

“Connecting Mexico to the OptIPuter”

**Invited Presentation
Reunion Otono 2006
San Luis Potosi, Mexico
October 20, 2006**

**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**



**“The future is already here, it’s just not evenly distributed”
William Gibson, Author of Neuromancer**



- **Home Broadband**
 - 1-5 Mbps



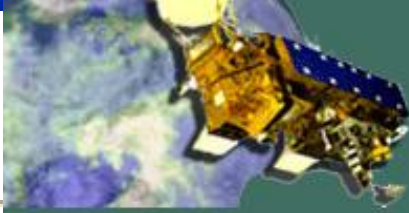
- **University Dorm Room Broadband**
 - 10-100 Mbps



- **Calit2 Global Broadband**
 - 1,000-10,000 Mbps



Challenge: Average Throughput of NASA Data Products to End User is Typically < 50 Mbps

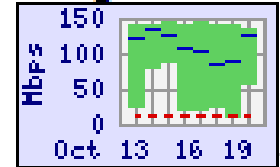


ENSIGHT Active Testing
AQUA Destinations

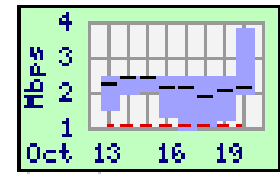
Tested
October 2006

Internet2 Backbone is 10,000 Mbps!
Throughput is < 0.5% to End User

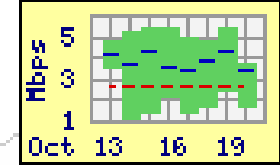
Oregon St.



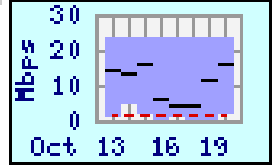
UCL



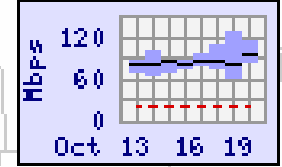
RSS



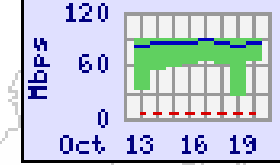
Montana



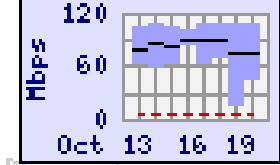
Wisconsin



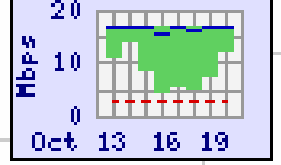
Boston U



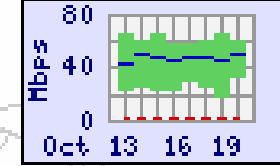
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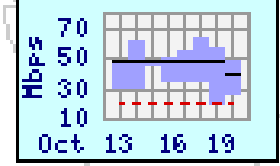
Colo State



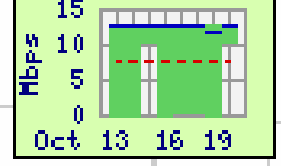
SUNY-SB



JPL-AIRS



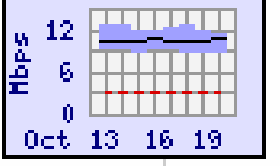
NSIDC u



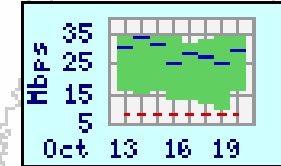
NOAA-Camp Springs



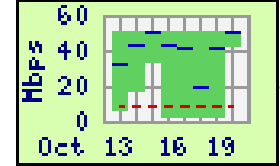
Arizona



NSSTC



UCSD



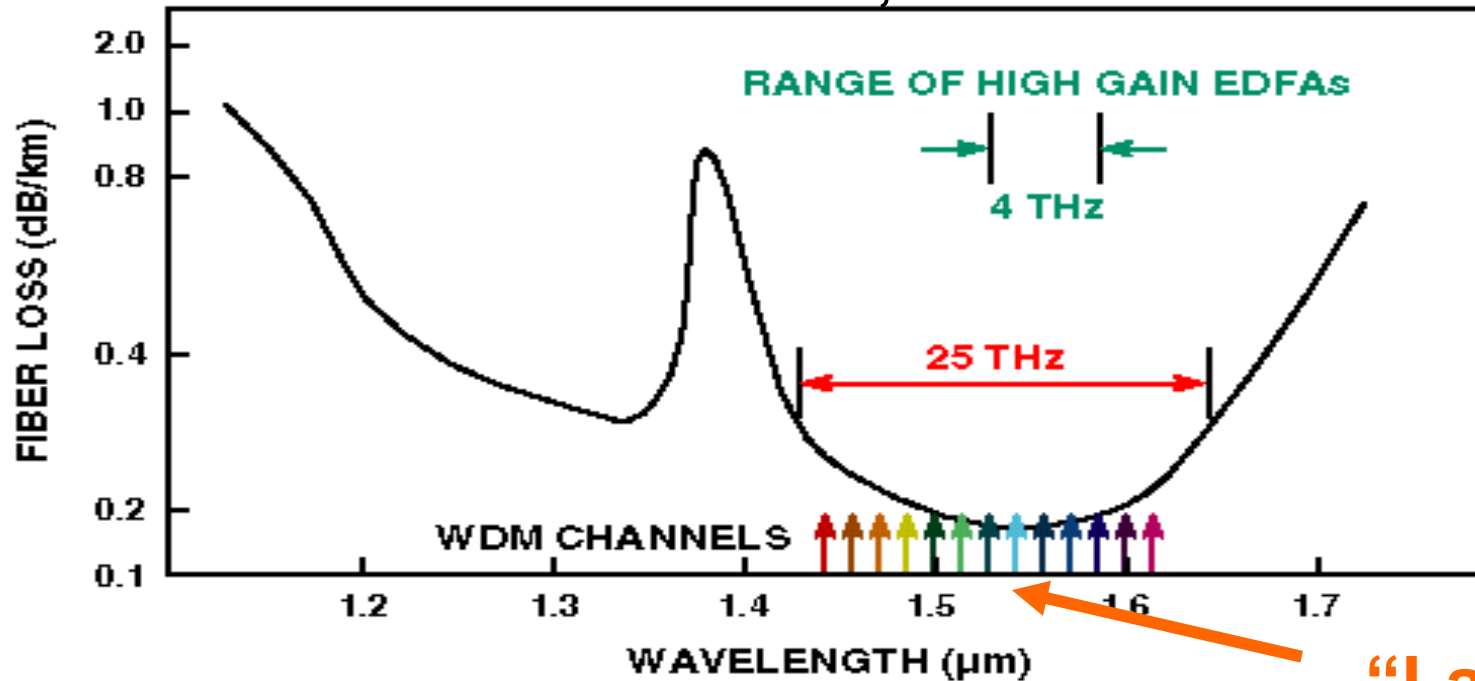
Dedicated Optical Channels Makes High Performance Cyberinfrastructure Possible

WAVELENGTH DIVISION MULTIPLEXING (WDM)

10 Gbps per User ~ 200x Shared Internet Throughput

- EXPLOITS
 - ENORMOUS BANDWIDTH OF SILICA FIBER
 - HIGH-GAIN WIDEBAND OPTICAL AMPLIFIERS

Source: Steve Wallach, Chiaro Networks

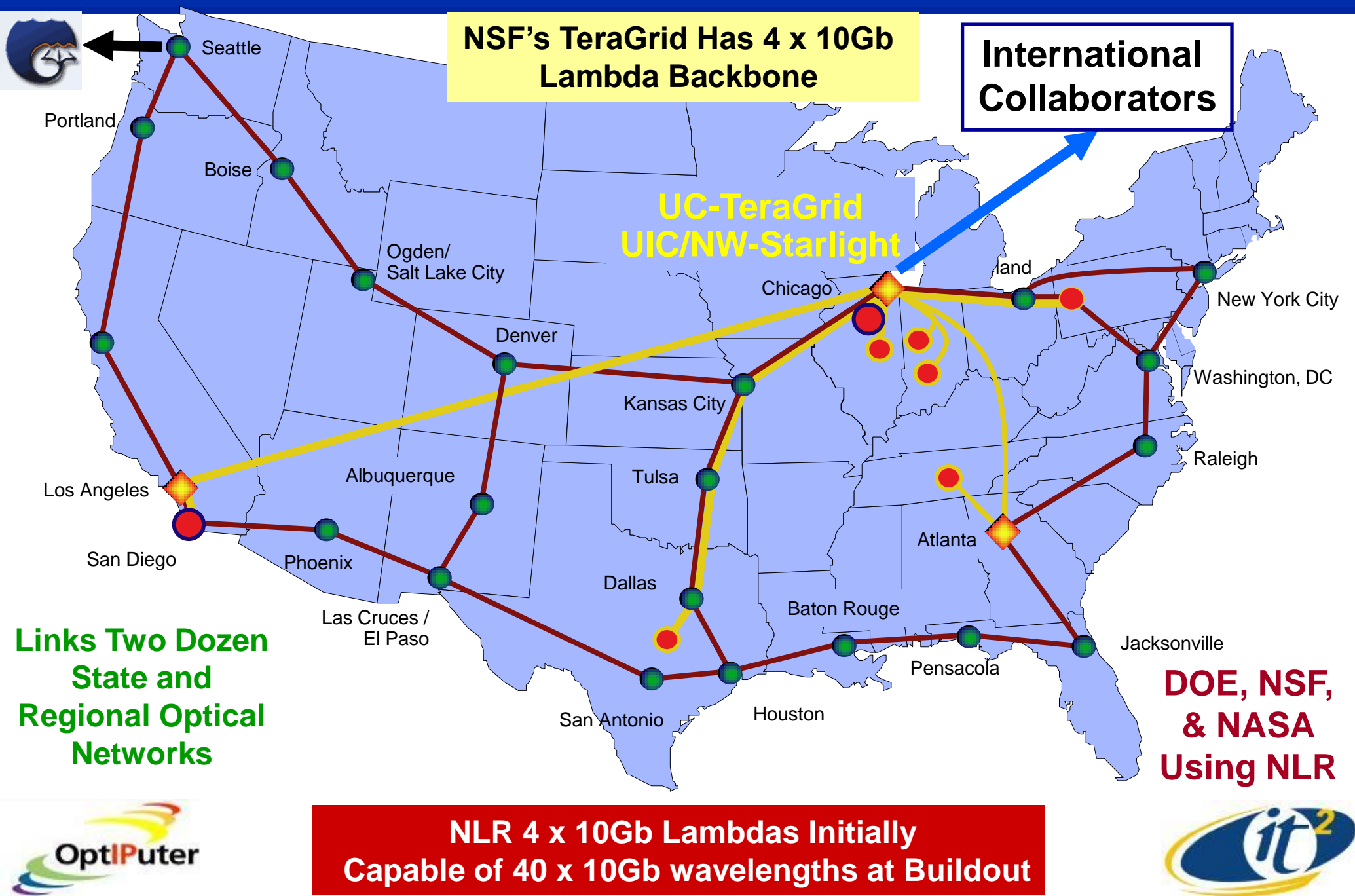


“Lambdas”

**Parallel Lambdas are Driving Optical Networking
The Way Parallel Processors Drove 1990s Computing**



National Lambda Rail (NLR) and TeraGrid Provides Cyberinfrastructure Backbone for U.S. Researchers



Two New Calit2 Buildings Provide Major New Laboratories for Living in the Future



UC Irvine

- **New Laboratory Facilities**
 - Nanotech, BioMEMS, Chips, Radio, Photonics, Grid, Data, Applications
 - Virtual Reality, Digital Cinema, HDTV, Synthesis
- **Over 1000 Researchers in Two Buildings**
 - Linked via Dedicated Optical Networks
 - International Conferences and Testbeds



Disseminating Calit2 Research to the Spanish-Speaking World

CALIFORNIA INSTITUTE FOR TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY



home about us people research partners education newsroom events

Newsroom

» News Releases

Web Articles

In The News

Multimedia

Resource Center

Presentations

Newsroom > Web Articles

Spanish translation provided by Cicese.



