OptIPuter Planetary-Scale Applications Overview

Opening Talk
CENIC '07 Calit2 Tour
March 12, 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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Two New Calit2 Buildings Provide ~340,000 GSF and New Laboratories for "Living in the Future"



- Over 1000 Researchers in Two Buildings
  - Linked via Dedicated Optical Networks
  - International Conferences and Testbeds
- New Laboratories
  - Nanotechnology
  - Virtual Reality, Digital Cinema



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Preparing for a World in Which Distance is Eliminated…

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People Experience
Many Different Levels of Broadband









- **Mobile Broadband**
  - **0.1-0.5 Mbps**
- **Home Broadband**
  - **1-5 Mbps**
- **University Dorm Room Broadband**
  - **10-100 Mbps**
- **Calit2 Global Broadband**
  - **1,000-10,000 Mbps**

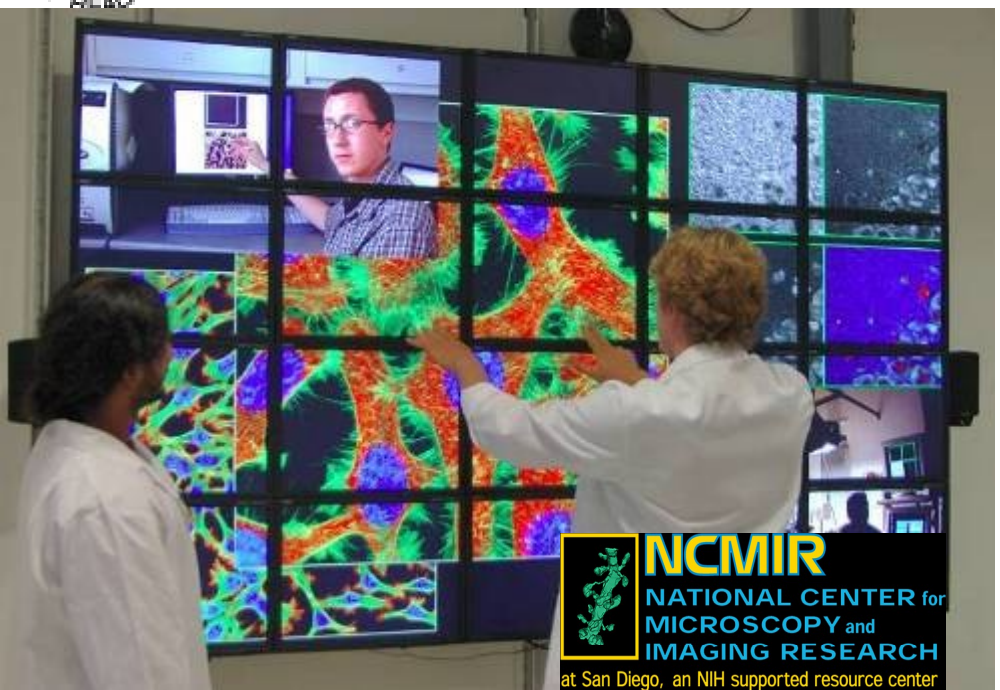
"The future is already here, it's just not evenly distributed"
William Gibson, Author of Neuromancer

100,000 Fold Range
All Here Today!

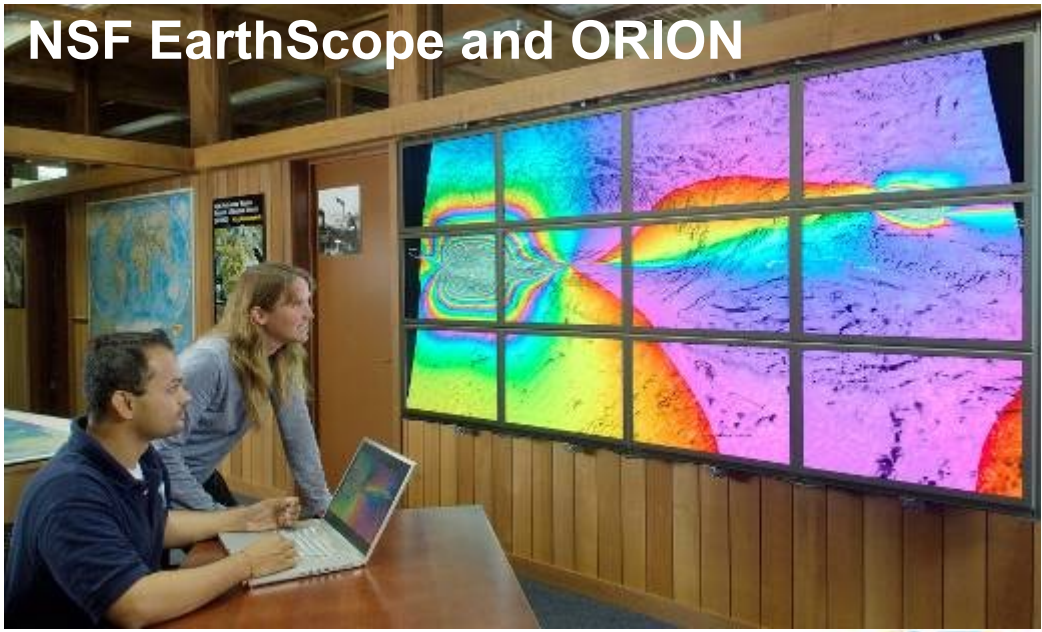
The OptIPuter Project – Creating High Resolution Portals Over Dedicated Optical Channels to Global Science Data

