Experiments in Living in the Virtual/Physical World

Opening Keynote Talk

C5: The Eighth International Conference on Creating, Connecting and Collaborating through Computing
Calit2@UC San Diego

January 25, 2010

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

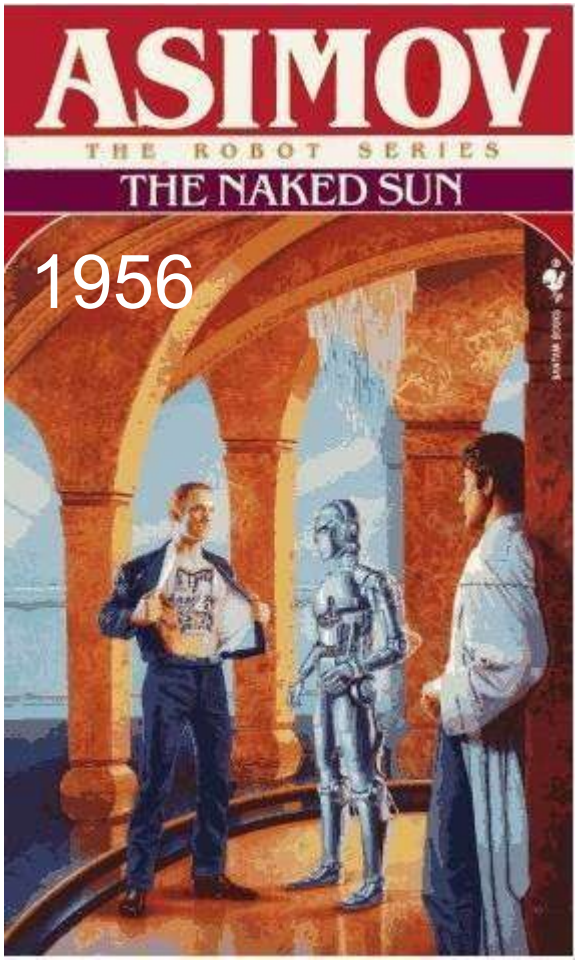
Twitter: lsmarr

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Over Fifty Years Ago, Asimov Described a World of Telepresence



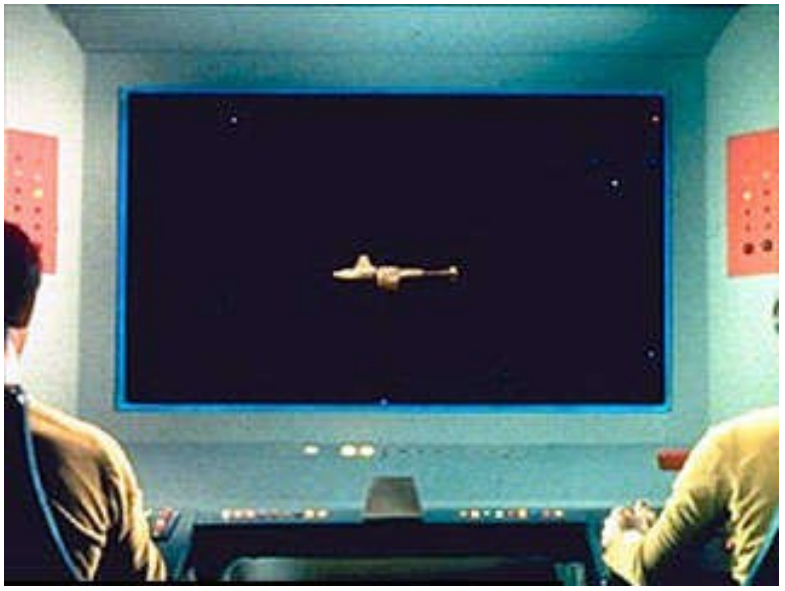
A policeman from Earth, where the population all lives underground in close quarters, is called in to investigate a murder on a distant world. This world is populated by very few humans, rarely if ever, coming into physical proximity of each other. Instead the people "View" each other with trimensional “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 Beginnings of Commercialization: PicturePhone Introduced 40 Years Ago



NEW LOOK PICTUREPHONE

Now you can *see* as well as talk The Picturephone has Touch-Tone controls to make calls and control the television screen so you can see the person you're talking to, be seen yourself, or have a darkened screen. Attended service between New York, Washington and Chicago began in 1964.

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www.bellsystemmemorial.com/telephones-picturephone.html

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

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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

1996

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

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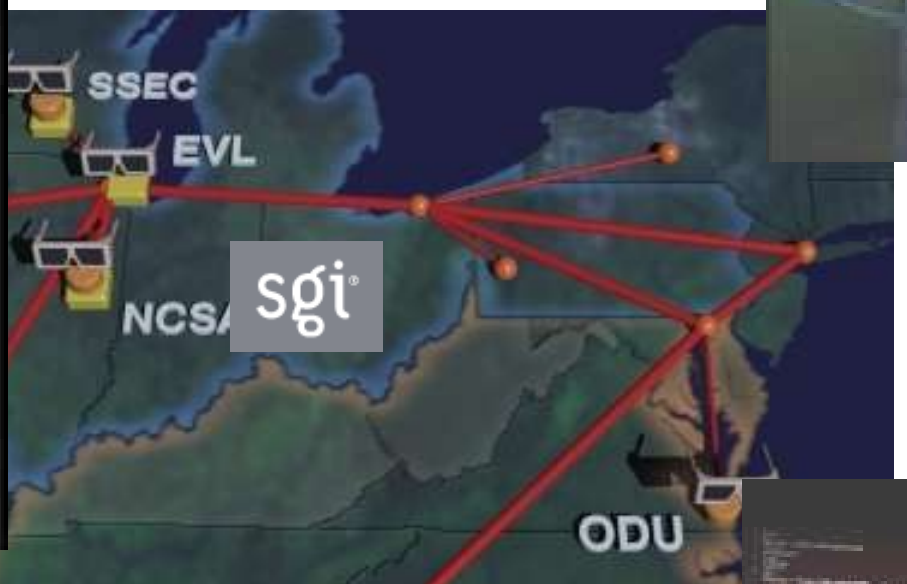
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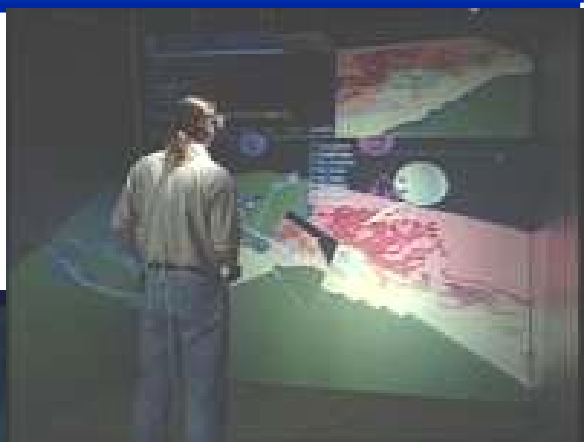
Alliance 1997: Collaborative Video Production via Tele-Immersion and Virtual Director

