# “A New Global Research Platform – Dedicated 10Gbps Lightpaths”

**Panel**

**Symposium on “How Will the U.S. Elections Change US-China Cooperation?”**

**Tsinghua University**

**Beijing, China**

**November 10, 2008**

**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**

OptIPuter

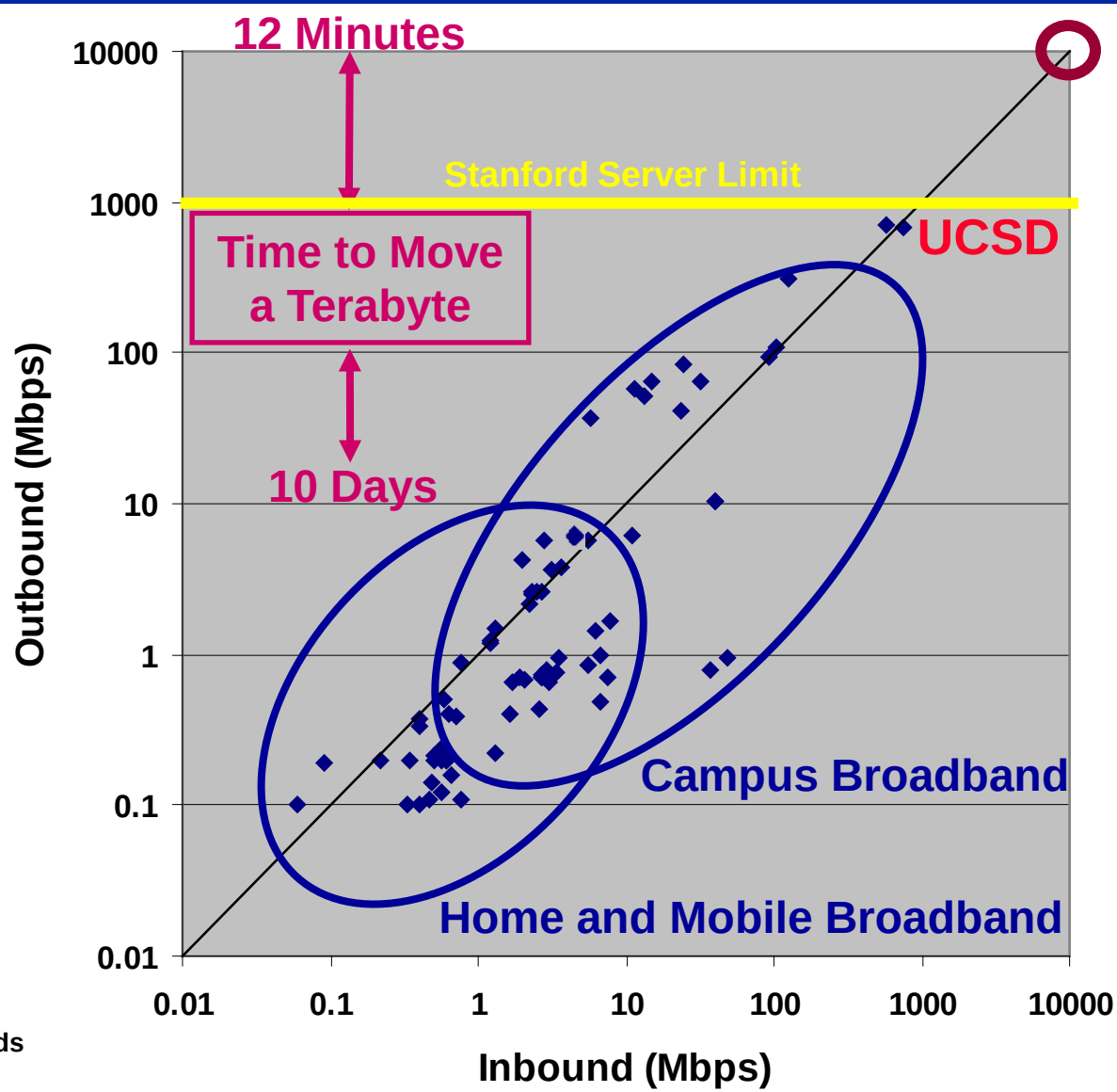
it²

# Beyond Shared Internet Bandwidth: Ultra-Broadband Will Change International Cooperation

**Computers In:**

Australia
Canada
China
Czech Rep.
India
Japan
Korea
Mexico
Moorea
Netherlands
Poland
Taiwan
United States

Source: Larry Smarr and Friends




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100-1000x Normal Internet!

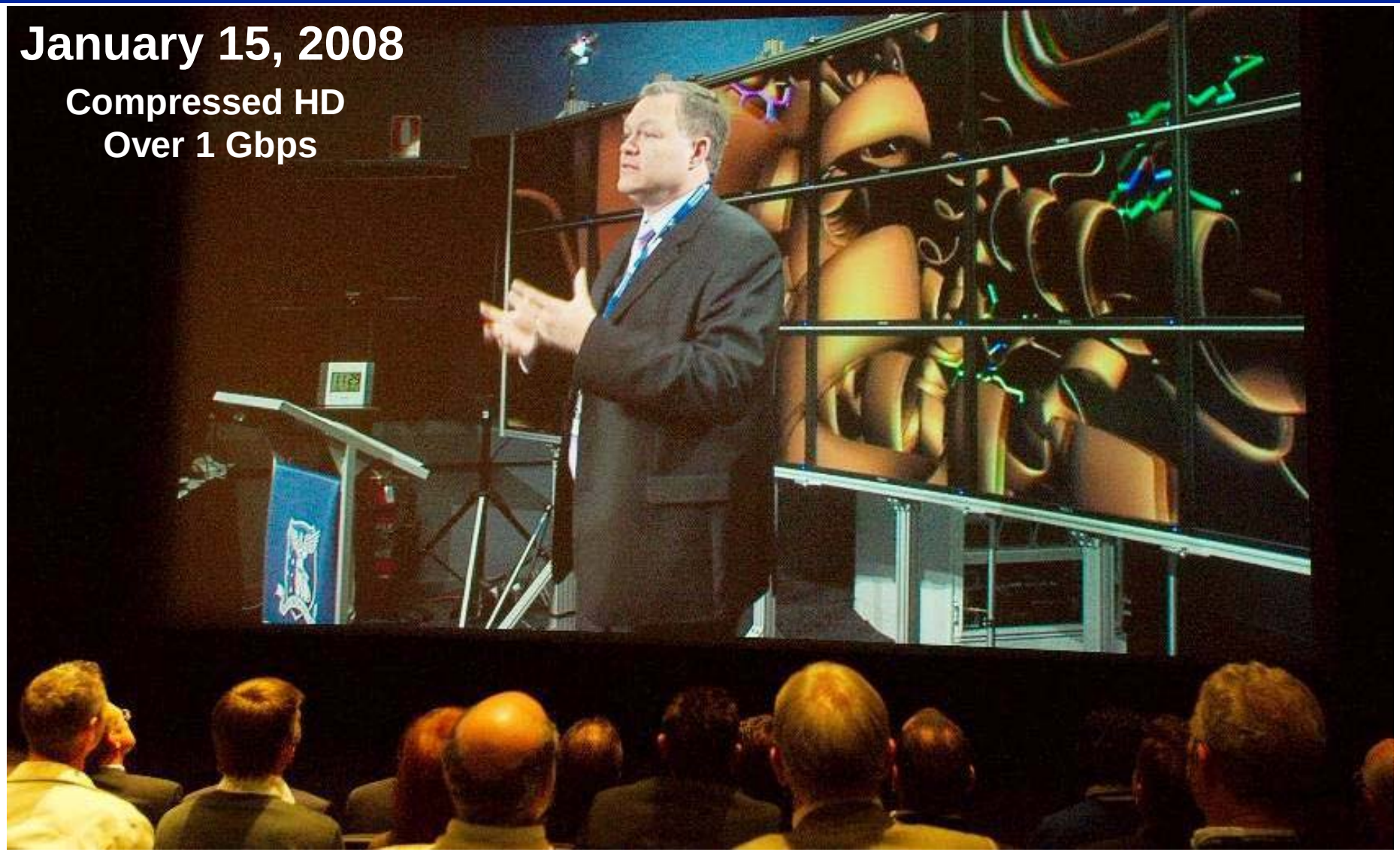
Data Intensive Sciences Require Fast Predictable Bandwidth

Measured Bandwidth from User Computer to Stanford Gigabit Server in Megabits/sec
http://netspeed.stanford.edu/

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# Creating International “Room Sharing” Experiences