Academicos Afiliados a Calit2@UCI Incrementan Honores y Premios Recibidos

Oct. 19, 2006 -- Academicos afiliados a Calit2 de UC Irvine ([Calit2@UCI](#)) han amasado recientemente una abundante cantidad de premios, regalos, apoyos económicos y honores.

Magda El Zarki, profesora de ciencias de la computación, ha sido nominada a la Silla Cor Wit de la Universidad Tecnológica de Delft en Holanda. Establecida en 2003 por la Fundación Cor Wit, La Silla Co Wit se otorga anualmente a un investigador internacional en el campo de las telecomunicaciones e informática cuyo trabajo se enfoca en la interface entre la tecnología y la sociedad. Las redes, es la principal área de la profesora El Zarki, con particular énfasis en multimedia y sistemas wireless.

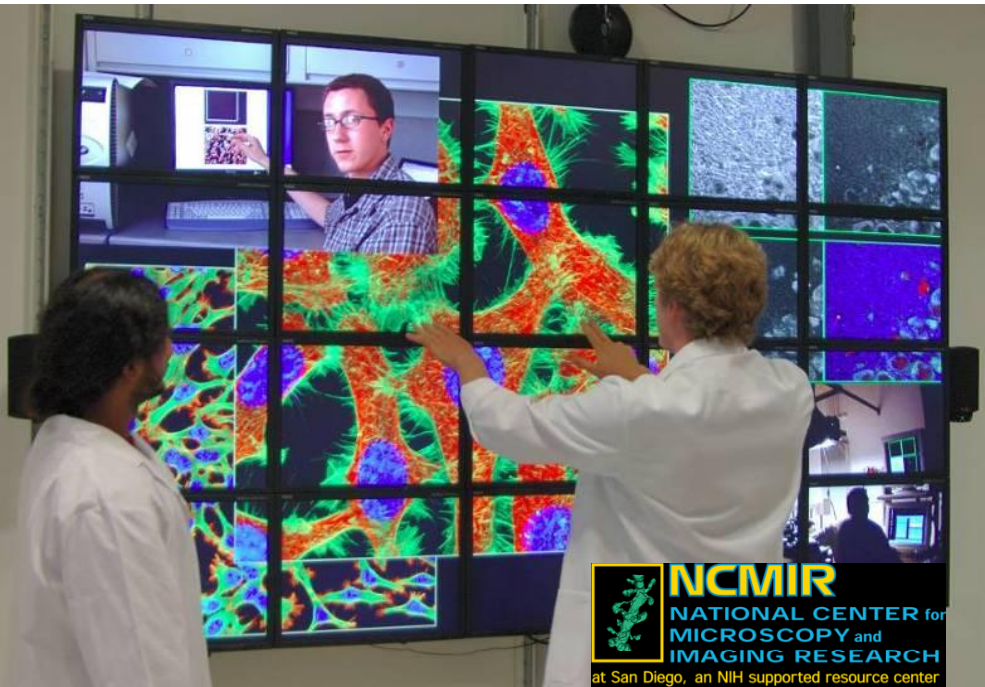


The OptIPuter Project – Creating High Resolution Portals Over Dedicated Optical Channels to Global Science Data

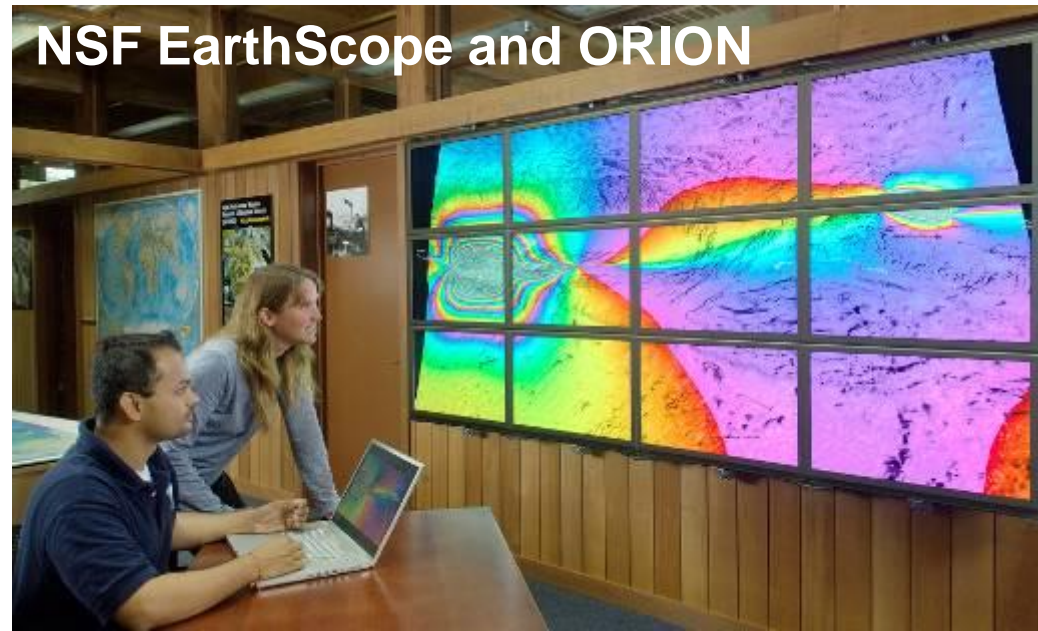
- **NSF Large Information Technology Research Proposal**
 - Calit2 (UCSD, UCI) and UIC Lead Campuses—Larry Smarr PI
 - Partnering Campuses: SDSC, USC, SDSU, NCSA, NW, TA&M, UvA, SARA, NASA Goddard, KISTI, AIST, CRC(Canada), CICESE (Mexico)
- **Engaged Industrial Partners:**
 - IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent
- **\$13.5 Million Over Five Years—Now In the Fifth Year**



NIH Biomedical Informatics Research Network



NCMIR
NATIONAL CENTER for
MICROSCOPY and
IMAGING RESEARCH
at San Diego, an NIH supported resource center



NSF EarthScope and ORION

SCRIPPS INSTITUTION OF
OCEANOGRAPHY



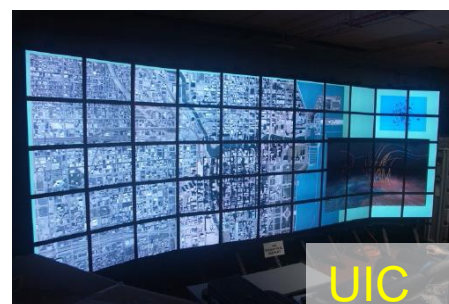
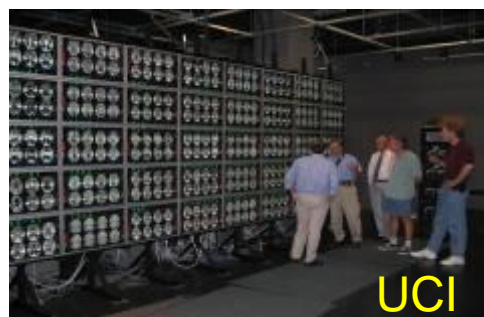
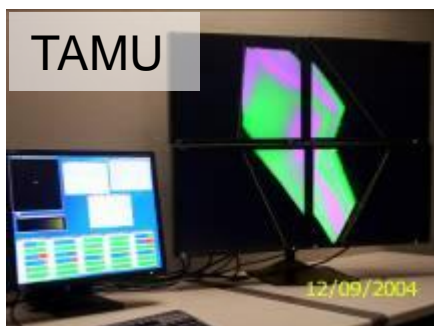
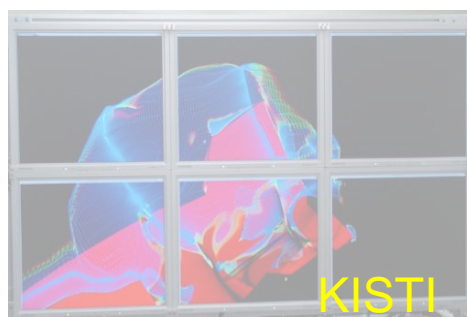
OptIPortals: 40-200 MegaPixel Collaboration with 5-60 Terabytes Storage Connected by Lambdas



Price: \$1K/Megapixel (plus storage and network as needed)



Many OptIPortals are Already in Use in the U.S. and Internationally



Prototyping the User Interface of 2015

One Hundred Million Pixels Connected at 10Gbps



Calit2@UCI Apple Tiled Display Wall
Driven by 25 Dual-Processor G5s
50 Apple 30" Cinema Displays

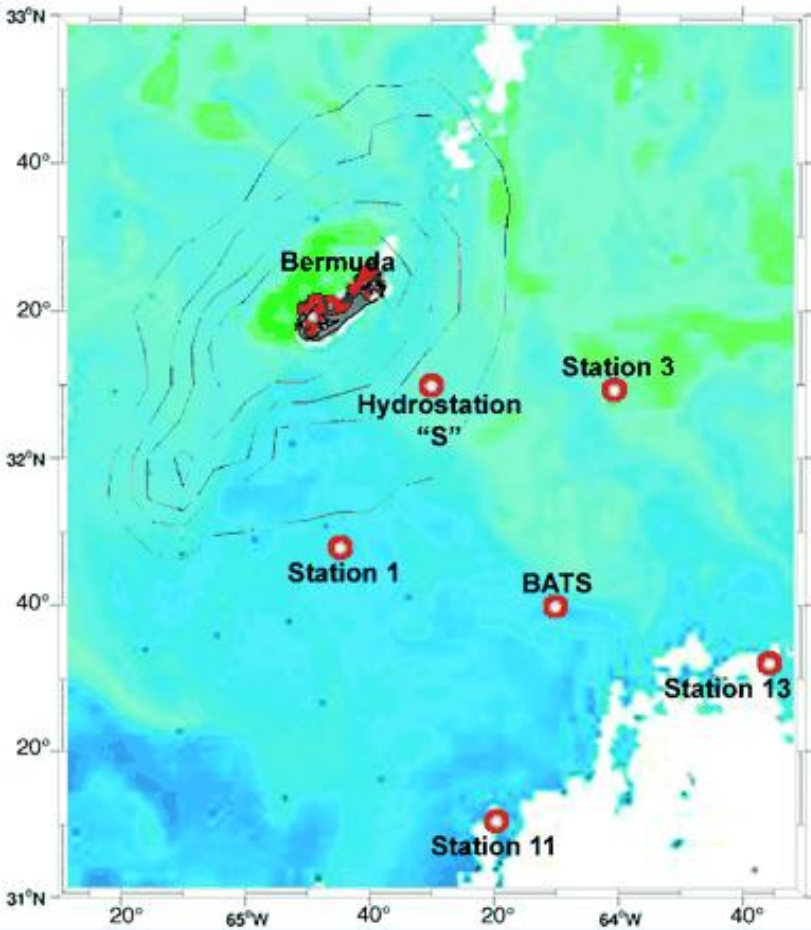
Data—One Foot Resolution
USGS Images of La Jolla, CA



