Living in a Totally Connected World

Invited Speaker
Science Lecture Series
Torrey Pines High School
San Diego, CA
January 9, 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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A Mobile Internet Powered by a Planetary-Scale Optical Backplane

- **Wireless Access--Anywhere, Anytime**
  - Broadband Speeds
  - "Always Best Connected"
- **Billions of New Wireless Internet End Points**
  - Information Appliances
  - Sensors and Actuators
  - Embedded Processors
- **Emergence of a Distributed Planetary Computer**
  - Ubiquitous High Definition Video Flows
  - Parallel Lightwaves in Optical Backbone
  - Storage of Data Everywhere
  - Scalable Distributed Computing Power

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Scenarios in This New World

- Customized medical care based on genotype plus real-time vital signs
- Intelligent transportation systems to enable efficient traffic flow
- Real-time environmental data collection to inform decision making and policy setting
- Vast networked gaming environments in which to learn, communicate, work
- Digital entertainment networks, CineGrid



These scenarios are all based on…
- integrated systems of underlying technologies
- applied to real-world problems
- affecting California's economy and quality of life

"Someday, all this will be infrastructure."

Source: Warren Miller, New Yorker, April 11, 1988

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Broadband Depends on Where You Are









- **Mobile Broadband**
  - 0.1-0.5 Mbps

100,000 Fold Range
All Here Today!

- **Home Broadband**
  - 1-10 Mbps

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

- **University Dorm Room Broadband**
  - 10-100 Mbps

- **Calit2 Global Broadband**
  - 1,000-10,000 Mbps

What Is Calit2?

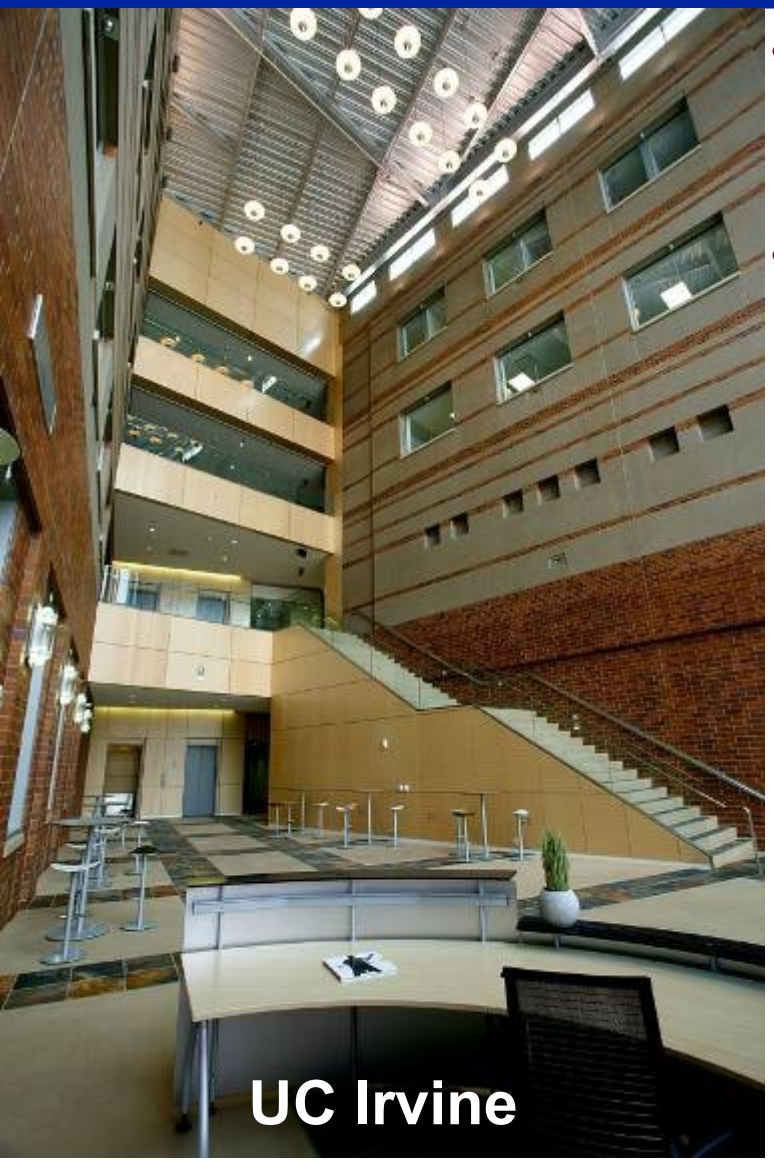
- **Research on the Future of the Internet and its Transformation of Our Society**
- **Core Partnership Between UCSD and UCI**
  - **Several Hundred Faculty**
  - **Alliances With Other Campuses**
- **Prototyping Of Infrastructure Through "Living Laboratories"**
  - **From Campus to Planetary Scale**
  - **Partnerships With Multiple Levels of Government and Industry**
  - **Secret Sauce: Technical Professionals to Move Projects Forward**
- **Multidisciplinary Research *Teams***
  - **Faculty, Postdocs, Staff, Students**
  - **Industry Partners –**
    - **From Giants to Start-up Companies**
  - **Community Partners**
    - **Emergency Responders**



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Two New Calit2 Buildings Provide New Laboratories for "Living in the Future"



- "Convergence" Laboratory Facilities
  - Nanotech, BioMEMS, Chips, Radio, Photonics
  - Virtual Reality, Digital Cinema, HDTV, Gaming
- Over 1000 Researchers in Two Buildings
  - Linked via Dedicated Optical Networks



www.calit2.net

Preparing for a World in Which Distance is Eliminated…

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Calit2 Has Developed Undergrad Research Summer Research Programs on Both Campuses

Over 150 Students In Six Years

Calit2@UCSD
UGRAD RESEARCH SCHOLARSHIP
FEB. 27th DEADLINE



SURF-IT
CALIT2 IRVINE





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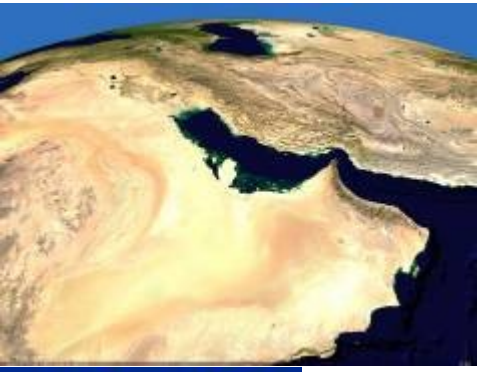
Bioengineering, Chemistry, Chemical Eng., Cog Sci, CSE, ECE, IR/PS, Music, Physics, SIO, Visual Arts

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How Can We Make Scientific Discovery as Engaging as Video Games?