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

it²

# Victoria Premier and Australian Deputy Prime Minister Asking Questions



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

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



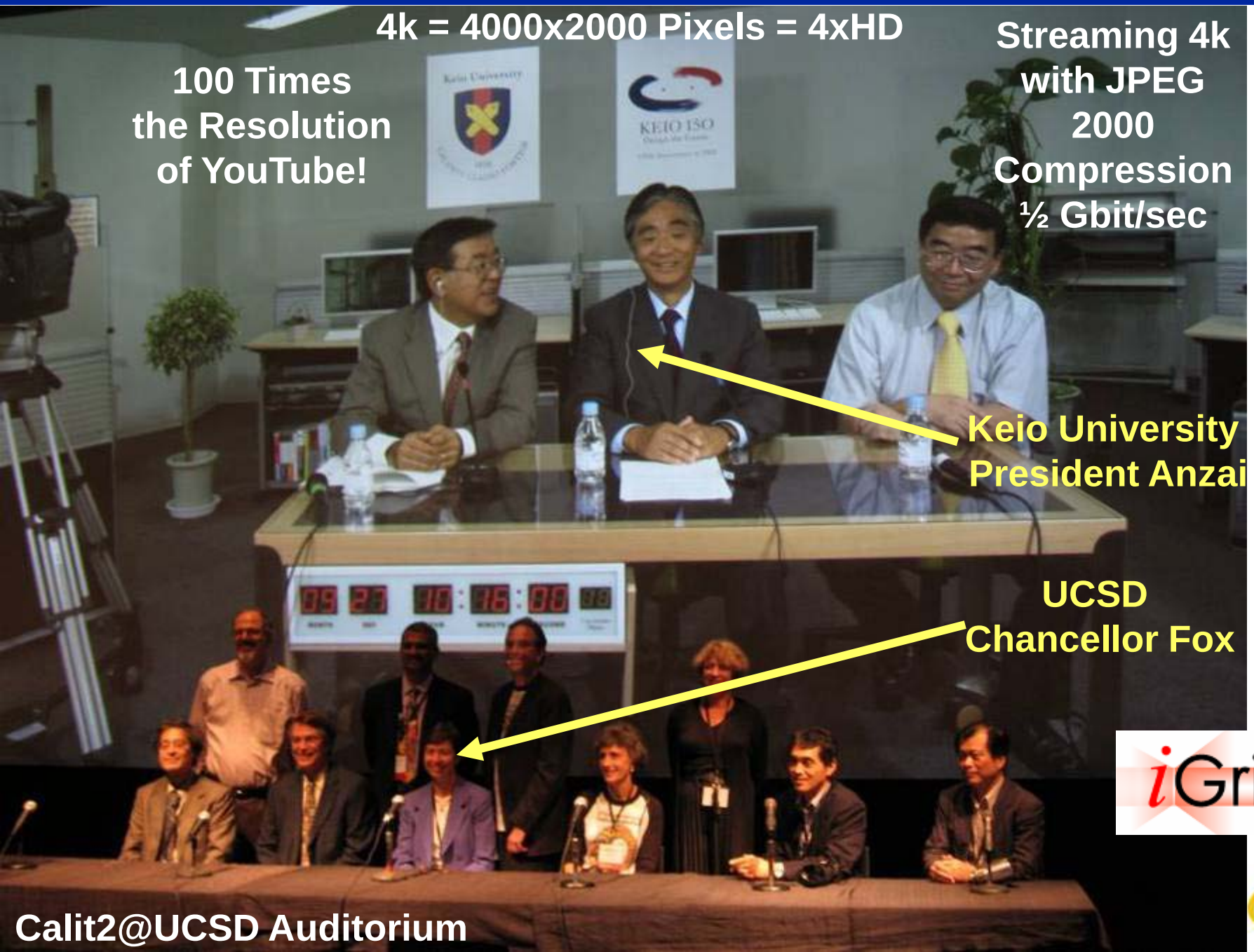
# HD Talk to Australia's Monash University from Calit2: Reducing International Travel




## Qvidium Compressed HD ~140 mbps

Source: David Abramson, Monash Univ

# Telepresence Meeting
# Using Digital Cinema 4k Streams Over 1Gbps Lightpath




Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

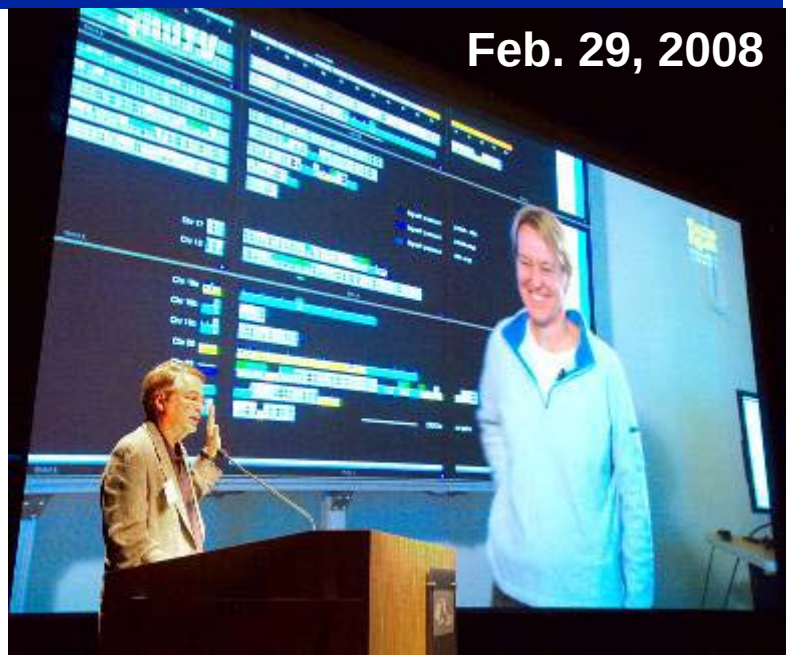
# OptIPuter Persistent Infrastructure Enables Calit2 and U Washington Collaboratory




OptIPuter

Ginger Armbrust's Diatoms: Micrographs, Chromosomes, Genetic Assembly

ROCKS









UW's Research Channel Michael Wellings

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# The Large Hadron Collider Uses a Global Fiber Infrastructure To Connect Its Users

## CERN Unveils Global Grid For Particle Physics Research

**The network can pull in the IT power of more than 140 computer centers in 33 countries to crunch an expected 15 million GB of data every year.**

By Antone Gonsalves
InformationWeek
October 3, 2008 04:57 PM

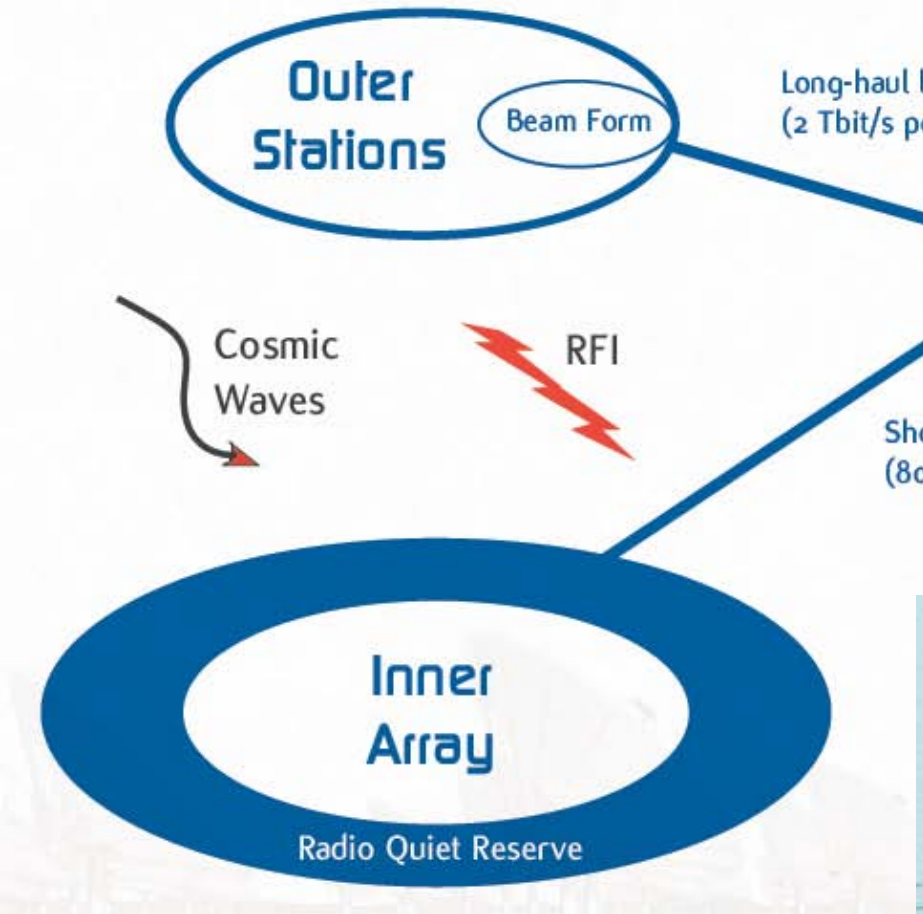
- **The grid relies on optical fiber networks to distribute data from CERN to 11 major computer centers in Europe, North America, and Asia**
- **The grid is capable of routinely processing 250,000 jobs a day**
- **The data flow will be ~6 Gigabits/sec or 15 million gigabytes a year for 10 to 15 years**

