2008—The Year of Global Telepresence

Kenote Presentation
15th Mardi Gras Conference
Center for Computation and Technology at LSU
Louisiana State University
February 2, 2008

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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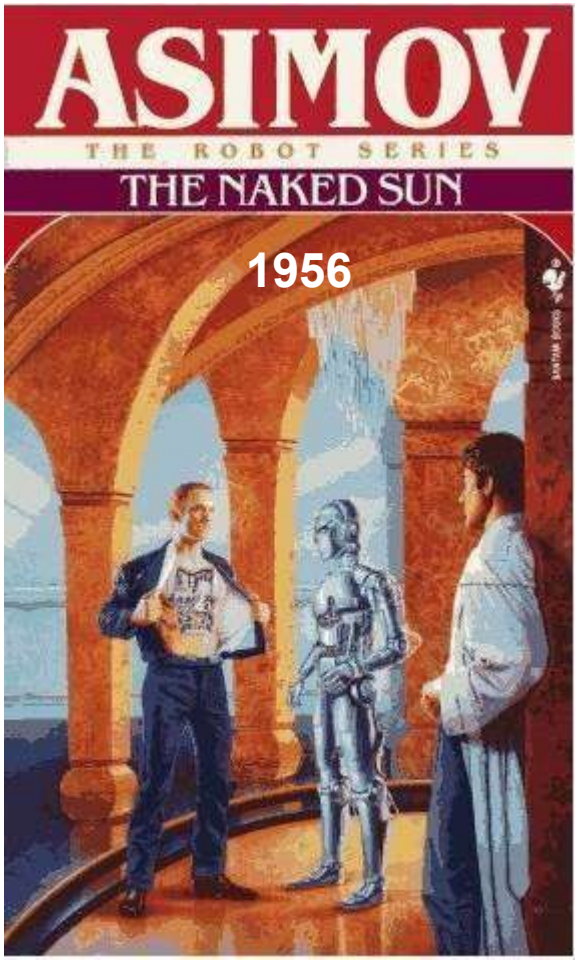
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Abstract

The concept of Telepresence is at least fifty years old, being quite pervasive in science fiction of the 1950s and 1960s. By the late 1980s prototypes using commercial telecommunications were being carried out by research labs in industry and universities, several of which I was involved with. Today, the California Institute for Telecommunications and Information Technology, a UCSD/UCI partnership, has a variety of projects underway exploring persistent 1-10 gigabit/s optical paths connecting people and devices on local, regional, national, and global scales. We are also developing large scale visualization walls, termed "OptIPortals," containing tens to hundreds of millions of pixels, which create large "pixel real estate" for remote collaboration. As part of our digital cinema project, CineGrid, we are experimenting with using four thousand line resolution (4k) video streams carried over dedicated gigabit/sec optical light paths to establish a Telepresence on a global scale. In 2008, many national and international sites will link up their OptIPortals over 1 or 10 gigabit/s light paths, with embedded HD or digital cinema streams, creating a global-scale collaboratory.

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Fifty Years Ago, Asimov Described a World of Telepresence



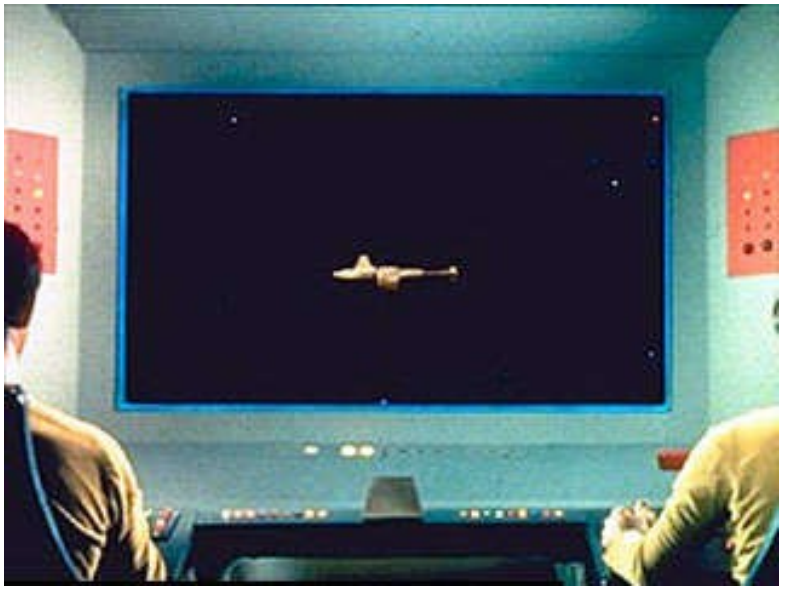
A policeman from Earth, where the population all lives underground in close quarters, is called in to investigate a murder on a distant world. This world is populated by very few humans, rarely if ever, coming into physical proximity of each other. Instead the people "View" each other with trimensional “holographic” images.

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TV and Movies of 40 Years Ago Envisioned Telepresence Displays









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Source: Star Trek 1966-68; Barbarella 1968

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The Bellcore VideoWindow -- A Working Telepresence Experiment



(1989)

"Imagine sitting in your work place lounge having coffee with some colleagues. Now imagine that you and your colleagues are still in the same room, but are separated by a large sheet of glass that does not interfere with your ability to carry on a clear, two-way conversation. Finally, imagine that you have split the room into two parts and moved one part 50 miles down the road, without impairing the quality of your interaction with your friends."

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Source: Fish, Kraut, and Chalfonte-CSCW 1990 Proceedings

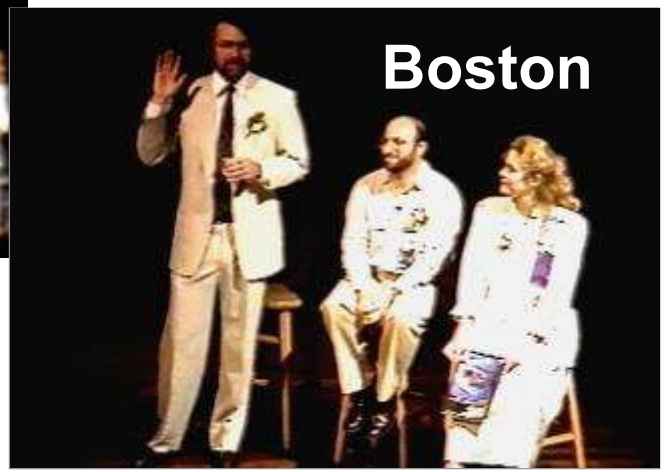
A Simulation of Telepresence

Using Analog Communications to Prototype the Digital Future

"What we really have to do is eliminate distance between individuals who want to interact with other people and with other computers."
— Larry Smarr, Director, NCSA

- **Televisualization:**
  - **Telepresence**
  - **Remote Interactive Visual Supercomputing**
  - **Multi-disciplinary Scientific Visualization**







"We're using satellite technology…to demo what It might be like to have high-speed fiber-optic links between advanced computers in two different geographic locations."

— Al Gore, Senator
Chair, US Senate Subcommittee on Science, Technology and Space

ATT & Sun

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SIGGRAPH 1989

NCSA™

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Caterpillar / NCSA: Distributed Virtual Reality for Global-Scale Collaborative Prototyping





NCSA™

Real Time Linked Virtual Reality and Audio-Video Between NCSA, Peoria, Houston, and Germany

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1996

www.sv.vt.edu/future/vt-cave/apps/CatDistVR/DVR.html

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Calit2 Continues to Pursue Its Initial Mission:

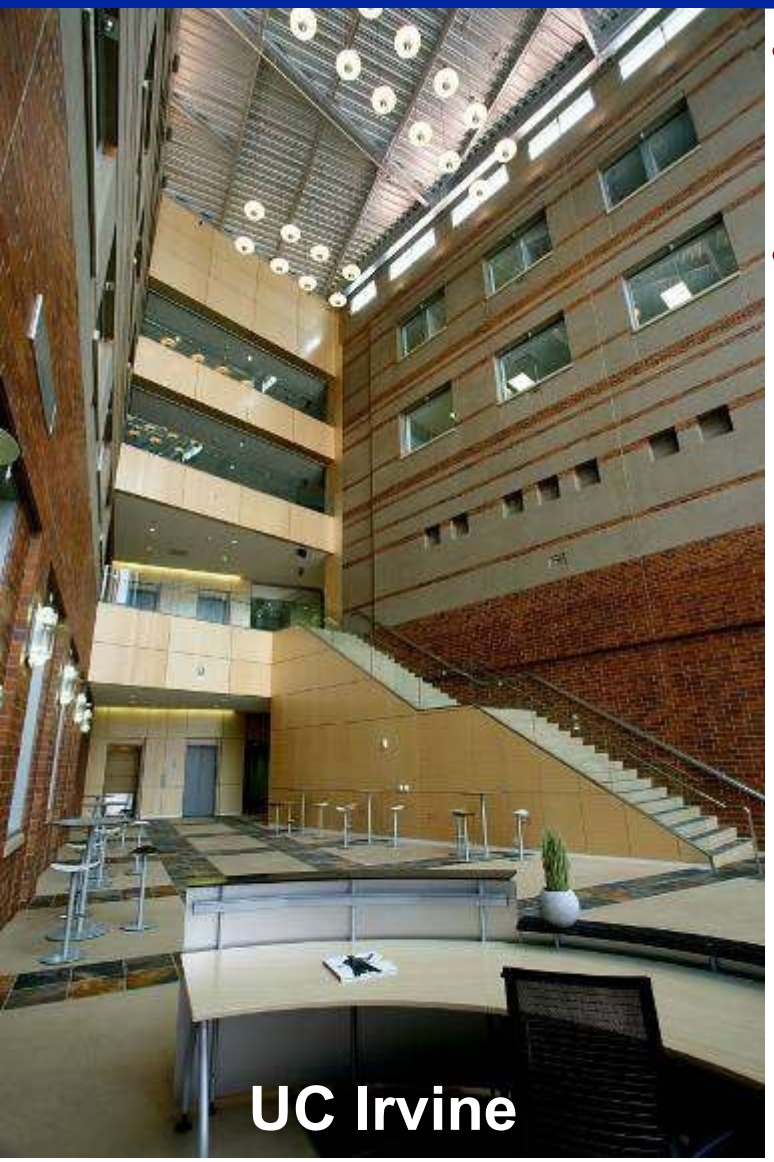
Envisioning How the Extension of Innovative Telecommunications and Information Technologies Throughout the Physical World will Transform Critical Applications Important to the California Economy and its Citizens' Quality Of Life.

Calit2 is a University of California "Institutional Innovation" Experiment on How to Invent a Persistent Collaborative Research and Education Environment that Provides Insight into How the UC, a Major Research University, Might Evolve in the Future.

