Global Cyberinfrastructure to Support e-Research

Invited Talk
e-XPO: e-Research@Monash
Monash University
Melbourne, Australia
August 19, 2009

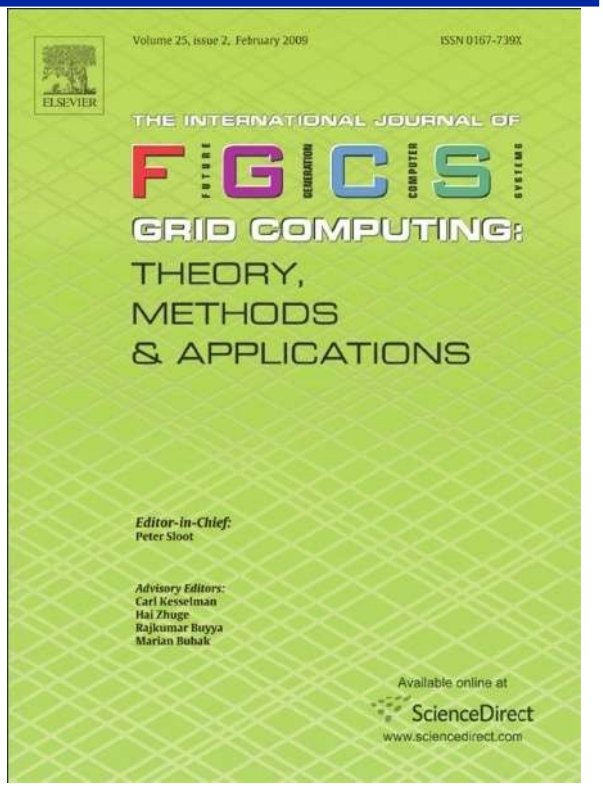
Dr. Larry Smarr
Director, California Institute for Telecommunications and Information Technology
Harry E. Gruber Professor,
Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD

OptIPuter

it²

The OptIPuter Creates an OptIPlanet Collaboratory: Enabling Data-Intensive e-Research





"OptIPlanet: The OptIPuter Global Collaboratory" – Special Section of Future Generations Computer Systems, Volume 25, Issue 2, February 2009

evl electronic visualization laboratory

NSF

ROCKS www.rocksclusters.org

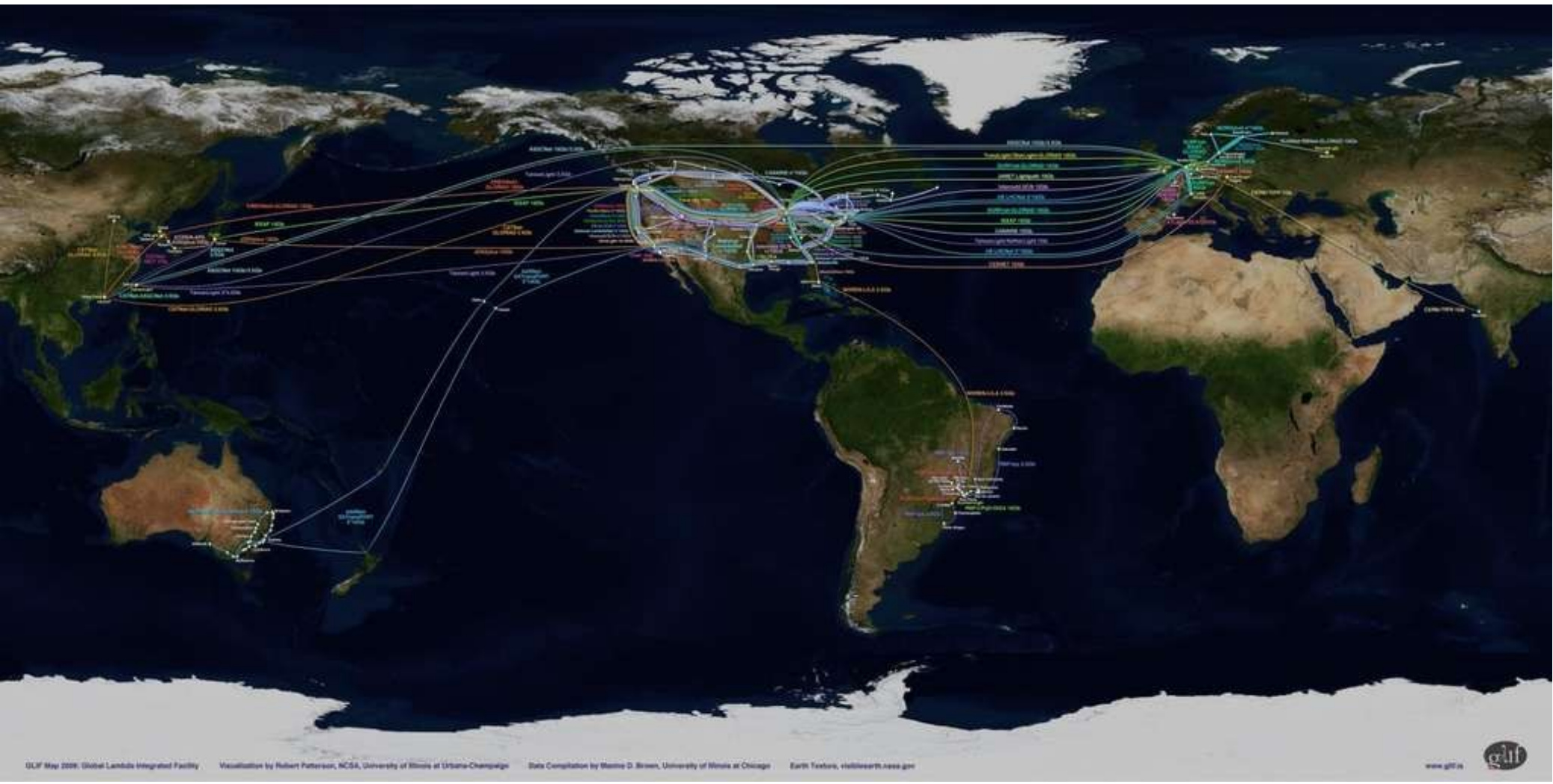
SAGE

OptIPuter

Calit2 (UCSD, UCI), SDSC, and UIC Leads—Larry Smarr PI
Univ. Partners: NCSA, USC, SDSU, NW, TA&M, UvA, SARA, KISTI, AIST
Industry: IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent

it²

Global Innovation Centers are Being Connected with 10,000 Megabits/sec Clear Channel Lightpaths



Research on 100 Gbps and 1 Tbps

Source: Maxine Brown, UIC and Robert Patterson, NCSA

On-Line Resources Help You Build Your Own OptIPortal

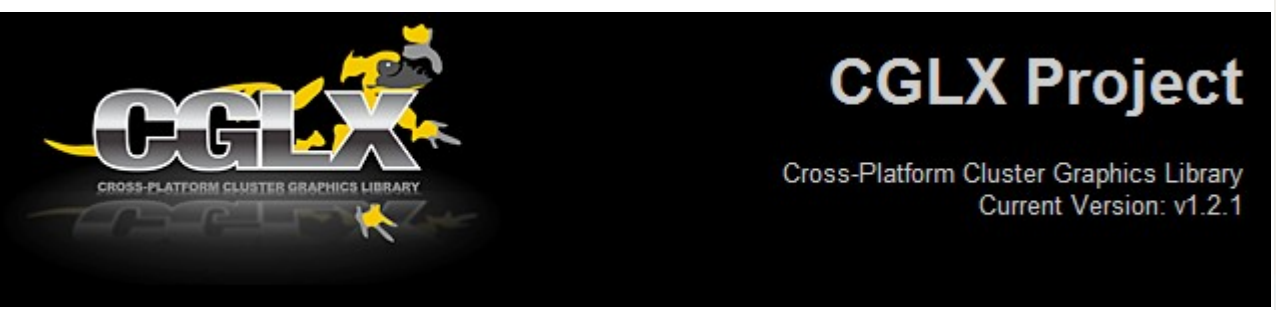
www.optiputer.net

http://wiki.optiputer.net/optiportal



www.evl.uic.edu/cavern/sage





http://vis.ucsd.edu/~cglx/



OptIPuter

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1/3 Billion Pixel OptIPortal Linked to NASA Goddard Earth Satellite Images of October 2007 Wildfires



