"Why Researchers are Using Advanced Networks"

Remote Talk from Calit2 to:
Building KAREN Communities for Collaboration Forum
KIWI Advanced Research and Education Network
University of Auckland, Auckland City, New Zealand
July 3, 2007

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

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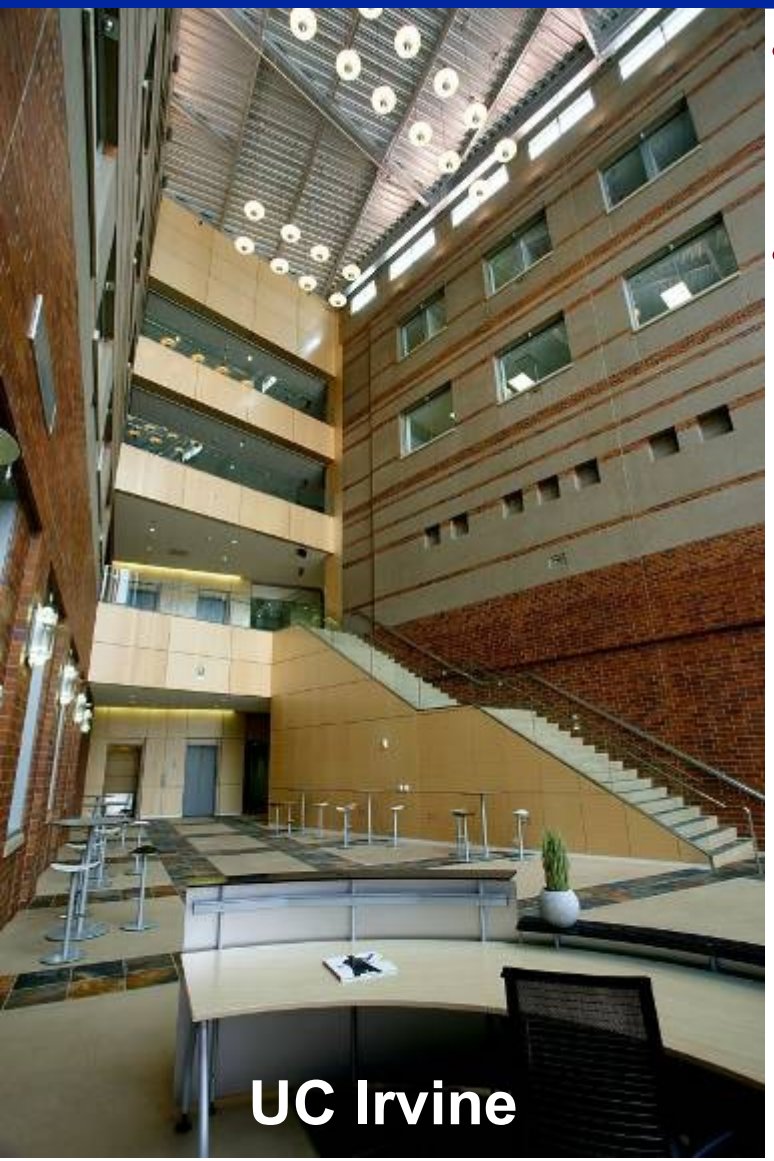
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Abstract

During the last few years, a radical restructuring of optical networks supporting e-Science projects has occurred around the world. Universities are acquiring access to private, high bandwidth light pipes (termed "lambdas") through the National LambdaRail (in the U.S.) and internationally through the Global Lambda Integrated Facility. These personal light paths provide direct access to global data repositories, scientific instruments, and computational resources from Linux clusters in individual user laboratories. Today, the California Institute for Telecommunications and Information Technology (Calt2), a UCSD/UCI partnership, has a variety of applications underway exploring persistent 1-10 gigabit/s optical paths. We are also developing applications for scalable visualization walls, which serve as light pipe termination devices (OptIPortals), developed by our partner the Electronic Visualization Laboratory at the University of Illinois at Chicago. At this forum, Laurin Herr will explain in detail our digital cinema project, CineGrid, in which we connect multiple sites using four thousand line resolution (4k) video streams. I will describe how LambdaGrids enable new capabilities in collaborative work environments, remote observatories, visual supercomputing, virtual reality, and interactive knowledge repositories.

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



- "Convergence" Laboratory Facilities
  - Nanotech, BioMEMS, Chips, Radio, Photonics
  - Virtual Reality, Digital Cinema, HDTV, Gaming
- Over 1000 Researchers in Two Buildings
  - Linked via Dedicated Optical Networks



www.calit2.net

Preparing for a World in Which Distance is Eliminated…

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Broadband Depends on Where You Are









- **Mobile Broadband**
  - **0.1-0.5 Mbps**

100,000 Fold Range
All Here Today!

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

"The future is already here,
it's just not evenly distributed"
William Gibson, Author of Neuromancer

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

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

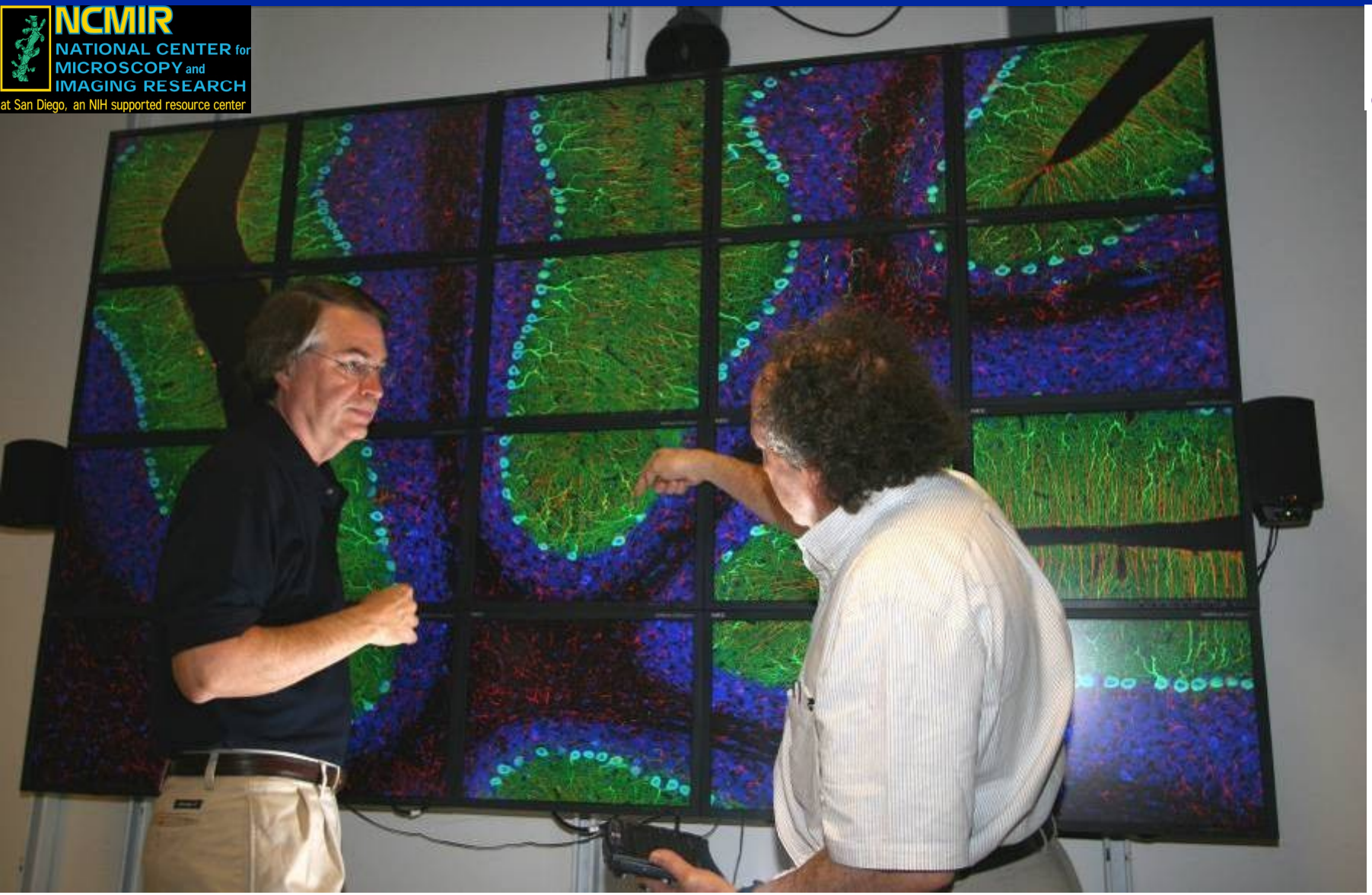
The OptIPuter Project: Creating High Resolution Portals Over Dedicated Optical Channels to Global Science Data