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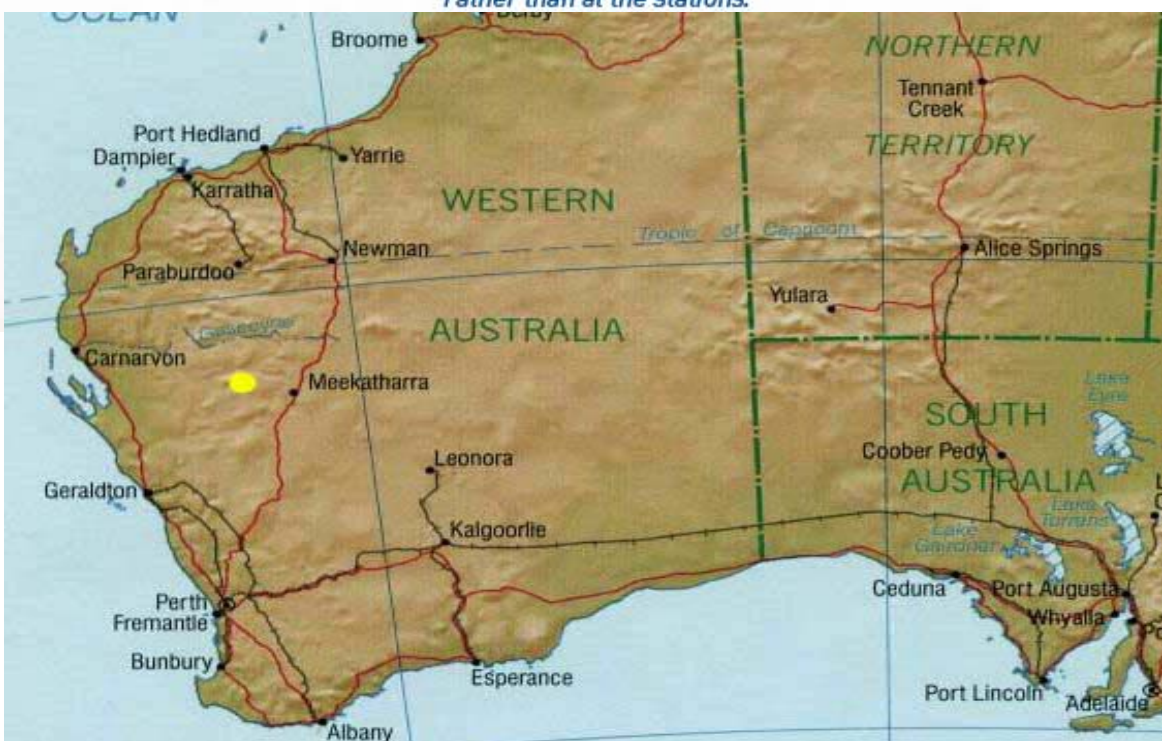
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# Next Great Planetary Instrument: The Square Kilometer Array Requires Dedicated Fiber

www.skatelescope.org




*Schematic of SKA signal flow. Advances in signal transport technology may later allow more signals to be processed at the core, rather than at the stations.*



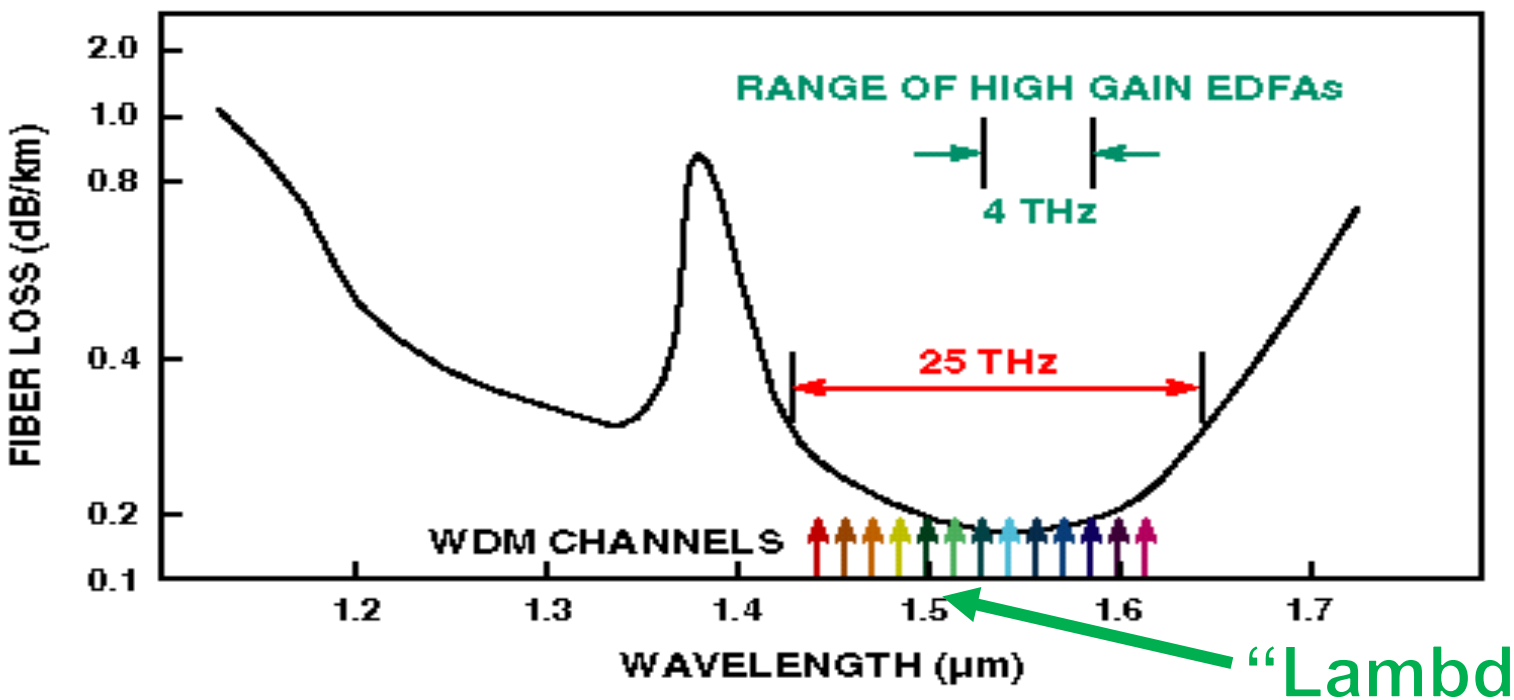

**Transfers Of 1 TByte Images World-wide Will Be Needed Every Minute!**

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# Dedicated Optical Fiber Channels Makes Ultra-Broadband Possible

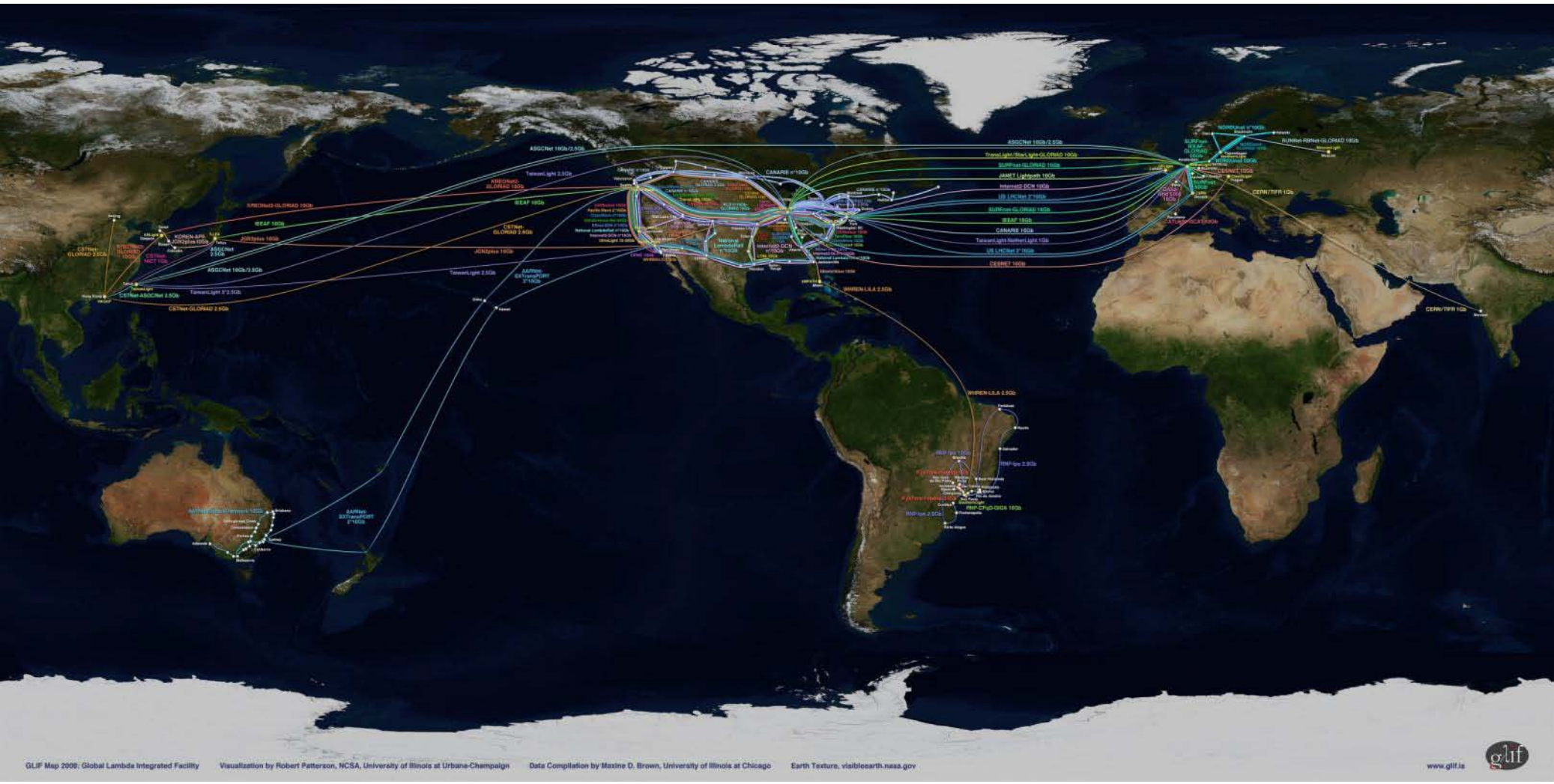
## WAVELENGTH DIVISION MULTIPLEXING (WDM)