OptIPuter

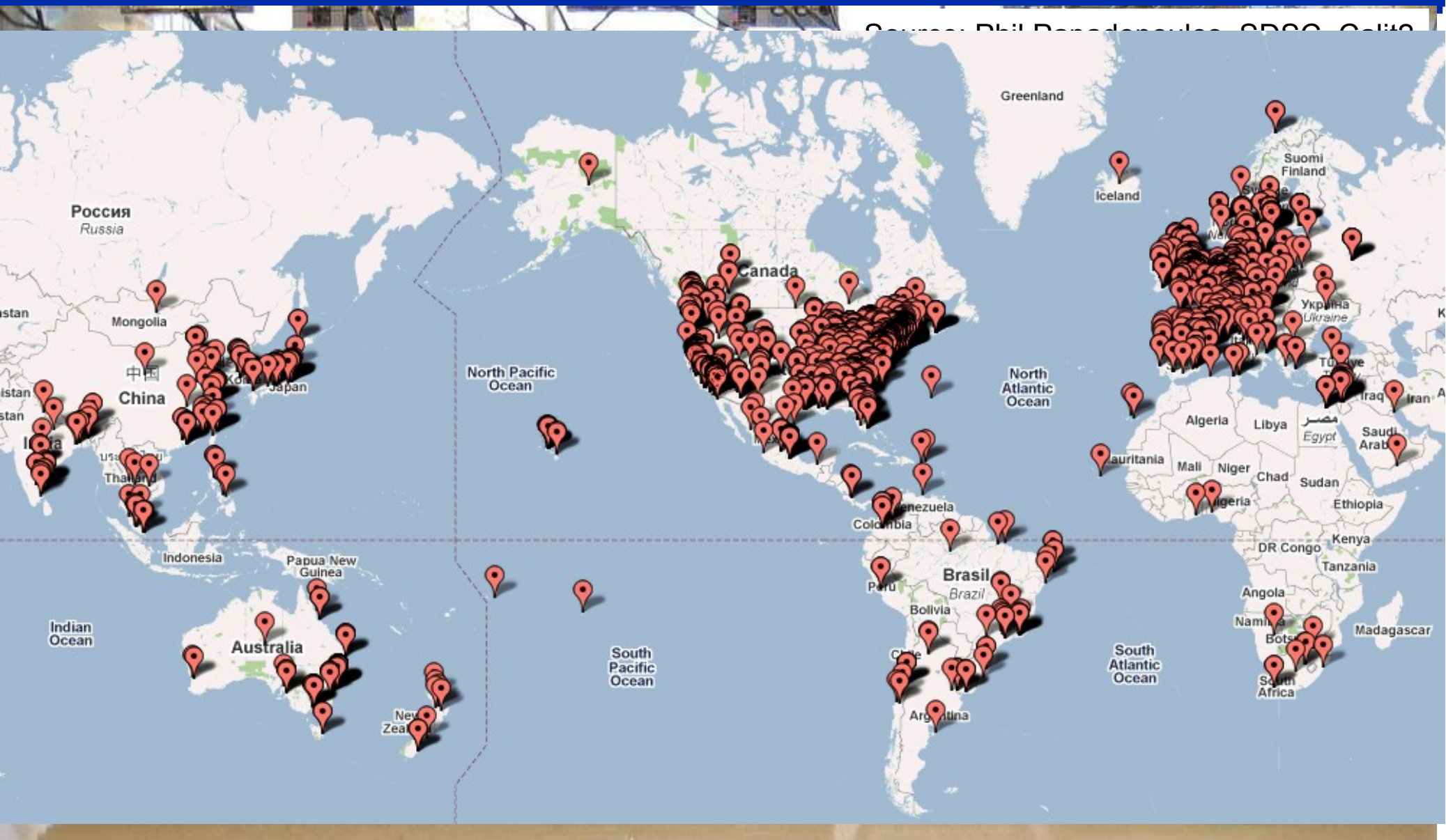
Powered by Rocks ROCKS

Source: Falko Kuester, Calit2@UCSD

CGLX

it²

Calit2 Microbial Metagenomics Cluster- Next Generation Optically Linked Science Data Server

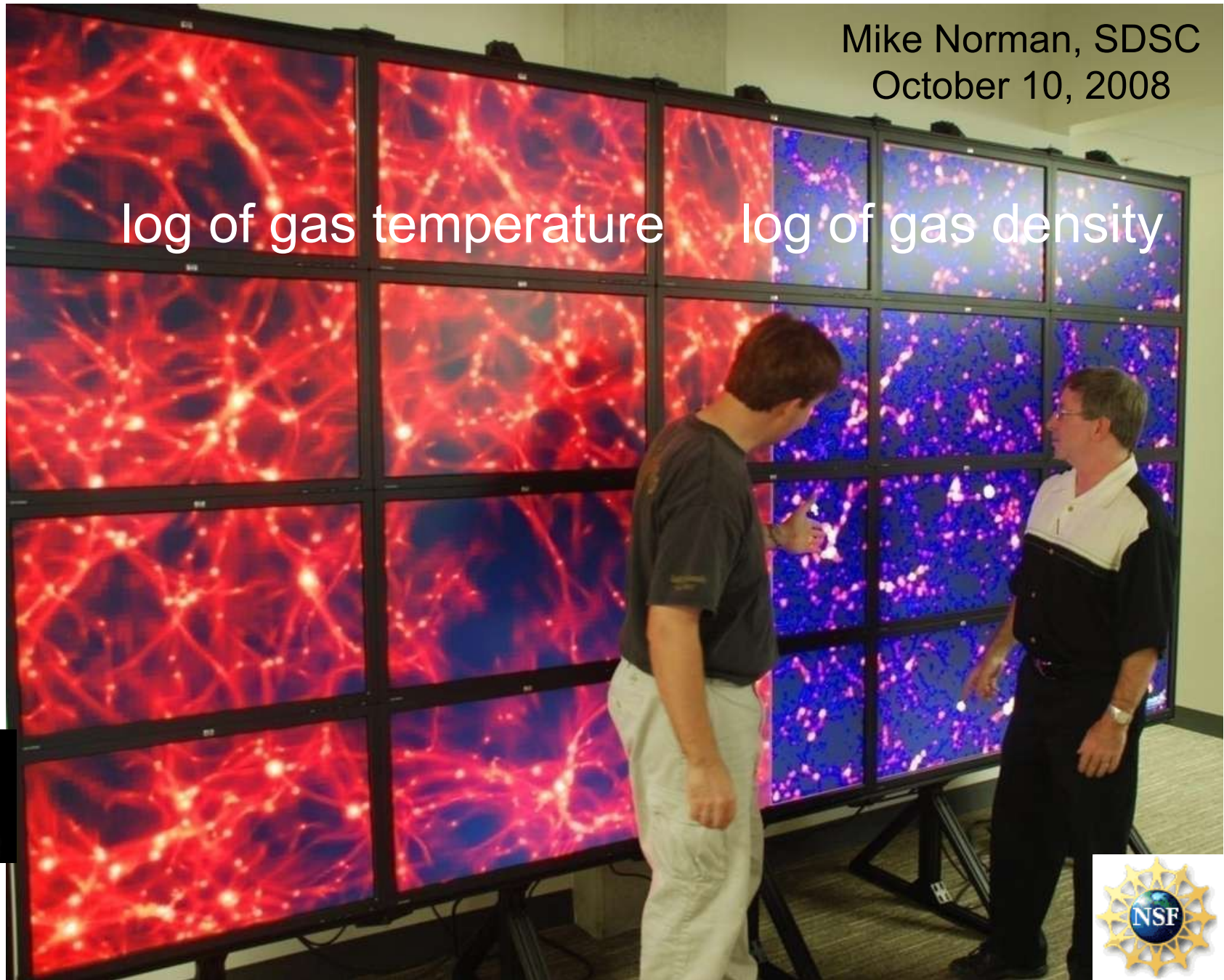


OptIPuter SDSC ROCKS camera Marine Microbial Ecology J. Craig Venter INSTITUTE it2

