Wildfires, Hydrology, and Microbes: Possible Areas for Collaboration with Calit2

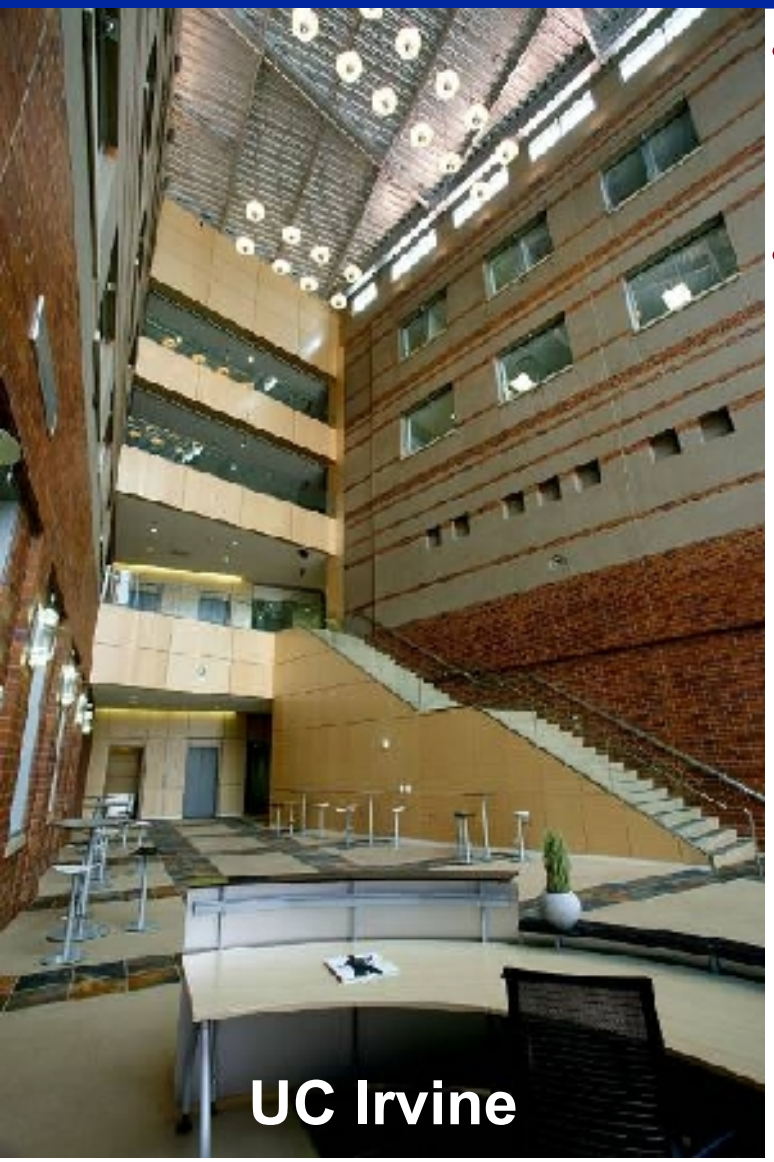
Invited Speaker
Desert Research Institute
Reno, Nevada
November 16, 2007

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

UCSD
UCIrvine

it²

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…

UCSD
UCIrvine

ROADnet and HiSeasNet are Prototypes of the Future of *In Situ* Earth Observing Systems

BRINGING THE INFORMATION SUPERHIGHWAY TO THE DIRT ROAD AND THE HIGH SEAS

http://roadnet.ucsd.edu

Real-time Observatories, Applications, and Data management Network ROADNet



Office of Naval Research

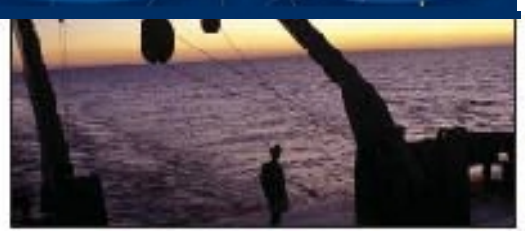
NSF

SDSU

SDSC
SAN DIEGO SUPERCOMPUTER CENTER

IGPP







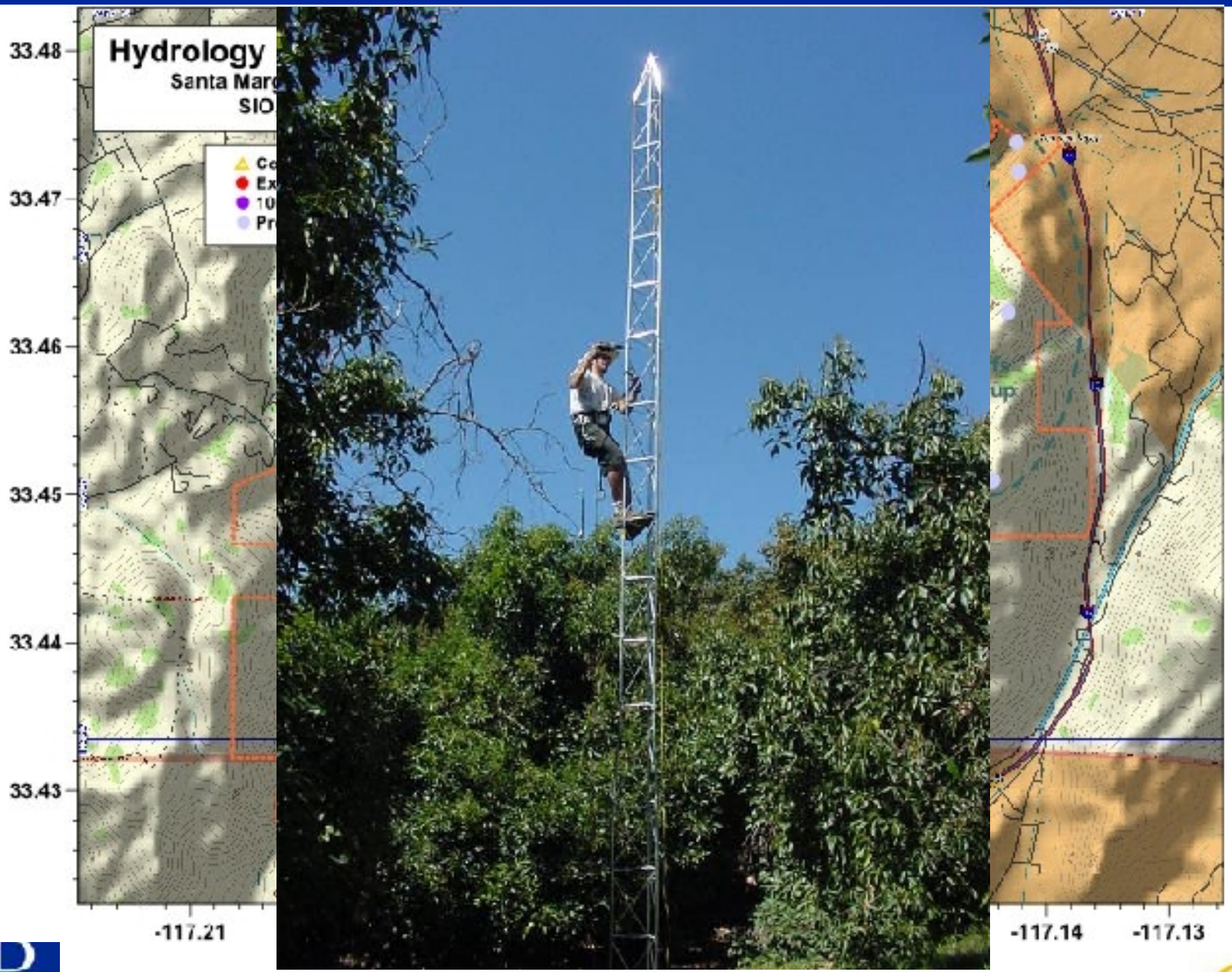


HiSeasNet

The Real-time Observatories, Applications and Data management Network is an interdisciplinary collaboration funded by the National Science Foundation and the Office of Naval Research. Participating institutions include Scripps Institution of Oceanography and the San Diego Supercomputer Center at the University of California, San Diego.

PROVIDING COMMUNICATIONS AND NETWORKING FOR THE ORION FLEET OF MOORED OCEAN OBSERVATORIES

Environmental SensorNets--Water and Climate Instruments in the Santa Margarita Ecological Reserve



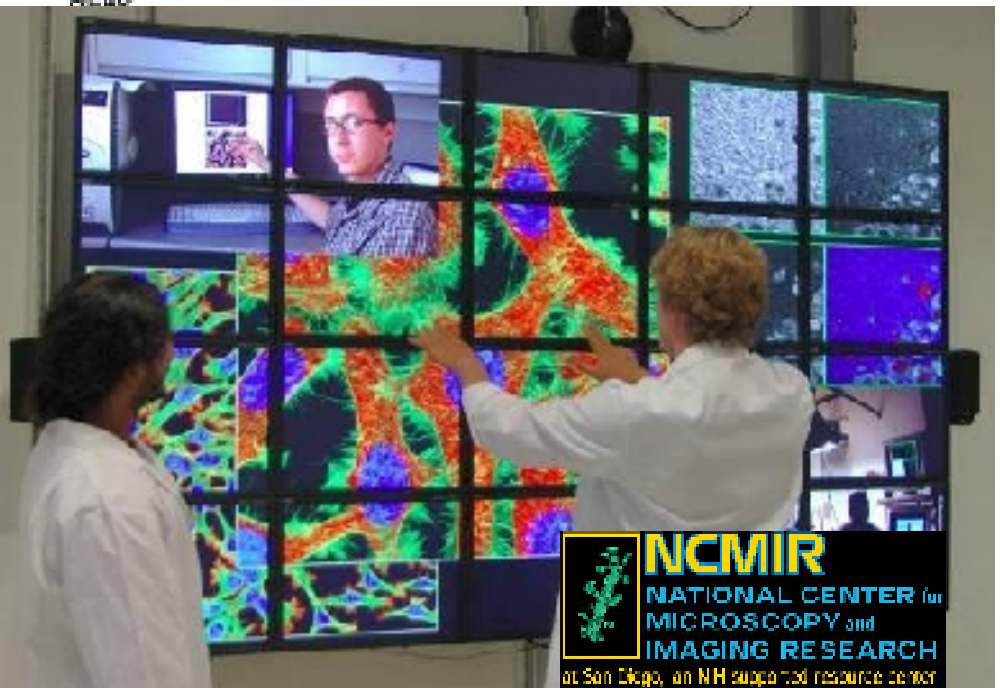
Source, Dan Cayan, UCSD SIO

UCSD
UCIrvine

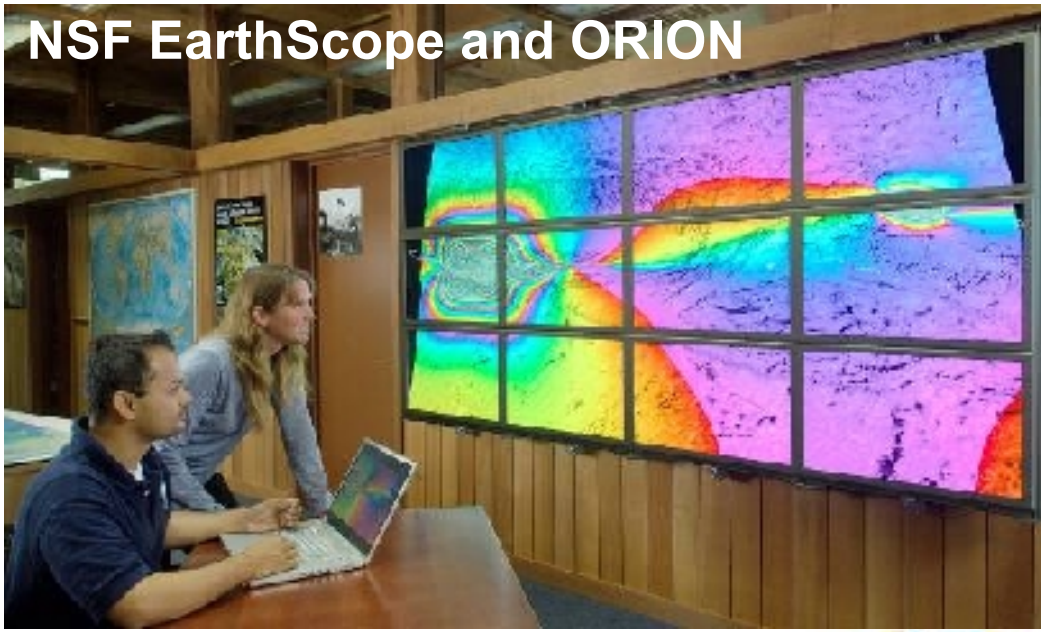
The OptIPuter Project – Creating High Resolution Portals Over Dedicated Optical Channels to Global Science Data

- 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 Six and Final Yea..