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




**WDM Enables 10Gbps Shared Internet on One Lambda and a Personal 10Gbps Lambda on the Same Fiber!**

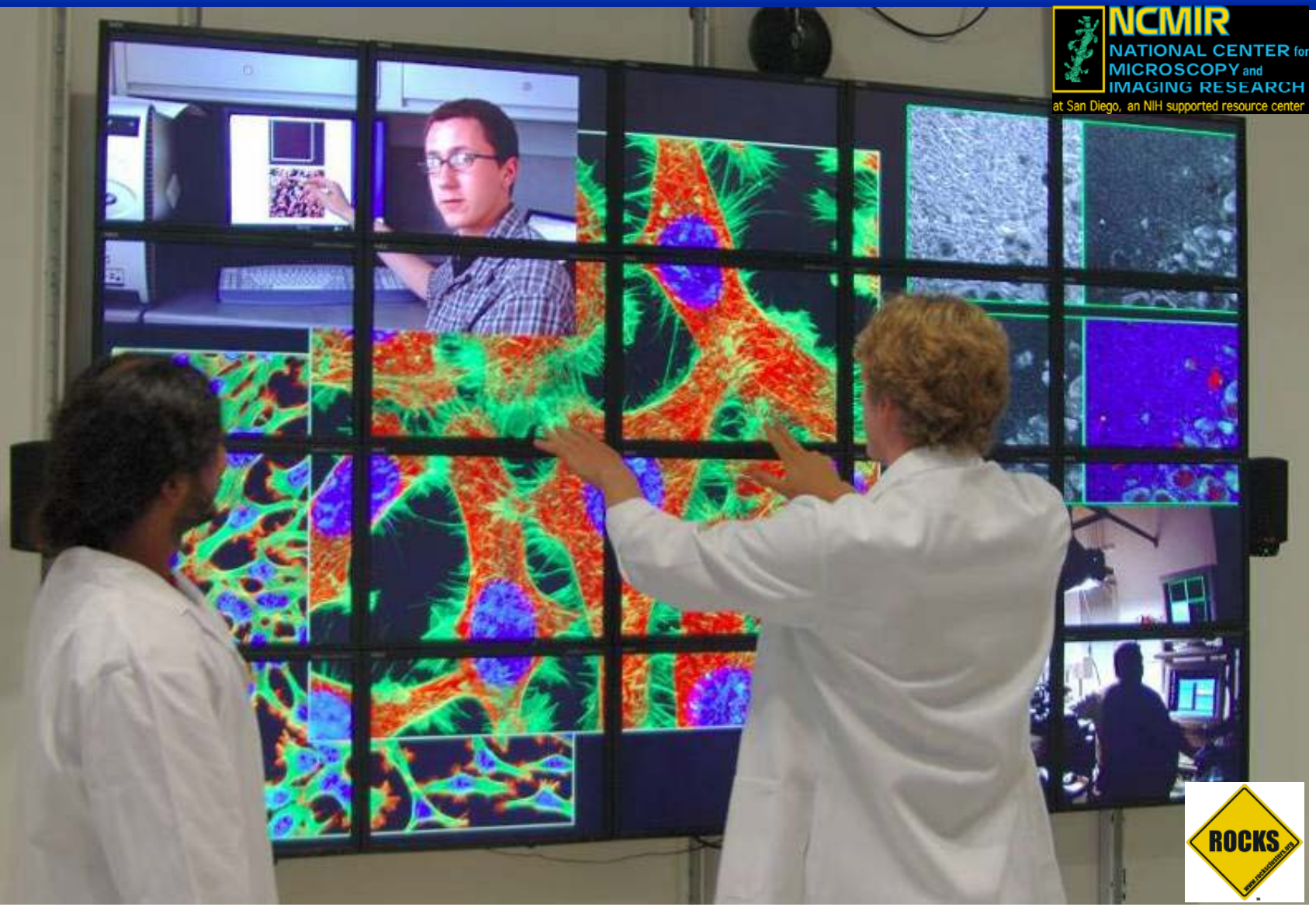
# Global Lambda Integrated Facility:
# 1 to 10Gbps Dedicated Lightpath Infrastructure




## Interconnects Global
## Public Research Innovation Centers

**Source: Maxine Brown, UIC and Robert Patterson, NCSA**

# The OptIPuter Project: High Resolution Collaboratory Over Dedicated Optical Channels to Global Science Data




**Scalable Adaptive Graphics Environment (SAGE)**

evl electronic visualization laboratory

NSF

**Now in Sixth and Final Year**

Picture Source: Mark Ellisman, David Lee, Jason Leigh

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**Calit2 (UCSD, UCI), SDSC, and UIC Leads—Larry Smarr PI**
**Univ. Partners: NCSA, USC, SDSU, NW, TA&M, UvA, SARA, KISTI, AIST**
**Industry: IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent**

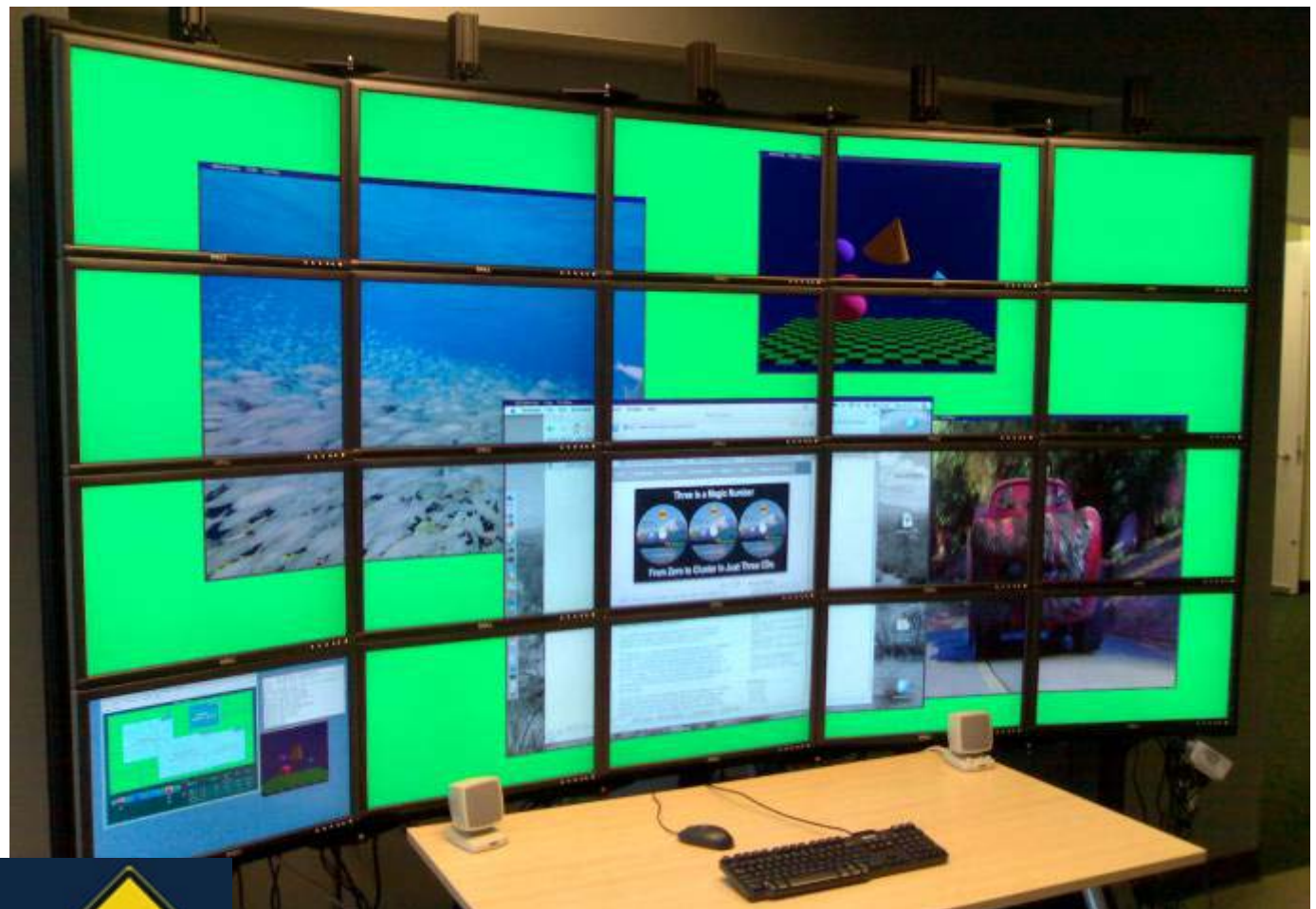
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# My OptIPortal™ – Affordable Termination Device for the OptIPuter Global Backplane