OptIPortals: Scaling up the Personal Computer For Supernetwork Connected Data-Intensive Users

SDSC
SAN DIEGO SUPERCOMPUTER CENTER

Two 64K Images From a Cosmological Simulation of Galaxy Cluster Formation



ROCKS
www.rocksclusters.org

CGLX

OptIPuter

NSF

Remote Control of Scientific Instruments: Live Session with JPL and Mars Rover from Calit2



Source: Falko Kuester, Calit2; Michael Sims, NASA

Just in Time OptIPlanet Collaboratory: Live Session Between NASA Ames and Calit2@UCSD



From Start to This Image in Less Than 2 Weeks!

View from NASA Ames Lunar Science Institute Mountain View, CA

Virtual Handshake

HD compressed 6:1

NASA Interest in Supporting Virtual Institutes

OptIPuter

CGLX

Source: Falko Kuester, Calit2; Michael Sims, NASA

it²

OptIPuter Persistent Infrastructure Enables Calit2 and U Washington CAMERA Collaboratory



OptIPuter

Ginger Armbrust's Diatoms: Micrographs, Chromosomes, Genetic Assembly

ROCKS



MOORE FOUNDATION



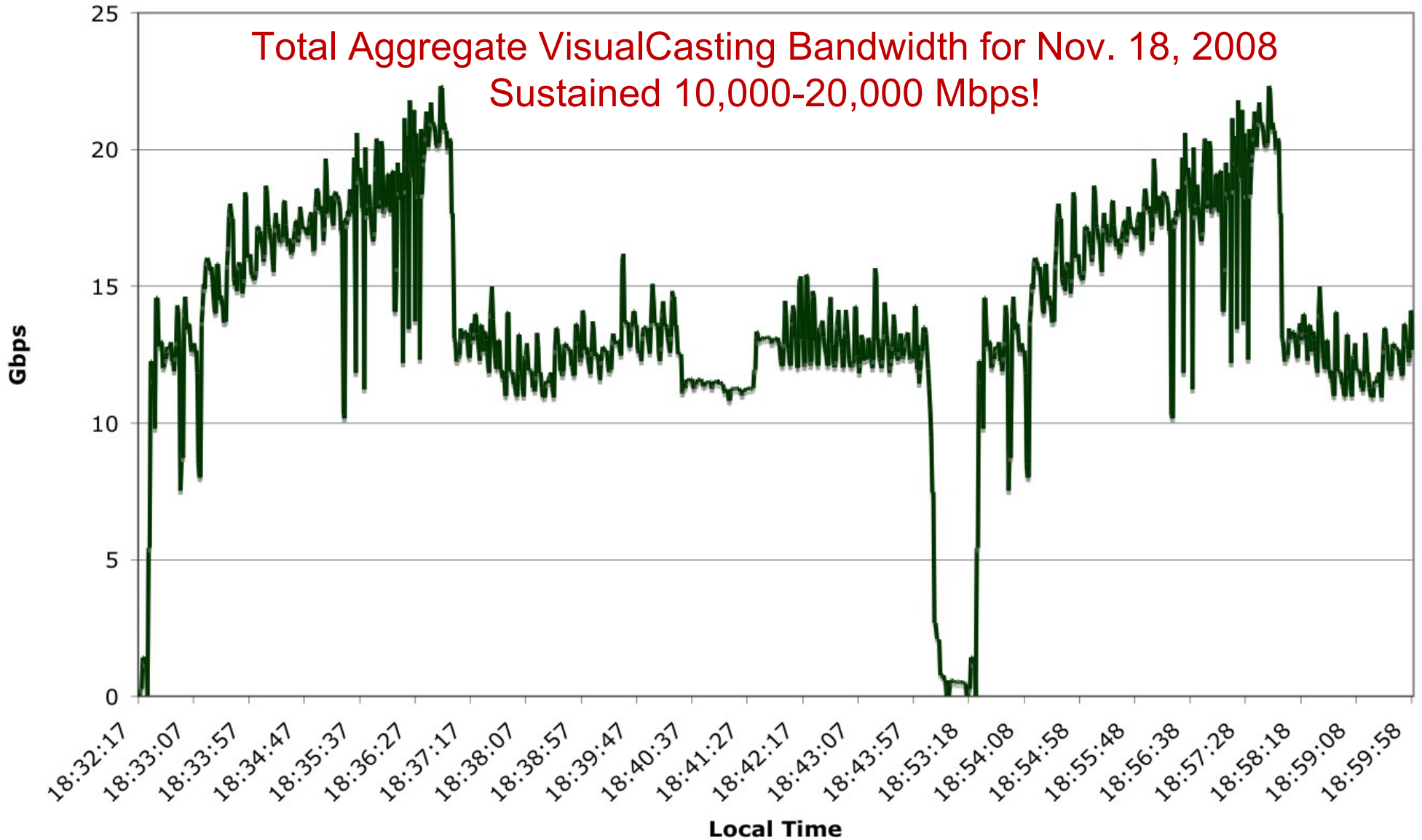
camera
Marine Microbial Ecology

NSF

OptIPuter

it2

EVL's SAGE OptIPortal VisualCasting Multi-Site OptIPuter Collaboratory



Source: Jason Leigh, Luc Renambot, EVL, UI Chicago

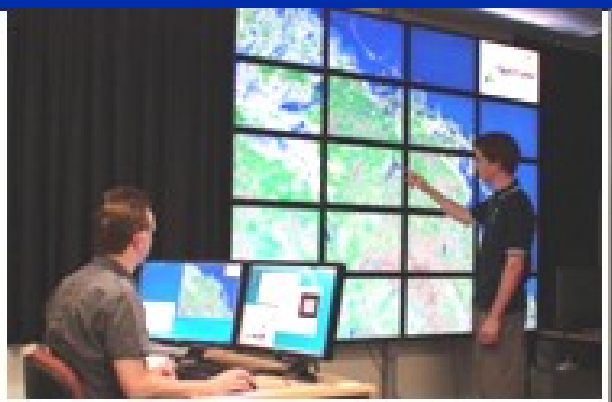
“To ensure a competitive economy for the 21st century, the Australian Government should set a goal of making Australia the pre-eminent location to attract the best researchers and be a preferred partner for international research institutions, businesses and national governments.”