Source: Falko Kuester, Calit2@UCI
NSF Infrastructure Grant

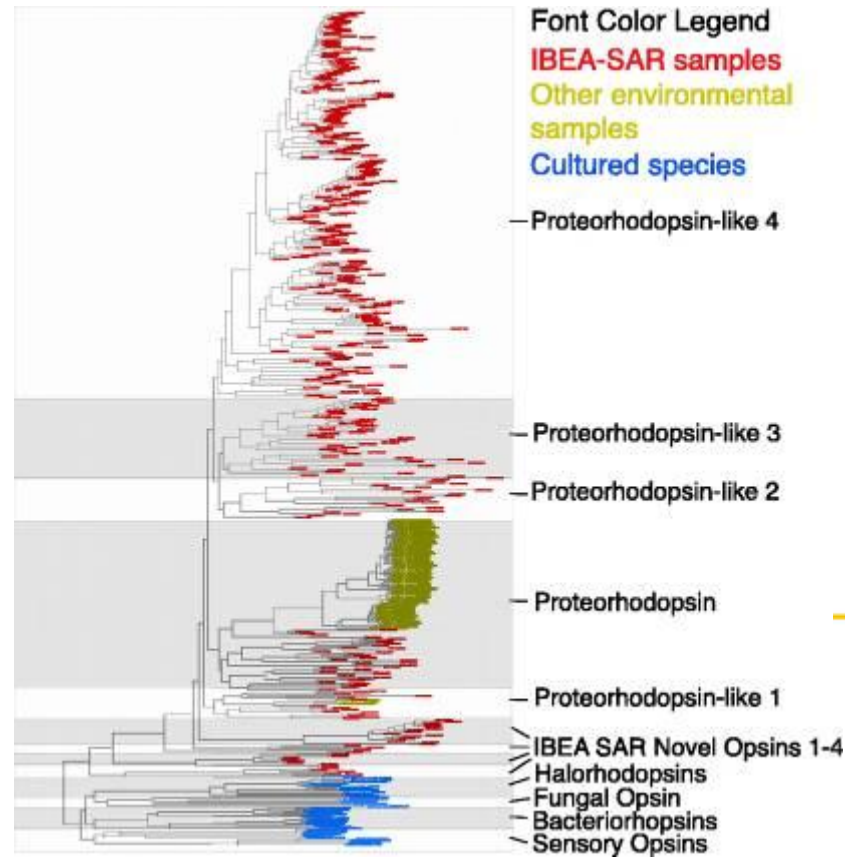


The Sargasso Sea Experiment: The Power of Environmental Metagenomics



MODIS-Aqua satellite image of ocean chlorophyll in the Sargasso Sea grid about the BATS site from 22 February 2003

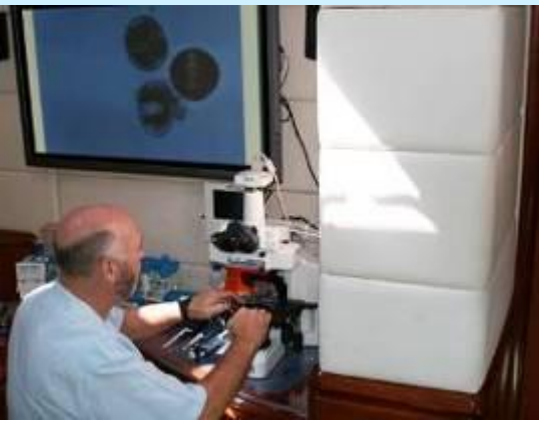
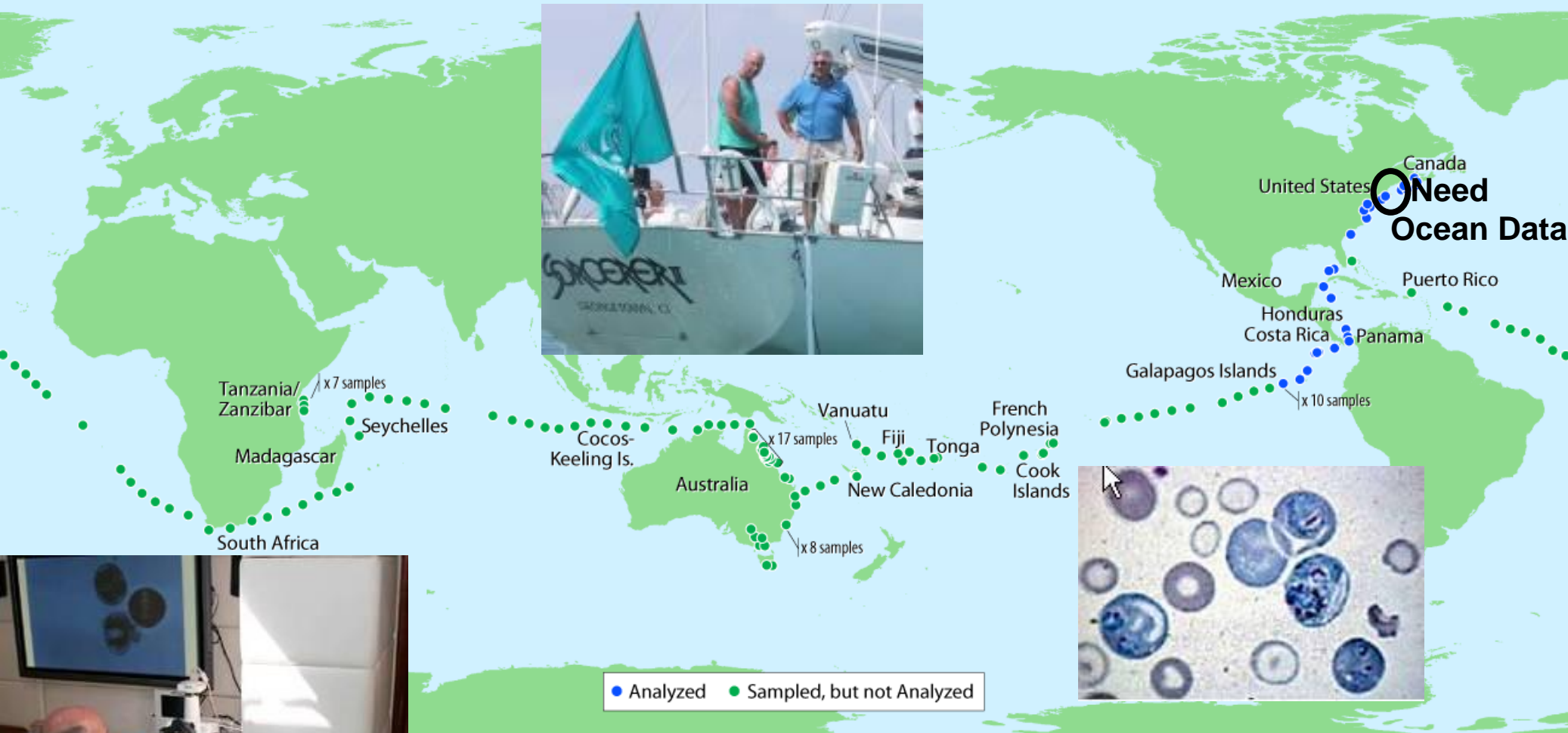
- Yielded a Total of Over 1 billion Base Pairs of Non-Redundant Sequence
- Displayed the Gene Content, Diversity, & Relative Abundance of the Organisms
- Sequences from at Least 1800 Genomic Species, including 148 Previously Unknown
- Identified over 1.2 Million Unknown Genes



**J. Craig Venter,
et al.
Science
2 April 2004:
Vol. 304.
pp. 66 - 74**

J. Craig Venter
I N S T I T U T E

Marine Genome Sequencing Project – Measuring the Genetic Diversity of Ocean Microbes



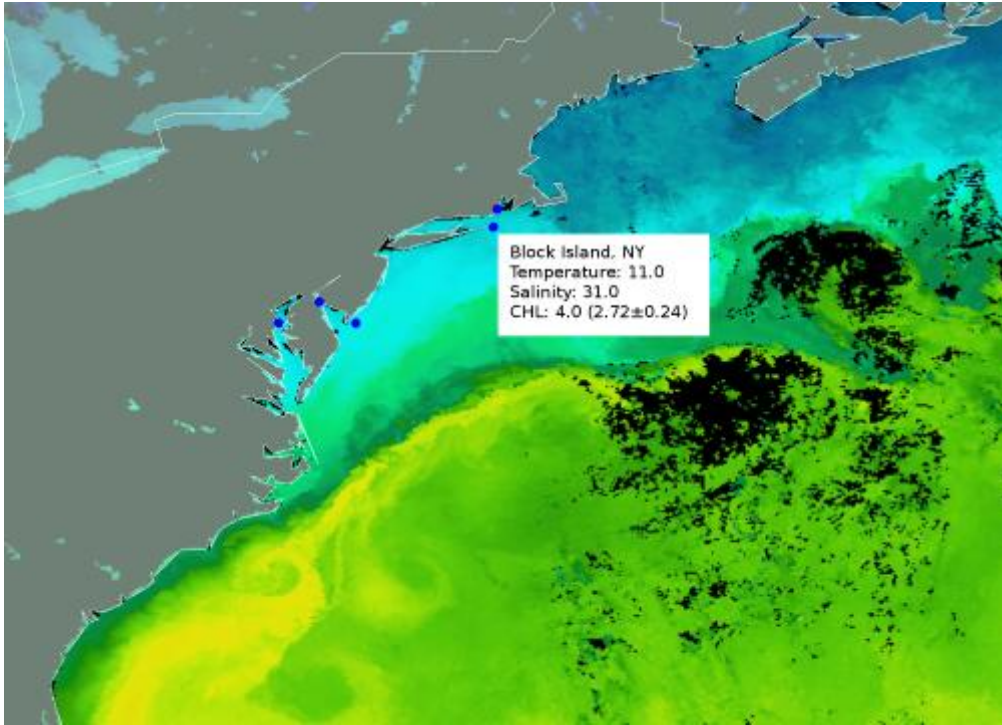
**Sorcerer II Data Will Double
Number of Proteins in GenBank!**



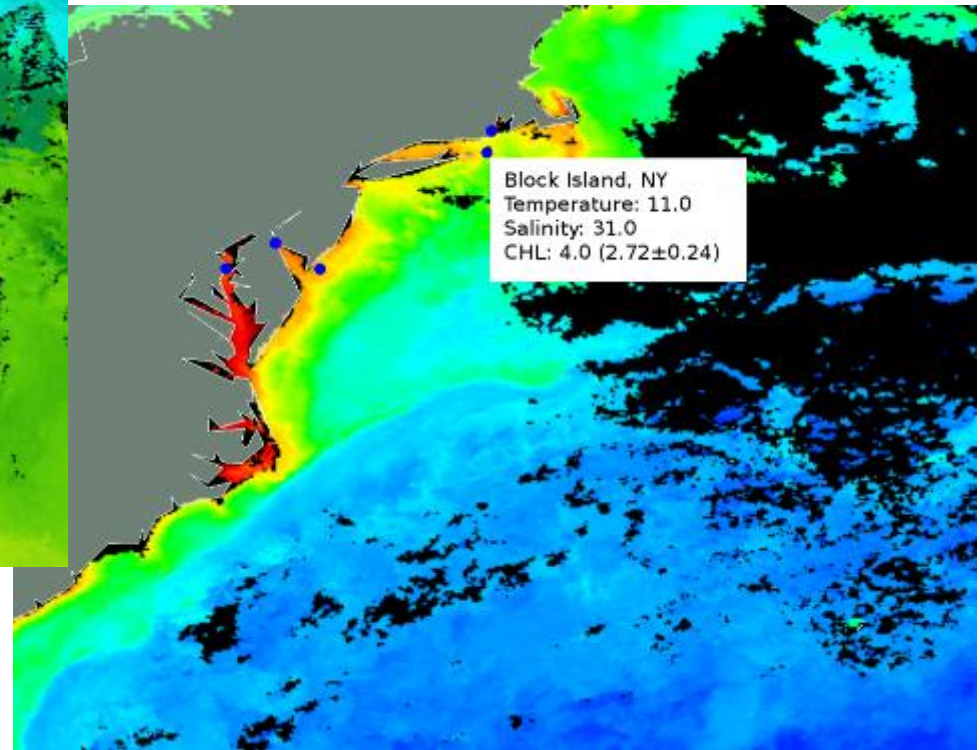
CAMERA is Acquiring NASA Aqua-MODIS Satellite Data to Match Sequencing Sites at Time of Sampling

- **Metadata: Defining Environment at Sampling Site**

**AQUA MODIS Images covering
GOS sites #8 – 12,
mid-November, 2003**



Sea Surface Temp



Chlorophyll

CAMERA: Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis

National LambdaRail
Direct Connect
Computation and Storage Complex

PI Larry Smarr

Funded by: Gordon and Betty Moore Foundation



Joint Partnership of:



Paul Gilna Ex. Dir.

