"A Pioneer Speaks – A History & Future of Telepresence

Invited Talk
Telepresence World
San Diego University
June 4, 2007

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Jacobs School of Engineering, UCSD

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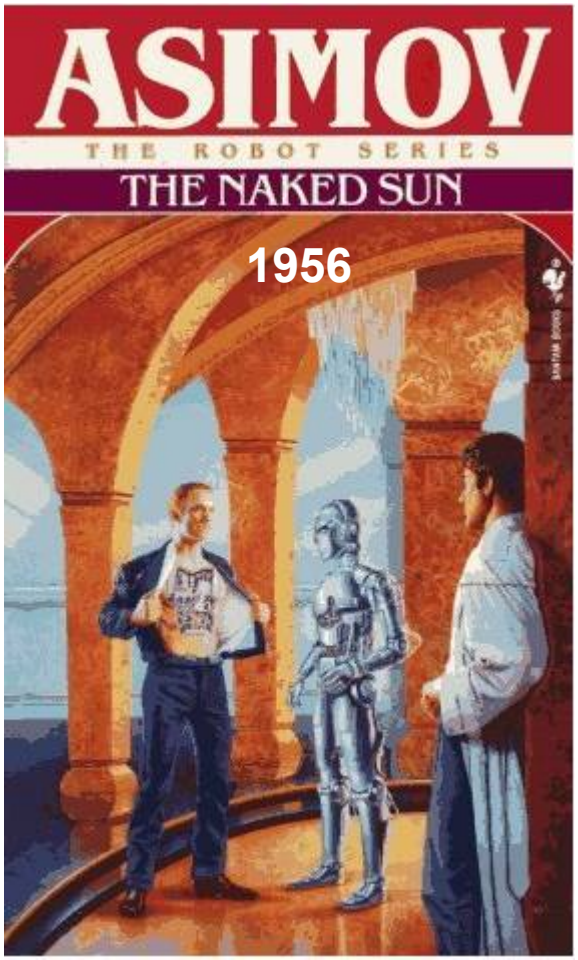
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Abstract

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 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.

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Fifty Years Ago, Asimov Described a World of Telepresence



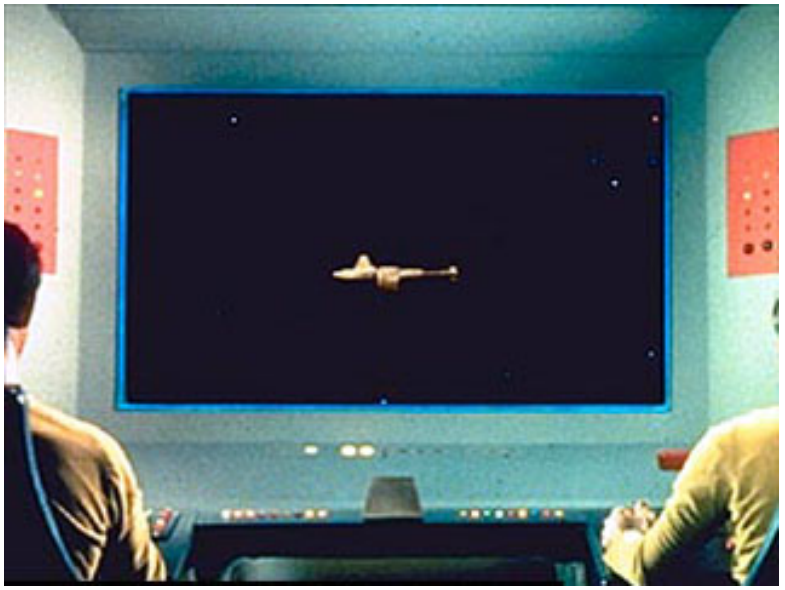
A policeman from Earth, where the population all lives underground in close quarters, is called in to investigate a murder on a distant world. This world is populated by very few humans, rarely if ever, coming into physical proximity of each other. Instead the people "View" each other with trimensional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



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www.bellsystemmemorial.com/telephones-picturephone.html

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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

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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

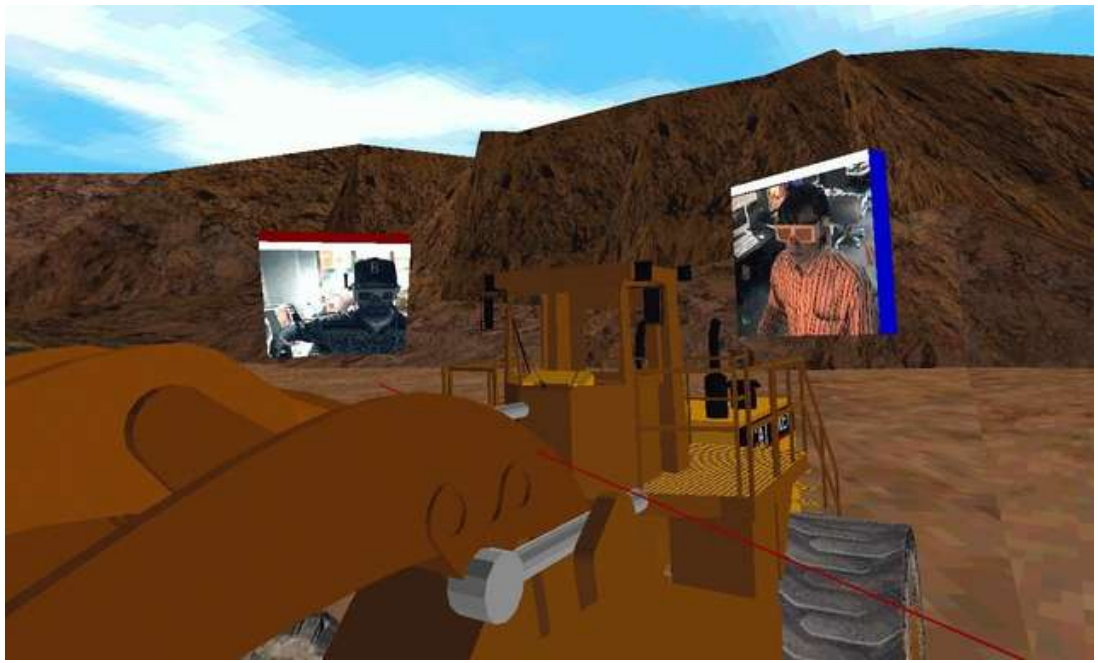
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SIGGRAPH 1989

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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