NIH Biomedical Informatics Research Network



NSF EarthScope and ORION



SCRIPPS INSTITUTION OF OCEANOGRAPHY

Using Advanced Info Tech and Telecommunications to Accelerate Response to Wildfires



Early on October 23, 2007, Harris Fire San Diego

UCSD
UCIrvine

Photo by Bill Clayton, http://map.sdsu.edu/

it²

Calit2 Added Live Feeds From HPWREN Cameras to KPBS Google Map



www.calit2.net/newsroom/release.php?id=1194

HPWREN Time Lapse Photography of October 2007 San Diego Harris Fire From Lyons Peak

OCTOBER 24, 2007

Lyons Peak Webcam Overrun By Fire



Time Lapse Photography: October 2007 Firestorm in San Diego

This movie shows footage from the four High Performance Wireless Research & Education Network (HWPWREN) cameras on Lyons Peak on Oct 24, 2007, from midnight to noon. The four different frames, from left to right, represent cameras from the north, east, south, and west, respectively. These data were provided by HPWREN, which is an interdisciplinary and multi-institutional UC San Diego research and education program, led by Principal Investigator Hans-Werner Braun at the San Diego Supercomputer Center.

HPWREN is funded by the National Science Foundation: Grant Numbers 0087344 and 0426879.



Four HWPWREN Cameras on Oct 24, 2007,
from Midnight to Noon.
The Four Different Frames, from Left to Right,
Represent Cameras from the North, East, South, and West,
Respectively. These Data were Provided by HPWREN,
Led by Principal Investigator Hans-Werner Braun at SDSC
Movie Created by Kerry Key and Frank Vernon, SIO

UCSD
UCIrvine

NASA's Aqua Satellite's MODIS Instrument Provided "Situational Awareness" of the 14 SoCal Fires

Calit2, SDSU, and NASA Goddard Used NASA Prioritization and OptIPuter Links to Cut time to Receive Images from 24 to 3 Hours



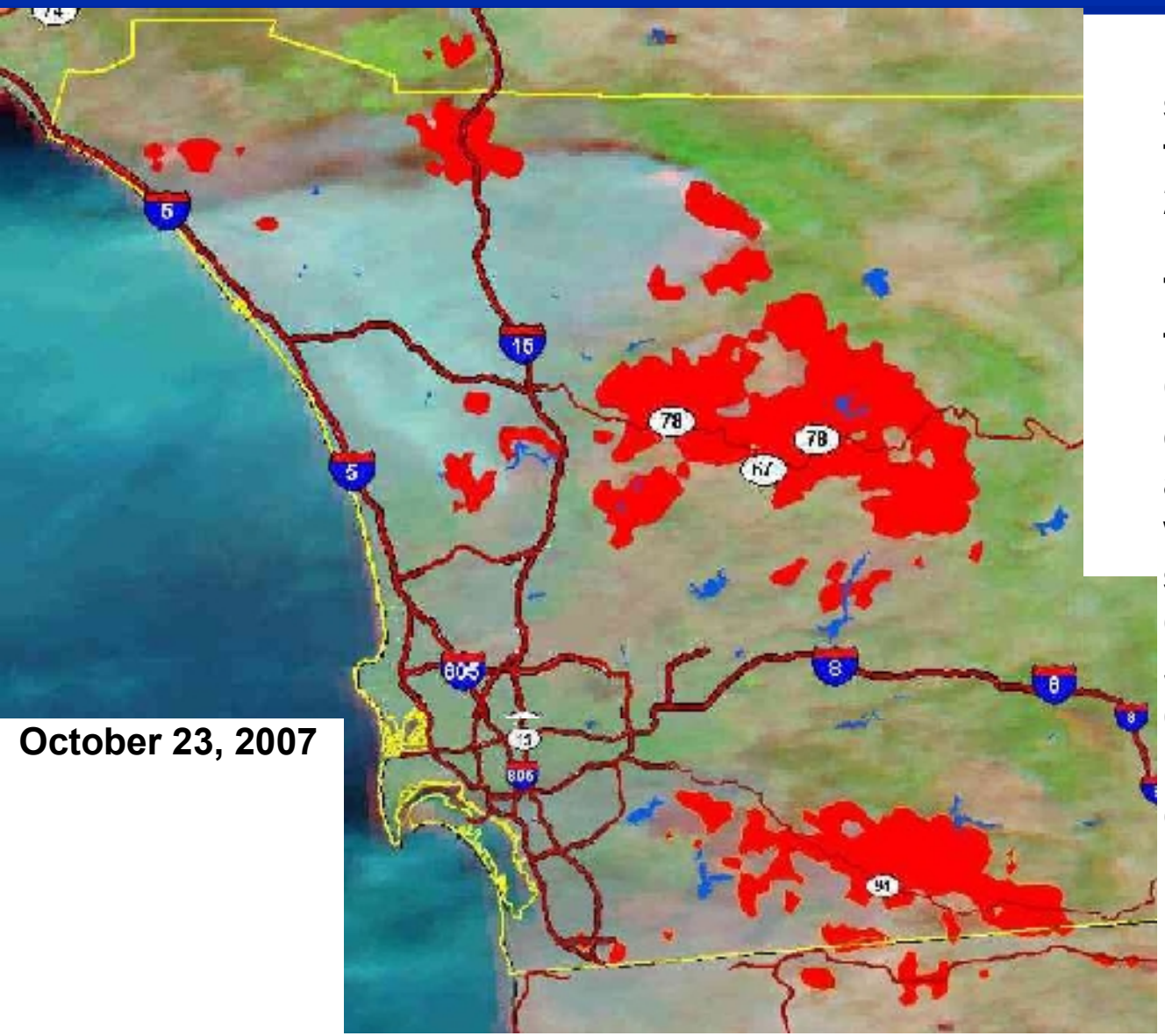
Moderate Resolution Imaging Spectroradiometer (MODIS)

UCSD
UCIrvine

NASA/MODIS Rapid Response
www.nasa.gov/vision/earth/lookingatearth/socal_wildfires_oct07.html

it²

SDSU's San Diego GIS Force Group of Volunteers Geo-Referenced MODIS Data and Distributed Over Web



October 23, 2007

"We apologize for the slow server performance in the first two days of the wildfires (Oct. 21 & 22) due to overloaded requests from Web users. Tuesday we were given access to major Intel computers at Calit2 at UCSD and special connectivity between SDSU and UCSD (OptIPuter) from which this page is now being served (special thanks to John Graham, Eric Frost, Larry Smarr, John DeNune, and Cristiano). It is super fast now."
-- SDSU Department of Geography, Oct. 25, 11:00am.

UCSD
UCIrvine

Site organized by Dr. Ming-Hsiang Tsou, SDSU

http://map.sdsu.edu/

it2

MODIS Images Provide Targeting Information to NASA's EO-1 Satellite Which Cuts Through Smoke

Composite of the Red, Blue, and Green Channels



Three of the Shortwave Infrared Channels



October 23, 2007 Witch Wildfire south of Escondido, California

EO-1's Hyperion Spectrometer Observes 220 Contiguous Wavelengths From Visible Light To Shortwave Infrared

UCSD
UCIrvine

NASA/EO-1 Team

www.nasa.gov/vision/earth/lookingatearth/socal_wildfires_oct07.html

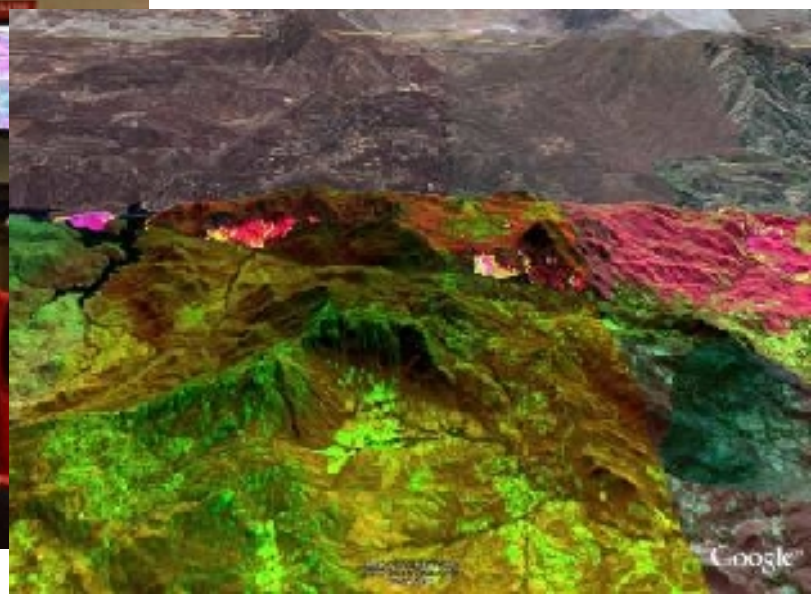
it²

Unmanned Aircraft Provided Near Real-Time SoCal Fire Images October 2007

www.nasa.gov/centers/dryden/news/Features/2007/wildfire_socal_10_07.html



Flight Plan and Ikhana Data Displayed in San Diego Emergency Operations Center's Situation Room