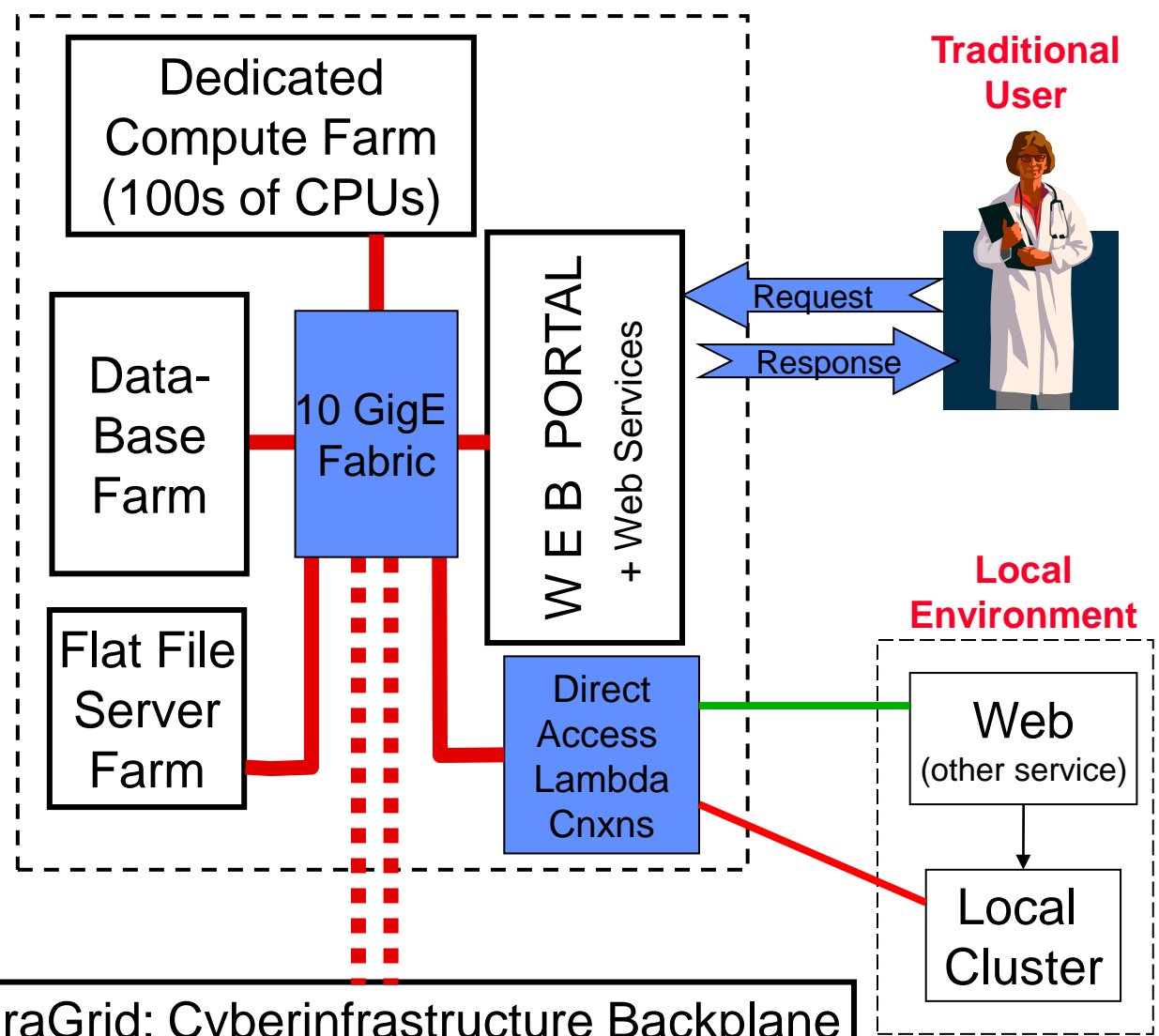


**Calit2 is Now Attracting Private Foundation Grants
Announced January 17, 2006--\$24.5M Over Seven Years**



Calit2's Direct Access Core Architecture Will Create Next Generation Metagenomics Server

- Sargasso Sea Data
- Sorcerer II Expedition (GOS)
- JGI Community Sequencing Project
- Moore Marine Microbial Project
- NASA and NOAA Satellite Data
- Community Microbial Metagenomics Data



TeraGrid: Cyberinfrastructure Backplane
(scheduled activities, e.g. all by all comparison)
(10000s of CPUs)



Source: Phil Papadopoulos, SDSC, Calit2

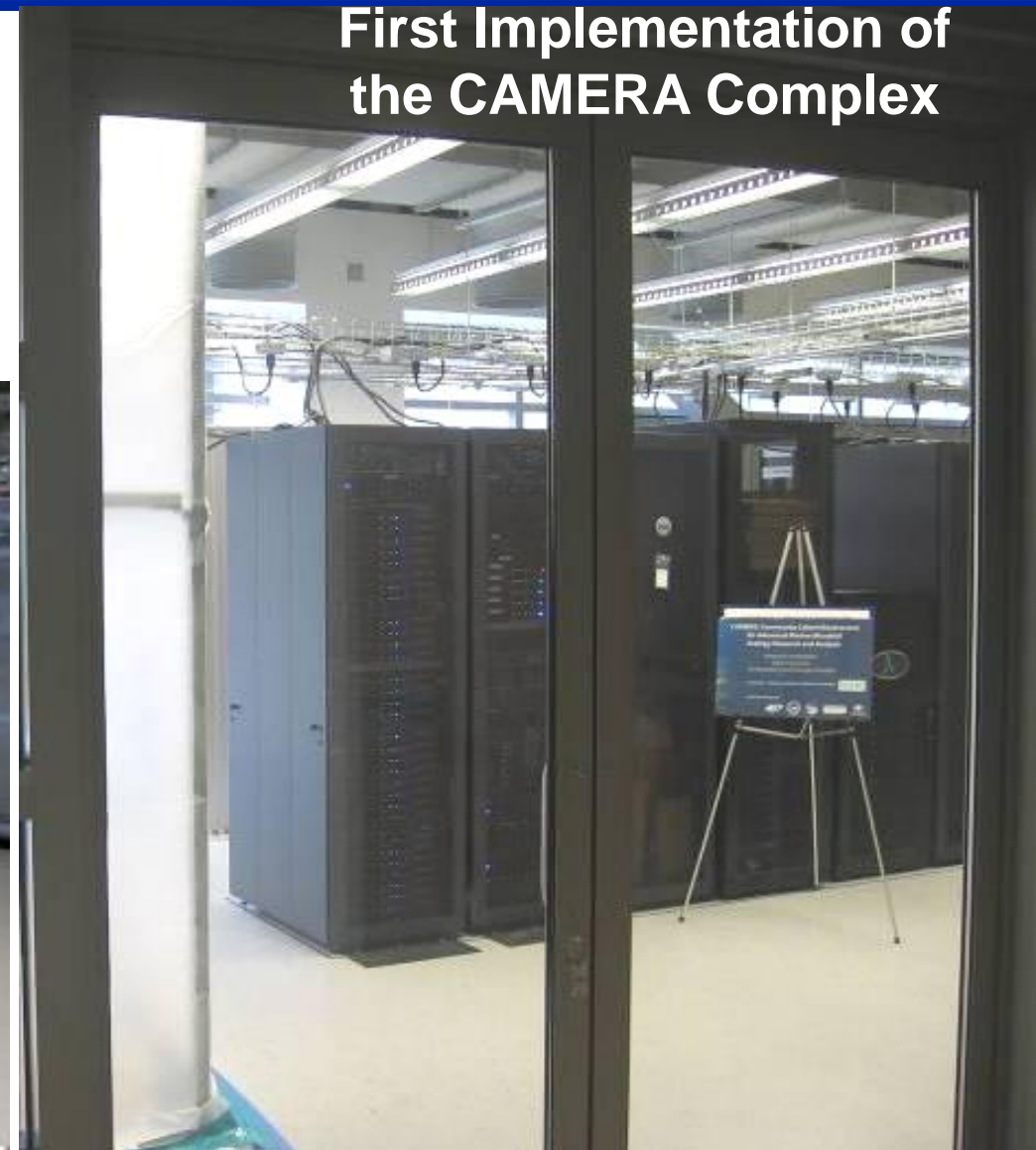
The Future Home of the Moore Foundation Funded Marine Microbial Ecology Metagenomics Complex

