The Importance of Large-Scale Computer Science Research Efforts

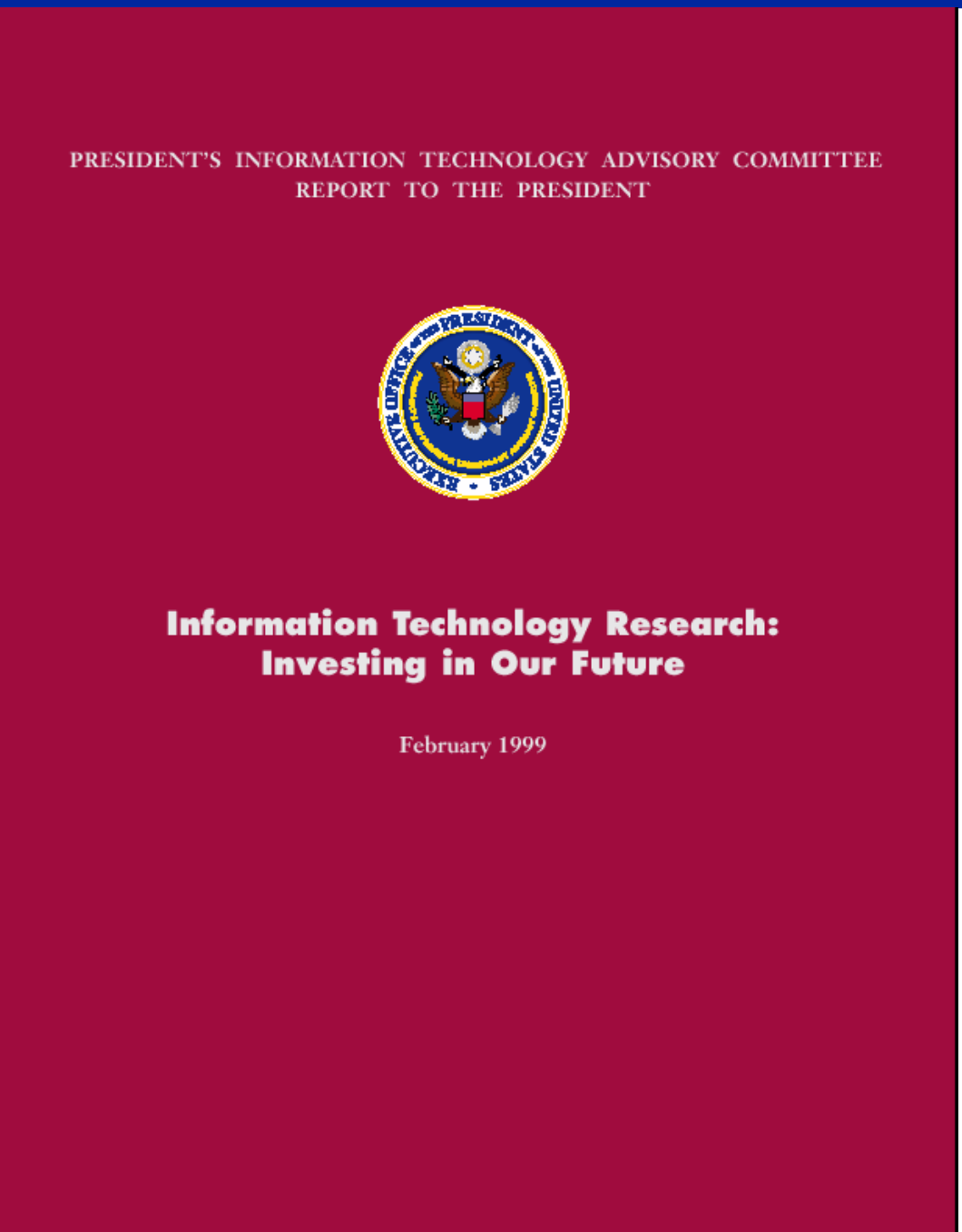
Talk at Public Seminar on
Large-Scale NSF Research Efforts for the Future
Computer Museum
Mountain View, CA
October 20, 2005

Dr. Larry Smarr
Director, California Institute for Telecommunications and Information Technologies
Harry E. Gruber Professor,
Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD

OptIPuter

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In 1999 PITAC Recommended Increasing Federal IT R&D Investment by $1.4 Billion/Year



- Ramped Up Over Five Years
- Four Priorities for Long Term Basic IT Research
  - Software
  - Scalable Information Infrastructure
  - High-End Computing
  - Socio-Economic Impacts
- Led to NSF Information Technology Research (ITR) Program
  - Competitive Peer Review
  - ~Thousands Proposals/ Yr.
  - Several Hundred Selected