- 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

evl electronic visualization laboratory





OptIPuter

Powered by Rocks ROCKS

Source: Phil Papadopoulos SDSC, Calit2

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# OptIPortal Can Scale Up to 1/3 Billion Pixels



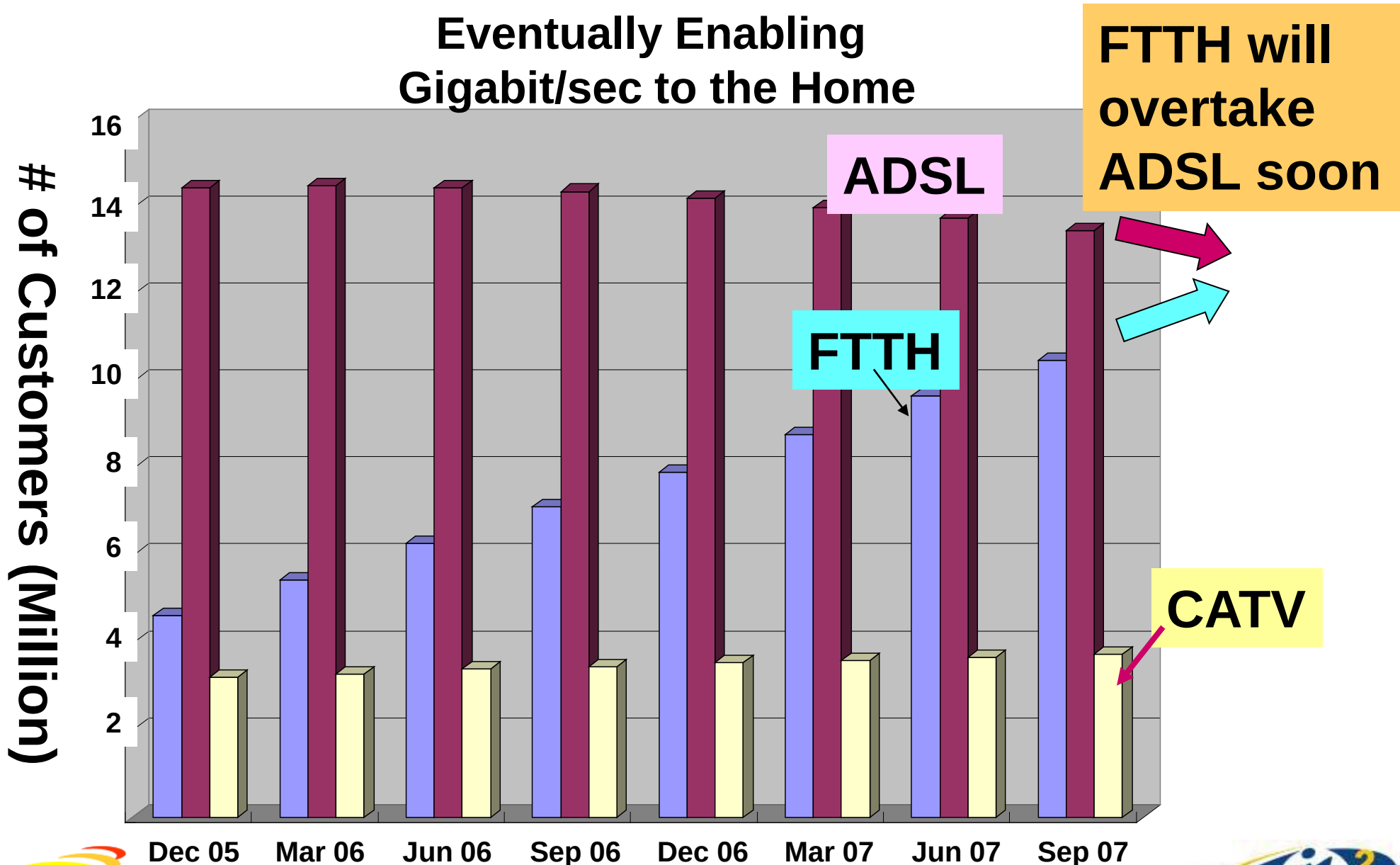
**Spitzer Space Telescope (Infrared)**



**Hubble Space Telescope (Optical)**

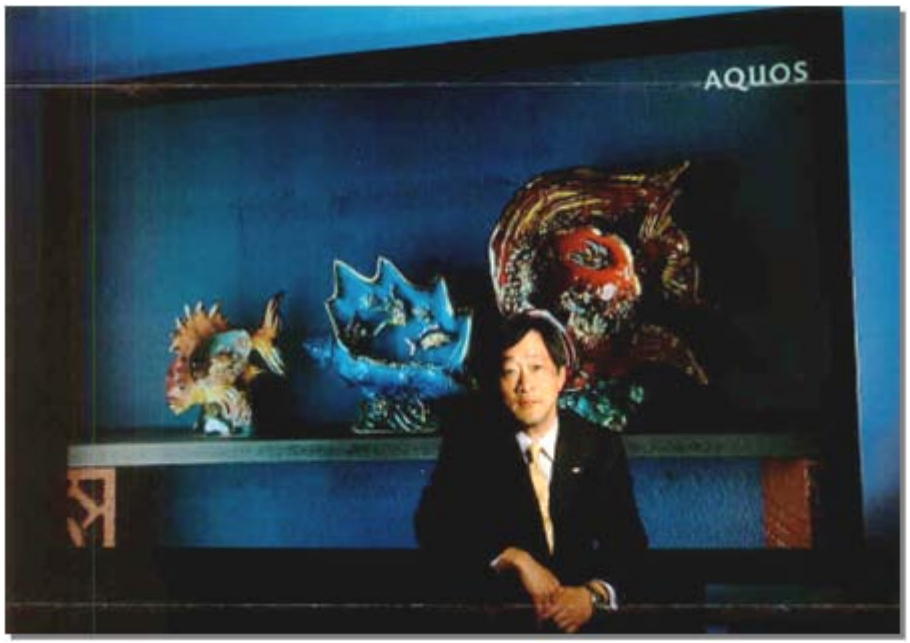
**Source: Falko Kuester, Calit2@UCSD**

# Broadband Users in Japan: Over 10 Million Homes Have Fiber Connection




Source: Takashi Shimizu, NTT Network Innovation Laboratories

# In the Near Future, Walls of Homes and Offices will be Electroactive



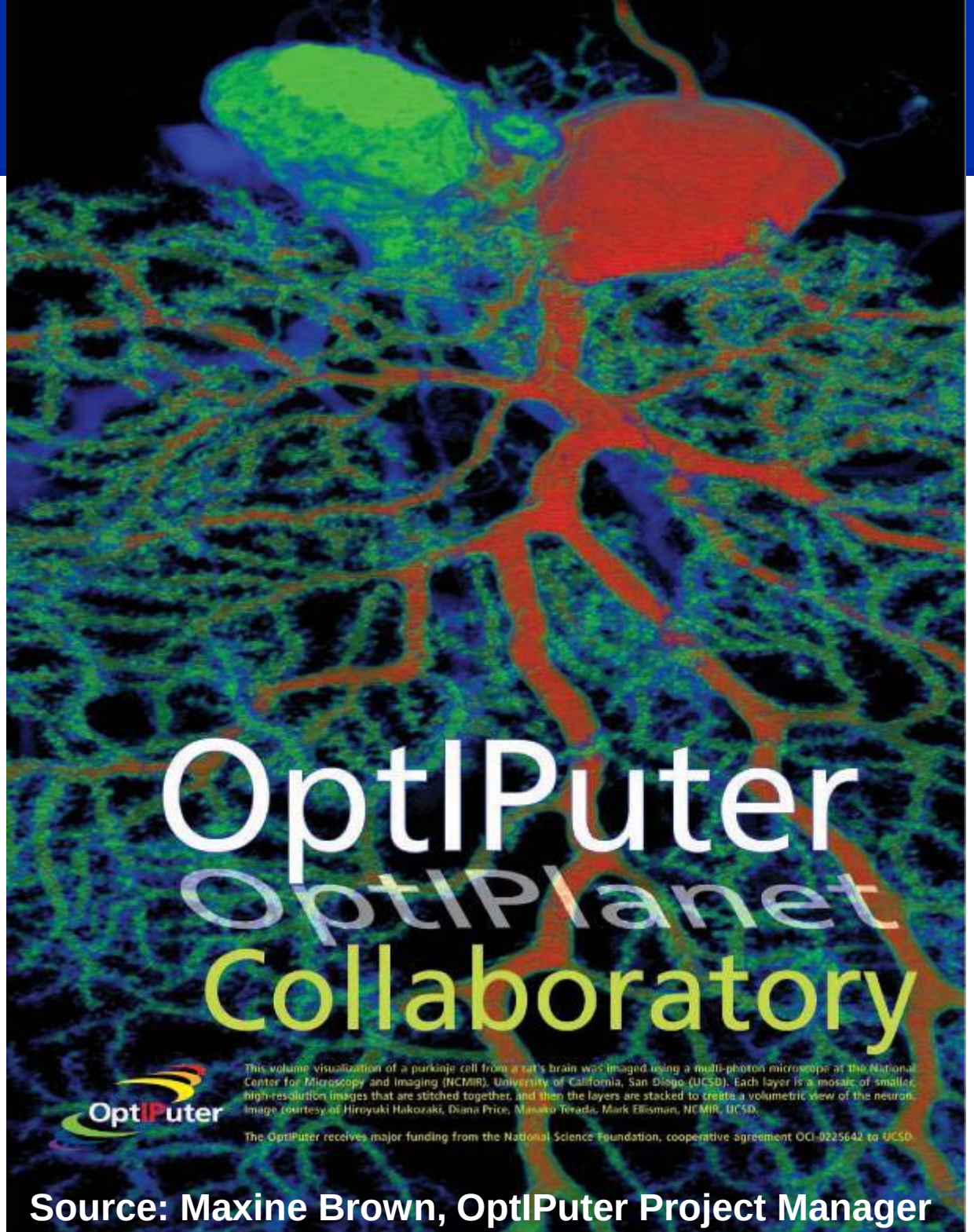

## Chairman of Sharp

**"In Ten Years' Time Entire Walls Could Be Screens"**

**Forbes, June 4, 2007**

## Sharp Labs of America / EVL Public-Private Partnership



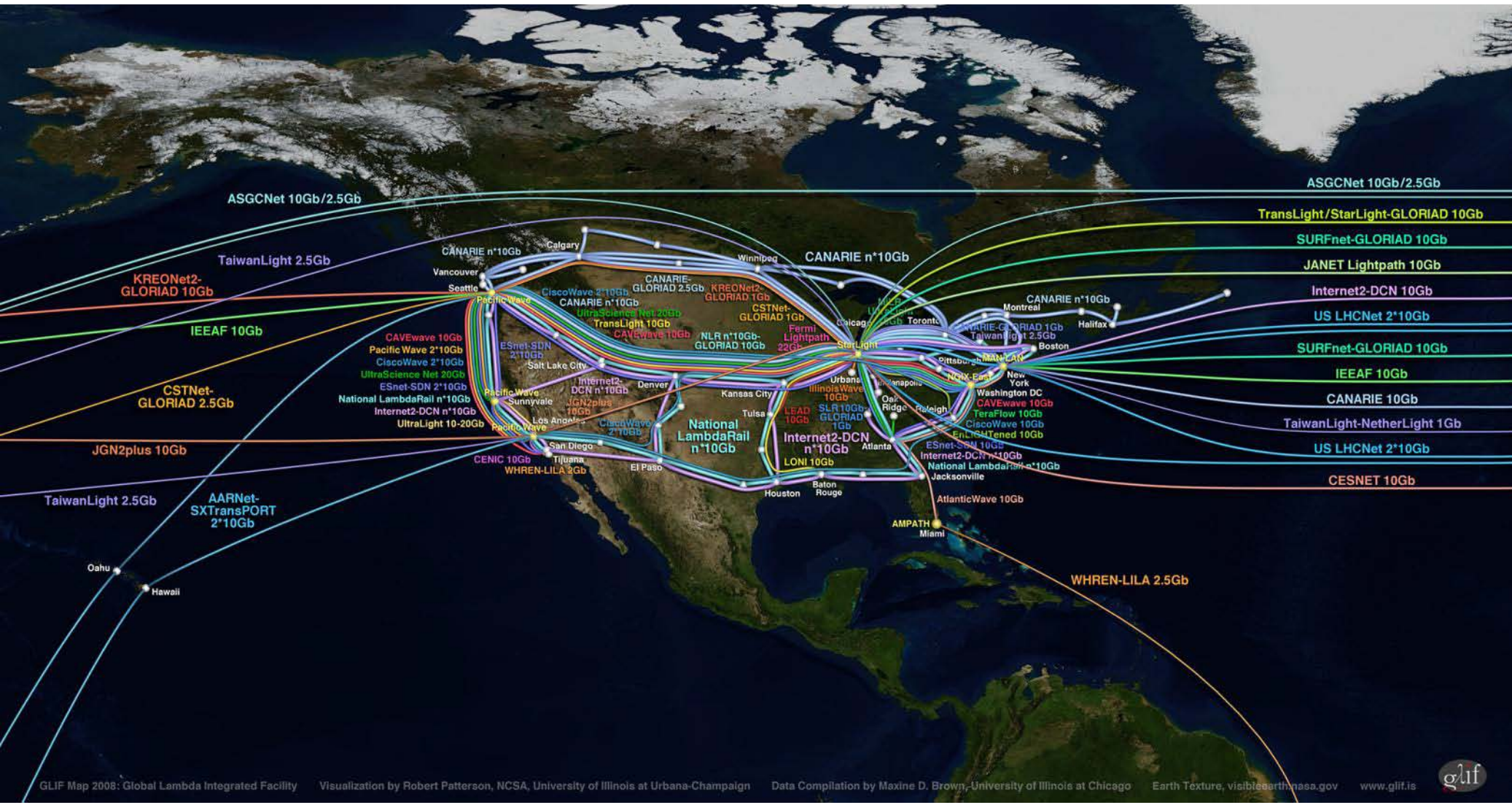