Alliance Project Linking CAVE, ImmersaDesk, Power Wall, and Workstation

Alliance Application Technologies
Environmental Hydrology Team











NCSA™ UIC

sgi

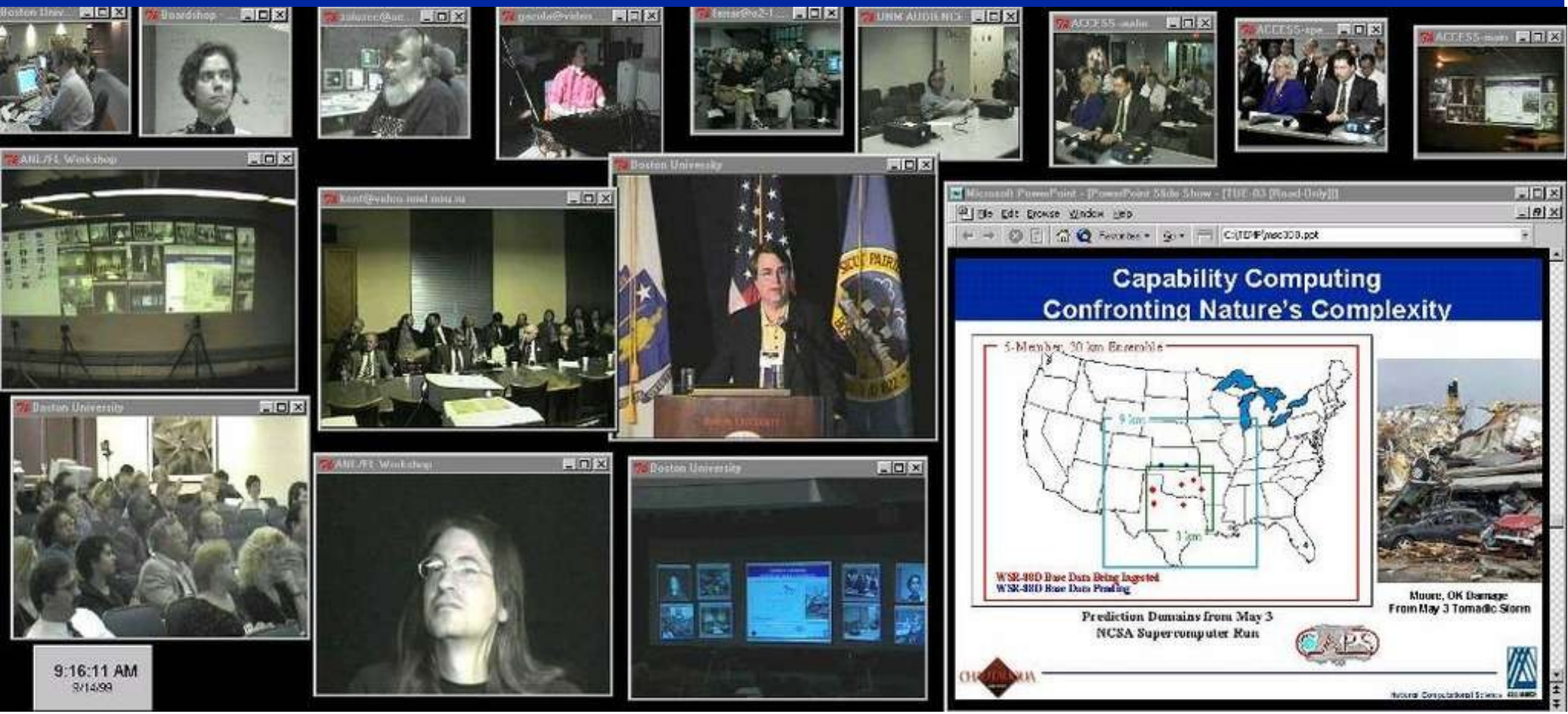
ALLIANCE

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Donna Cox, Robert Patterson, Stuart Levy, NCSA Virtual Director Team
Glenn Wheless, Old Dominion Univ.

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From Telephone Conference Calls to Access Grid International IP Multicast



1999

CHAUTAUQUA ALLIANCE

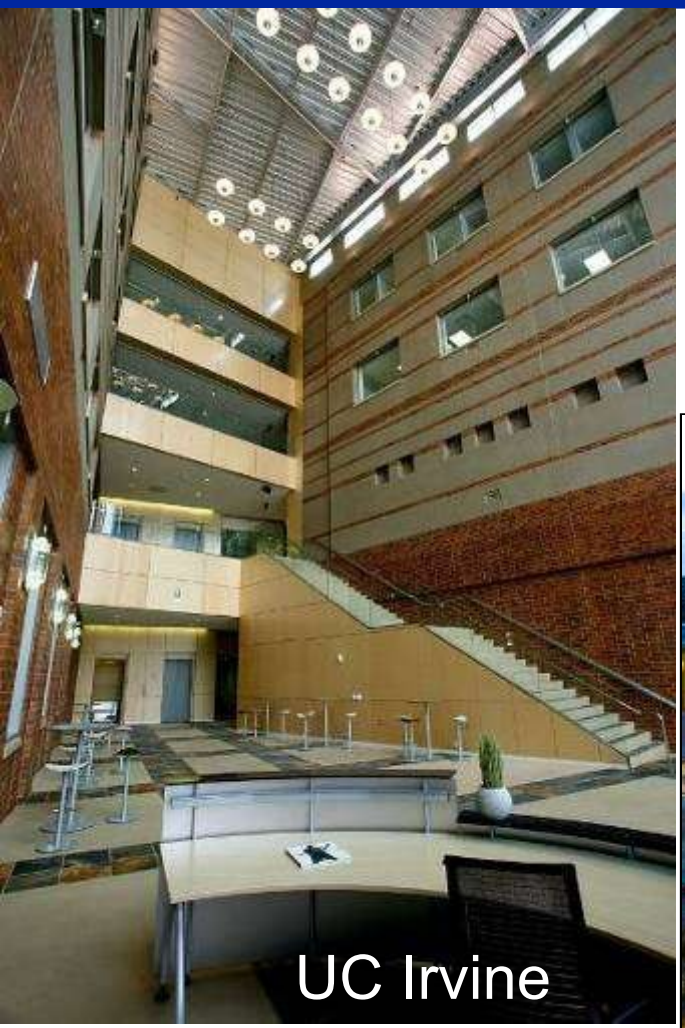
National Computational Science ALLIANCE

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Access Grid Lead-Argonne
NSF STARTAP Lead-UIC's Elec. Vis. Lab

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Two New Calit2 Buildings Provide 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**



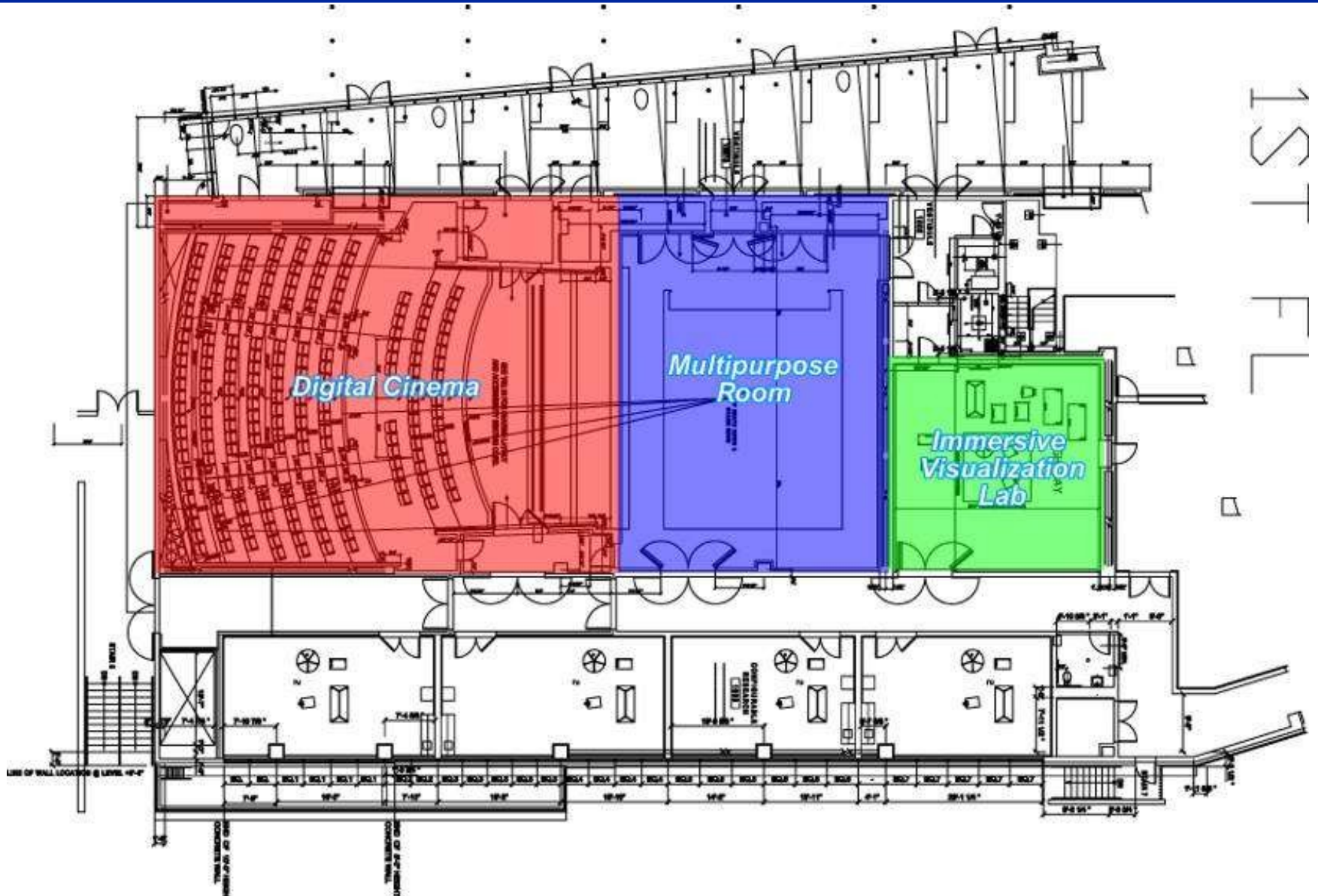
www.calit2.net

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Preparing for a World in Which Distance is Eliminated…