Over the Next Decade
Vast SensorNets Will Feed a Planetary Optical Core

- The Small
  - Pervasive Self-Powered Micro- and Nano-Sensors
- The Cheap
  - One-Cent Radios
- The Smart
  - System-on-Chip Integration of Computers with Sensors
- The Big
  - Terabit Optical Internet Core
  - Gigabit Wireless Streams

- New Approach to IT Research
  - Large Scale Testbeds
  - Build Integrated Systems
  - Work with End Users
  - Collaborate Across:
    - Disciplines
    - Campuses
    - University / Industry
- Three Examples:
  - RESCUE
  - OptIPuter
  - LOOKING

Source: Rajesh Gupta, UCSD

"The all optical fibersphere in the center finds its complement
e wireless ethersphere on the edge of the network."
– George Gilder

Research on Responding to Crises and Unexpected Events (RESCUE)



Information Flow Within the Responding Organizations and the Public

Security, Privacy& Trust
Cross Cutting Issue at Every Level

Social & Disaster Science
Context, Model &
Understanding of Process,
Organizational Structure, Needs

Engineering & Transportation
Validation Platform for
Role of IT Research

Information Centric Computing
Enhanced Situational Awareness

Networking & Computing Systems
Computing, Communication, & Storage Systems Under Extreme Situations

rescue

PIs: Sharad Mehrotra, UCI; Ramesh Rao, UCSD

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RESCUE
Community Advisory Board

Ellis Stanley – Chair
General Manager, City of Los Angeles
Emergency Preparedness Department

Jim Watkins (retired)
Governor's Office
Emergency Services

Bob Garrott
Los Angeles County
Office of Emergency Mgmt.

Paulette Murphy
Space and Naval Warfare
Systems Command
(SPAWAR)

Dawna Finley
Tom Hume
Eileen Salmon
City of Irvine
Emergency Management

Karen Butler
Program Manager
Communications Division
San Diego Police Department

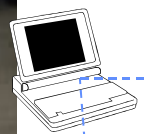
William Maheu
Assistant Chief of Police
City of San Diego

David Rose
Lieutenant Officer
UC San Diego Police Dept.

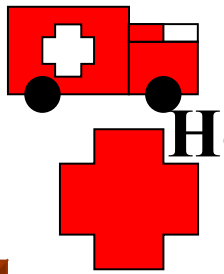
Linda Bogue
Emergency Mgmt. Coordinator
Environmental Health & Safety
University of California, Irvine

Quickly Re-Establishing Communications: Calit2 Network R & D



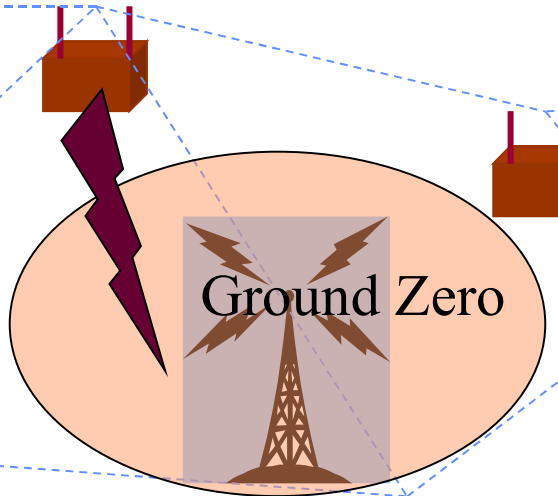


Disaster site



Hospital







Incident command center

Deploy Portable Relay Nodes



responsphere

rescue

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NSF Infrastructure Grant Establishes Calit2 Project Rescue Testbeds in Irvine & in San Diego

- **Localized Site-Specific Disasters via Crisis Response Drills**
  - Calit2 team Joins Community Drills
- **Large Scale Regional Disasters via Simulations**
  - ImageCat Transportation
- **Gaslamp Quarter, San Diego/UCSD**
  - Ubiquitous Wireless Coverage in Downtown San Diego
  - Test Network Architecture Enhancement and New Applications
- **CAMAS (*Crisis Assessment, Mitigation, And Analysis*) – UCI Campus**
  - Field-Test and Refine Research on Information Collection, Analysis, Sharing, and Dissemination