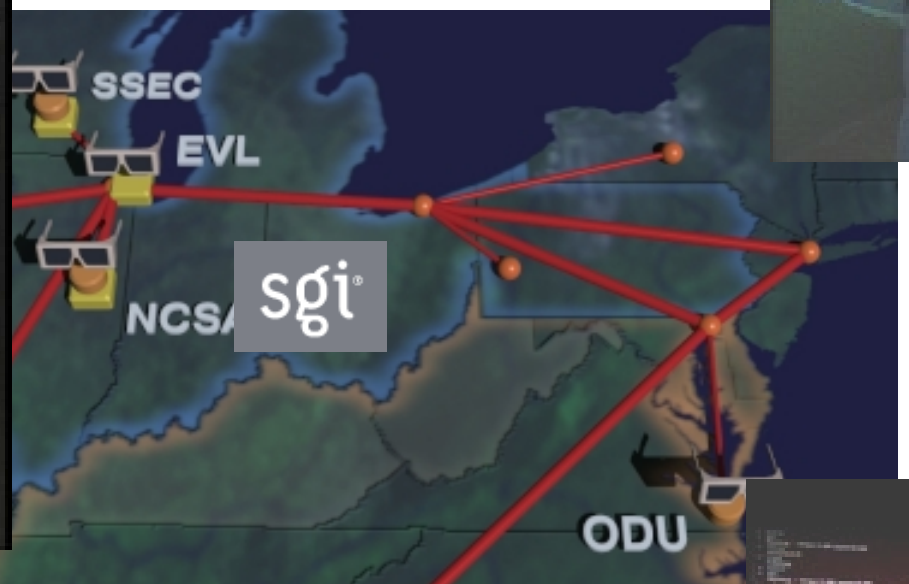
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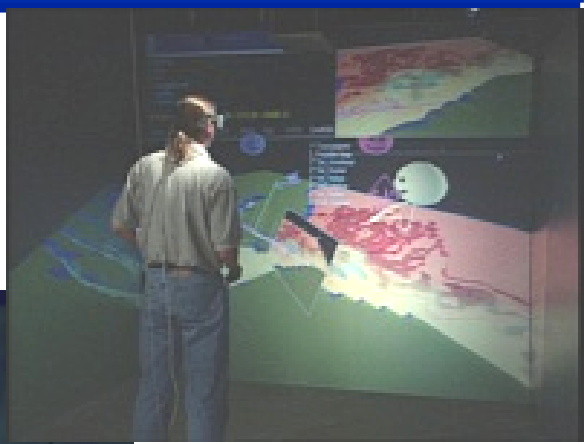
Alliance 1997: Collaborative Video Production via Tele-Immersion and Virtual Director

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

Alliance Application Technologies
Environmental Hydrology Team











NCSA™ UIC

sgi

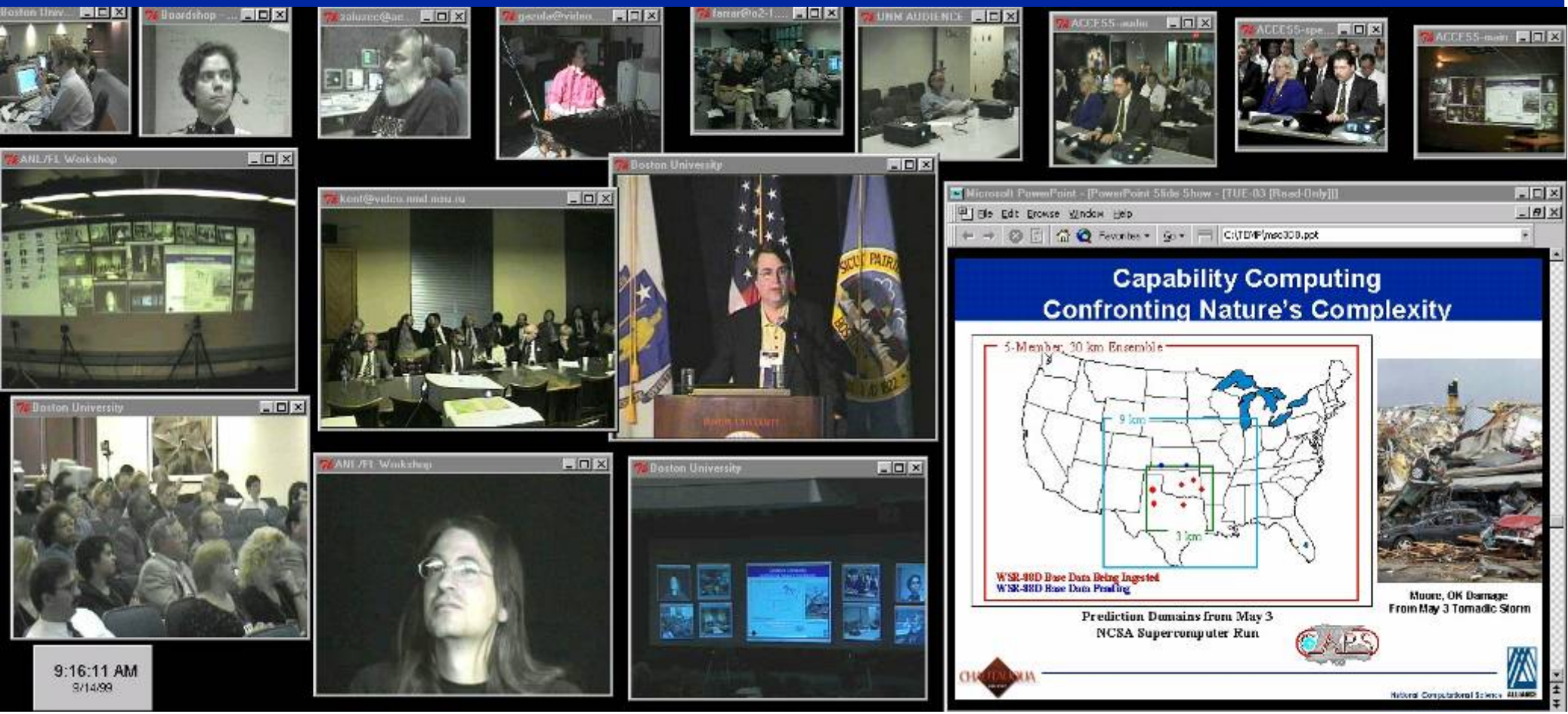
ALLIANCE

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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…