Pilot Flies Predator B from NASA Dryden in Edwards AF Base

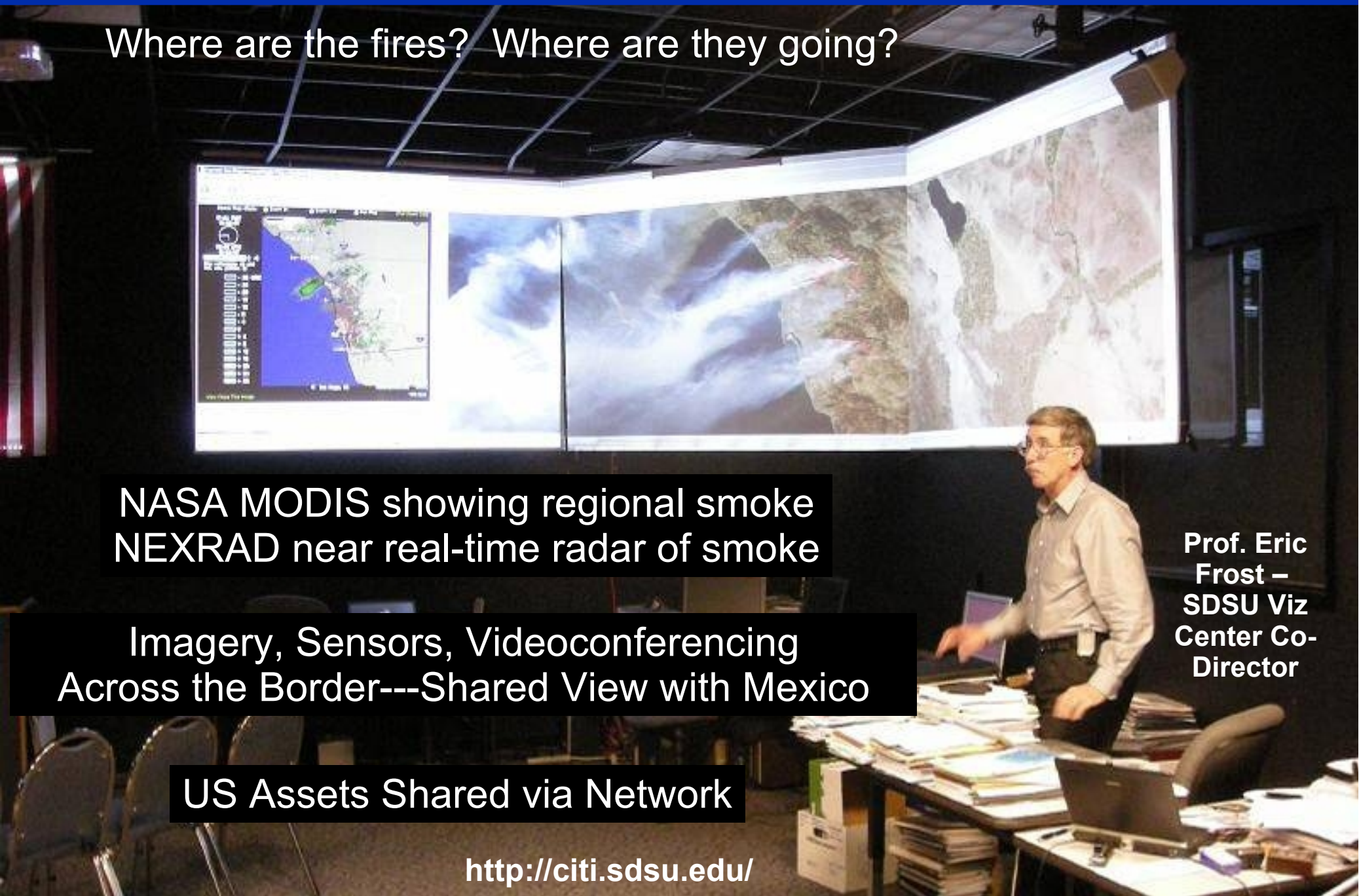




NASA Ikhana Carrying Autonomous Modular Scanner on 8 Hour Flight, Coordinated with the FAA, Downlinks to NASA Ames

NASA Ames Overlaid Thermal-Infrared Images on Google Earth Maps, Transmitted in Near-Real Time to the Interagency Fire Center in Boise, Idaho

Prototyping Future Knowledge Integration Center for Emergency Response



FIRESNet: Fire Informatics and Realtime Environmental Sensor Network

- **Wireless System**
  - Local (30 Mb/s)
  - Back to UC Riverside
  - Over CENIC to others
- **Sensors Include:**
  - High-Res Cameras
    - All Visible
    - Some IR
  - Met-Stations
  - Particulate Sensors
  - Seismometers



Angora Ridge fire
June 25, 2007







Proposal Under review:
UCSD, VCR, UCD

Source:
Graham Kent, SIO, UCSD

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





UCSD UCIrvine

Powered by Rocks ROCKS

Source: Phil Papadopoulos SDSC, Calit2

it²

Calit2, SDSC, and SIO are Creating Environmental Observatory Rooms



UCSD
UCIrvine

The CoreWall Project

- The CoreWall Project develops tools for collaborative real-time core description, stratigraphic correlation, and data visualization to be used by the marine, terrestrial and Antarctic science communities.
- Main Institutions: U. Minnesota (LacCore- Laccustrine Core Repository), U. Illinois Chicago (EVL), Columbia U. (LDEO- Lamont-Doherty Earth Observatory), U. Colorado (INSTAAR- Institute of Artic and Alpine Research)
- Partners: Integrated Ocean Drilling Program, Antarctic Drilling Program (ANDRILL), CHRONOS
- NSF OCE 0602117
- www.corewall.org







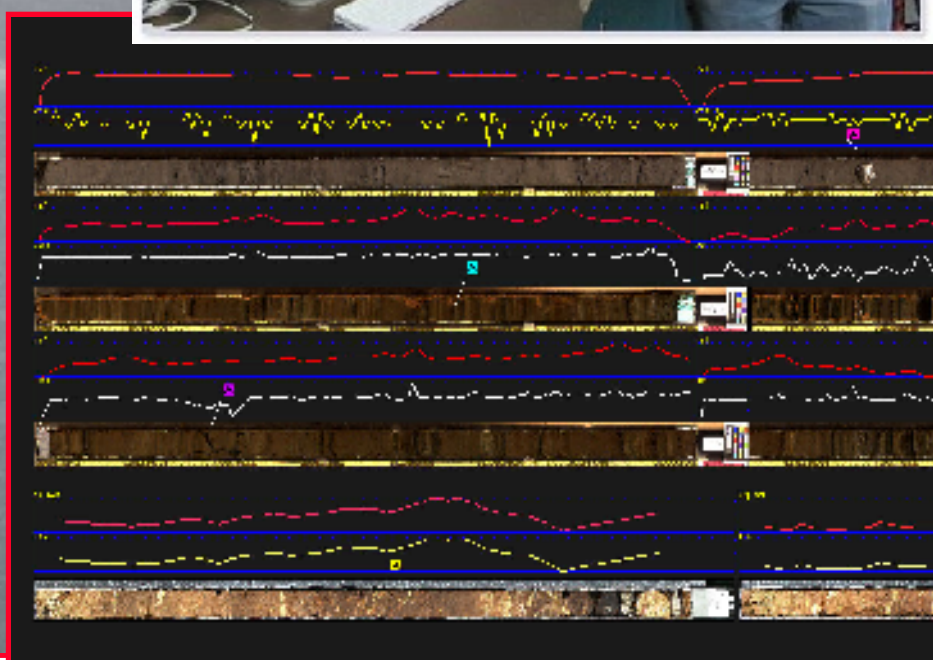
UCSD
UCIrvine

it²

Fall 2006
CoreWall Deployed at McMurdo Station, Antarctica







UCSD
UCIrvine

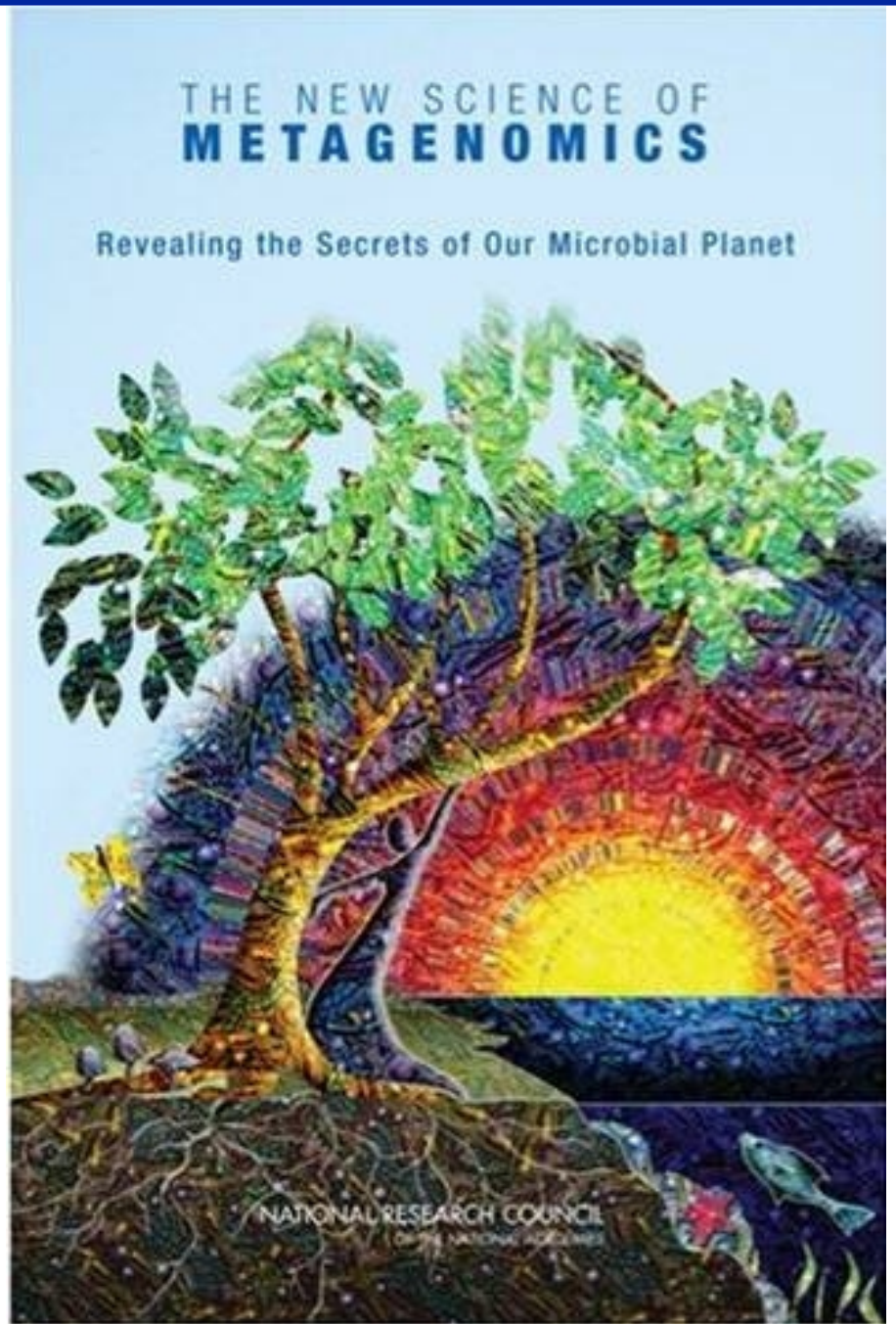
www.apple.com/science/profiles/andrill/

it²

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

UCSD
UCIrvine

it²

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



MARINE MICROBIOLOGY INITIATIVE

Gordon and Betty MOORE FOUNDATION

Sorcerer II Data Will Double Number of Proteins in GenBank!