responsphere

bren:school information and computer sciences

PI: Magda El Zarki, ICS, UCI
www.responsphere.org

RESCUE Strongly Coupled with NIH WIISARD Grant

Wireless Internet Information System for Medical Response in Disasters

Working Closely with the First Responder Community







Triage

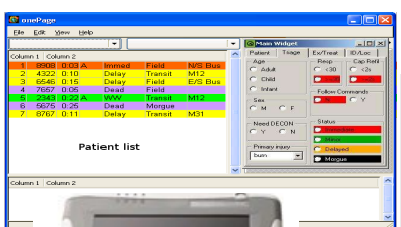
First Tier







802.11 pulse ox



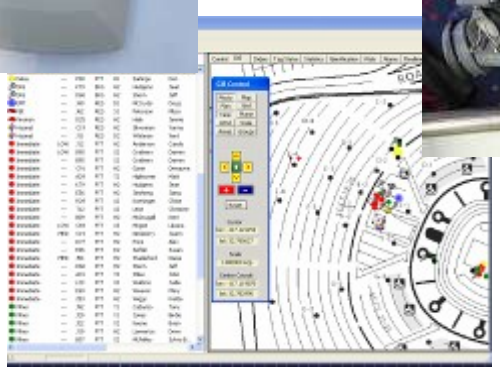
Patient list



Mid Tier



Wireless Networks



Command Center

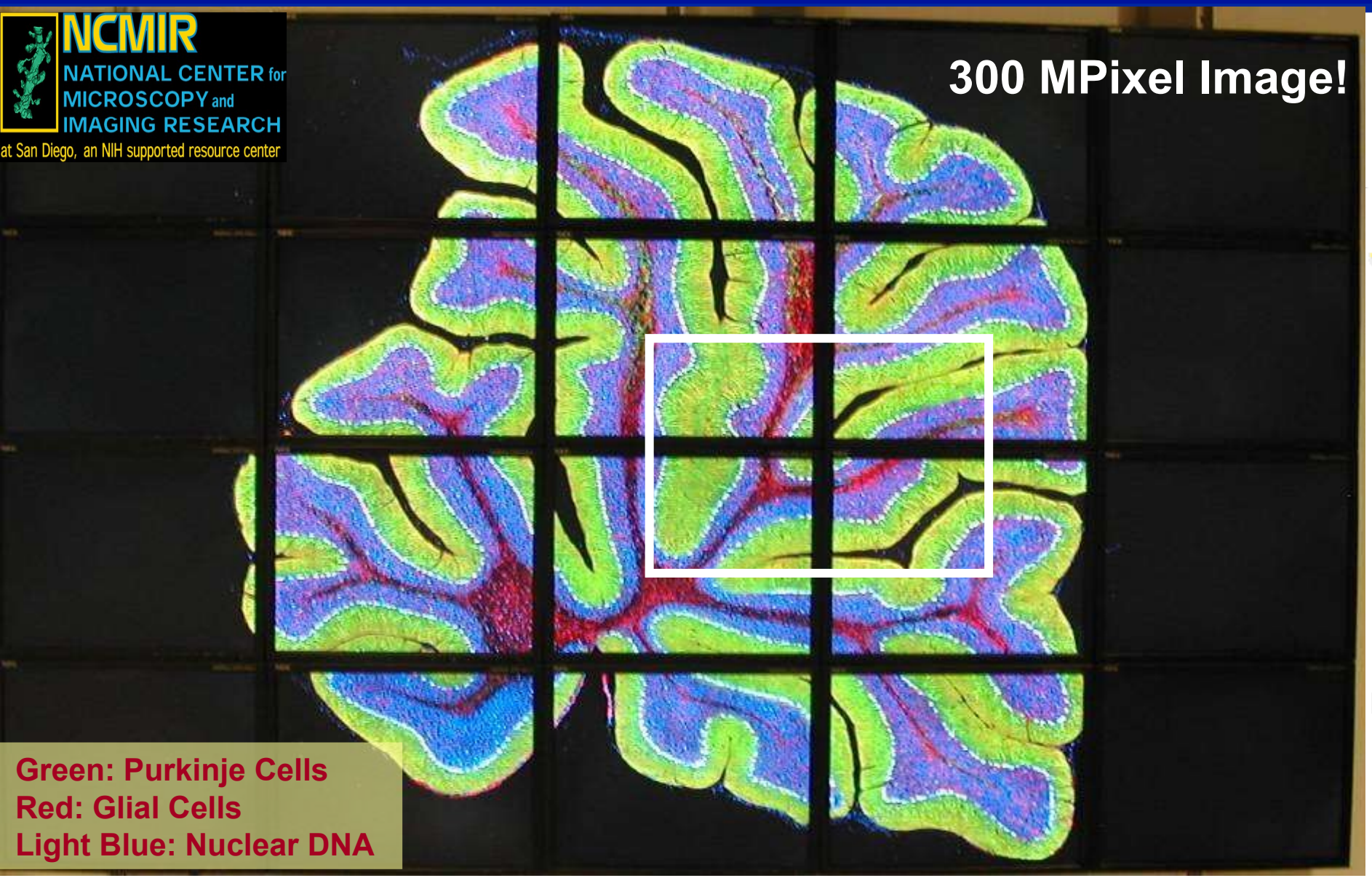




Reality Flythrough
Mobile Video

The OptIPuter -- From the Grid to the LambdaGrid: High Resolution Portals to Global Science Data