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

OptIPuter

NSF

$13.5M Over Five Years



Picture Source: Mark Ellisman, David Lee, Jason Leigh

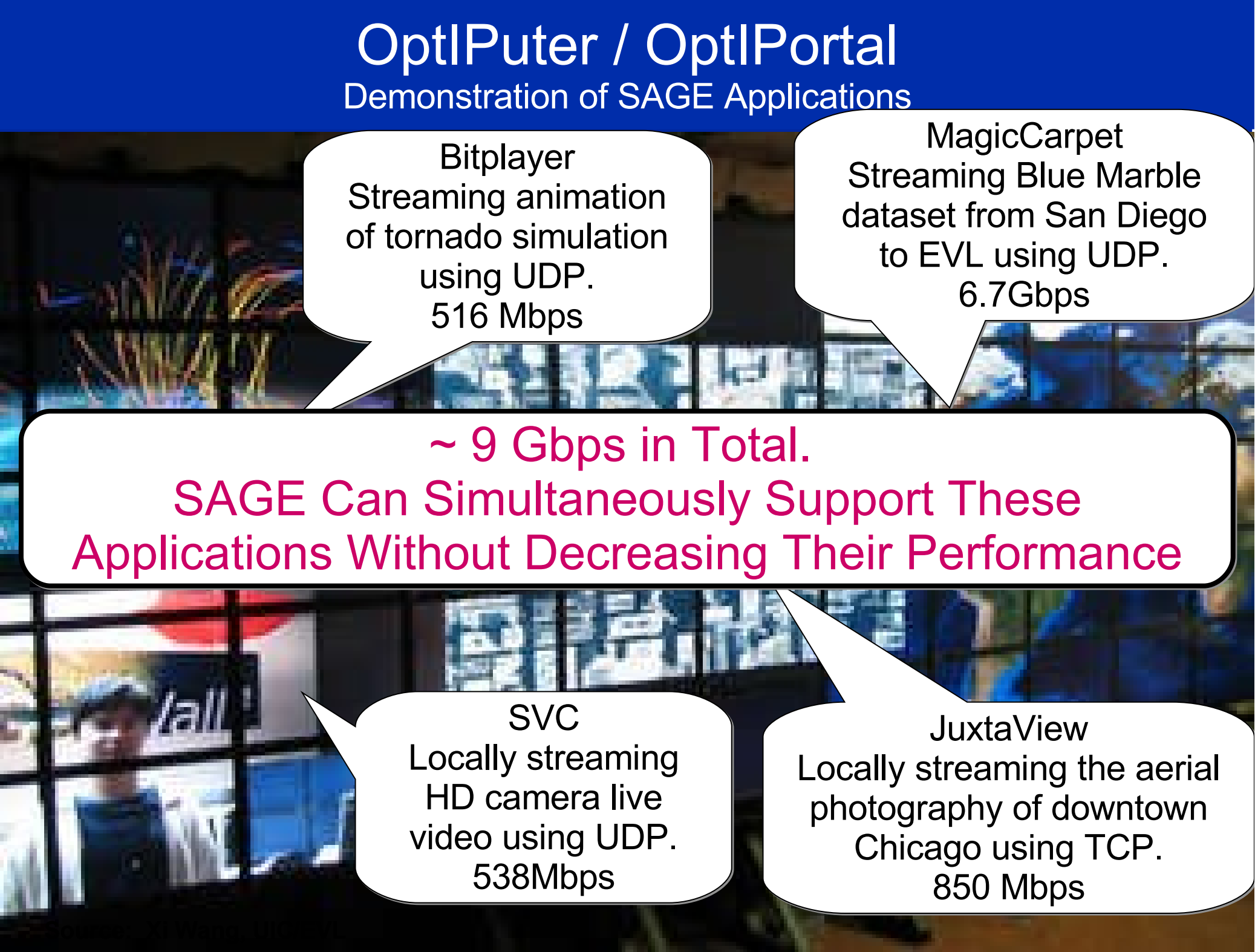
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Calit2 (UCSD, UCI) and UIC Lead Campuses—Larry Smarr PI
Univ. Partners: SDSC, USC, SDSU, NW, TA&M, UvA, SARA, KISTI, AIST
Industry: IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent

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OptIPuter / OptIPortal

Demonstration of SAGE Applications



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

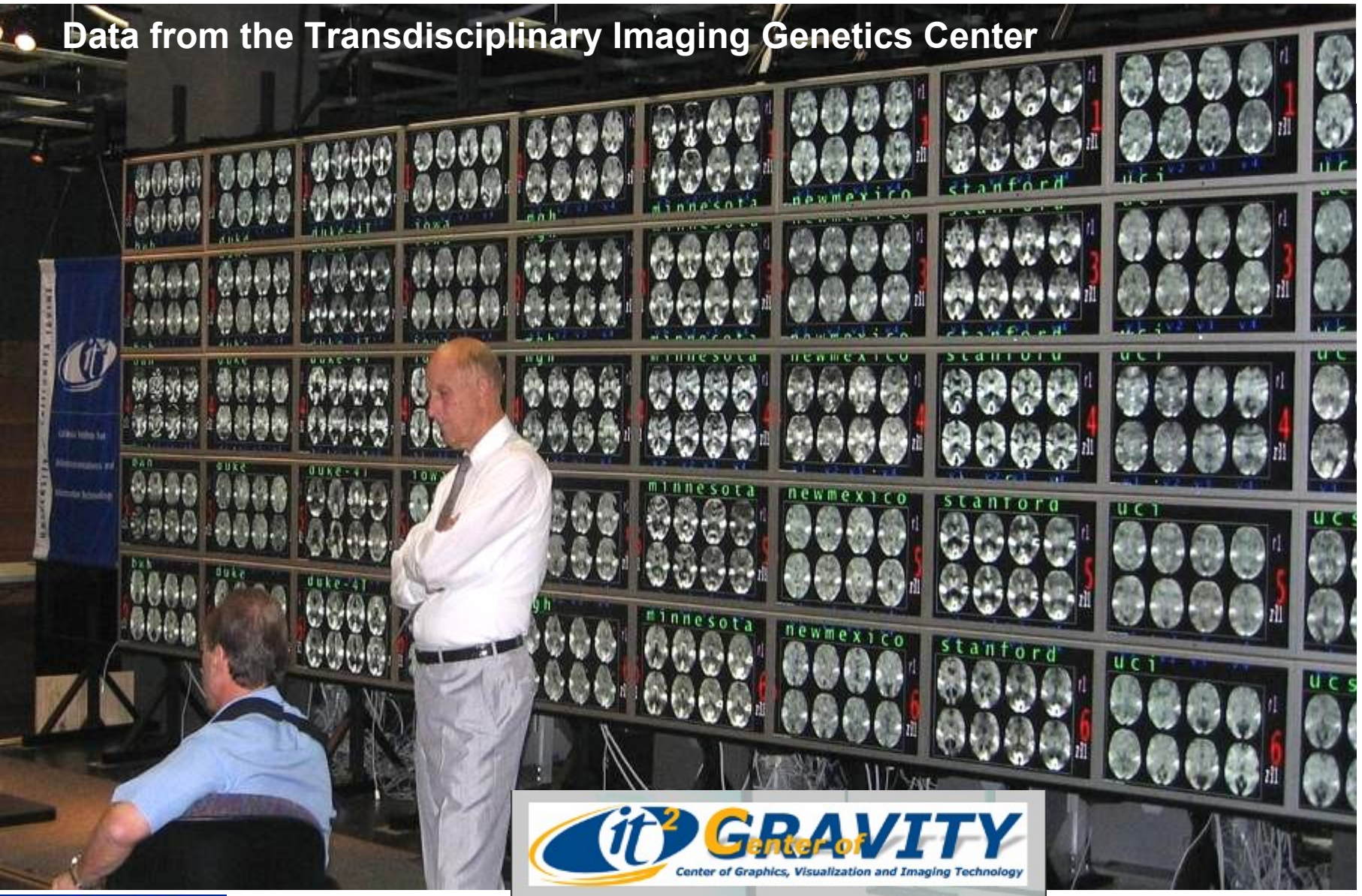
- 20 Dual CPU Nodes, Twenty 24” Monitors, ~$50,000
- 1/4 Teraflop, 5 Terabyte Storage, 45 Mega Pixels--Nice PC!
- Scalable Adaptive Graphics Environment (SAGE) Jason Leigh, EVL-UIC