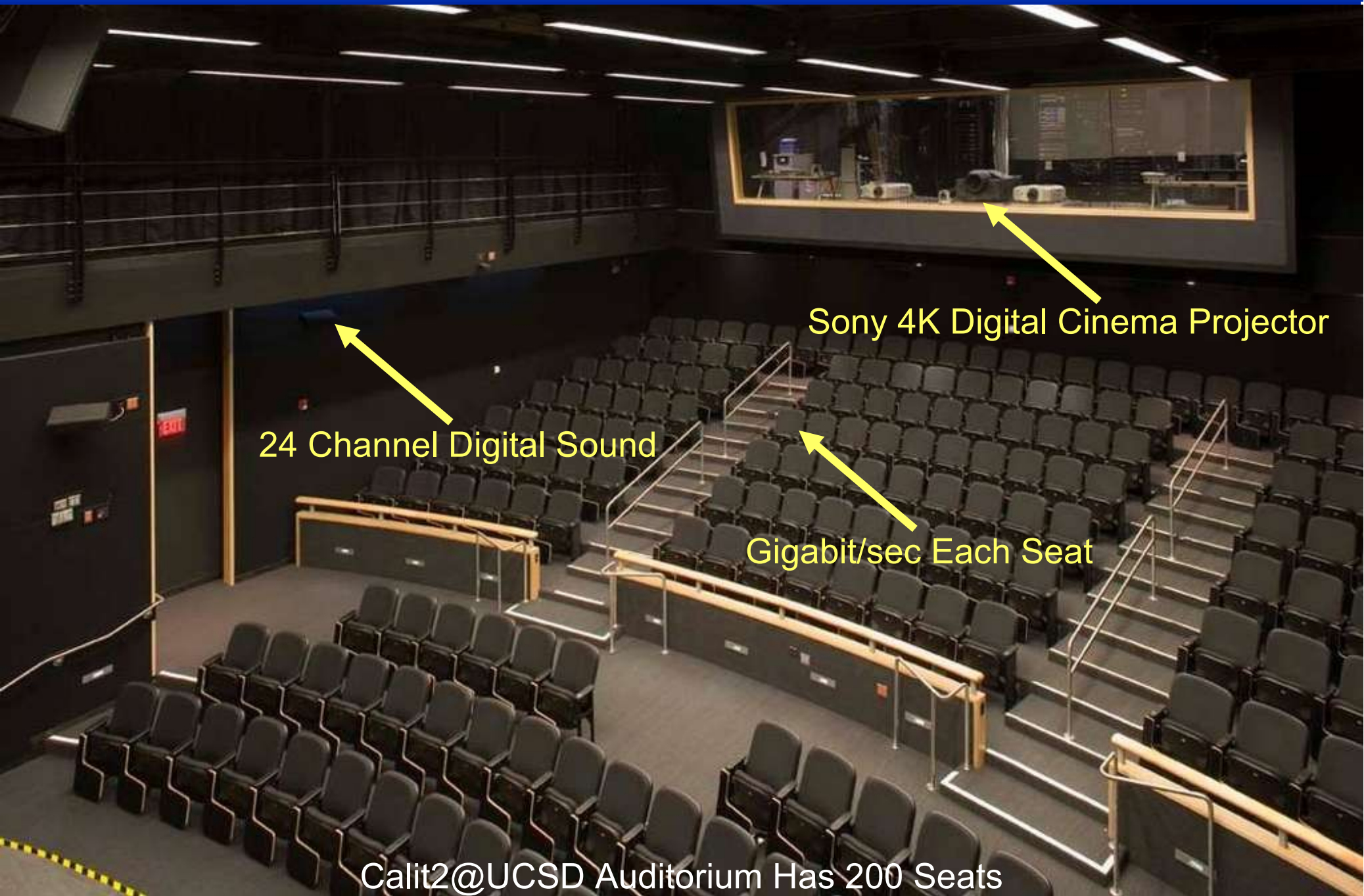
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Calit2@UCSD Designed Three Experimental New Media Arts Spaces into Atkinson Hall



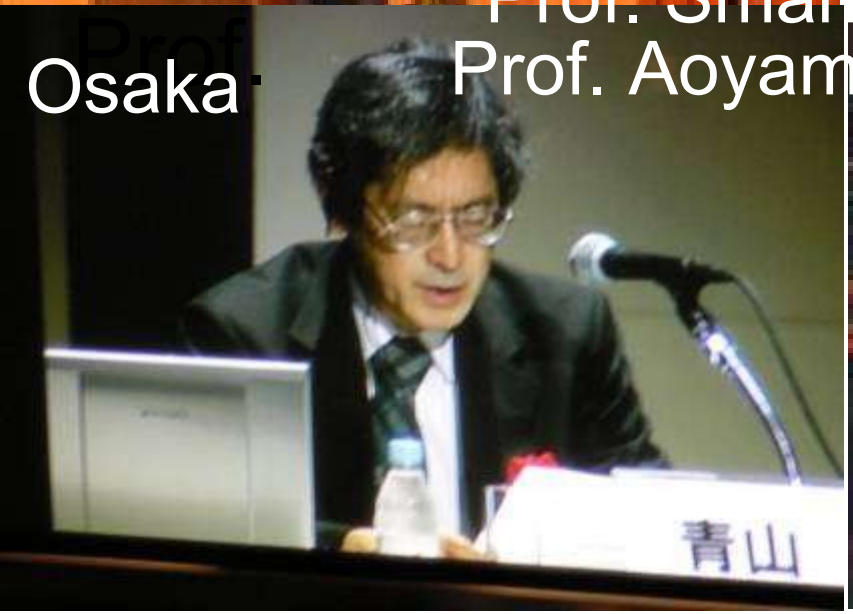
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Digital Auditorium: Building a Global Collaboratorium



Multiple Gigabit HD Streams Over Lambdas Will Radically Transform Global Collaboration





Telepresence Using Uncompressed 1.5 Gbps HDTV Streaming Over IP on Fiber Optics-- 75x Home Cable "HDTV" Bandwidth!



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"I can see every hair on your head!"—Prof. Aoyama

Source: U Washington Research Channel

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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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Linking the Calit2 Auditoriums at UCSD and UCI with LifeSize HD for Shared Seminars



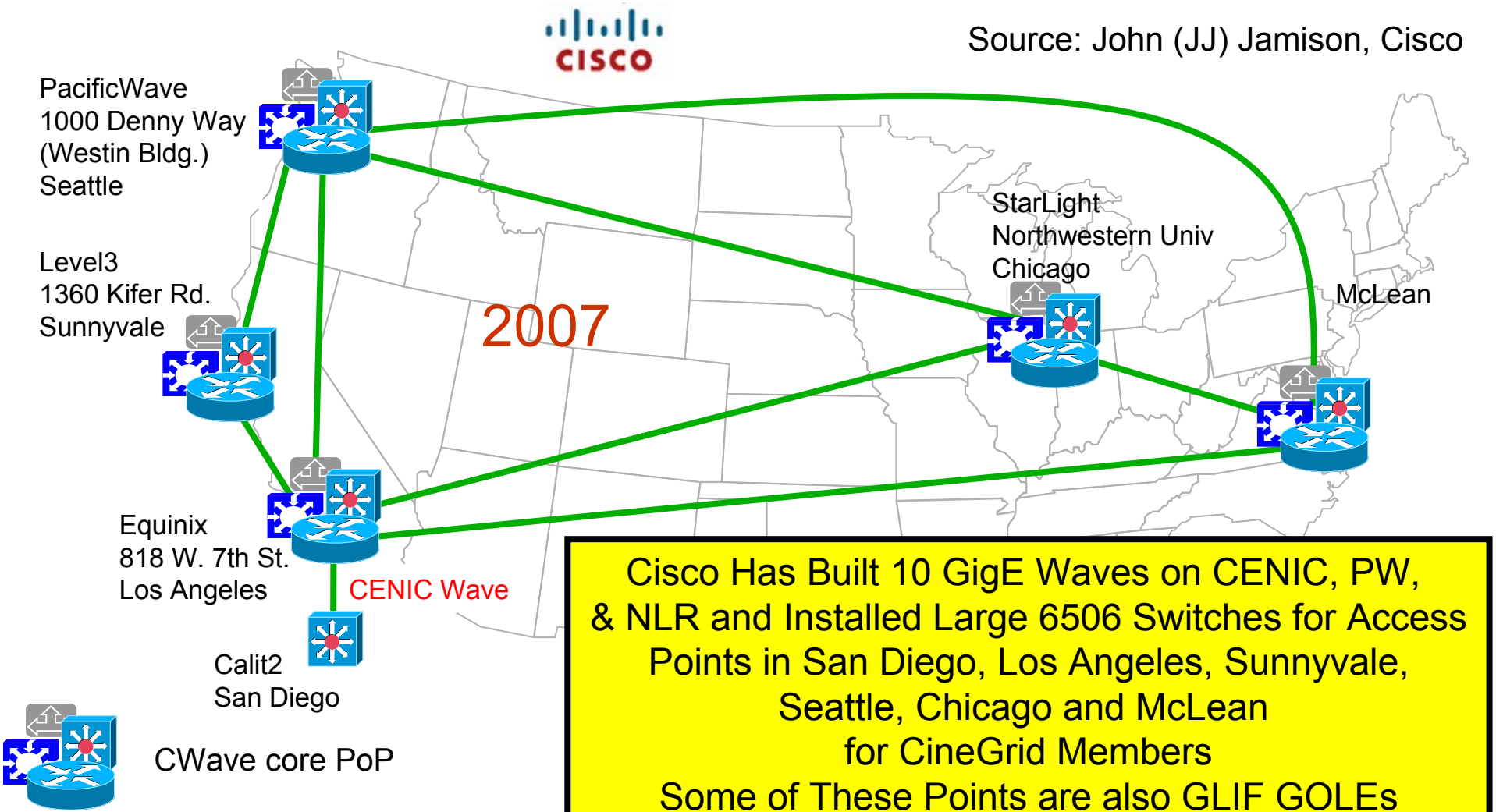
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Photo by Erik Jepsen, UC San Diego