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



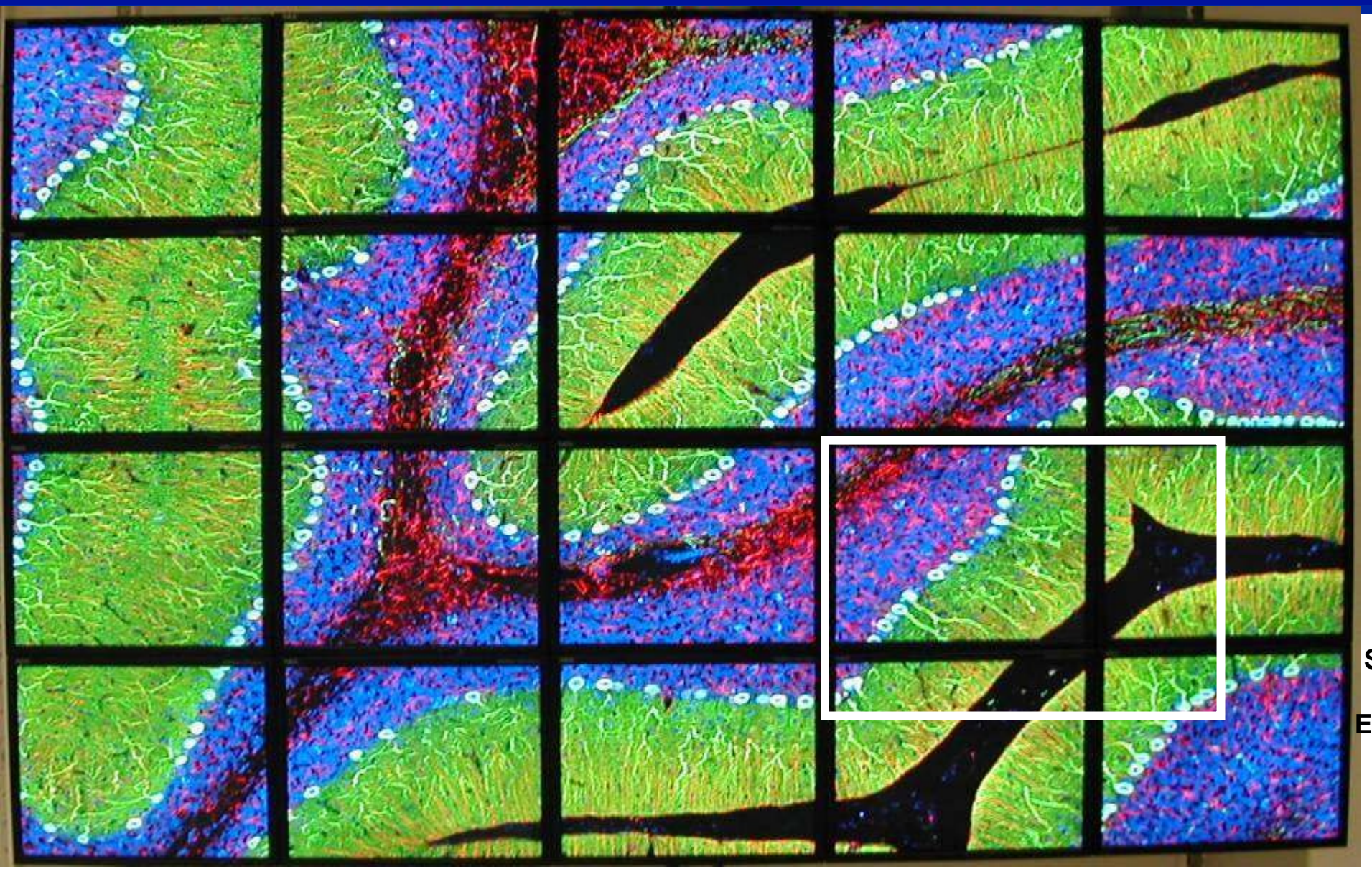
Green: Purkinje Cells
Red: Glial Cells
Light Blue: Nuclear DNA

