“Cal-(IT)2 Projects with Sun Microsystems”

Invited Talk at the Sun Microsystems Booth
Supercomputing 2004
Pittsburgh, PA
November 9, 2004

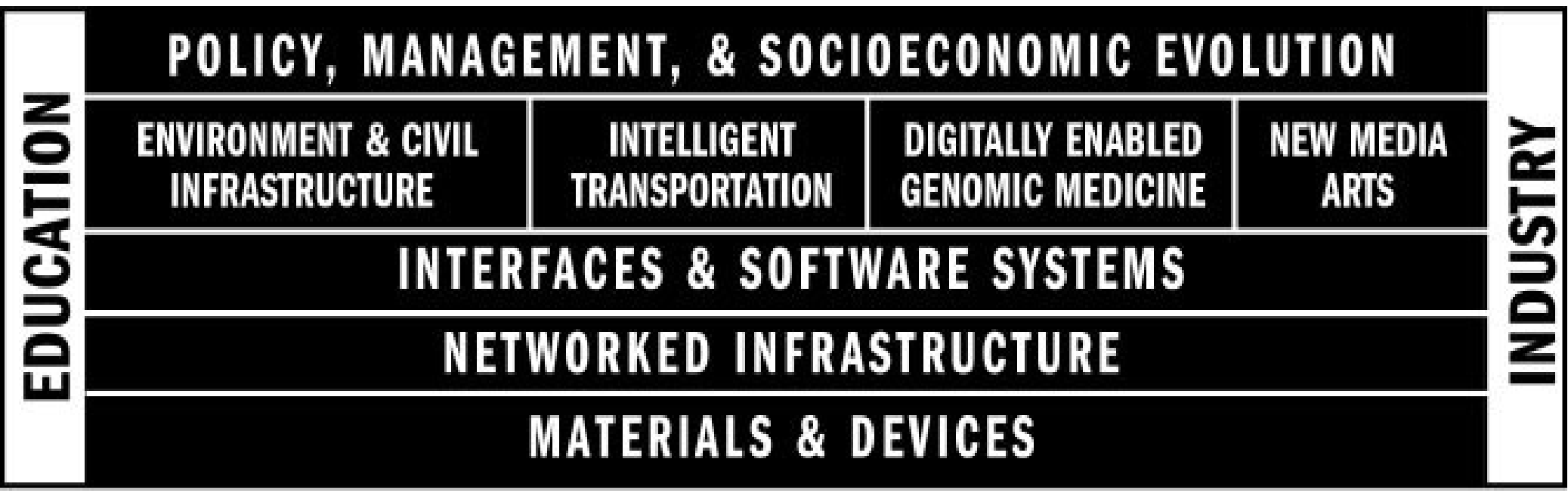
Dr. Larry Smarr
Director, California Institute for Telecommunications and Information Technology
Harry E. Gruber Professor,
Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD

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Cal-(IT)²--An Integrated Approach the Future of the Internet

UC San Diego & UC Irvine Faculty Working in Multidisciplinary Teams With Students, Industry, and the Community



Extending the Internet Throughout the Physical World

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www.calit2.net

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Two New Cal-(IT)^2 Buildings Will Become Global Collaboration Laboratories



State of California
Provided $100M Capital

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- Will Create New Laboratory Facilities:
  - Virtual Reality and Virtual Team Rooms
  - UCSD Opening in 2005 with the First 8Mpixel Digital Cinema Projector in US
    - = 4 x HDTV
- International iGrid 2005 Will be Hosted



Cal-(IT)^2@UCSD Building Is Connected To Outside With 140 Optical Fibers

it^2

Innovation Driven by Cal-(IT)^2 Industrial Partners Teaming with Academic Research and Education

- Funding Faculty Research Projects
- Supporting Graduate/Undergraduate Fellows
- Providing Access to Living Labs Equipment
- Joining on Federal Grants
- Co-Sponsoring Workshops/Conferences
- Hosting Seminars or Lectures



- Endowing Chaired Professorships

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$85 Million from Industrial Partners in Matching Funds

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Sun Microsystems Has Participated In and Co-Hosted Many Cal-(IT)² Events



Sun's Steve Scharf
Presenting at UCI
Lunch-n-Learn Seminar
July 2004



Sun's Emil Sarpa and Jeff Nagle
at Calit2 All-Hands Meeting
April 2004

Sun Co-Hosted with Cal-(IT)2
the GEON All Hands Meeting
Gala Dinner
August 2004



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Imagining a Fiber Optic Infrastructure Supporting Interactive Visualization--SIGGRAPH 1989