UCSD
UCIrvine

J. Craig Venter INSTITUTE

it²

Enormous Increase in Scale of Known Genes Over Last Decade

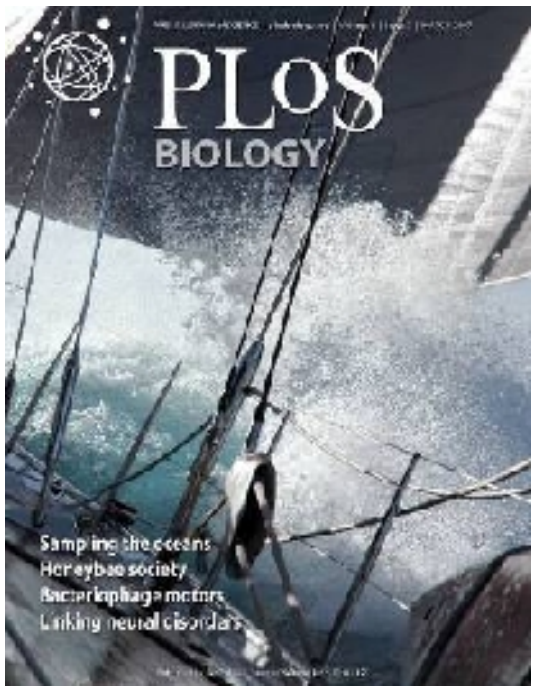
1995
First Microbe Genome



1.8 Million Bases
1749 Genes

J. Craig Venter
INSTITUTE

2007
Ocean Microbial Metagenomics



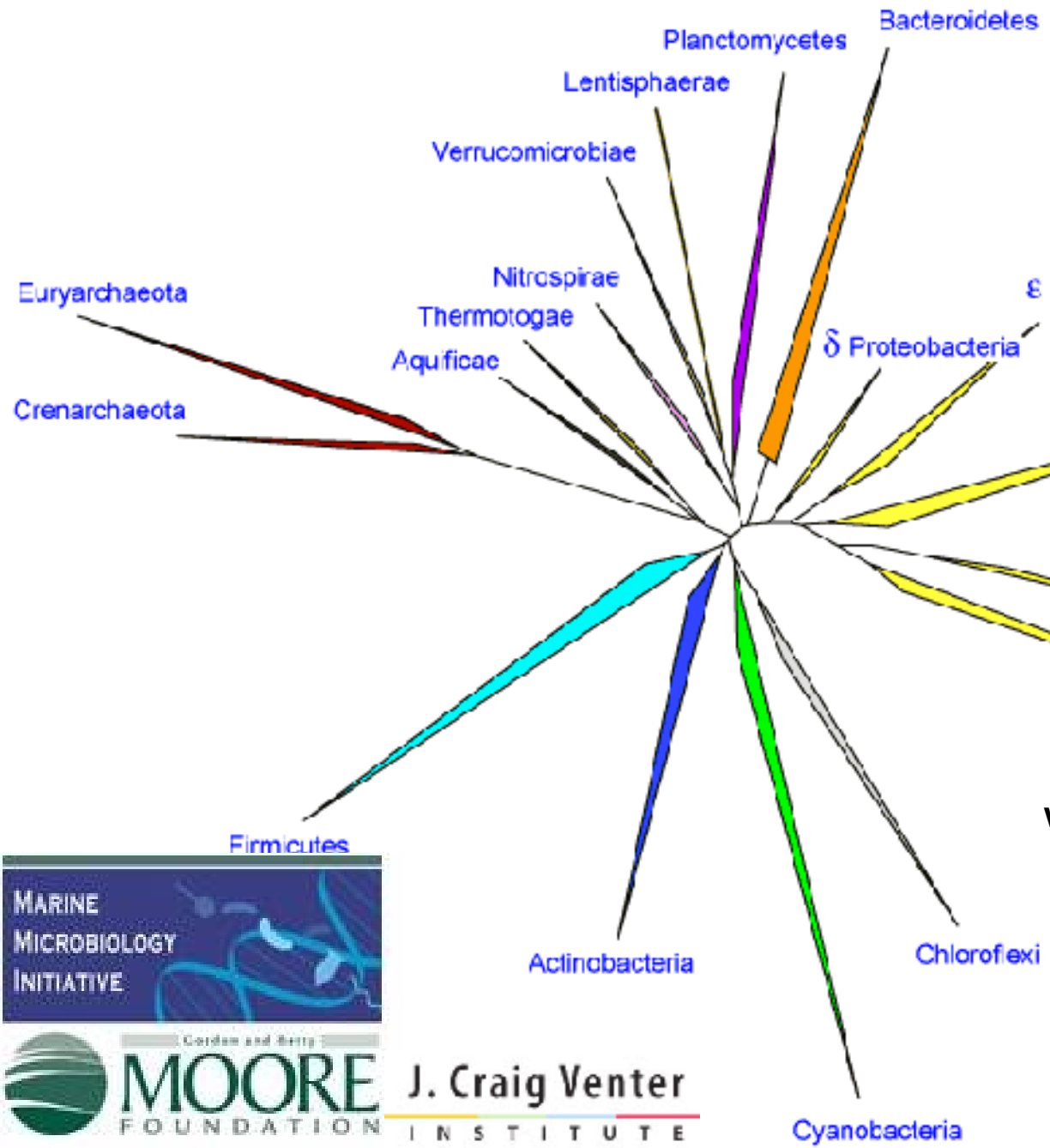
6.3 Billion Bases
5.6 Million Genes

~3300x

UCSD
UCIrvine

it²

Moore Foundation Funded the Venter Institute to Provide the Full Genome Sequence of 155+ Marine Microbes