Source: Mark Ellisman, David Lee, Jason Leigh

OptIPuter

Calit2 (UCSD, UCI) and UIC Lead Campuses—Larry Smarr PI
Partners: SDSC, USC, SDSU, NW, TA&M, UvA, SARA, KISTI, AIST

Scalable Displays Allow Both Global Content and Fine Detail



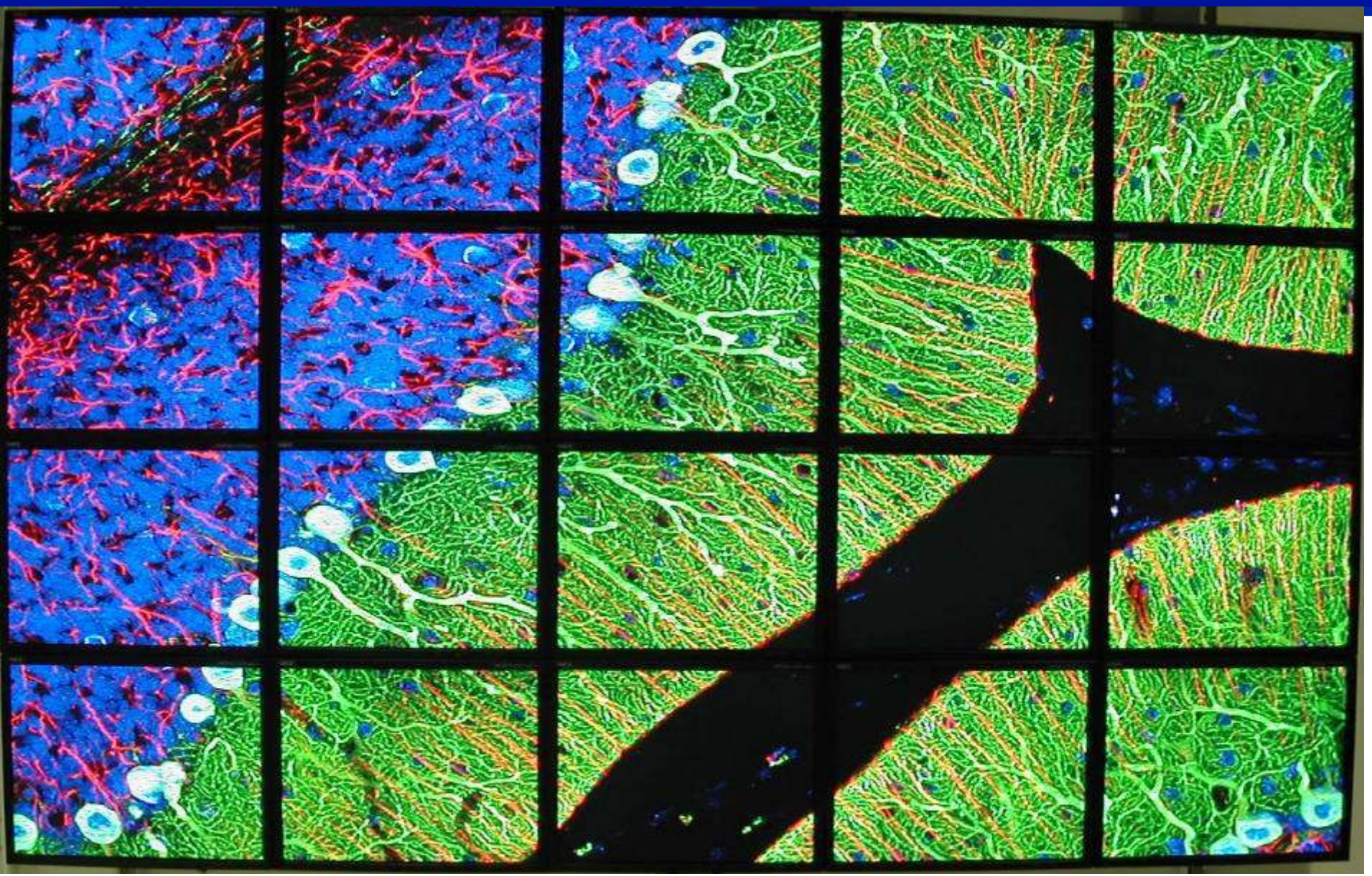
Source: Mark Ellisman, David Lee, Jason Leigh

OptIPuter

30 MPixel SunScreen Display Driven by a 20-node Sun Opteron Visualization Cluster

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Allows for Interactive Zooming from Cerebellum to Individual Neurons