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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 4K Digital Cinema Projects: "Learning by Doing"

CineGrid @ iGrid 2005



CineGrid @ AES 2006





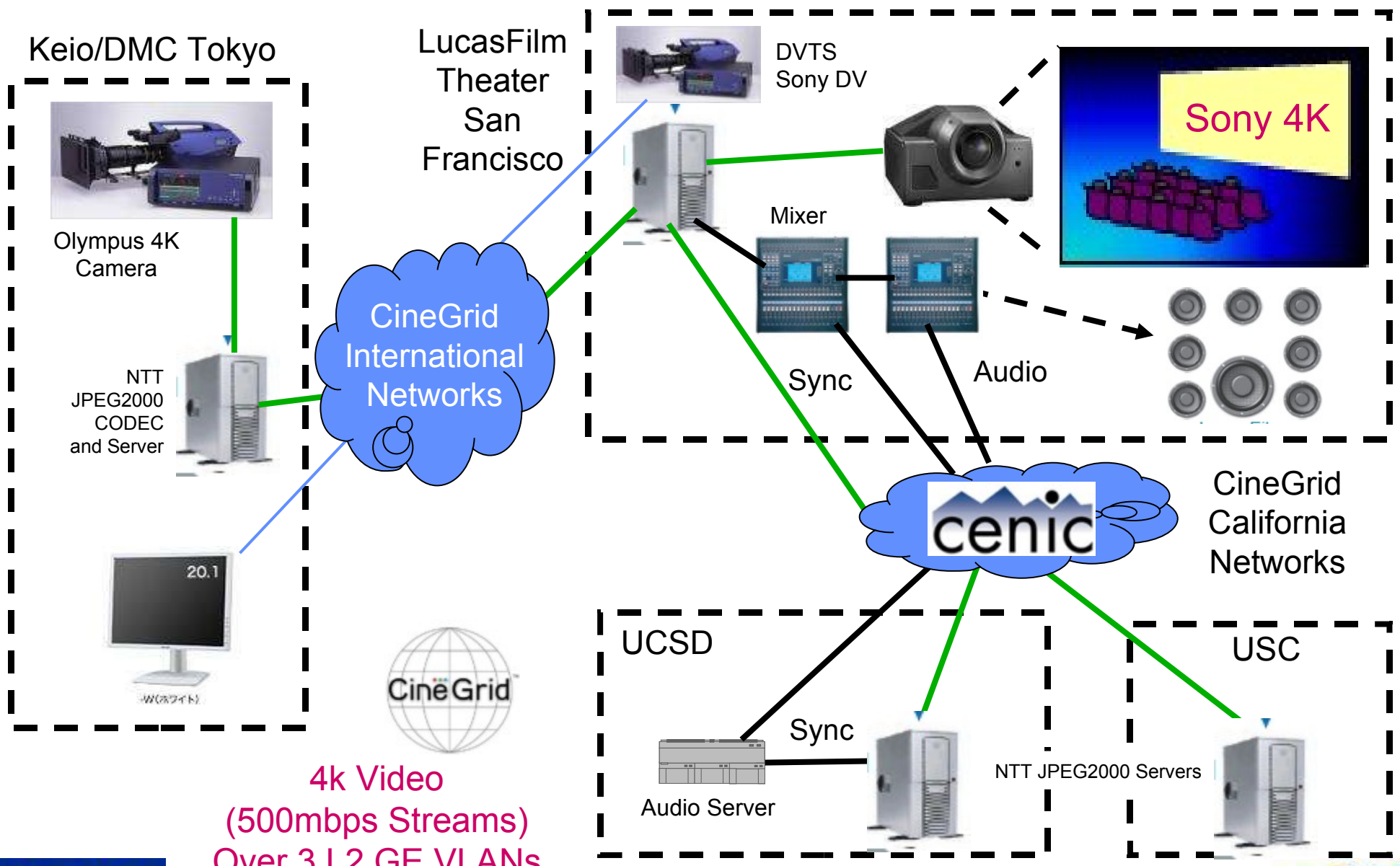
CineGrid @ Holland Festival 2007



CineGrid @ GLIF 2007

Audio Engineering Society (AES)/LucasFilm

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



4k Video
(500mbps Streams)
Over 3 L2 GE VLANs
Plus 24 Channel Audio
Over Another GE

Source: Peter Otto, Calit2

First Tri-Continental Premier of a Streamed 4K Feature Film With Global HD Discussion



CRCA

CISCO
C-wave
CineGrid

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4K Transmission Over 10Gbps--
4 HD Projections from One 4K Projector

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Becoming Dragon-A Mixed Reality, Durational Performance Combining Virtual Reality, Motion Capture, Second Life



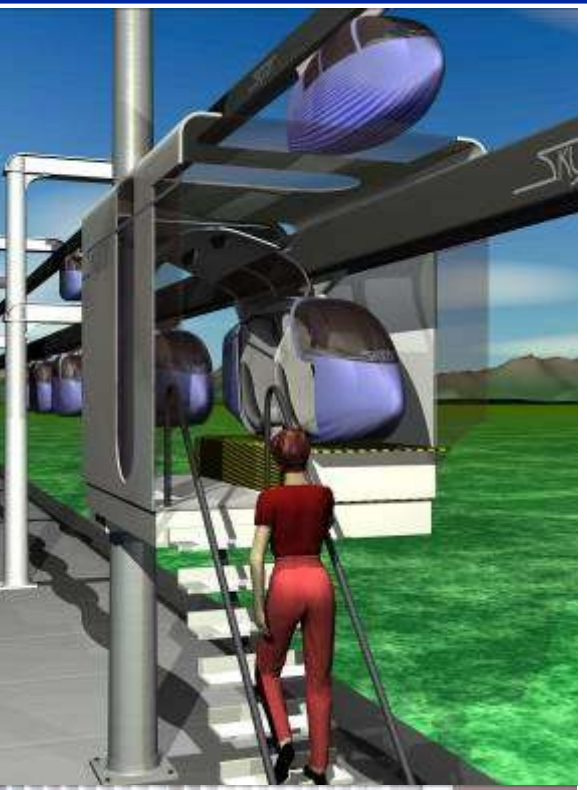
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365 hours, from December 1-17th, 2008

Source: Micha Cárdenas, CRCA, Calit2

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Bringing Engineering into Cyberspace:
Second Life Simulator for Engineering Design of Unimodal SkyTran







- **Unimodal Inc. – OC Based Company – Developing a Personal Rapid Transit System Called SkyTran**
  - **UniModal Needed to Develop and Test Software That will Prevent Magnetic-Levitated Vehicles from Colliding as they Merge On and Off Roadway**
- **Calit2 Research Team Created Canto Bay in Virtual World Second Life to do Simulations and Modeling**
  - **Canto Bay and Calit2 Offers Solution by Building a Simulated System in Canto Bay and Modeling the Logic-Control Layer**
- **Simulation Provides Feedback to Company Engineers About Design Decisions Before Deploying in Real World Later this Year**
- **Calit2 Research Team Gets Funding to Make Further Refinements in Simulation Research and for Student Support**