Geography **Earth Sciences** **Anatomy** **Neurosciences**









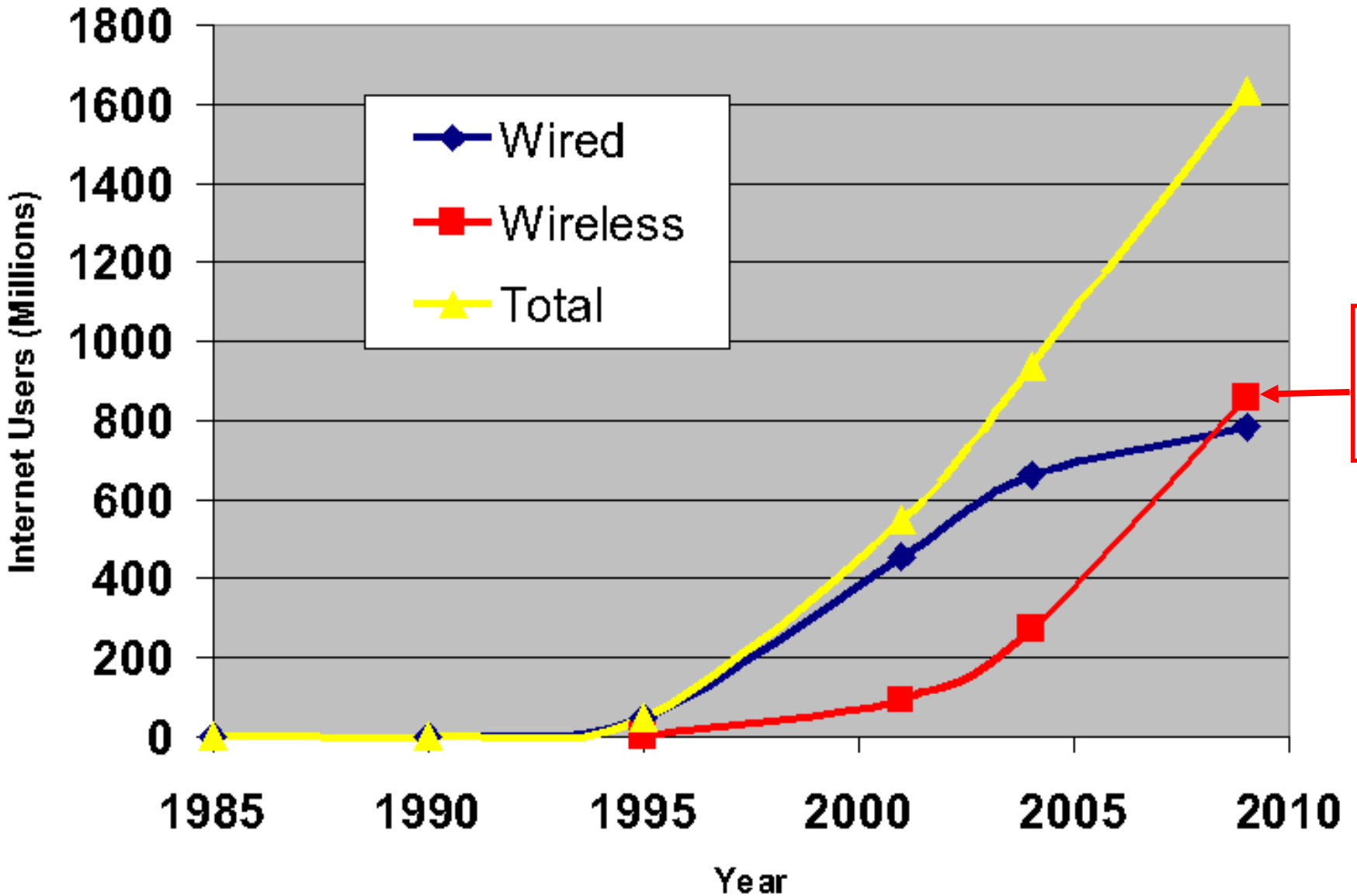
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The Preuss School UCSD

SDSC

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Transitioning to the "Always-On" Mobile Internet



http://www.etforecasts.com/products/ES_intusersv2.htm

Using Students to Glimpse the Future of Widespread Use of Spatially Aware Wireless Devices

- Broadband Internet Connection via Wireless Wi-Fi
- Year- Long "Living Laboratory" Experiment 2001-02
  - 500 Computer Science & Engineering Undergraduates
- 300 Entering UCSD Sixth College Students—Fall 2002
- Experiments with Geo-Location and Interactive Maps





ACTIVE CAMPUS .UCSD.EDU

Microsoft Research

hp invent

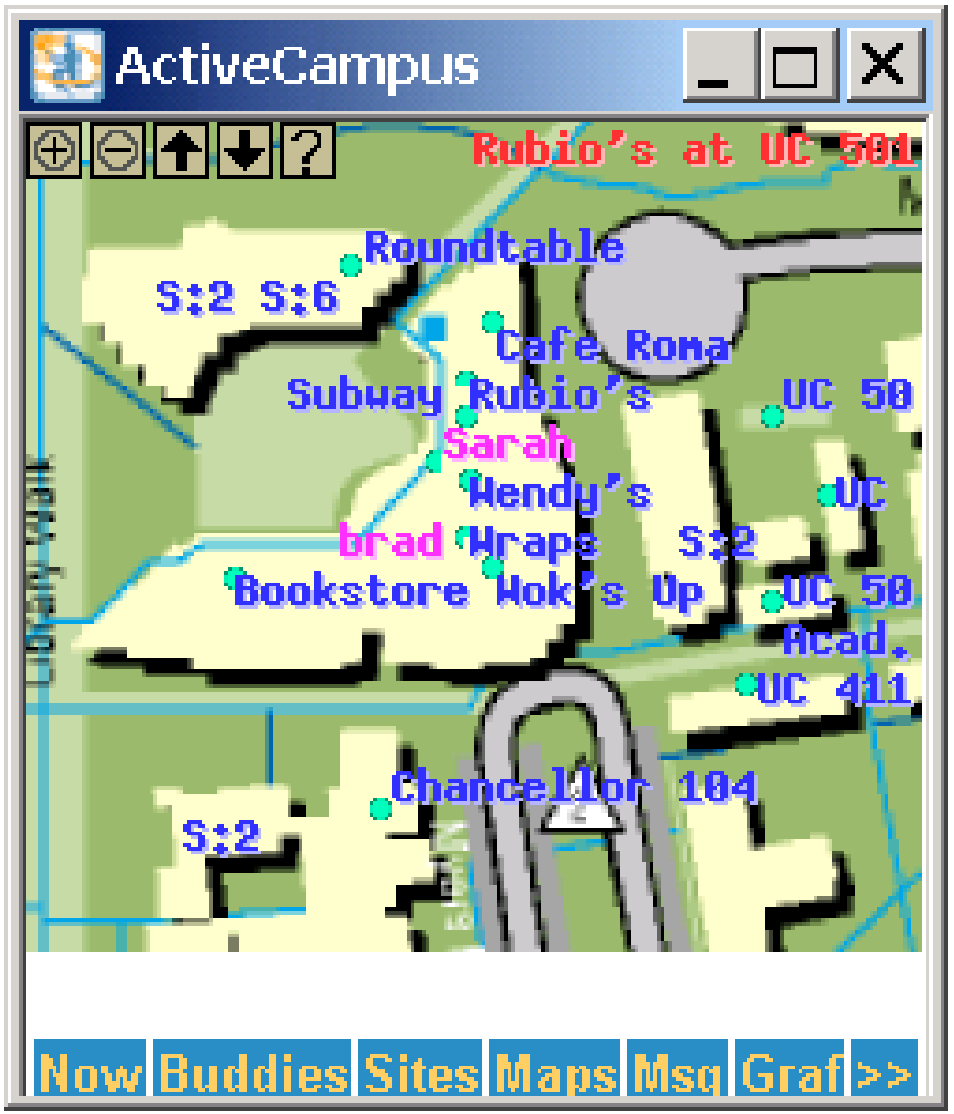
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Calit2 Team: Bill Griswold, Gabriele Wienhausen, UCSD