Source: Phil Papadopoulos SDSC, Calit2

Prototyping the PC of 2015: Two Hundred Million Pixels Connected at 10Gbps



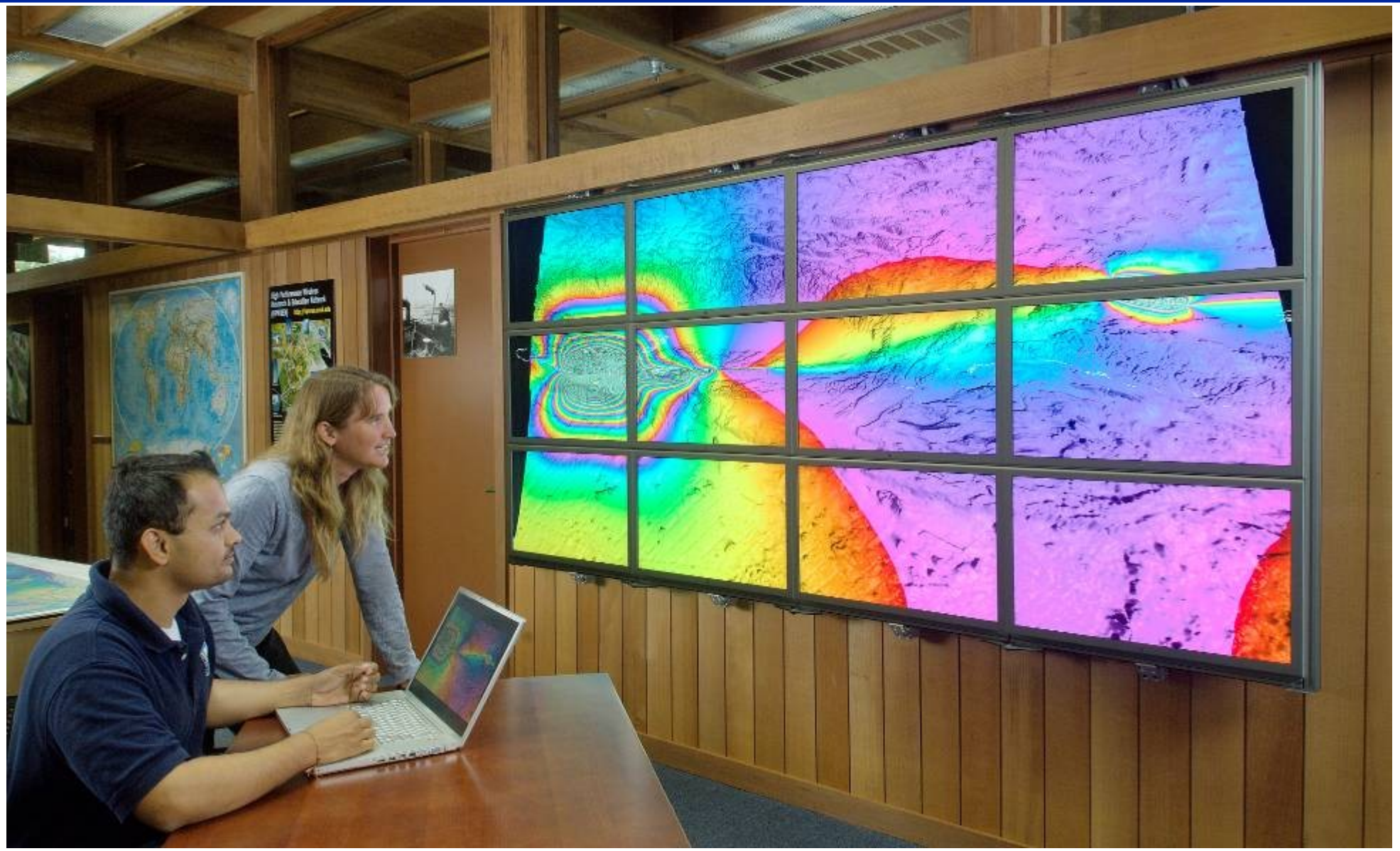
OptIPuter

50 Apple 30” Cinema Displays Driven by 25 Dual-Processor G5s

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Source: Falko Kuester, Calit2@UCI
NSF Infrastructure Grant

Apple iCluster Display Wall for Visualization of Seismic Network Data



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SCRIPPS INSTITUTION OF OCEANOGRAPHY

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Showing your Science at Meetings-- The Portable Mini-Mac Wall

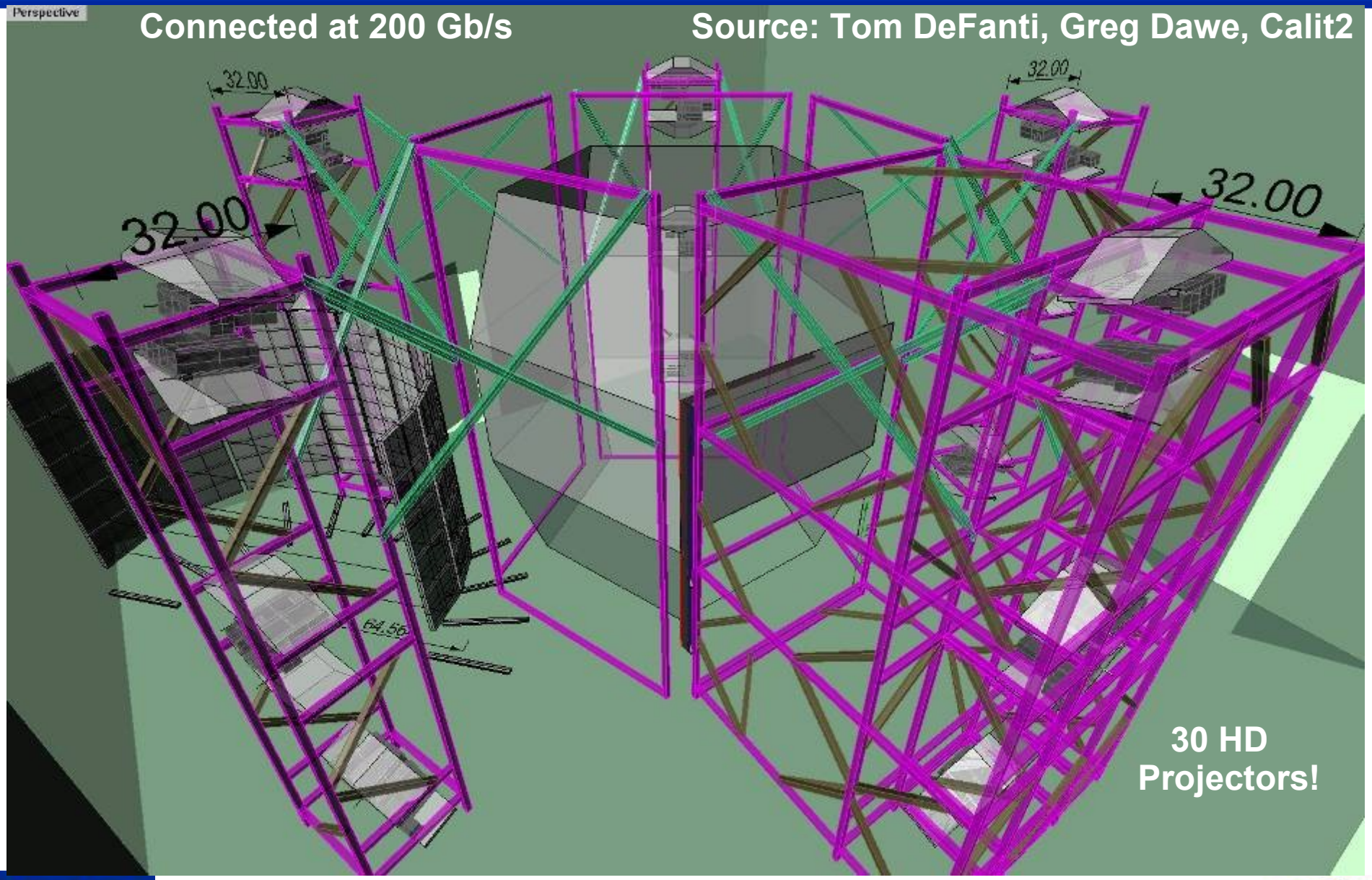


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ANL's Rick Stevens Studying Deep Sea Vent Ecology at Supercomputing '06

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3D OptIPortal Calit2 StarCAVE Telepresence "Holodeck"



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60 GB Texture Memory,
Renders Images 3,200 Times the Speed of Single PC

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Accelerator: Global Connections Between University Research Centers at 10Gbps