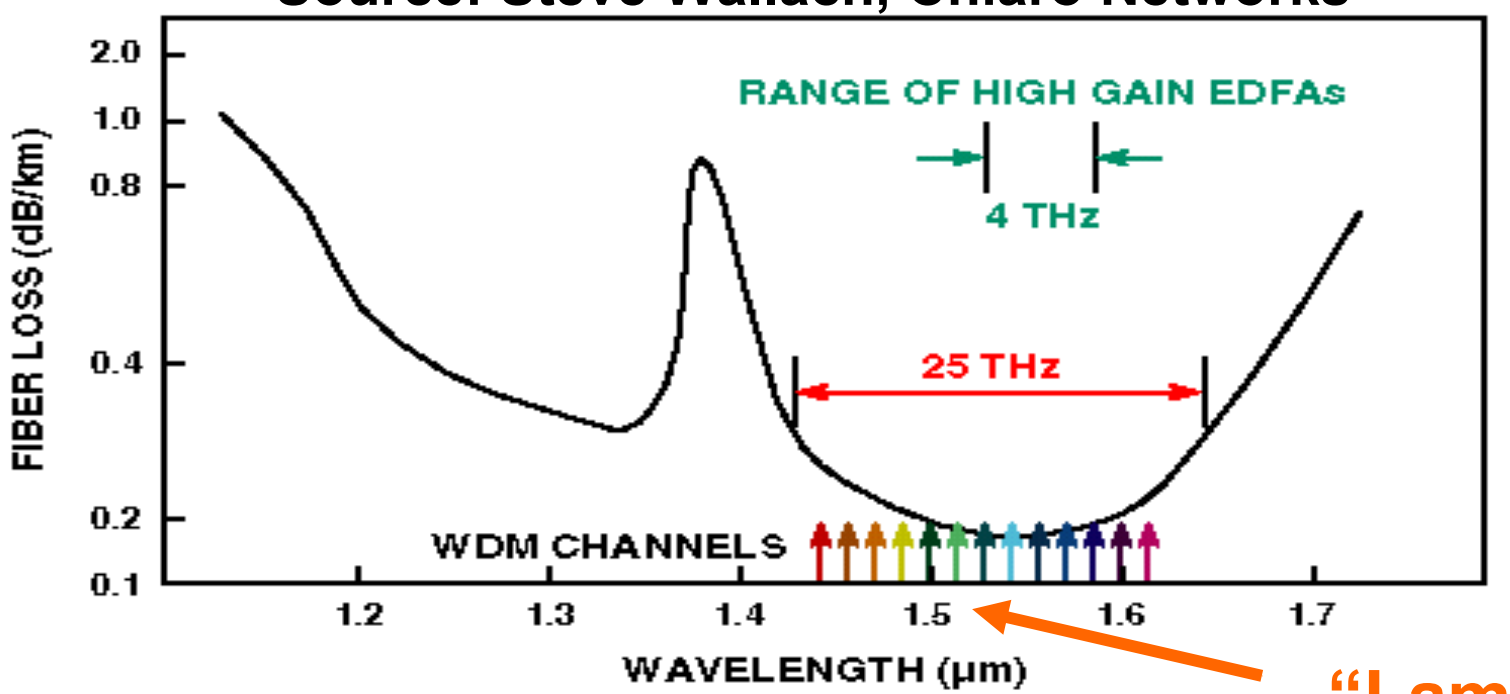
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Dedicated Optical Channels Makes High Performance Cyberinfrastructure Possible

WAVELENGTH DIVISION MULTIPLEXING (WDM)

- EXPLOITS
  - ENORMOUS BANDWIDTH OF SILICA FIBER
  - HIGH-GAIN WIDEBAND OPTICAL AMPLIFIERS

Source: Steve Wallach, Chiaro Networks



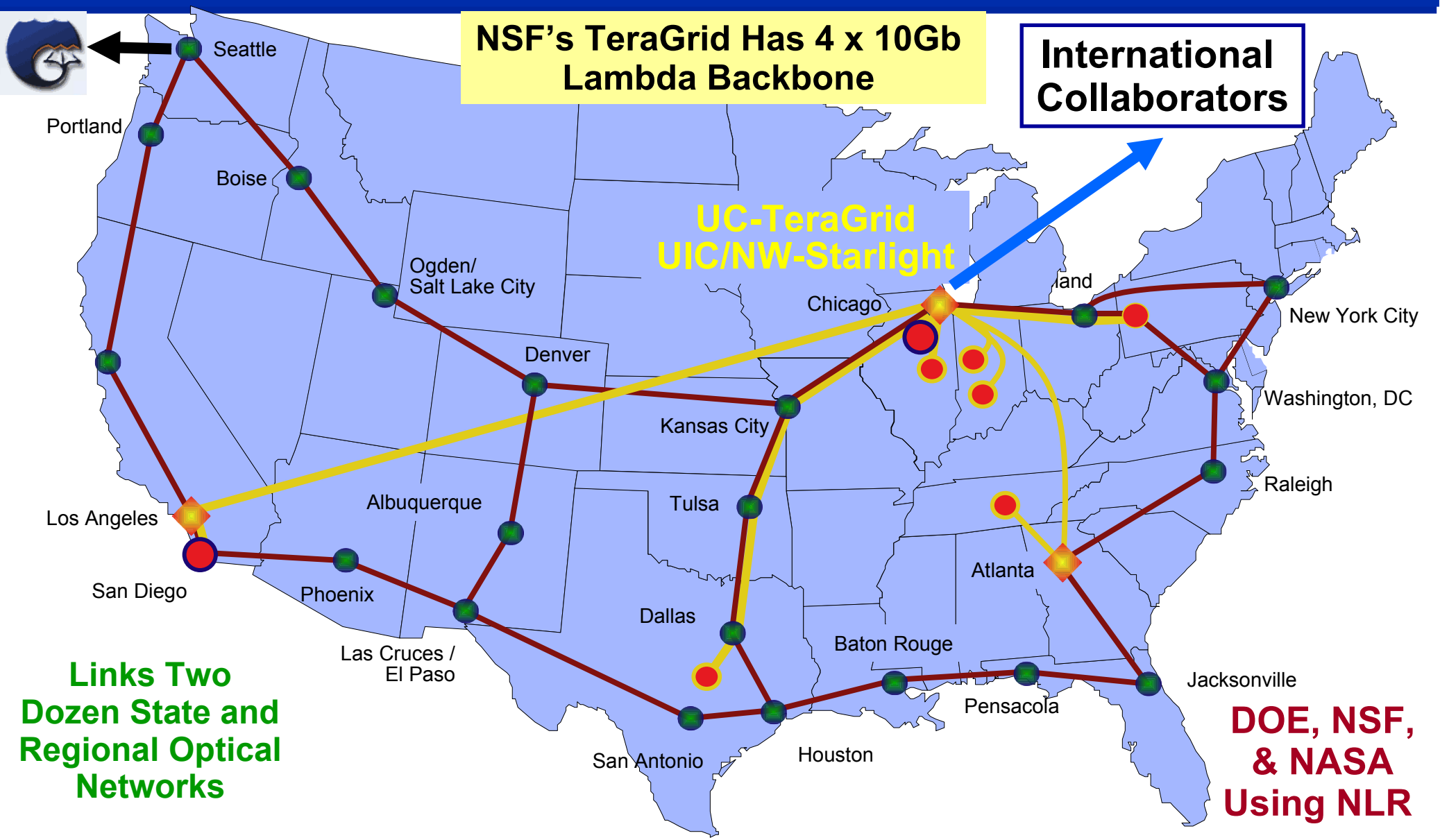
"Lambdas"