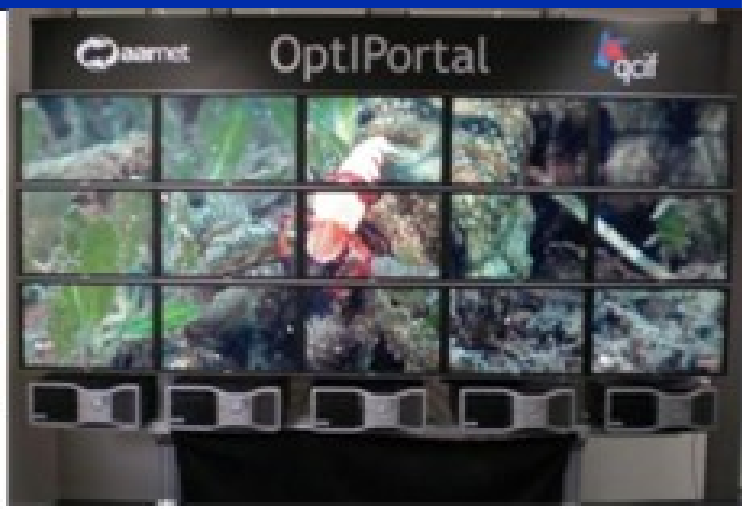
Launch of the 100 Megapixel OzIPortal Kicked Off a Rapid Build Out of Australian OptIPortals



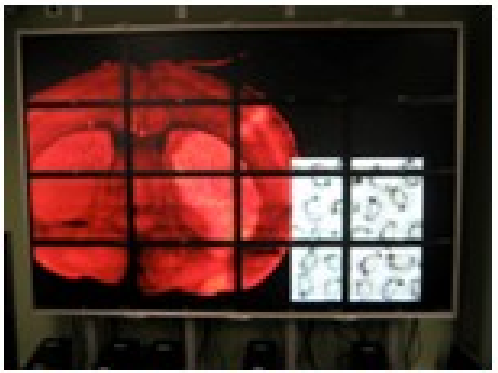
ANU



U Queensland



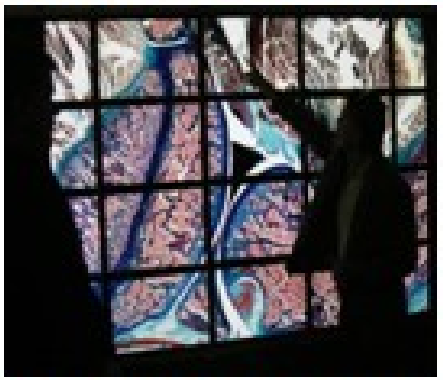
AARNet



Monash U-Caufield



CSIRO



Monash U-Clayton



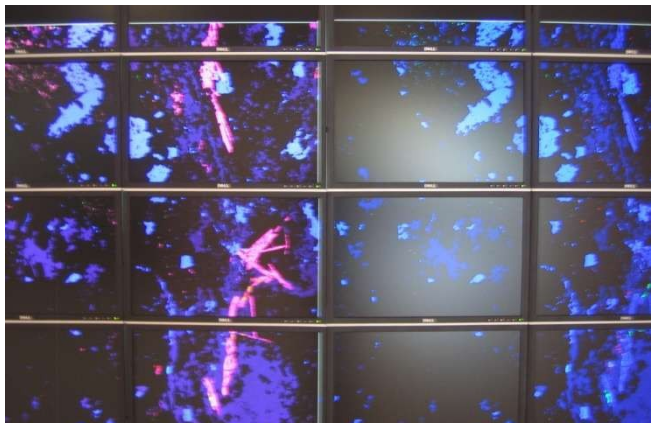
U Wellington, NZ

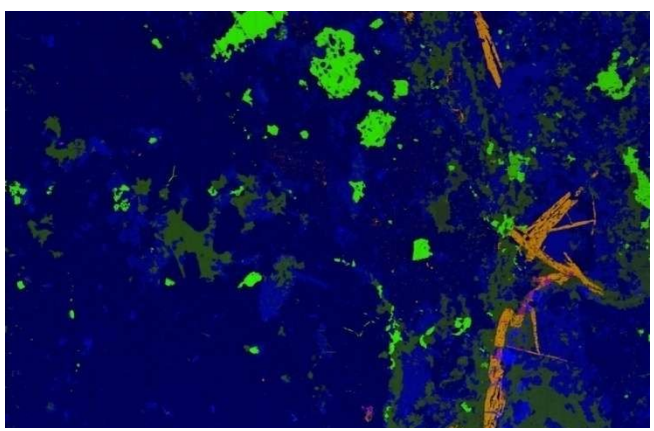
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Latest Australian OptIPortal-- Australian Synchrotron in Melbourne







Images from Microspectroscopy Beamline
4000 x 4000 Pixel Scan Images of Clay
Provided by Chris Ryan from CSIRO

Source: Chris Myers, Victorian e-Research Strategic Initiative

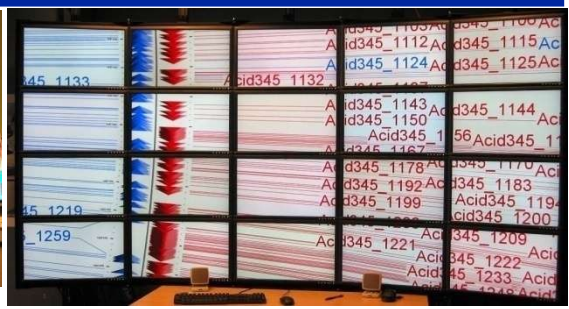
North American OptIPuter Team OptIPortals



