“Towards Telepresence"

Opening Talk
Delegation from the Chief of Naval Operations’ Strategic Studies Group
Cyberspace & Maritime Operations in 2030
Calit2@UCSD
March 13, 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 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

Preparing for a World in Which Distance is Eliminated…

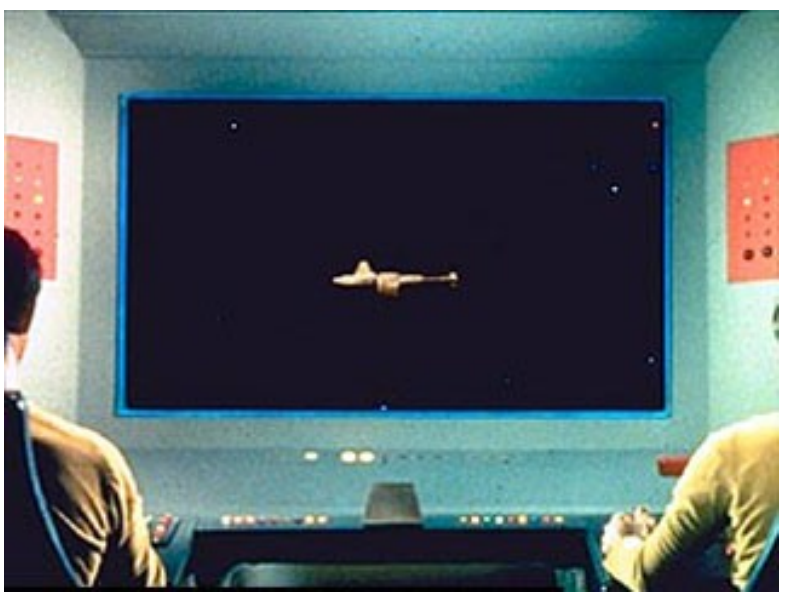
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TV and Movies of 40 Years Ago Envisioned Telepresence Displays









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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.

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."

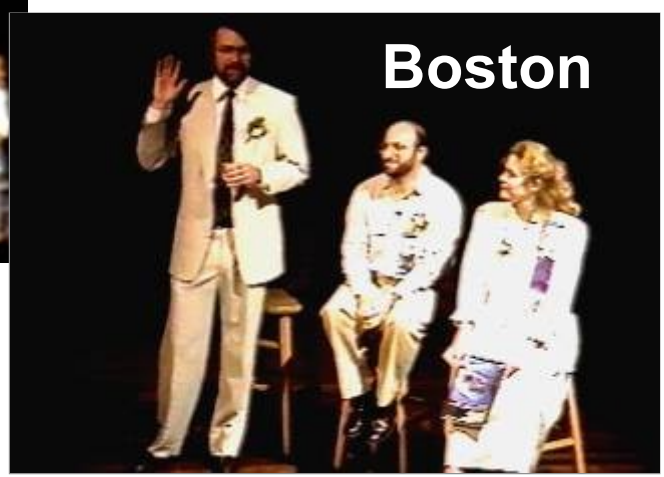
Source: Fish, Kraut, and Chalfonte-CSCW 1990 Proceedings

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

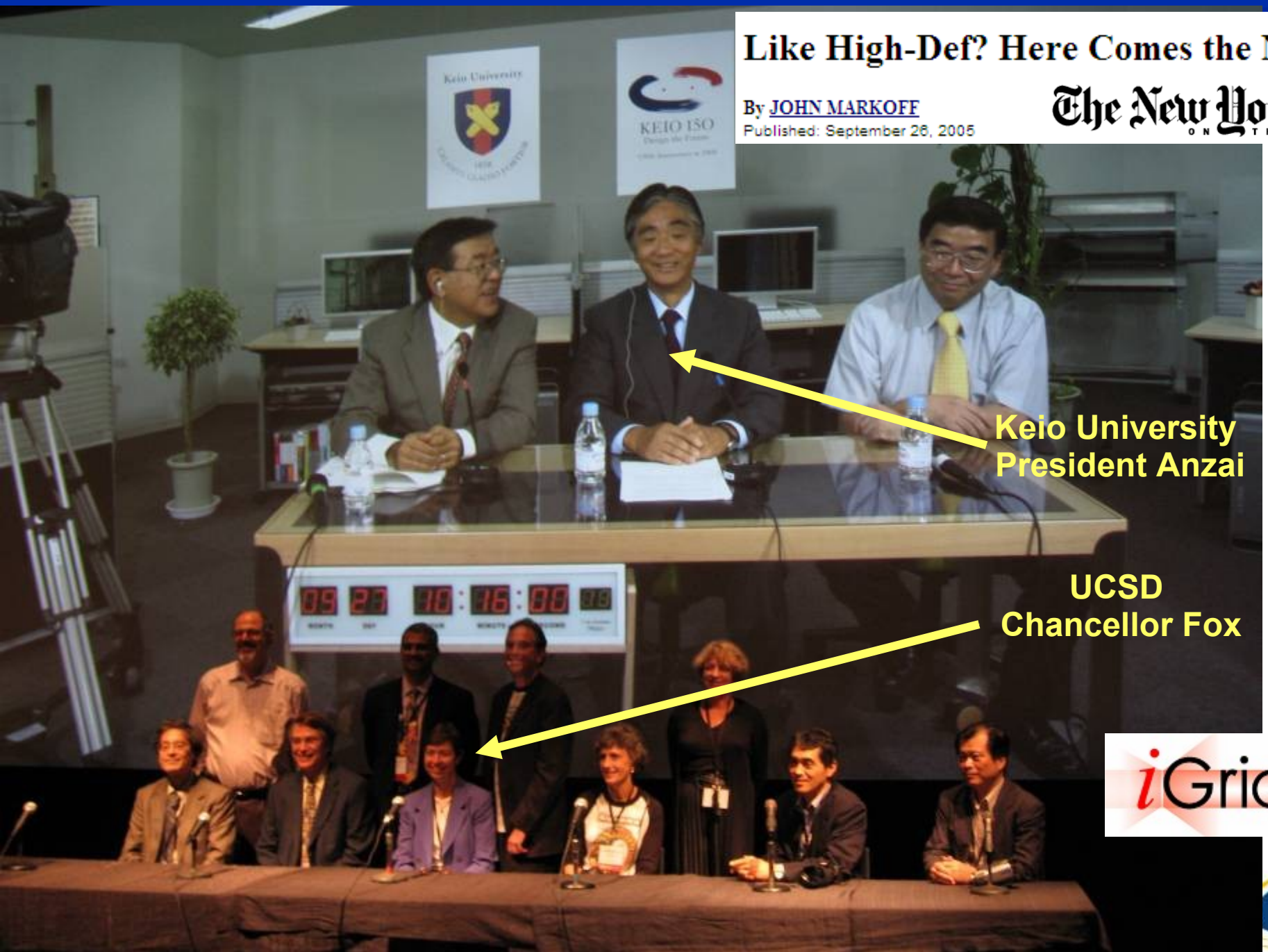
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SIGGRAPH 1989