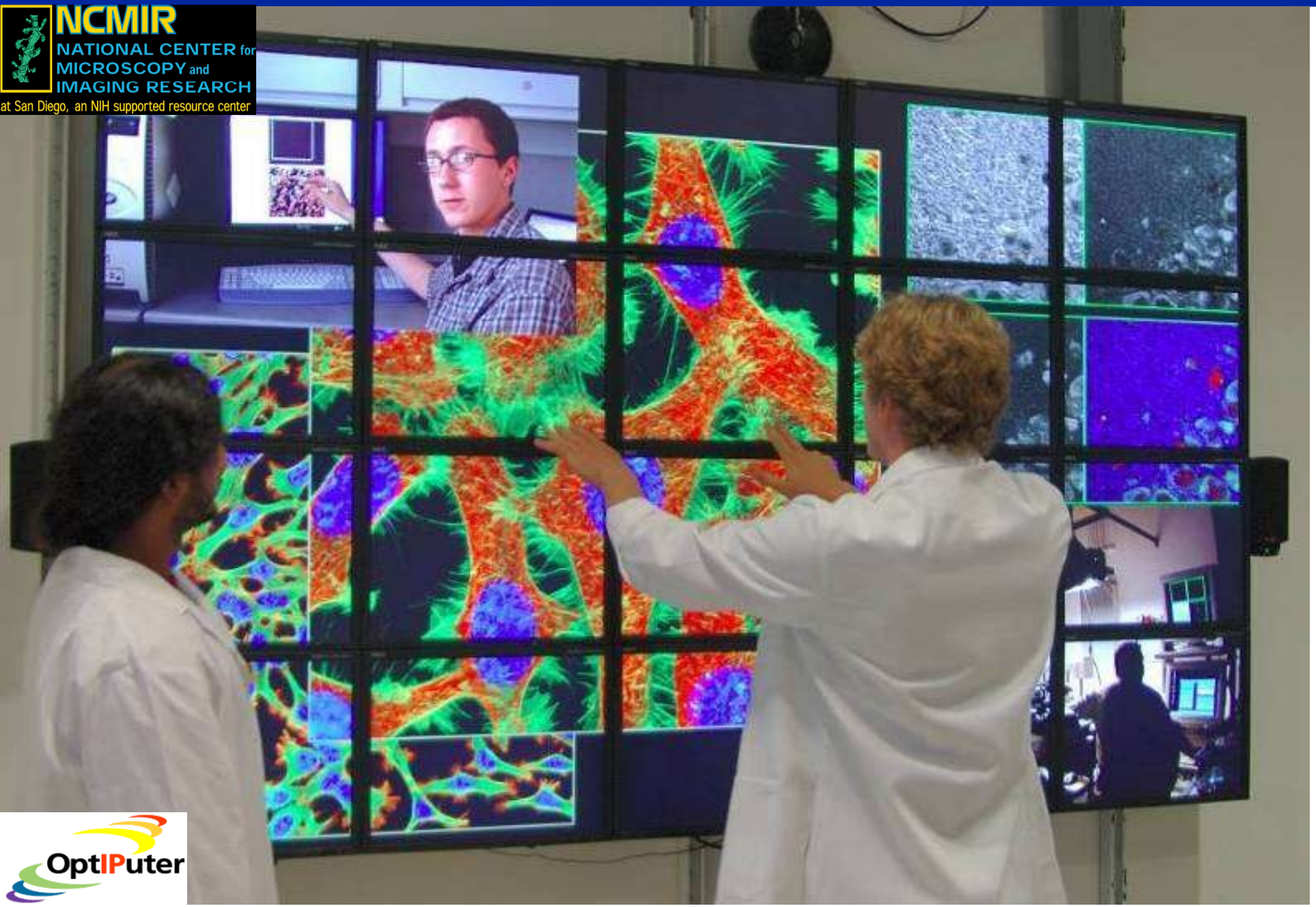
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Source: Christa Lopes, ICS, UCI

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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

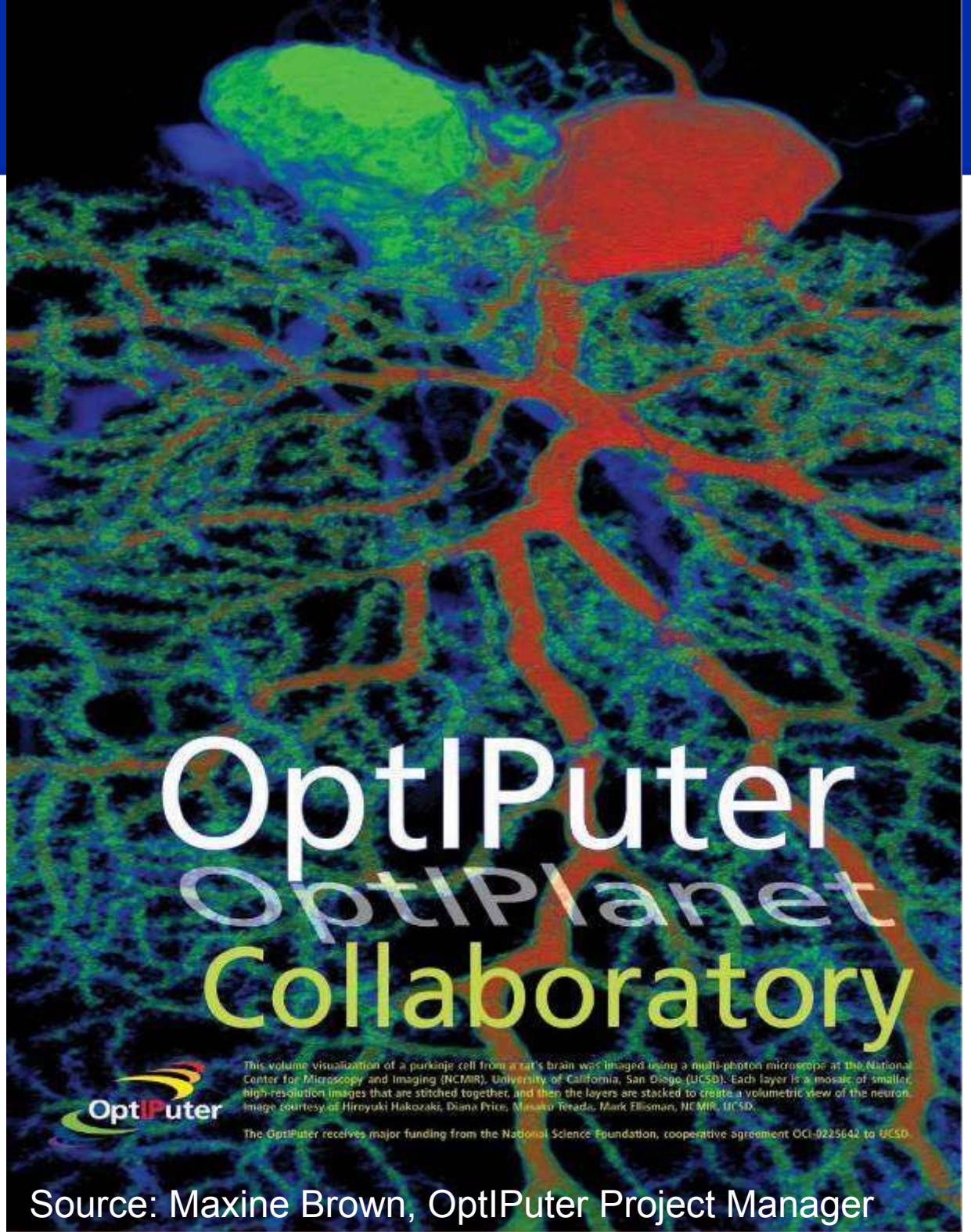
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Calit2 (UCSD, UCI) and UIC Lead Campuses—Larry Smarr PI

Univ. Partners: SDSC, USC, SDSU, NW, TA&M, UvA, SARA, KISTI, AIST

Industry: IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent

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Source: Maxine Brown, OptIPuter Project Manager

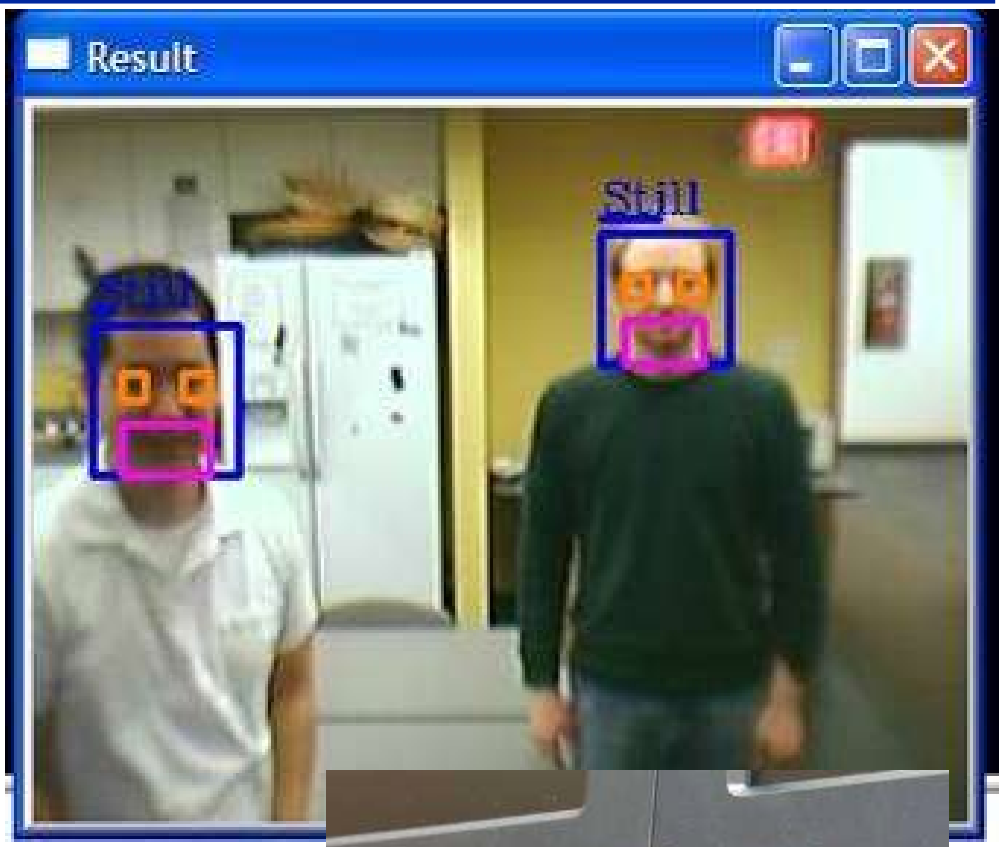
Green Initiative:

Can Optical Fiber Replace Airline Travel for Continuing Collaborations?