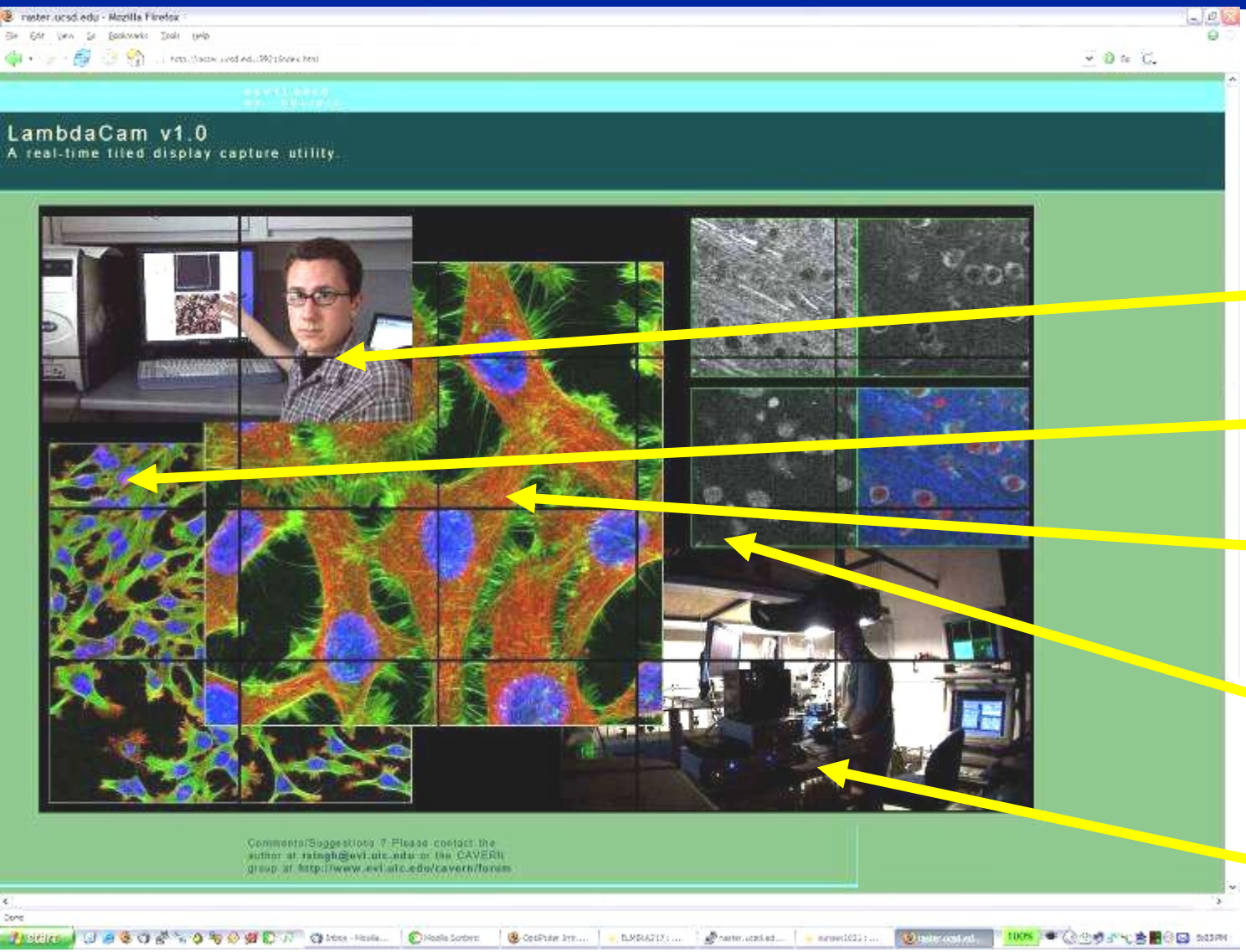


OptIPuter

Source: Mark Ellisman, David Lee, Jason Leigh

it²

OptIPuter Scalable Adaptive Graphics Environment (SAGE) Allows Integration of HD Streams



SAGE Developed Under Jason Leigh, EVL

- HD Video from BIRN Trailer
- Macro View of Montage Data
- Micro View of Montage Data
- Live Streaming Video of the RTS-2000 Microscope
- HD Video from the RTS Microscope Room