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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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The Local, State, National, and Global OptIPuter Supports Complex Data-Intensive Science

COMMENTARY

Riding the light towards new science

LARRY SMARR

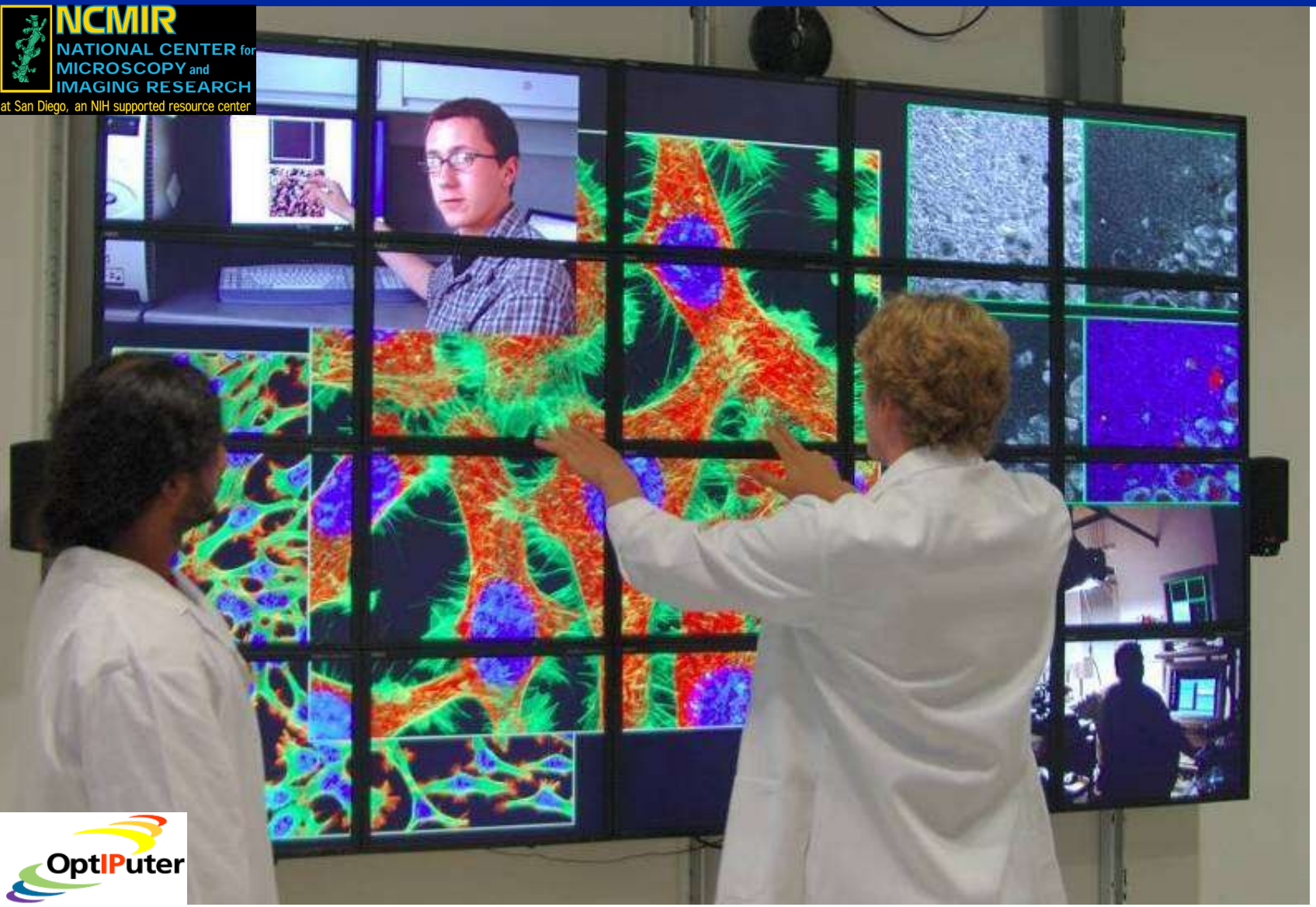
nature photonics | VOL 1 | MARCH 2007 | www.nature.com/naturephotonics

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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



Scalable Adaptive Graphics Environment (SAGE)

evl electronic visualization laboratory

NSF

$13.5M Over Five Years

Picture Source: Mark Ellisman, David Lee, Jason Leigh

OptIPuter

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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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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

evl electronic visualization laboratory





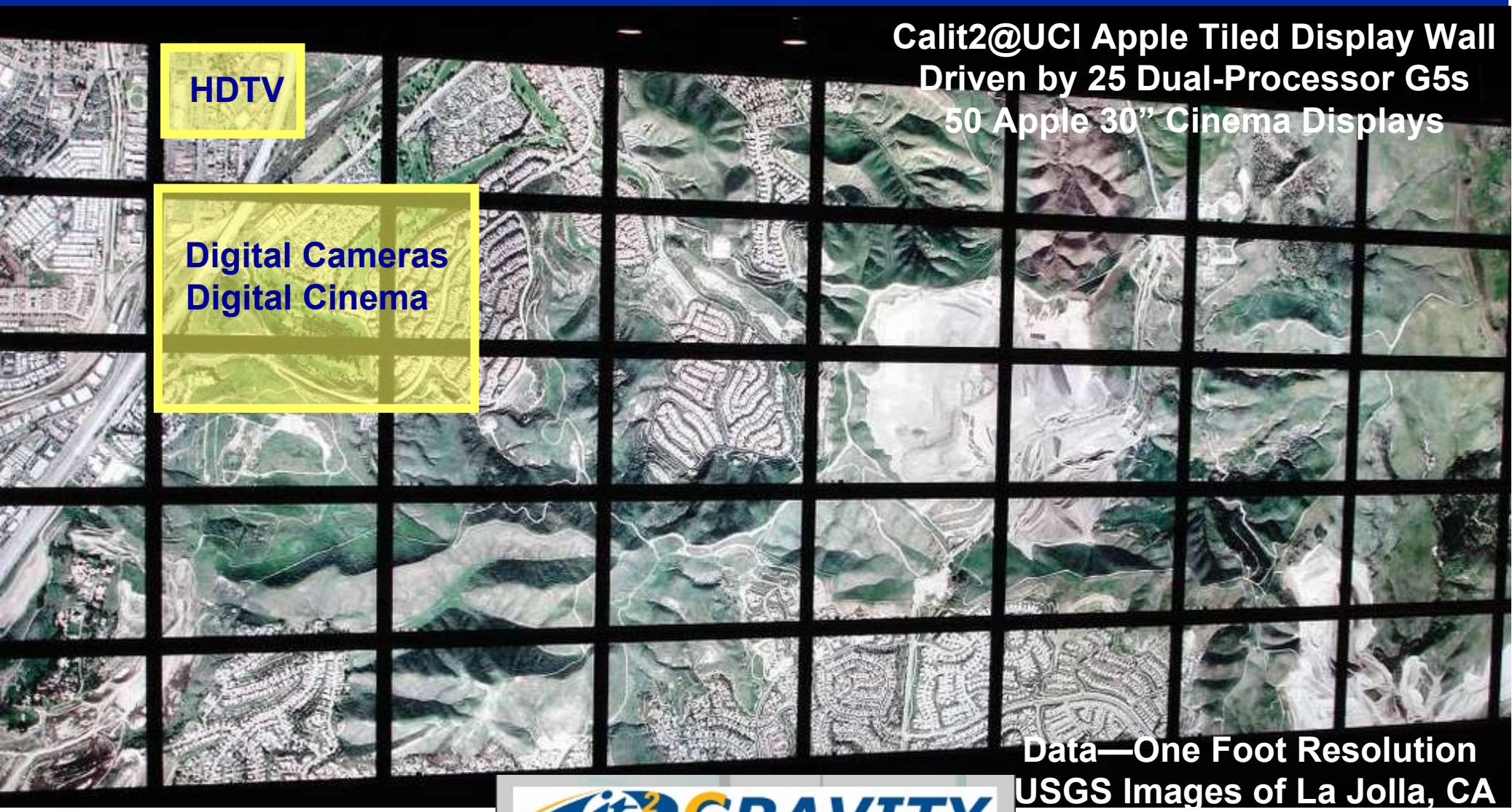
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Powered by Rocks ROCKS

Source: Phil Papadopoulos SDSC, Calit2

it²

Beyond 4k – From 8 Megapixels Towards a Billion Pixels



it² Center of GRAVITY
Center of Graphics, Visualization and Imaging Technology

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Source: Falko Kuester, Calit2@UCI
NSF Infrastructure Grant

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The OptIPuter Enabled Collaboratory: Remote Researchers Jointly Exploring Complex Data



Falko Kuester, UCSD;
Steven Jenks, UCI

OptIPuter

2,000 Mbps

80 NVIDIA Quadro FX 5600 GPUs

OptIPuter Connects the Calit2@UCI 200M-Pixel Wall to the 220M-Pixel Display at Calit2@UCSD With Shared Fast Deep Storage and High Definition Video



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Brain Circuitry Modeling and Visualization
In Collaboration with the
Transdisciplinary Imaging Genetics Center (TIGC) at UCI

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Borderless Collaboration Between Global University Research Centers at 10Gbps