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U Michigan Virtual Space Interaction Testbed (VISIT) Instrumenting OptIPortals for Social Science Research

- **Using Cameras Embedded in the Seams of Tiled Displays and Computer Vision Techniques, we can Understand how People Interact with OptIPortals**
  - **Classify Attention, Expression, Gaze**
  - **Initial Implementation Based on Attention Interaction Design Toolkit (J. Lee, MIT)**
- **Close to Producing Usable Eye/Nose Tracking Data using OpenCV**





Leading U.S. Researchers on the Social Aspects of Collaboration

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Source: Erik Hofer, UMich, School of Information

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High Definition Video Connected OptIPortals: Virtual Working Spaces for Data Intensive Research



LifeSize HD

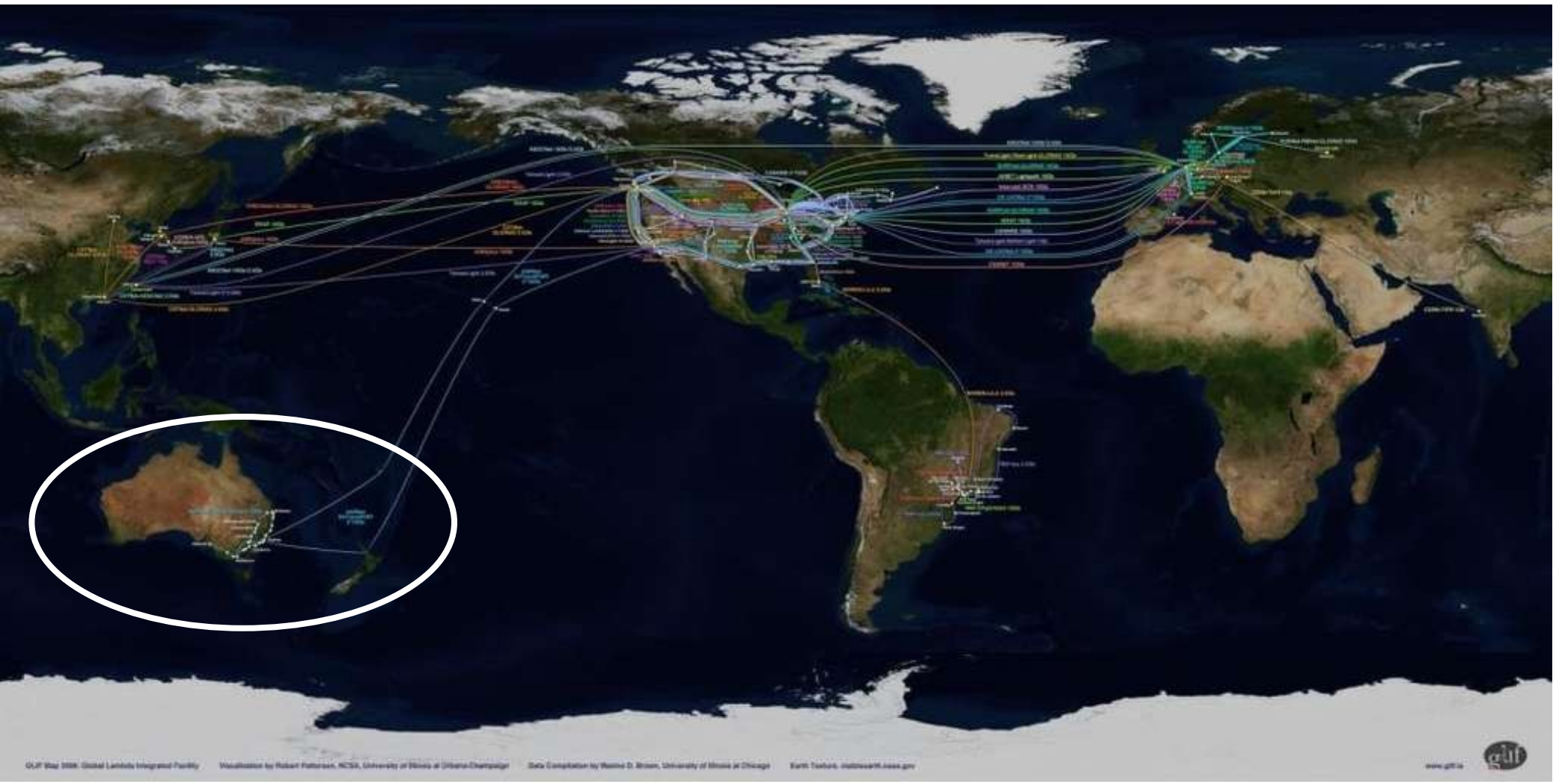
NASA Ames
Lunar Science Institute
Mountain View, CA

NASA Interest
in Supporting
Virtual Institutes

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Source: Falko Kuester, Kai Doerr Calit2; Michael Sims, NASA

Global Innovation Centers are Being Connected with 10,000 Megabits/sec Clear Channel Lightpaths

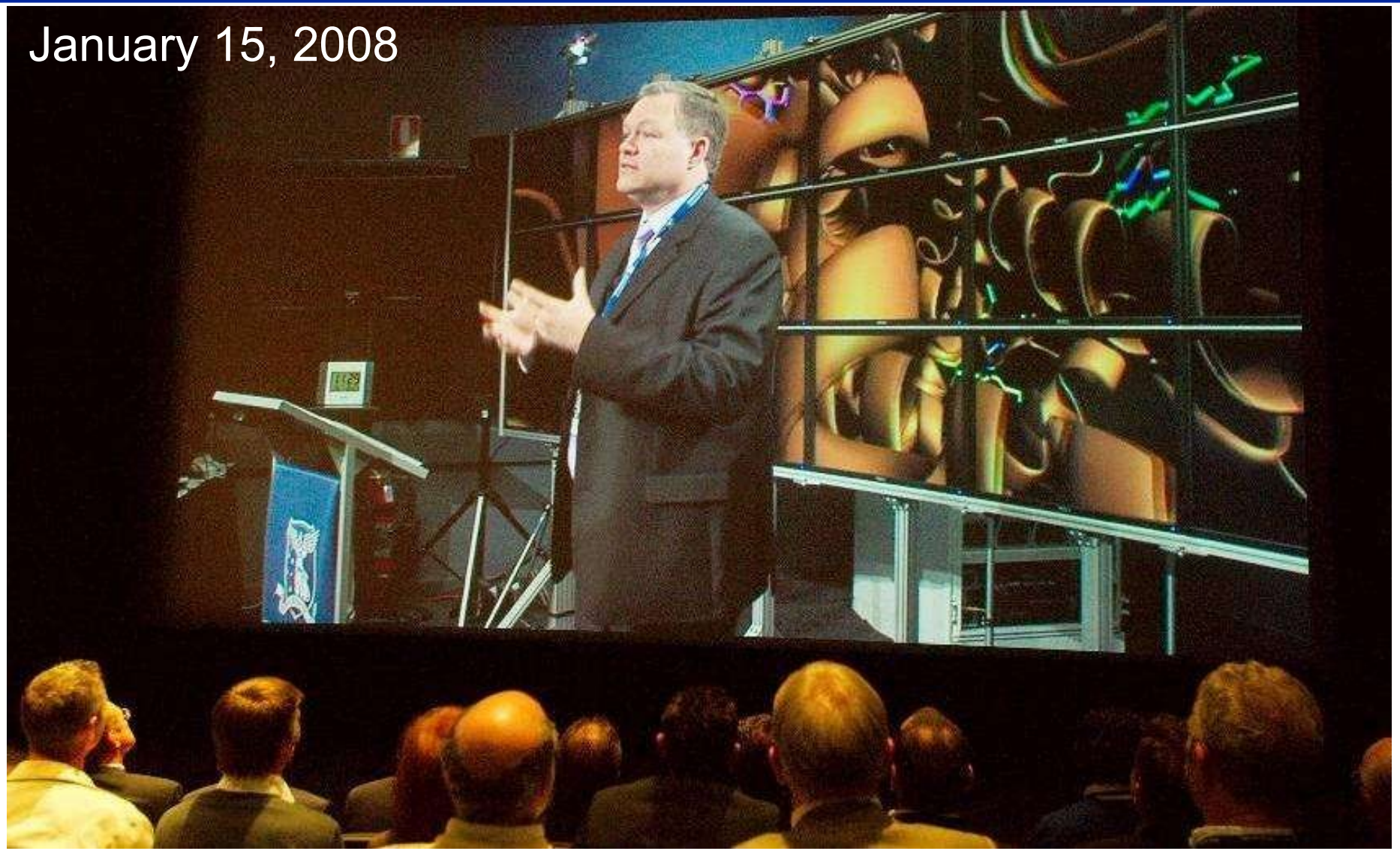


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Research on 100 Gbps and 1 Tbps

Source: Maxine Brown, UIC and Robert Patterson, NCSA

Launch of the 100 Megapixel OzIPortal Kicked Off a Rapid Build Out of Australian OptIPortals



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

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Covise, Phil Weber, Jurgen Schulze, Calit2
CGLX, Kai-Uwe Doerr , Calit2
http://www.calit2.net/newsroom/release.php?id=1421