- **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



NSF EarthScope and ORION



SCRIPPS INSTITUTION OF OCEANOGRAPHY

Calit2 Has Become a Global Hub for Optical Connections

Between University Research Centers at 10Gbps

Maxine Brown, Tom DeFanti, Co-Chairs

iGrid 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

the UC Discovery Grant

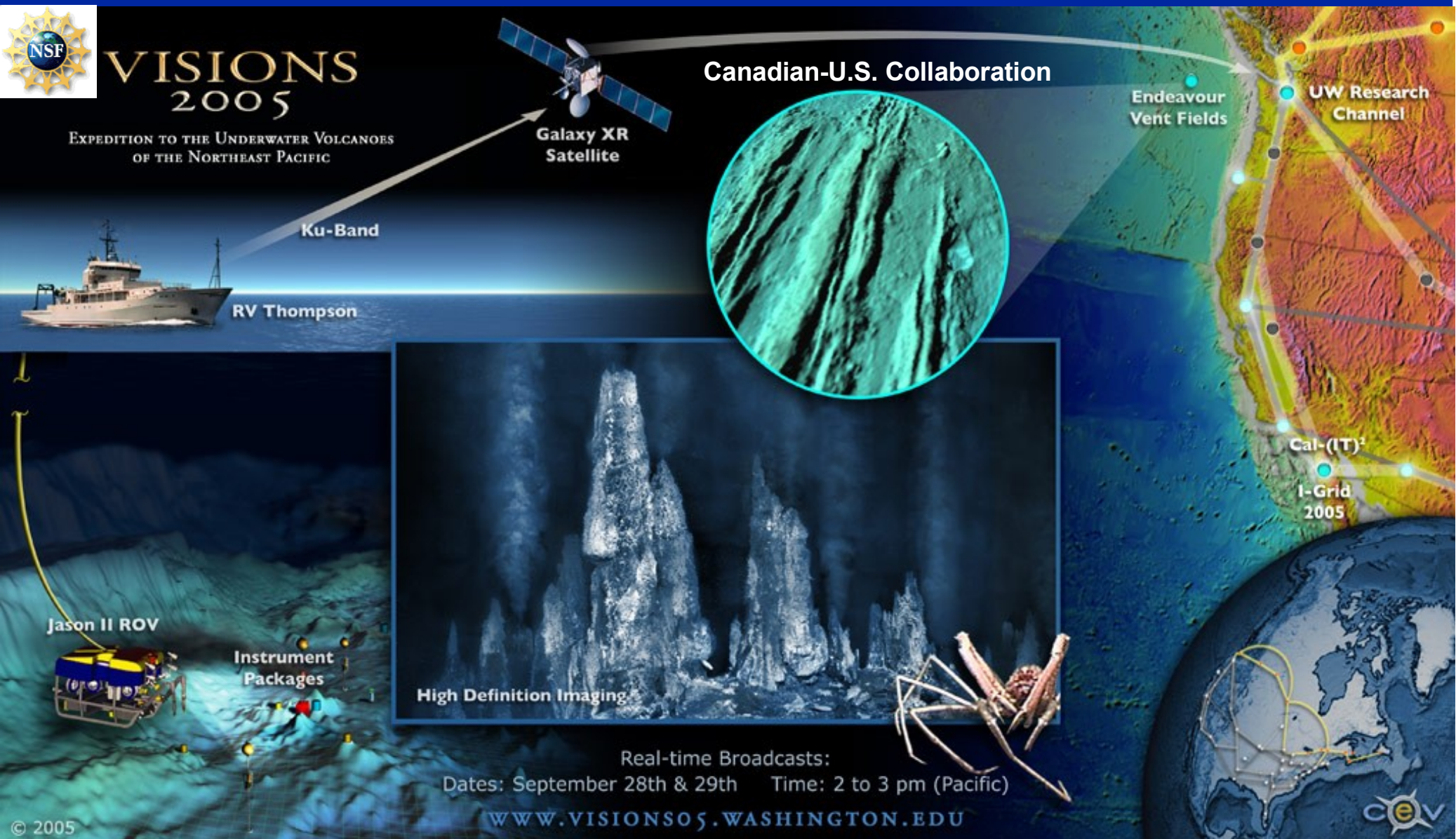


21 Countries Driving 50 Demonstrations

1 or 10Gbps to Calit2@UCSD Building

Sept 2005

First Remote Interactive High Definition Video Exploration of Deep Sea Vents



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See John Delaney Keynote Tomorrow

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

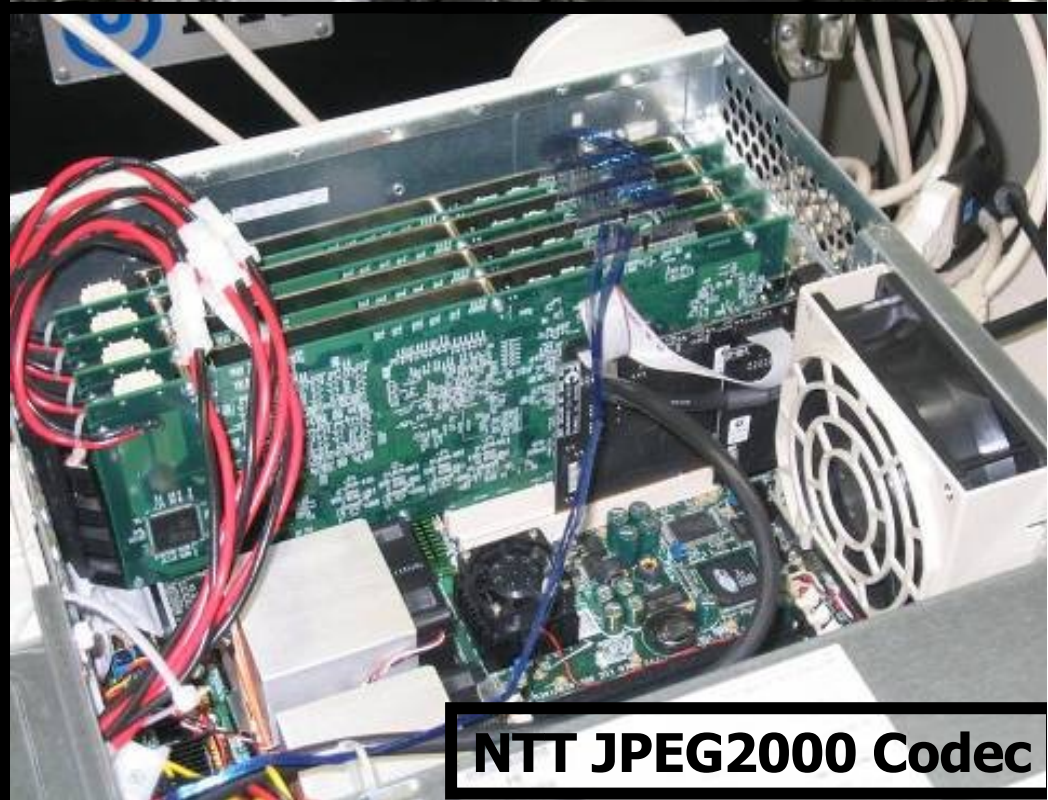
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iGrid Lambda 4k Digital Cinema Streaming Services: The CineGrid Node at Keio University, Tokyo Japan