**Source: Maxine Brown, OptIPuter Project Manager**

**Green Initiative:**

**Can Optical Fiber Replace Airline Travel for Continuing Collaborations ?**

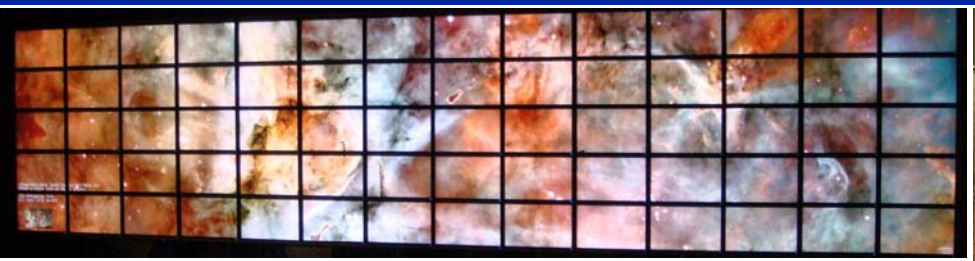
# Global Lambda Integrated Facility
# North America




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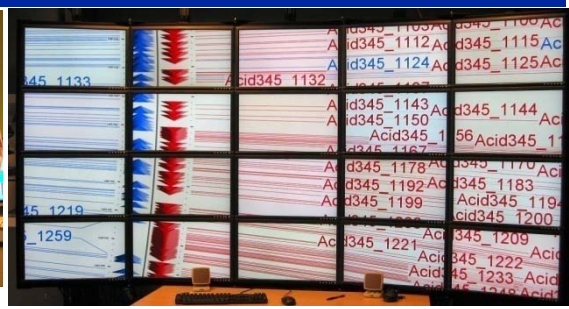
# OptIPuter Team OptIPortals



Calit2@UCSD



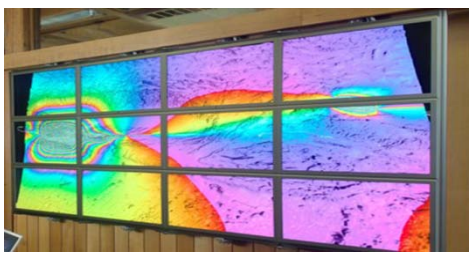
Calit2@UCSD



Calit2@UCSD



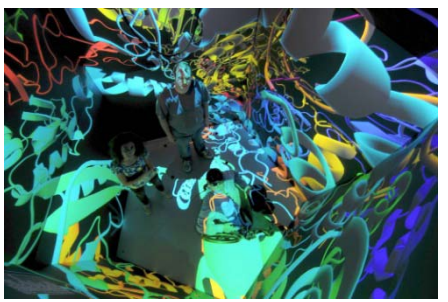
NCMIR-UCSD



SIO-UCSD



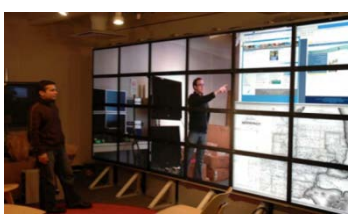
Calit2@UCSD



Calit2@UCSD



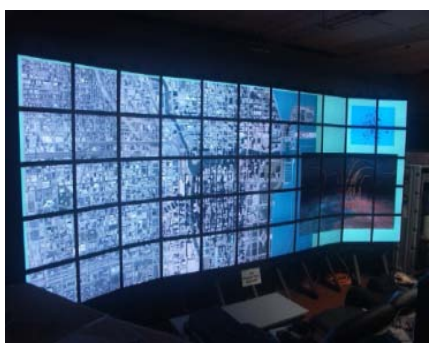

USGS



VISIT-U Michigan



EVL@UIC



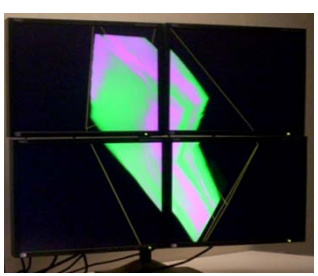
EVL@UIC



Calit2@UCI



iCAIR-
Northwestern U



Texas A&M

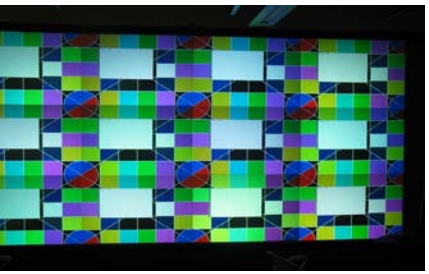


EVL@UIC

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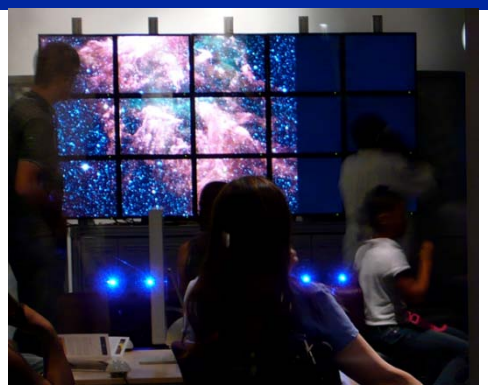
# North American OptIPortals