Phylogenetic Trees Created by Uli Stingl, Oregon State

Blue Means Contains One of the Moore 155 Genomes

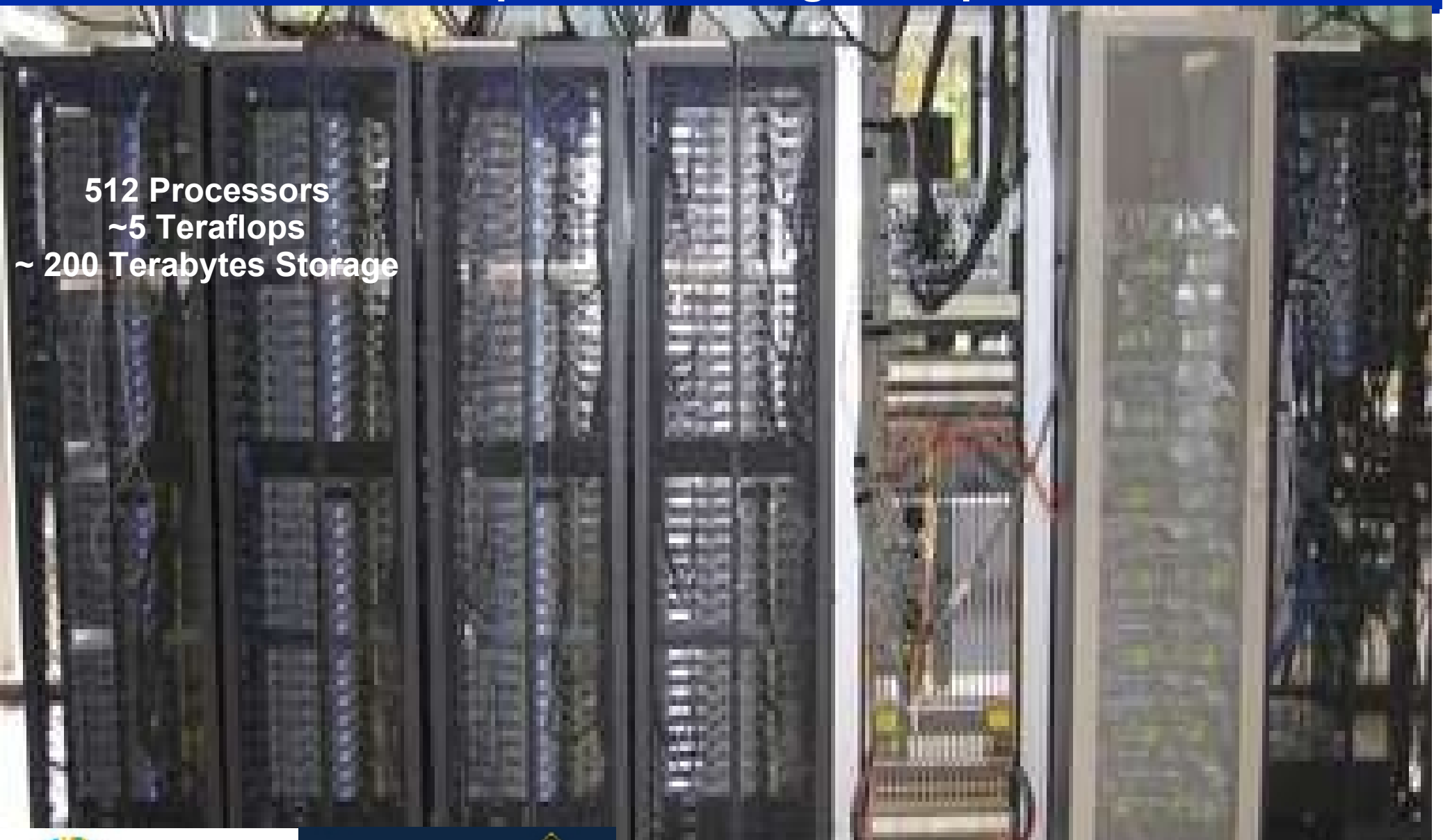
www.moore.org/microgenome/trees.aspx

MARINE MICROBIOLOGY INITIATIVE

MOORE FOUNDATION

J. Craig Venter INSTITUTE

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

it²

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

Sargasso Sea Data

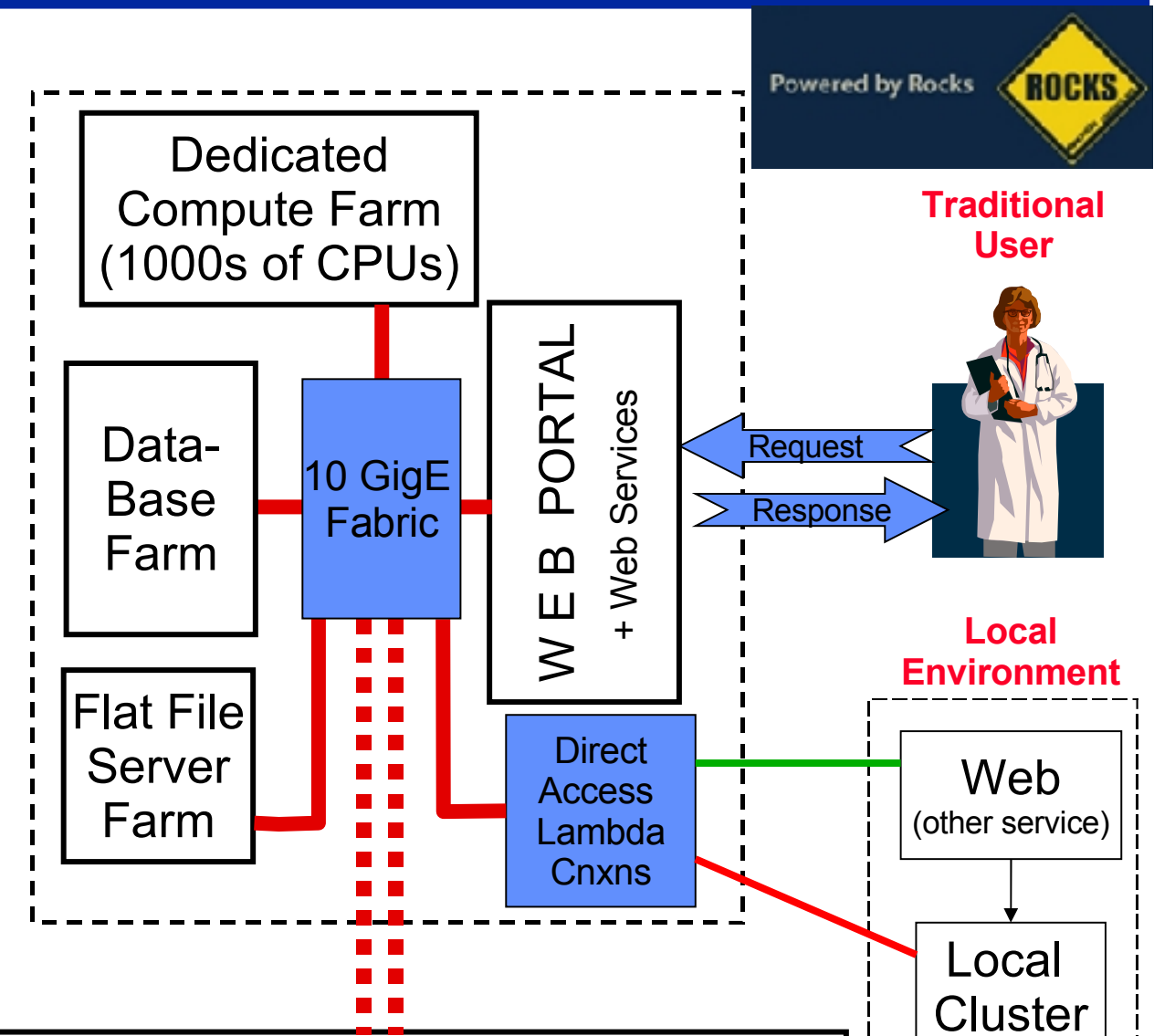
Sorcerer II Expedition (GOS)

JGI Community Sequencing Project

Moore Marine Microbial Project

NASA and NOAA Satellite Data

Community Microbial Metagenomics Data



Source: Phil Papadopoulos, SDSC, Calit2

CAMERA 1.2
is Here Next Week!

HOME | ABOUT CAMERA | METAGENOMICS | RESEARCH | NEWS | EVENTS | DISCUSSION FORUMS

PLoS Biology Ocean Metagenomics Collection



New CAMERA production server, 512-CPU, 5-Teraflops, 200-Terabyte cluster.

Webcast archive of March

WELCOME TO CAMERA!

CAMERA stands for Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research and Analysis. The aim of this project is to serve the needs of the microbial ecology research community by creating a rich, distinctive data repository and a bioinformatics tools resource that will address many of the unique challenges of metagenomic analysis.

WHAT DO YOU WANT TO DO?

- Register with Camera to access services (first time users only)
  - step-by-step registration tutorial
- Run Blast against the available datasets
  - get status of past runs
- Download available datasets
- Ask questions or get help in the user forums
- Report a problem
- Suggest new features (via forums or email)
- Learn more about the Camera project

CURRENT STATUS

- Current application version - 1.1 (release notes) deployed 07/08/2007

Funded by the Moore Foundation

Gordon and Betty MOORE FOUNDATION

New version 1.2

We're anticipating the release of version 1.2 in the week of September 24.
Read the preliminary release notes for more details of this upcoming release.

Upcoming Events

- German Conference on Bioinformatics September 26th, 2007
- Genomes, Medicine, and the Environment 2007 October 8th, 2007

camera Marine Microbial Ecology

http://camera.calit2.net/

J. Craig Venter INSTITUTE

it2

“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

J. Craig Venter INSTITUTE

it²

Use of Tiled Display Wall OptIPortal to Interactively View Microbial Genome



UCSD
UCIrvine

Powered by Rocks

ROCKS

Acidobacteria bacterium Ellin345
Soil Bacterium 5.6 Mb

it2

Use of Tiled Display Wall OptIPortal to Interactively View Microbial Genome



UCSD
UCIrvine

Source: Raj Singh, UCSD

it²

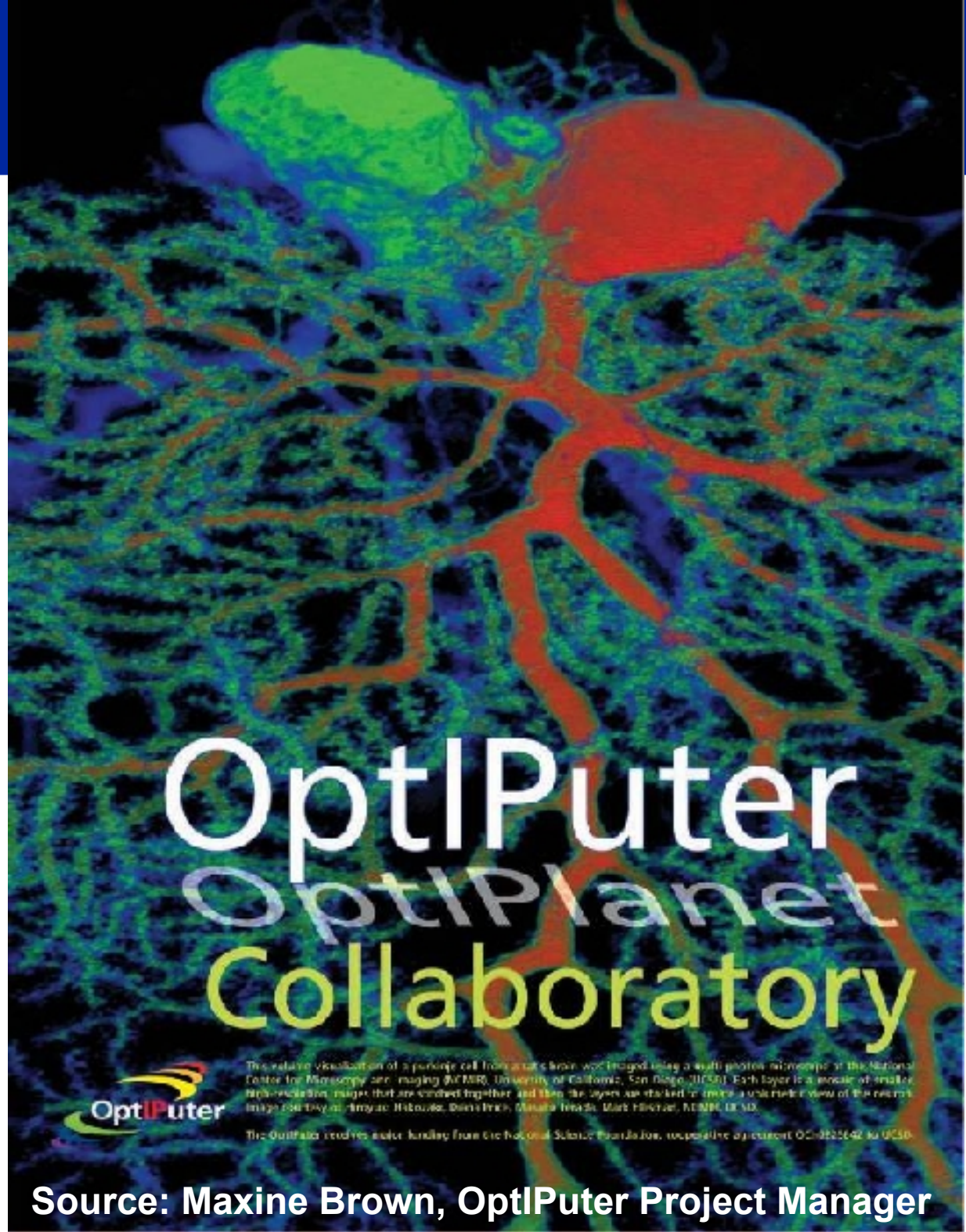
Use of Tiled Display Wall OptIPortal to Interactively View Microbial Genome



UCSD
UCIrvine

Source: Raj Singh, UCSD

it²



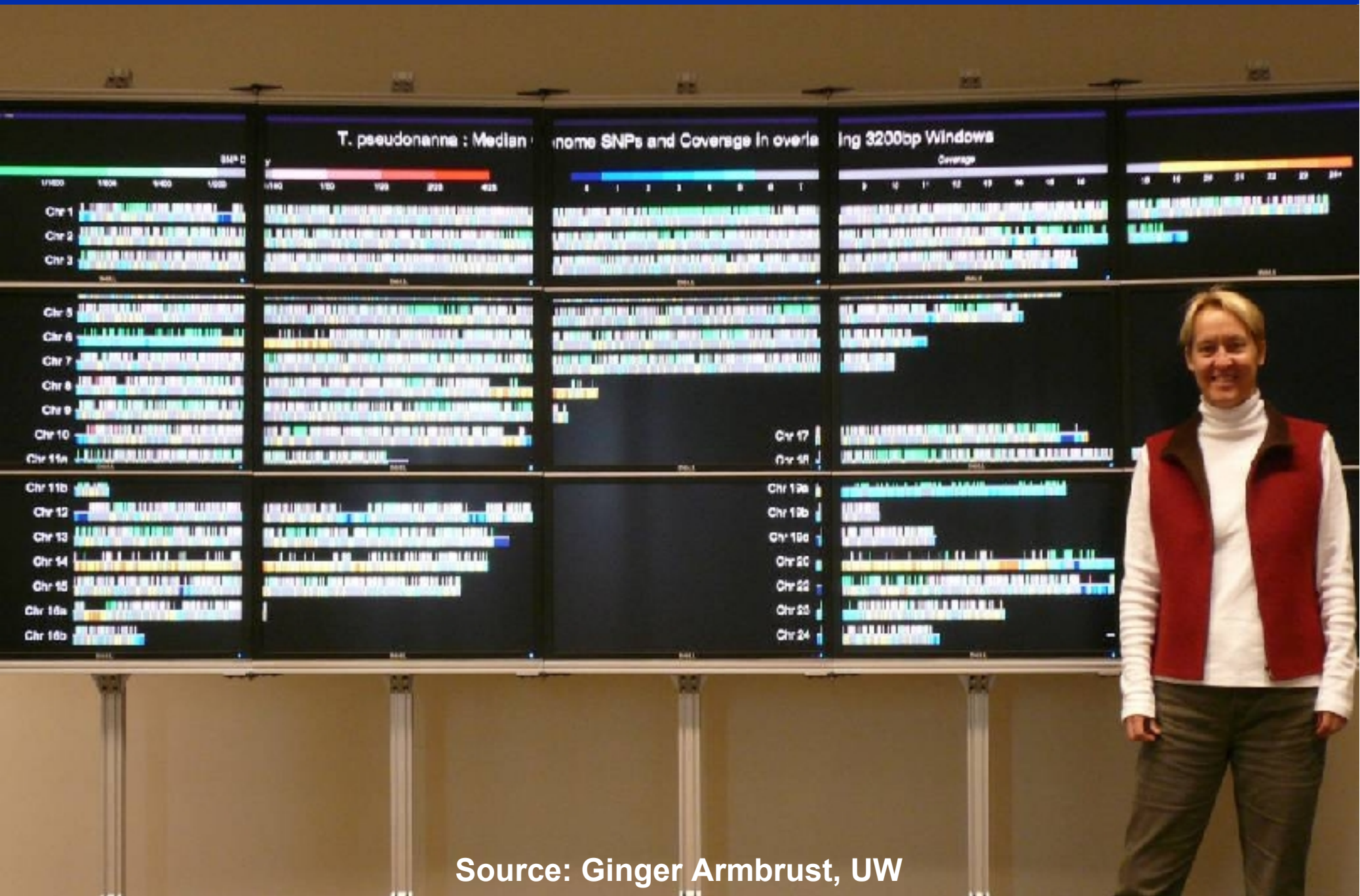
Source: Maxine Brown, OptIPuter Project Manager