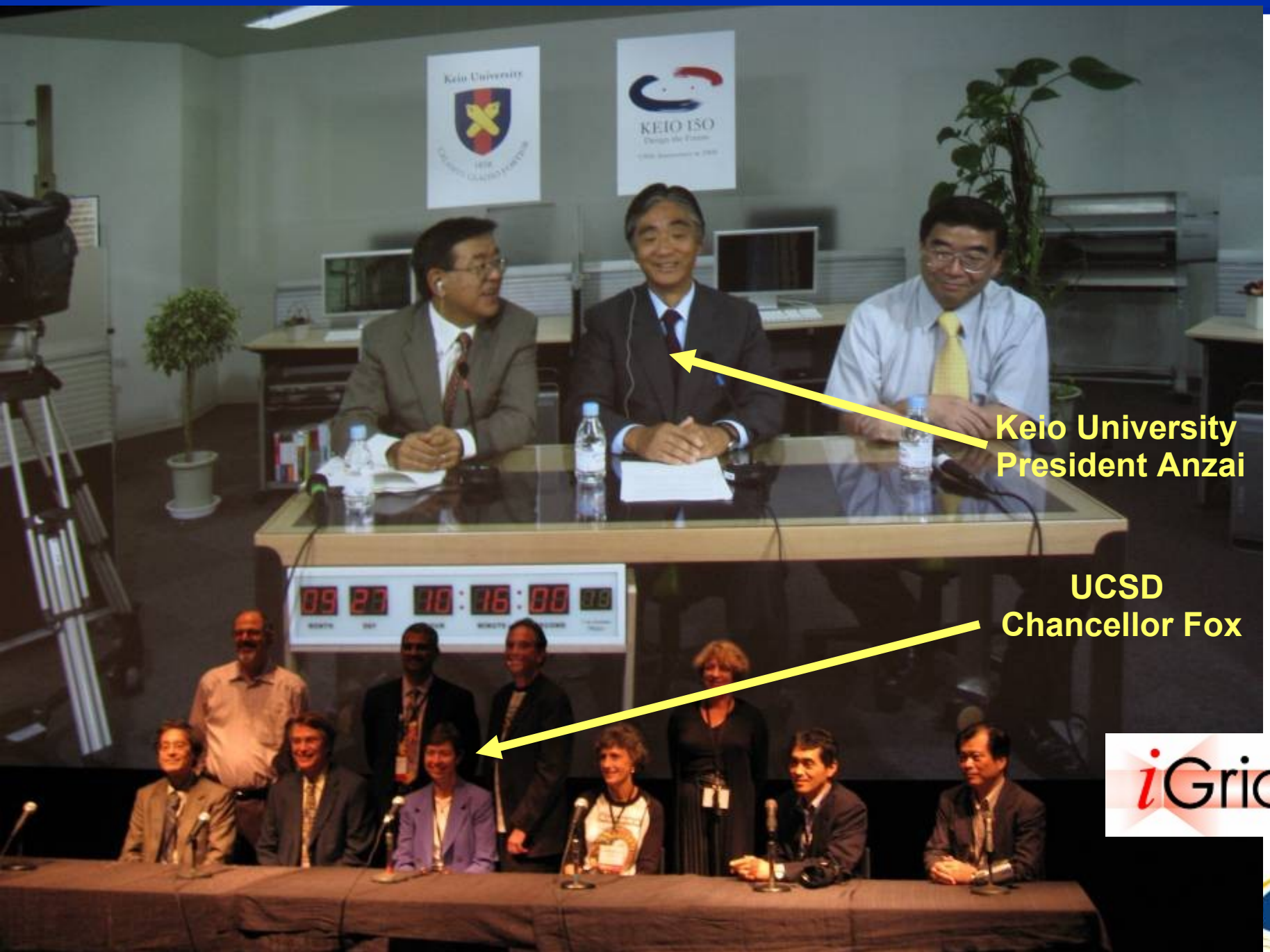








Laying The Technical Basis for Global Digital Cinema: Telepresence Meeting in Calit2 Digital Cinema Auditorium

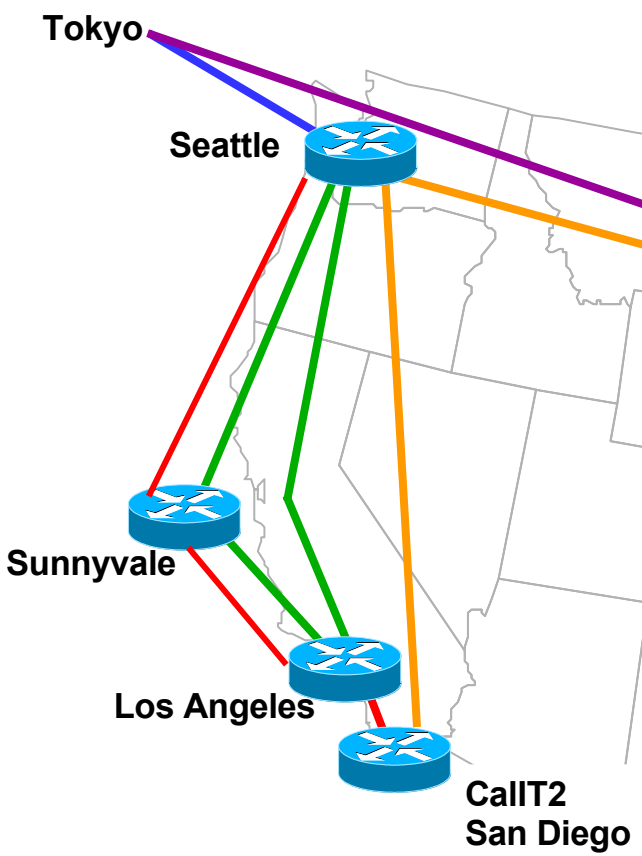


Sony
NTT
SGI

iGrid 2005

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Emerging CineGrid Infrastructure



Cisco is building two 10 GigE "Cisco Waves" on NLR on the West Coast and switches for access points in San Diego, Los Angeles, Sunnyvale, & Seattle for CineGrid

Toronto

Chicago

Europe

CENIC is making available persistent 1 GigE access ports in San Diego, Los Angeles, Sunnyvale, & San Francisco for CineGrid and the fiber for 2x10GigE between UCSD and LA

Via GLIF, CineGrid extends to Japan via Seattle & Chicago; to Canada via Seattle & Chicago; to Europe via Chicago & Amsterdam. Further extension likely to China, Korea, Singapore, India, New Zealand, Australia, others.