Purdue U



AOSS-U Michigan



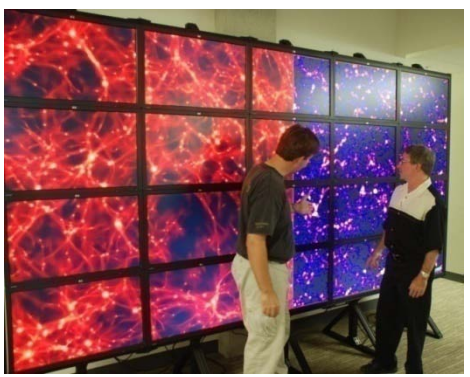
Adler Planetarium - Chicago



TRCC, Chicago



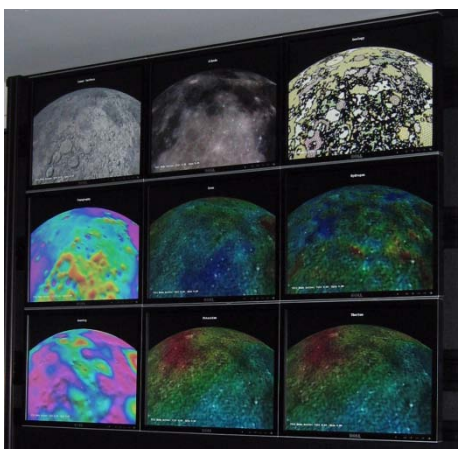
U Washington



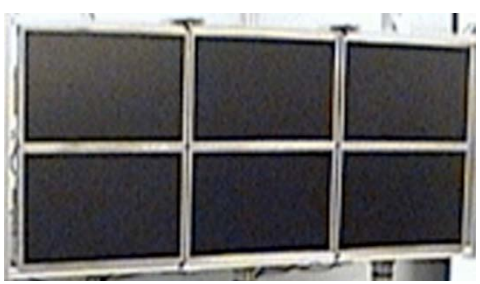
SDSC - UCSD



DMC-U Michigan



NASA Goddard



Florida International U

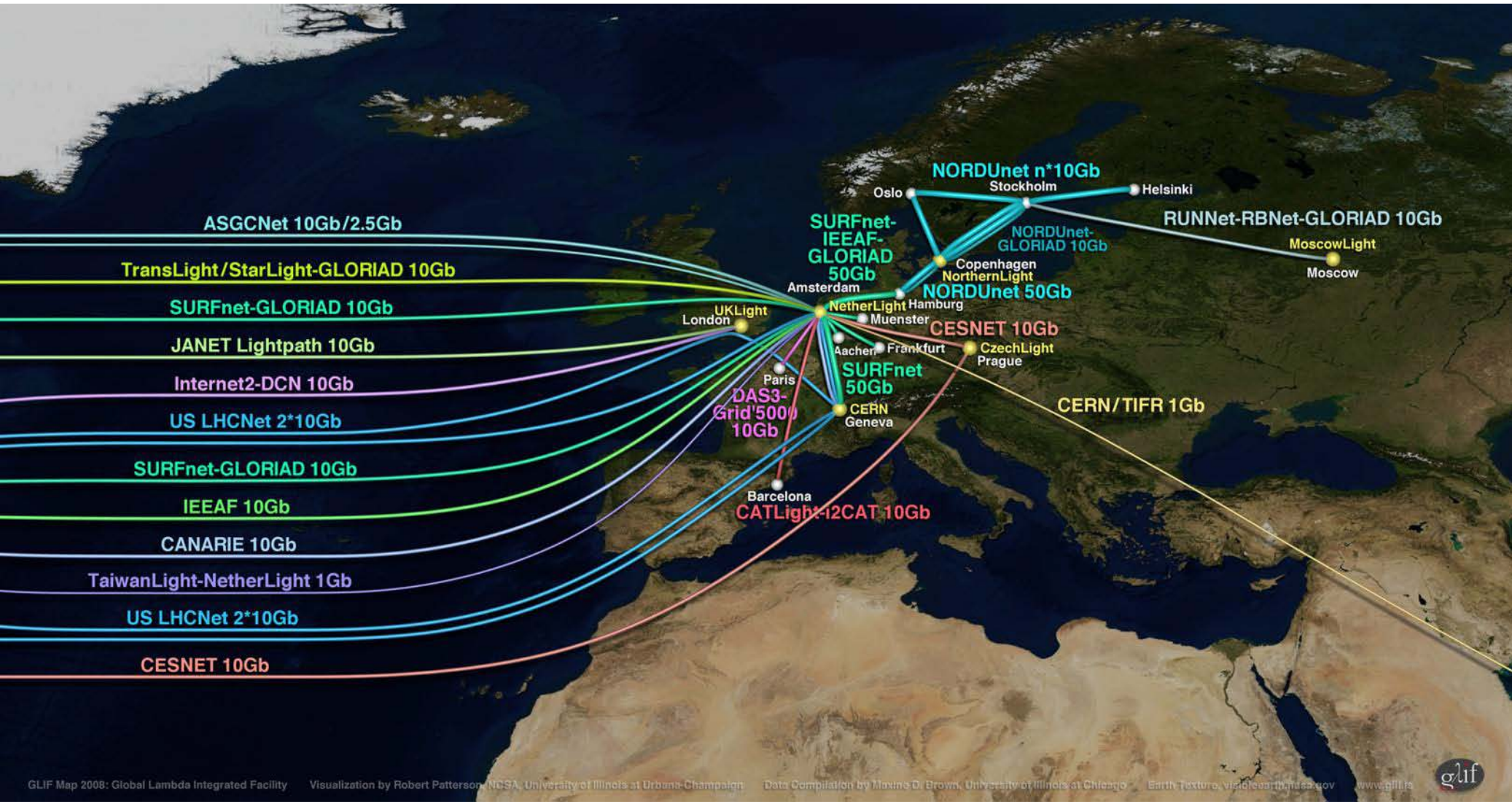


CICESE, Mexico

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# Global Lambda Integrated Facility
# Europe




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# European OptIPortals



Space Research Institute-Moscow



Science Innovation Center Chernogolovka, Russia




Masaryk U- Czech Republic



Zurich, Switzerland



SARA- Netherlands

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# Global Lambda Integrated Facility
# Australia / New Zealand




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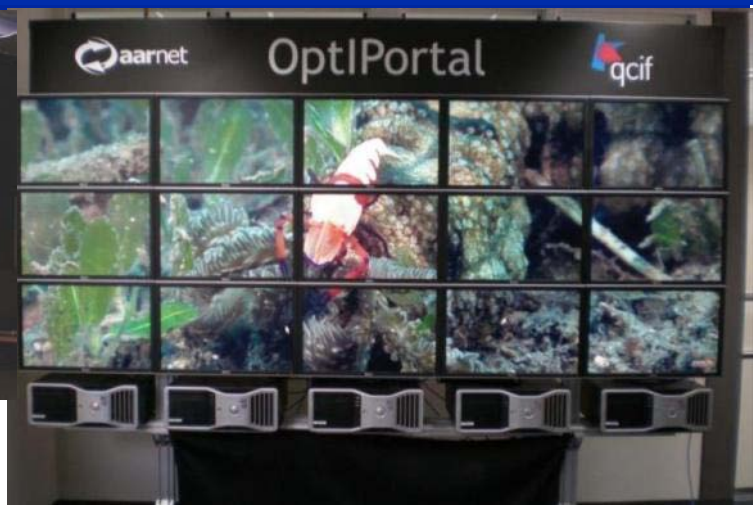
# Australian / New Zealand OptIPortals