Maxine Brown, Tom DeFanti, Co-Chairs

iGrid 2005

THE GLOBAL LAMBDA INTEGRATED FACILITY

www.igrid2005.org



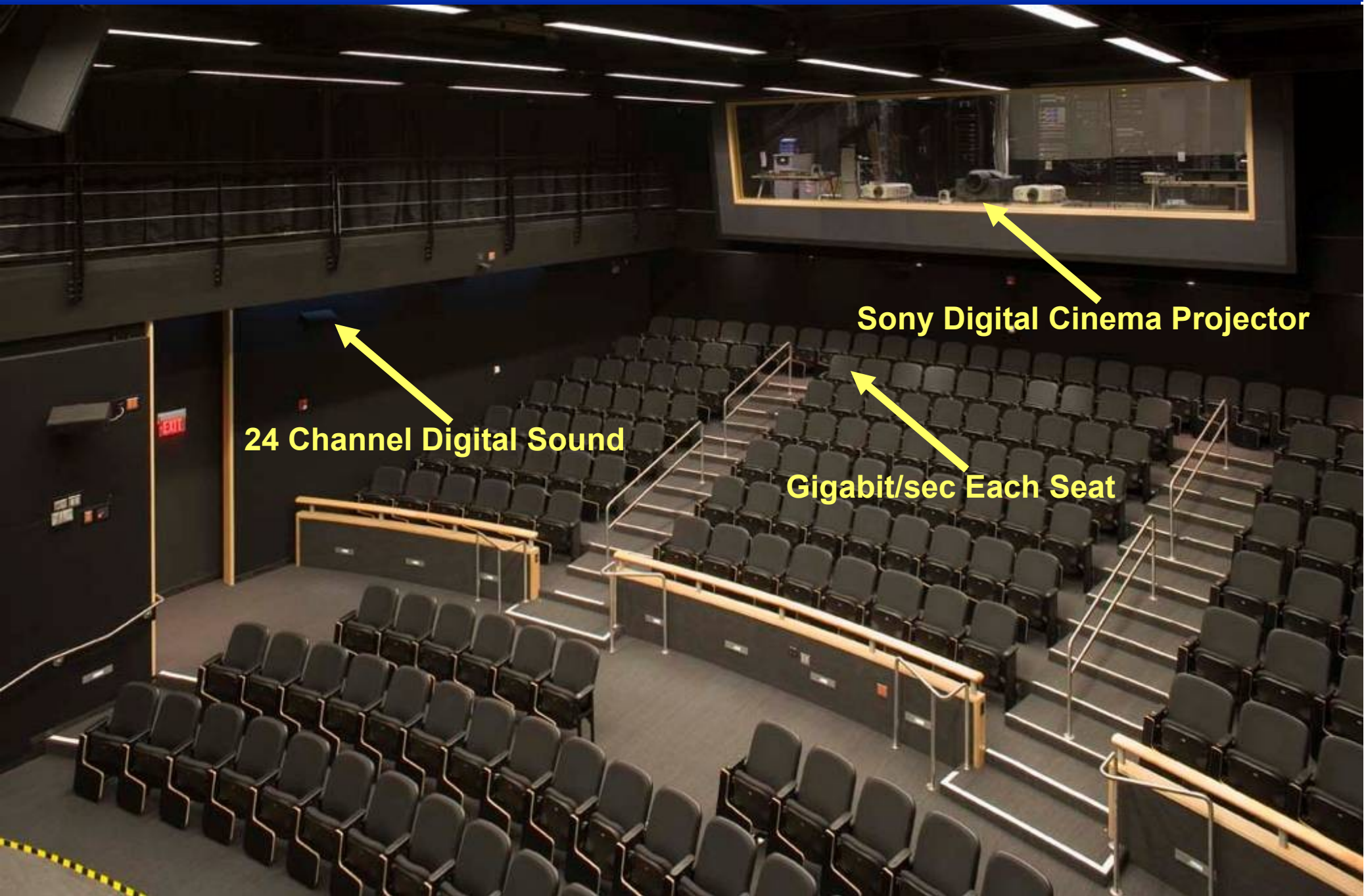
the UC Discovery Grant

September 26-30, 2005
Calit2 @ University of California, San Diego
California Institute for Telecommunications and Information Technology

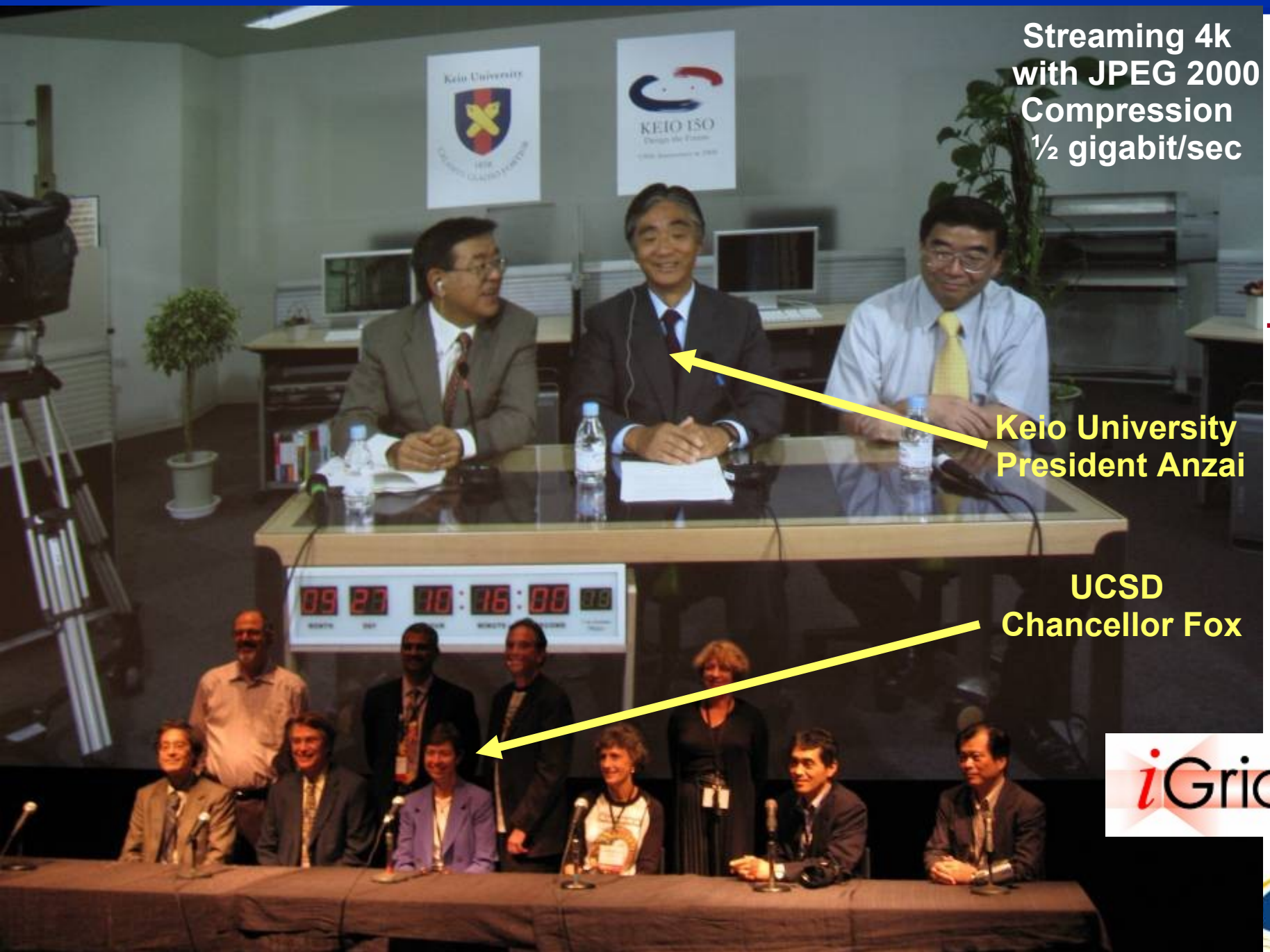


21 Countries Driving 50 Demonstrations
1 or 10Gbps to Calit2@UCSD Building
Sept 2005

Building a Global Collaboratorium



First Trans-Pacific Super High Definition Telepresence Meeting in New Calit2 Digital Cinema Auditorium



Talk by Laurin Herr Weds.

Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

iGrid 2005

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









Source: Toppan Printing

Kyoto Nijo Castle

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Brain Imaging Collaboration -- UCSD & Osaka Univ. Using Real-Time Instrument Steering and HDTV