Maxine Brown, Tom DeFanti, Co-Chairs

iGrid 2005

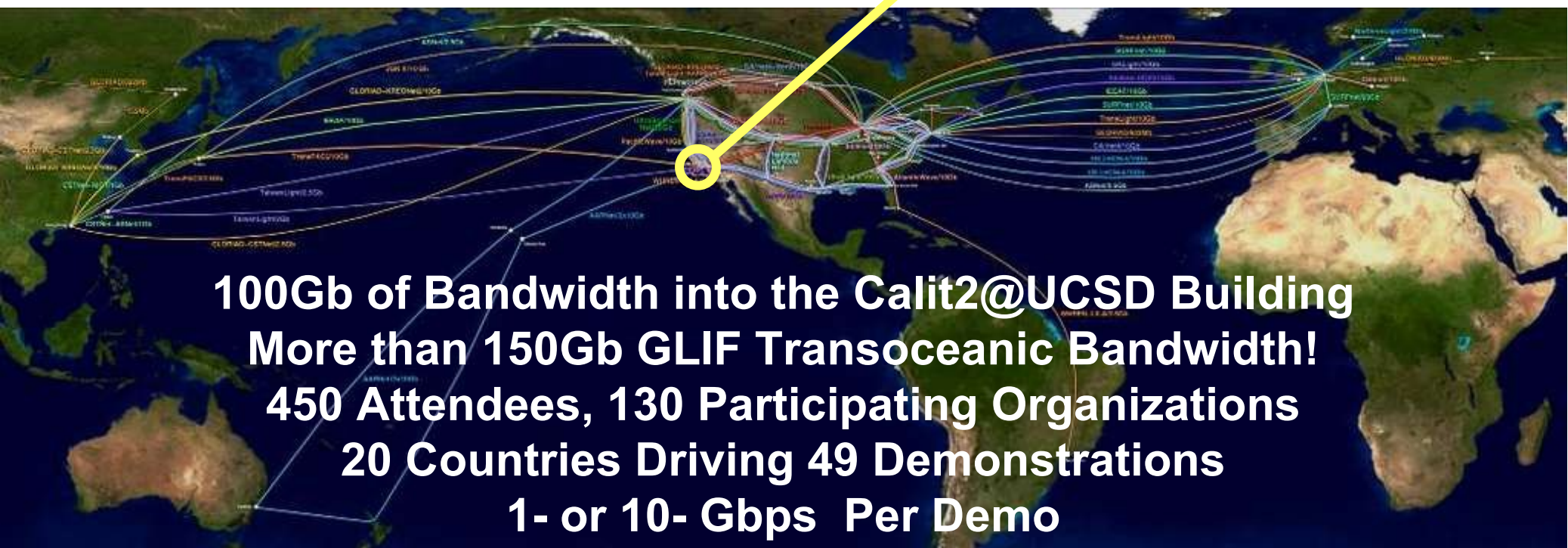
THE GLOBAL LAMBDA INTEGRATED FACILITY

www.igrid2005.org



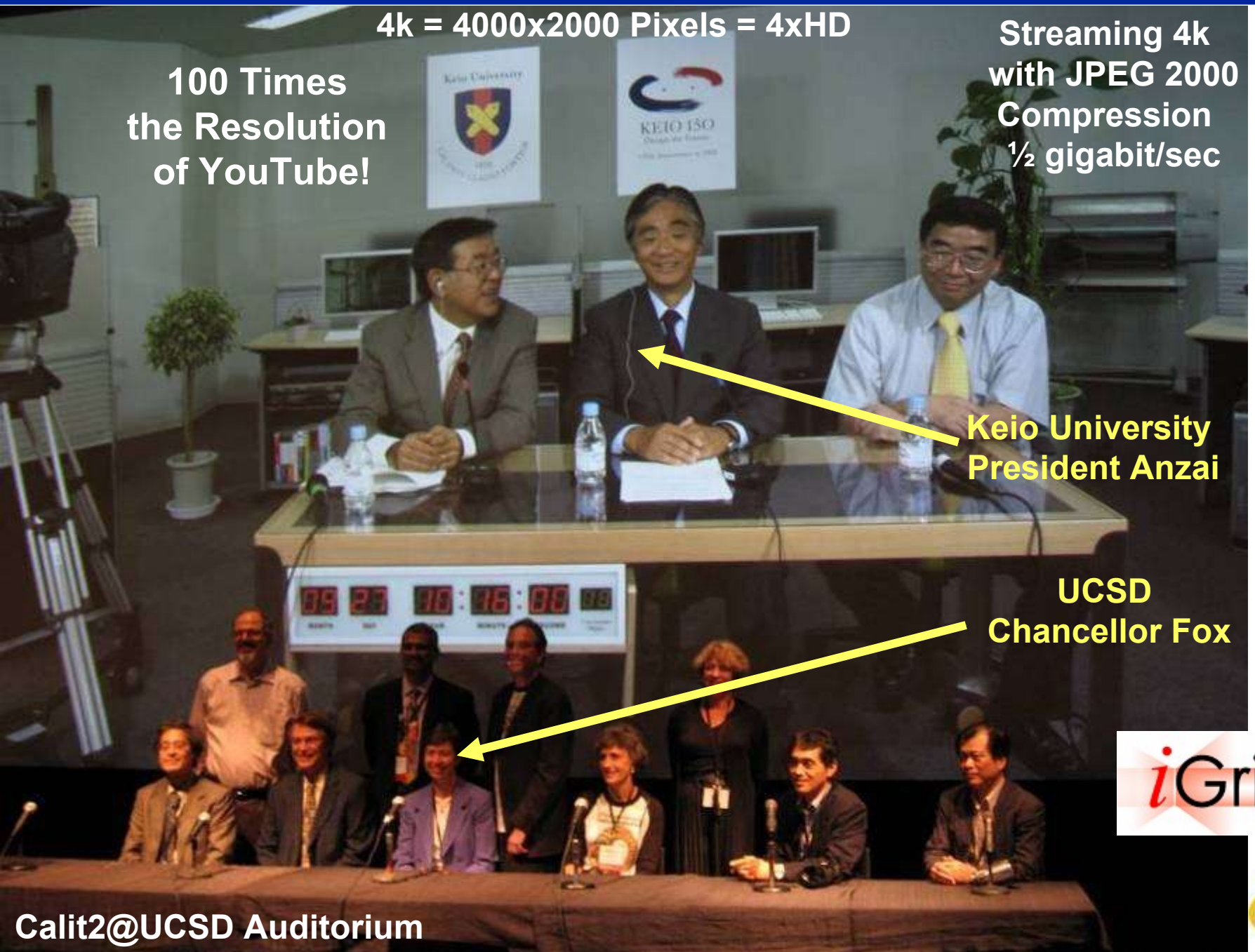
the UC Discovery Grant

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



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

First Trans-Pacific Super High Definition Telepresence Meeting Using Digital Cinema 4k Streams



CineGrid™

Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

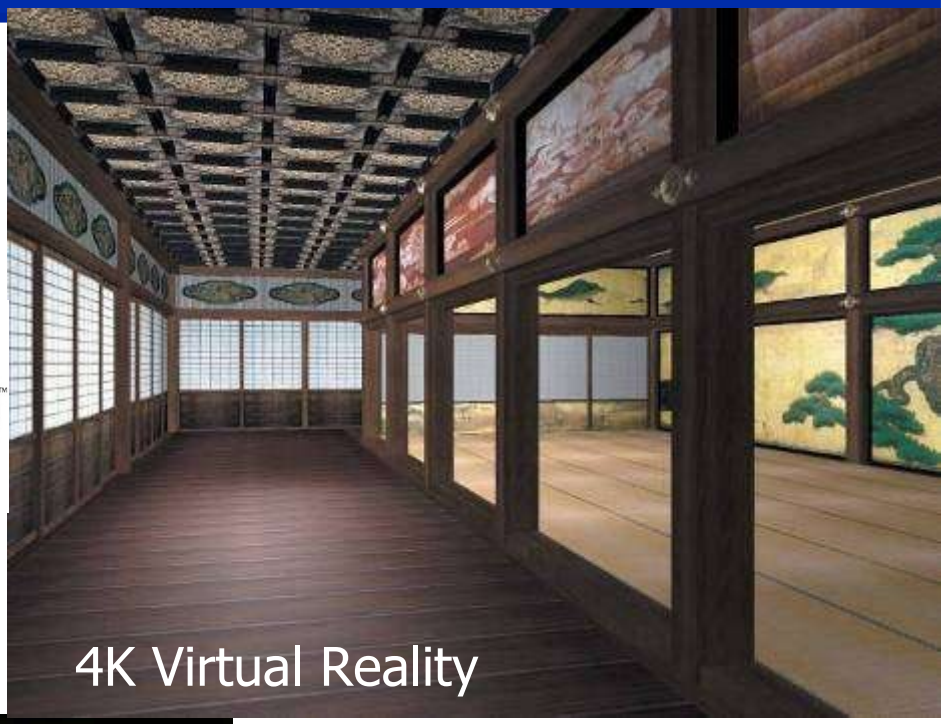
iGrid 2005

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CineGrid @ iGrid2005:
Six Hours of 4K Projected in Calit2 Auditorium

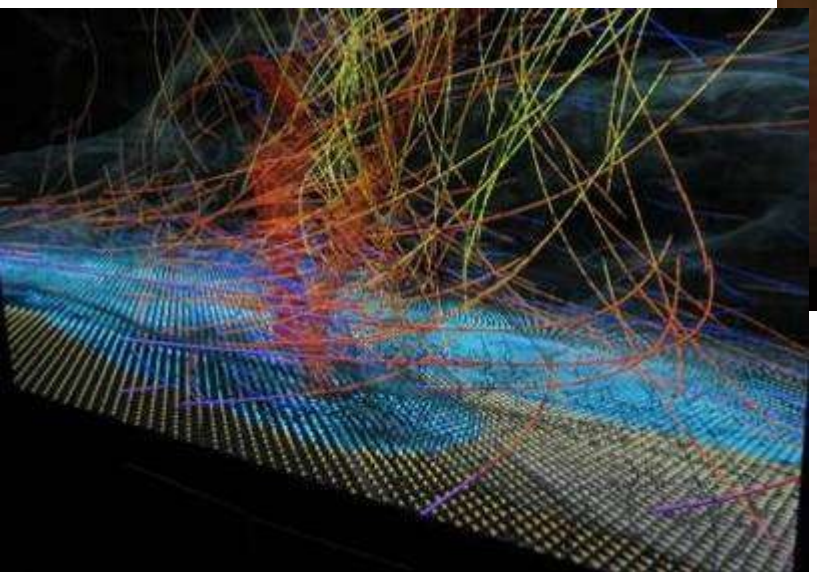
4K Distance Learning





4K Virtual Reality

4K Scientific Visualization





4K Digital Cinema

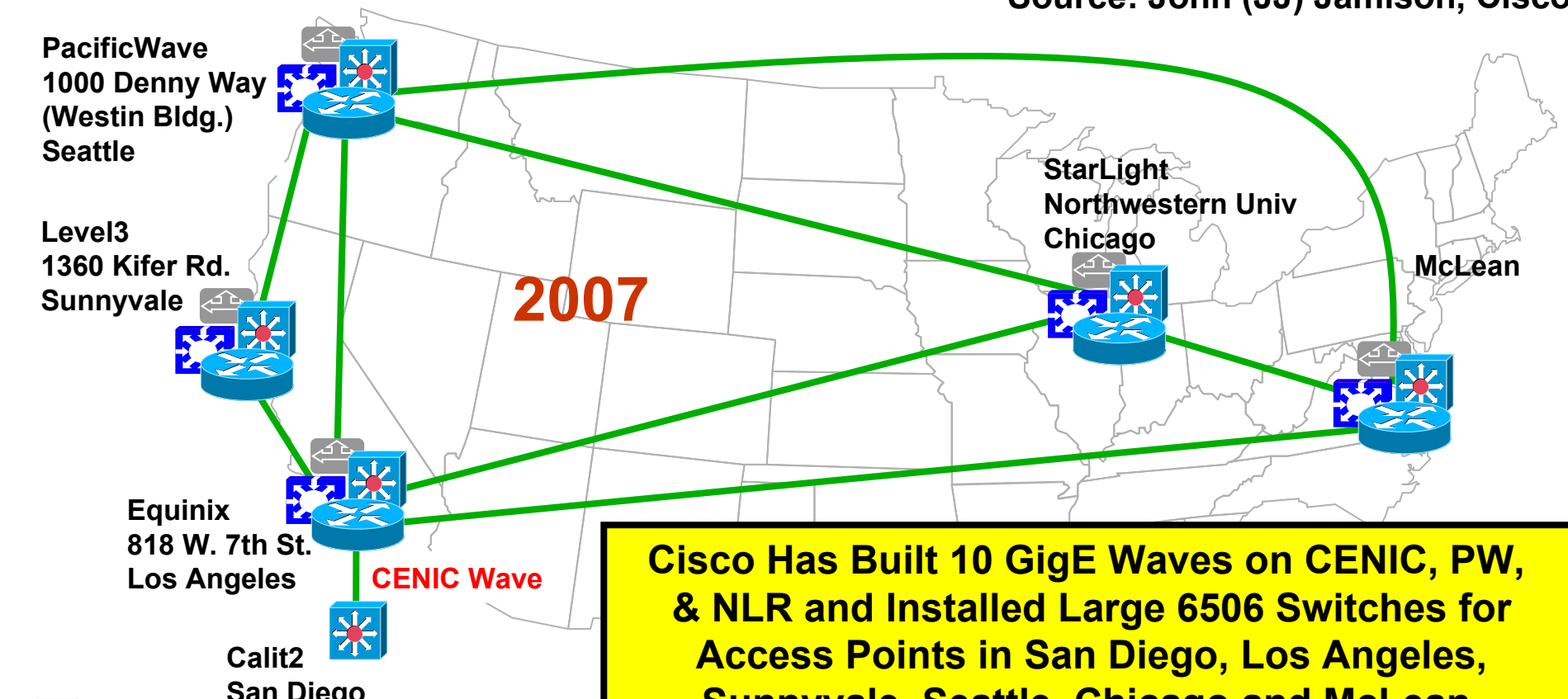
4K *Anime*



Source: Laurin Herr

Cisco CWave for CineGrid: A New Cyberinfrastructure for High Resolution Media Streaming*