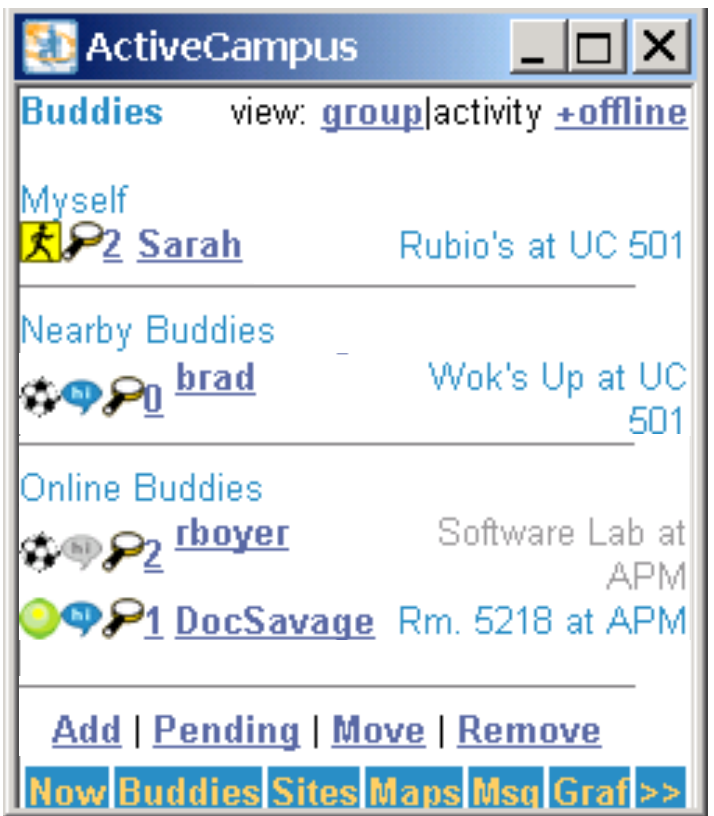
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Spatially Aware World—Everyone and Everything Knows Where the Others Are



UCSD ActiveCampus – Outdoor Map

- **Technologies of Geolocation**
  - GPS chips
  - Access Point Triangulation
  - Bluetooth Beacons
  - Gyro chips



Source: Bill Griswold, UCSD

Calit2's WIISARD Project Has Innovated Wireless Systems to Support SoCal First Responders





















Aug. 22, 2006 MMST Disaster Drill at Calit2@UCSD Involved Over 200 First Responders

Calit2 Provides Real Time Personalized Commute Information



Recently Expanded to Include Orange and LA Counties

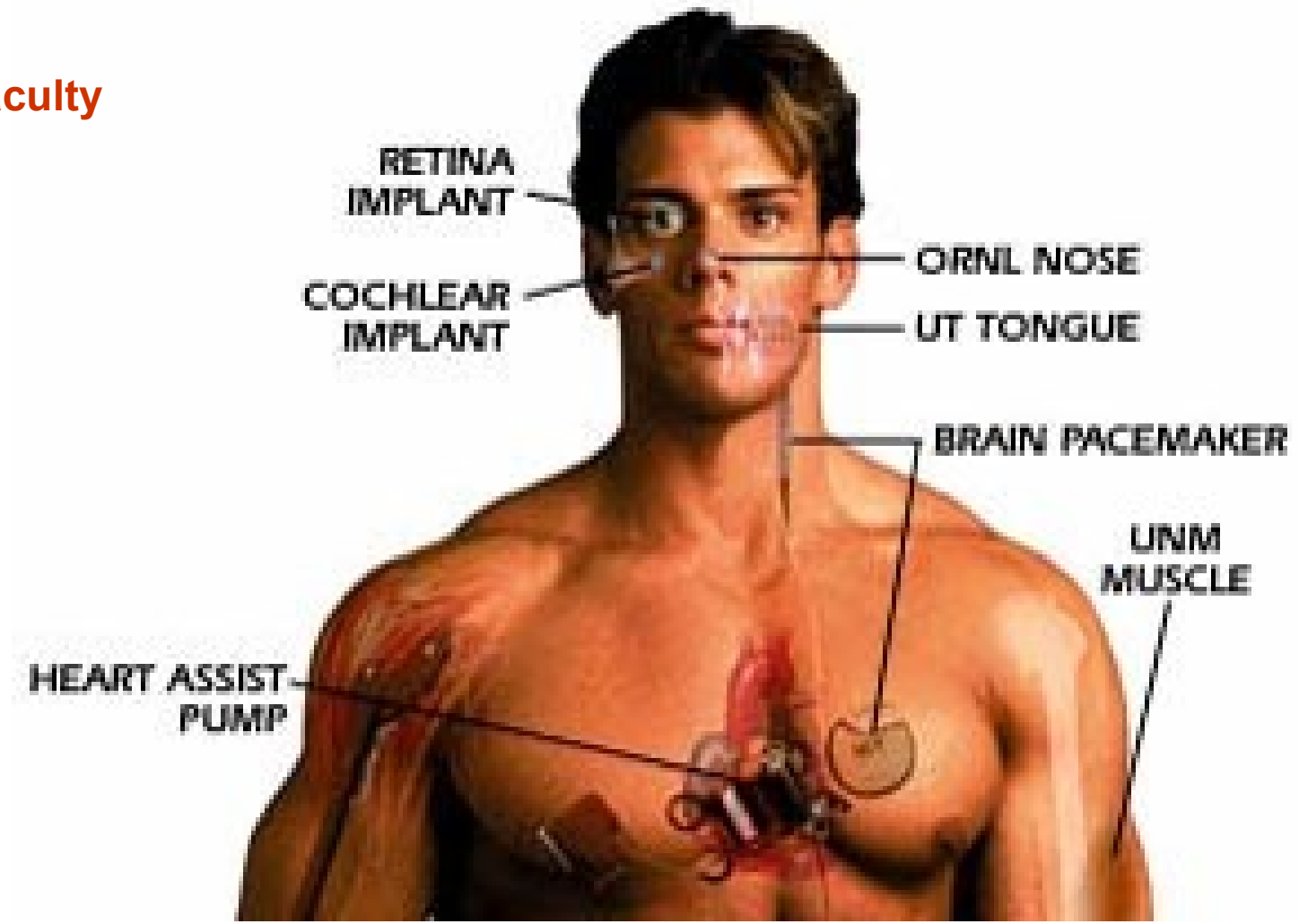
866-500-0977
Over 1,000 Calls Per Day!

