Explorer. The browser window title is "NANO HUB.ORG - Microsoft Internet Explorer". The address bar shows the URL: http://www.nanohub.org/index.php?option=com_wrapper&wrap=RasMol. The website header features the "NANO HUB" logo and the tagline "Online Simulation and More". A search bar is located to the right of the logo. On the left side, there is a "Navigation" menu with the following items: Home, On-Line Simulation (with sub-items: Electronics, MEMS, Materials, Chemistry, ECAD, Devices, Process, General Productivity, Tool Index, Help), Resources (with sub-items: Courses, Short Courses, Seminars), Education (with sub-items: Nano Curriculum, Summer Institute, Summer Schools), and Community (with sub-items: Linking Bio & Nano, Nanocomputing Debate, Forums, Repository). The main content area displays a "RasMol Version 2.7.1.1" window. This window has a menu bar with "File", "Display", "Colours", "Options", "Export", and "Help". The central view shows a 3D wireframe model of a carbon nanotube, which is a cylindrical structure composed of interconnected hexagonal carbon atoms. The status bar at the bottom of the browser window indicates "Applet vncviewer started" and "Internet".



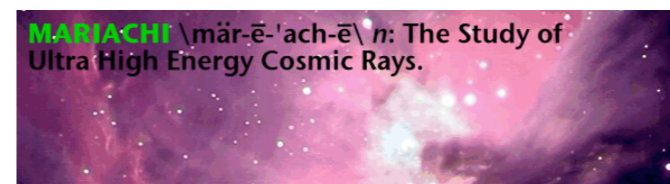
- Learning **supported by** CI. (cyber-enabled learning).
- Workforce development **to create and use** CI for S&E research and education.
- **Broadened participation:** Exploit the new opportunities that cyberinfrastructure brings for ... people who, because of physical capabilities, location, or history, have been excluded from the frontiers of scientific and engineering research and education.
- Explore CI support for **integrated research and education.**