Most Powerful Electron Microscope in the World -- Osaka, Japan





telescience project



HDTV

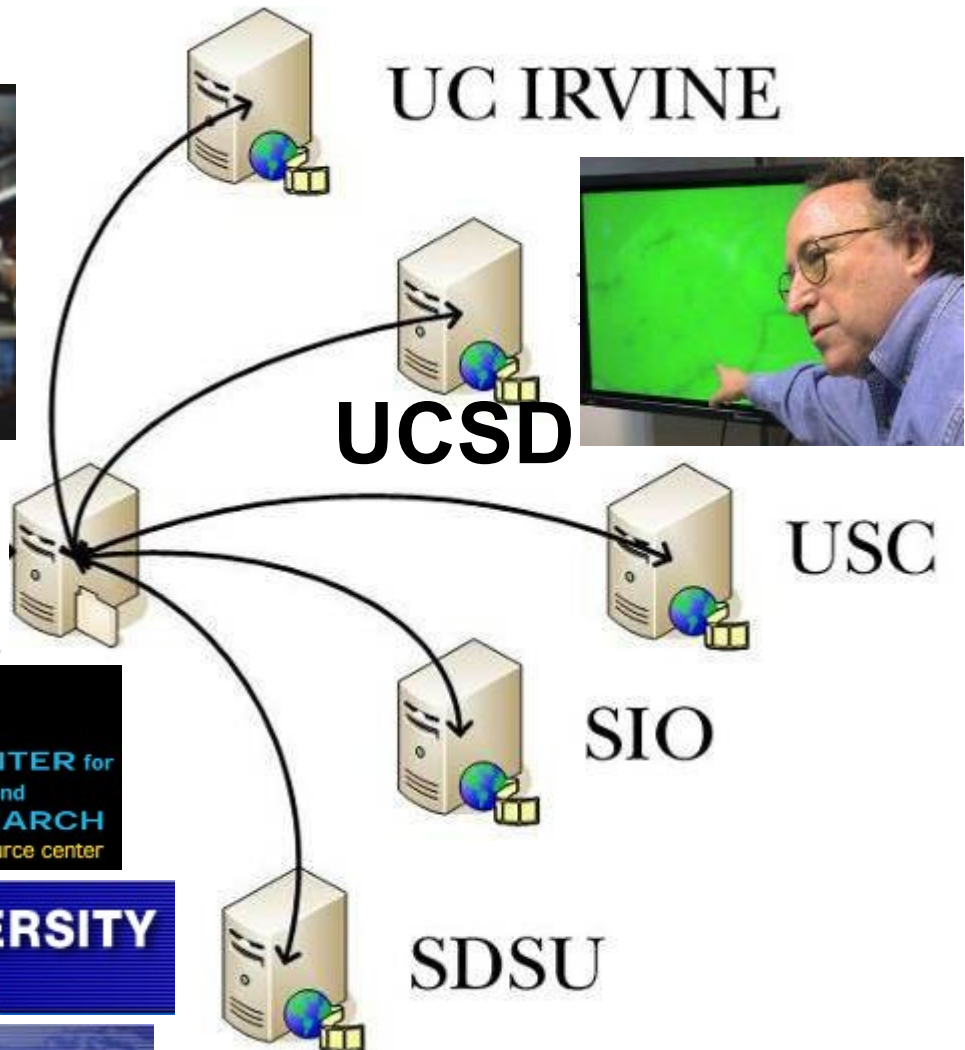
NBCR

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

OSAKA UNIVERSITY

KDDI GROUP KDDI Labs USA

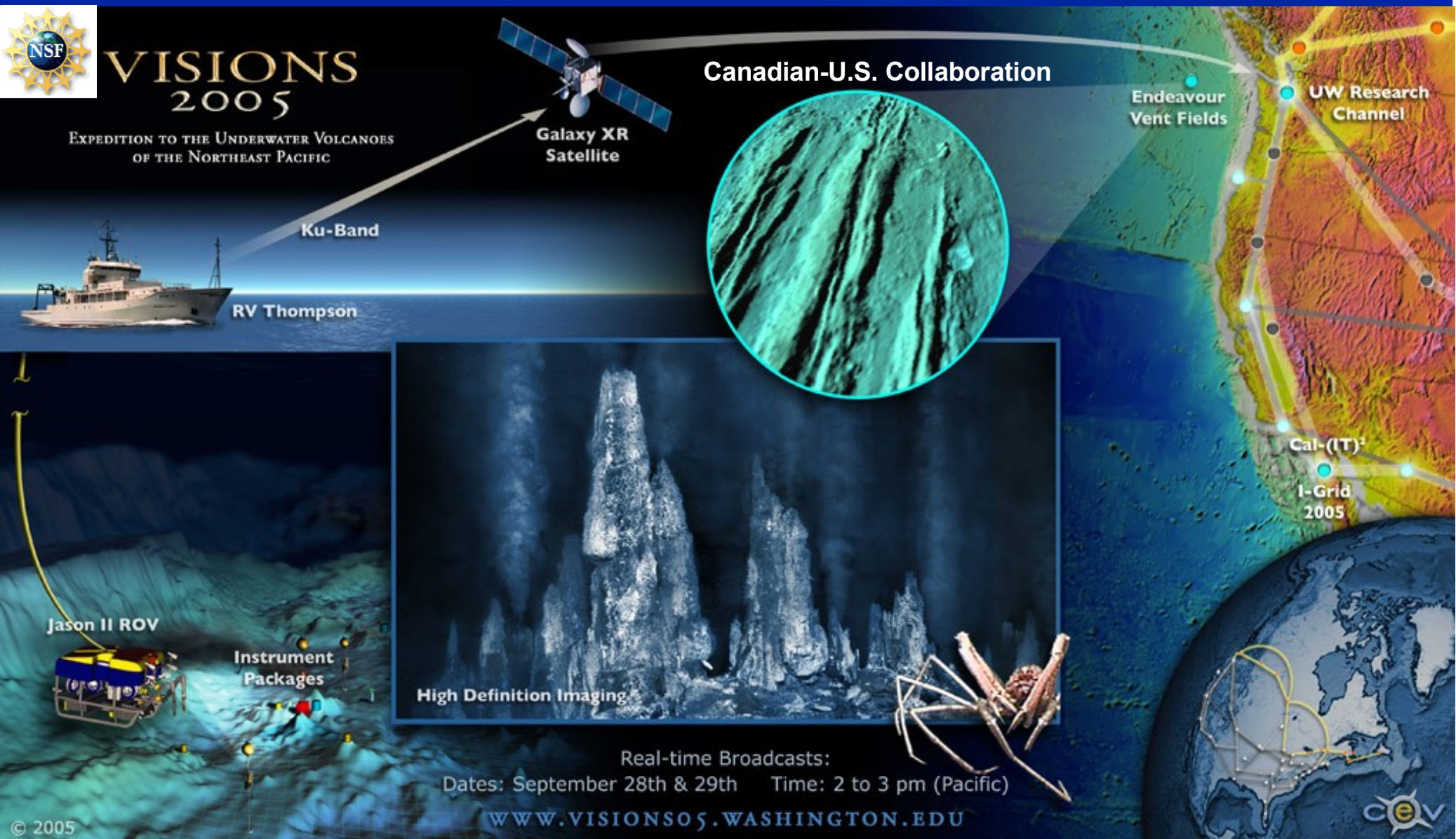
Southern California OptIPuter



Source: Mark Ellisman, UCSD

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First Remote Interactive High Definition Video Exploration of Deep Sea Vents



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UCIrvine

Source John Delaney & Deborah Kelley, UWash

High Definition Still Frame of Hydrothermal Vent Ecology 2.3 Km Deep



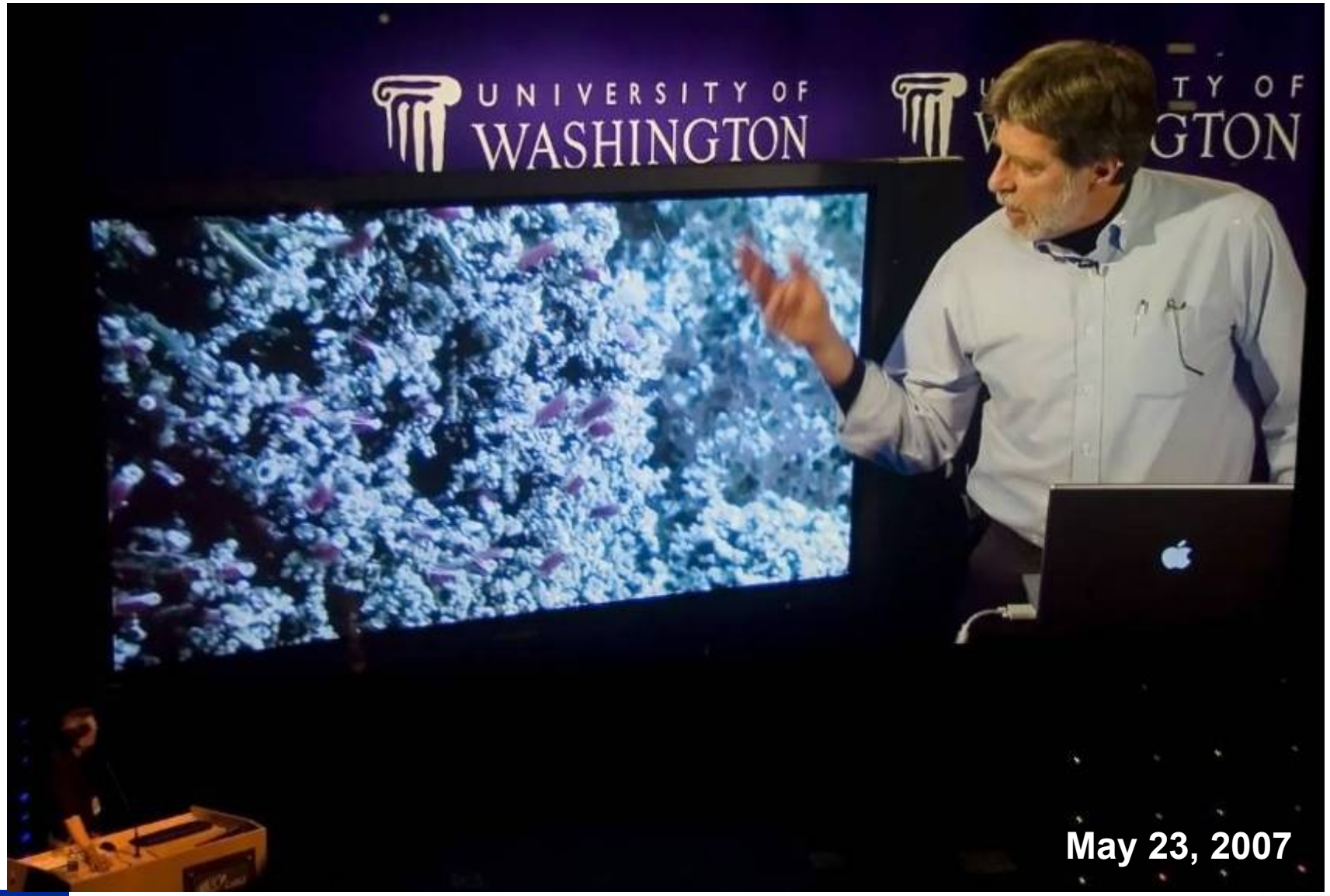
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White Filamentous Bacteria on 'Pill Bug' Outer Carapace

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e-Science Collaboratory Without Walls Enabled by Uncompressed HD Telepresence

1500 Mbits/sec Calit2 to UW Research Channel Over NLR



John Delaney, PI LOOKING, Neptune

Photo: Harry Ammons, SDSC

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Calit2, SDSC, EVL, and SIO are Creating Environmental Observatory Control Rooms



UCSD UCIrvine evl electronic visualization laboratory SDSC SAN DIEGO SUPERCOMPUTER CENTER SCRIPPS INSTITUTION OF OCEANOGRAPHY it2

Towards a Total Knowledge Integration System for the Coastal Zone—SensorNets Linked to OptIPuter

- Moorings
- Ships
- Autonomous Vehicles
- Satellite Remote Sensing
- Drifters
- Long Range HF Radar
- Near-Shore Waves/Currents
- COAMPS Wind Model
- Nested ROMS Models
- Data Assimilation and Modeling
- Data Systems



Yellow—Proposed Initial OptIPuter Backbone

SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM

ROADNet

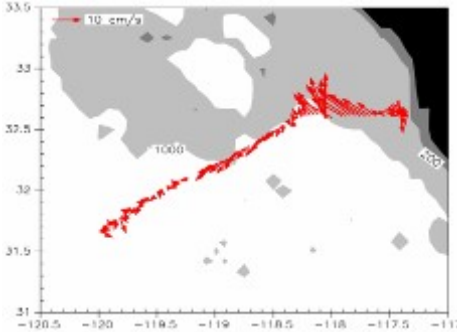
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www.sccoos.org/