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http://traffic.calit2.net

Lifechips--Merging Two Major Industries: Microelectronic Chips & Life Sciences

65 UCI Faculty



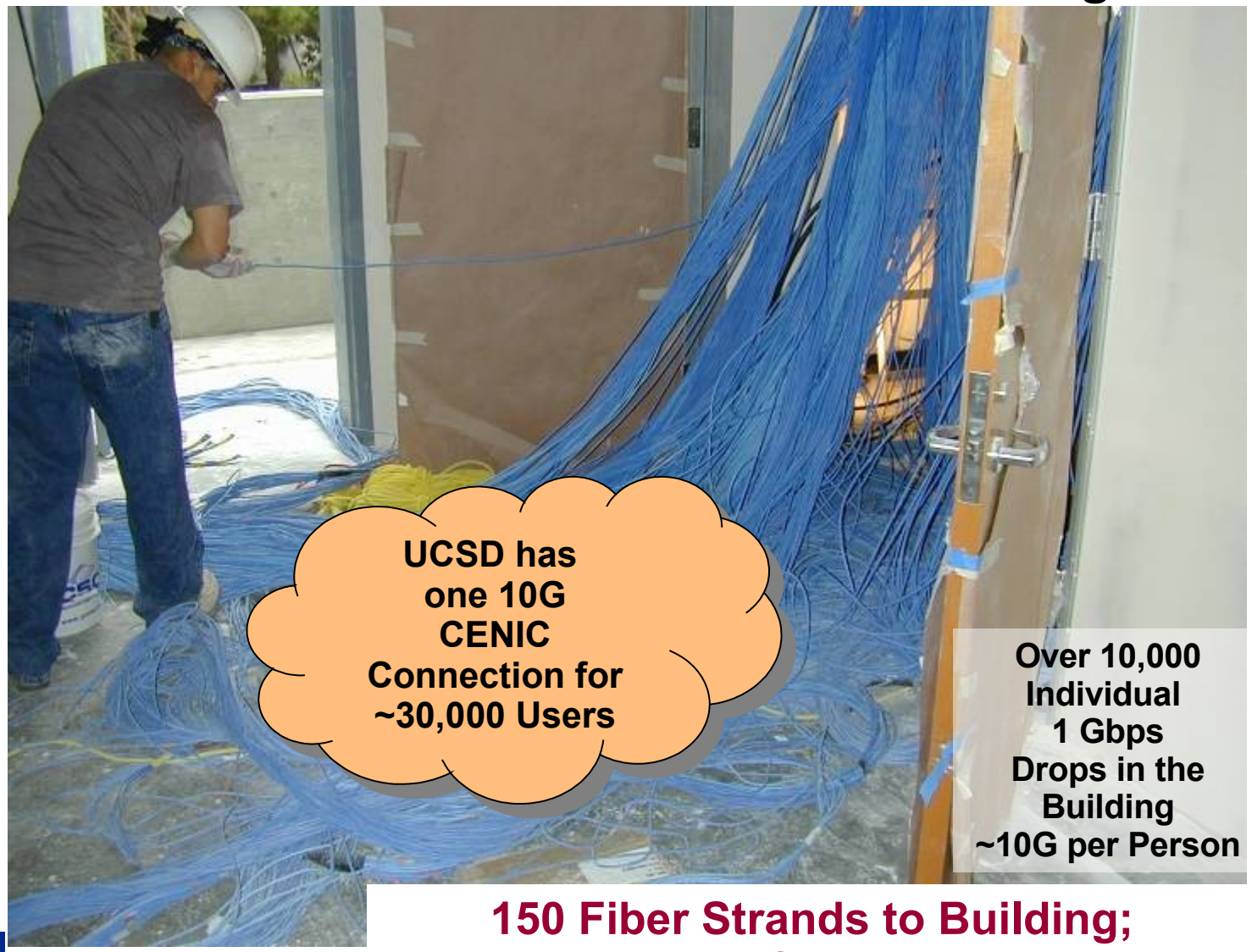
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lifechips
university of california, irvine
www.lifechips.org

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The Calit2@UCSD Building is Designed for Prototyping Extremely High Bandwidth Applications

1.8 Million Feet of Cat6 Ethernet Cabling



24 Fiber Pairs to Each Lab

150 Fiber Strands to Building; Experimental Roof Radio Antenna Farm Ubiquitous WiFi

Photo: Tim Beach, Calit2

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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





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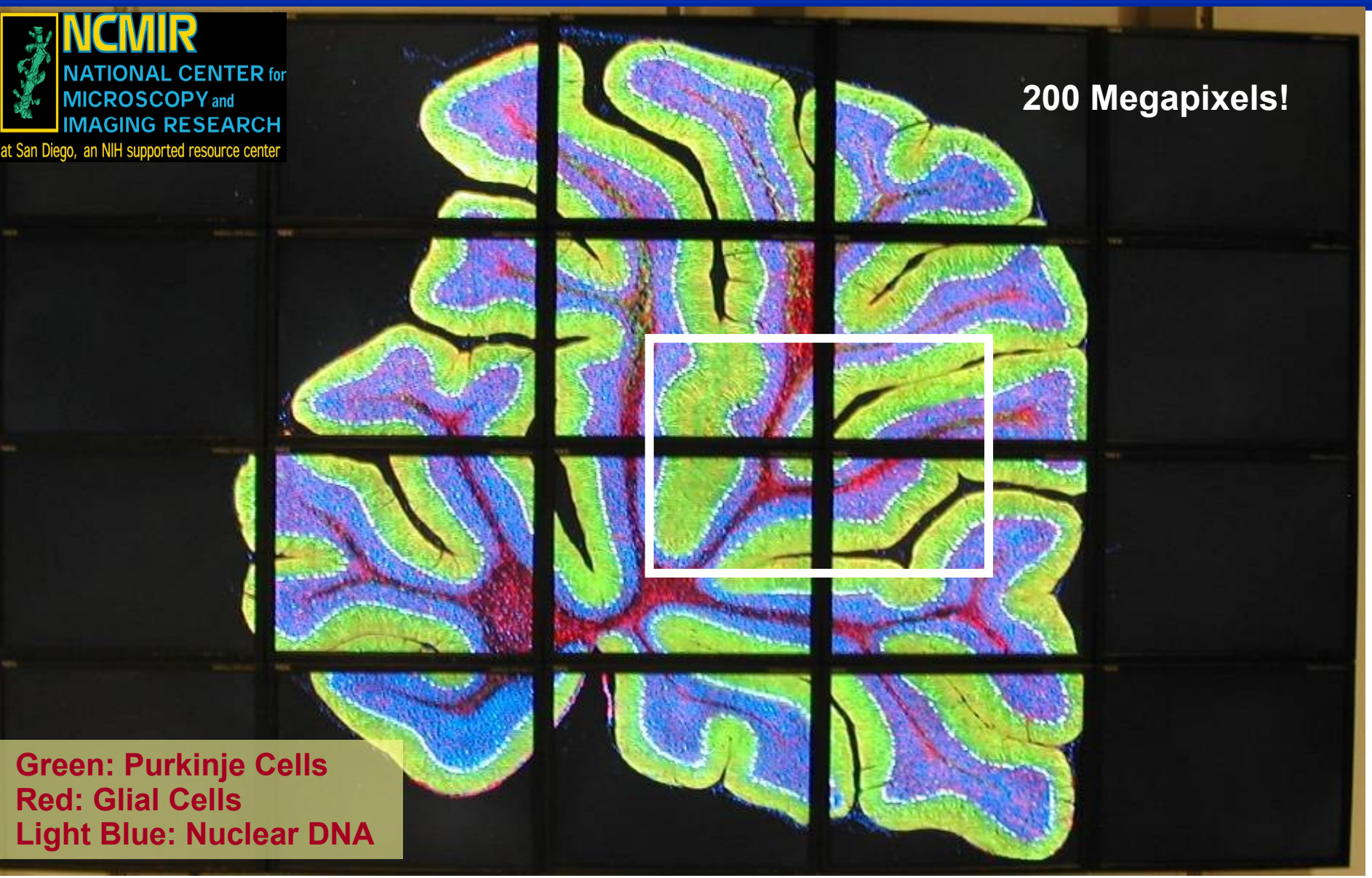
Powered by Rocks ROCKS