UCSD
UCIrvine

An Emerging High Performance Collaboratory for Microbial Metagenomics



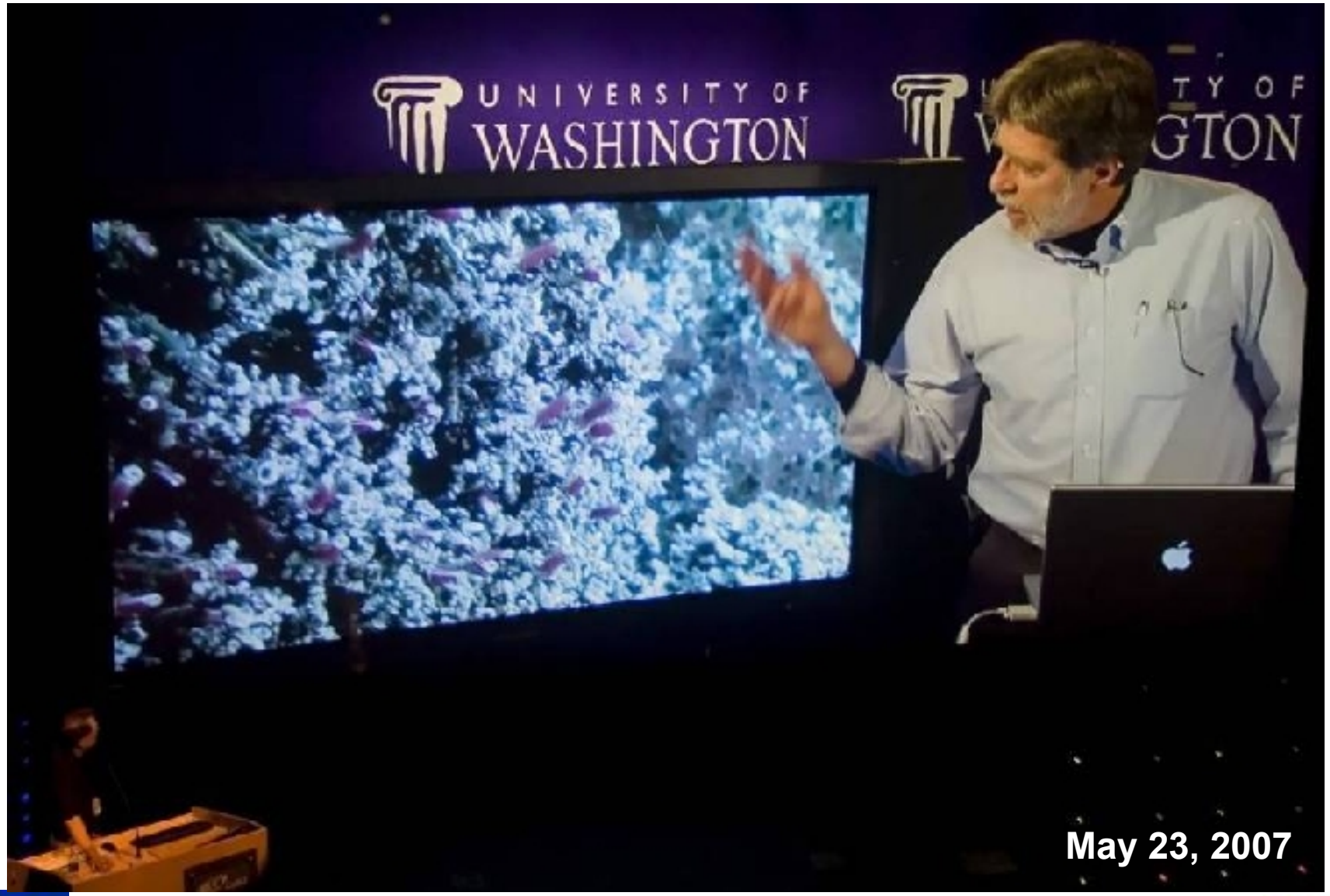
New Genome Wall at UWashington
Chromosomes of Marine Diatom Thallasiosira Pseudonanna