NCSA™

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



Like High-Def? Here Comes the Next Level

By JOHN MARKOFF
Published: September 26, 2005

The New York Times ON THE WEB

Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

iGrid 2005

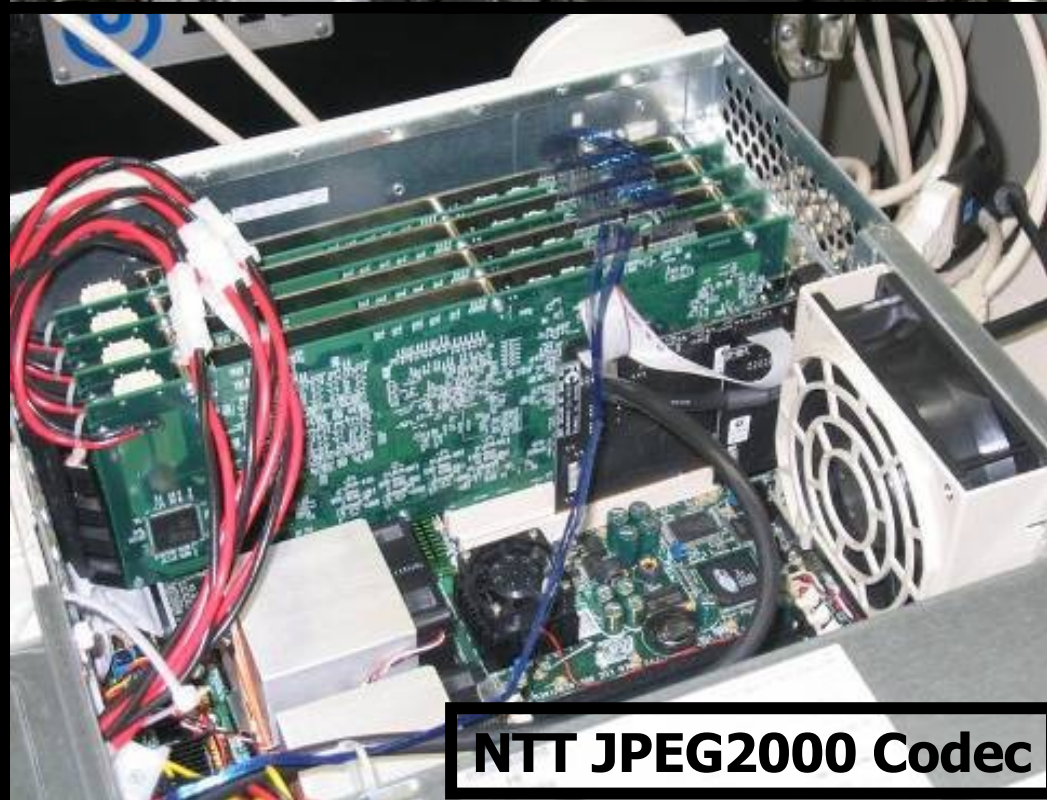
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iGrid Lambda 4k Digital Cinema Streaming Services: The CineGrid Node at Keio University, Tokyo Japan