Source: John (JJ) Jamison, Cisco



Cisco Has Built 10 GigE Waves on CENIC, PW, & NLR and Installed Large 6506 Switches for Access Points in San Diego, Los Angeles, Sunnyvale, Seattle, Chicago and McLean for CineGrid Members Some of These Points are also GLIF GOLEs

CineGrid Founding Members

- Cisco Systems
- Keio University DMC
- Lucasfilm Ltd.
- NTT Network Innovation Laboratories
- Pacific Interface Inc.
- Ryerson University/Rogers Communications Centre
- San Francisco State University/INGI
- Sony Electronics America
- University of Amsterdam
- University of California San Diego/Calit2/CRCA
- University of Illinois Chicago/EVL
- University of Illinois at Urbana-Champaign/NCSA
- University of Southern California/School of Cinematic Arts
- University of Washington/Research Channel

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The Founding Members of CineGrid are an extraordinary mix of media arts schools, research universities, and scientific laboratories connected by 1GE and 10GE networks used for research & education

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CineGrid Institutional Members

- California Academy of Sciences
- Dark Strand
- JVC America
- Louisiana State University CCT
- Nortel Networks
- Renaissance Computing Institute (RENCI)
- Sharp Labs USA
- Sharp Corporation
- Tohoku University/Kawamata Laboratory
- Waag Society

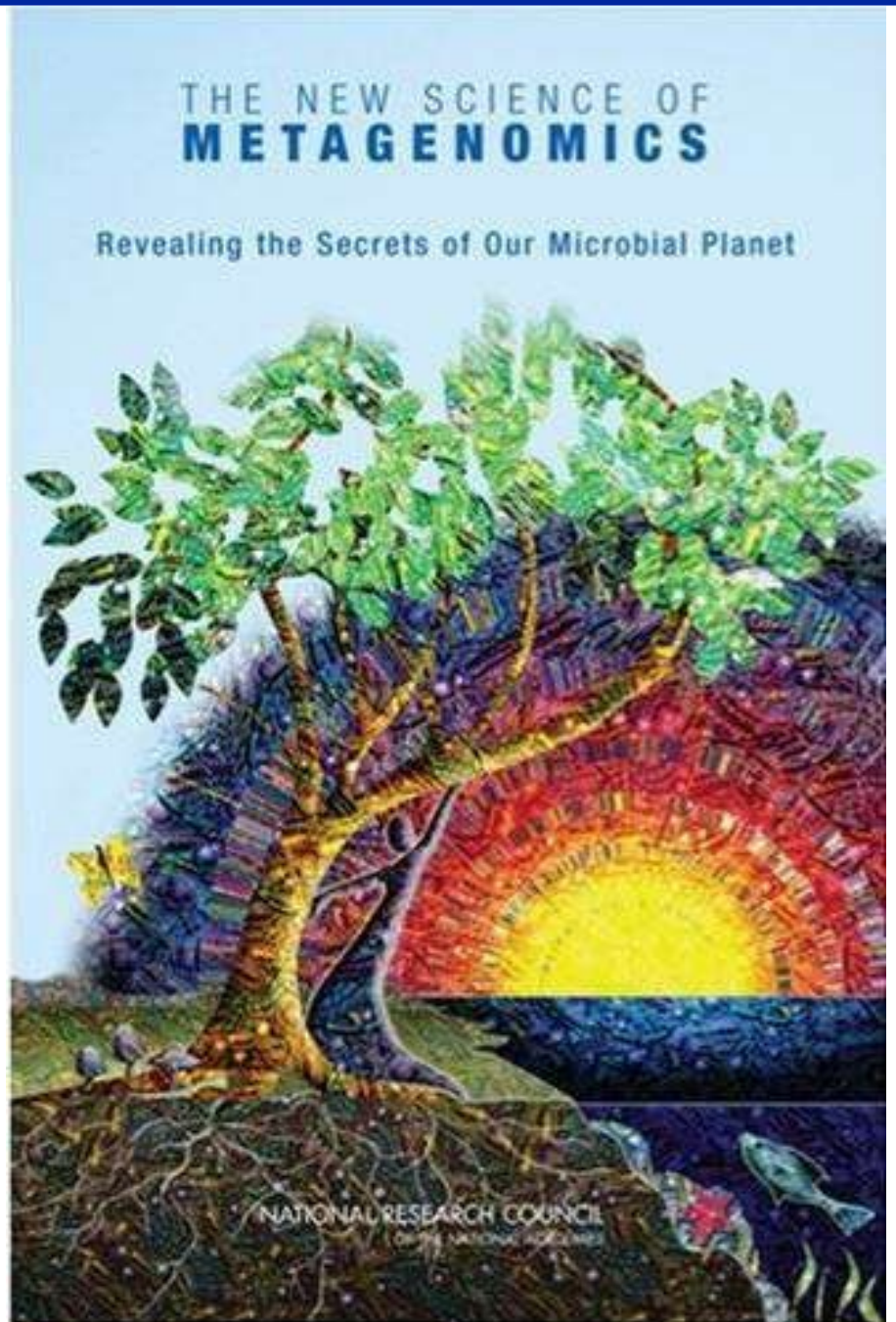
CineGrid members operate their own digital media facilities and cyberinfrastructure for digital cinema and HDTV production, post-production, distribution and exhibition distributed on a global scale, as well as for telepresence, distance learning and scientific visualization.

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The New Science of Metagenomics

NRC Report:

Metagenomic data should be made publicly available in international archives as rapidly as possible.



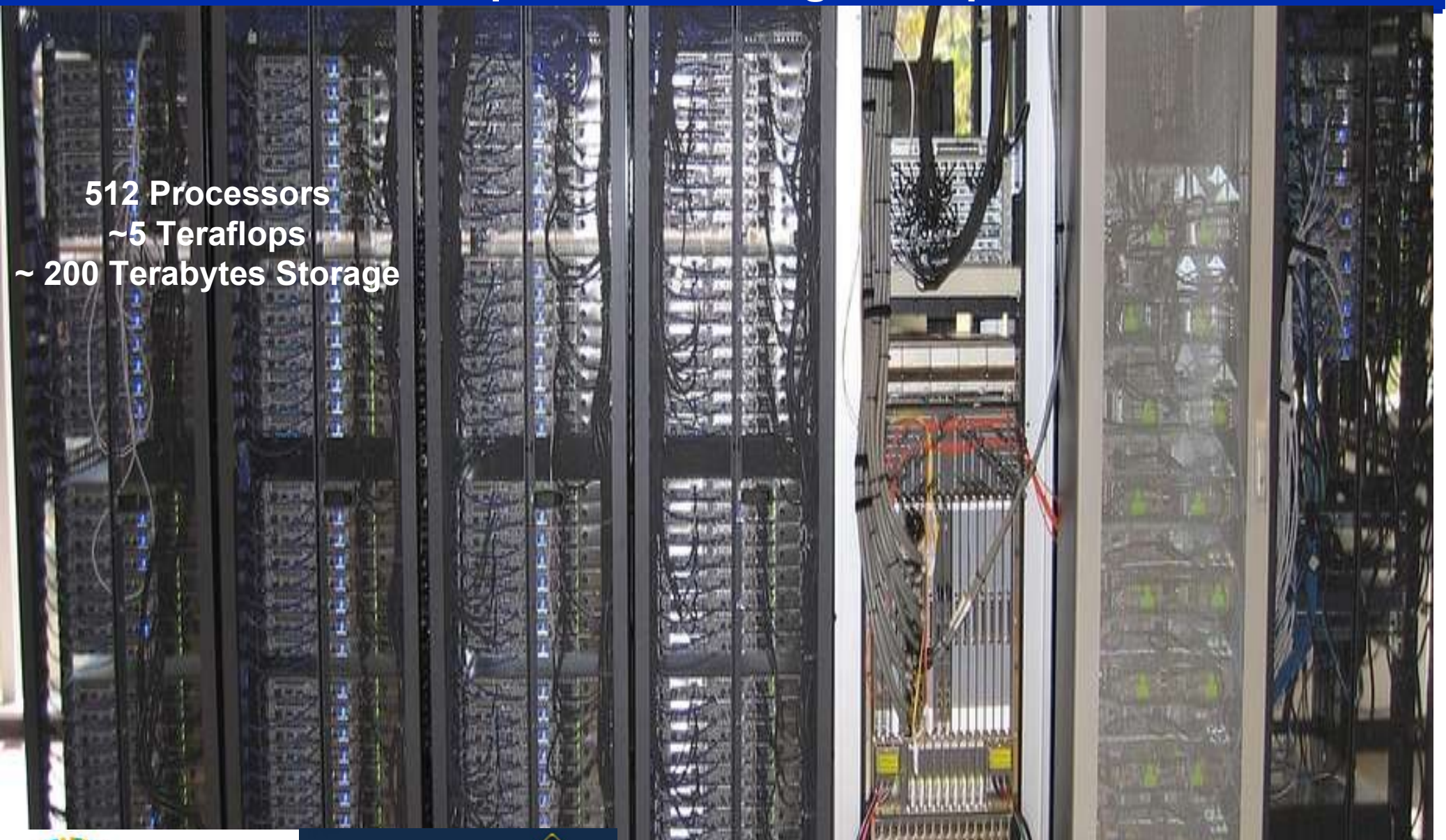
"The emerging field of metagenomics, where the DNA of entire communities of microbes is studied simultaneously, presents the greatest opportunity -- perhaps since the invention of the microscope – to revolutionize understanding of the microbial world." –

National Research Council
March 27, 2007

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Calit2 Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis (CAMERA) Compute and Storage Complex



camera
Marine Microbial Ecology

Powered by Rocks
ROCKS

Source: Phil Papadopoulos, SDSC, Calit2

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“Instant” Global Microbial Metagenomics CyberCommunity

Over 1300 Registered Users From 48 Countries



USA	761
United Kingdom	64
Germany	54
Canada	46
France	44
Brazil	33

camera
Marine Microbial Ecology

J. Craig Venter
INSTITUTE

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Calit2's Direct Access Core Architecture Has Created Next Generation Metagenomics Server

Gordon and Betty MOORE FOUNDATION

Sargasso Sea Data

Sorcerer II Expedition (GOS)