COCMP

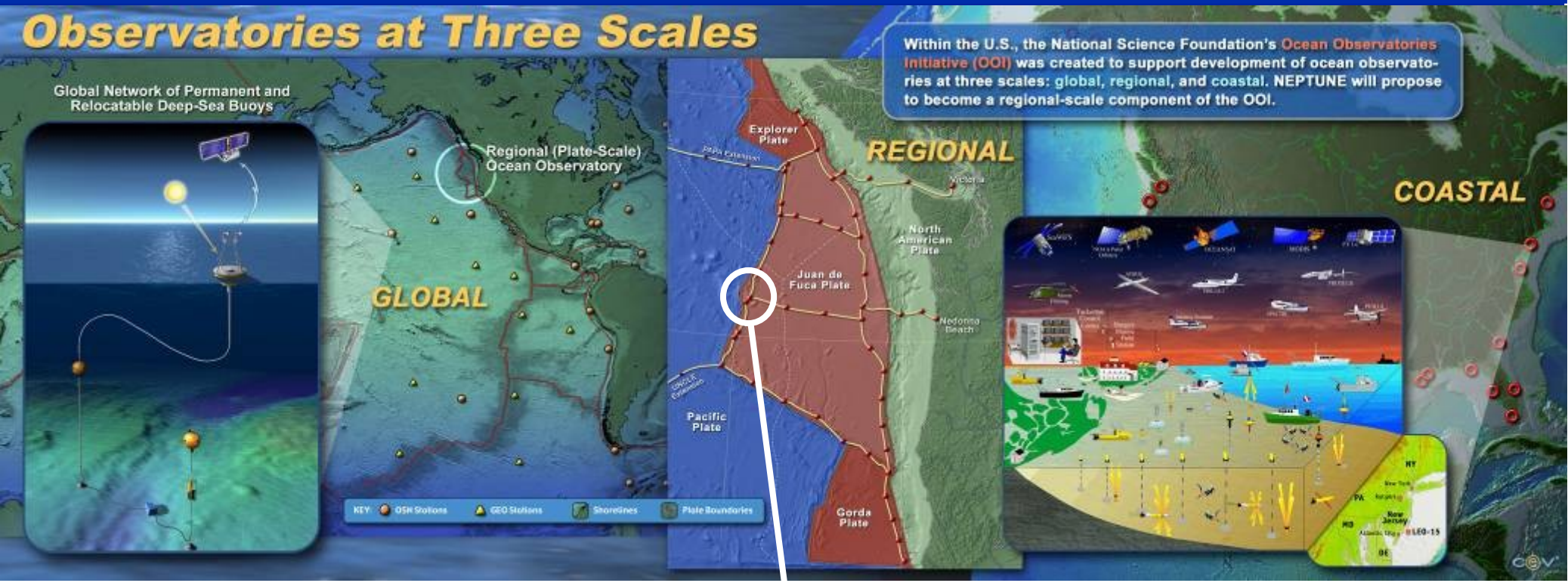
Coastal Ocean Currents Monitoring Program

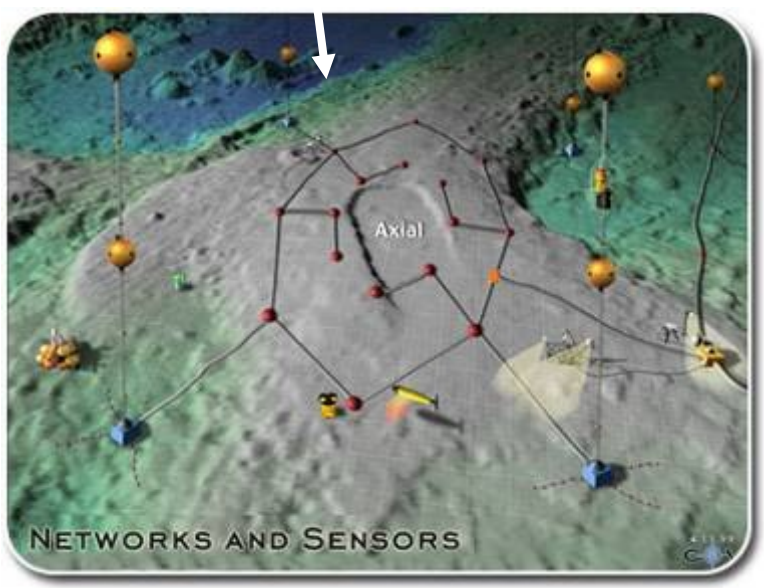




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NSF's Ocean Observatories Initiative (OOI) Envisions Global, Regional, and Coastal Scale Observatories

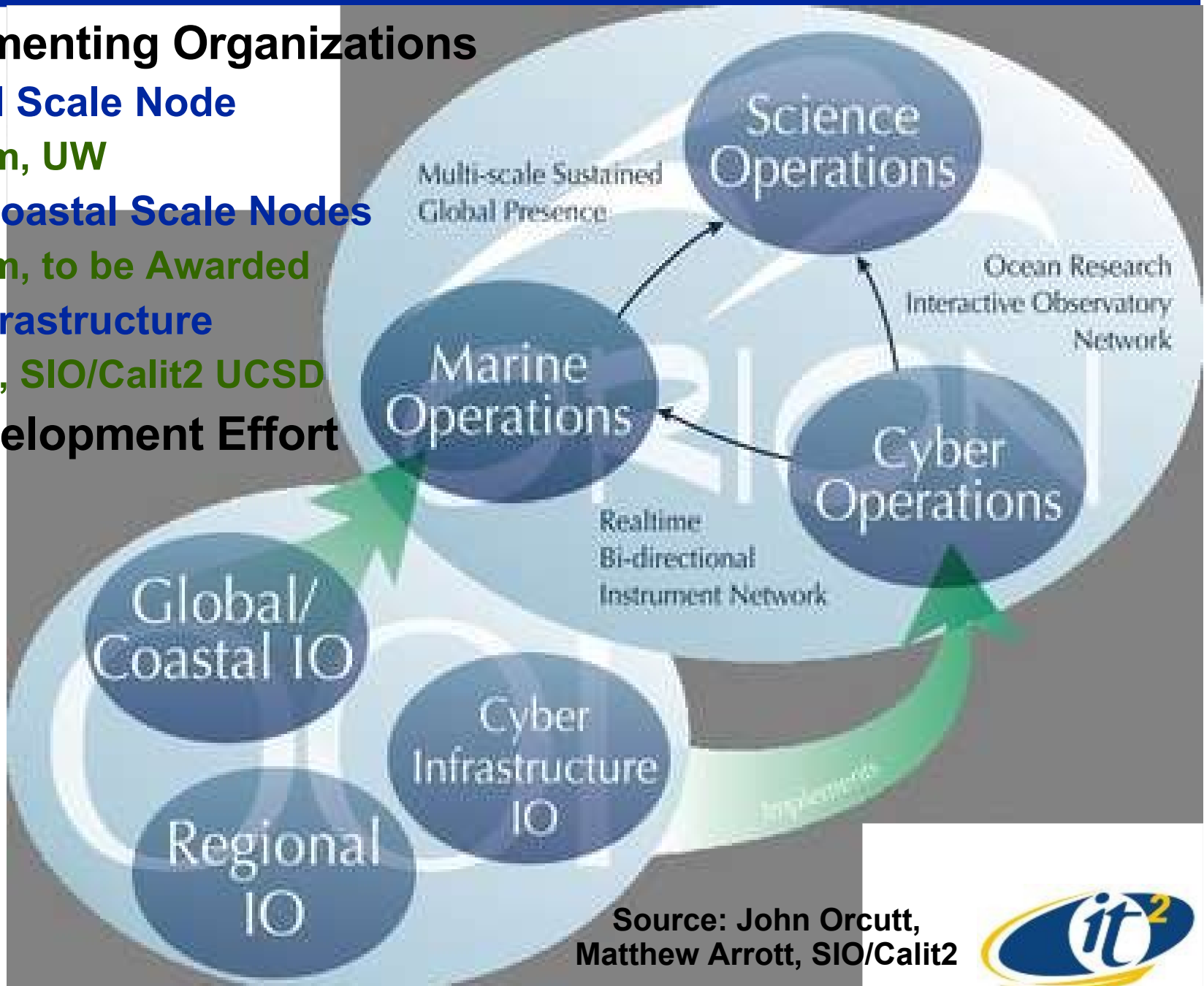




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Ocean Observatory Initiative -- Initial Stages

- **OOI Implementing Organizations**
  - **Regional Scale Node**
    - **$150m, UW**
  - **Global/Coastal Scale Nodes**
    - **$120m, to be Awarded**
  - **Cyberinfrastructure**
    - **$30m, SIO/Calit2 UCSD**
- **6 Year Development Effort**



Source: John Orcutt, Matthew Arrott, SIO/Calit2

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Integrating Supercomputer Visualization of Oceans with HD in a Collaborative Environment



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Source:Jason Leigh, Luc Renambot, EVL, UIC

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

Plus 155 Marine Microbial Genomes



Each Sample ~2000 Microbial Species

Specify Ocean Data

Sorcerer II Data Will Double Number of Proteins in GenBank!