CineGrid Cisco 6506

10GigE Cisco NLR Wave

1& 10 GigE CENIC Waves

IEEAF Wave via PNWGP/TLEX

CAVEwave (CENIC and NLR via PNWGP

JGN2

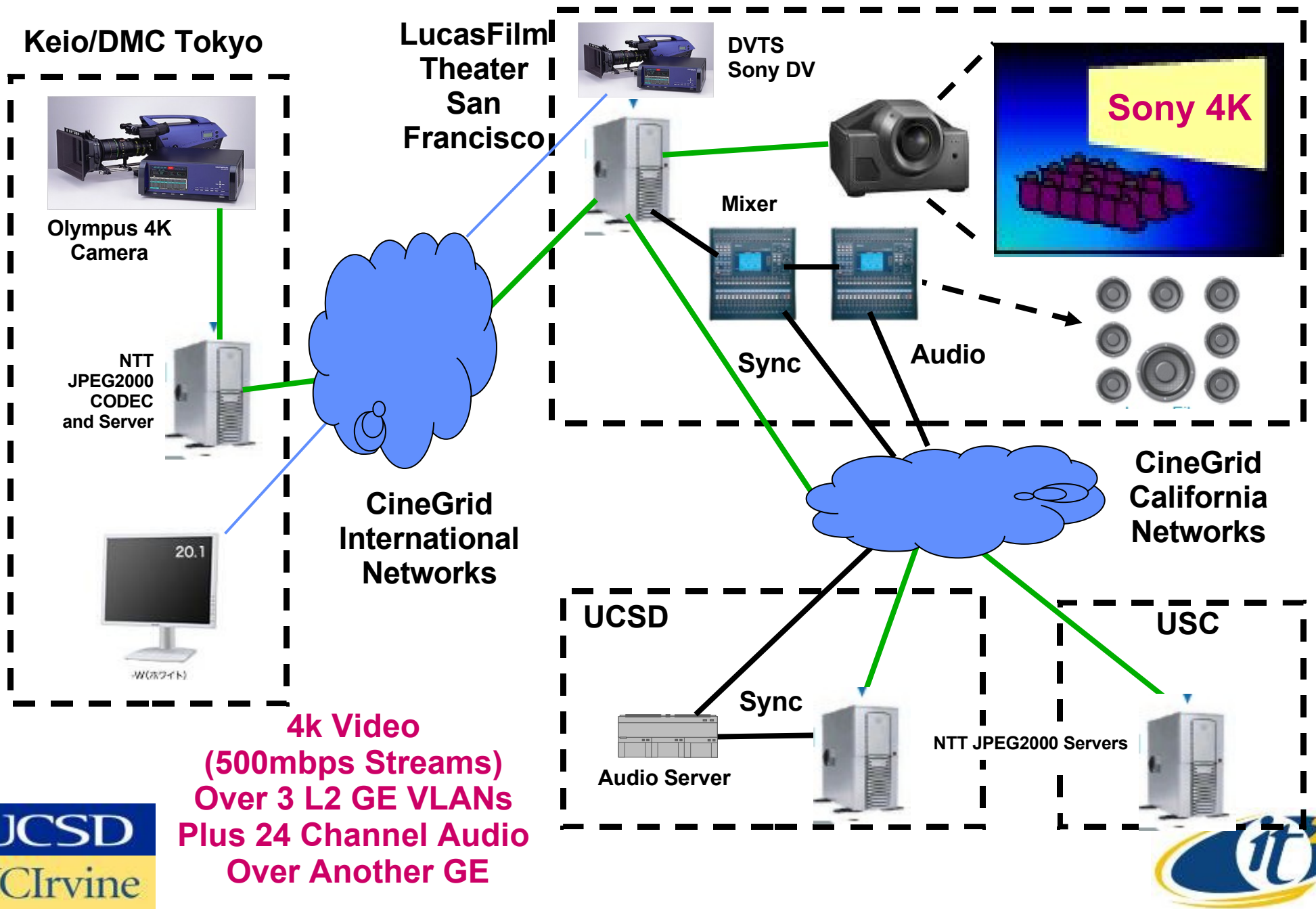
CA*net4

Defanti will Show
CineGrid
4k Content Today

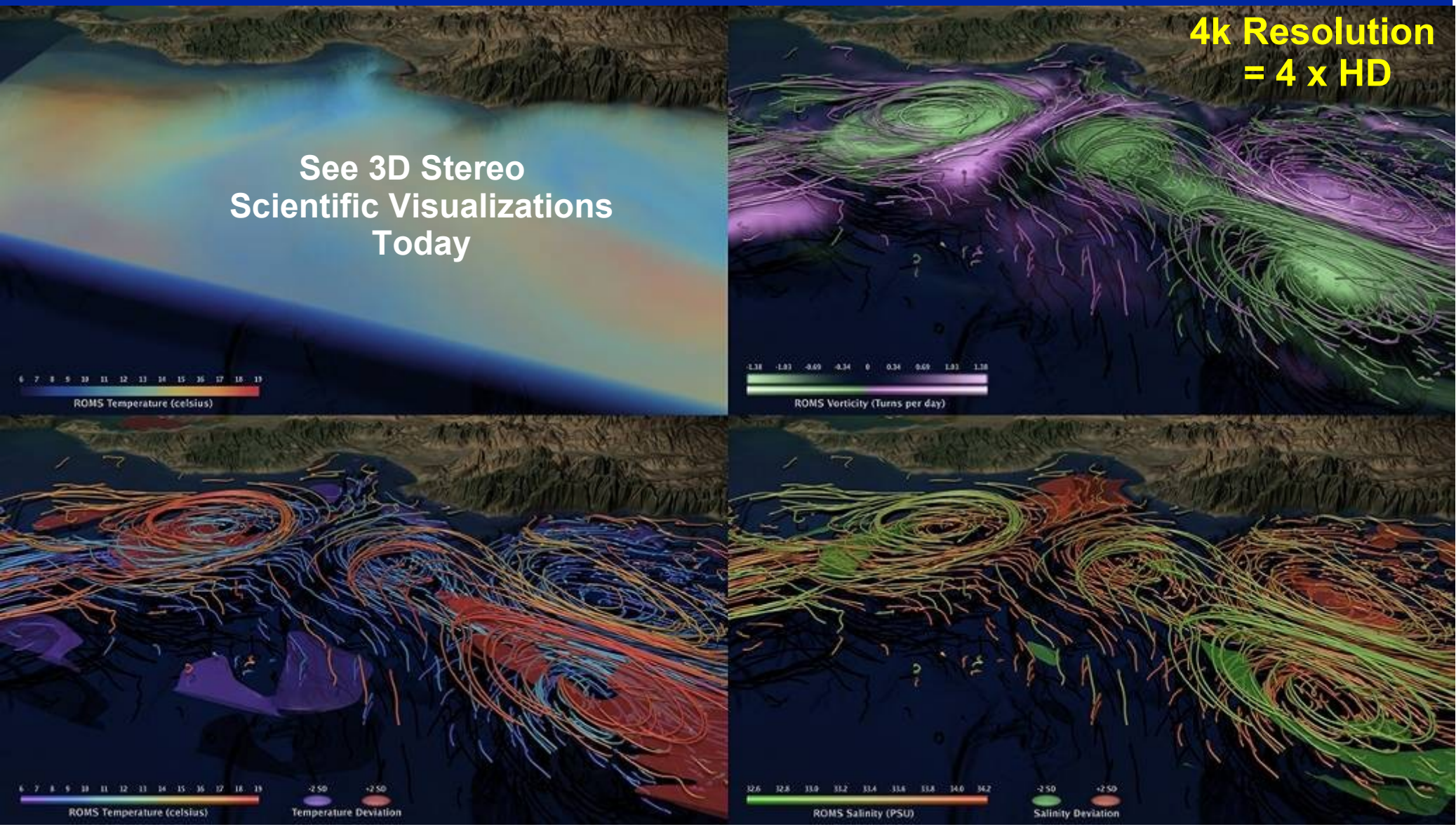
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Audio Engineering Society (AES)/LucasFilm