Victoria Premier and Australian Deputy Prime Minister Asking Questions



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

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



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HD Talk to Australia's Monash University from Calit2: Reducing International Travel



Qvidium Compressed HD ~140 mbps

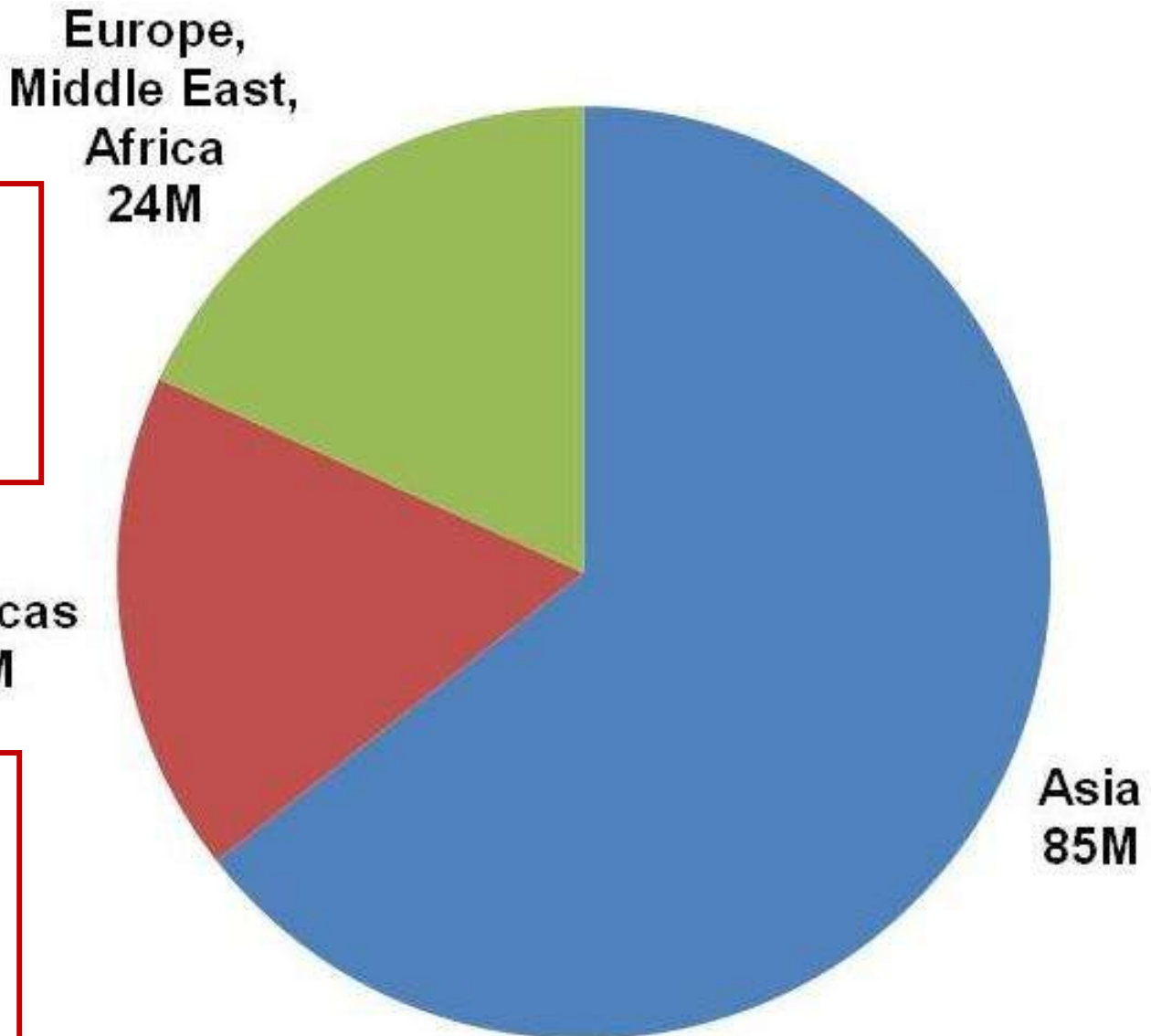
Source: David Abramson, Monash Univ

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Globally Fiber to the Premise is Growing Rapidly, Mostly in Asia

FTTP Connections Growing at ~30%/year



130 Million Households with FTTH in 2013

Source: Heavy Reading (www.heavyreading.com), the market research division of Light Reading (www.lightreading.com).

Multi-User Global Workspace: San Diego, Chicago, Saudi Arabia

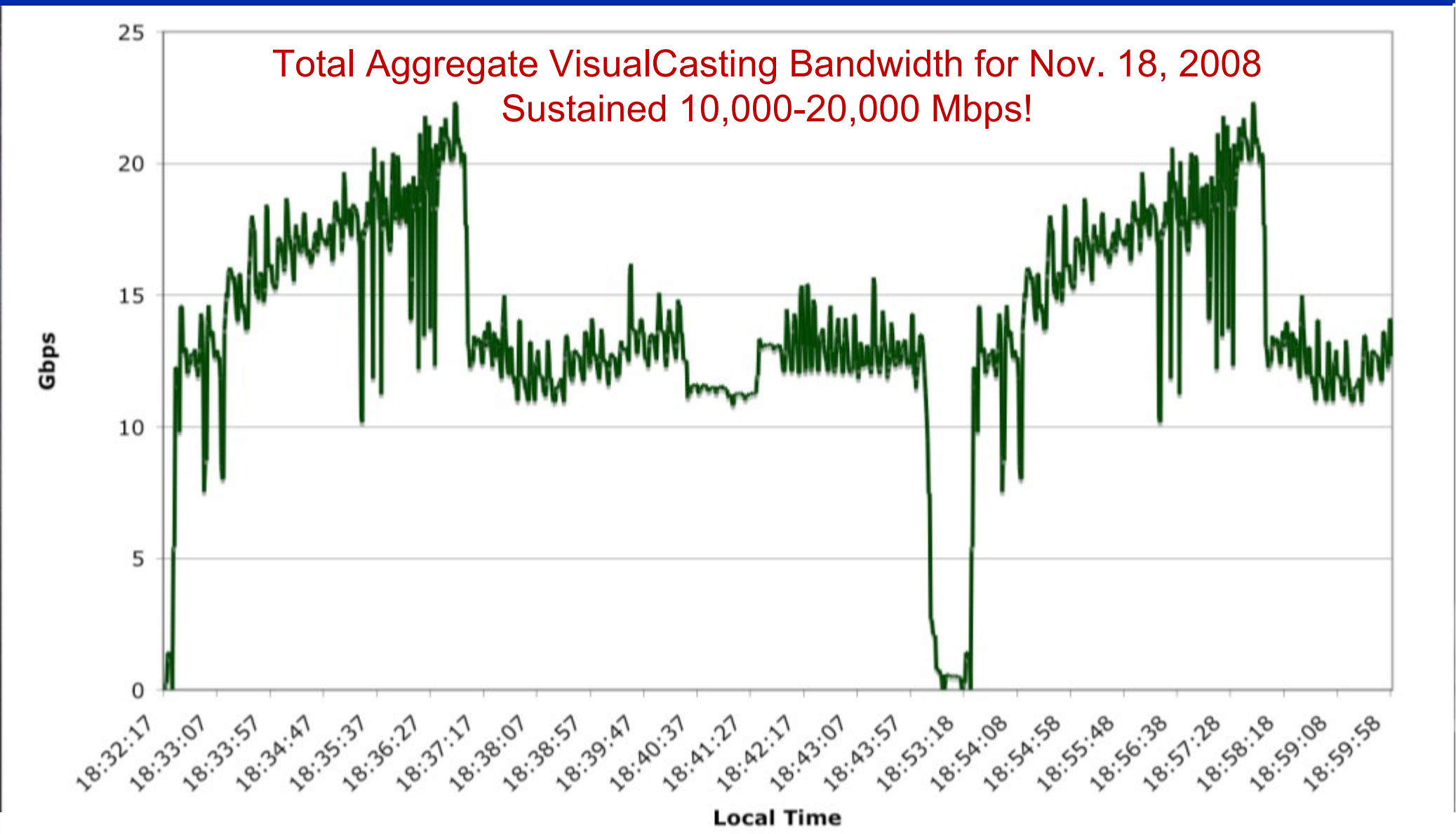


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Source: Tom DeFanti, KAUST Project, Calit2

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EVL's SAGE OptIPortal VisualCasting Multi-Site OptIPuter Collaboratory