Calit2@UCSD



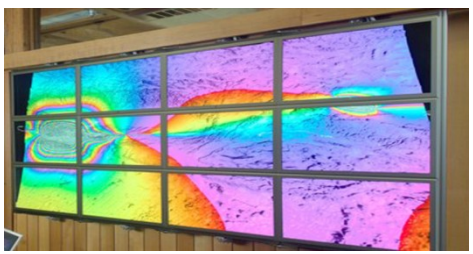
Calit2@UCSD



Calit2@UCSD



NCMIR-UCSD



SIO-UCSD



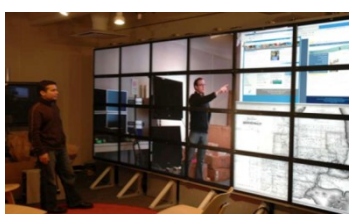
Calit2@UCSD



Calit2@UCSD



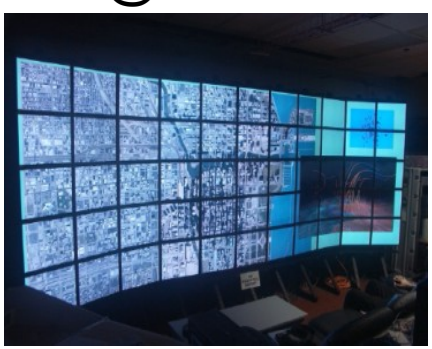
USGS



VISIT-U Michigan



EVL@UIC



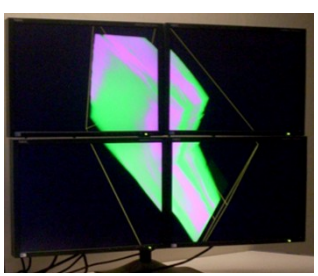
EVL@UIC



Calit2@UCI



iCAIR-
Northwestern U



Texas A&M



EVL@UIC

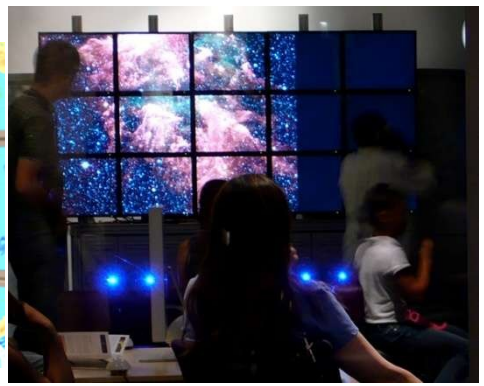
North American OptIPortals



U Washington



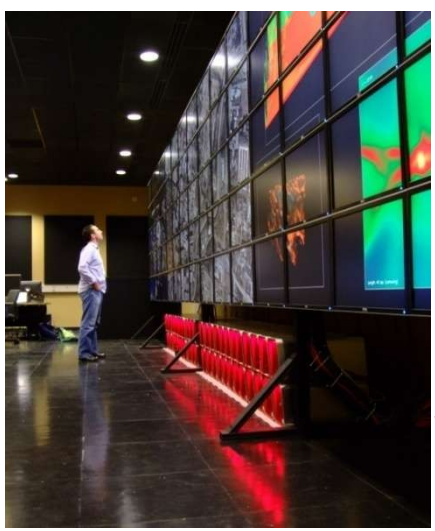
AOSS-U Michigan



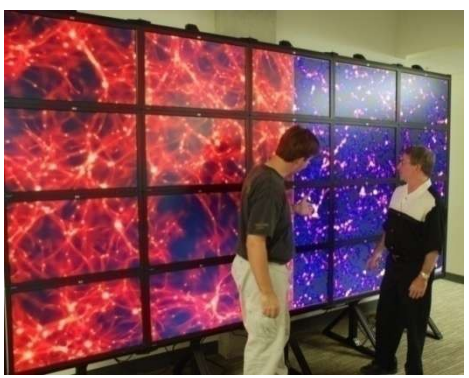
Adler Planetarium - Chicago



TRCC, Chicago



TACC TeraGrid



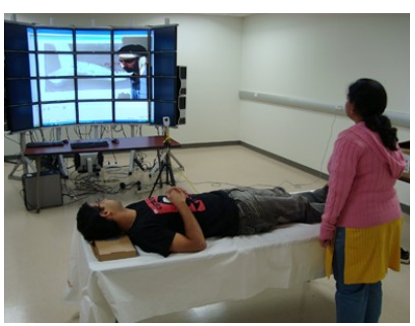
SDSC - UCSD



DMC-U Michigan



NASA Goddard



UC Irvine

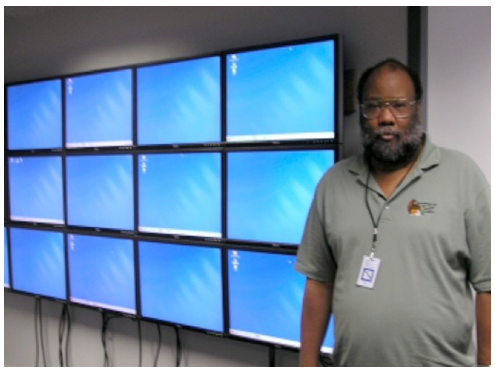


UCSD

North American OptIPortals



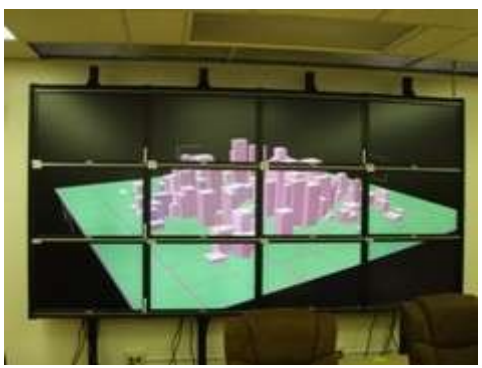
Sharp Corp.



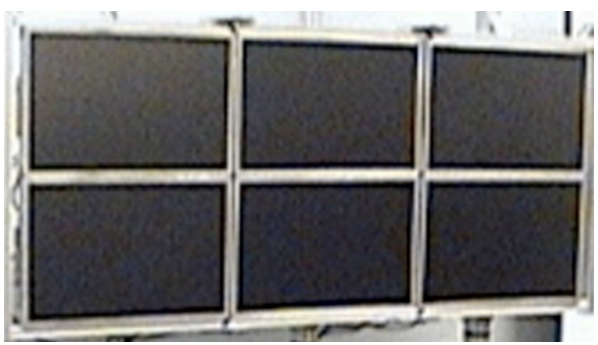
Rincon



Nortel



U Hawaii



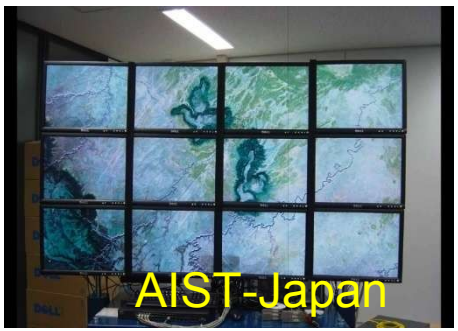
Florida International U





CICESE, Mexico

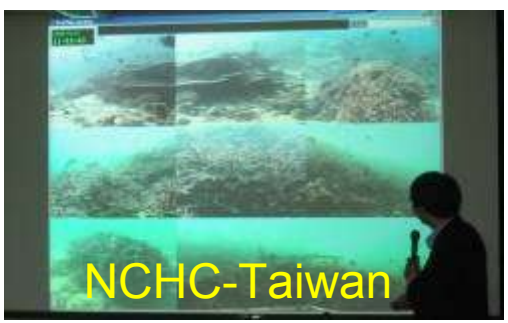
International OptIPortals Are Being Adopted Globally Connected by GLIF



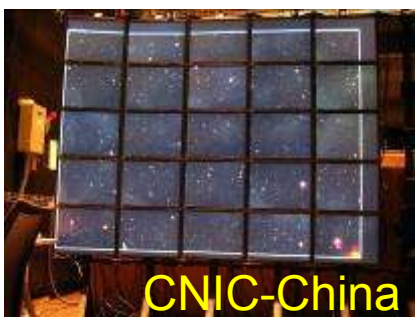


















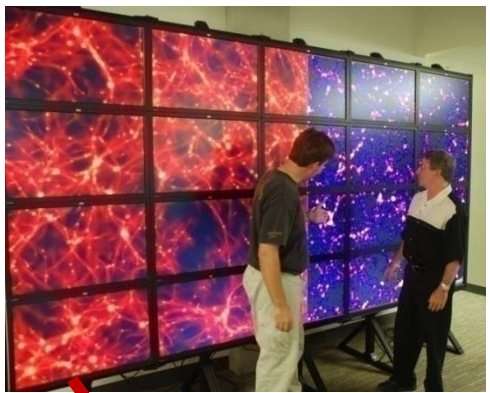




OptIPuter

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Academic Research "OptIPlatform" Cyberinfrastructure: A 10Gbps Lightpath Cloud