Source: Phil Papadopoulos SDSC, Calit2

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OptIPuter Scalable Displays Are Used for Multi-Scale Biomedical Imaging

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



Green: Purkinje Cells
Red: Glial Cells
Light Blue: Nuclear DNA

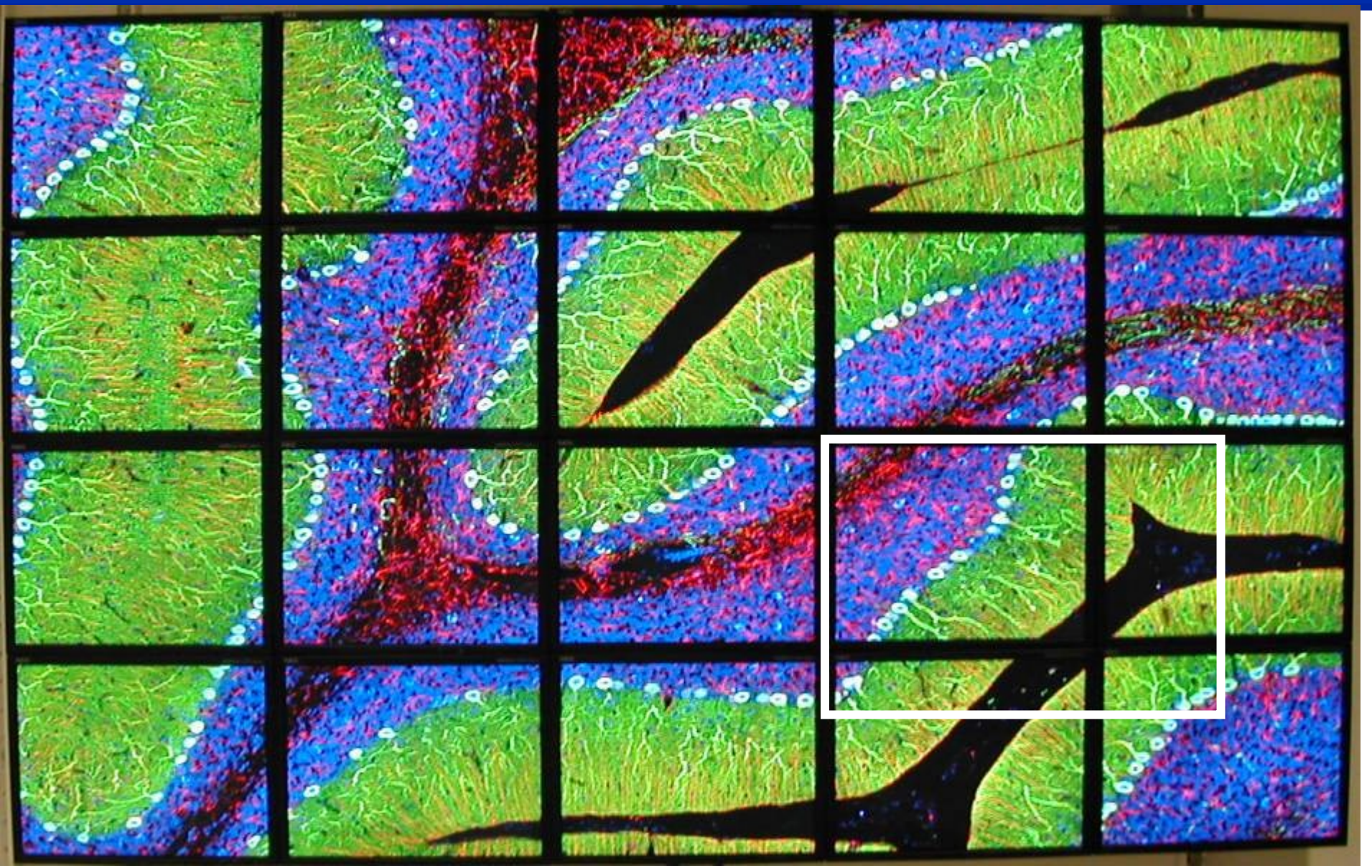
Source: Mark Ellisman, David Lee, Jason Leigh

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Two-Photon Laser Confocal Microscope Montage of 40x36=1440 Images in 3 Channels of a Mid-Sagittal Section of Rat Cerebellum Acquired Over an 8-hour Period

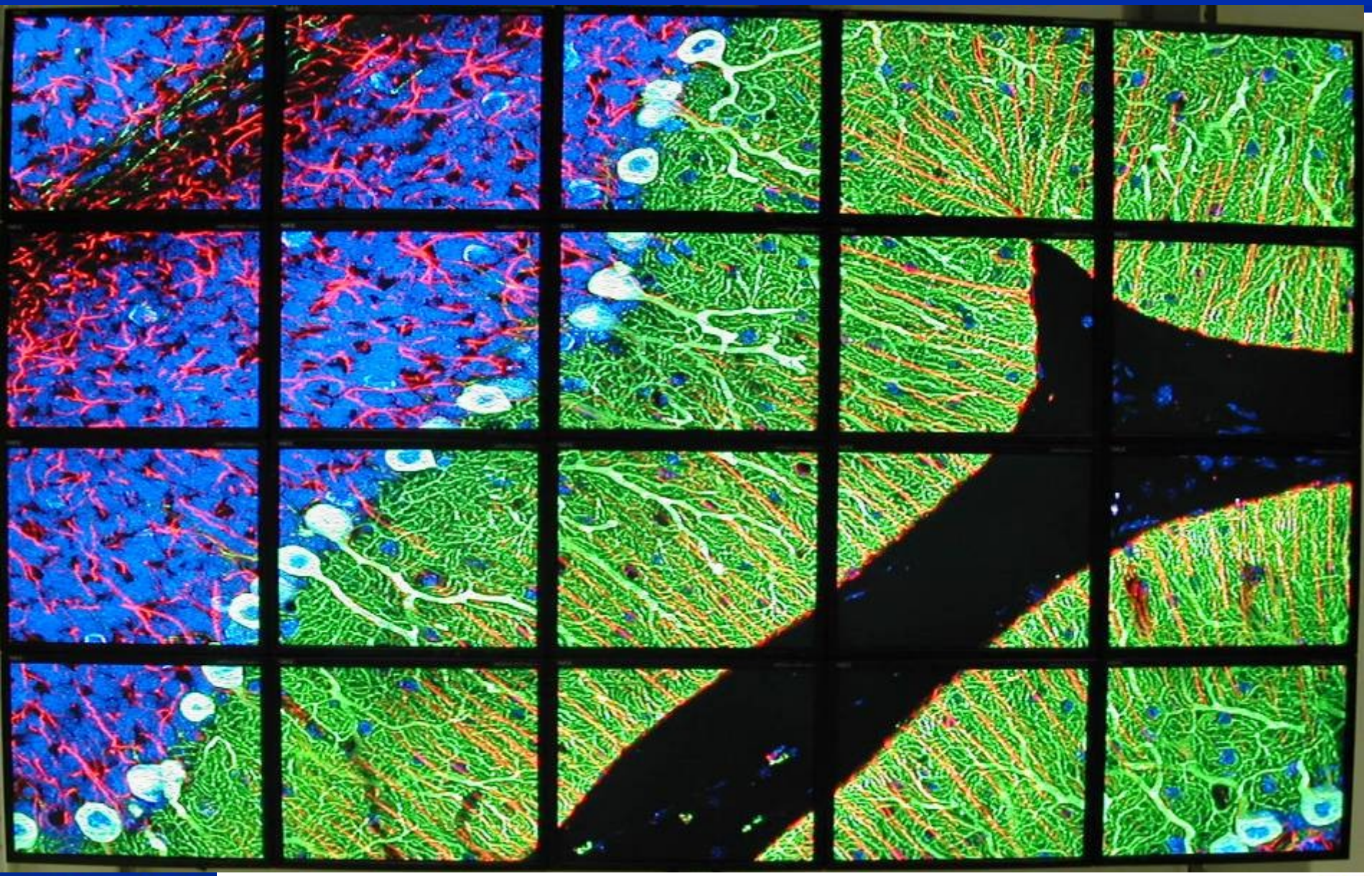
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Scalable Displays Allow Both Global Content and Fine Detail