Parallel Lambdas are Driving Optical Networking The Way Parallel Processors Drove 1990s Computing

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National Lambda Rail (NLR) and TeraGrid Provides Cyberinfrastructure Backbone for U.S. Researchers



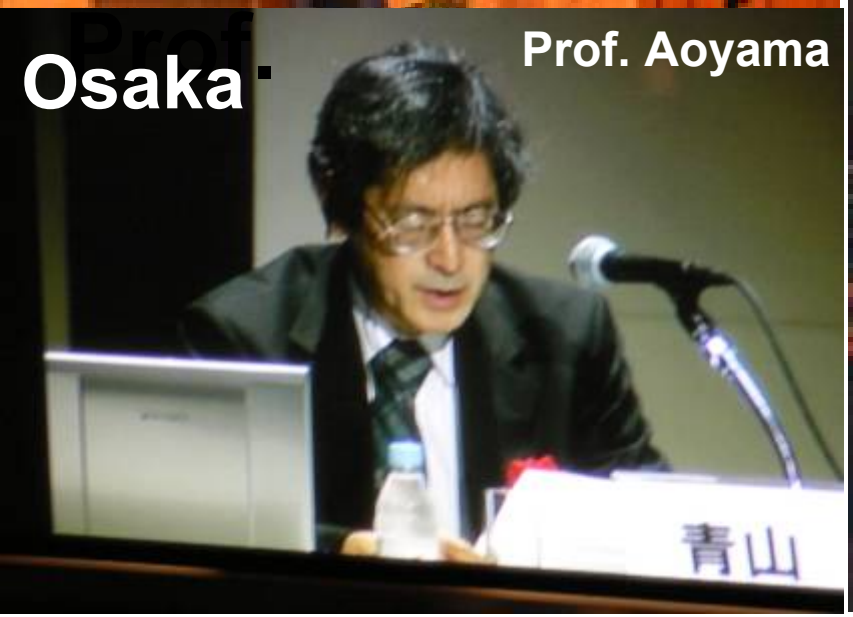
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NLR 4 x 10Gb Lambdas Initially Capable of 40 x 10Gb wavelengths at Buildout

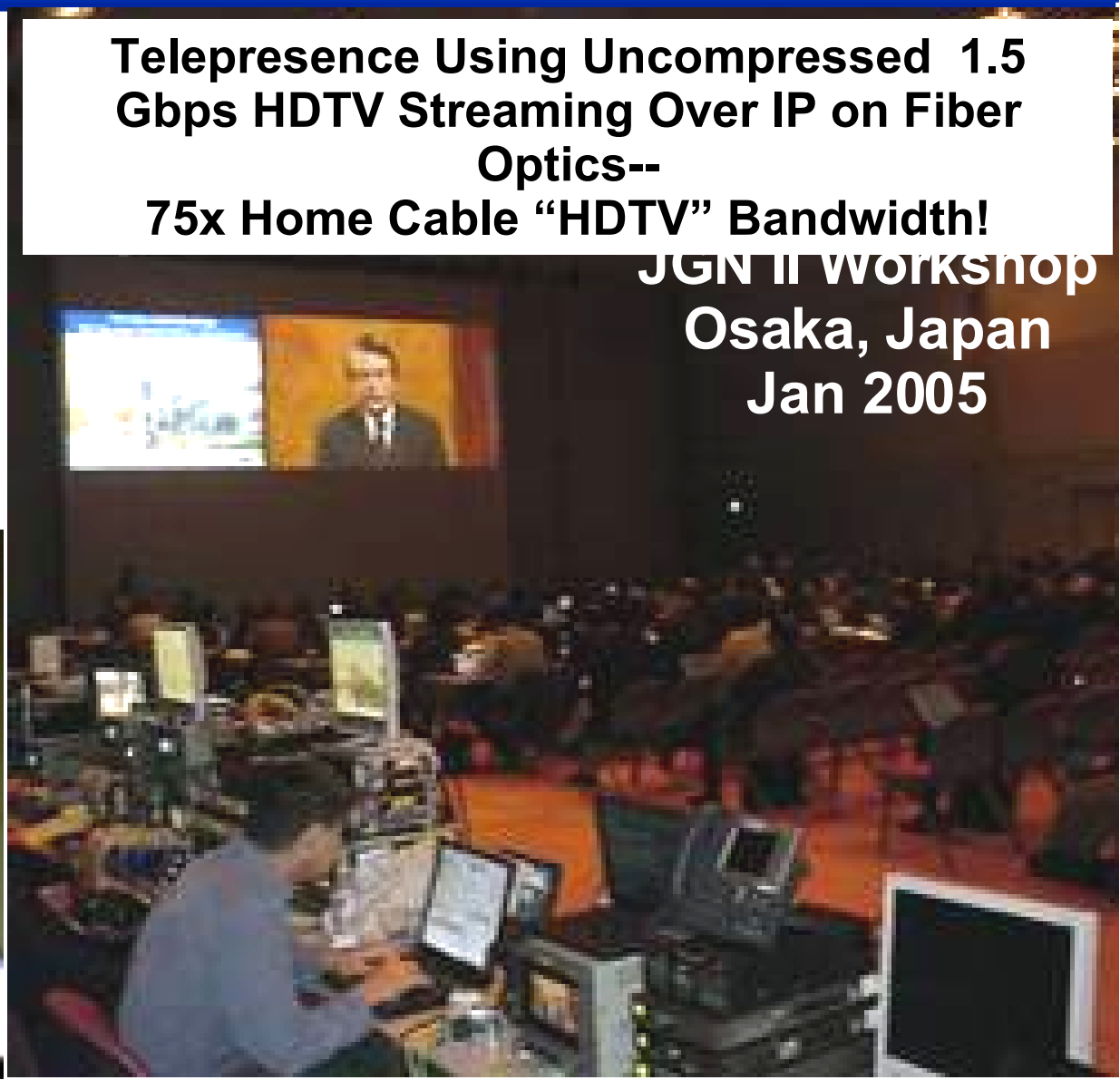
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Multiple Gigabit HD Streams Over Lambdas Will Radically Transform Global Collaboration