**Public GOS Data Release:
January 16, 2007**

**Major Buildout of Calit2
Server Room Underway**



**First Implementation of
the CAMERA Complex**



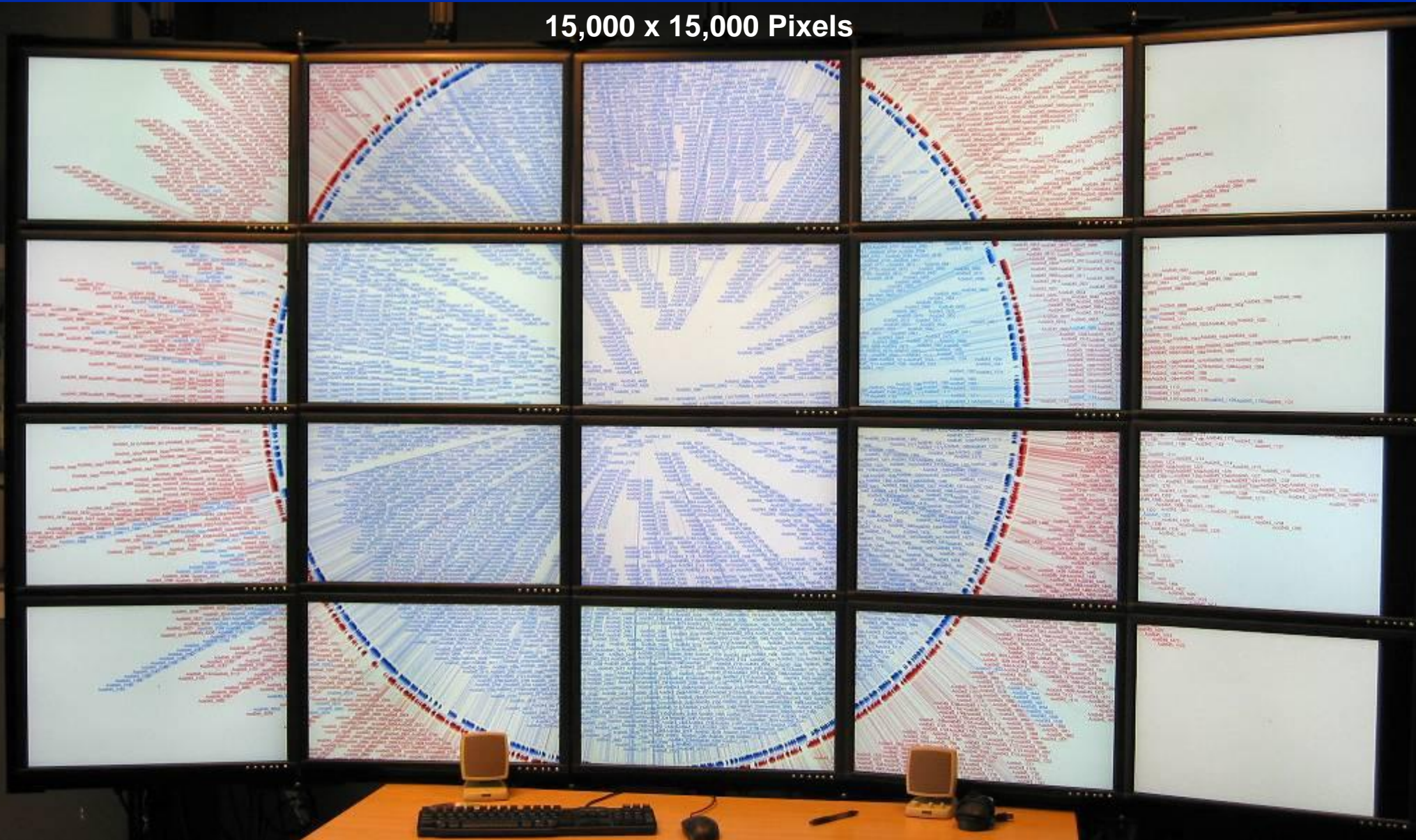
Photos Courtesy Joe Keefe, Calit2

J. Craig Venter
INSTITUTE



Use of OptIPortal to Interactively View Microbial Genome

15,000 x 15,000 Pixels



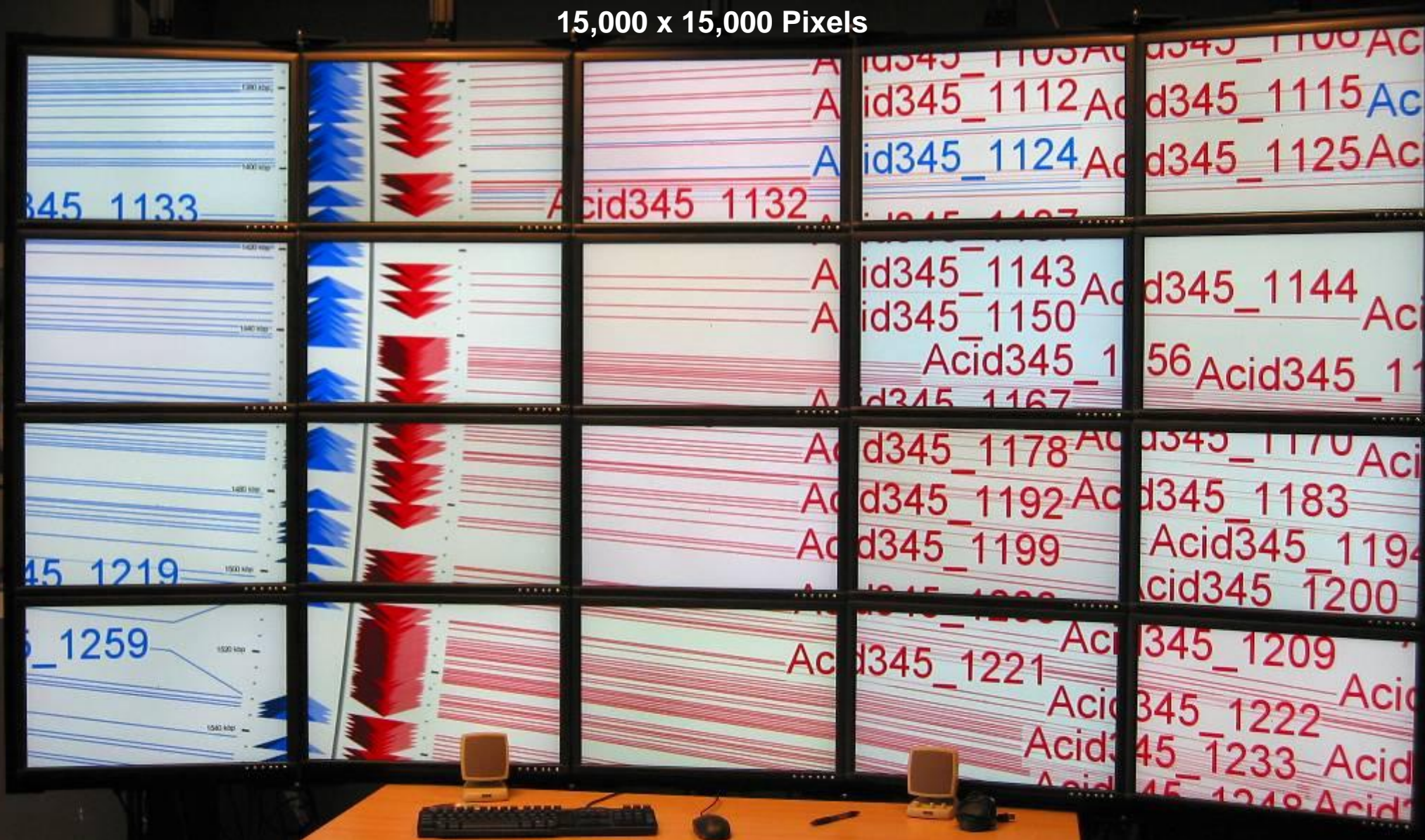
Use of OptIPortal to Interactively View Microbial Genome

15,000 x 15,000 Pixels



Use of OptIPortal to Interactively View Microbial Genome

15,000 x 15,000 Pixels



My OptIPortal™ – Affordable Termination Device for the OptIPuter Global Backplane

- 20 Dual CPU Nodes, 20 24" Monitors, ~\$50,000
- 1/4 Teraflop, 5 Terabyte Storage, 45 Mega Pixels--Nice PC!
- Scalable Adaptive Graphics Environment (SAGE) Jason Leigh, EVL-UIC



Powered by Rocks



Source: Phil Papadopoulos SDSC, Calit2

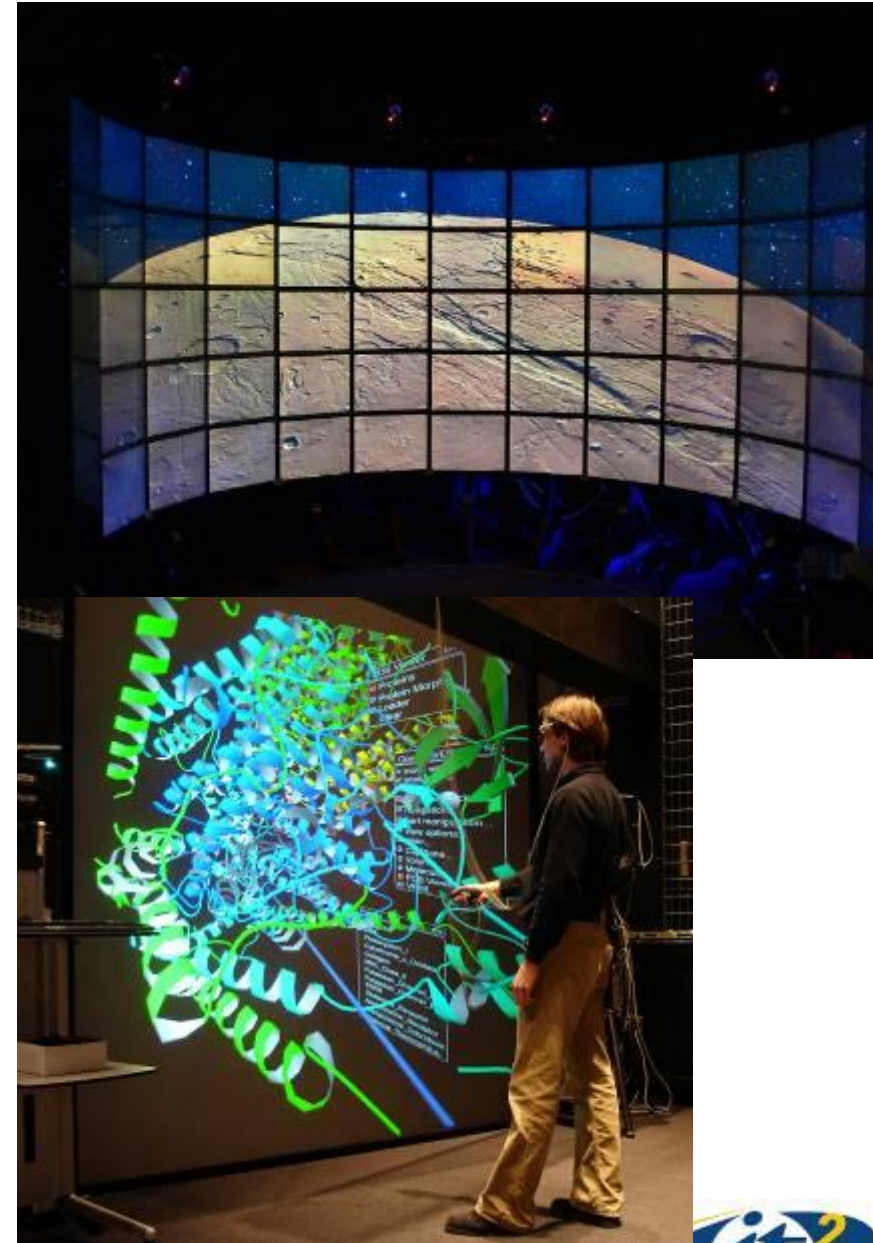
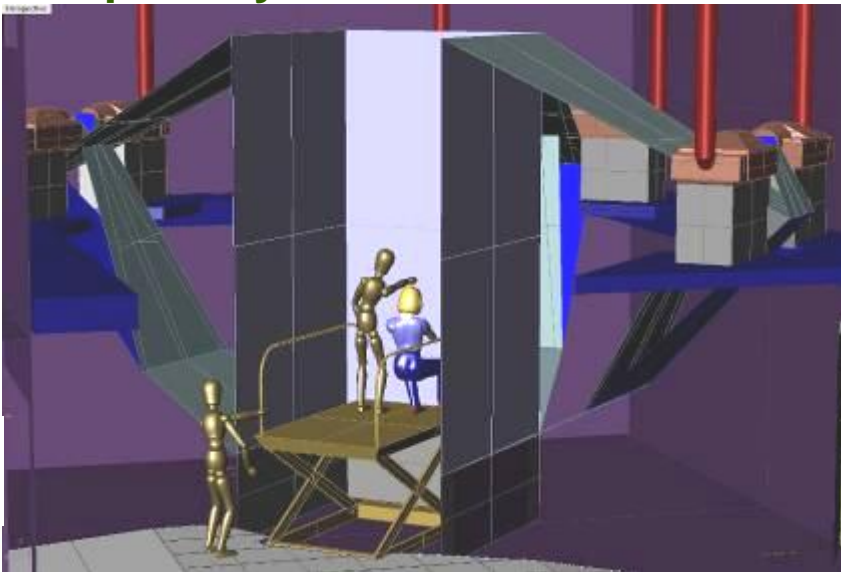


Calit2 is Now OptIPuter Connecting Remote Moore-Funded Microbial Researchers



Partnering with UIC Electronic Visualization Lab to Create Next Generation Virtual Reality OptIPortals

- **Varrier Autostereo Virtual Reality**
 - Head-Trackted No Need for Glasses
 - 65 High Resolution LCD Tiles
 - 45 Mpixels/eye of Visual Stereo
- **4KAVE—Digital Cinema Quality VR**
 - Working Prototype 4 Mpixel Wall
 - Full Scale 4KAVE Being Designed
 - Two Sony 4K Projectors Per Wall
 - 32 Mpixel/eye of Stereo w/4-Walls



evl electronic
visualization
laboratory

OptIPuter

Dan Sandin, Greg Dawe, Tom Peterka, Tom DeFanti, Jason Leigh, Jinghua Ge, Javier Girado, Bob Kooima, Todd Margolis, Lance Long, Alan Verlo, Maxine Brown, Jurgen Schulze, Qian Liu, Ian Kaufman, Bryan Glogowski