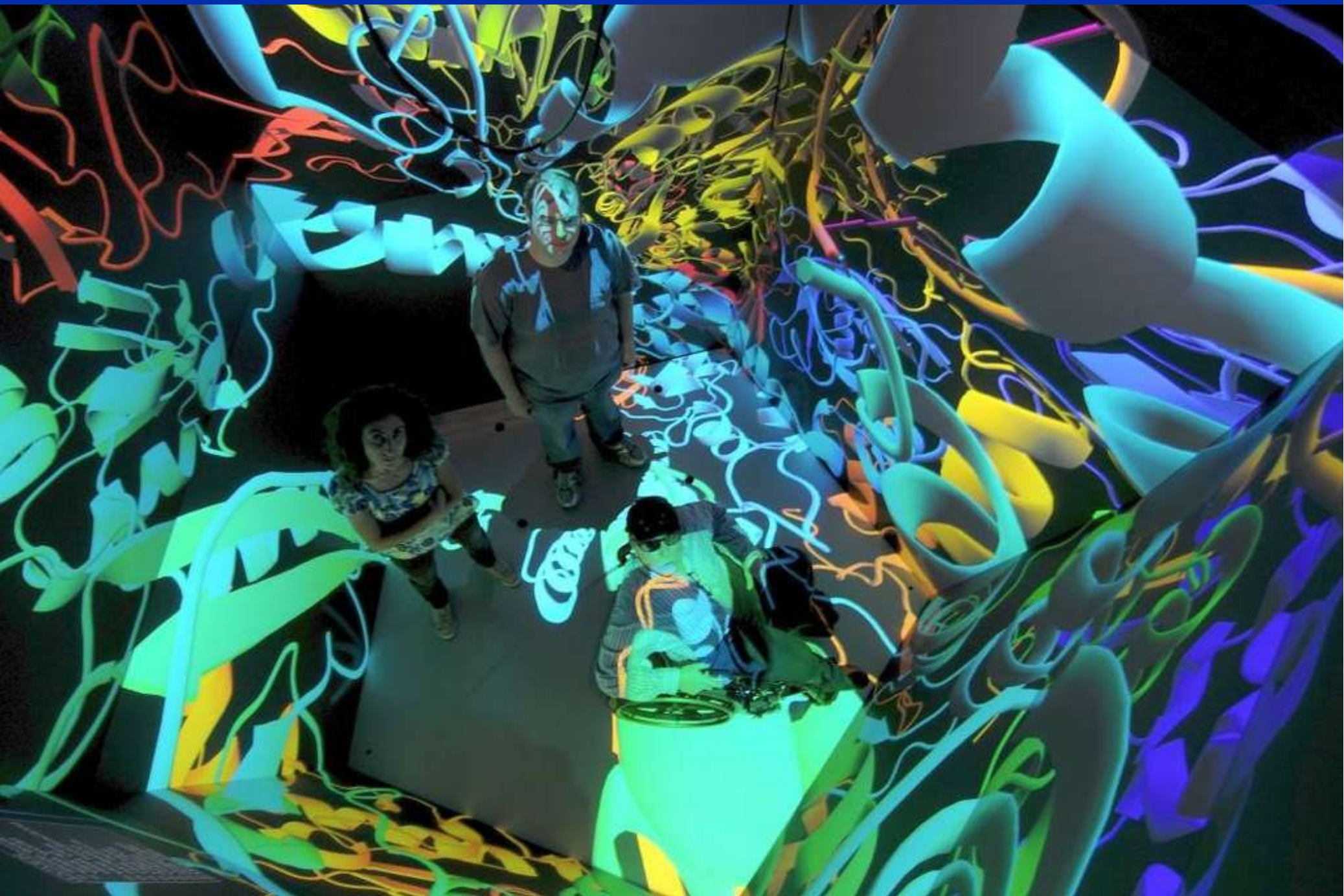


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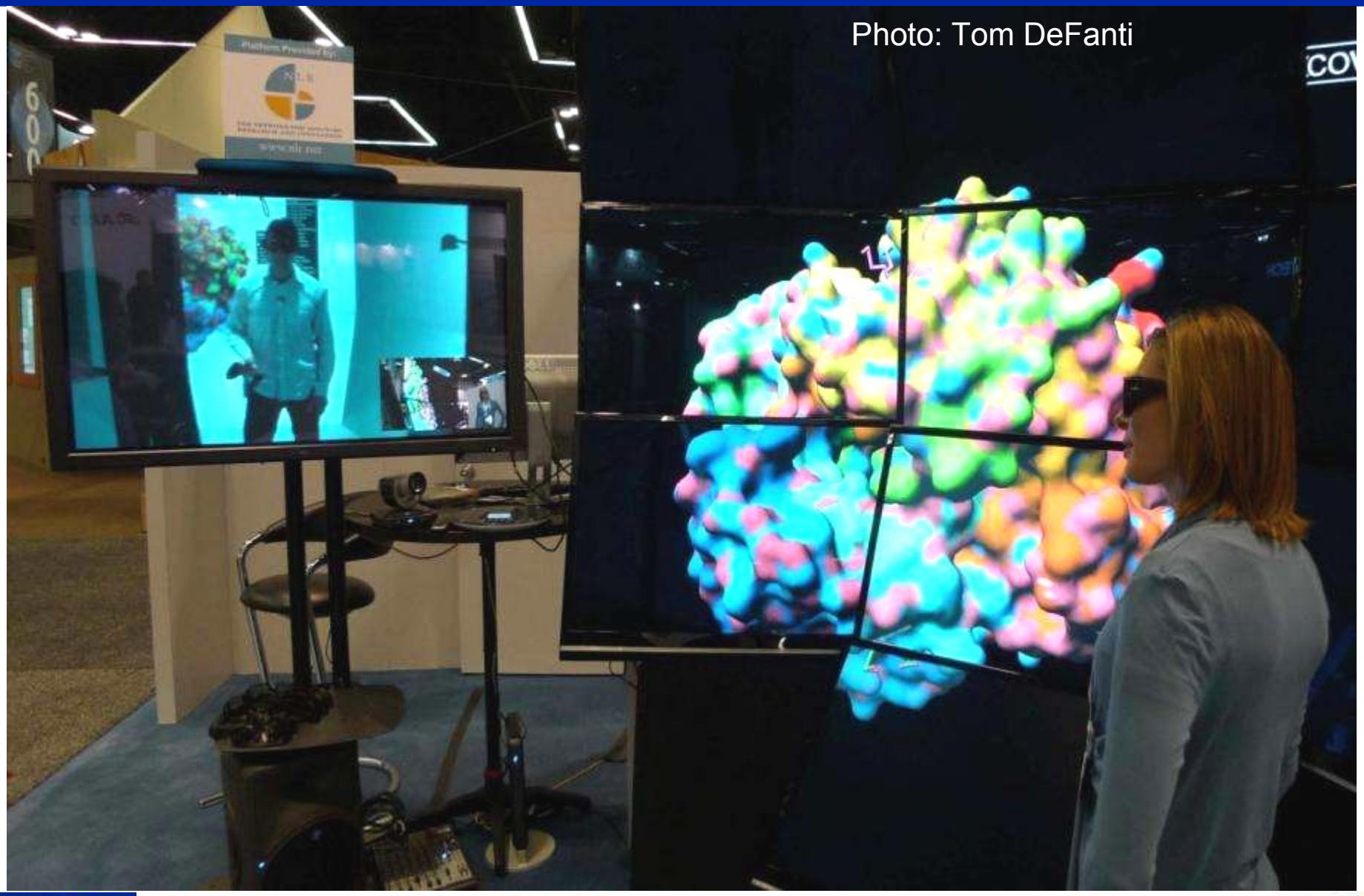
Source: Jason Leigh, Luc Renambot, EVL, UI Chicago

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Ultra Resolution Virtual Reality: Toward a 3D Global Collaboratory



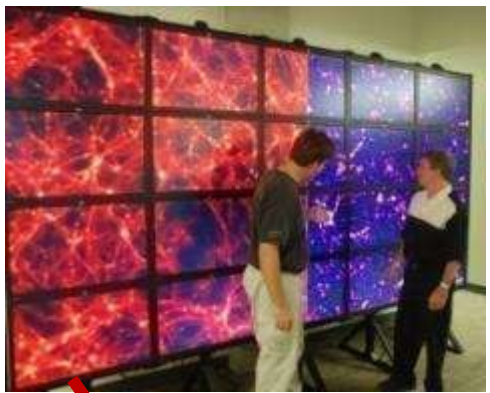
CAVE to CAVE Collaboration with HD Video



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Calit2's Jurgen Schulze in San Diego in StarCAVE and Kara Gribskov at SC'09 in Portland, OR with NextCAVE

Academic Research "OptIPlatform" Cyberinfrastructure: A 10Gbps Lightpath Cloud



End User OptIPortal



Instruments



HD/4k Telepresence



HD/4k Video Cams

HPC



10G Lightpaths

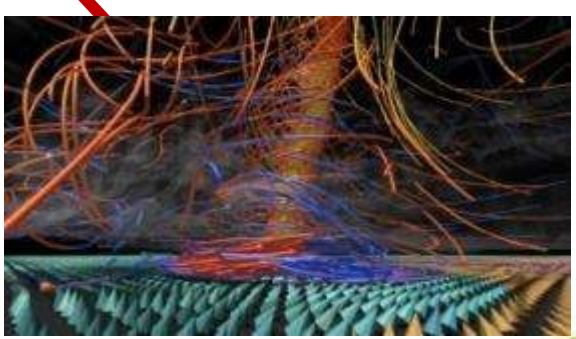


TeraGrid

Campus Optical Switch



Data Repositories & Clusters



HD/4k Video Images

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