Source: Ginger Armbrust, UW

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

1500 Mbits/sec Calit2 to UW Research Channel Over NLR



John Delaney, PI LOOKING, Neptune

Photo: Harry Ammons, SDSC

UCSD
UCIrvine

Embedded iHDTV in an OptIPortal Enables Collaboration



Larry Smarr in Reno

Source: Michael Wellings
Research Channel
Univ. Washington

Ginger Armbrust in Seattle

UCSD
UCIrvine





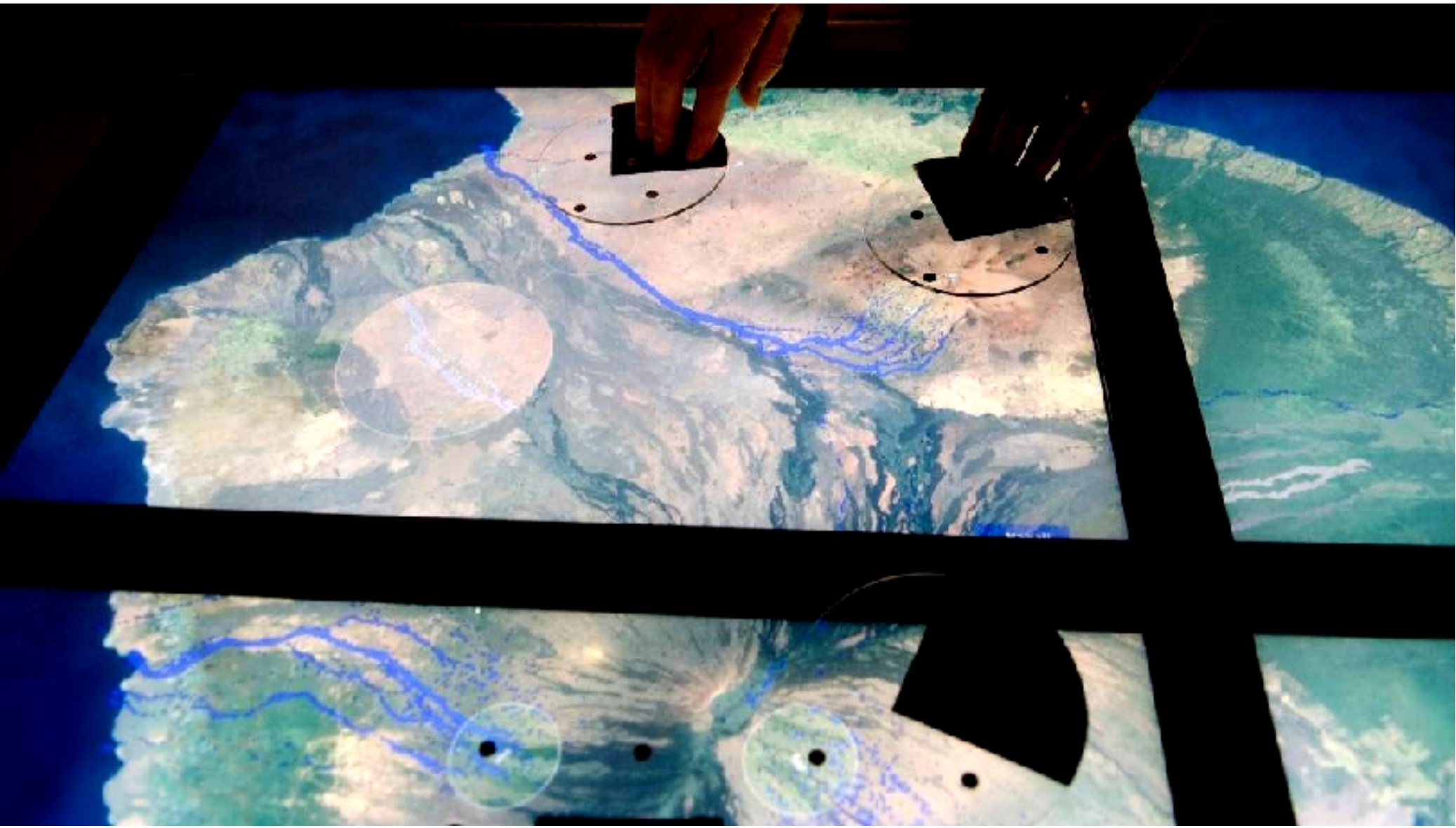
it²

Beyond the OptIPortal LambdaTable, StarCAVE, and Varrier



electronic visualization laboratory

LambdaTable Can Be Customized for Interactive Museum Learning



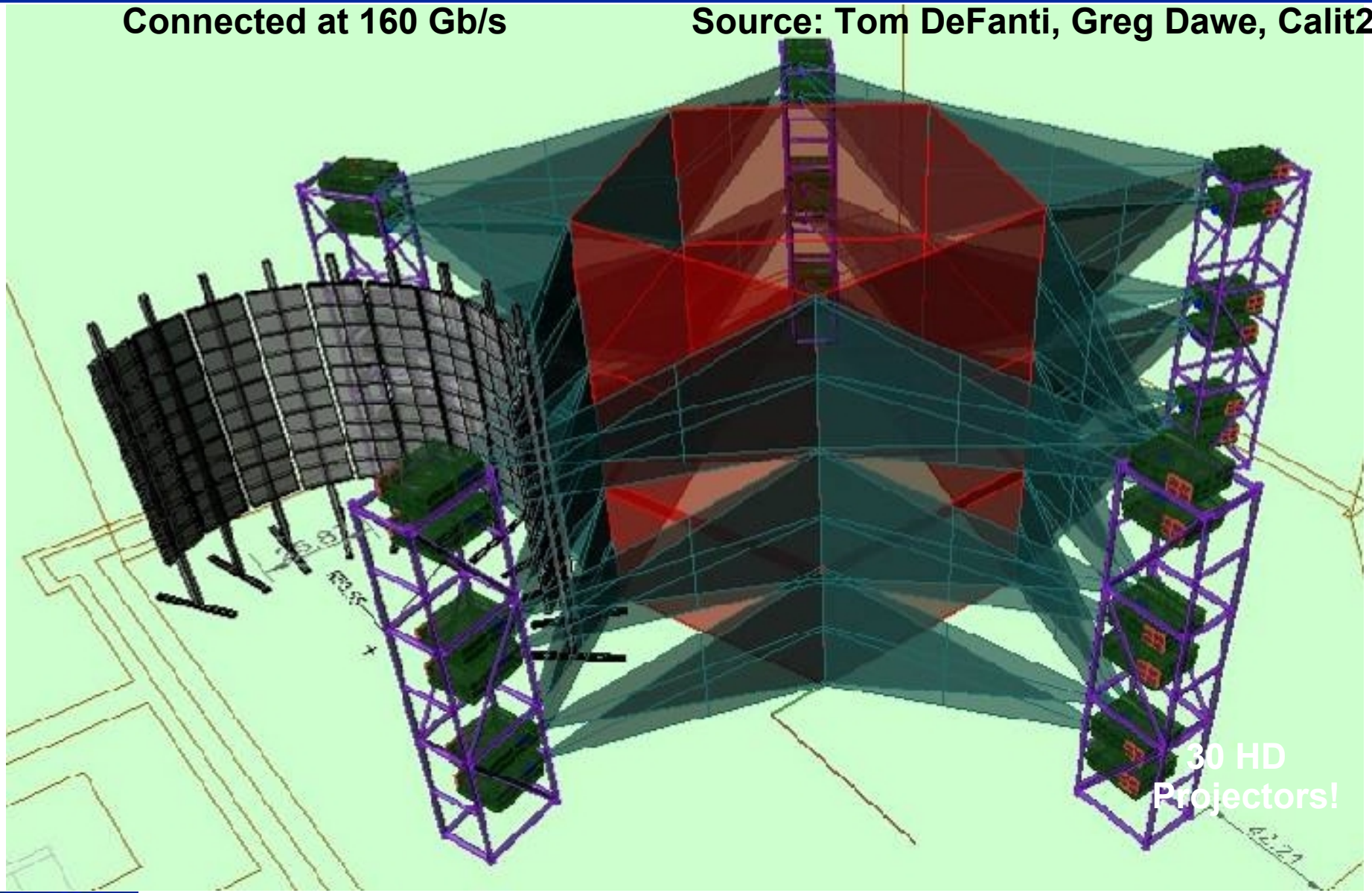
UCSD
UCIrvine

Source: EVL, UIC

it²

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

Connected at 160 Gb/s **Source: Tom DeFanti, Greg Dawe, Calit2**



UCSD
UCIrvine

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

it²

StarCAVE Panoramas









How Do You Get From Your Lab to the National LambdaRail?

"Research is being stalled by 'information overload,' Mr. Bement said, because data from digital instruments are piling up far faster than researchers can study. In particular, he said, campus networks need to be improved. High-speed data lines crossing the nation are the equivalent of six-lane superhighways, he said. But networks at colleges and universities are not so capable. "Those massive conduits are reduced to two-lane roads at most college and university campuses," he said. Improving cyberinfrastructure, he said, "will transform the capabilities of campus-based scientists."

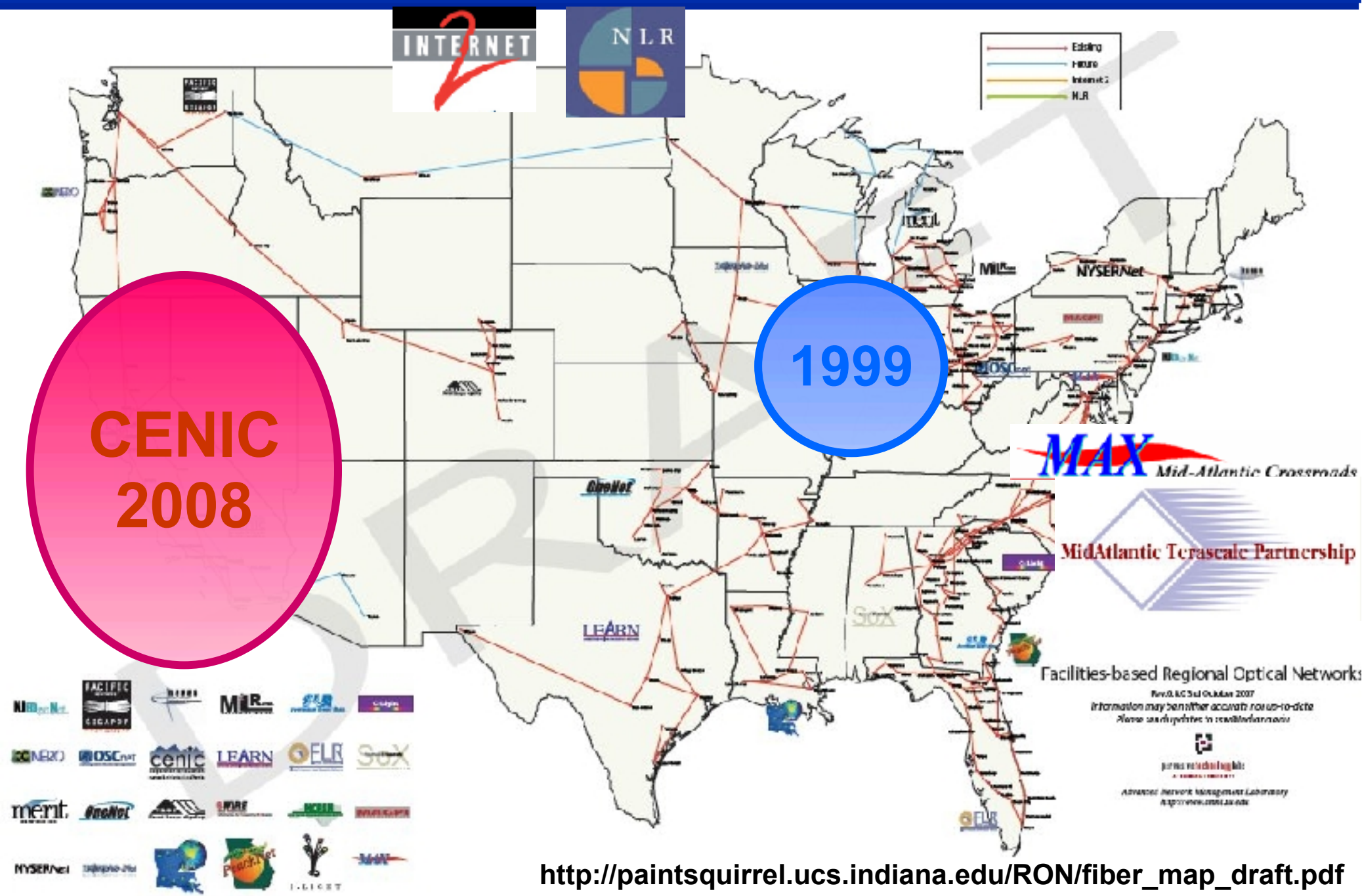
-- Arden Bement, the director of the National Science Foundation



www.ctwatch.org

UCSD
UCIrvine

Interconnecting Regional Optical Networks Is Driving Campus Optical Infrastructure Deployment



California (CENIC) Network Directions

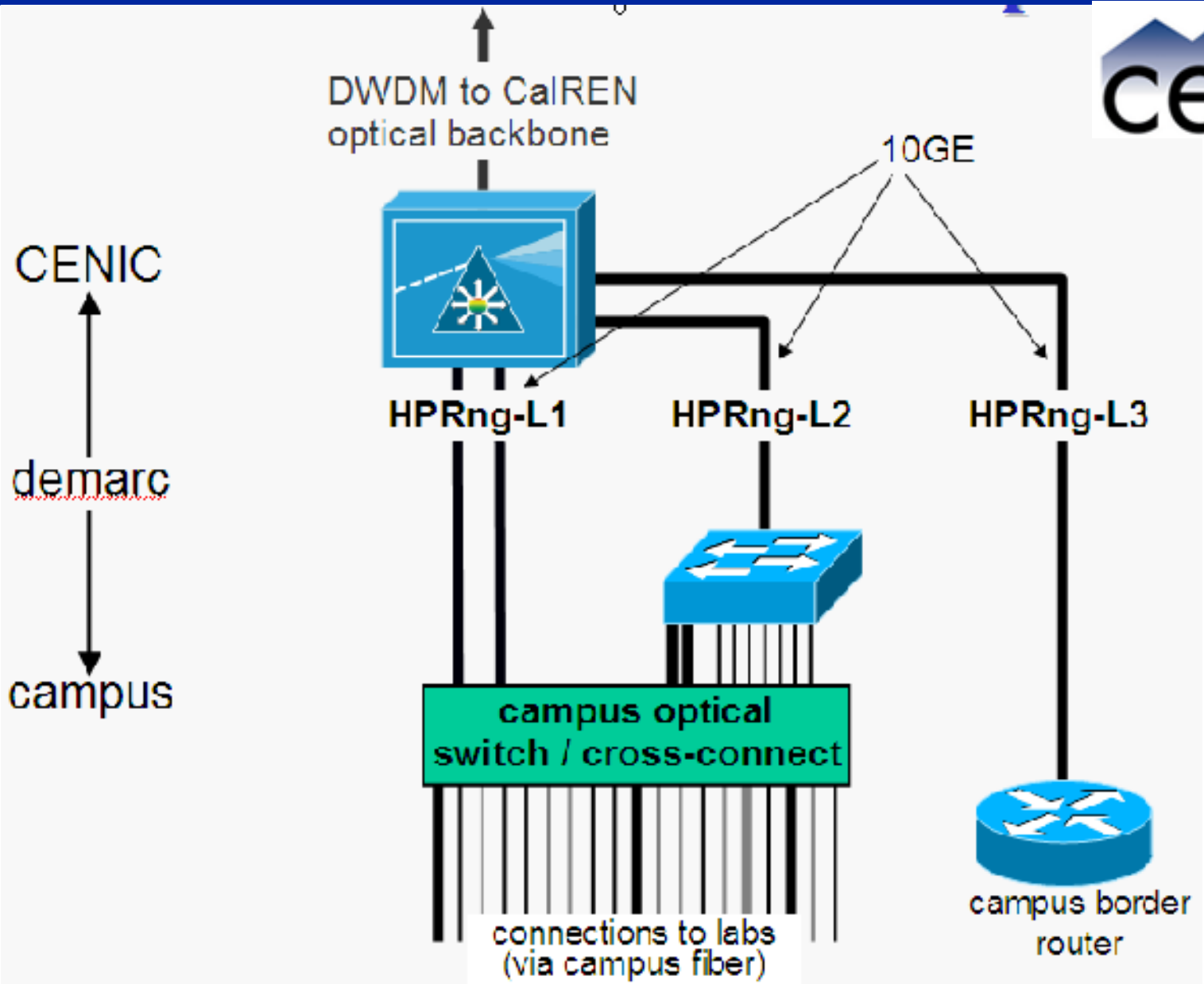
- More Bandwidth to Research University Campuses
  - One or Two 10GE Connections to Every Campus
- More Bandwidth on the Backbone
  - 40Gbps Or 100Gbps
- Support for New Protocols and Features
  - IPv6 Multicast
  - Jumbo Frames: 9000 (or More) Bytes
- "Hybrid Network" Design, Incorporating Traditional Routed IP Service and the New Frame and Optical Circuit Services:
  - "HPRng-L3" = Routed IP Network
  - "HPRng-L2" = Switched Ethernet Network
  - "HPRng-L1" = Switched Optical Network