Global Connections Between University Research Centers at 10Gbps

Maxine Brown, Tom DeFanti, Co-Chairs

*i*Grid 2005

THE GLOBAL LAMBDA INTEGRATED FACILITY

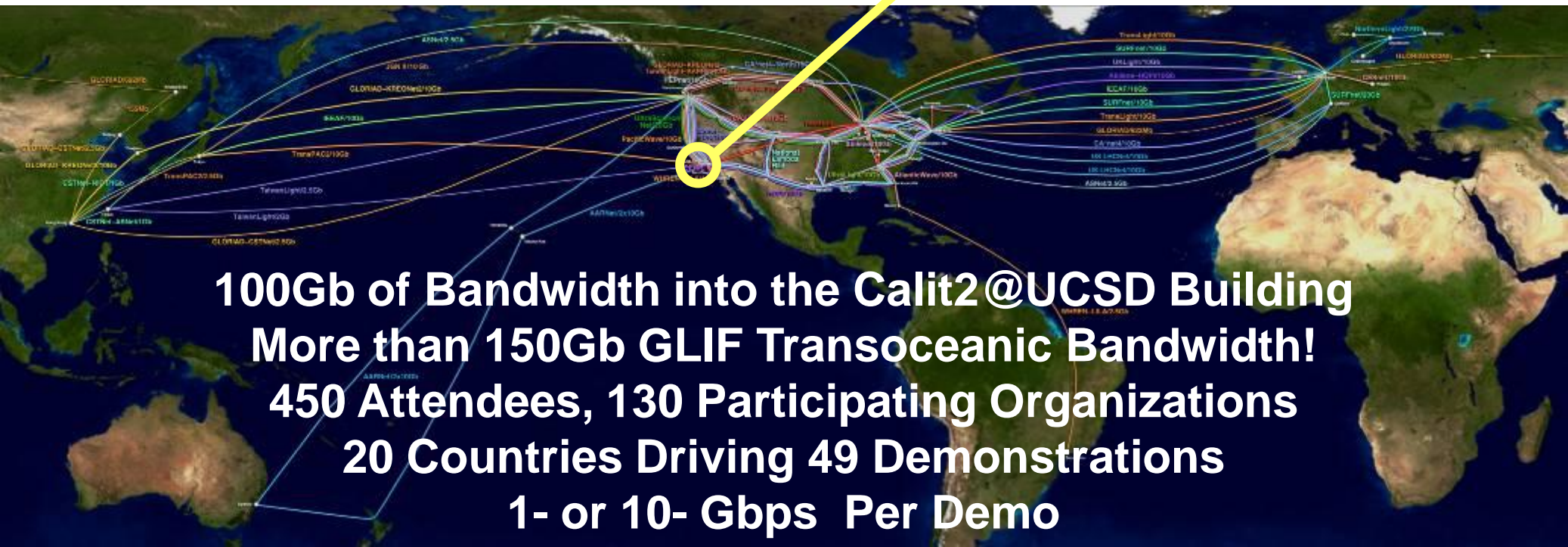
www.igrid2005.org



September 26-30, 2005

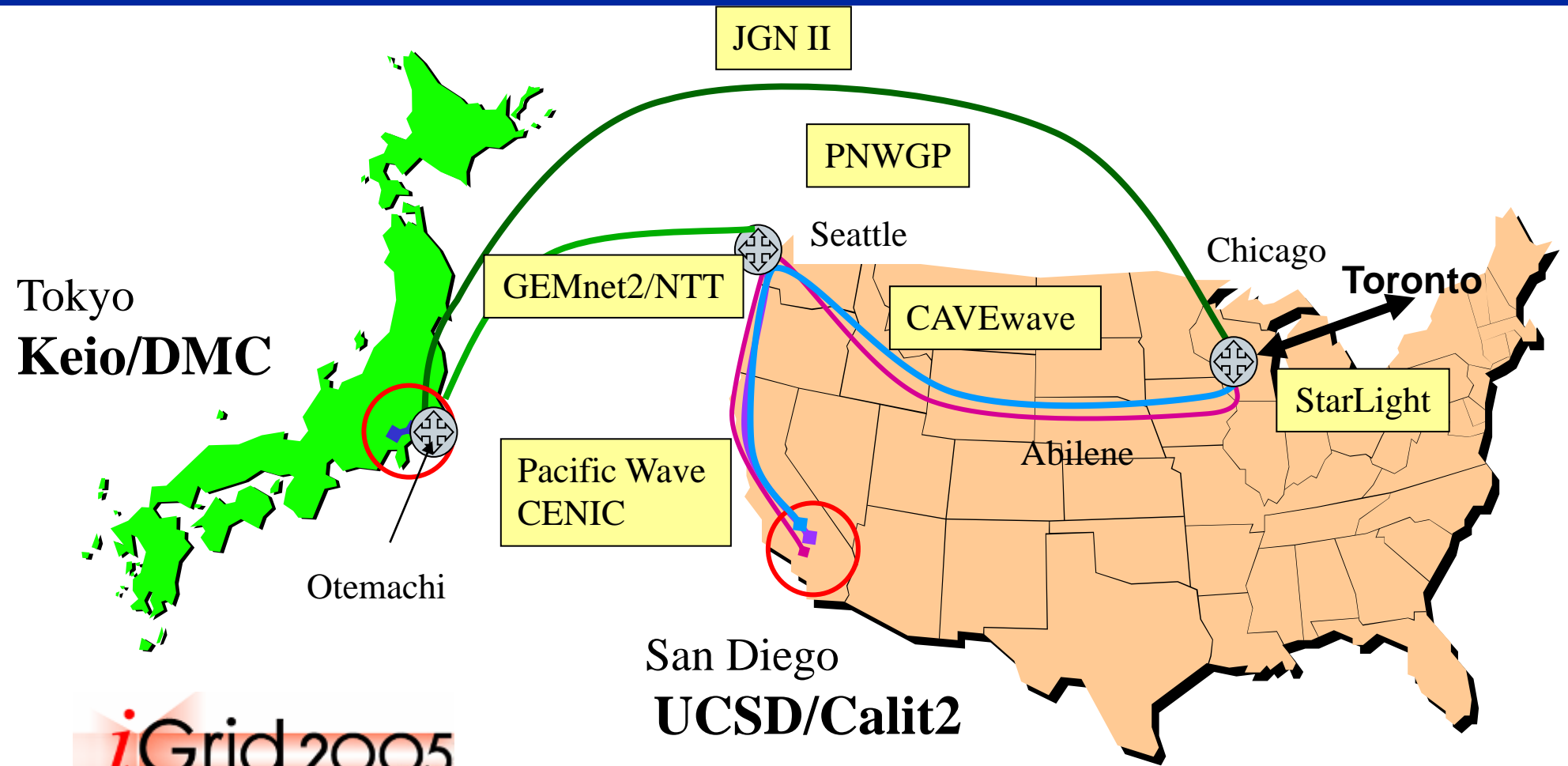
Calit2 @ University of California, San Diego

California Institute for Telecommunications and Information Technology



100Gb of Bandwidth into the Calit2@UCSD Building
More than 150Gb GLIF Transoceanic Bandwidth!
450 Attendees, 130 Participating Organizations
20 Countries Driving 49 Demonstrations
1- or 10- Gbps Per Demo

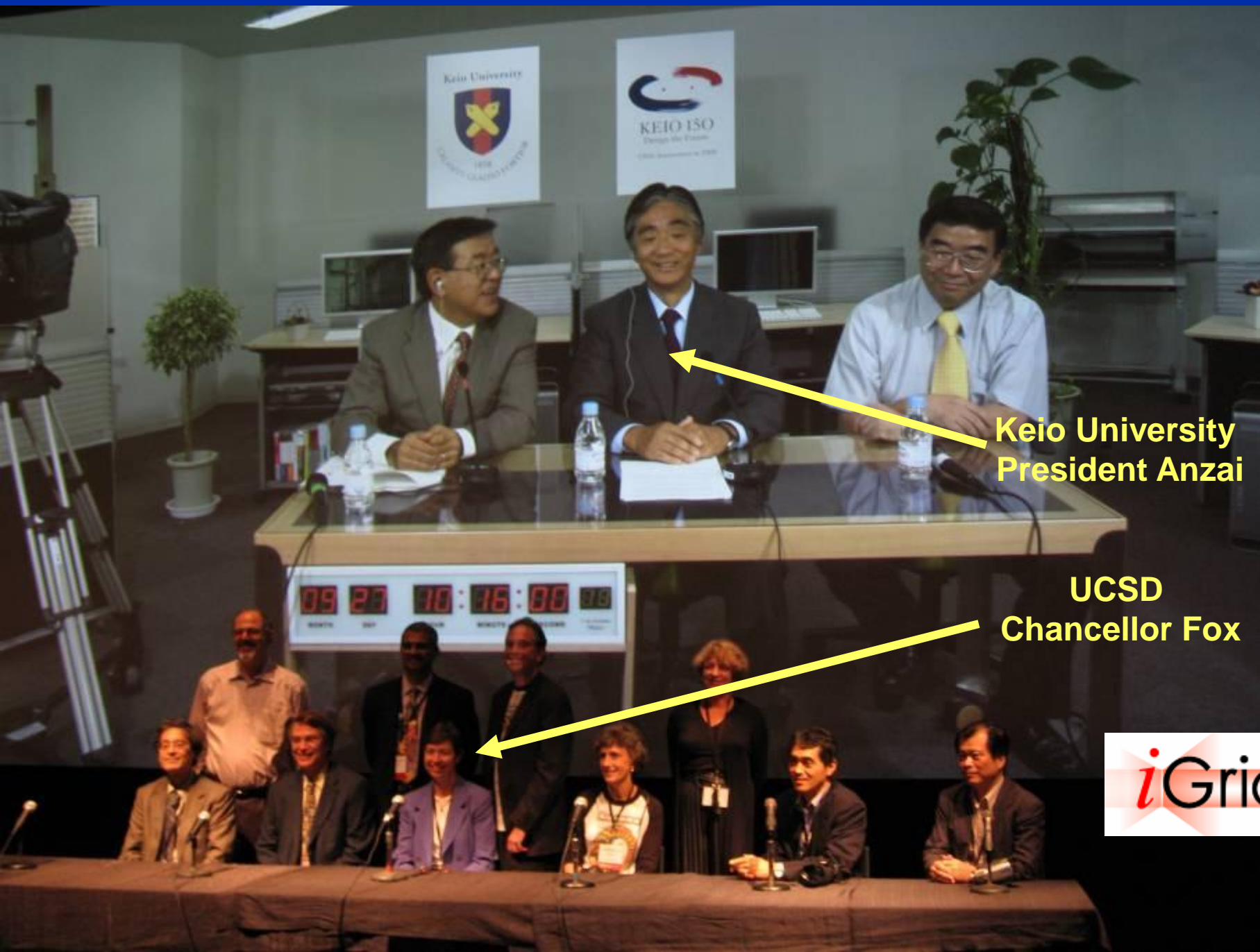
iGrid Lambda Digital Cinema Streaming Services: CineGrid™ International Real-Time 4K Streaming



iGrid 2005

September 2005

Telepresence Meeting in Calit2 Digital Cinema Auditorium



Keio University
President Anzai

UCSD
Chancellor Fox

Lays
Technical
Basis for
Global
Digital
Cinema

Sony
NTT
SGI

*i*Grid 2005



iGrid Lambda Data Services: Sloan Sky Survey Data Mining and Visualizing Data Using OptIPuter

- **SDSS-I**

- **Imaged 1/4 of the Sky in Five Bandpasses**
 - **8000 sq-degrees at 0.4 arc sec Accuracy**
- **Detecting Nearly 200 Million Celestial Objects**
- **Measured Spectra Of:**
 - **> 675,000 galaxies**
 - **90,000 quasars**
 - **185,000 stars**

~200 GigaPixels!

iGRID2005

**From Federal Express to Lambdas:
Transporting Sloan Digital Sky Survey
Data Using UDT**

- **SDSS-II**

- **Underway till 2008**

Robert Grossman, UIC with

Johns Hopkins University, USA; Korea Astronomy and Space Science Institute, KISTI, Korea; University of Tokyo, Japan; National Astronomical Observatory, Chinese Academy of Sciences, China; University of Melbourne, Australia; Max-Planck-Institut fur Plasmaphysik, Germany