"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
National Center for Supercomputing Applications, UIUC



ATT & Sun





"Using satellite technology…demo of 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

http://sunsite.lanet.lv/ftp/sun-info/sunflash/1989/Aug/08.21.89.tele.video

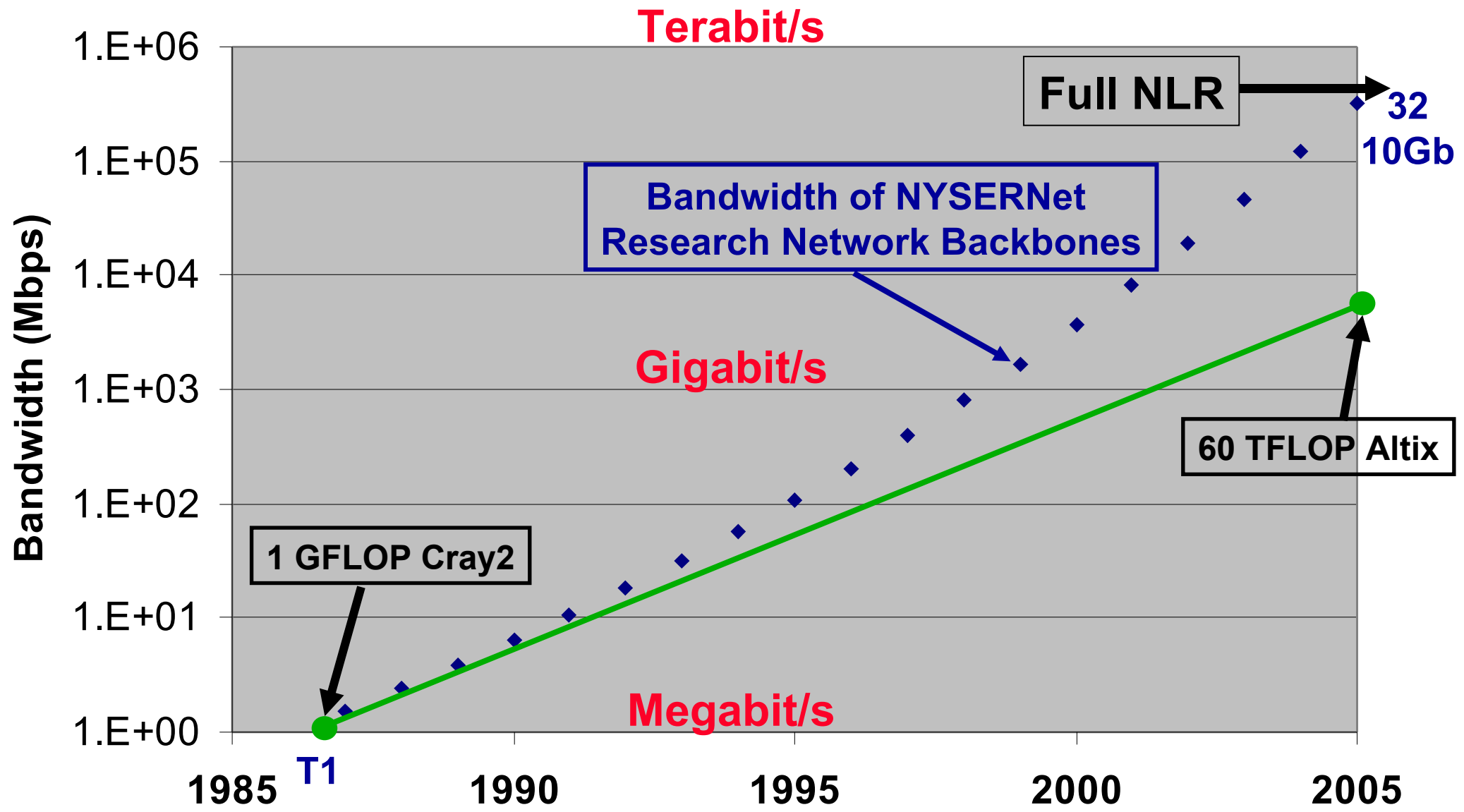
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NCSA™

Source: Maxine Brown

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Optical WAN Research Bandwidth Has Grown Three Times Faster than Supercomputer Speed!