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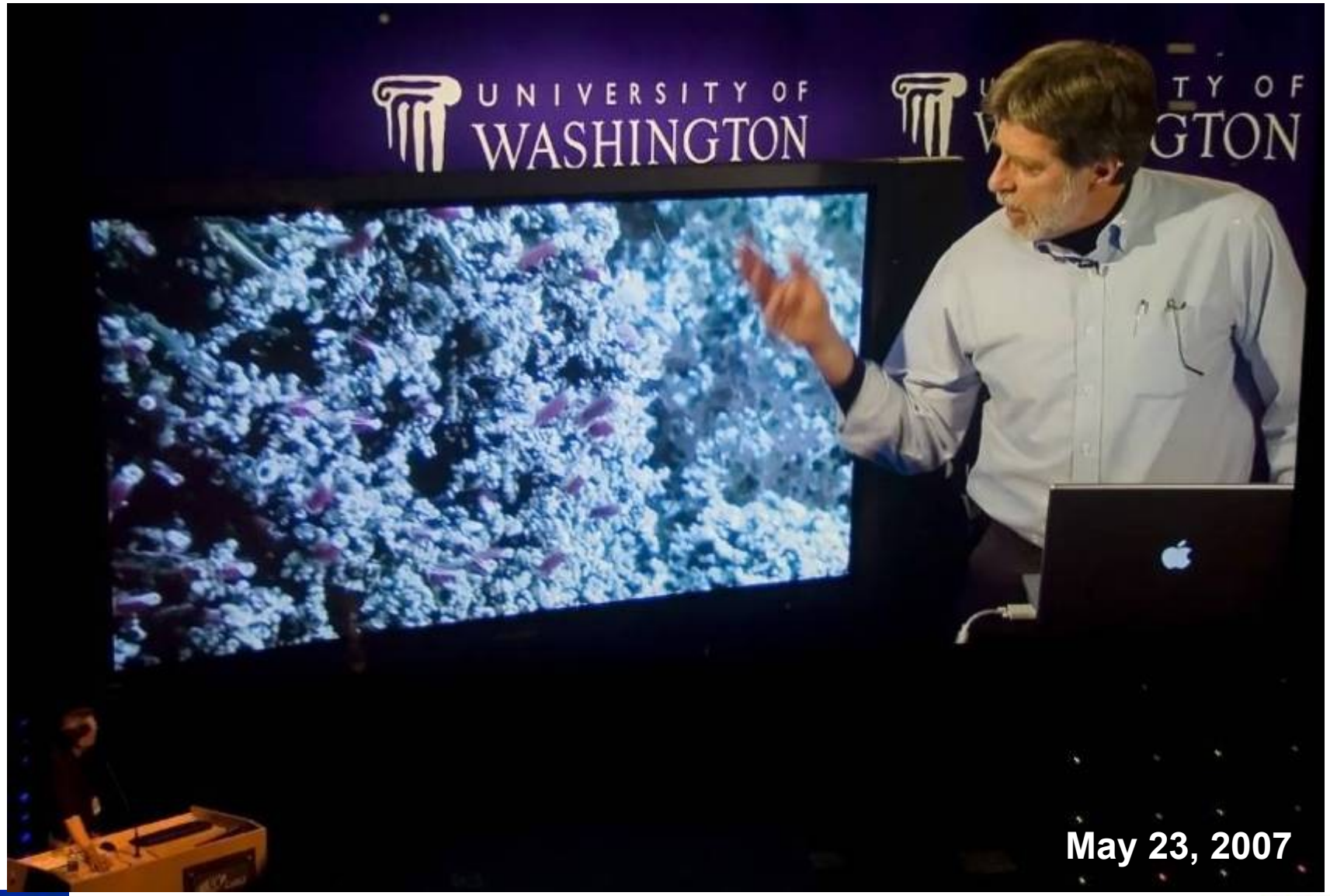
Allows for Interactive Zooming from Cerebellum to Individual Neurons



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e-Science Collaboratory Without Walls Enabled by iHDTV Uncompressed HD Telepresence

1500 Mbits/sec Calit2 to UW Research Channel Over NLR



John Delaney, PI LOOKING, Neptune

Photo: Harry Ammons, SDSC

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Embedded iHDTV in an OptIPortal Enables Collaboration



Larry Smarr in Reno

Source: Michael Wellings
Research Channel
Univ. Washington

Ginger Armbrust in Seattle

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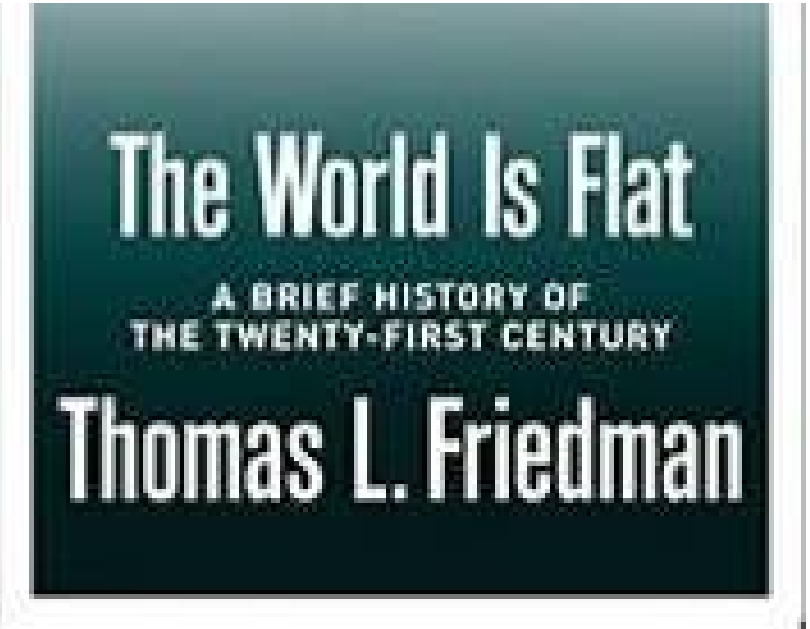
SC07 is the International Conference for High Performance Computing, Networking, Storage and Analysis