BIOINFORMATICS CI INSTITUTE



EPIC



MARIACHI



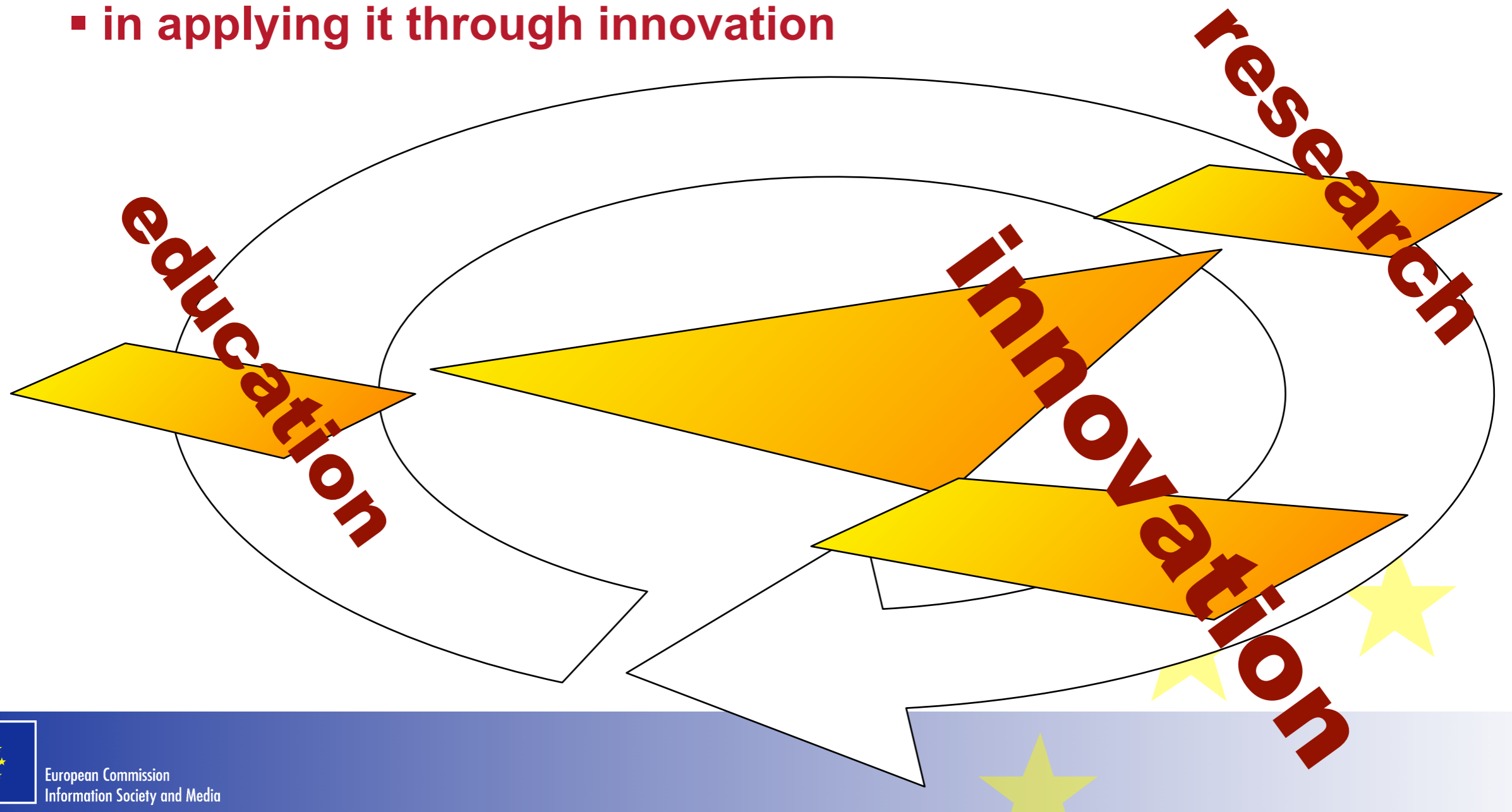
CyberBridges



FP7 - Putting the knowledge