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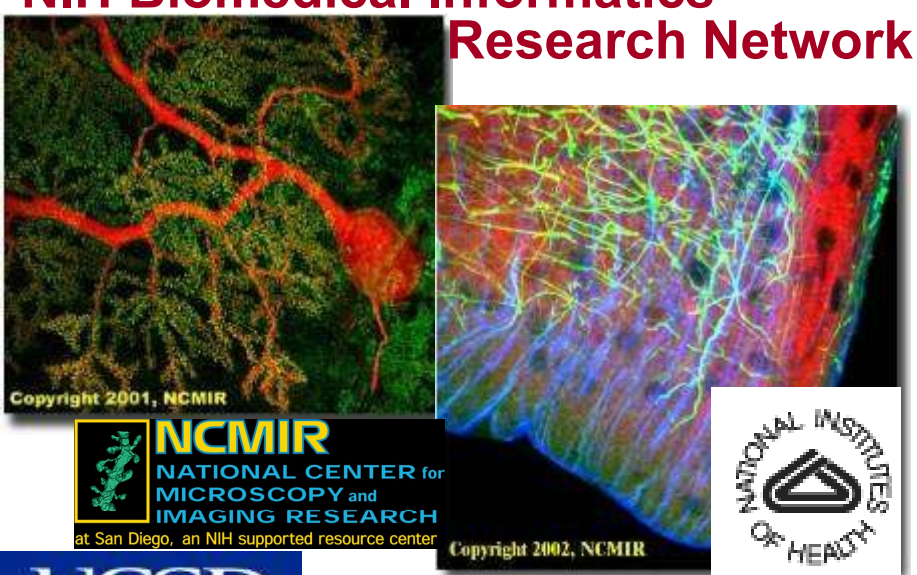
Source: Timothy Lance, President, NYSERNet

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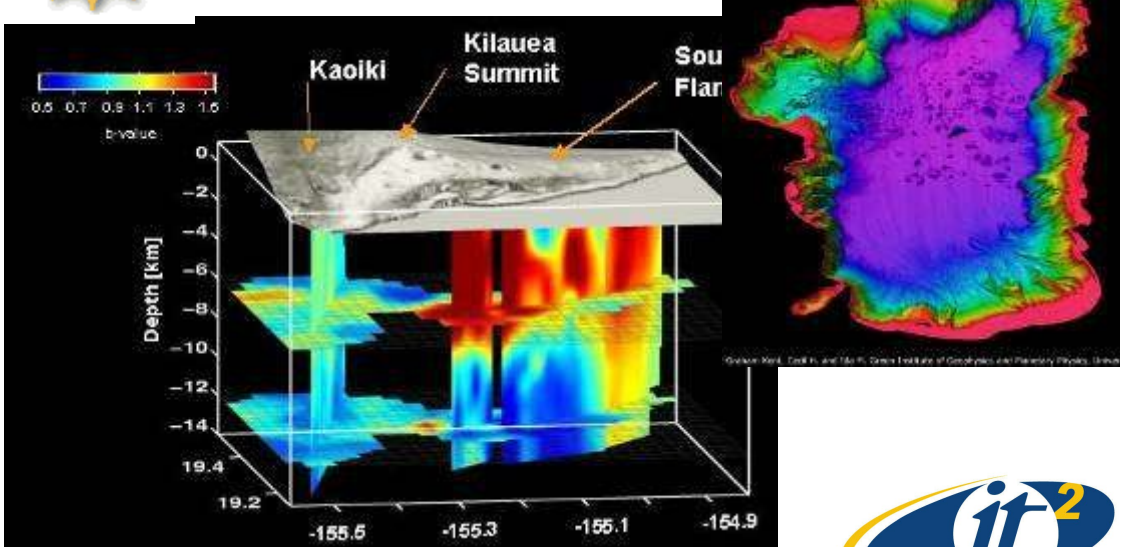
The OptIPuter Project –
Removing Bandwidth as an Obstacle In Data Intensive Sciences

- **NSF Large Information Technology Research Proposal**
  - Cal-(IT)^2 and UIC Lead Campuses—Larry Smarr PI
  - USC, SDSU, NW, Texas A&M, Univ. Amsterdam Partnering Campuses
- **Industrial Partners**
  - IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Big Bandwidth
- **$13.5 Million Over Five Years**
- **Optical IP Streams From Lab Clusters to Large Data Objects**

NIH Biomedical Informatics Research Network



NSF EarthScope and ORION



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http://ncmir.ucsd.edu/gallery.html

siovizcenter.ucsd.edu/library/gallery/shoot1/index.shtml

What is the OptIPuter?