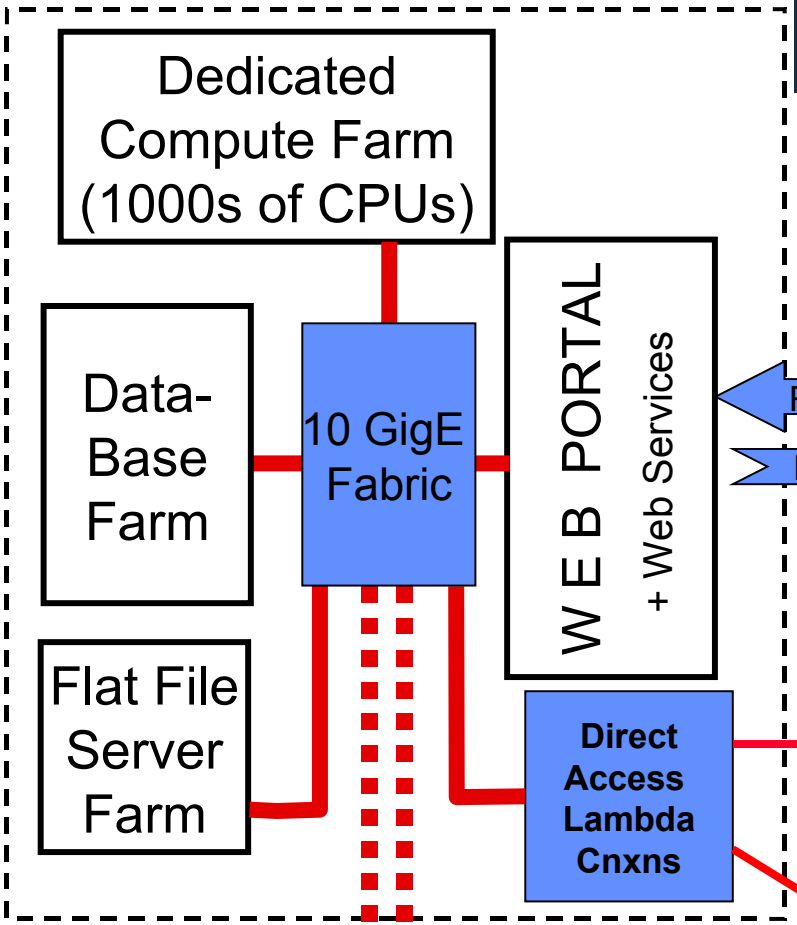
JGI Community Sequencing Project

Moore Marine Microbial Project

NASA and NOAA Satellite Data

Community Microbial Metagenomics Data

Powered by Rocks



Source: Phil Papadopoulos, SDSC, Calit2

CENTER FOR EARTH OBSERVATIONS & APPLICATIONS

SCRIPPS INSTITUTION OF OCEANOGRAPHY

SDSC SAN DIEGO SUPERCOMPUTER CENTER

UCSD UCIrvine

J. Craig Venter INSTITUTE

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New Genome Wall at UWashington
Chromosomes of Marine Diatom Thallasiosira Pseudonanna



Source: Ginger Armbrust, UW

Embedded iHDTV in an OptIPortal Enables Collaboration—Next Step 4k!



Larry Smarr in Reno

Source: Michael Wellings
Research Channel
Univ. Washington

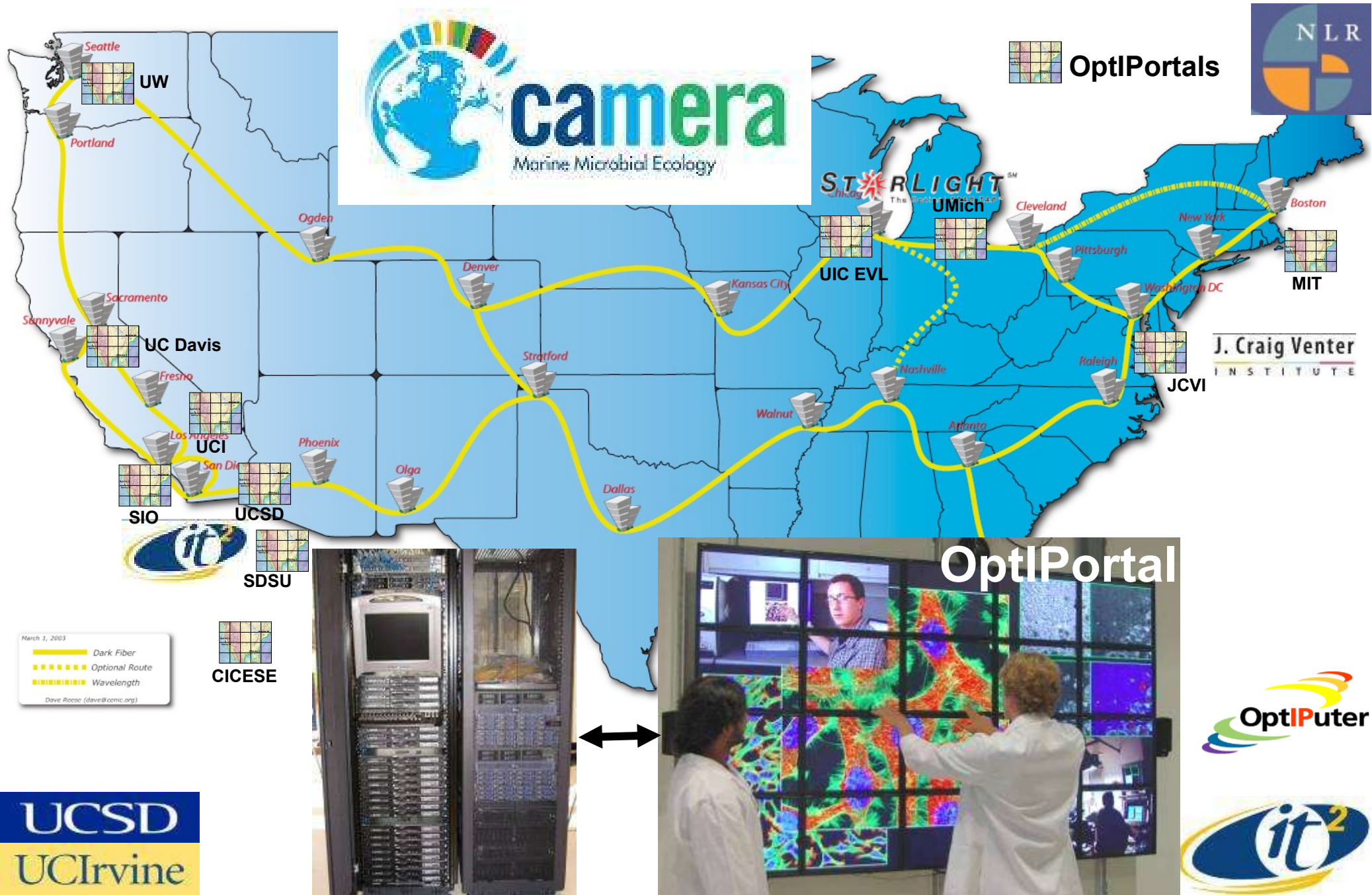
Ginger Armbrust in Seattle

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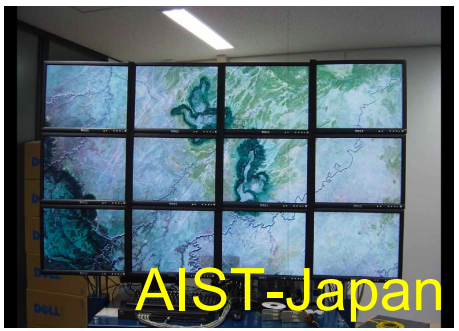


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An Emerging High Performance Collaboratory for Microbial Metagenomics

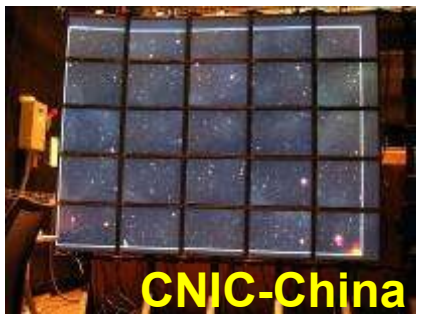


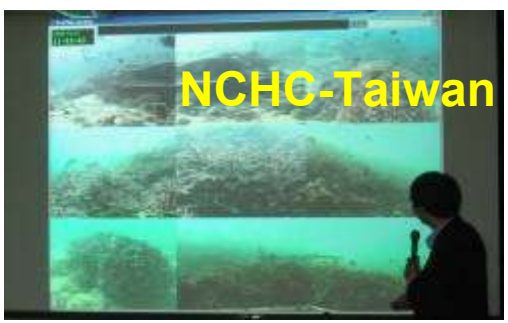
OptIPortals
Are Being Adopted Globally























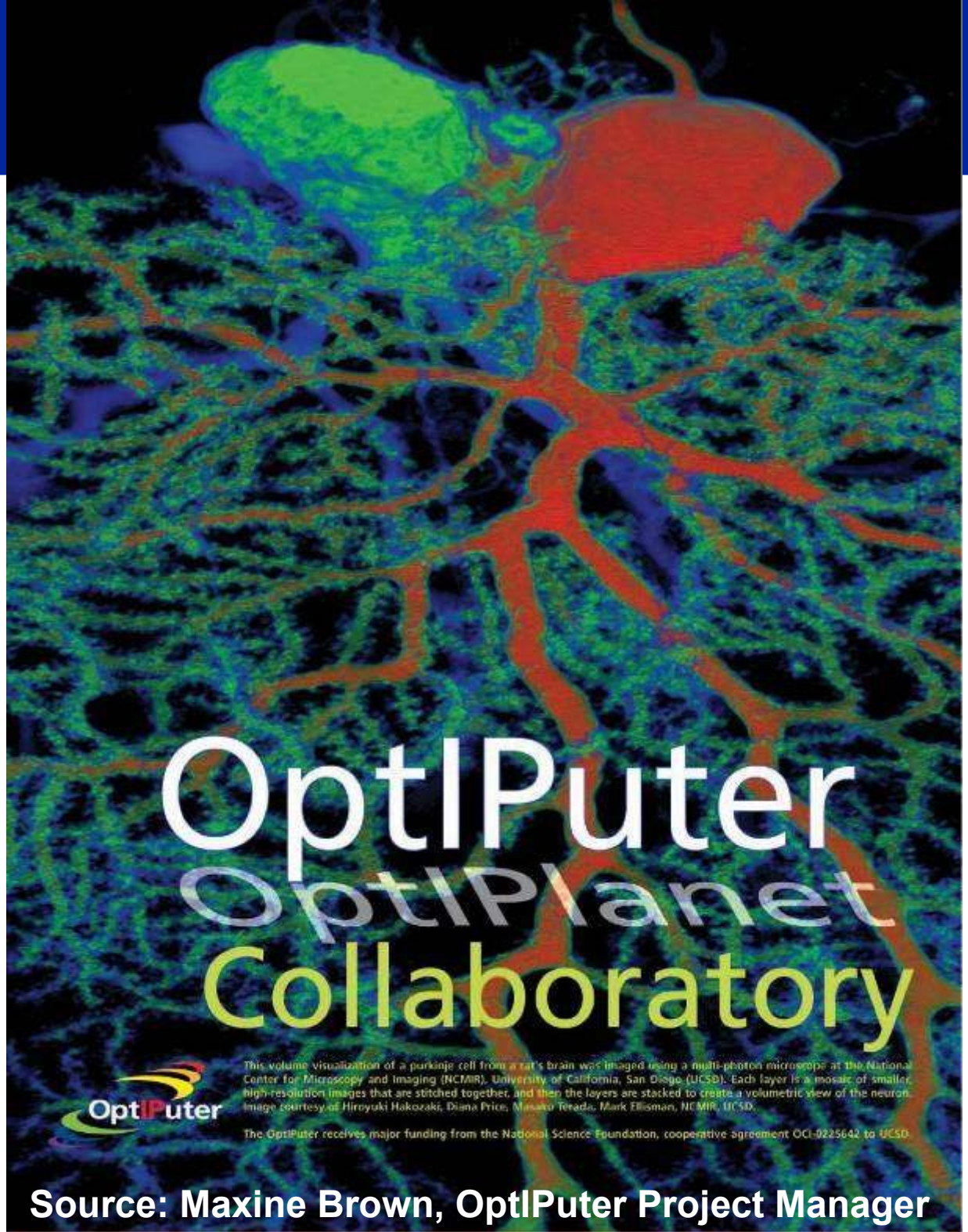


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evl electronic visualization laboratory