**Sloan Digital
Sky Survey**

Image of
the Week

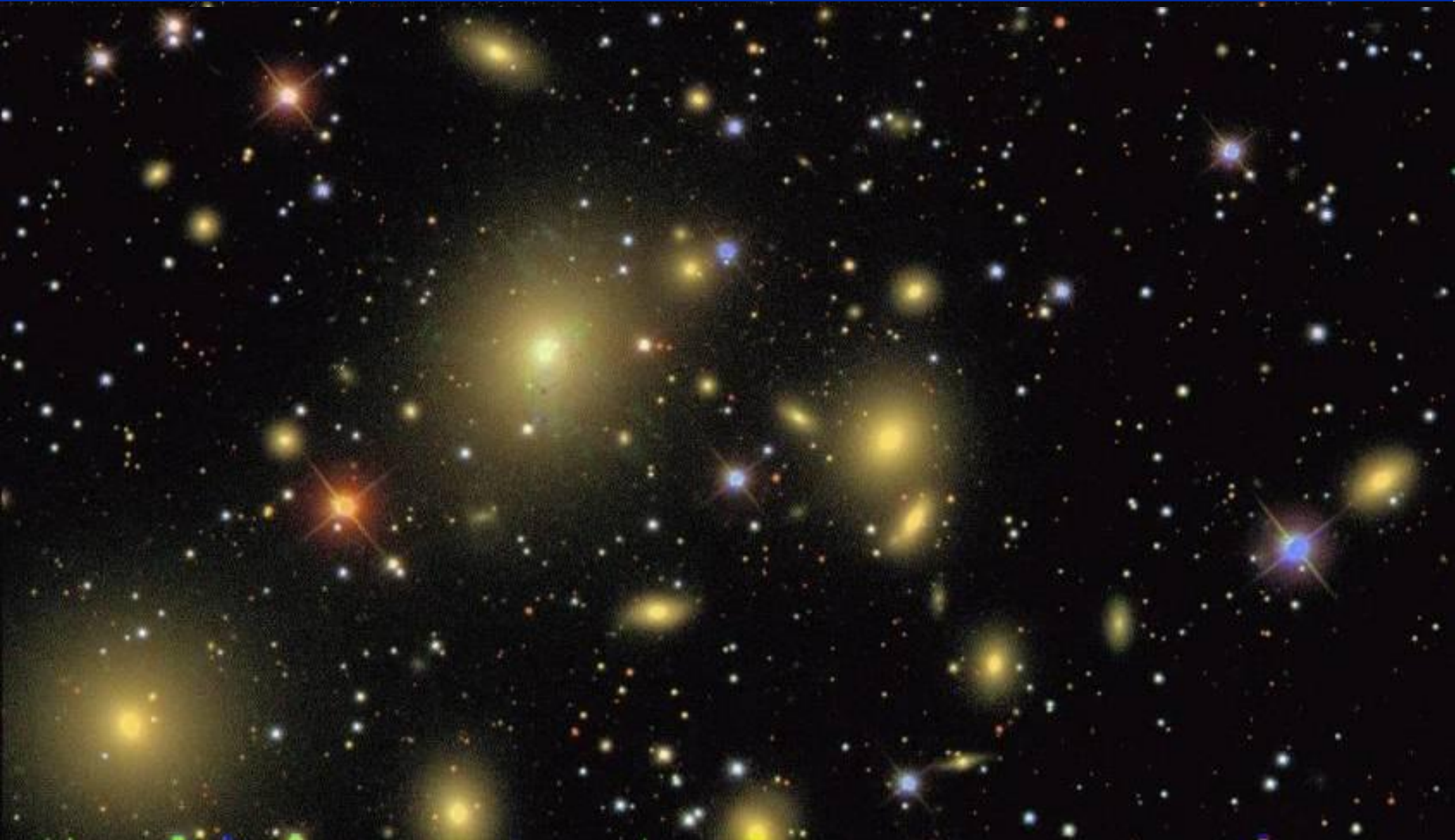


OptIPuter

www.sdss.org



Example of SDSS Image Zoom: Perseus Cluster



iGrid Scientific Instrument Services: Enable Remote Interactive HD Imaging of Deep Sea Vent

NSF
VISIONS 2005
EXPEDITION TO THE UNDERWATER VOLCANOES OF THE NORTHEAST PACIFIC

RV Thompson

Galaxy XR Satellite

Ku-Band

Canadian-U.S. Collaboration

Endeavour Vent Fields

UW Research Channel

Cal-(IT)²

I-Grid 2005

Jason II ROV

Instrument Packages

High Definition Imaging

Real-time Broadcasts:
Dates: September 28th & 29th Time: 2 to 3 pm (Pacific)

WWW.VISIONS05.WASHINGTON.EDU

© 2005

ceV



Source John Delaney & Deborah Kelley, UWash



High Definition Still Frame of Hydrothermal Vent Ecology 2.3 Km Deep



Source:
John Delaney and
Research Channel,
U Washington

White Filamentous Bacteria on 'Pill Bug' Outer Carapace

iGrid Lambda Virtual Reality Services: Cultural History--Kyoto Nijo Castle



Source:
Toppan
Printing

Interactive VR
Streamed Live
from Tokyo to
Calit2 Over
Dedicated GigE
and
Projected at
4k Resolution



iGrid Lambda e-Science: Enabling U.S. / Mexico Scientific Collaborations

Opening a University Fiber Highway between Mexico and the USA

<http://iGridMX.cicese.mx>

contact

Carlos Casasus and Eric Frost
CUDI, Mexico, and San Diego State University (SDSU), USA
ccasasus@cudi.edu.mx, eric.frost@sdsu.edu

collaborators

CUDI, Mexico: Carlos Casasus • SDSU, USA: Eric Frost, Bob Welty, John Graham • CICESE, Mexico: Javier Mendieta Jiménez, Luis Farfán, Edgar Pavia, Tereza Cavazos, Raúl Hazas Izquierdo, Salvador Castañeda, Julián Delgado, José Luis Rodríguez • CONACYT, Mexico: Jaime Parada, Juan Milton Garduño, Carlos Duarte • Telmex, Mexico: Benjamin Podoswa • Stanford University, USA: Milton Chen • University of California, San Diego, USA: Peter Arzberger, Cindy Zheng

Optical fiber newly installed between San Diego and Tijuana, and ultimately extending down to CICESE in Ensenada in the Baja California Peninsula, is enabling collaborative USA/Mexican research in Earth, oceanographic and atmospheric sciences. At iGrid, 3D visualizations of shared terrain enable scientists to better understand the consequences of fires, floods, and earthquakes, which have no geographical boundaries. Environmental modeling and simulation visualizations fed by real-time sensor information combined with legacy visualizations provide hybrid visualizations for situational awareness for public safety, economic effect assessment, and shared Homeland Security.

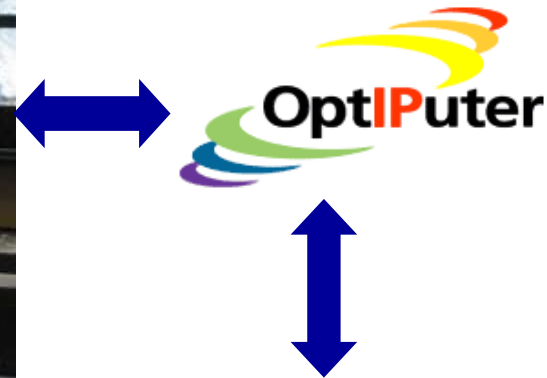


Dedicated Optical Fiber Collaboratory: Remote Researchers Jointly Exploring Complex Data

CICESE



**Deploy Throughout Mexico
After CICESE Test**



Proposal:
Connect OptIPortals
Between CICESE
and Calit2@UCSD
with 10 Gbps Lambda

UCSD



Collaboration Between CICESE and UCSD in Ocean Microbe Genomics



Department of
BIOLOGICAL OCEANOGRAPHY

Dedicated to
Biological and
Fisheries
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MSc students

Productivity

WELCOME



Related sites

Oceanology Division
Marine Sciences
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IMECOCAL
FLUCAR
Agenda 21 Local
CICESE magazine
Books & journals

Ecology of Marine Plankton

Phytoplankton and bacteria culture; photosynthesis, respiration, in vivo fluorescence and absorption of phytoplankton; inorganic carbon and oxygen in seawater. [ext. 242-86]



**UCSD and CICESE
Have 30-Year History
of Collaboration**



First Step Completed: CUDI-CENIC Fiber Dedication at Border Governor's Conference, July 14, 2005



US



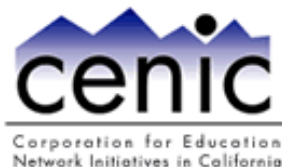
Mexico

Torreon Conference---Fiber Dedication Linking Mexico and US, crossing at San Diego-Tijuana

- **Shared Security**
- **Energy**
- **Trans-National Crime**
- **Education and Research**
- **Business Development**



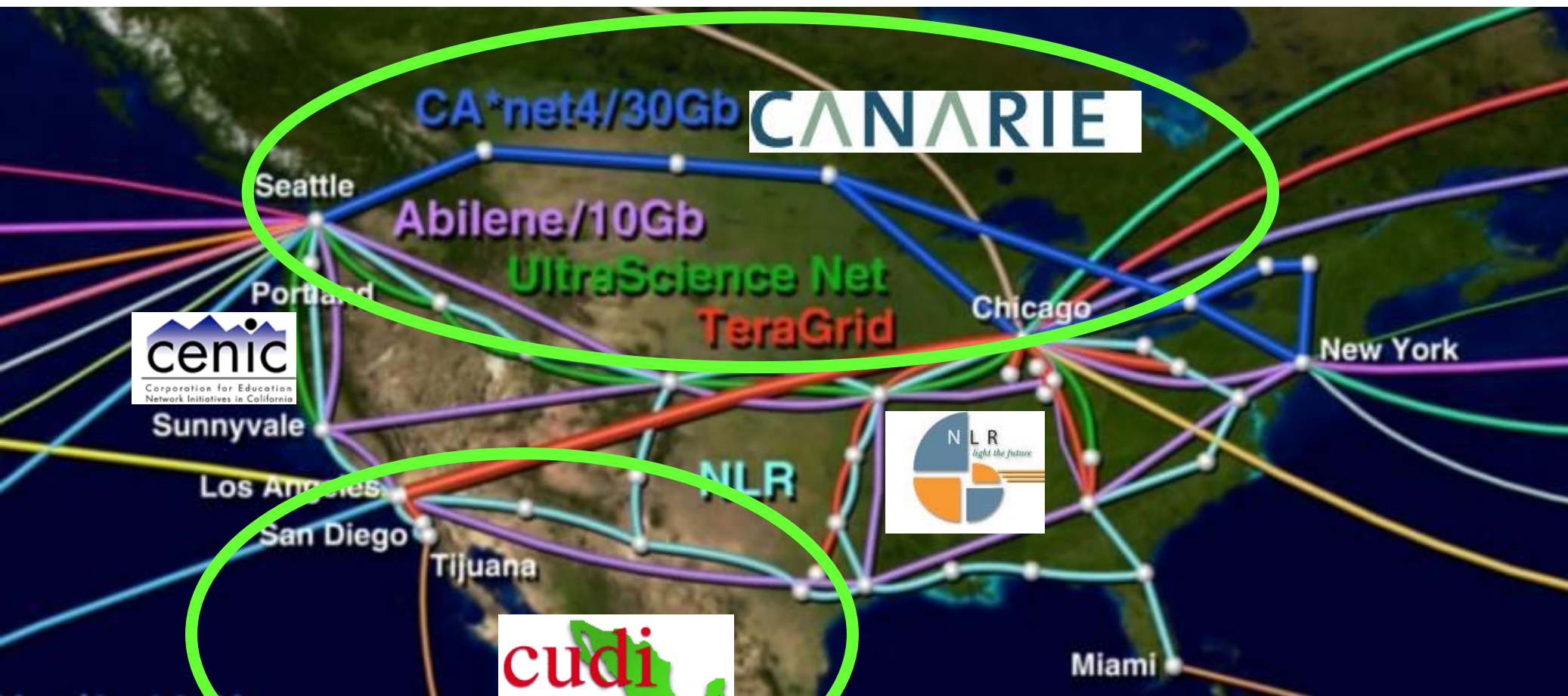
Culmination of Three Years of Work Between Calit2, CICESE, CENIC, and CUDI