- **Optical networking, Internet Protocol, Computer Storage, Processing and Visualization Technologies**
  - Dedicated Light-pipe (One or More 1-10 Gbps WAN Lambdas)
  - Links Linux Cluster End Points With 1-10 Gbps per Node
  - Does NOT Require TCP Transport Layer Protocol
  - Exploring Both Intelligent Routers and Passive Switches

- **Applications Drivers:**
  - Interactive Collaborative Visualization of Large Remote Data Objects
    - Earth and Ocean Sciences
    - Biomedical Imaging

www.optiputer.net

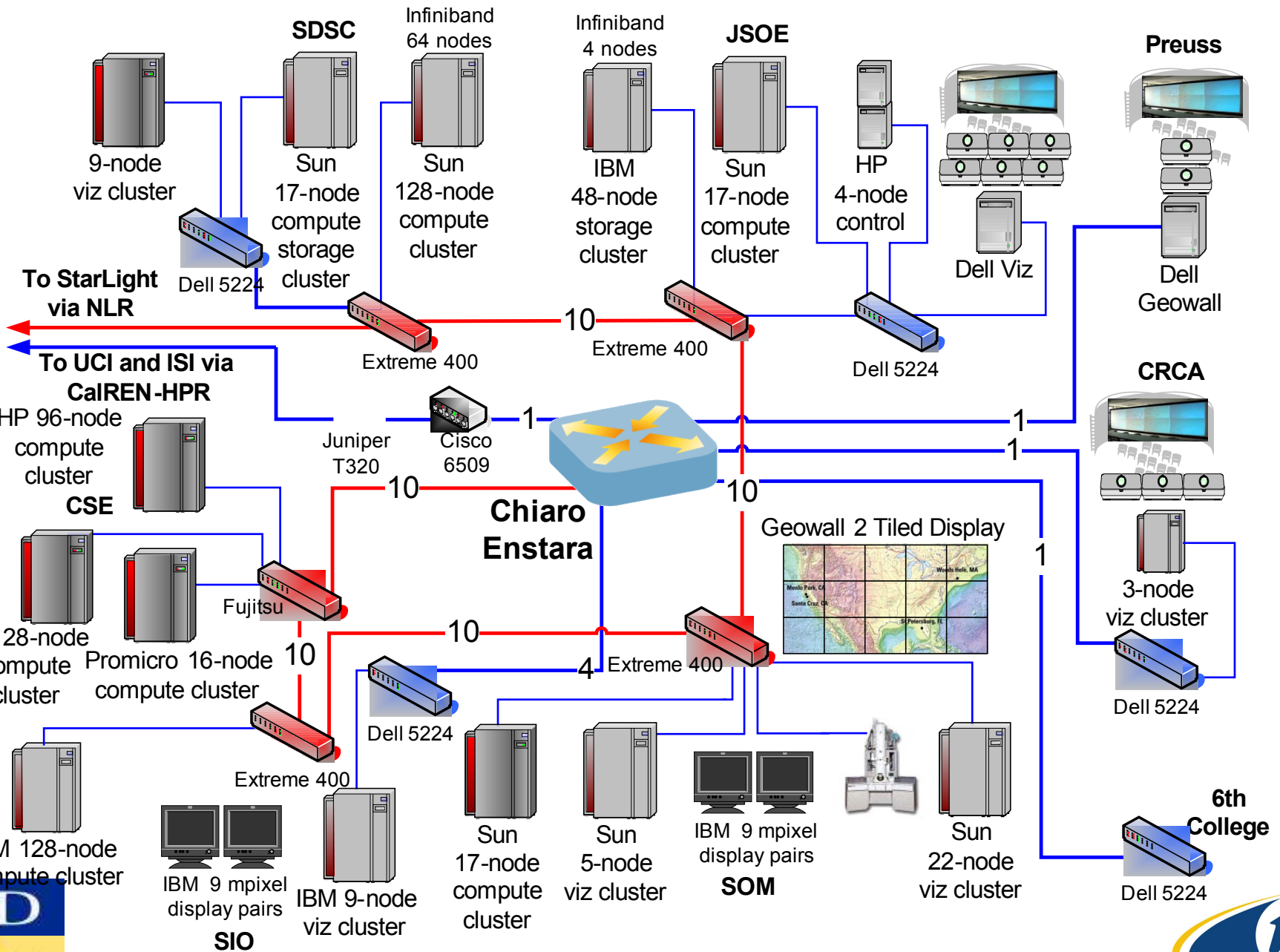
- **The OptIPuter Exploits a New World in Which the Central Architectural Element is Optical Networking, NOT Computers — The Network REALLY is the Computer!**

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See Nov 2003 Communications of the ACM for Articles on OptIPuter Technologies

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Creating a Model for a Campus LambdaGrid at UCSD



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Added Sun OptIPuter End Nodes for Compute, Storage and Visualization