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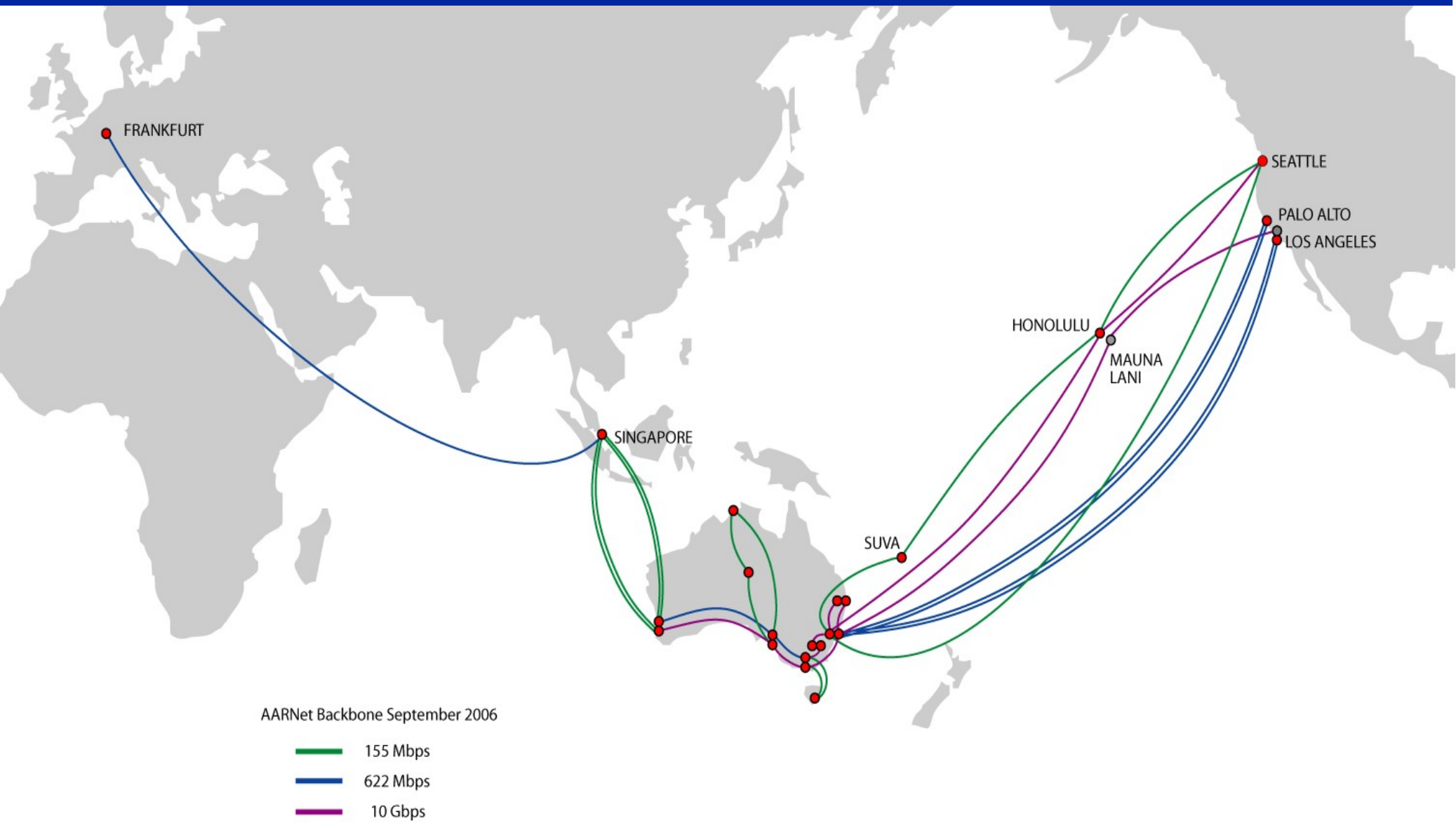
Source: Maxine Brown, OptIPuter Project Manager

Green Initiative:

Can Optical Fiber Replace Airline Travel for Continuing Collaborations ?

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AARNet International Network



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Launch of the 100 Megapixel OzIPortal Over Qvidium Compressed HD on 1 Gbps CENIC/PW/AARNet Fiber



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www.calit2.net/newsroom/release.php?id=1219

“Using the Link to Build the Link”
Calit2 and Univ. Melbourne Technology Teams

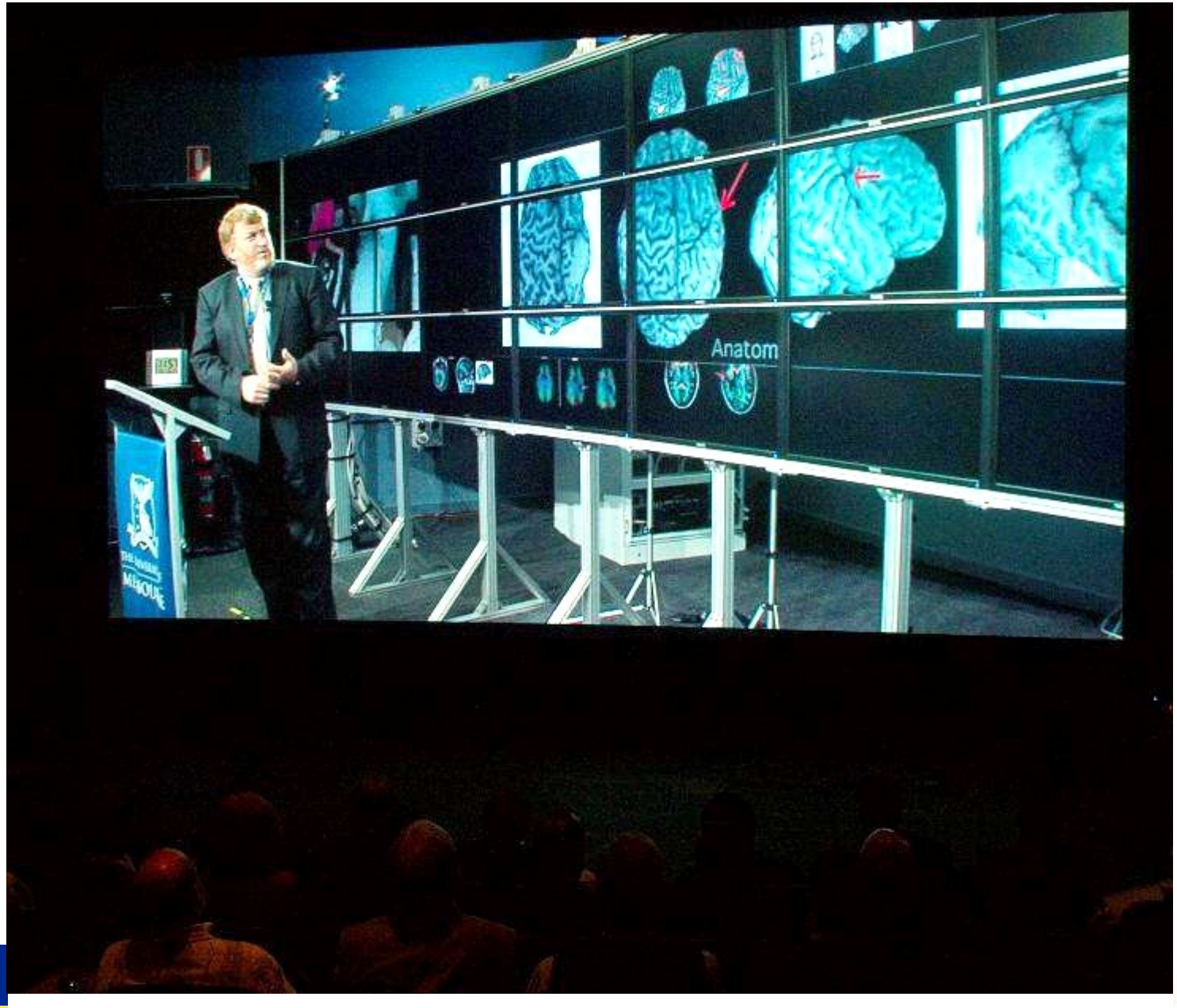


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No Calit2 Person Physically Flew to Australia to Bring This Up!

www.calit2.net/newsroom/release.php?id=1219

UM Professor Graeme Jackson Planning Brain Surgery for Severe Epilepsy



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www.calit2.net/newsroom/release.php?id=1219

Victoria Premier and Australian Deputy Prime Minister Asking Questions



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www.calit2.net/newsroom/release.php?id=1219

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University of Melbourne Vice Chancellor Glyn Davis in Calit2 Replies to Question from Australia



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Calit2, SDSC, and SIO are Creating Environmental Observatory Rooms



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Remote Interactive High Definition Video of Deep Sea Hydrothermal Vents



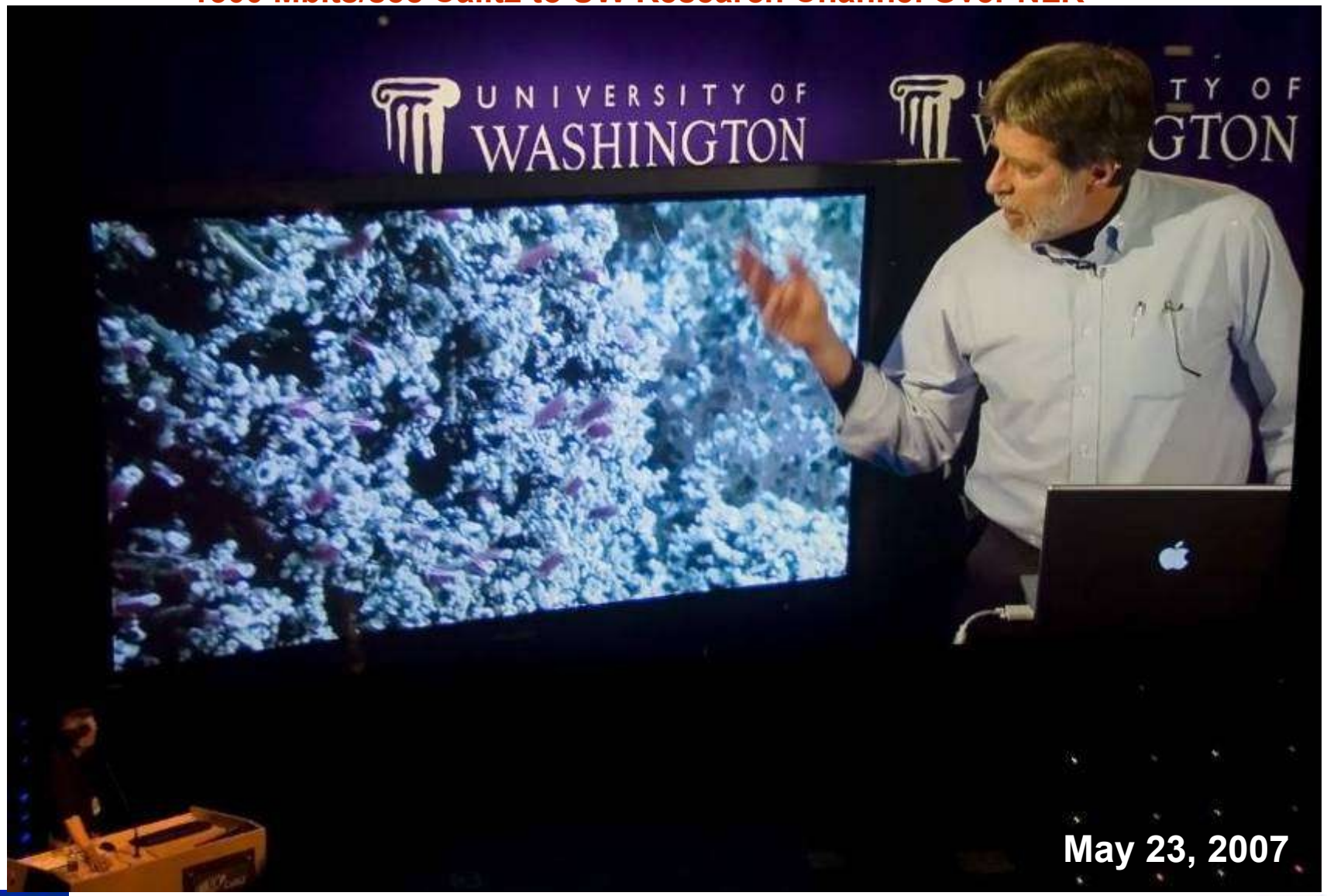
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Source John Delaney & Deborah Kelley, UWash