Trans-Pacific CineGrid 4K Demonstration, October 8, 2006



The Synergy of Digital Art and Science Visualization of JPL Simulation of Monterey Bay

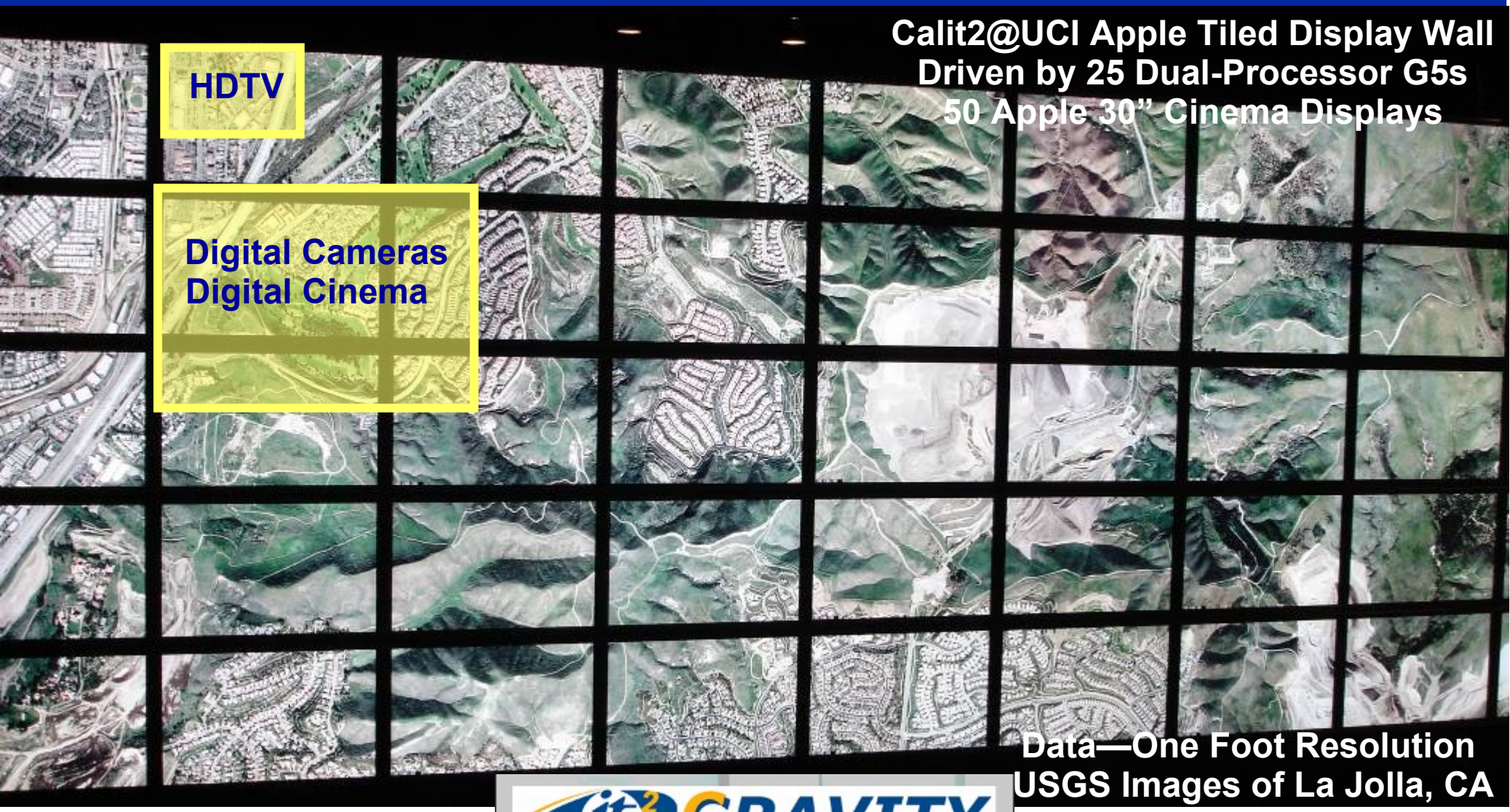


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Source: Donna Cox, Robert Patterson, NCSA
Funded by NSF LOOKING Grant

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Beyond 4k – From 8 Megapixels Towards a Billion Megapixels



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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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

See OptIPortal’s Today





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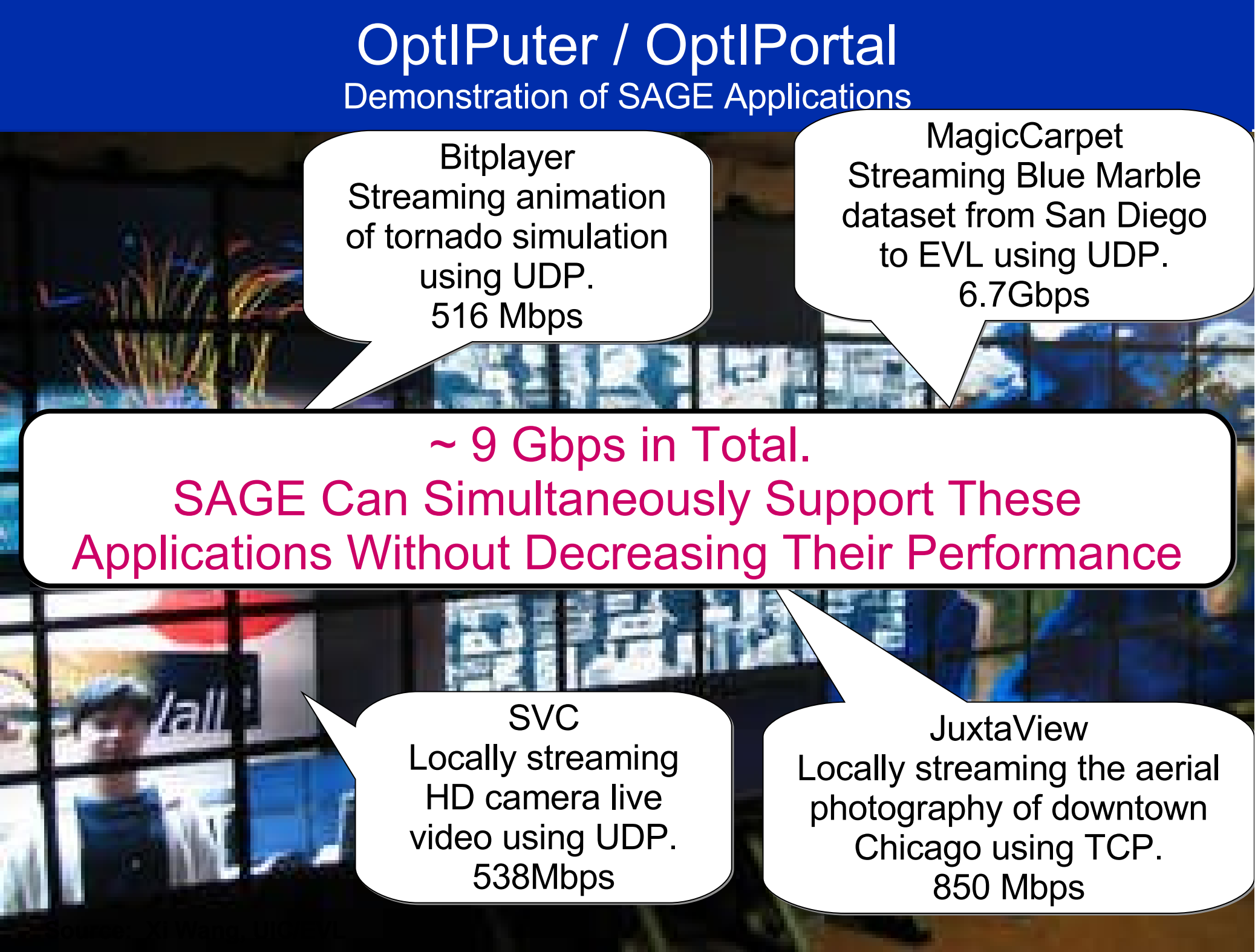
Powered by Rocks ROCKS