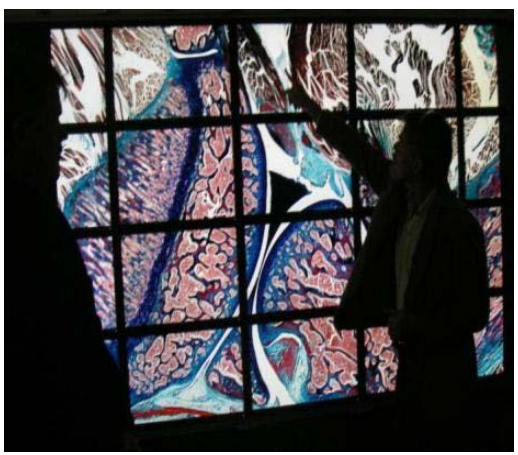
ANU



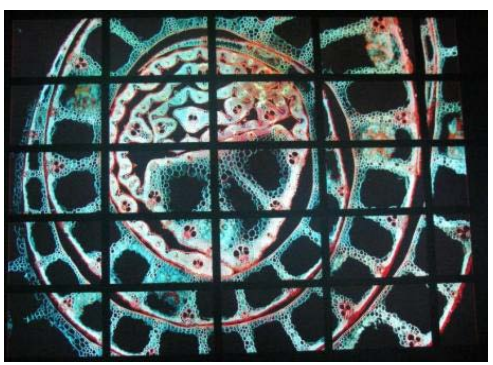
U Queensland




AARNet



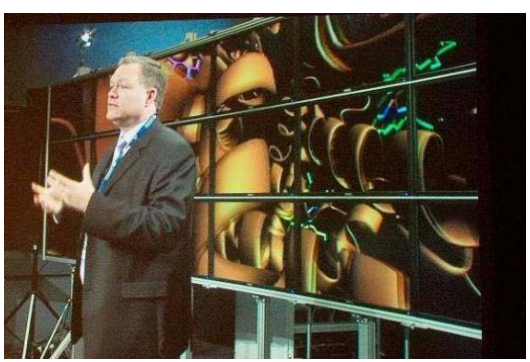
Monash U



CSIRO



U Wellington, NZ

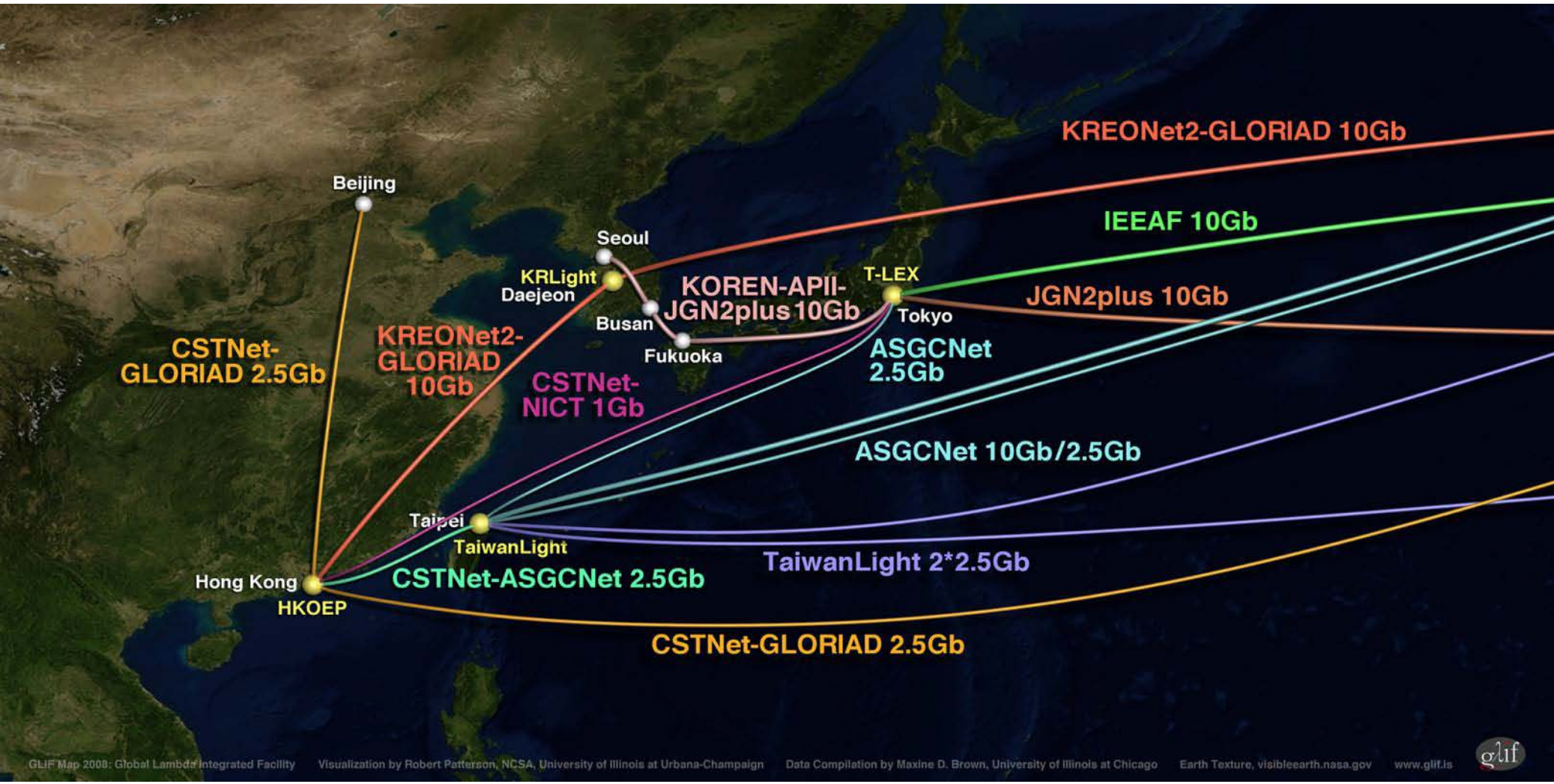


U Melbourne

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# Global Lambda Integrated Facility
# Northeast Asia

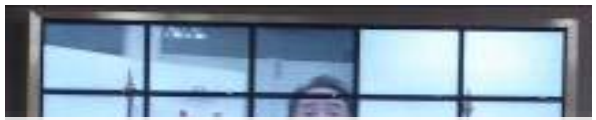


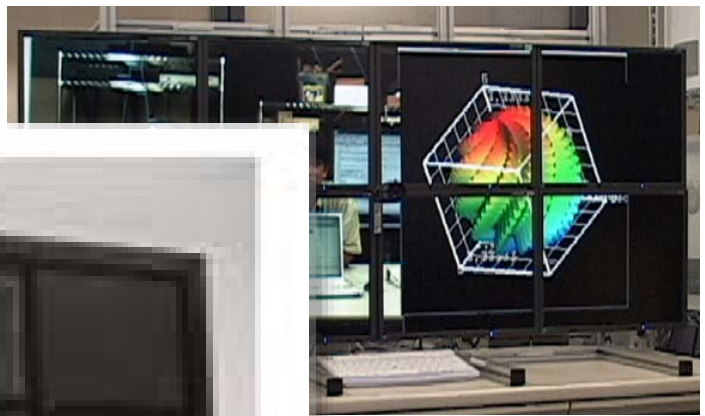

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# Northeast Asia OptIPortals







AIST-Ja

apan



KIST



C-Taiwan



**Computer Network Information Center, Chinese Academy of Sciences**
**CNIC-China**

# Pacific Rim Applications and Grid Middleware Assembly
# PRAGMA Grid Established in Beijing 2004




PRAGMA

OptIPuter

**17-18 May 2004 CNIC-CAS**

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# Information and Communication Technology (ICT) Is Major Contributor to $CO_2$ Emissions*

- **The ICT Industry Carbon Footprint is Equivalent to that of the Aviation Industry—But Doubling Every Two Years!**
- **Energy Usage of a Single Compute Rack is Measured in House-Equivalents**
- **ICT Emissions Growth is Fastest of any Sector in Society, Especially at Universities as Data-Intensive Research Spreads Across Disciplines**
- **Can Fiber Optics Help?**
  - **Place Data Centers Near Renewable Energy Sources**
  - **Consolidate Departmental Clusters and Storage**
  - **Create Campus-Wide "Data Utilities" for Instruments**

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# ICT Industry is Already Acting to Reduce Carbon Footprint

## Sun's 'portable' Blackbox data center

**Company unveils new one-box data center**

Sun Microsystems' CEO Jonathan Schwartz showed off the company's new "Project Blackbox" in a Menlo Park, Calif., parking lot Tuesday. Sun says the gear is not only preassembled, but it's tough and arrives ready to run.

**HP's Green Business Technology Initiative**



Innovative Dynamic Smart Cooling

Cut cooling costs in the data center as much as 40%.

» Learn more

**Buying Green**

updated 10:47 a.m. EST, Wed November 28, 2007

## Google pushes 'green' power initiative

## Intel Becomes Largest Purchaser of Green Power in the U.S.

**Company Tops EPA Green Power Partner List, Vows to Drive for Greater Efficiency While Spurring Growth in Renewable Market**

## How Microsoft is going green

Biodiesel trucks, solar-powered data centers are just a couple environmentally friendly track

*By John Fontana , Network World , 01/09/2008*

## IBM Project Big Green

Big Green Banner

Project Big Green is a $1 billion investment to dramatically increase the efficiency of IBM products. New IBM products and services,

# California's Universities are Engines for Green Innovation—Partnering with Industry

**UCSD Structural Engineering Dept. Conducted Tests May 2007**

Sun microsystems

UCSD Jacobs School of Engineering



7 Racks plus Network



Takes up 2 Parking Spaces



Data Power Cooling

- **Measure and Control Energy Usage**
- **Separate Large Compute/ Storage from User Labs Using Optical Fibers**
- **Computer Science Lab for Green IT**
- **International Collaboration with Canada/Australia**
  - **Place Data Center Near Non-Carbon Energy**



**$2M NSF-Funded GreenLight Project**

OptIPuter

**UCSD (Calit2 & SOM) Bought Two Sun Boxes May 2008**

it²

# Opportunity for Collaborative Research Between UCSD-Tsinghua University?