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e-Science Collaboratory Without Walls Enabled by iHDTV Uncompressed HD Telepresence

1500 Mbits/sec Calit2 to UW Research Channel Over NLR



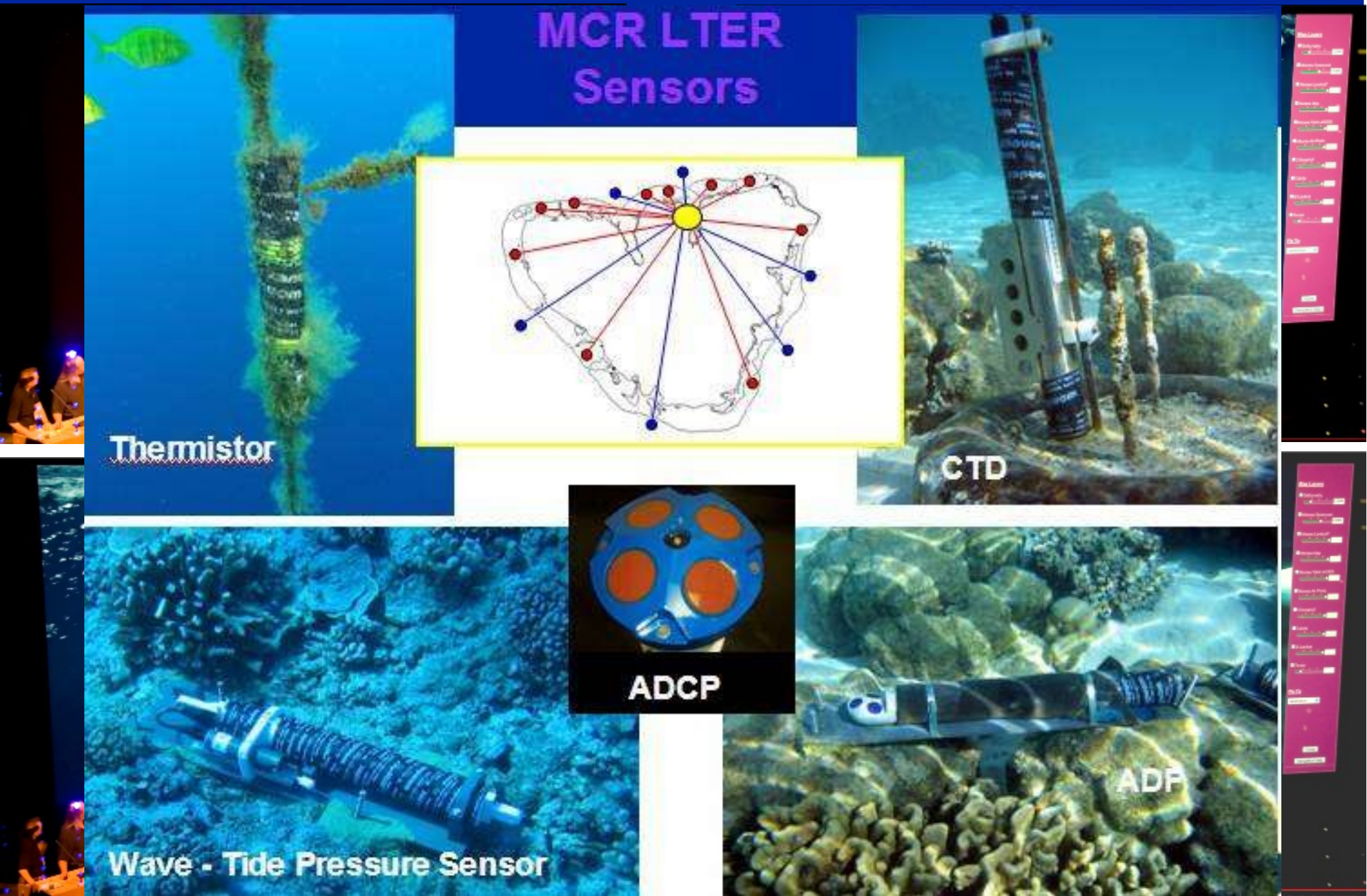
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John Delaney, PI LOOKING, Neptune

Photo: Harry Ammons, SDSC

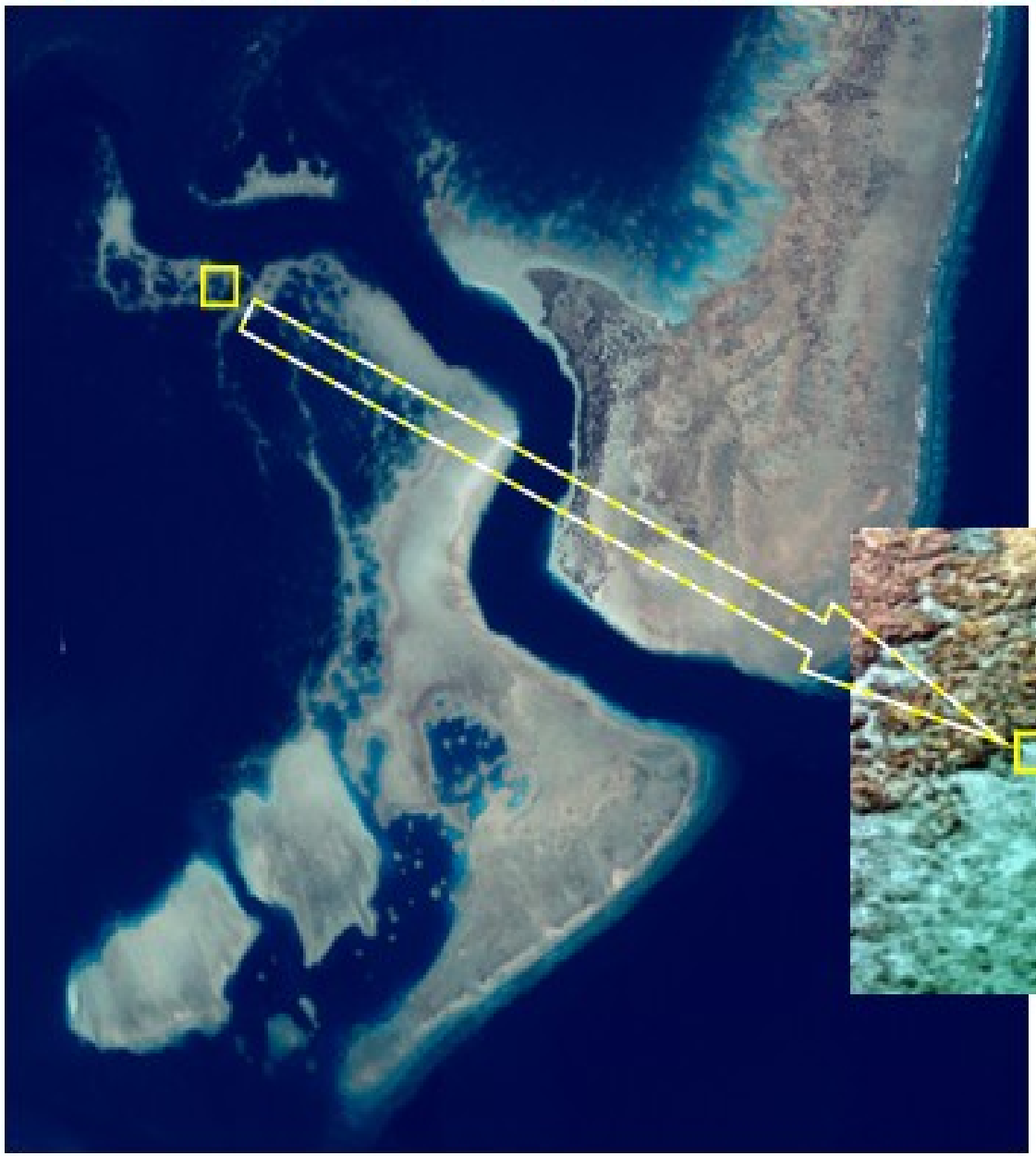
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Creating a Digital Moorea
Calit2 Collaboration with UC Gump Station (UCB, UCSB)