triangle at work

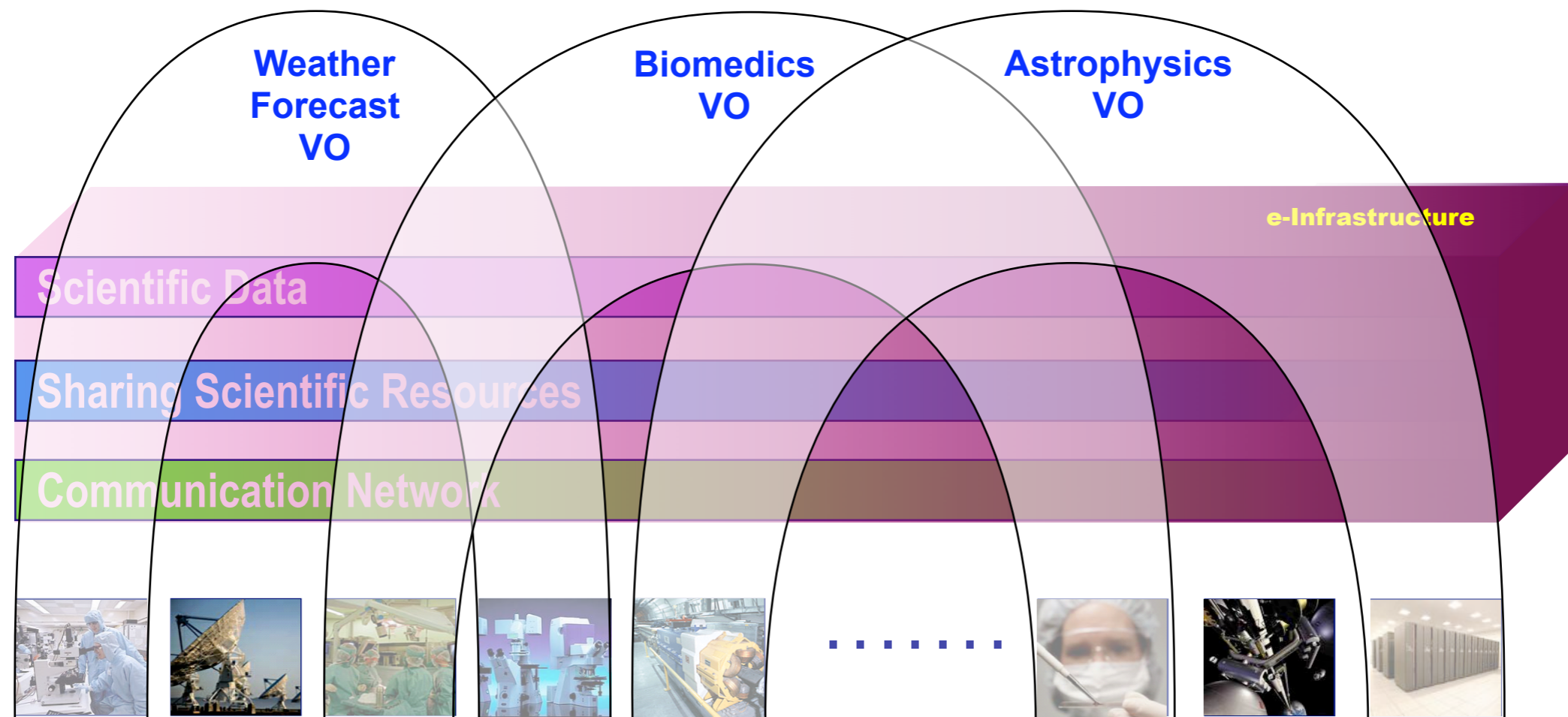
To be a genuinely competitive knowledge economy, Europe must be better