Source: Phil Papadopoulos SDSC, Calit2

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OptIPuter / OptIPortal

Demonstration of SAGE Applications



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



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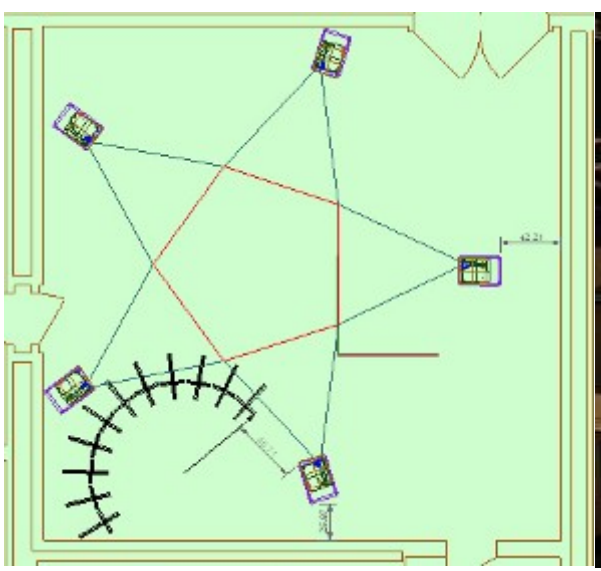
ANL's Rick Stevens Studying Deep Sea Vent Ecology at Supercomputing '06

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Partnering with UIC Electronic Visualization Lab to Create Next Generation OptIPortals

- Varrier Autostereo Virtual Reality
  - Head-Tracked No Need for Glasses
  - 65 LCD Tiles
  - 45 Mpixels/eye of Visual Stereo
- PentaCAVE— High Definition Surround
  - Working Prototype 4 Mpixel Wall
  - Full Scale PentaCAVE Being Built
    - 6 JVC HD2K Projectors Per Wall
    - 30 Mpixel/eye of Stereo w/5-Walls







Experience Both Today!

evl electronic visualization laboratory

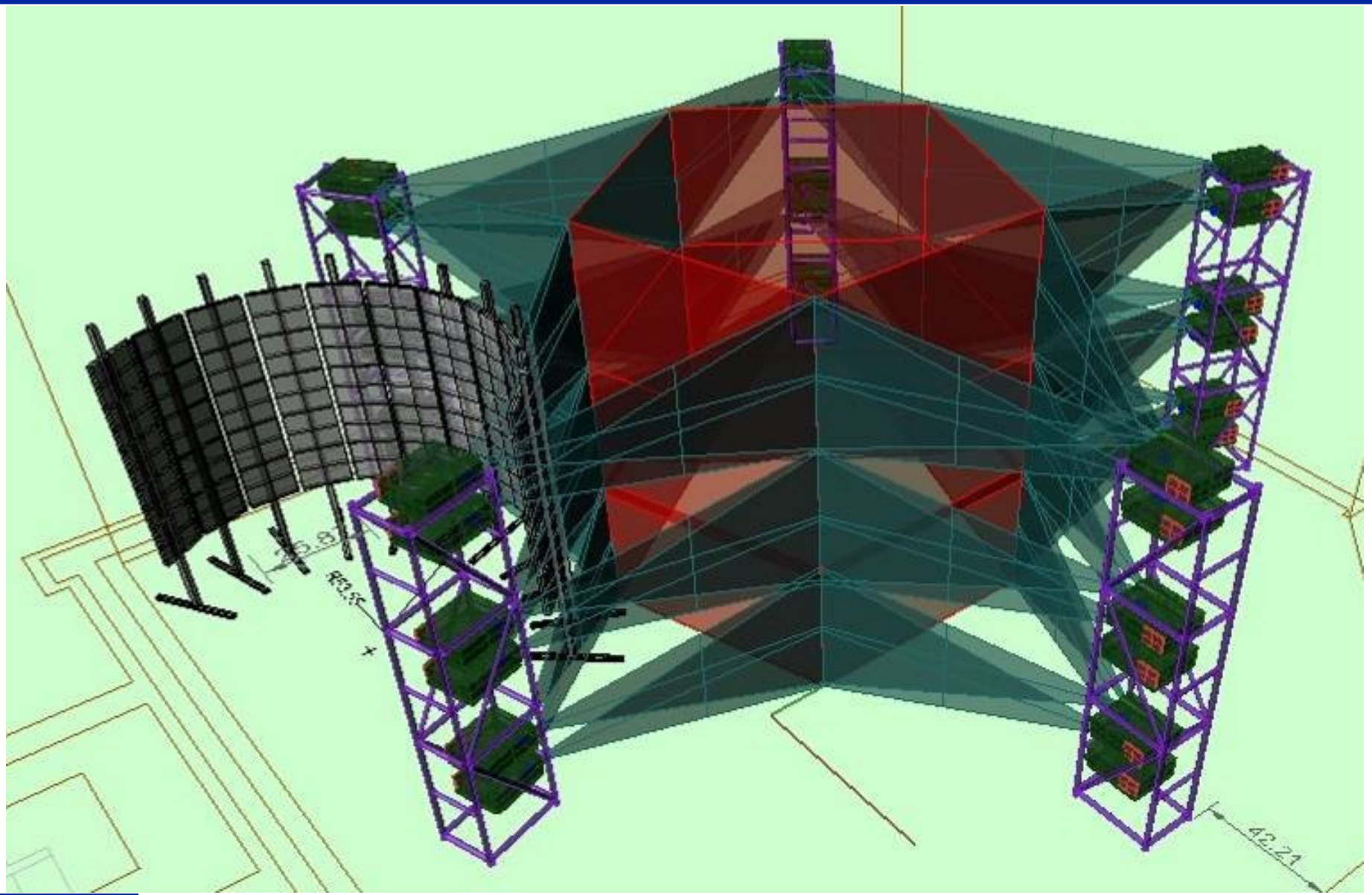
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Dan Sandin, Greg Dawe, Tom Peterka, Tom DeFanti, Jason Leigh, Jinghua Ge, Javier Girado, Bob Kooima, Todd Margolis, Lance Long, Alan Verlo, Maxine Brown, Jurgen Schulze, Qian Liu, Ian Kaufman, Bryan Glogowski