- 51-Nodes Dual Opteron 242-Based Purchase
  - Building Three OptIPuter 17-Node Clusters
    - Dual GigE, 4 GB memory, 36GB SCSI Raid
  - Located in Engineering, SDSC and NCMIR
- 21-Node Opteron-Based Visualization Server Purchased
  - Dual Opteron 246s, 2GB RAM, 36GB disk, Quadro300G graphics
  - Driving a 4x5 20 inch UXGA LCD Display Wall (+1 Display)
  - 40 Megapixel Display
  - New OptIPuter Supported Node For Brain Imaging Visualization
  - Nearly 7/24 Usage as Compute Cluster When Not Used For Visualization
- 6-Terabyte storage purchased
  - 3TB Added To Above Storage Cluster
  - 3TB StorEdge Server
  - Supporting OptIPuter Storage Research
- 128-Node Intel-Based Storage Cluster Donated by Sun Early 2004
  - Located at SDSC
  - OptIPuter and Other Research Support Activities

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OptIPuter End Nodes Are Smart Bit Buckets
i.e. Scalable Standards-Based Linux Clusters with Rocks & Globus

Building RockStar at SC2003







Complete SW Install and HW Build

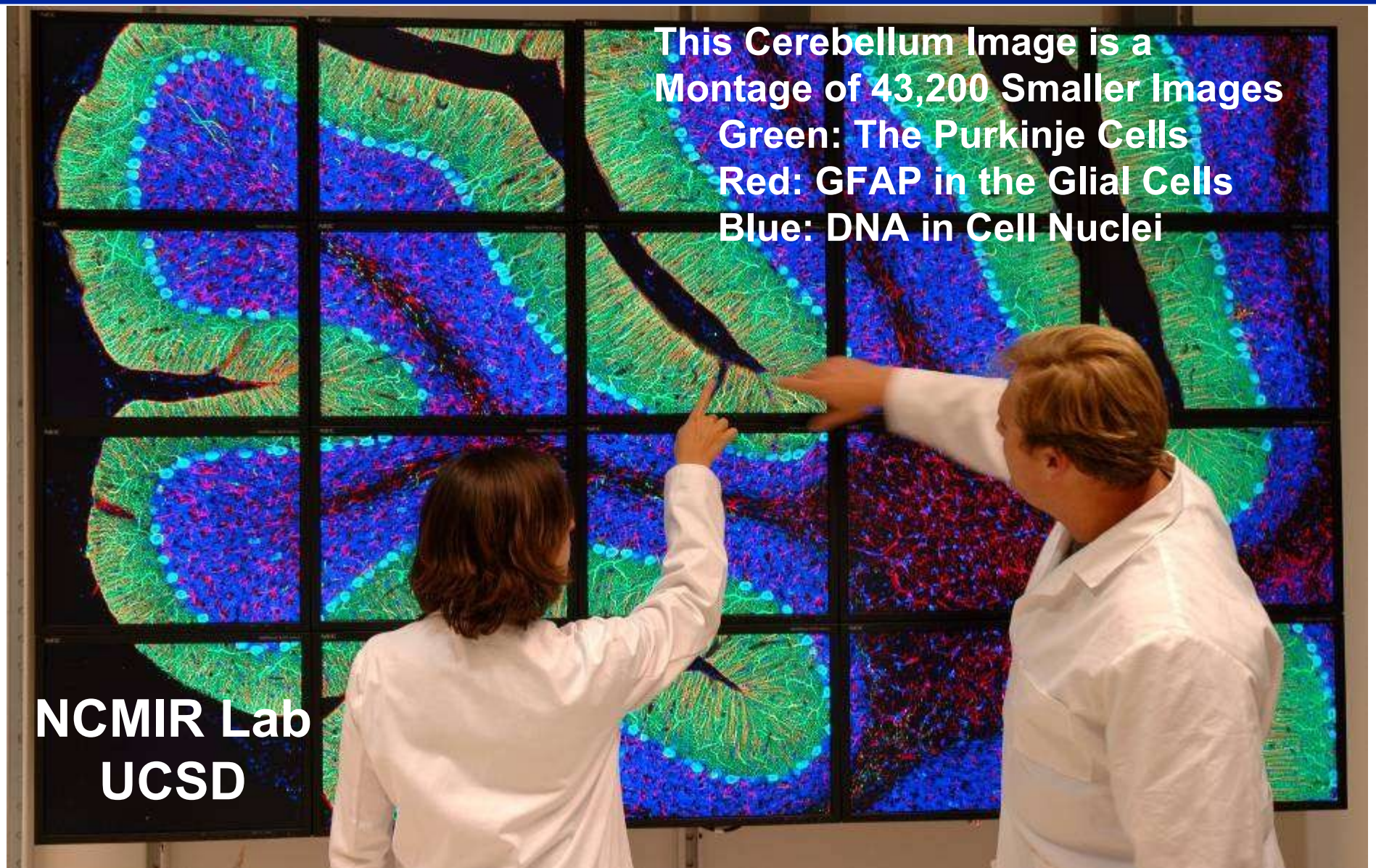
- From Piles of Parts to Running Cluster in Under 2 Hours
- Computational Chemistry & Brain Image Segmentation Ran
- Included the NSF Middleware (NMI) R3 Release of Software