camera
Marine Microbial Ecology

MARINE MICROBIOLOGY INITIATIVE

Gordon and Betty MOORE FOUNDATION

J. Craig Venter INSTITUTE

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

Sargasso Sea Data

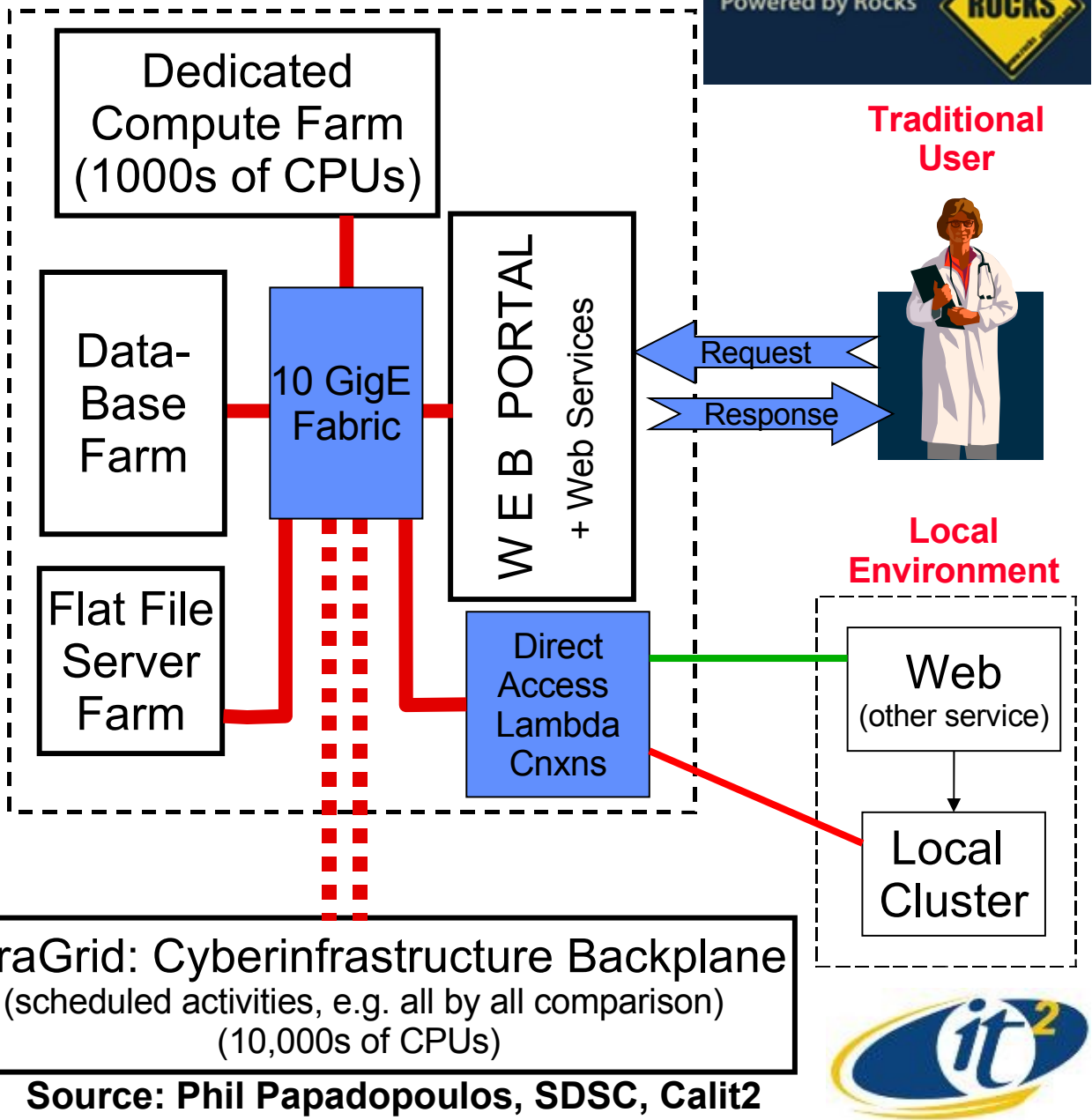
Sorcerer II Expedition (GOS)

JGI Community Sequencing Project

Moore Marine Microbial Project

NASA and NOAA Satellite Data

Community Microbial Metagenomics Data



Source: Phil Papadopoulos, SDSC, Calit2

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SDSC SAN DIEGO SUPERCOMPUTER CENTER

Gordon and Betty MOORE FOUNDATION

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Calit2 CAMERA Production
Compute and Storage Complex is On-Line



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Powered by Rocks
ROCKS

camera
Marine Microbial Ecology

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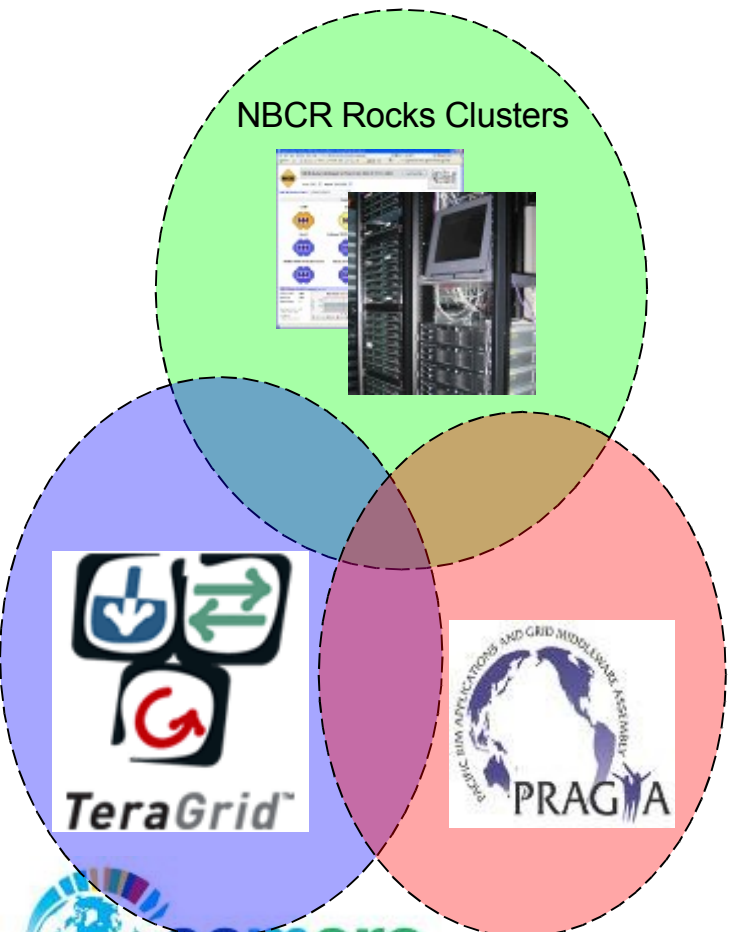
CAMERA Builds on Cyberinfrastructure Grid, Workflow, and Portal Projects in a Service Oriented Architecture

National Biomedical Computation Resource
an NIH supported resource center

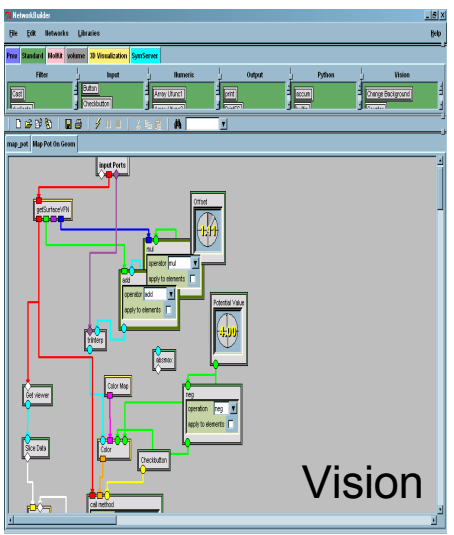
Located in Calit2@UCSD Building

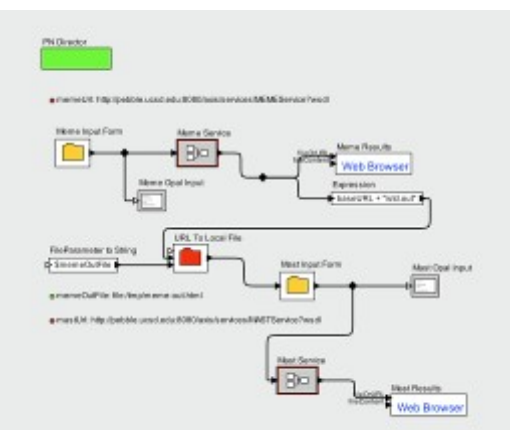
yberinfrastructure: Raw Resources, Middleware & Execution Environment