- in producing knowledge through research
- in diffusing it through education
- in applying it through innovation



e-Infrastructures in FP7 - strategy - Virtual Organizations (VO)

Bringing the best brains together
Sharing the best scientific resources

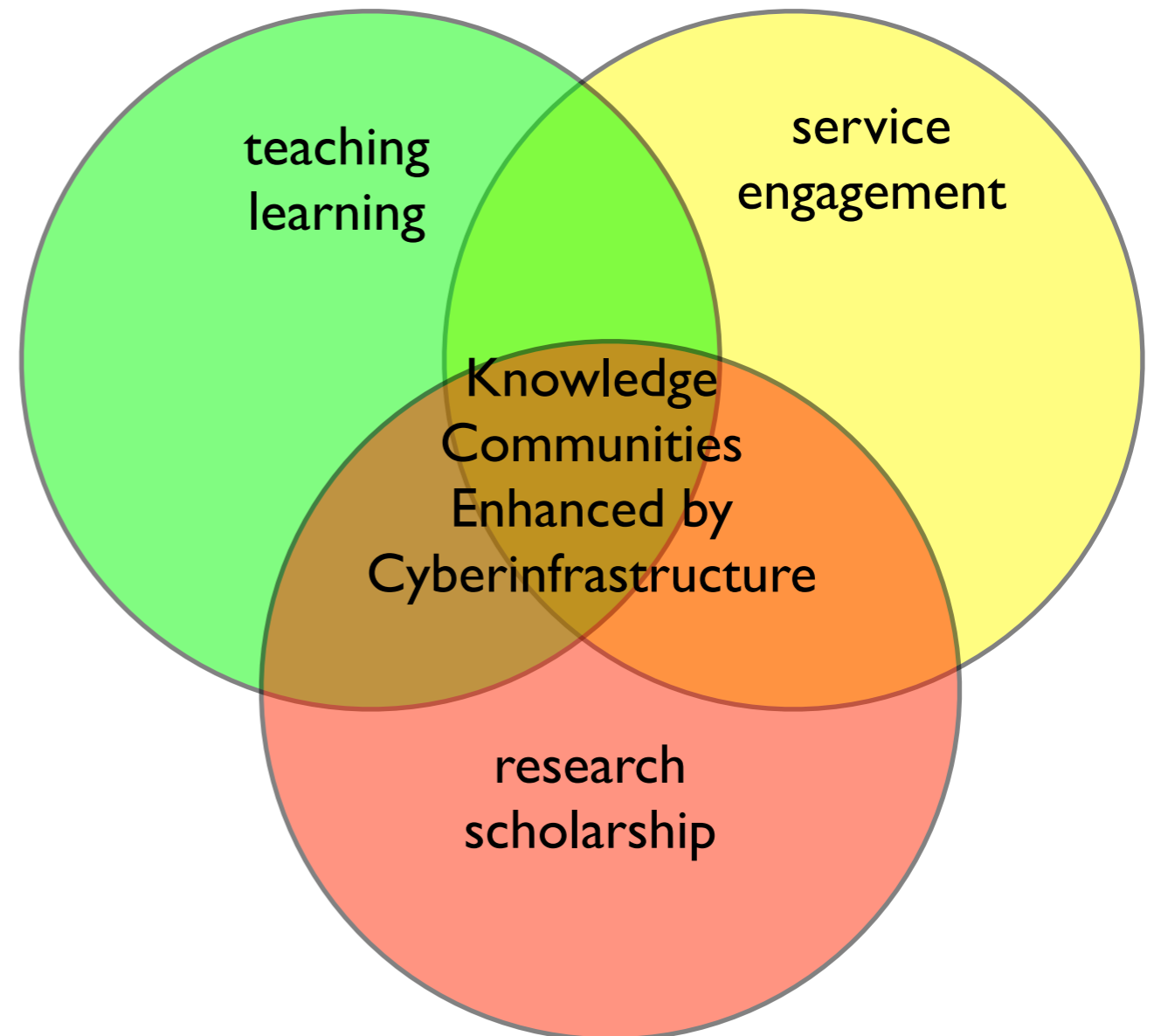


Producing the best science



And while we are at it...

- can we create CI platforms in support of research, learning, and societal engagement in ways that exploit complementarity between them?
 - *“Better than being there.”*
 - *Pasteur’s Quadrant research*
 - *Ubiquitous learning ecologies*



The opportunity is more than distributed computing and data storage. It is about using ICT/CI as an enhancement platform for knowledge-based communities to learn, discover, and engage in more “barrier free” ways.

The Meta University

A Personal View

What we are observing is the early emergence of a *Meta University* -- a transcendent, accessible, empowering, dynamic, communally-constructed framework of open materials and platforms on which much of higher education worldwide can be constructed or enhanced.

From Charles M. Vest, President Emeritus of MIT 37

The Meta University

- Will enable -- not replace -- residential campuses
- Will bring cost efficiencies to institutions through shared development;
- Will be adaptable -- not prescriptive;
- Will serve both teachers and learners;
- Will speed the propagation of high-quality education and scholarship;
- Will build capacity for economic development;
- Will build bridges across cultures and political boundaries; and
- Will be particularly important to the developing world.

From Charles M. Vest, President Emeritus of MIT 38

Something to ponder.....

Global Needs

Half of the world's population is under 20 years old.

Today, there are over 30 million people who are fully qualified to enter a university, but there is no place available. This number will grow to over 100 million during the next decade.

To meet the staggering global demand for advanced education, a major university would need to be created every week.

“In most of the world, higher education is mired in a crisis of access, cost, and flexibility. The dominant forms of higher education in developed nations—campus based, high cost, limited use of technology—seem ill-suited to addressing global education needs of the billions of young people who will require it in the decades ahead.”