Rocks is the 2004 Most Important Software Innovation
HPCwire Reader's Choice and Editor's Choice Awards

Source: Phil Papadopoulos, SDSC

Sun microsystems
SDSC
ROCKS
GAMESS
BIRN
OMEDICAL INFORMATICS RESEARCH NETWORK
NPACI

OptIPuter JuxtaView Software for Viewing High Resolution Images on Tiled Displays



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30 Million Pixel Display Driven By a 20-node Sun Opteron Visualization Cluster

Source: Mark Ellisman, David Lee, Jason Leigh

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The OptIPuter Will be Used to Enhance Collaboration



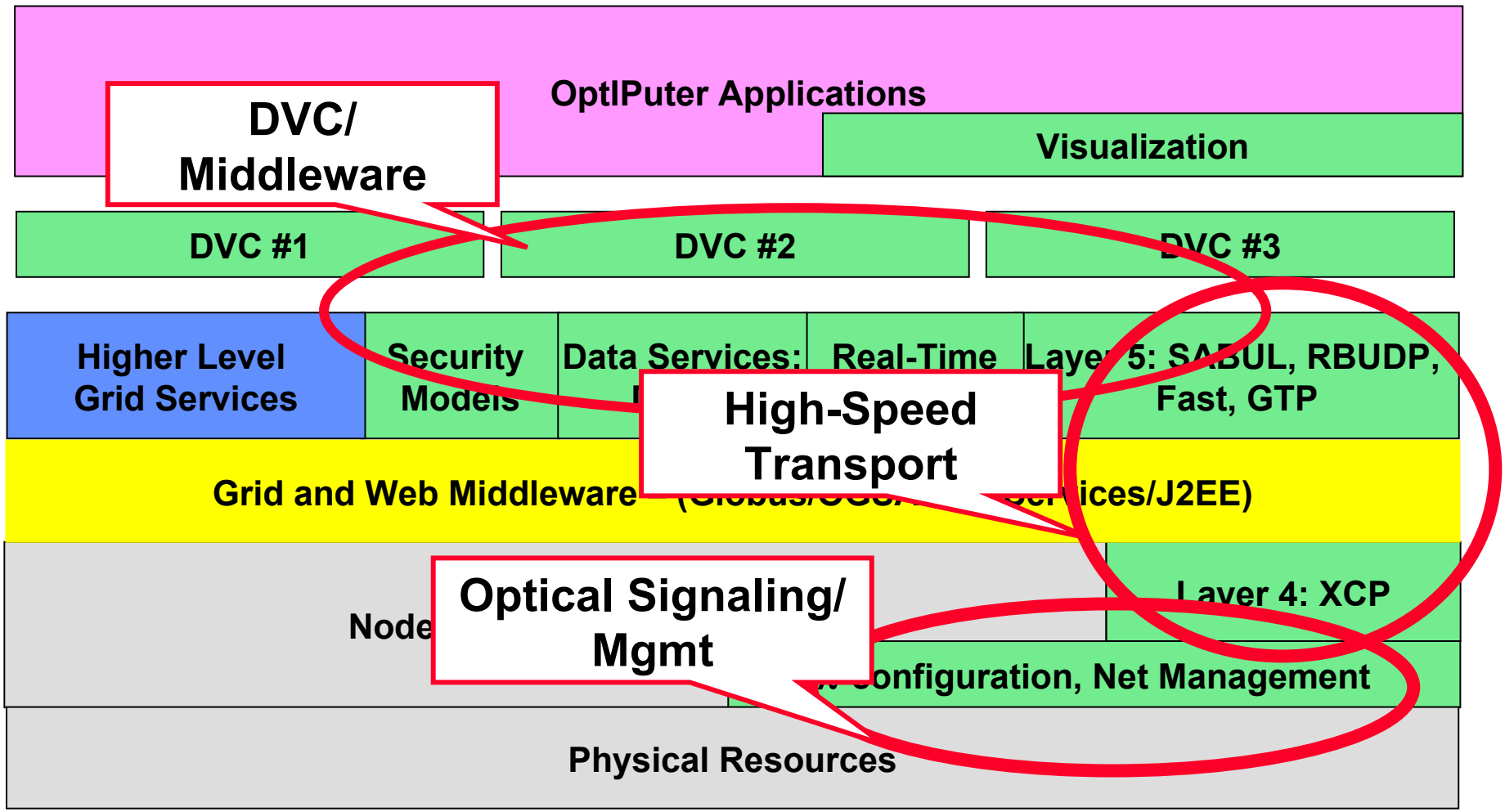
OptIPuter



OptIPuter Will Connect Falko Kuester's Cal-(IT)²@UCI Smart Classroom and The 30M-Pixel Display At UCSD Ellisman's BIRN Laboratories

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OptIPuter Middleware Architecture for Distributed Virtual Computers



From Grids to LambdaGrids

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Source: Andrew Chien, UCSD
OptIPuter Software Systems Architect

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10GE OptIPuter CAVEWAVE Will Help Launch the National LambdaRail



Next Step: Coupling NASA Centers to NSF OptIPuter

Source: Tom DeFanti, OptIPuter co-PI