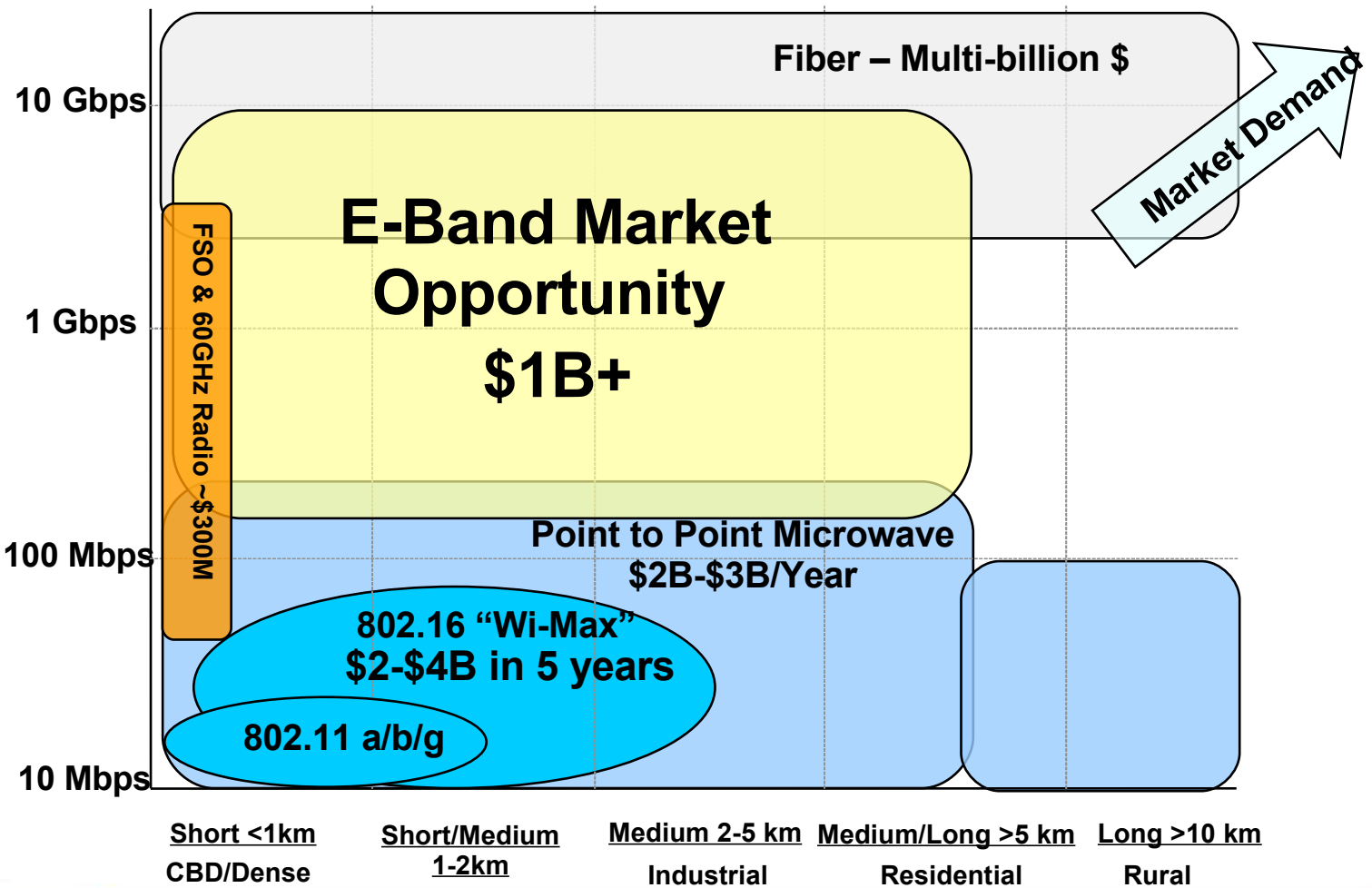




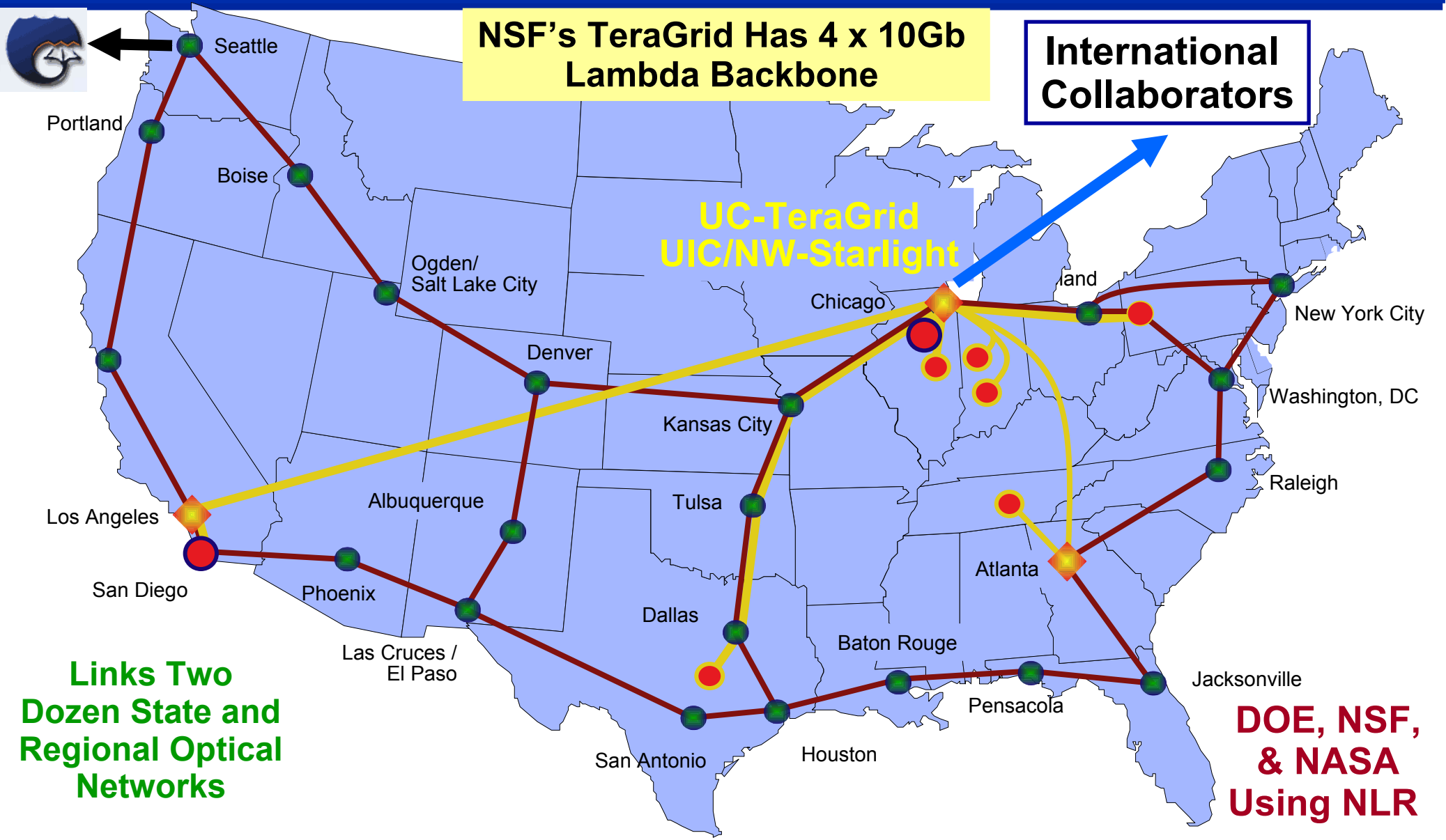


Gigabit/s Wireless is Already a Product!

E-Band mmW radio fills the gap between current broadband access technologies and enables Next Generation networking