Sir John Daniels

From James J. Duderstadt, President Emeritus, U. of Michigan

International e-science (cyberinfrastructure) movement

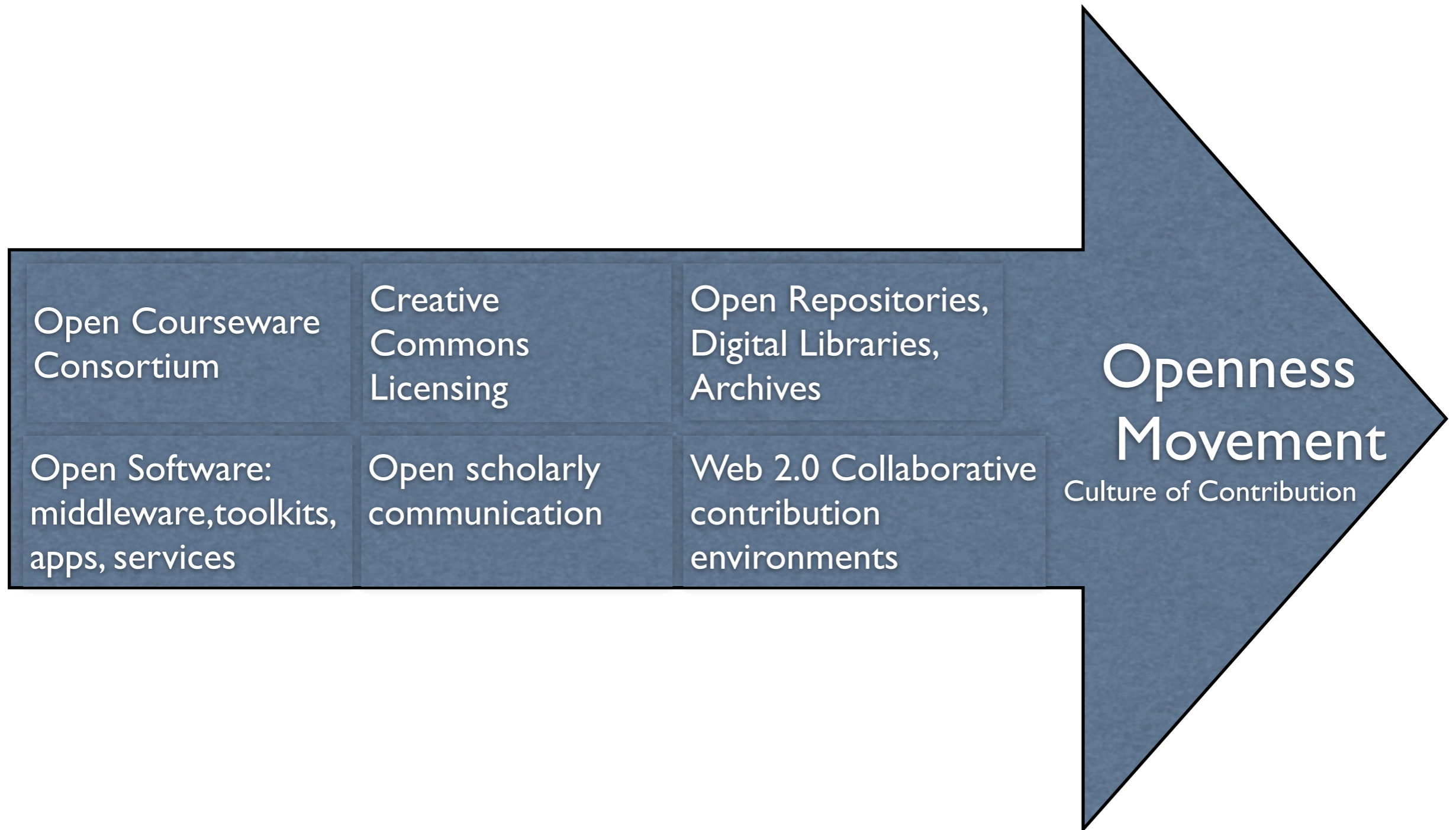


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Cyberinfrastructure

D. E. Atkins



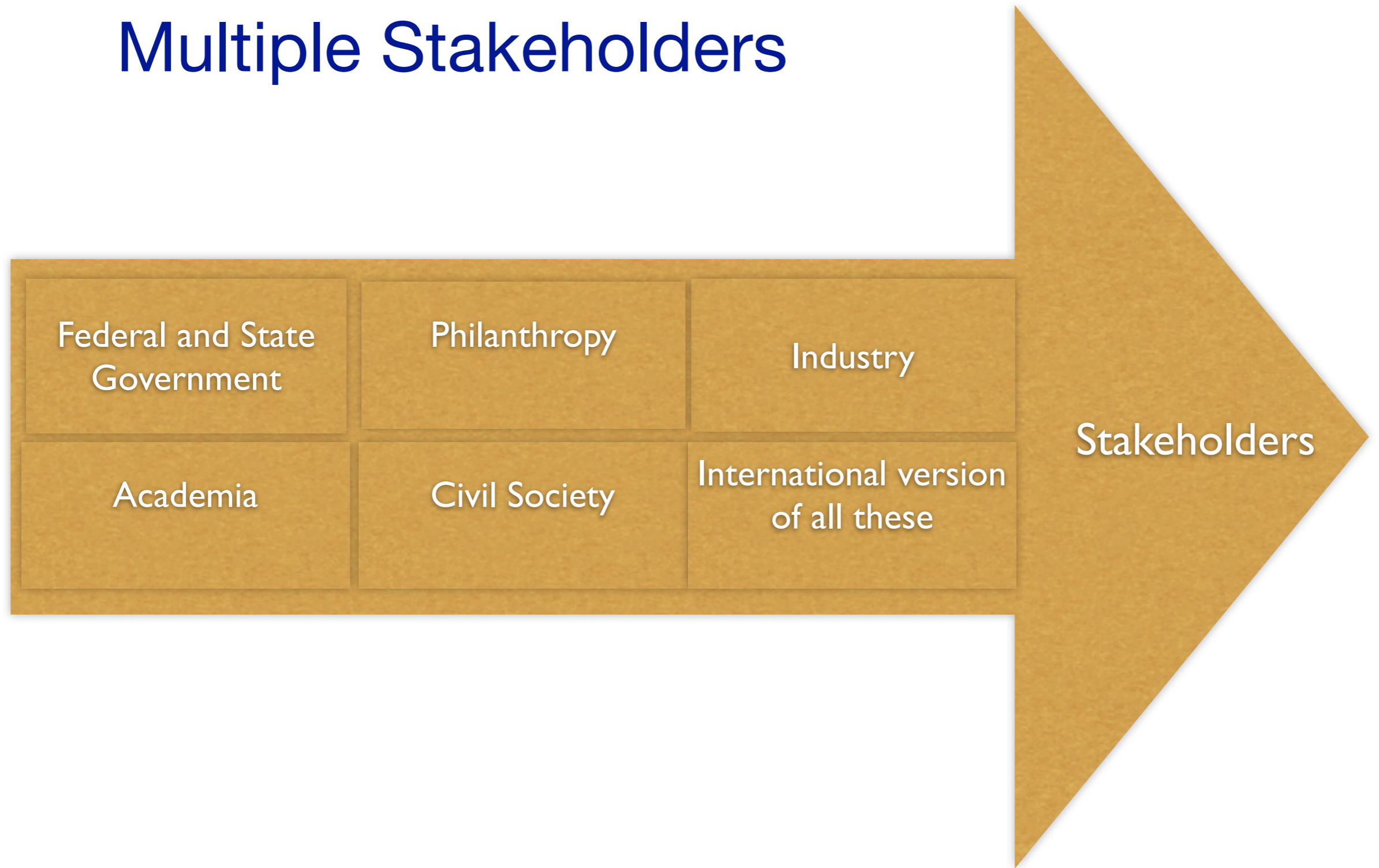
Openness Movement



Concepts, Visions of the Future of Learning & Discovery



Multiple Stakeholders



Gaming, collaboration,
virtual, immersive and
augmented reality





Questions

- The LHC community has made massive investments in high-capacity, globally-distributed grid computing to support the data analysis mission. But to what extent is it leveraging this investment to reduce the barriers of geography for the thousands of people involved in LHC projects?
- Being at CERN when on your campus. Being on your campus when at CERN.
- Broadened participation.
- Research and learning, including participation by students, citizen scientists, general public.



- Could at least a subset (microcosm?) of the LHC community develop a prototype of a “global meta university;” an open ecosystem of discovery and learning.
- Primary goal: more discovery and learning in the field of physics.
- Secondary goal - a large scale prototype of an open, global scale, “meta-university”?
- Possibility of broadened set of sponsors.
- Why not leadership in new CI-enabled platforms for participation in learning and discovery from the particle physics community?



- Perhaps such global-scale CI-enabled platforms for participation will be **essential** for success with the next generation linear accelerator.
- Furthermore perhaps eventually it can mitigate against the growing concern about the expense of creation, operation, and sustaining very expensive research infrastructure, and the attendant erosion of research funding for the use of such facilities.



Questions & Discussion



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