End User OptIPortal



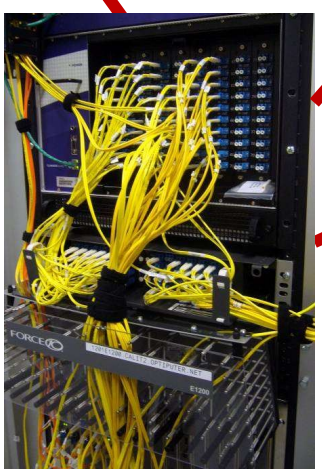
Instruments



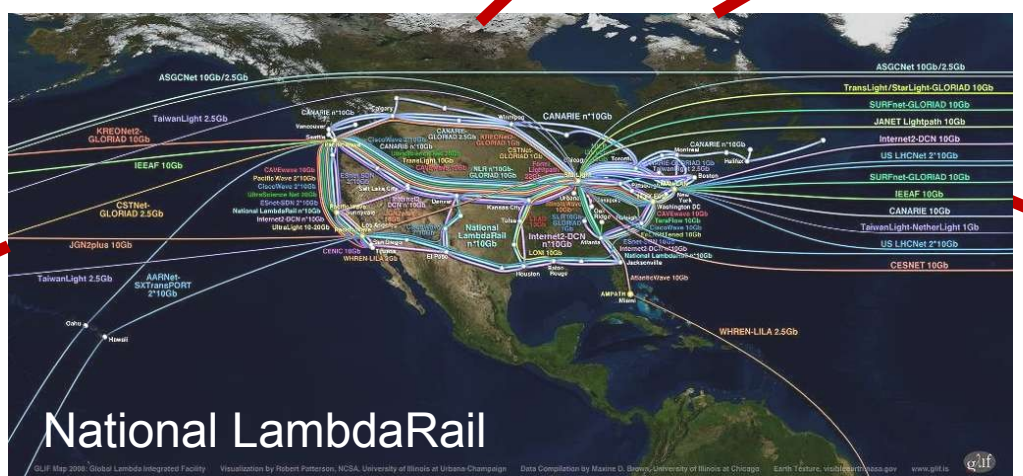
HD/4k Telepresence



HD/4k Video Cams



10G Lightpaths



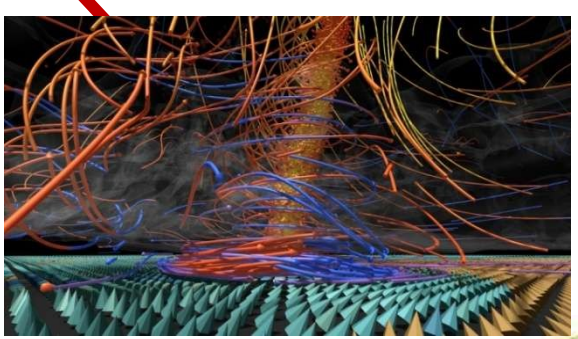
HPC

TeraGrid™

Campus Optical Switch



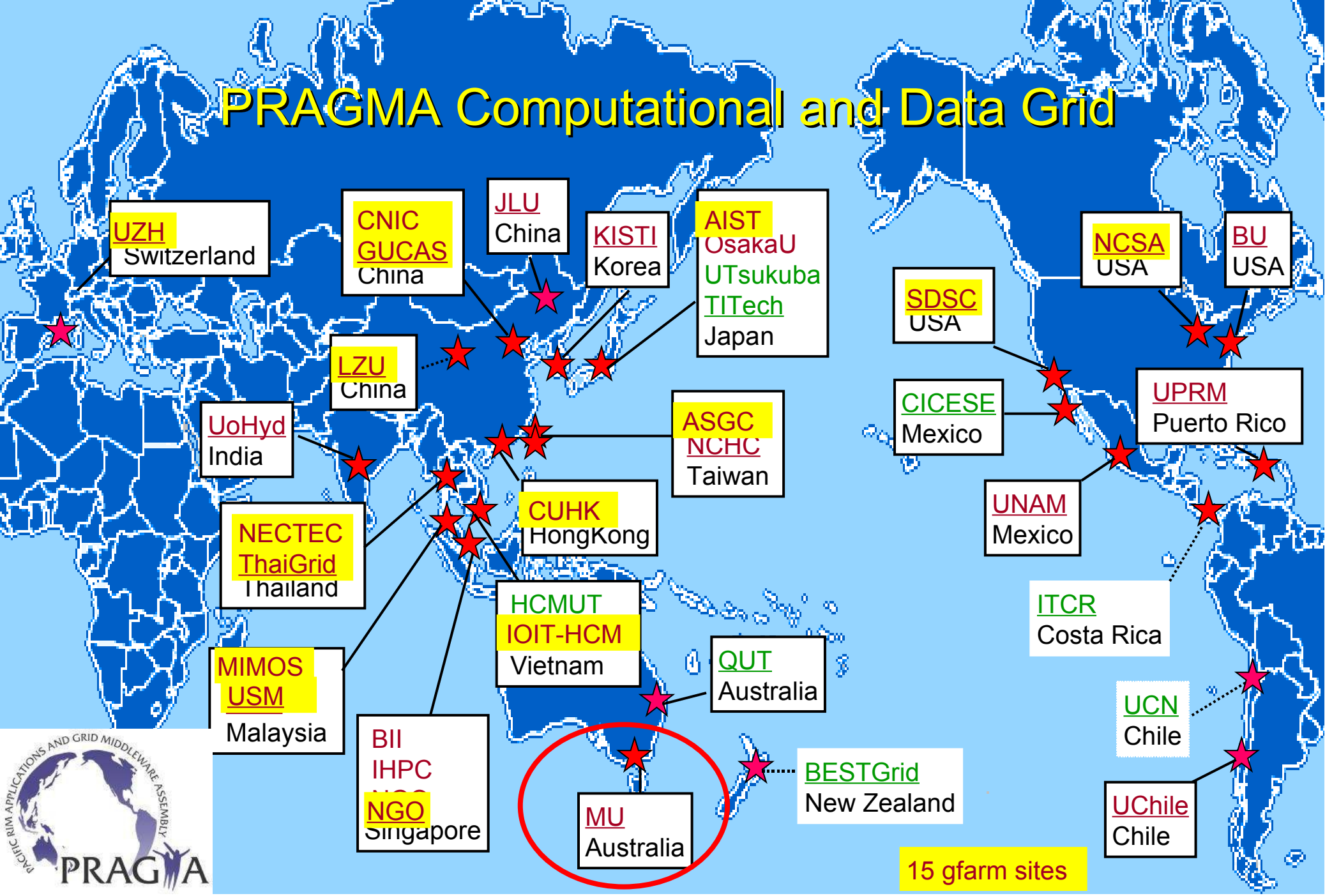
Data Repositories & Clusters



HD/4k Video Images

OptIPuter

it²

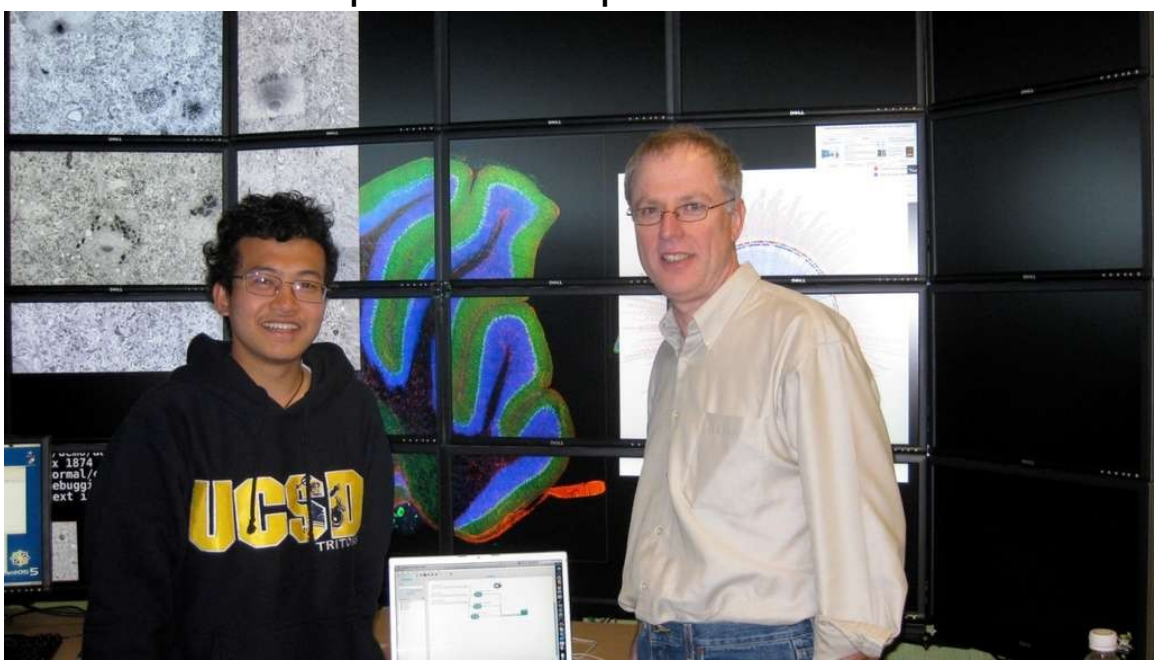

PRAGMA Computational and Data Grid
UZH
Switzerland
CNIC
GUCAS
China
JLU
China
KISTI
Korea
AIST
OsakaU
UTsukuba
TITech
Japan
NCSA
USA
BU
USA
SDSC
USA
LZU
China
UoHyd
India
ASGC
NCHC
Taiwan
CICESE
Mexico
UPRM
Puerto Rico
UNAM
Mexico
NECTEC
ThaiGrid
Thailand
CUHK
HongKong
HCMUT
IOIT-HCM
Vietnam
ITCR
Costa Rica
MIMOS
USM
Malaysia
QUT
Australia
UCN
Chile
BII
IHPC
NGO
Singapore
MU
Australia
BESTGrid
New Zealand
UChile
Chile
15 gfarm sites
PACIFIC RIM APPLICATIONS AND GRID MIDDLEWARE ASSEMBLY
PRAGMA
OptIPuter
34 Clusters from 28 Institutions in 16 Countries/Regions
(+ 8 in Preparation)
it2