Virtual Organizations



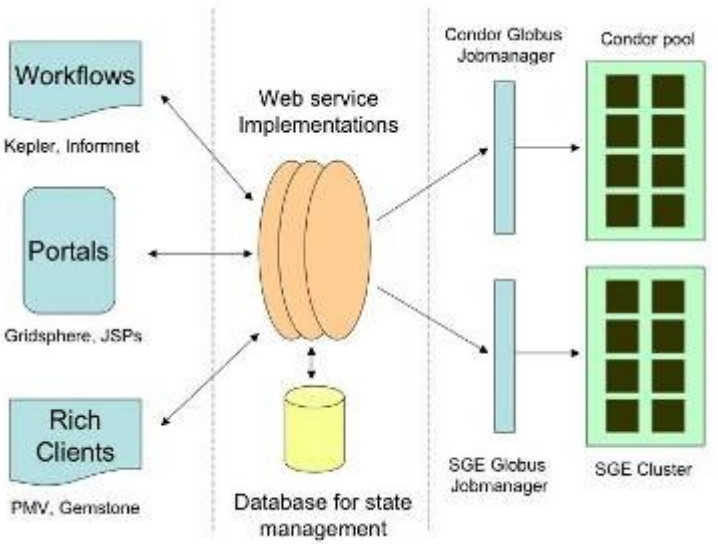
Workflow Management





KEPLER

Web Services

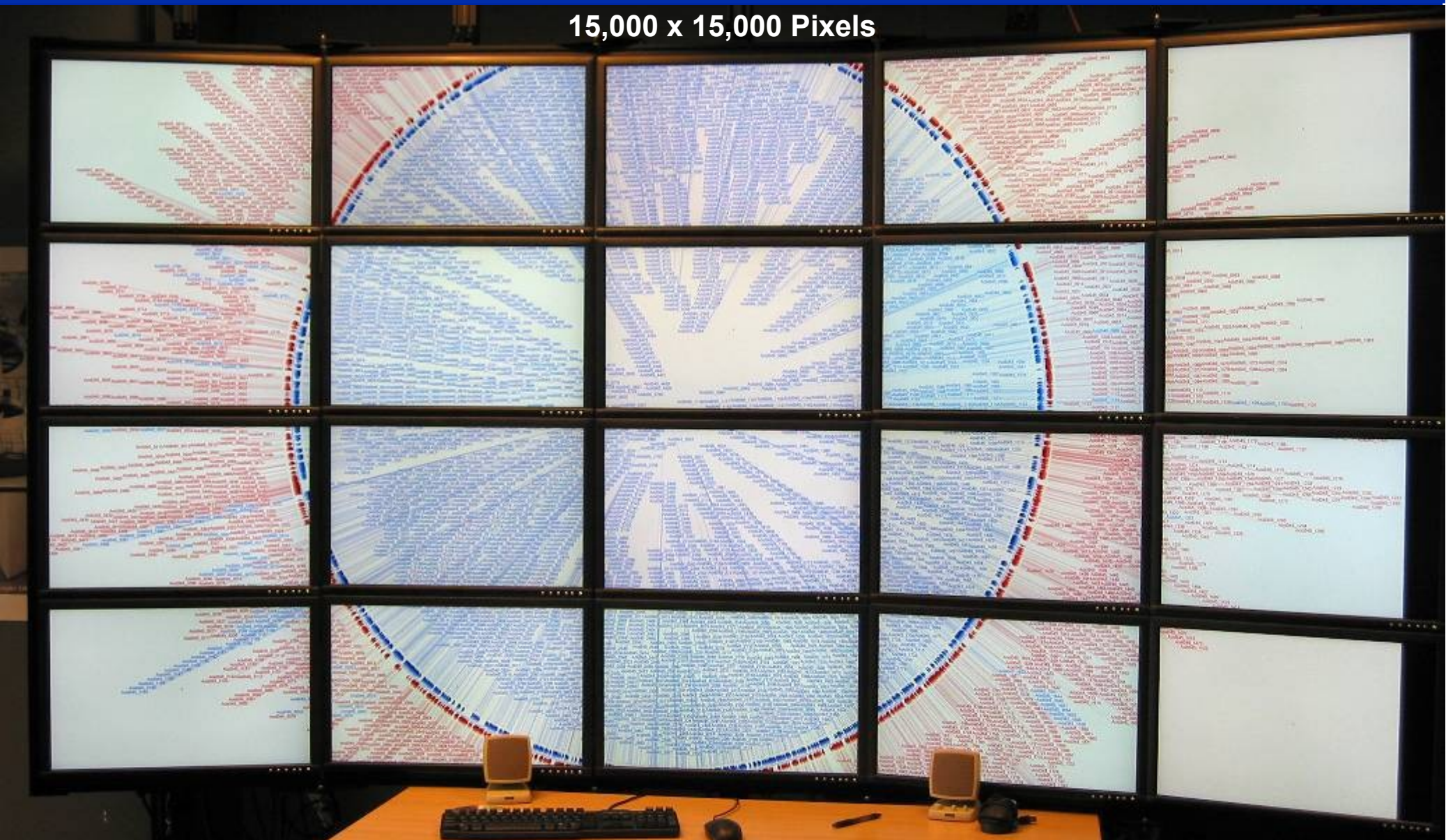


Telescience Portal

telescience project

it²

Use of OptIPortal to Interactively View Microbial Genome



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Source: Raj Singh, UCSD

Acidobacteria bacterium Ellin345 (NCBI)
Soil Bacterium 5.6 Mb

it²

Use of OptIPortal to Interactively View Microbial Genome



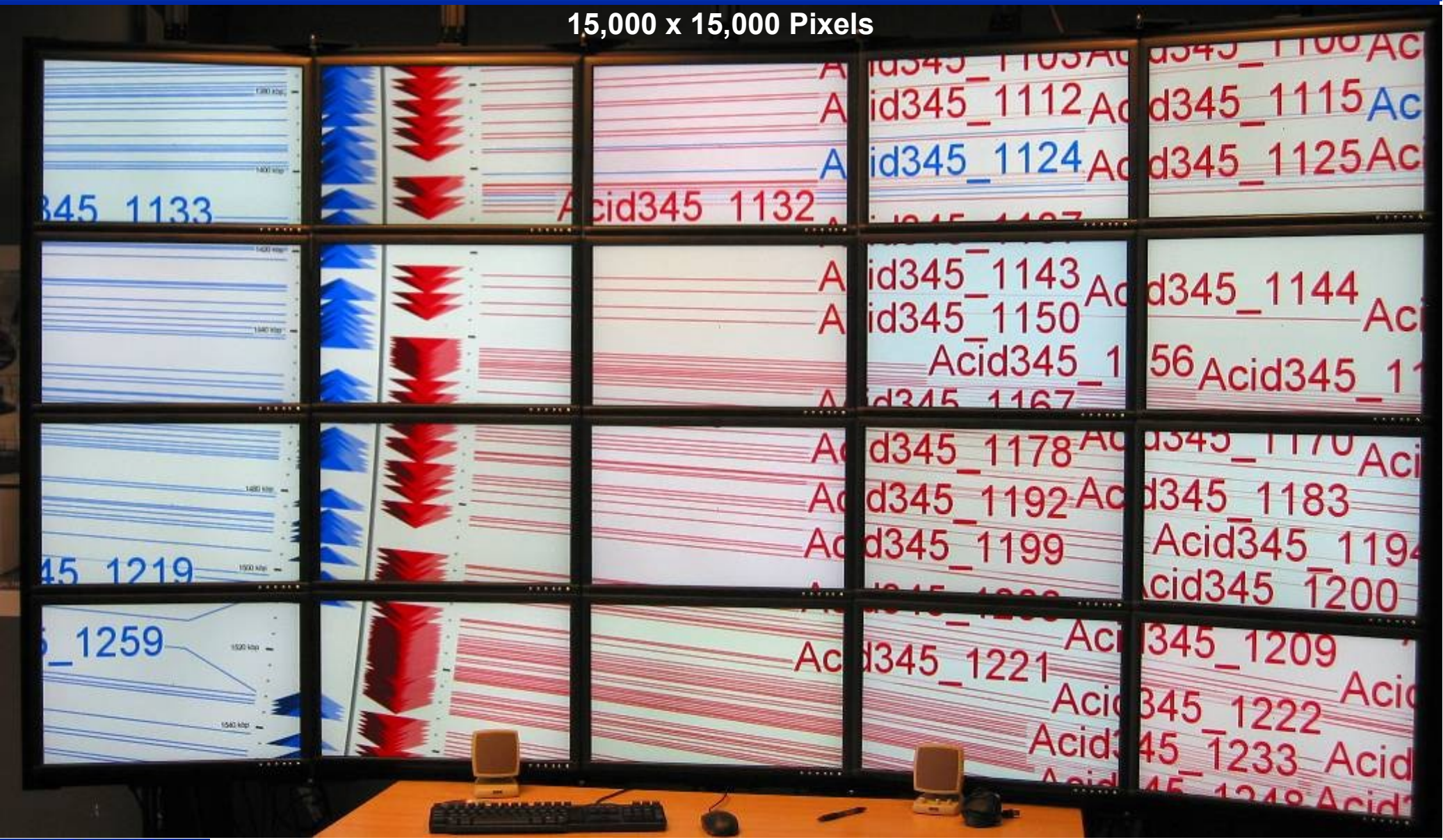
UCSD
UCIrvine

Source: Raj Singh, UCSD

Acidobacteria bacterium Ellin345 (NCBI)
Soil Bacterium 5.6 Mb

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Use of OptIPortal to Interactively View Microbial Genome



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Source: Raj Singh, UCSD

Acidobacteria bacterium Ellin345 (NCBI)
Soil Bacterium 5.6 Mb

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An Emerging High Performance Collaboratory for Microbial Metagenomics



Can We Create a "My Space" for Science Researchers? Microbial Metagenomics as a Cyber-Community

Over 1000 Registered Users From 45 Countries



USA	583
United Kingdom	46
Canada	35
France	35
Germany	32

camera
Marine Microbial Ecology

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