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



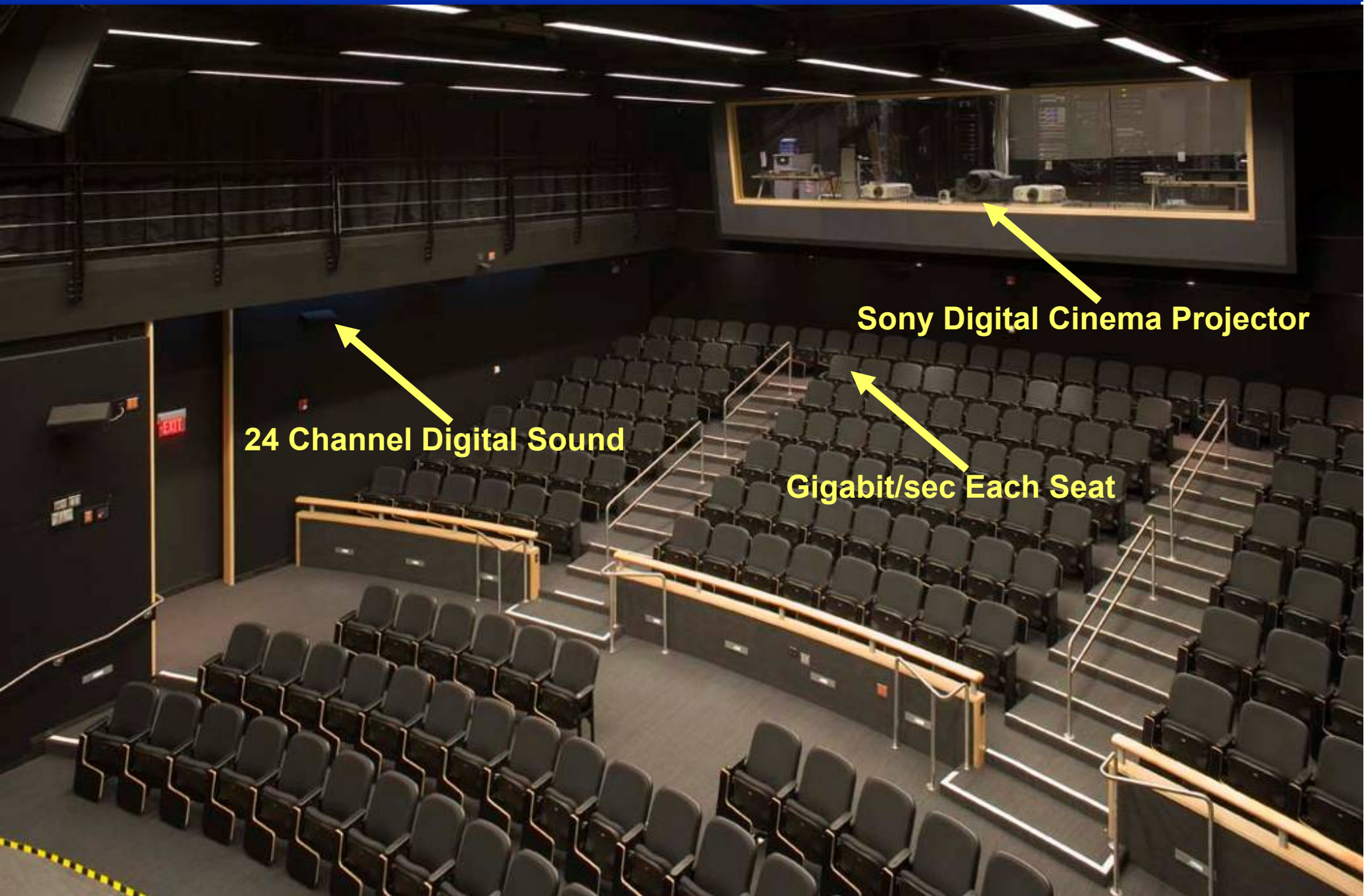
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"I can see every hair on your head!"—Prof. Aoyama

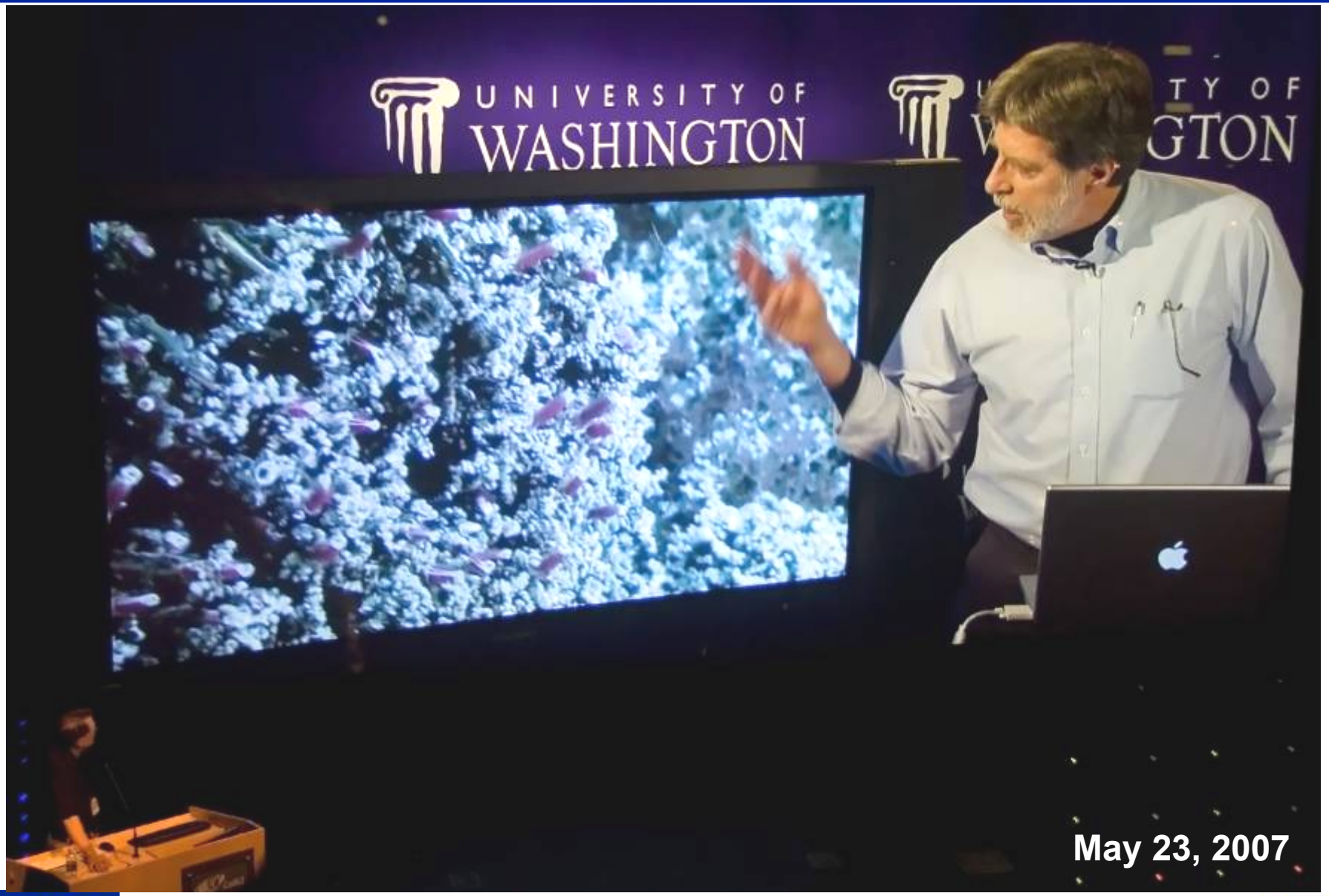
Source: U Washington Research Channel

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Building a Global Collaboratorium