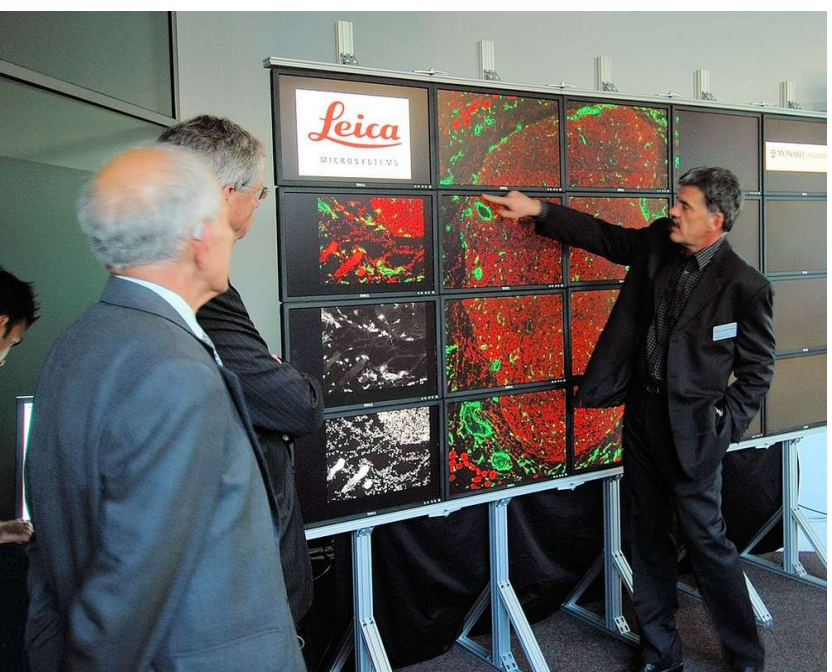
Virtual Microscopy & Analysis Using Scientific Workflows



Remote Control of Leica Microscope from Kepler Nov 2008

First OptIPortal/Kepler Link Feb 2009





First Remote Control of Leica Microscope in Germany to OptIPortal in Australia Using Kepler March 2009

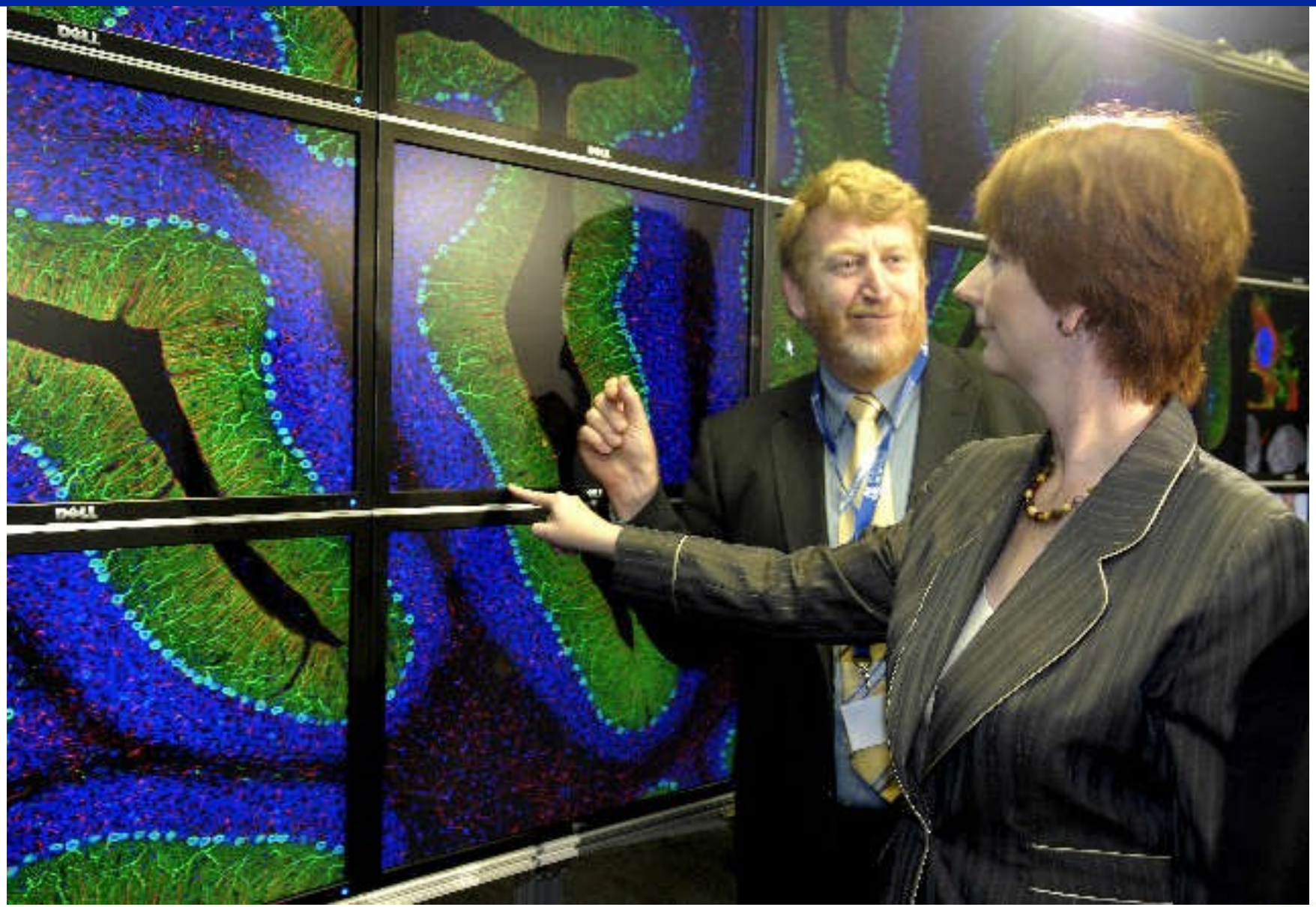
Source: David Abramson, U Monash

MASSIVE New Australian Imaging Environment

- **Multi-modal Australian Sciences Imaging and Visualisation Environment (Aust Synchrotron, Monash, CSIRO) - MASSIVE**
- **Specialist National HPC Facility Under National Computational Infrastructure Program**



Empowering the "Digital Education Revolution"



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PRIME@ Monash

- U.S. National Science Foundation Funding
- Preparing Students for the Global Workplace of the 21st Century
- Engaged in PRIME since 2004
- Projects range from bio-engineering, theoretical chemistry to computer science
- Has underpinned long lasting academic collaborations
  - Publications
  - Presentations at Conferences
- Undergraduate students without research experience!