LEADING THE WAY TO TOMORROW'S INTERNET



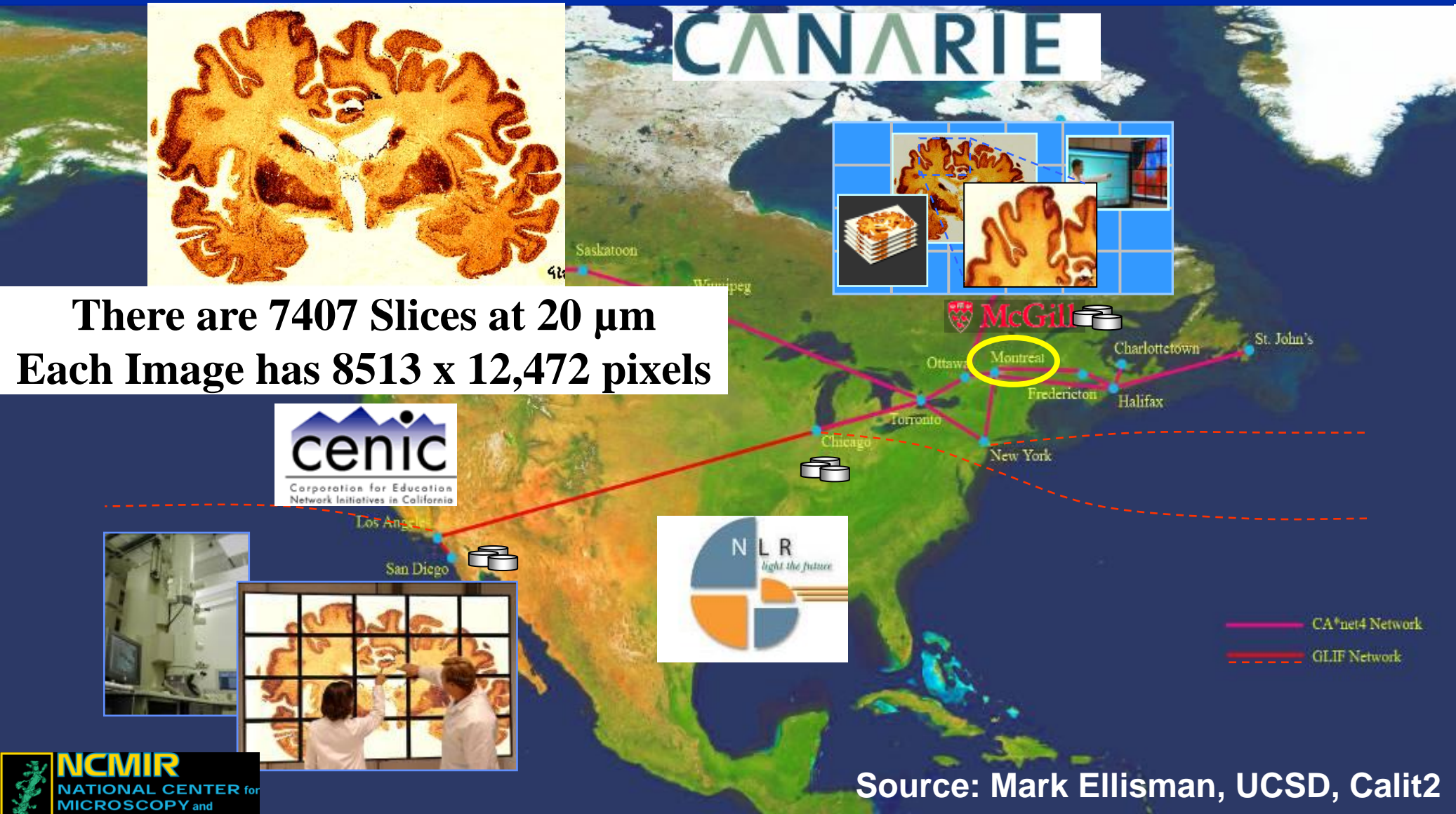
Toward a North American Superhighway for High Performance Collaboration



Next Step: Adding Mexico to Canada's CANARIE and the U.S. National Lambda Rail



San Diego Interactive Imaging of High Resolution Brain Slices Generated at McGill University

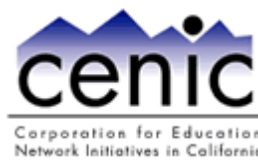


Canada is Moving Ahead with
CENIC-CANARIE Collaborations



Ryerson University's Rogers Communications Centre Linking to CA*net4 and CineGrid – Fall 2006

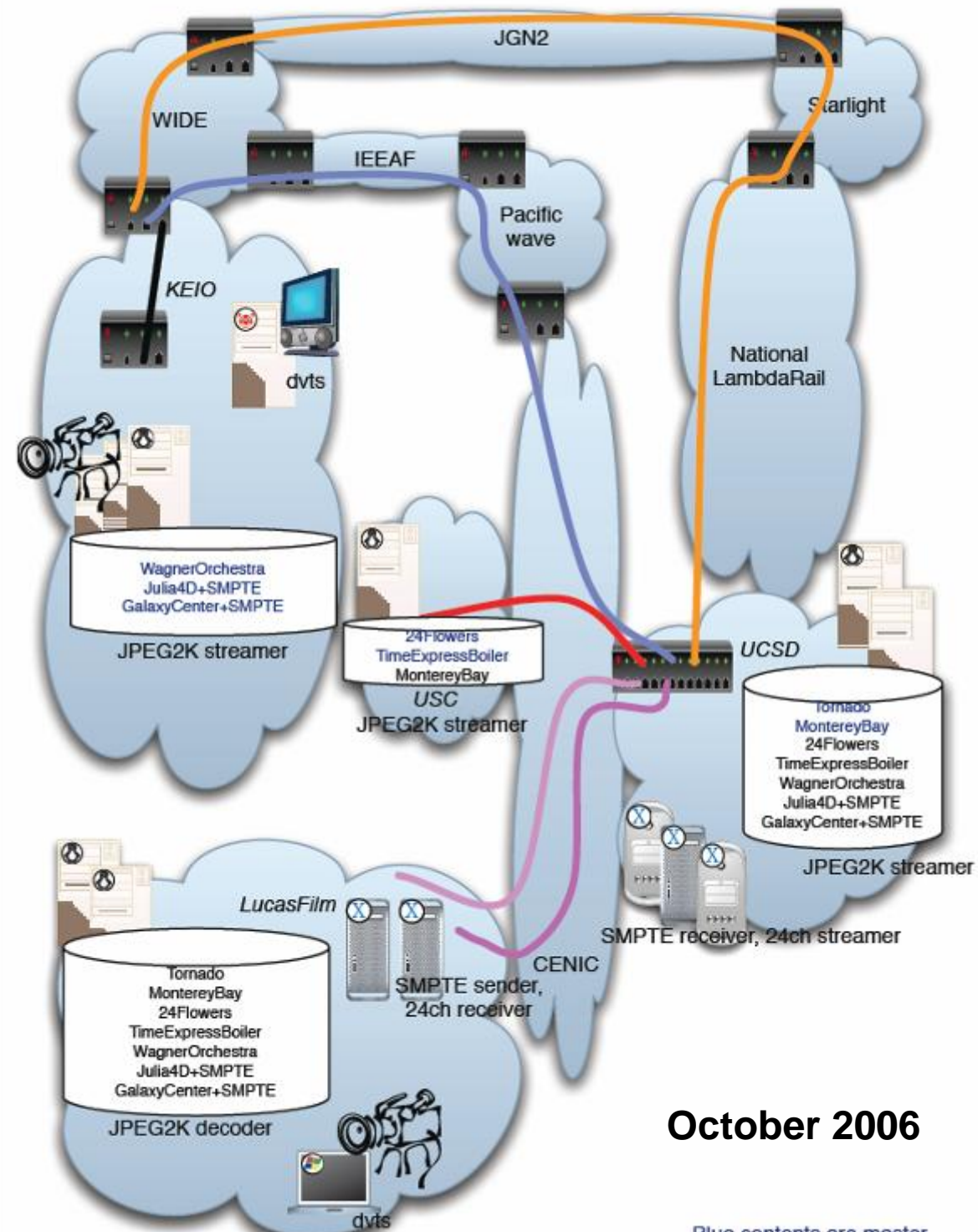
- **In the Heart of Toronto - Canada's Largest Media Centre**
 - **Creating Digital Cinema/Visualization Lab**
 - **School of Image Arts and School of Radio and Television Arts**
 - **1300 Undergraduate Students**



CineGrid@AES Networks

- CAVeWave
- CENIC/ CaREN
- JGN2/NICT
- National Lambda Rail (NLR)
- PacificWave
- Pacific Northwest GigaPOP
- StarLight
- WIDE/IEEAF

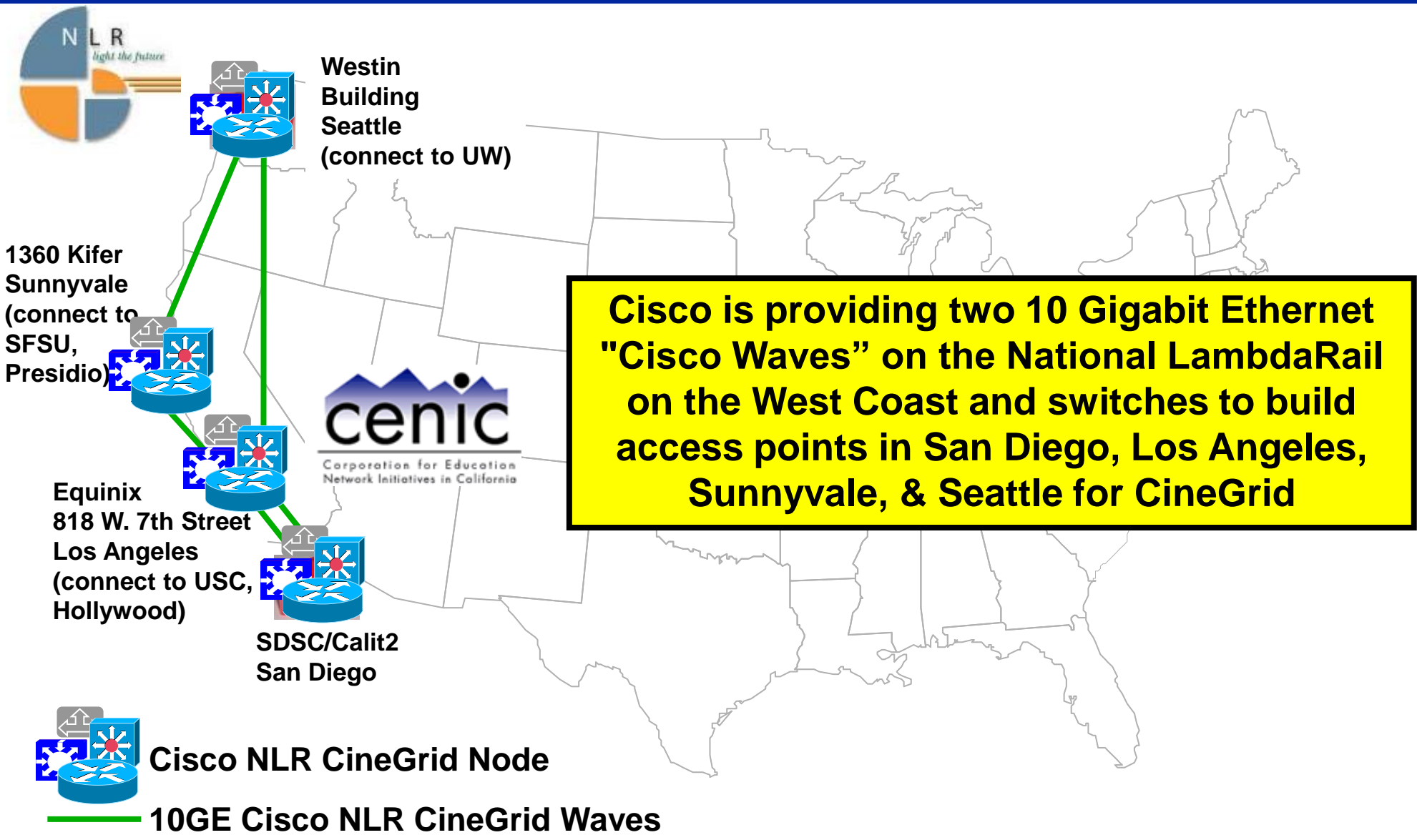
Source: Laurin Herr, Pacific Interface



October 2006

Blue contents are master
Black contents are backup

New Cisco Waves for CineGrid



Source: John Jamison, Cisco Systems