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Varrier and StarCAVE in Calit2 Immersion Visualization Room Summer 2007



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The New Optical Core of the UCSD Campus-Scale Testbed: Moving to Parallel Lambdas in 2007

Goals by 2007:

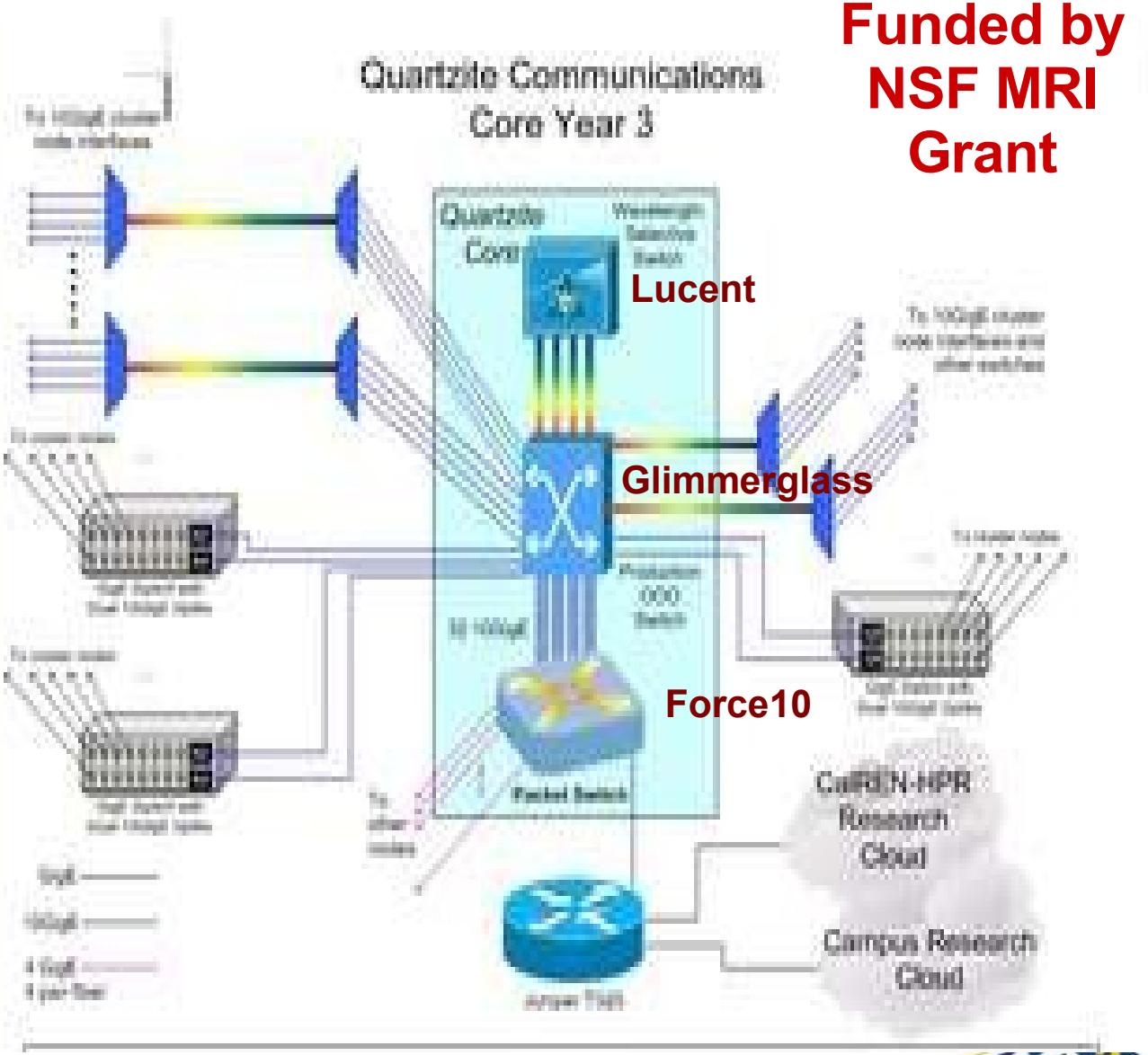
>= 50 endpoints at 10 GigE

>= 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

Source: Phil Papadopoulos, SDSC, Calit2

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

National LambdaRail
Direct Connect
Computation and Storage Complex

Funded by: Gordon and Betty Moore Foundation

PI Larry Smarr

Joint Partnership of:

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Hear Paul Gilna Talk at CENIC '07 Tomorrow

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!

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J. Craig Venter INSTITUTE

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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

CAMERA Goes
Live Tomorrow!

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Calit2 is Now OptIPuter Connecting Remote OptIPortal Moore-Funded Microbial Researchers via NLR



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

OptIPuter + CalREN-XD + TeraGrid = "OptiGrid"