2008


2007


2006


2005

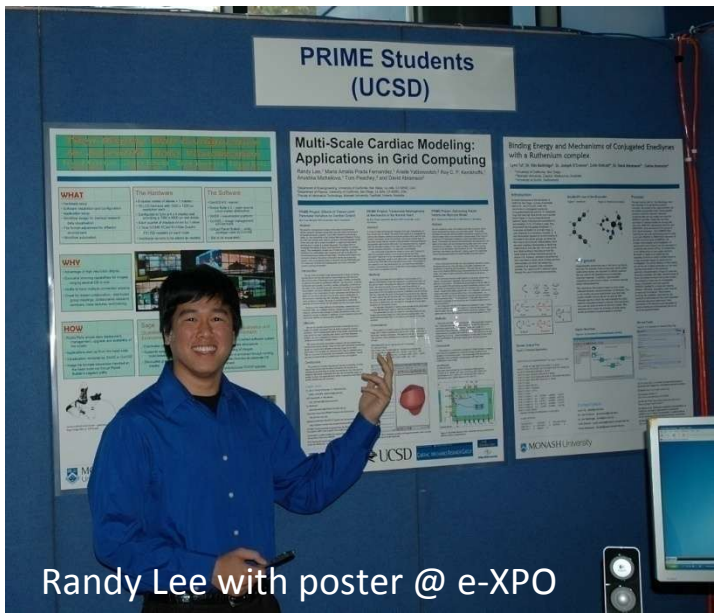


2004

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PRIME Presentations
Getting Global Research Experience

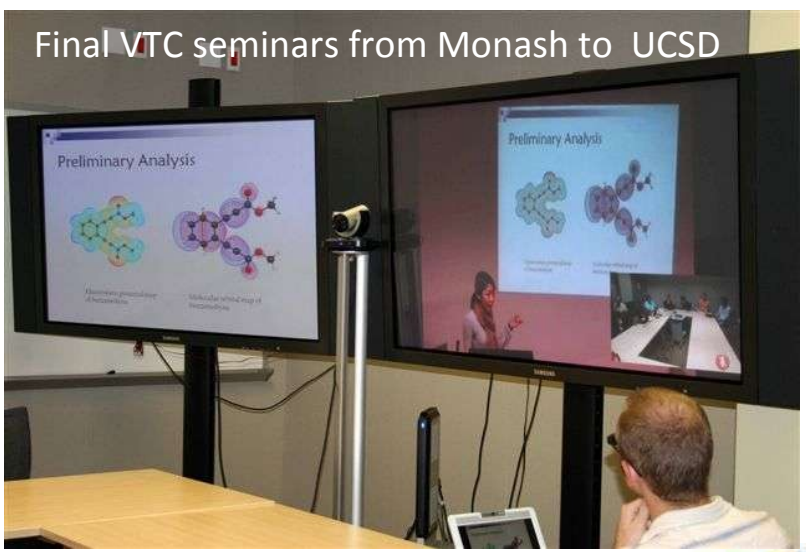


Randy Lee with poster @ e-XPO



Sirvard Nshanyan with Monash VC


Advanced training at UCSD



Final VTC seminars from Monash to UCSD

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Monash Undergraduate Research Projects Abroad (MURPA) International Research Seminar Series 2008

- Integrating Neuroscience Knowledge: Brain Research in the Digital Age, Mark Ellisman
- CAMERA: Community Cyberinfrastructure for Advanced Microbial Ecology Research and Analysis Larry Smarr
- On Accelerating Scientific Discovery using Scientific Workflows and the Kepler System, Ilkay Altintas
- Visualization, Jurgen Schulze
- Avian Flu Modeling, Wilfred Li
- Cardiac modeling, Andrew McCulloch
- Quantum Chemistry, Kim Baldridge

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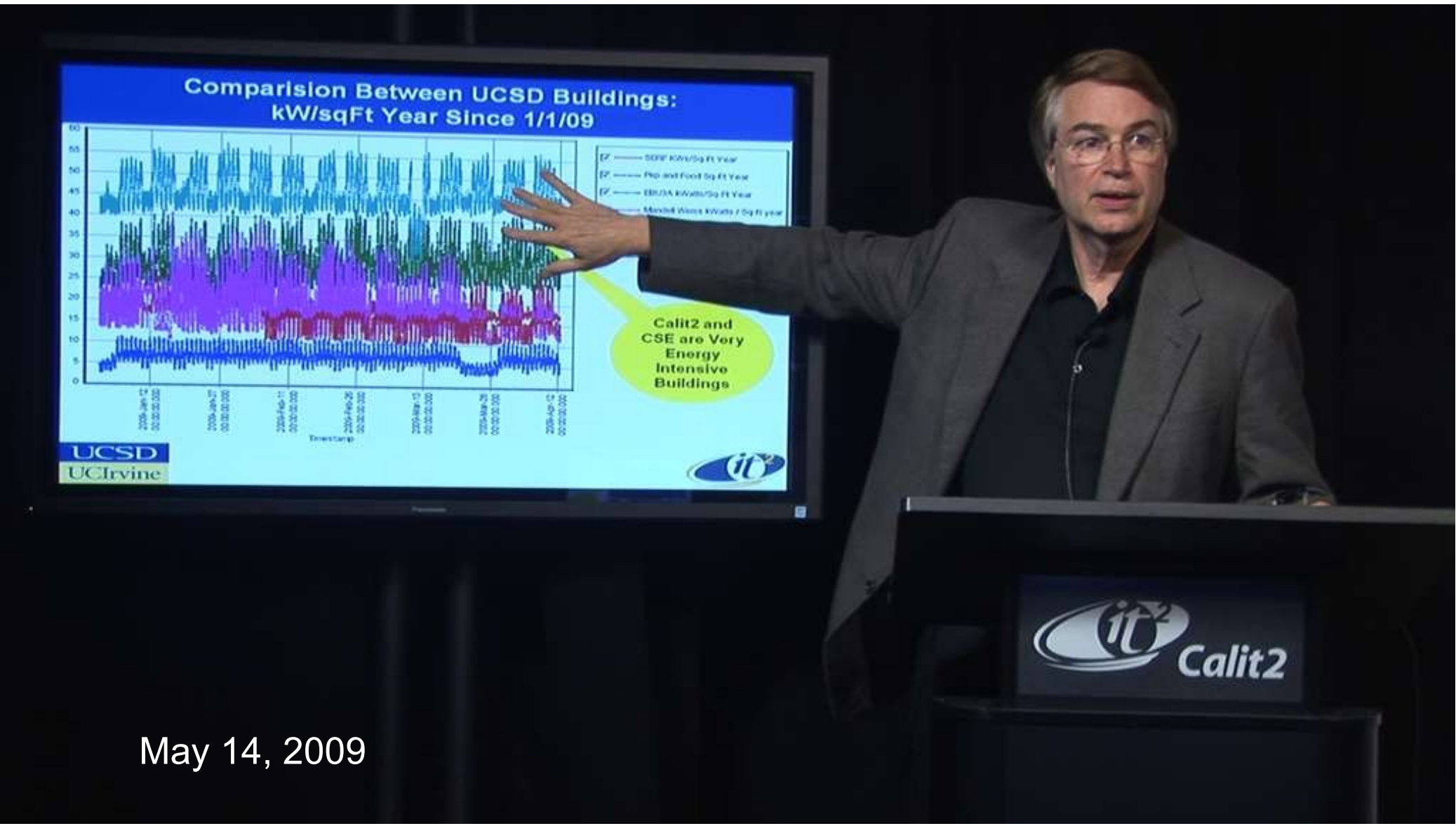
HD Talk to Australia's Monash University from Calit2: Reducing International Travel



Qvidium Compressed HD ~140 mbps

Source: David Abramson, Monash Univ

MURPA International
Research Seminar Series 2009



May 14, 2009

OptIPuter

Australia's National Broadband Network (NBN) Will Create the World's Most Ubiquitous Broadband

- **NBN Goals**
  - Connect 90% of Households with Fiber in Eight Years
  - Remaining 10% by Satellite or Wireless
  - 100 Mbit/s Broadband Per House
  - Driven by Consumer Internet, Telephone, Video
    - "Triple Play", eHealth, eCommerce…
- **Video Conferencing to Avoid Transportation**
- **"Smart" Electric Grid**
  - Reduce Household and Building Energy Usage
  - Avoid Peak Loading
  - Plug-In Hybrid with Renewable Electricity Generation
- **Cloud Computing and Storage at Renewable Sites**

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