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



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

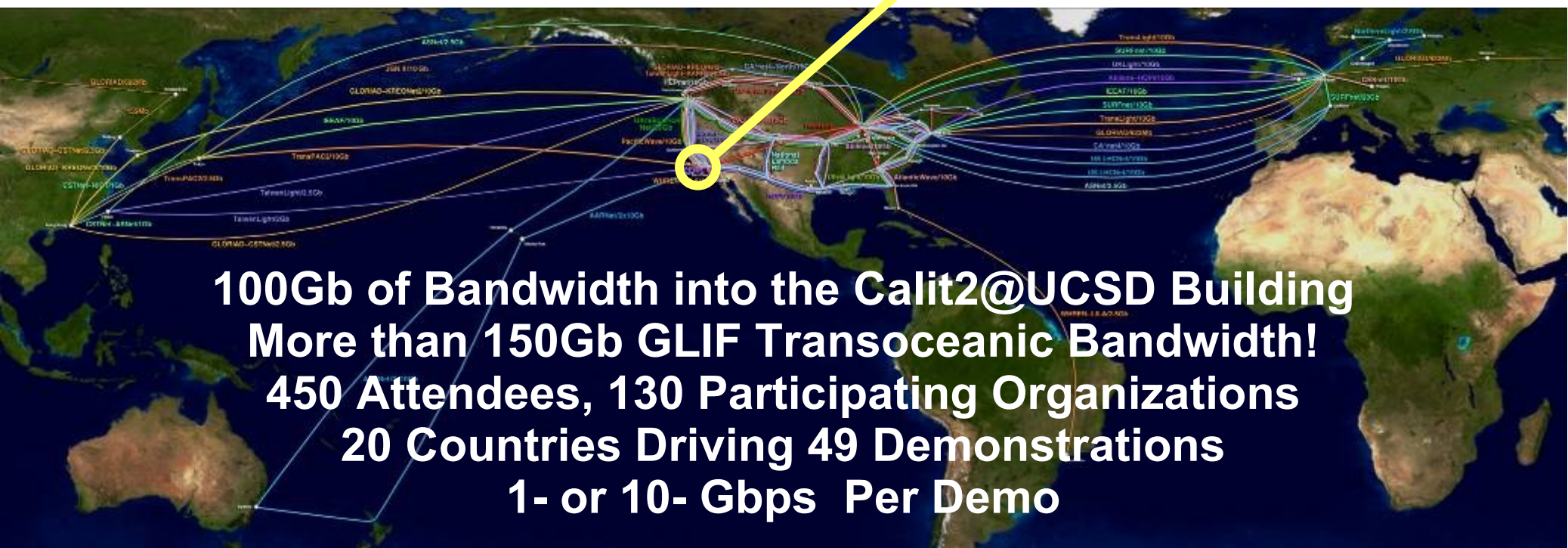


the UC Discovery Grant

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!