LambdaCam Used to Capture the Tiled Display on a Web Browser

OptIPuter

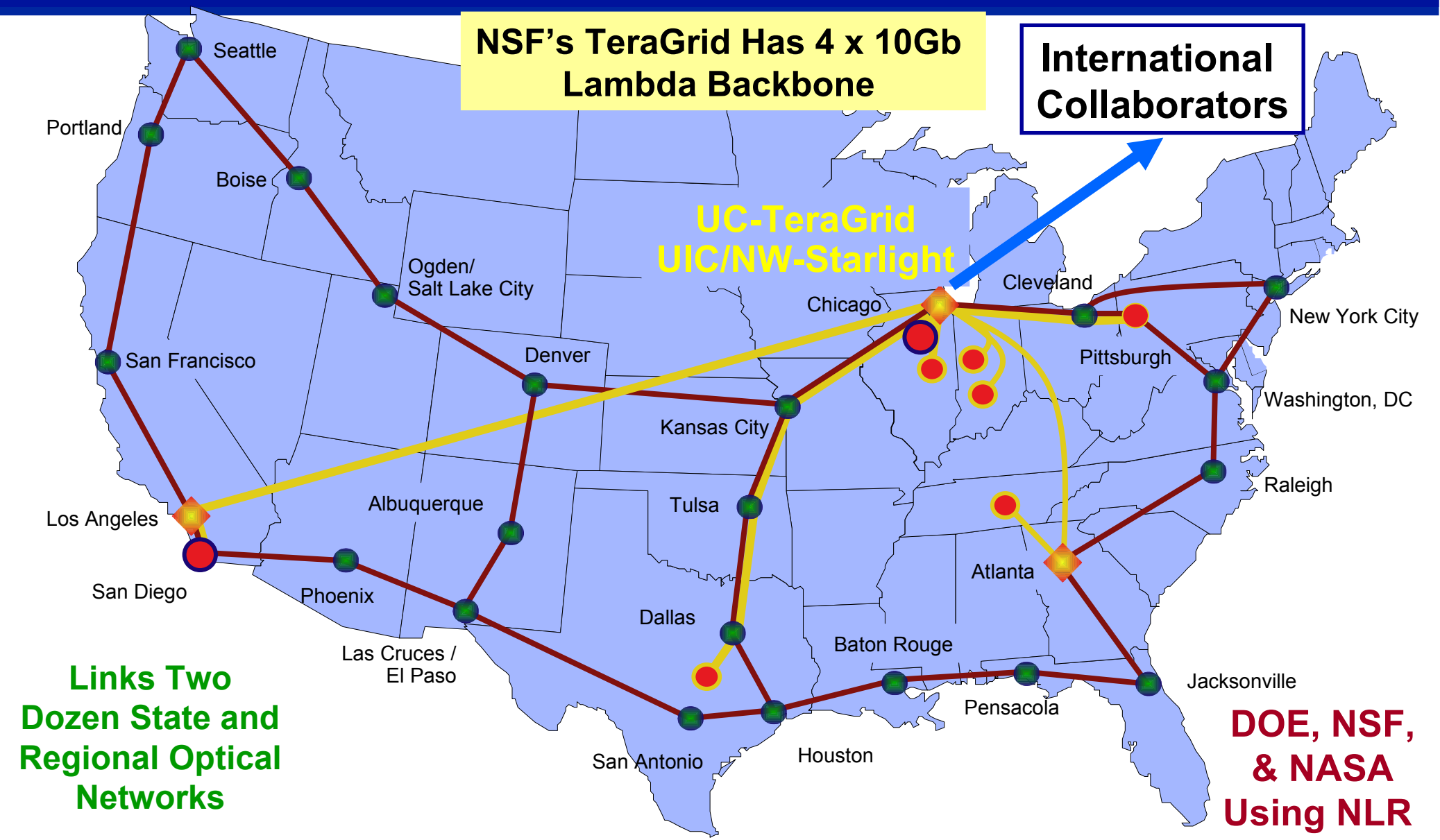
evl electronic visualization laboratory

Source: David Lee, NCMIR, UCSD

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

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National Lambda Rail (NLR) and TeraGrid Provides Researchers a Cyberinfrastructure Backbone