Uncompressed HD Telepresence
1500 Mbits/sec Calit2 to UW Research Channel Over NLR



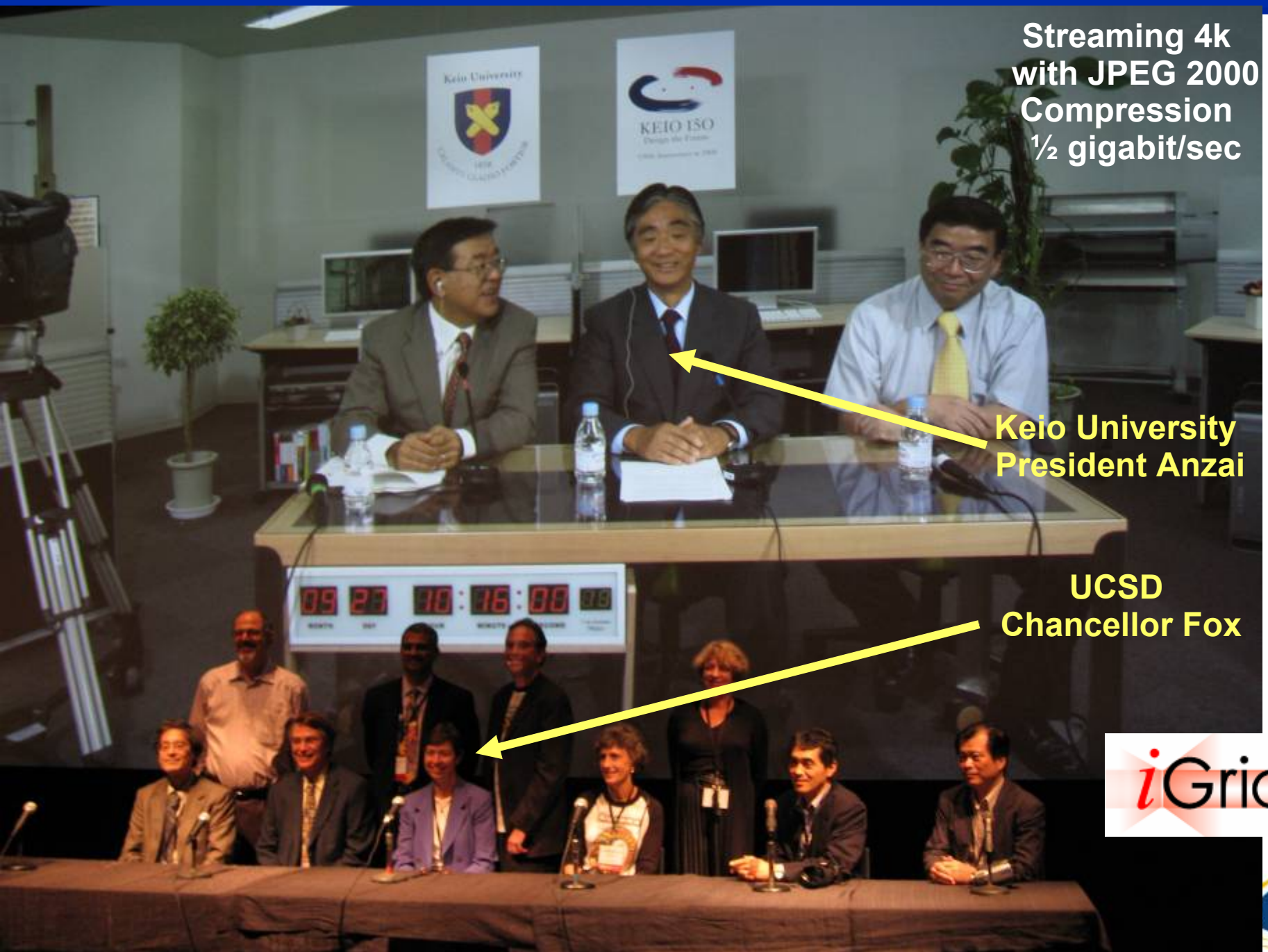
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John Delaney, PI LOOKING, Neptune

Photo: Harry Ammons, SDSC

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



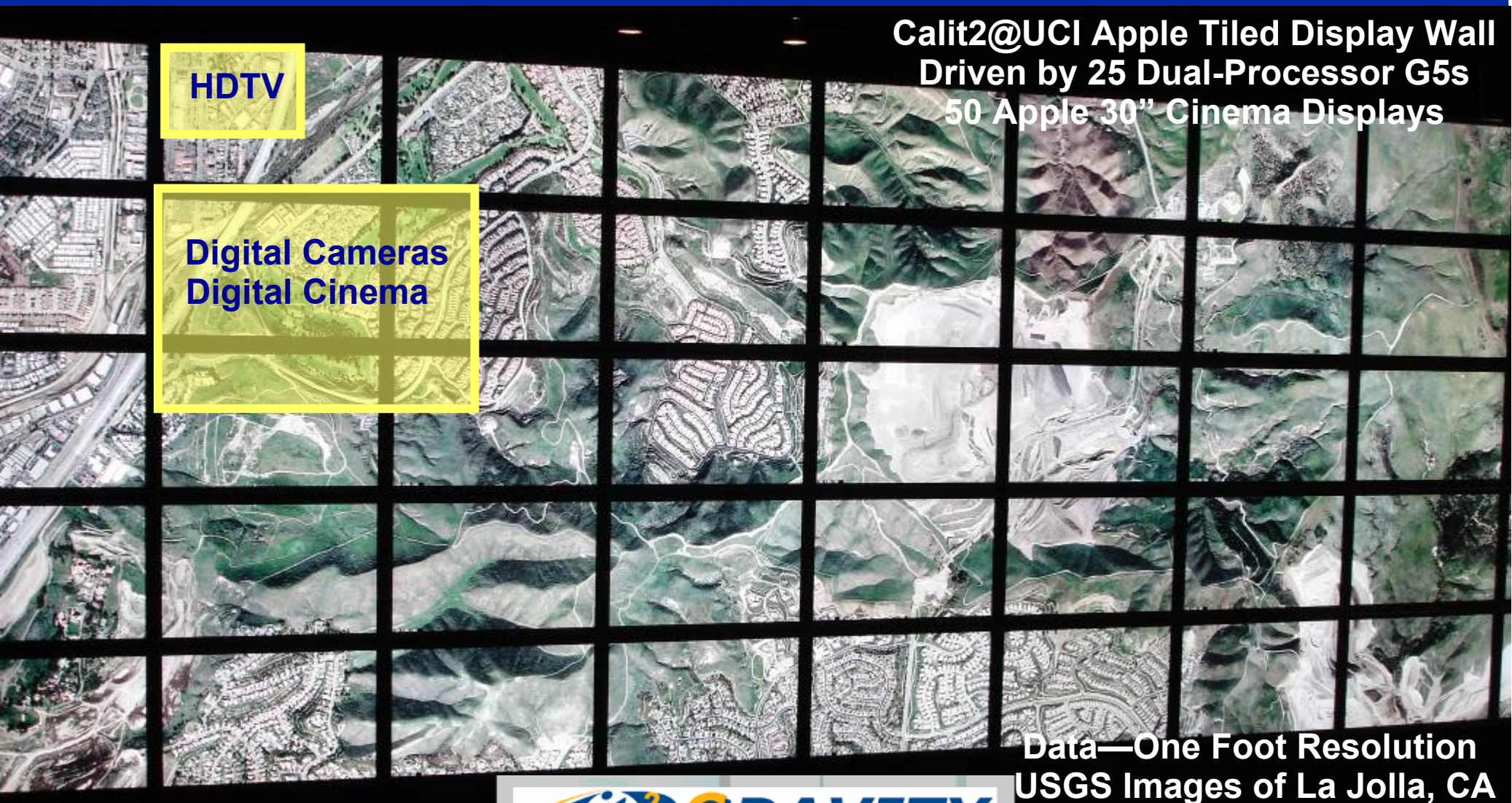
Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