November 10 -16, 2007
Reno Sparks Convention Center

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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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Borderless Collaboration Between Global University Research Centers at 10Gbps

Maxine Brown, Tom DeFanti, Co-Chairs

iGrid 2005

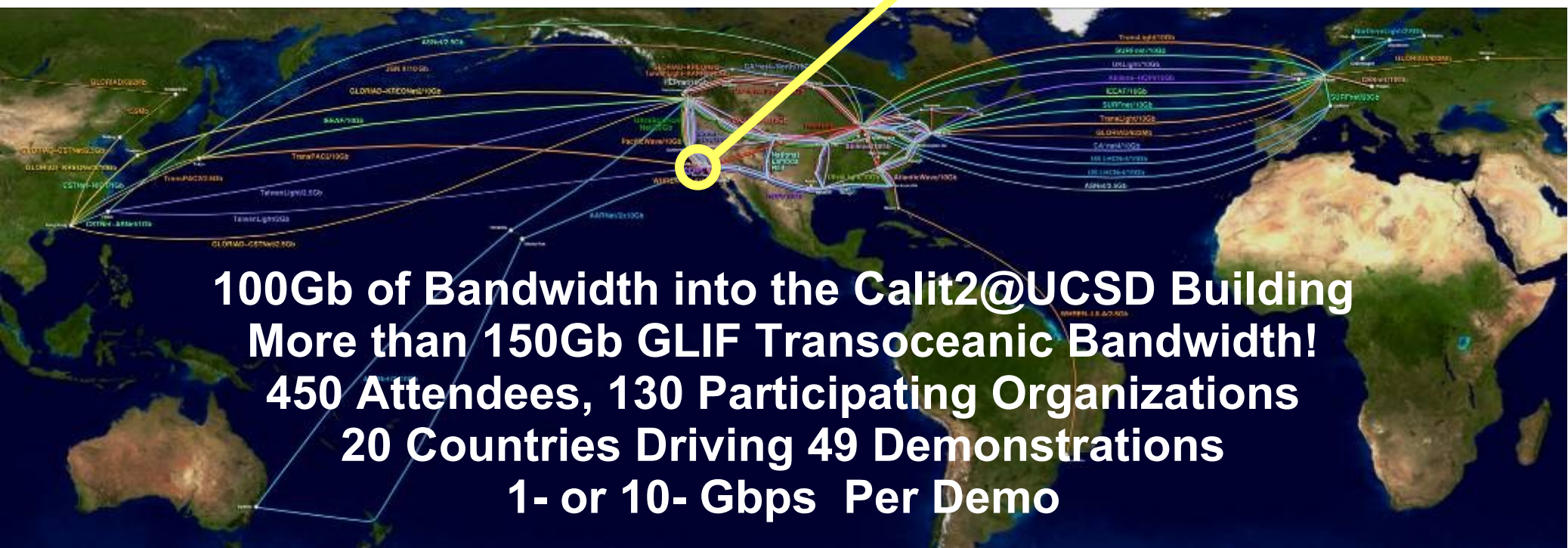
THE GLOBAL LAMBDA INTEGRATED FACILITY

www.igrid2005.org



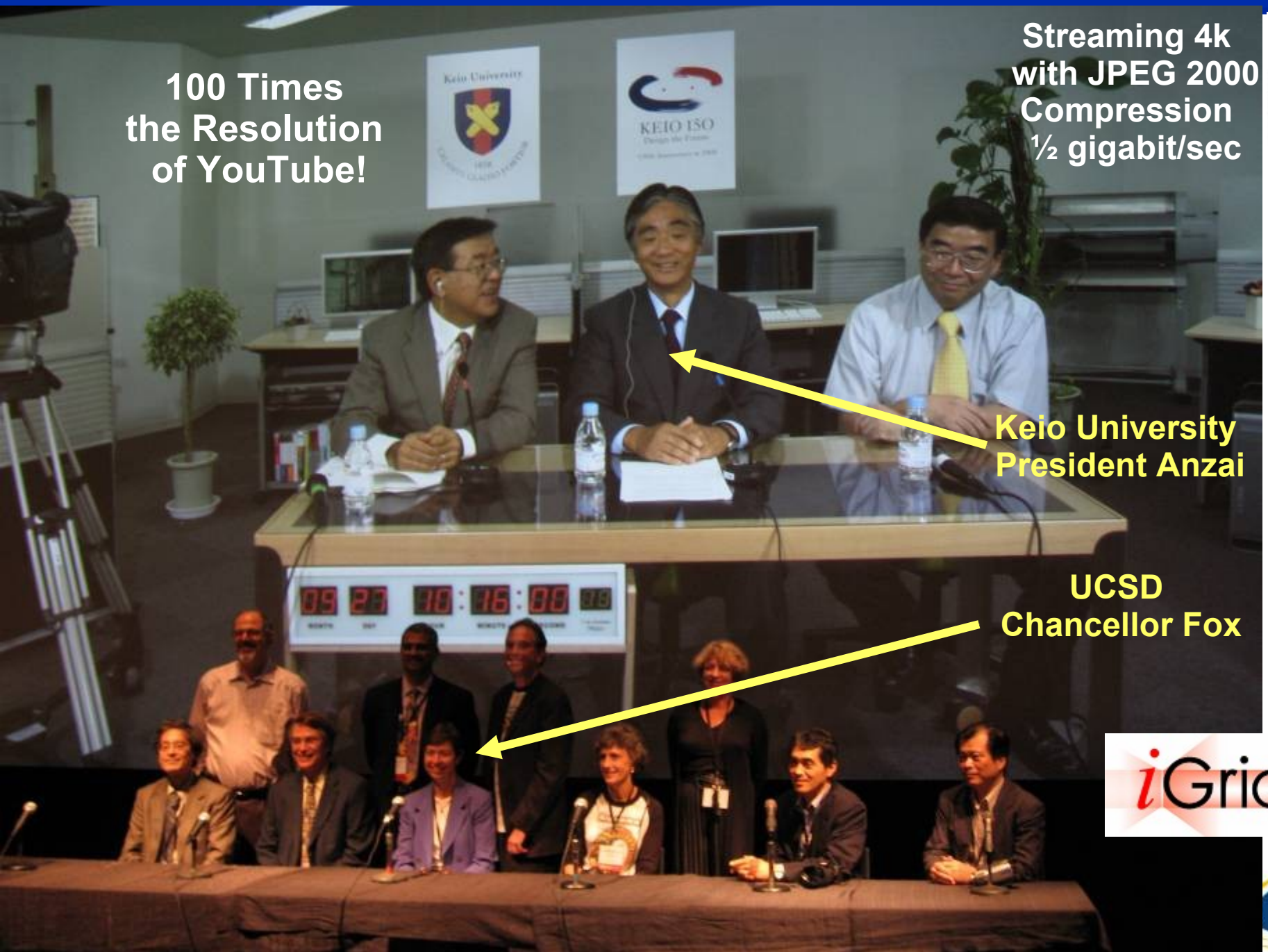
the UC Discovery Grant

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

First Trans-Pacific Super High Definition Telepresence Meeting Using Digital Cinema 4k Streams