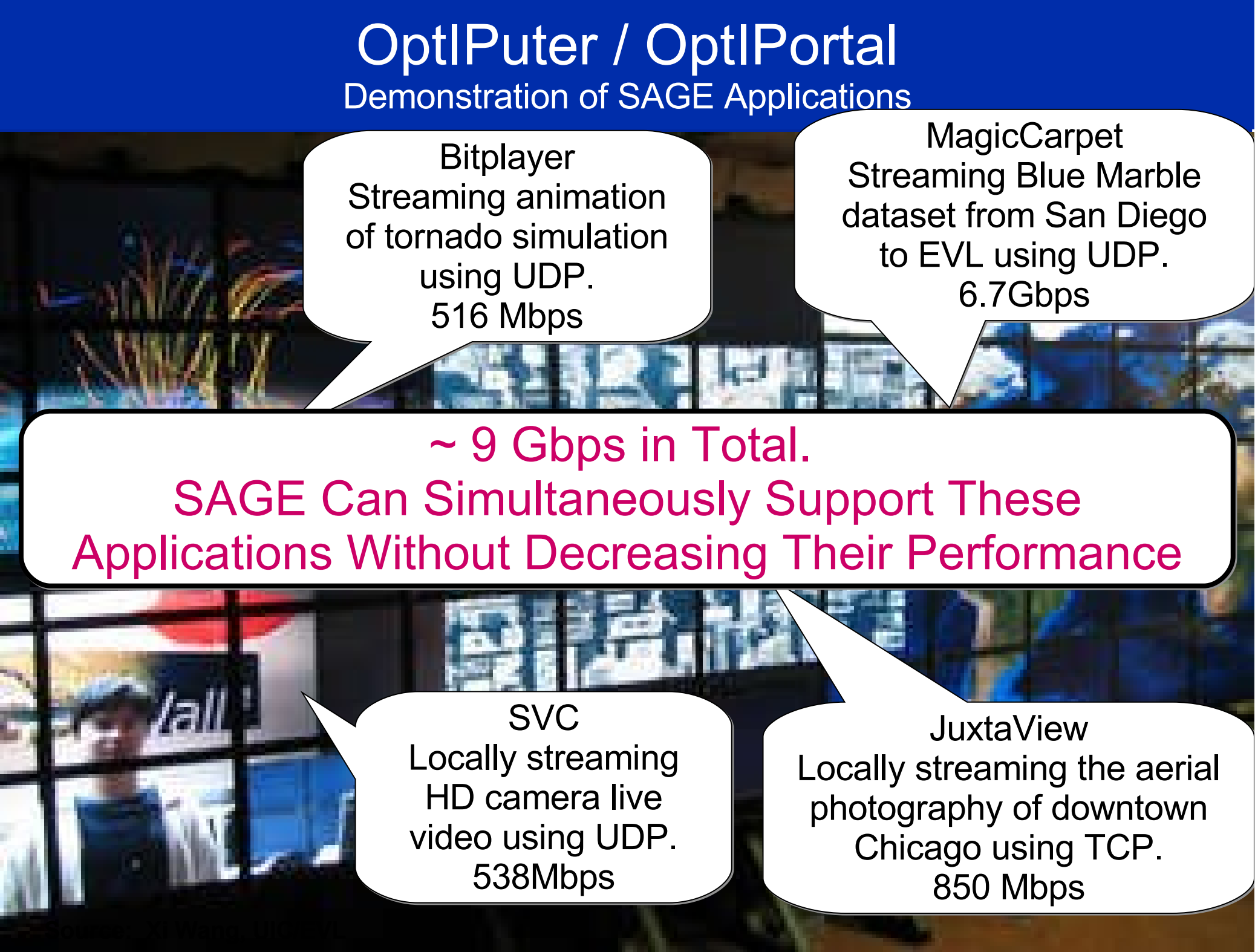
450 Attendees, 130 Participating Organizations