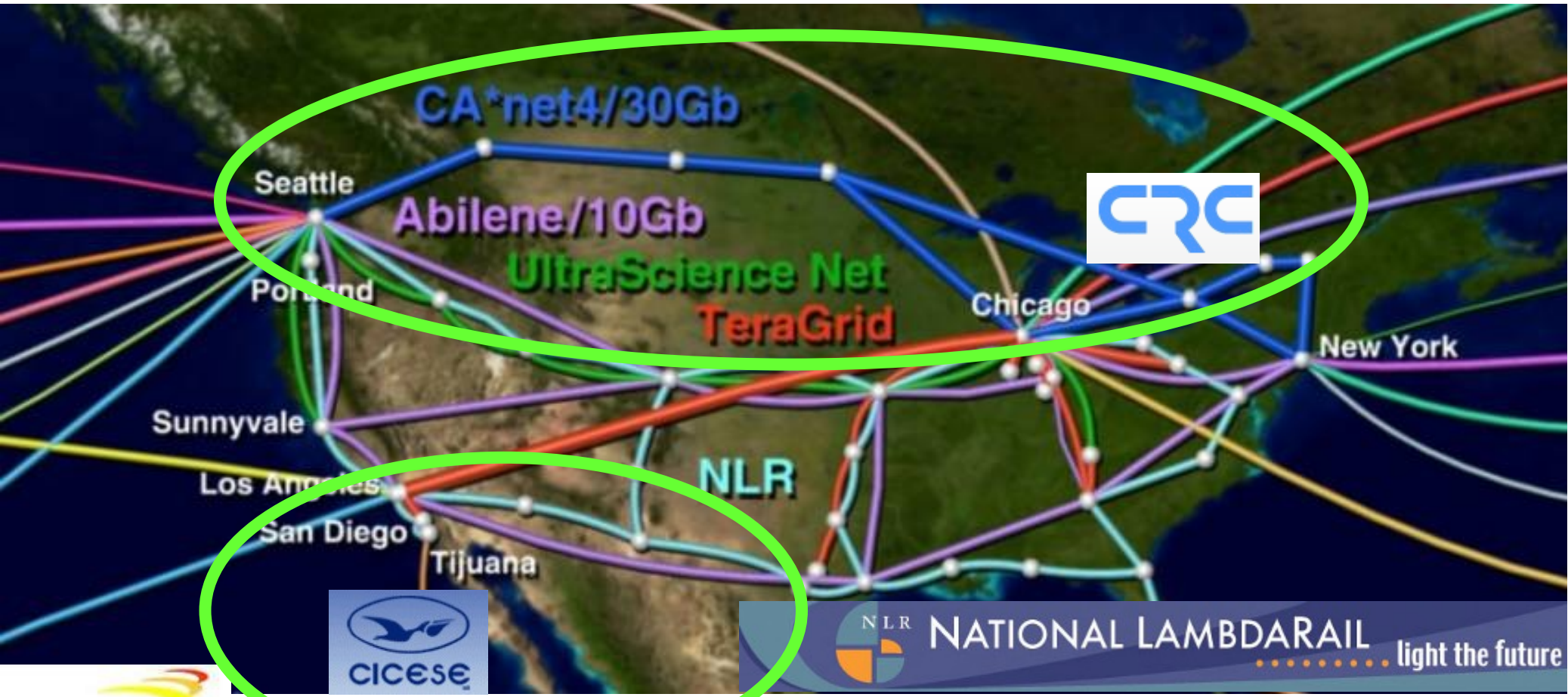
Creating a Critical Mass of End Users on a Secure LambdaGrid

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Source: Fran Berman, SDSC , Larry Smarr, Calit2

Creating a North American Superhighway for High Performance Collaboration

Canada's CRC was Connected via CANARIE to Calit2 in June 2006
Next Step is Connecting Mexico's CICESE to Calit2 within Six Months



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cudi

cenic
Corporation for Education Network Initiatives in California

CANARIE

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



There are 7407 Slices at 20 µm
Each Image has 8513 x 12,472 pixels

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

Source: Mark Ellisman, UCSD, Calit2

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

- **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**



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Connection to Calit2
Achieved Dec 18, 2006!

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Dedicated Optical Fiber Collaboratory: Remote Researchers Jointly Exploring Complex Data



Deploy Throughout Mexico After CICESE Test

OptIPuter



Proposal:

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

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CalViz--
HD Streaming Internationally



Photo: Courtesy of Harry Ammons

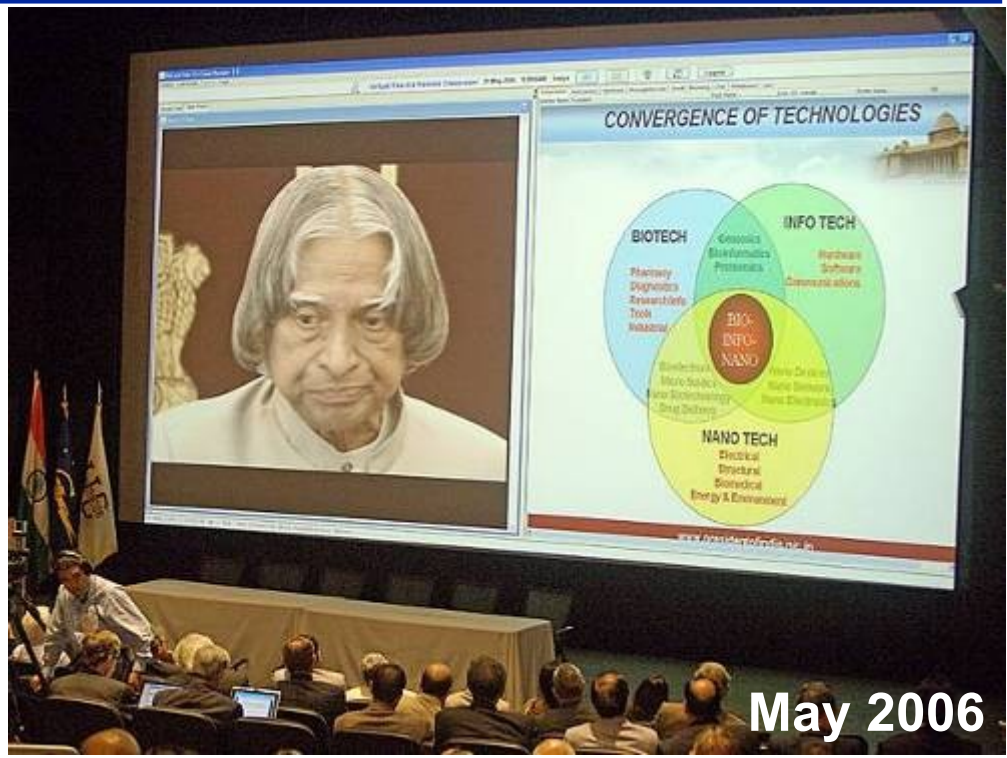
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See Studio on 1th Floor of Calit2@UCSD Building
Two Talks to Australia in 2006

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Qualcomm, Jacobs School of Engineering, & Calit2 International Initiative with India

- **Telecom Sector Trend:**
  - California Companies and Foreign Governments are Establishing R&D Centers Overseas
- **Plan For Engagement:**
  - Develop a Global R&D Alliance Involving Government, Academic Institutions and Industry
- **Status**
  - Raised Resources
  - Developed MOU with Ministry of Science and Technology, Government Of India
  - US-India Summit Meeting
  - Built Up an India-Interest Team
  - Exploring New Programs



- PURA--Societal Grid for a Billion People
- Convergence of Info- Nano - Bio
- Interactive Knowledge System
- Ubiquitous Unlimited Bandwidth

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