iGrid2005

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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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Integration of High Definition Video Streams with Large Scale Image Display Walls



Collaborative Analysis of Large Scale Images of Cancer Cells

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evl electronic visualization laboratory

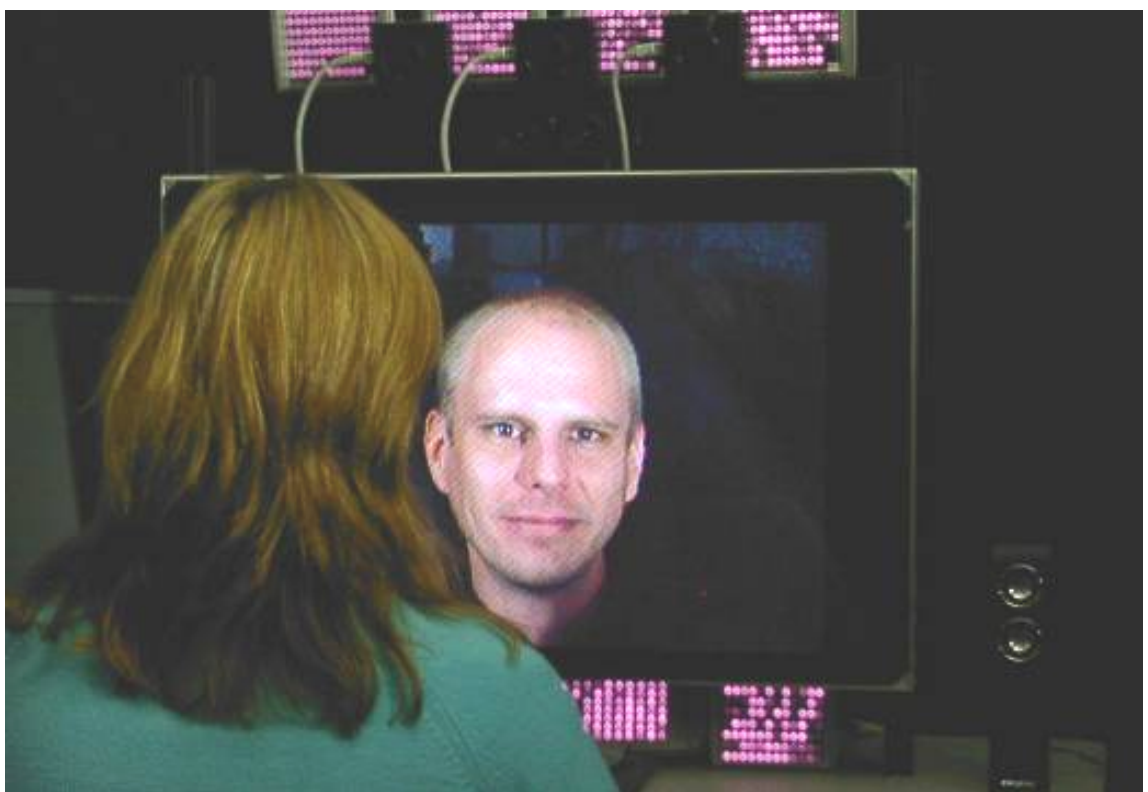
Source: David Lee, Mark Ellisman NCMIR, UCSD

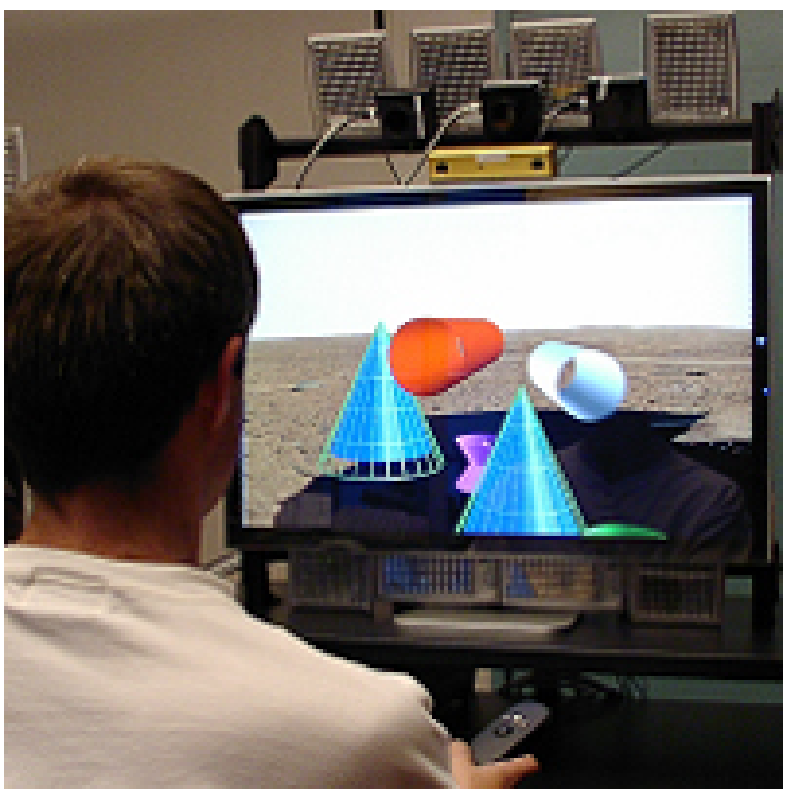
NCMIR NATIONAL CENTER for MICROSCOPY and IMAGING RESEARCH at San Diego, an NIH supported resource center