20 Countries Driving 49 Demonstrations

1- or 10- Gbps Per Demo

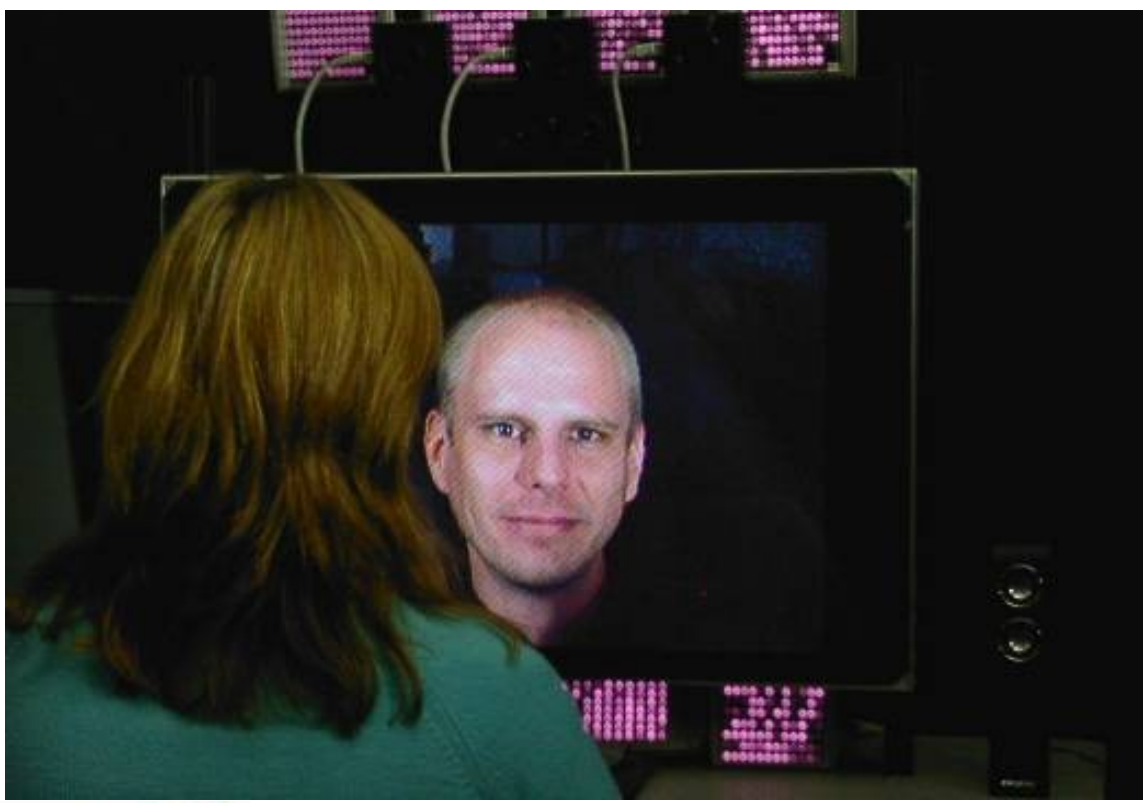
OptIPuter / OptIPortal

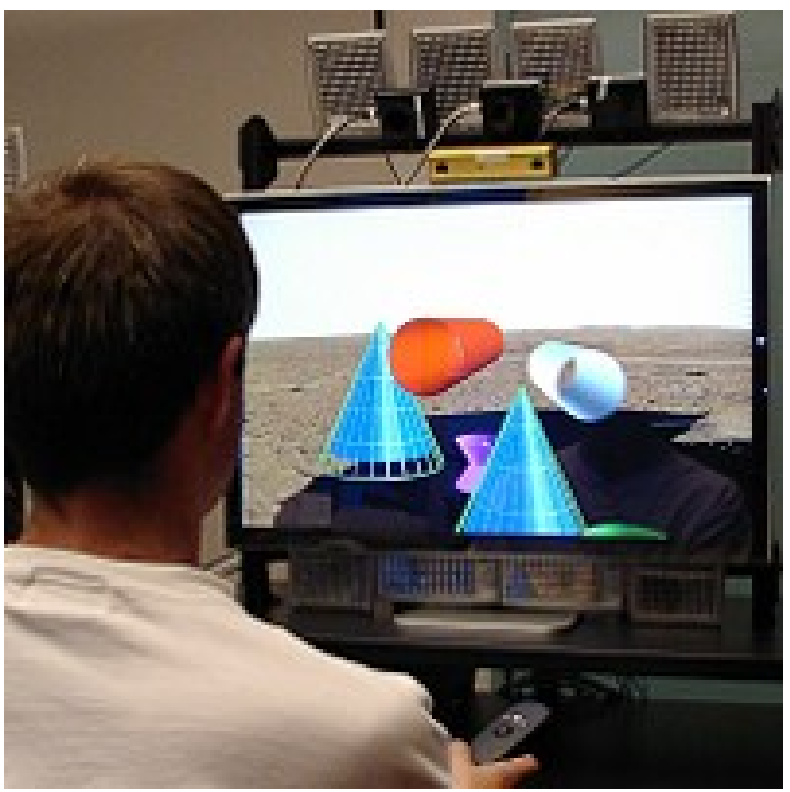
Demonstration of SAGE Applications



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



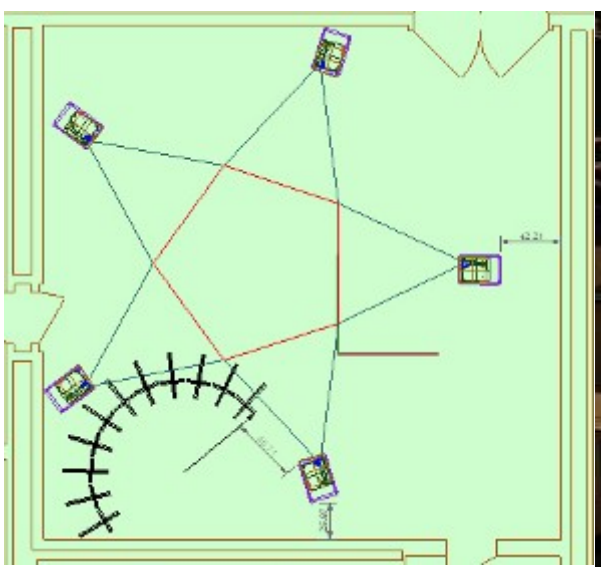


Source: Daniel Sandin, Thomas DeFanti, Jinghua Ge, Javier Girado, Robert Kooima, Tom Peterka—EVL, UIC

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!