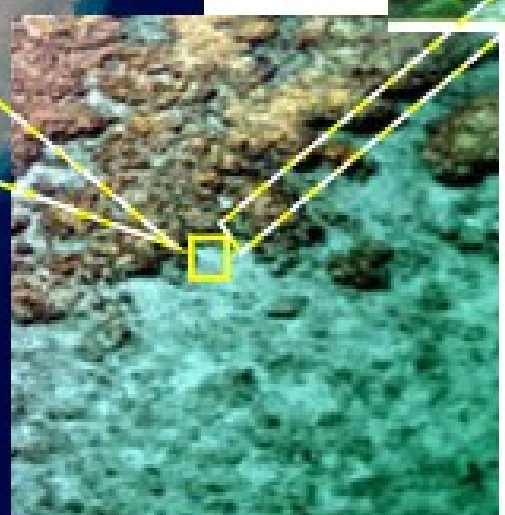


Calit2 ReefBot Design for Digital Reef Mapping

Explore Every Square Meter of the Moorea Coral Reef from a Remote Desktop



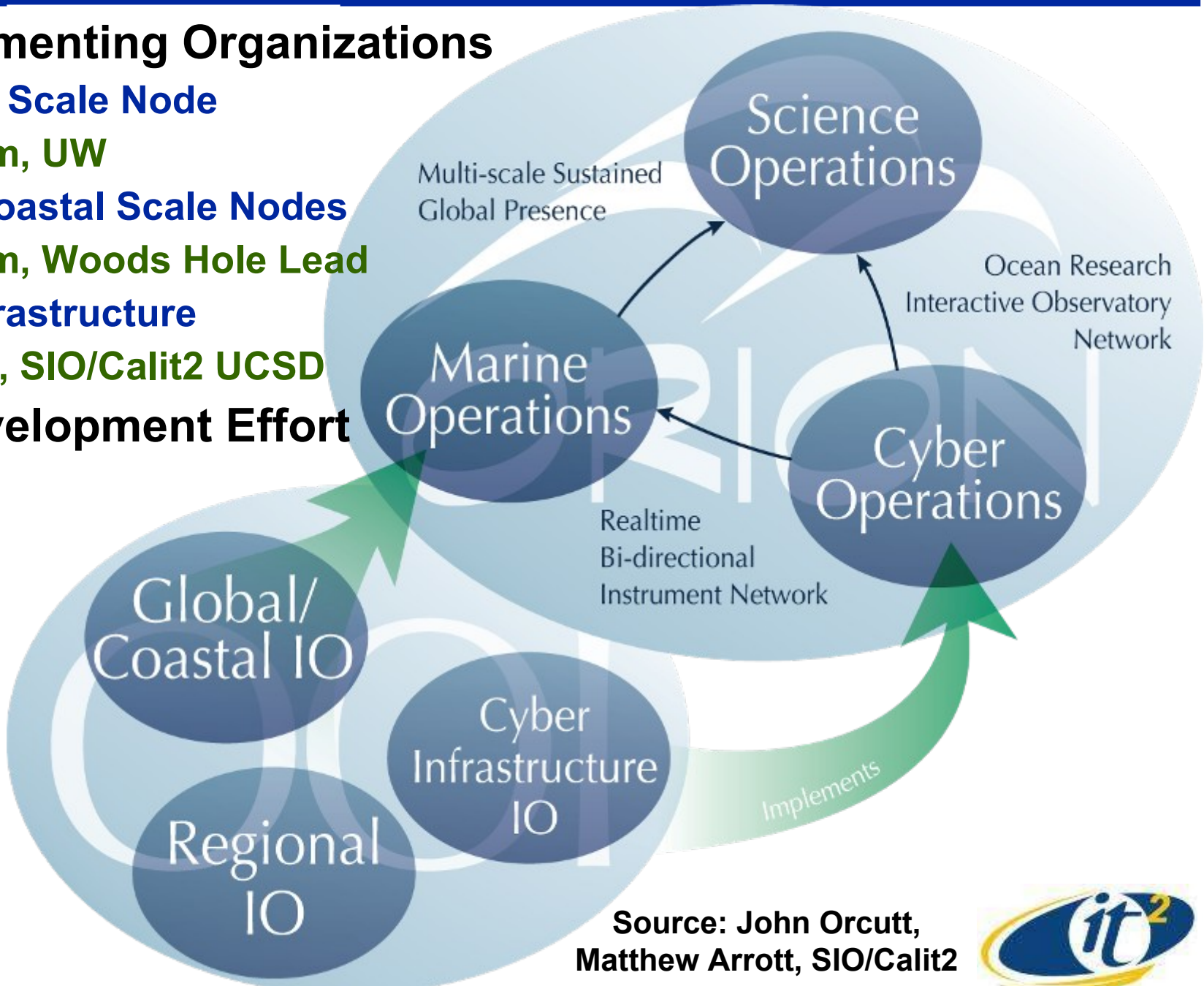




Use The Reef GIS
to Zoom Into
Any Portion
of the Shallow Reef
to View Details Down
to ~ Centimeter

Ocean Observatory Initiative -- Initial Stages

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



Source: John Orcutt, Matthew Arrott, SIO/Calit2

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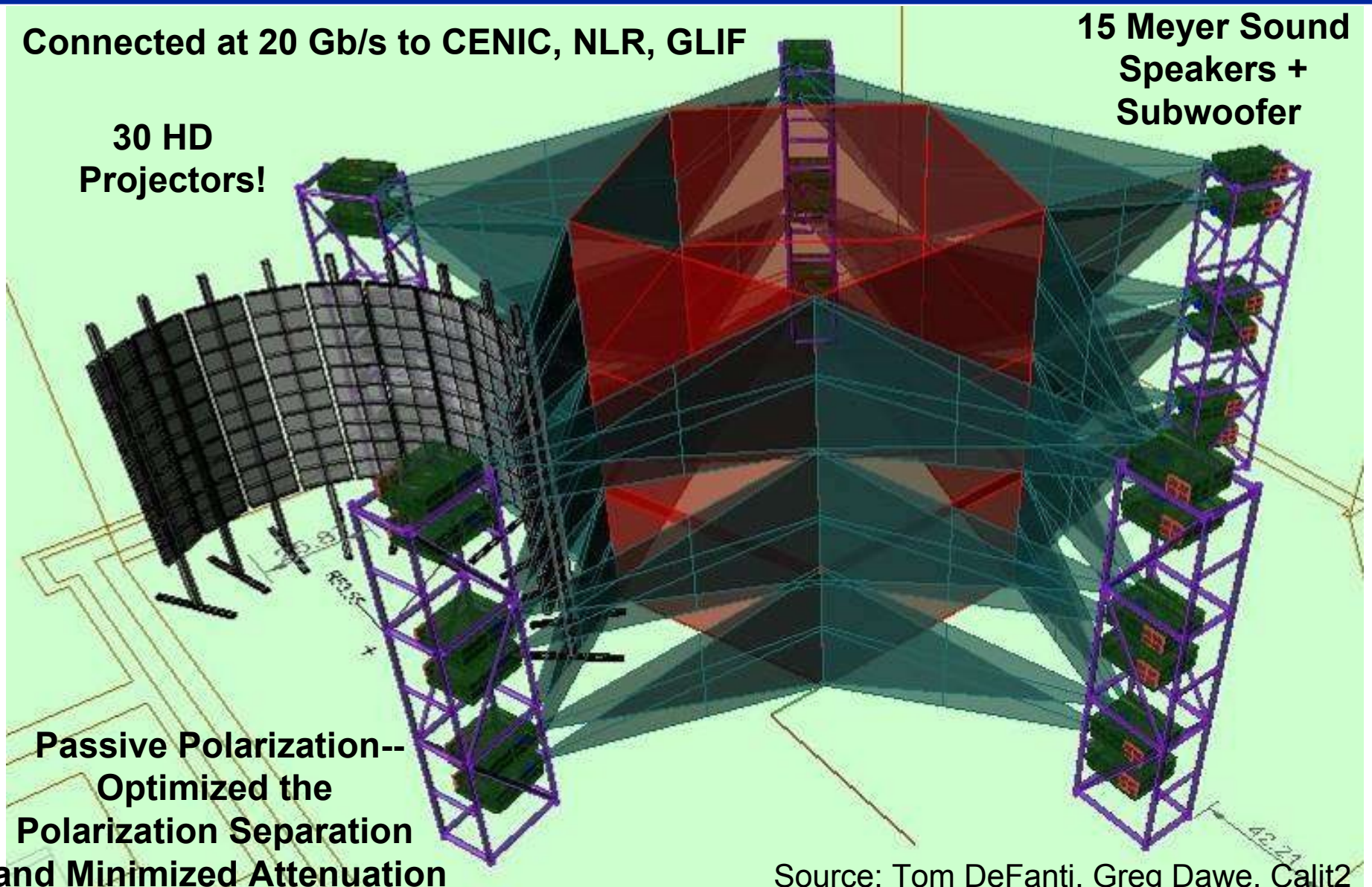
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Beyond the OptIPortal: LambdaTable, StarCAVE, and Varrier



electronic visualization laboratory

3D OptIPortals: Calit2 StarCAVE and Varrier Alpha Tests of Telepresence "Holodecks"



Source: Tom DeFanti, Greg Dawe, Calit2

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Cluster with 30 Nvidia 5600 cards-60 GB Texture Memory

StarCAVE Panoramas

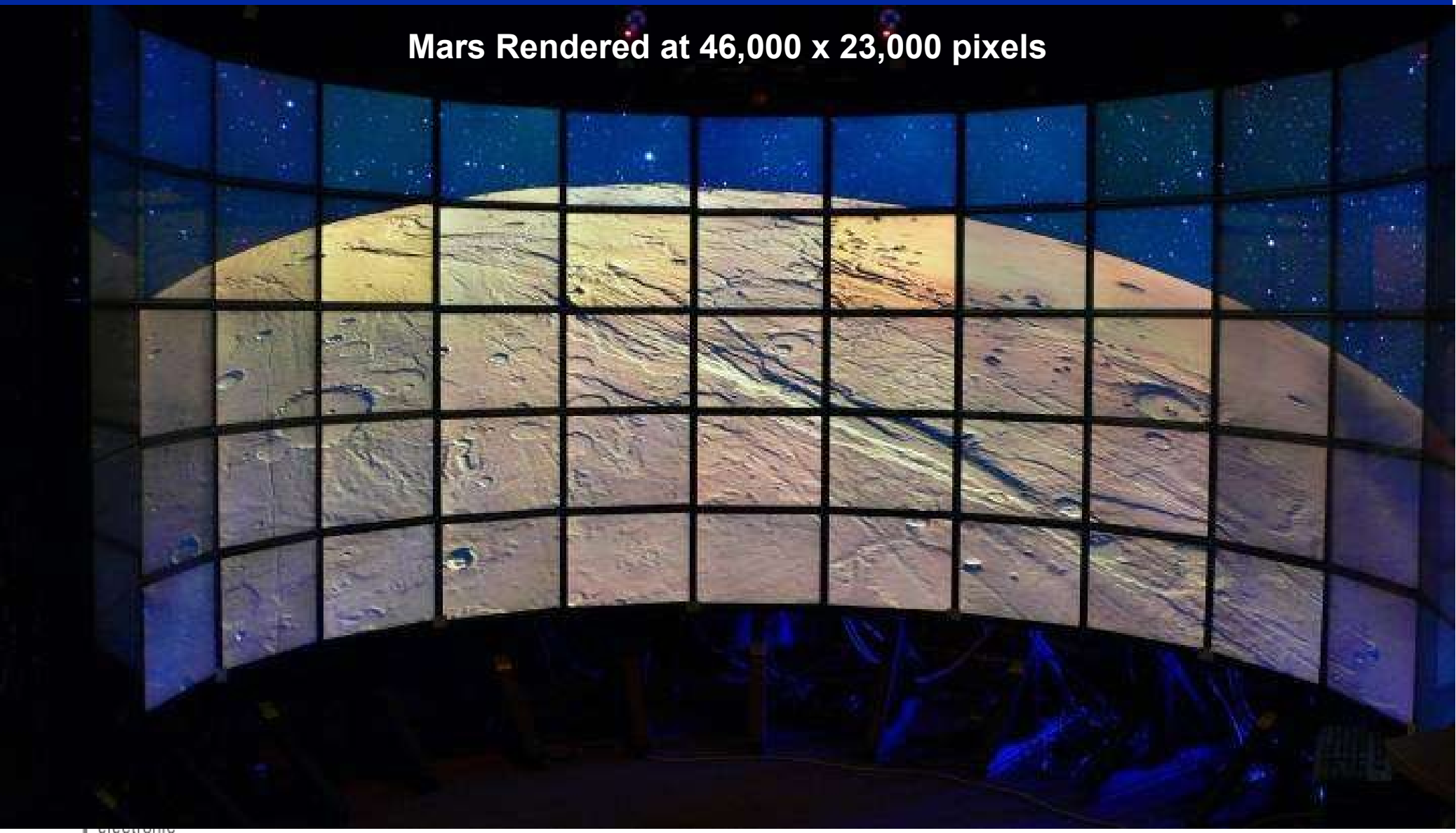








Calit2/EVL Varrier -- 60 Screen Stereo OptIPortal, no Glasses Needed



evl electronic visualization laboratory
UCIrvine

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

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