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3D Videophones Are Here!
The Personal Varrier Autostereo Display

- Varrier is a Head-Tracked Autostereo Virtual Reality Display
  - 30” LCD Widescreen Display with 2560x1600 Native Resolution
  - A Photographic Film Barrier Screen Affixed to a Glass Panel
- Cameras Track Face with Neural Net to Locate Eyes
- The Display Eliminates the Need to Wear Special Glasses



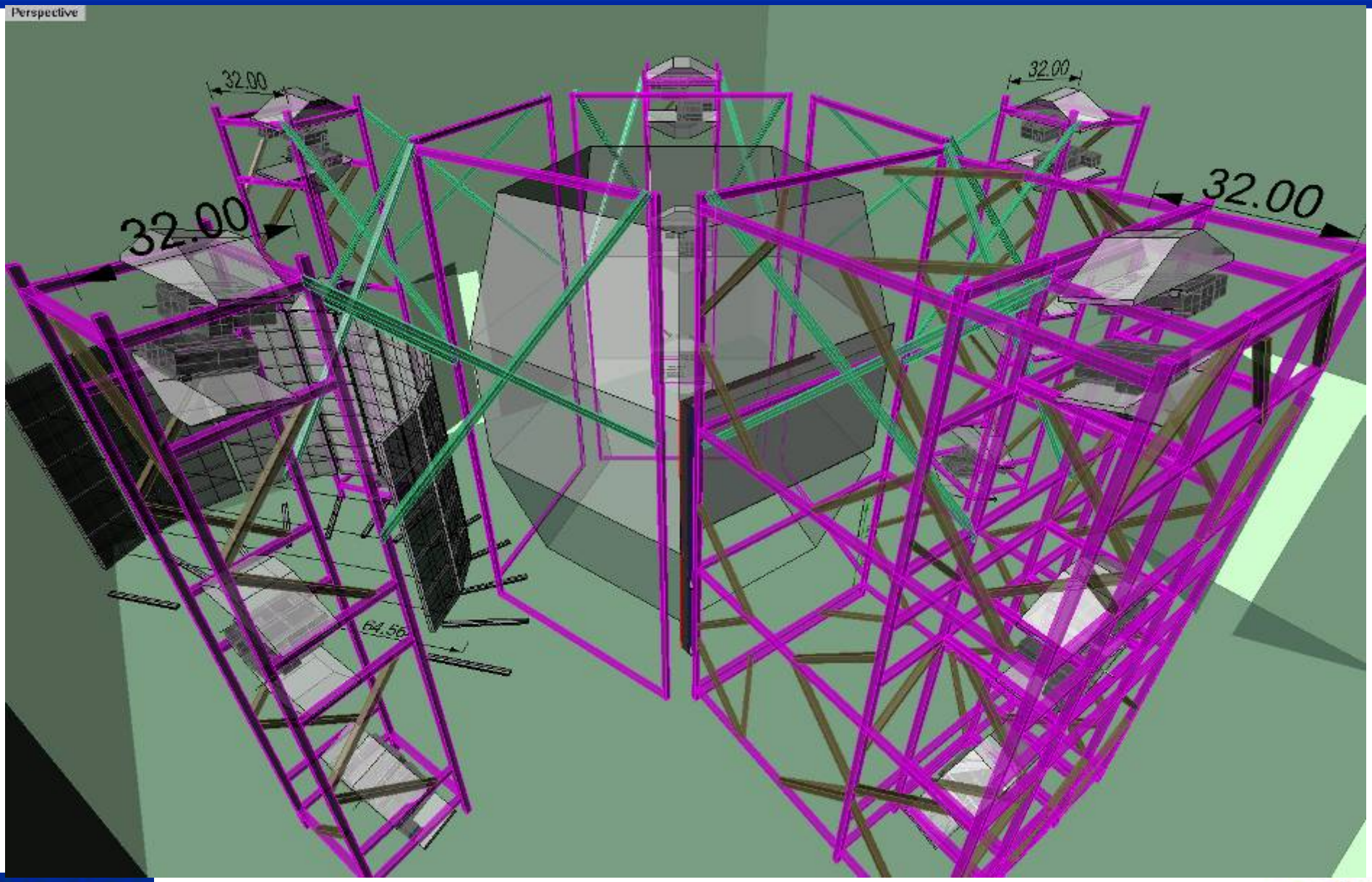


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Source: Daniel Sandin, Thomas DeFanti, Jinghua Ge, Javier Girado, Robert Kooima, Tom Peterka—EVL, UIC

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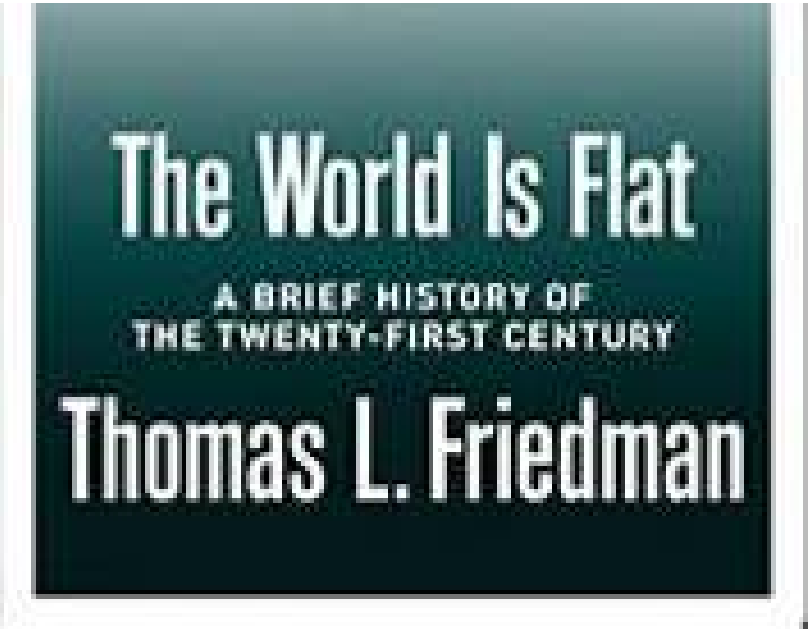
Calit2 StarCAVE
Telepresence "Holodeck"



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Ten Years Old Technologies--the Shared Internet & the Web--Have Made the World "Flat"

- **But Today's Telepresence Innovations:**
  - **Dedicated Fiber Paths**
  - **Streaming HD TV**
  - **Large Display Systems**
  - **Massive Computing and Storage**
- **Are Reducing the World to a "Single Point"**
  - **How Will Our Society Reorganize Itself?**



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