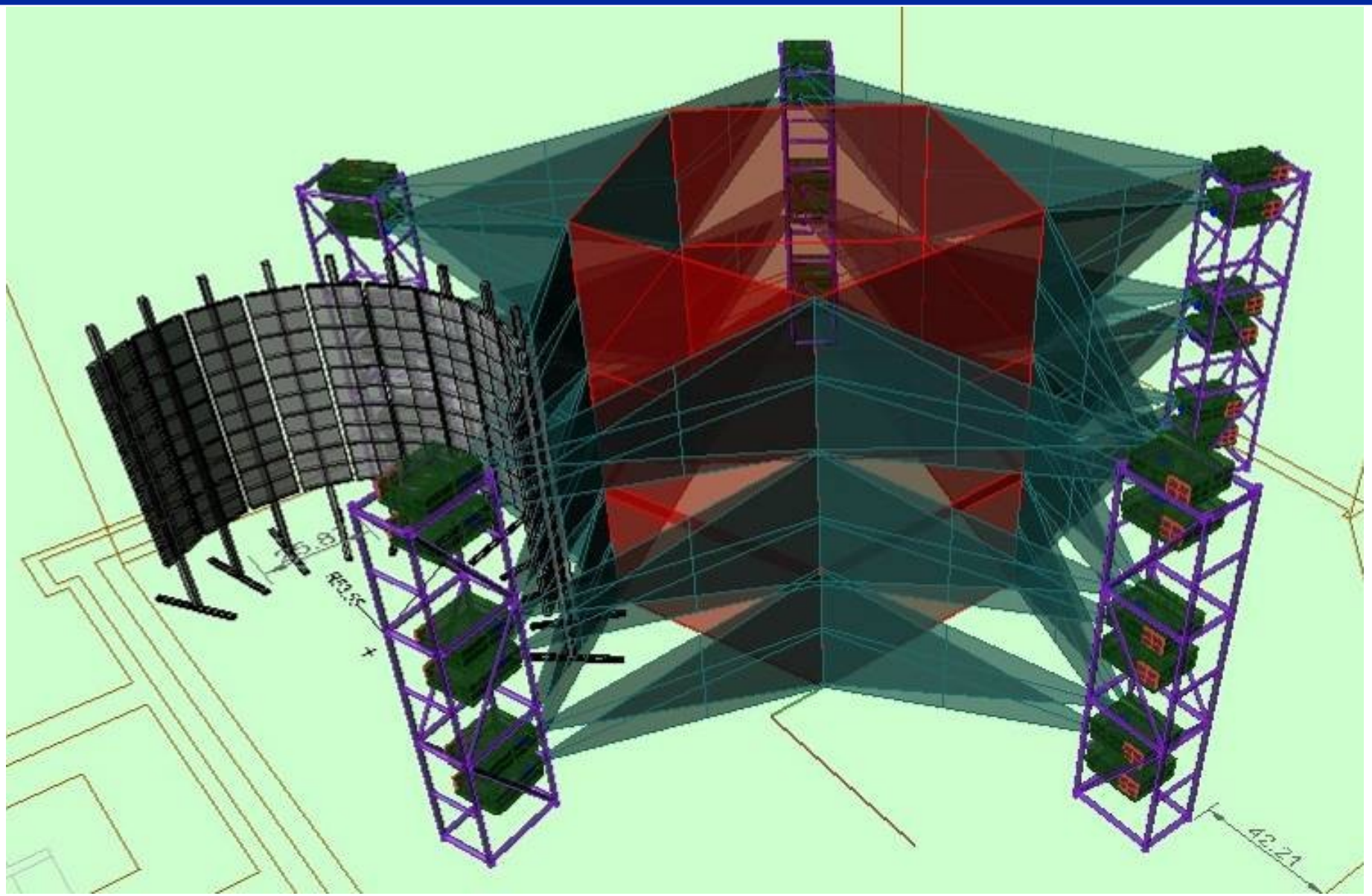
evl electronic visualization laboratory

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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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High Resolution Aerial Photography Generates Images With 10,000 Times More Data than Landsat7

Landsat7 Imagery
100 Foot Resolution
Draped on elevation data





New USGS Aerial Imagery
At 1-Foot Resolution

~10x10 square miles of 350 US Cities
2.5 Billion Pixel Images Per City!

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Prototyping the PC of 2015
One Hundred Million Pixels Connected at 10Gbps

Calit2 Working with NASA, USGS, NOAA, NIEHS, EPA, SDSU, SDSC, Duke, …

100M Pixel Tiled Wall in Calit2@UCSD Building



Source: Jason Leigh, EVL, UIC

Multi-Gigapixel Images are Available from Film Scanners Today



The Gigapxl Project
http://gigapxl.org

Large Image with Enormous Detail Require Interactive LambdaVision Systems



The OptIPuter Project is Pursuing Obtaining some of these Images for LambdaVision 100M Pixel Walls

One Square Inch Shot From 100 Yards

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

Goals by 2007:

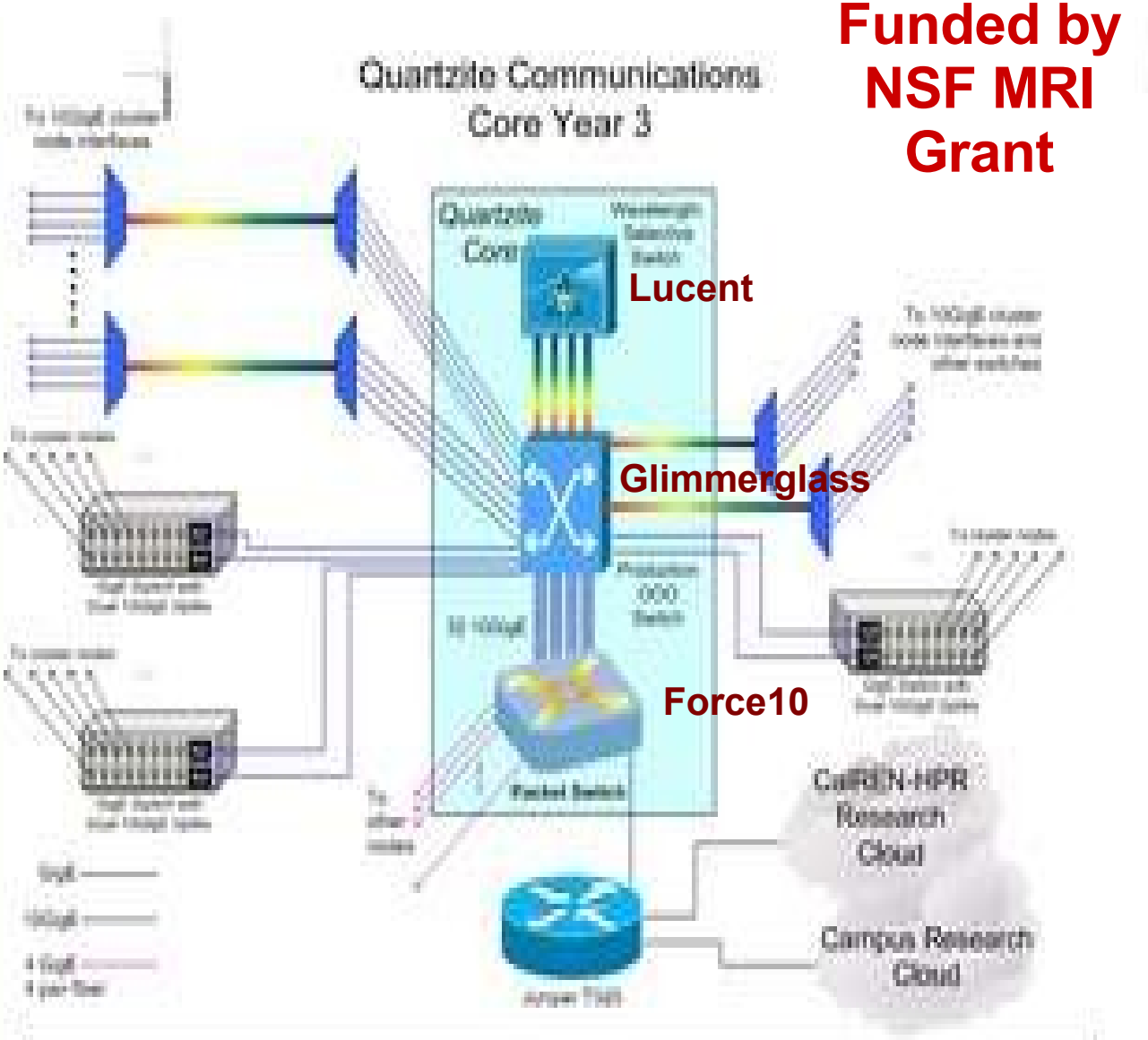
>= 50 endpoints at 10 GigE

>= 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

The Calit2 Terabit LAN OptIPuter Supporting Highly Parallel 4k CineGrid

- 4k Sources
  - Disk Precomputed Images
  - 128 4k Cameras
  - 512 HD Cameras

Source: Larry Smarr, Calit2



128 Node Cluster

Each Node Drives 4k Stream

Uncompressed 4k 6 Gbps Flows

Each LCD Displays 4k

128 10G NICs

128 WDM Fiber

128 10G NICs



16’

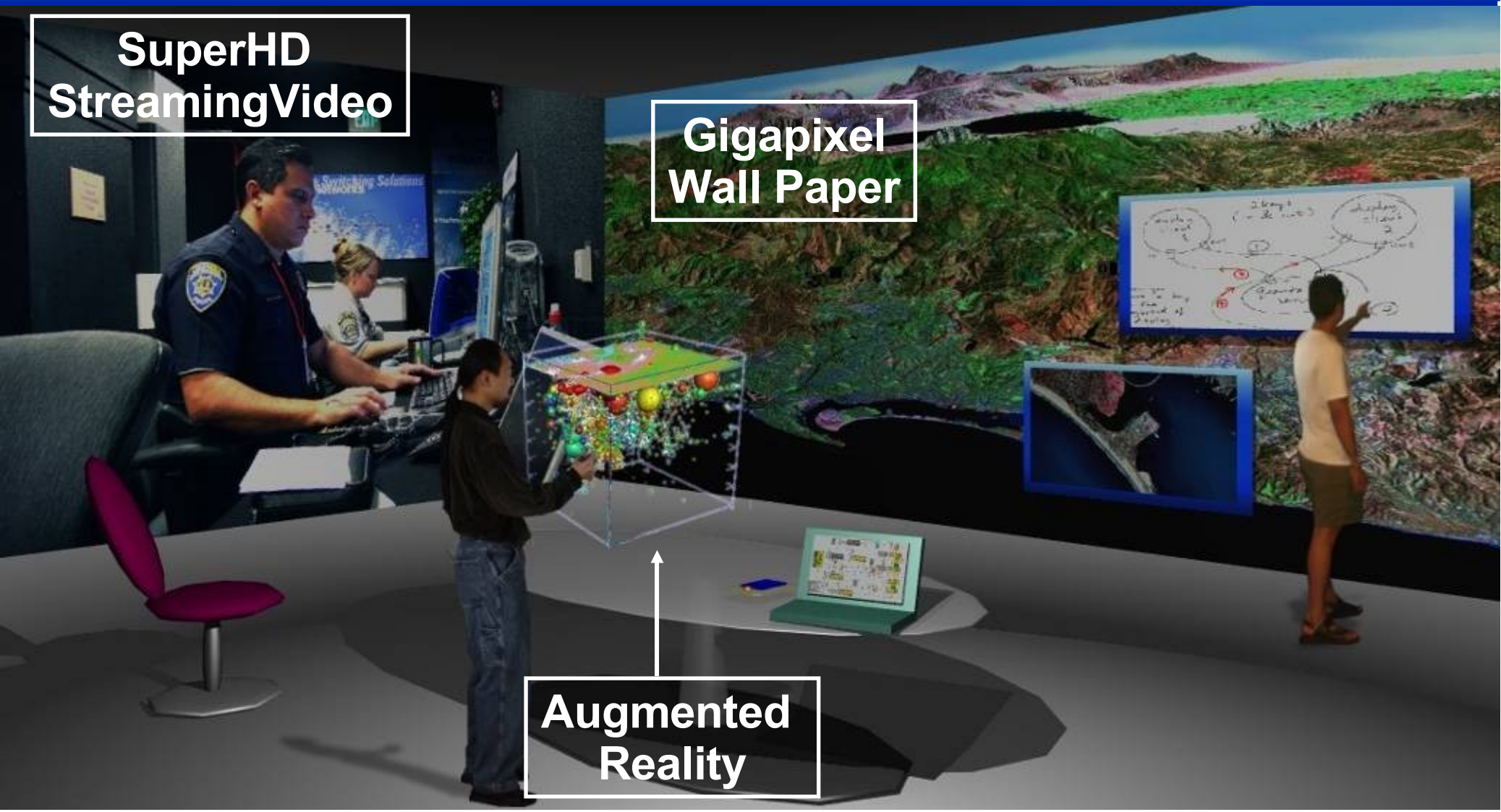
64’

One Billion Pixel Wall
128 (16x8) 4k LCDs

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A Vision for the Future: Towards Gigapixel Displays



1 GigaPixel x 3 Bytes/pixel x 8 bits/byte x 30 frames/sec ~ 1 Terabit/sec!

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Source: Jason Leigh, EVL, UIC

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