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Sun Sponsored Research Projects

- **Storage Related Projects Driven By Sun Partnership**
  - Supports Storage Development Research Staff
  - Integrate Storage Cluster Functionality Into Rocks Configuration Package
  - Expand Research on Parallel and Distributed File System Configurations
  - Integrate Dynamic Storage Allocation Into OptIPuter Middleware
- **Dedicated Storage Development Position Under Recruitment**
- **Discussions with Sun Concerning the Value of an Open-Source Solaris**

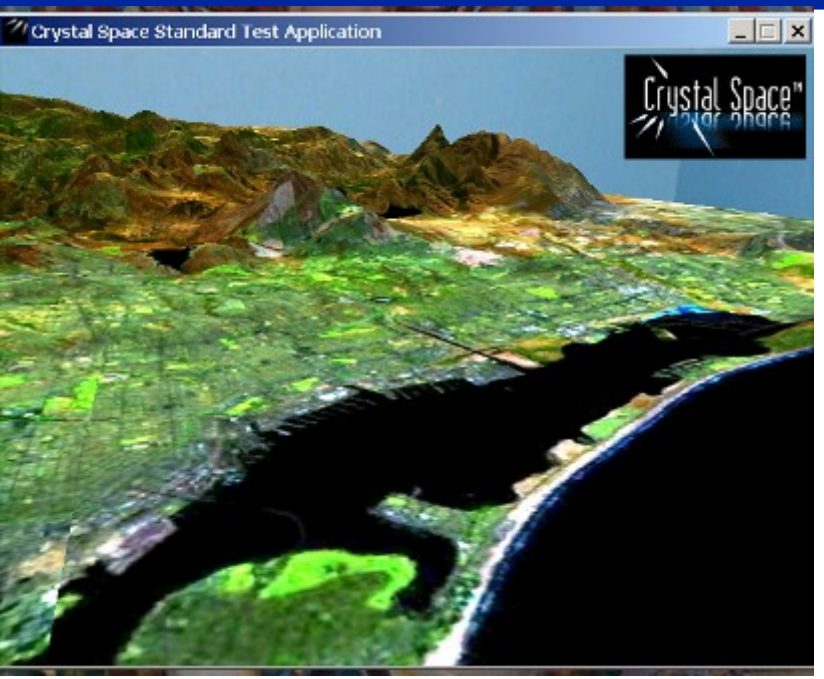
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Sun Sponsored Research Projects

- Three Projects Driven By Sun Partnership
- Demonstration Project of Playing a Game On Multiple Platforms,
  - e.g., Cellular Phone, PC, PDA (Heterogeneous Gaming Initiative)
- From Play Mechanics That Evolved From This Project:
  - Concurrently Developing Glyph Authoring System for Heterogeneous Gaming
- Developing a Sun Center of Excellence for Networking Gaming & Graphics
- Pending Proposal to Augment Above to Move Projects to Sun Hardware
  - Begin to Run Butterfly.Net Software on Sun Clusters

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Cal-(IT)²/SDSC Multi-User Heterogeneous Gaming Living Laboratory