} CalREN-XD

UCSD UCIrvine

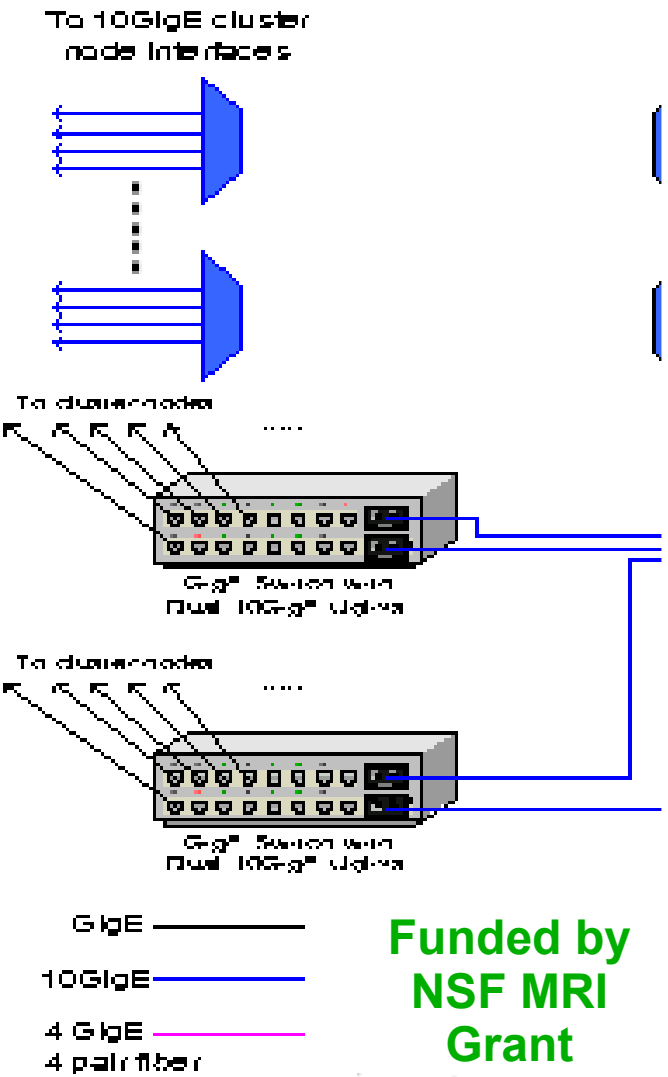
Source: Jim Dolgonas, CENIC

Campus Preparations Needed to Accept CENIC CalREN Handoff to Campus



Source: Jim Dolgonas, CENIC

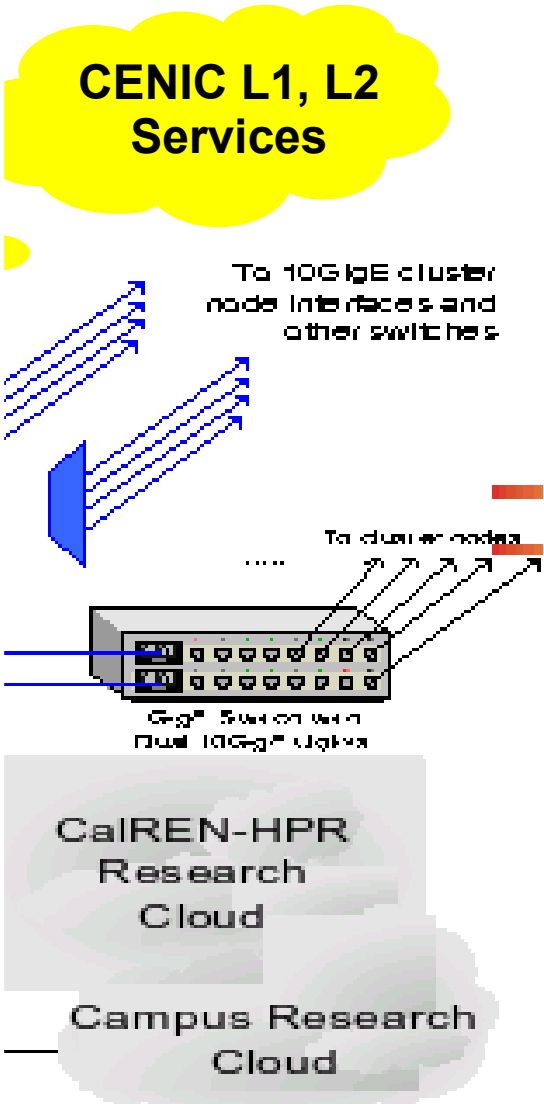
Current UCSD Experimental Optical Core: Ready to Couple to CENIC L1, L2, L3 Services



Goals by 2008:

- >= 50 endpoints at 10 GigE
- >= 32 Packet switched
- >= 32 Switched wavelengths
- >= 300 Connected endpoints

Approximately 0.5 TBit/s Arrive at the "Optical" Center of Campus
Switching will be a Hybrid Combination of:
Packet, Lambda, Circuit -- OOO and Packet Switches Already in Place

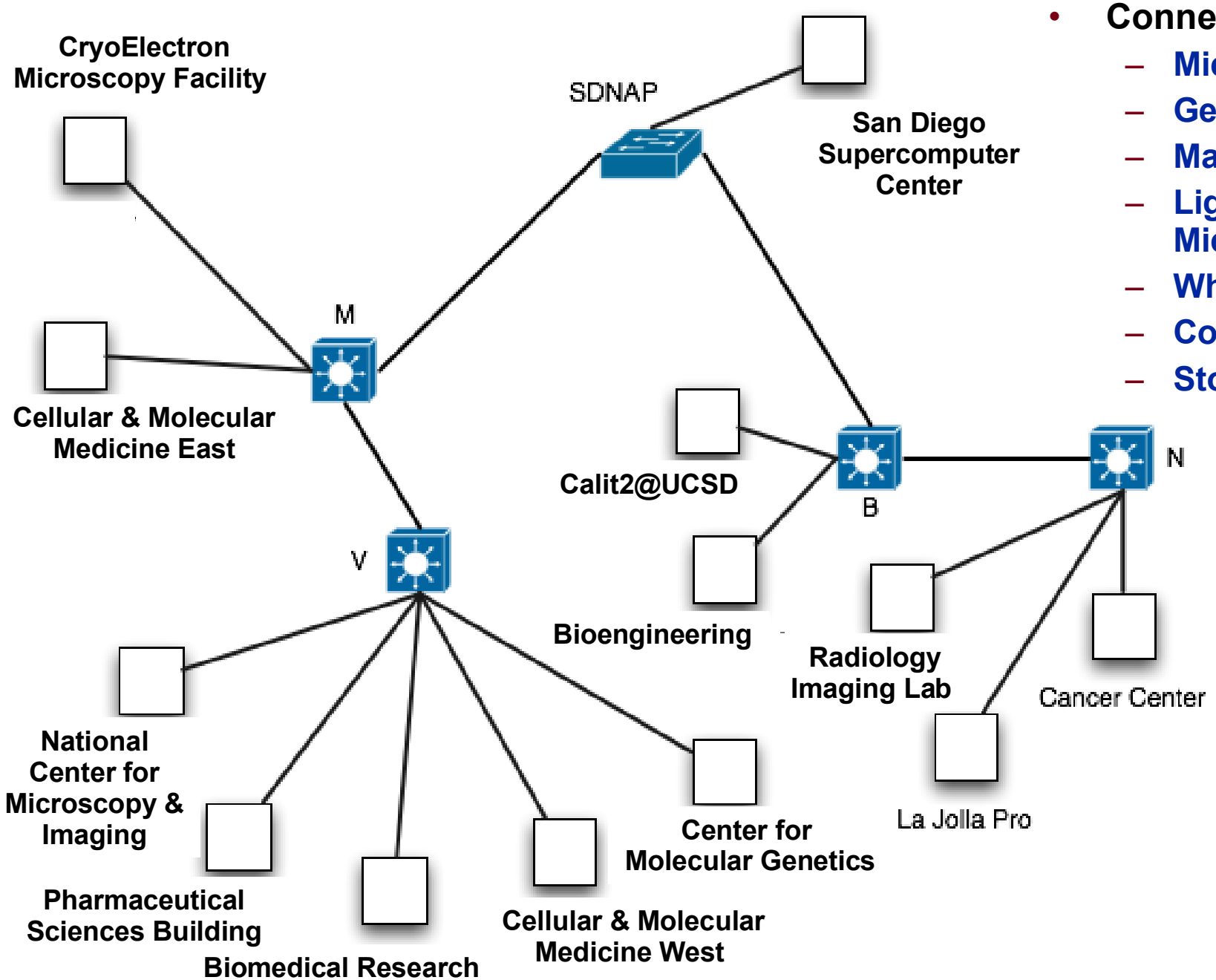


Funded by NSF MRI Grant

OptIPuter Border Router

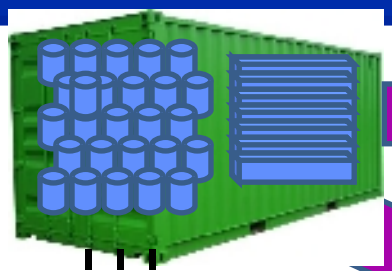
Source: Phil Papadopoulos, SDSC/Calit2 (Quartzite PI, OptIPuter co-PI)

UCSD Planned Optical Networked Biomedical Researchers and Instruments



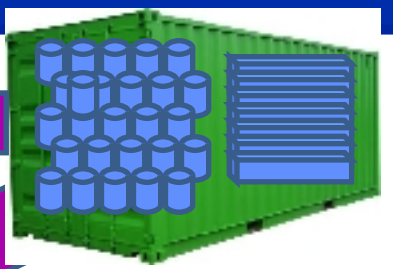
- **Connects at 10 Gbps :**
  - **Microarrays**
  - **Genome Sequencers**
  - **Mass Spectrometry**
  - **Light and Electron Microscopes**
  - **Whole Body Imagers**
  - **Computing**
  - **Storage**

Planned UCSD Production Campus Cyberinfrastructure Supporting Data Intensive Biomedical Research



Active Data Replication

N x 10 Gbit



Eco-Friendly Storage and Compute

N x 10 Gbit

N x 10 Gbit



10 Gigabit L2/L3 Switch

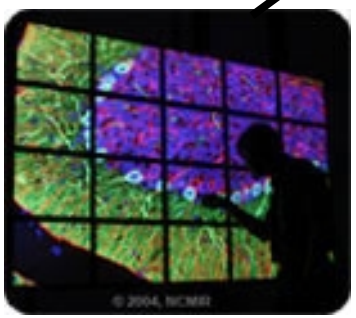
"Network in a box"
- > 200 Connections
- DWDM or Gray Optics

On-Demand Physical Connections

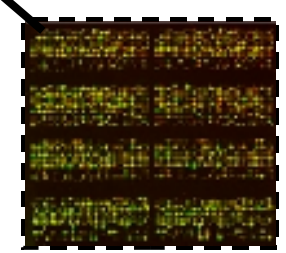
Wide-Area 10G
- CENIC/HPRng
- NLR Cavewave
- I2 NewNet
- Cinegrid
- …

Single 10 Gbit









Microarray

Your Lab Here

camera

NCMIR NATIONAL CENTER for MICROSCOPY and IMAGING RESEARCH

NBCR

UCSD

UCIrvine

Source: Phil Papadopoulos, SDSC/Calit2; Elazar Harel, UCSD

it²

Calit2/SDSC Proposal to Create a UC Cyberinfrastructure of OptIPuter "On-Ramps" to TeraGrid Resources

OptIPuter + CalREN-XD + TeraGrid = "OptiGrid"





Creating a Critical Mass of End Users on a Secure LambdaGrid

UCSD
UCIrvine

Source: Fran Berman, SDSC , Larry Smarr, Calit2

it2