CineGrid

Lays Technical Basis for Global Digital Cinema

Sony
NTT
SGI

iGrid 2005

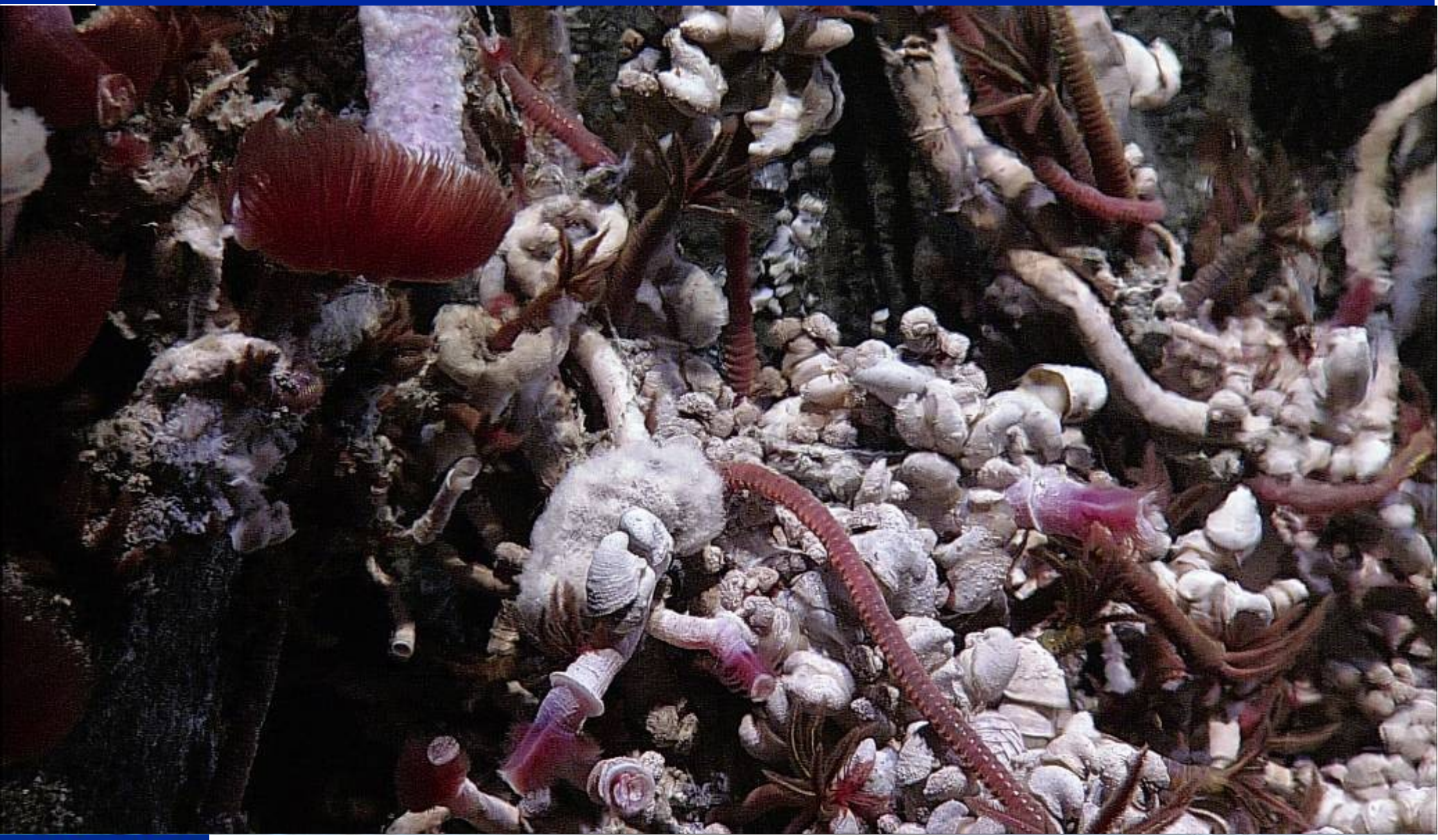
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Calit2, SDSC, and SIO are Creating Environmental Observatory Rooms



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Remote Interactive High Definition Video of Deep Sea Hydrothermal Vents



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Source John Delaney & Deborah Kelley, UWash

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Using Advanced Info Tech and Telecommunications to Accelerate Response to Wildfires



Early on October 23, 2007, Harris Fire San Diego

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Photo by Bill Clayton, http://map.sdsu.edu/

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Calit2 Added Live Feeds From HPWREN Cameras to KPBS Google Map



www.calit2.net/newsroom/release.php?id=1194

NASA's Aqua Satellite's MODIS Instrument Provided "Situational Awareness" of the 14 SoCal Fires

Calit2, SDSU, and NASA Goddard Used NASA Prioritization and OptIPuter Links to Cut time to Receive Images from 24 to 3 Hours



Moderate Resolution Imaging Spectroradiometer (MODIS)

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NASA/MODIS Rapid Response

www.nasa.gov/vision/earth/lookingatearth/socal_wildfires_oct07.html

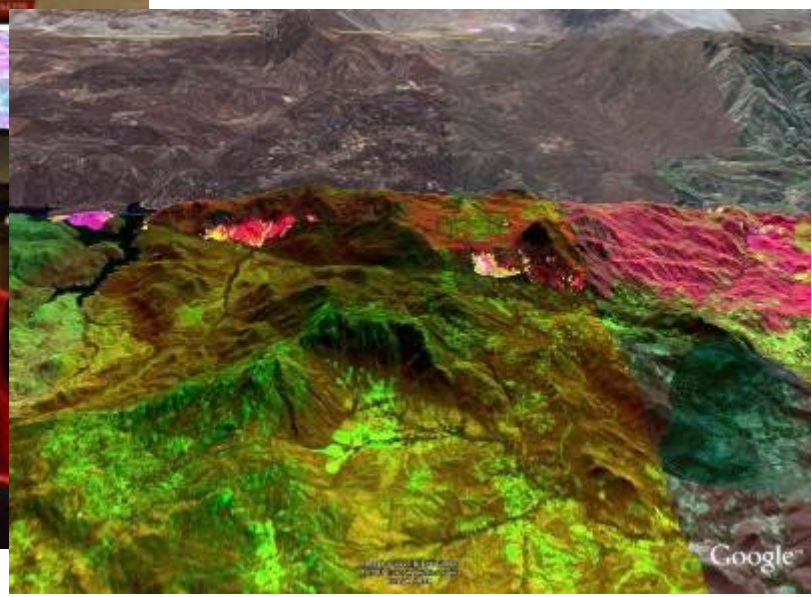
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Unmanned Aircraft Provided Near Real-Time SoCal Fire Images October 2007

www.nasa.gov/centers/dryden/news/Features/2007/wildfire_socal_10_07.html



Flight Plan and Ikhana Data Displayed in San Diego Emergency Operations Center's Situation Room



Pilot Flies Predator B from NASA Dryden in Edwards AF Base





NASA Ikhana Carrying Autonomous Modular Scanner on 8 Hour Flight, Coordinated with the FAA, Downlinks to NASA Ames

NASA Ames Overlaid Thermal-Infrared Images on Google Earth Maps, Transmitted in Near-Real Time to the Interagency Fire Center in Boise, Idaho

Prototyping Future Knowledge Integration Center for Emergency Response