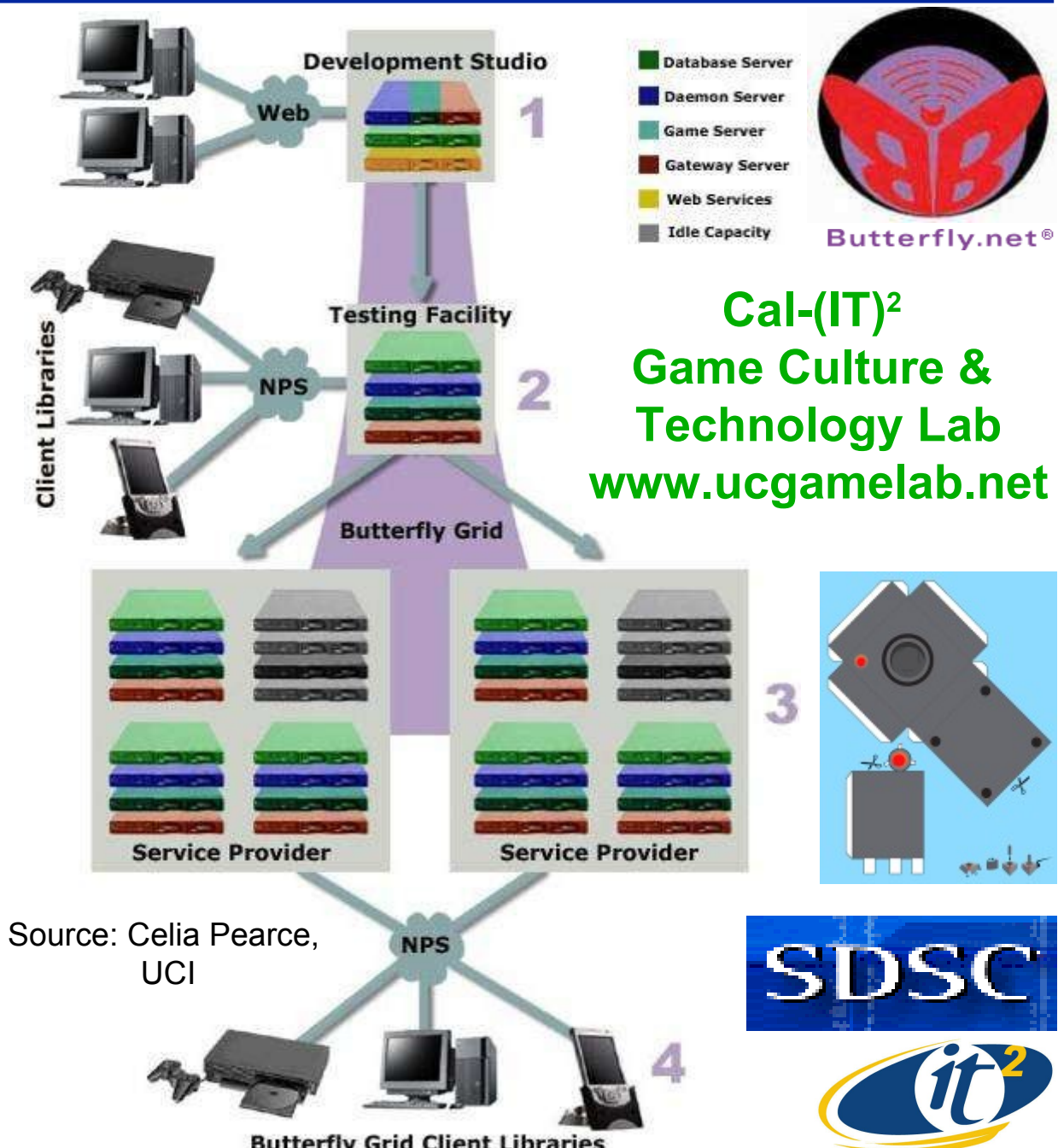


Linking to Cell Phone Games

Sun microsystems

Java

NOKIA
CONNECTING PEOPLE



Cal-(IT)²
Game Culture & Technology Lab
www.ucgamelab.net

Source: Celia Pearce, UCI

SDSC

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UCIrvine

Athomas Goldberg
& Doug Twilleager,
Sun Game Technologies

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Presenting in Trade Shows With Cal-(IT)^2 Industrial Partners



Student Projects From
UCI's Sun Microsystems-Sponsored Course
In Mobile Game Development
Are Being Showcased at the Sun Booth

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Cal-(IT)^2 Works with Affiliated Institutions to Enhance Interactions with Industrial Partners

Sun Microsystems designated the SDSU Viz Center, as a "Sun Center of Excellence for Collaborative Visualization." More recently, Sun donated a Sun "Zulu" high-end graphics system to that facility



Smarr with Eric Frost and Bob Welty,
co-Directors of SDSU's
Center for Information Technology and Infrastructure (CITI)

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