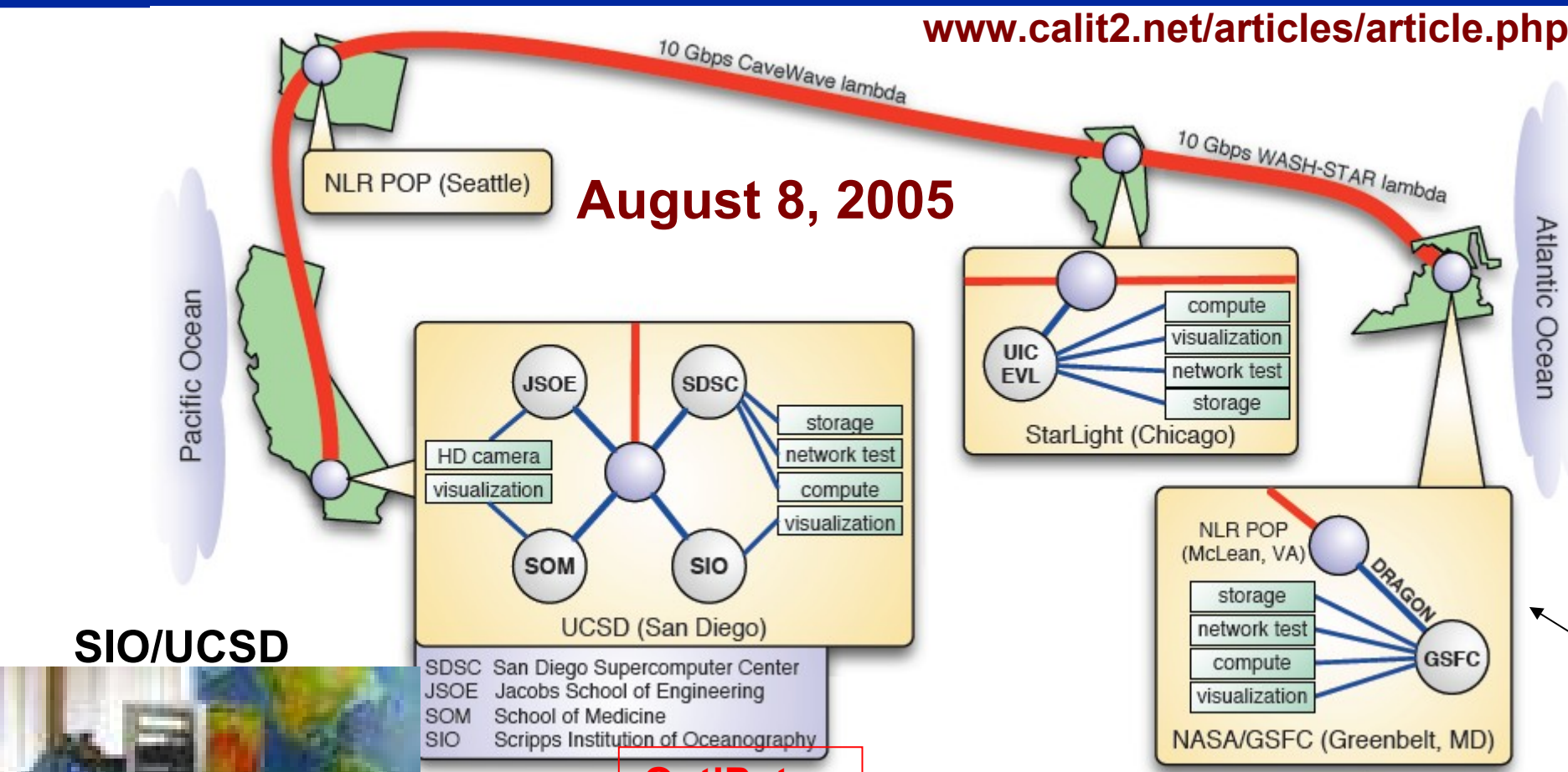
NLR 4 x 10Gb Lambdas Initially Capable of 40 x 10Gb wavelengths at Buildout

OptIPuter

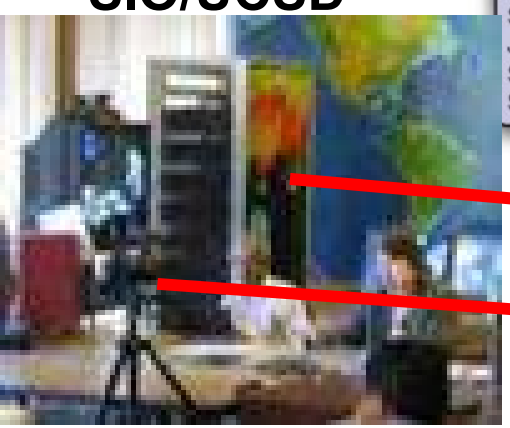
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Extending Telepresence with Remote Interactive Analysis of Data Over NLR

www.calit2.net/articles/article.php?id=660



SIO/UCSD



OptIPuter Visualized Data

HDTV Over Lambda



NASA Goddard

OptIPuter

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Lambdas Enable First Remote Interactive High Definition Video Exploration of Deep Sea Vents



OptIPuter

Source John Delaney & Deborah Kelley, UWash

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