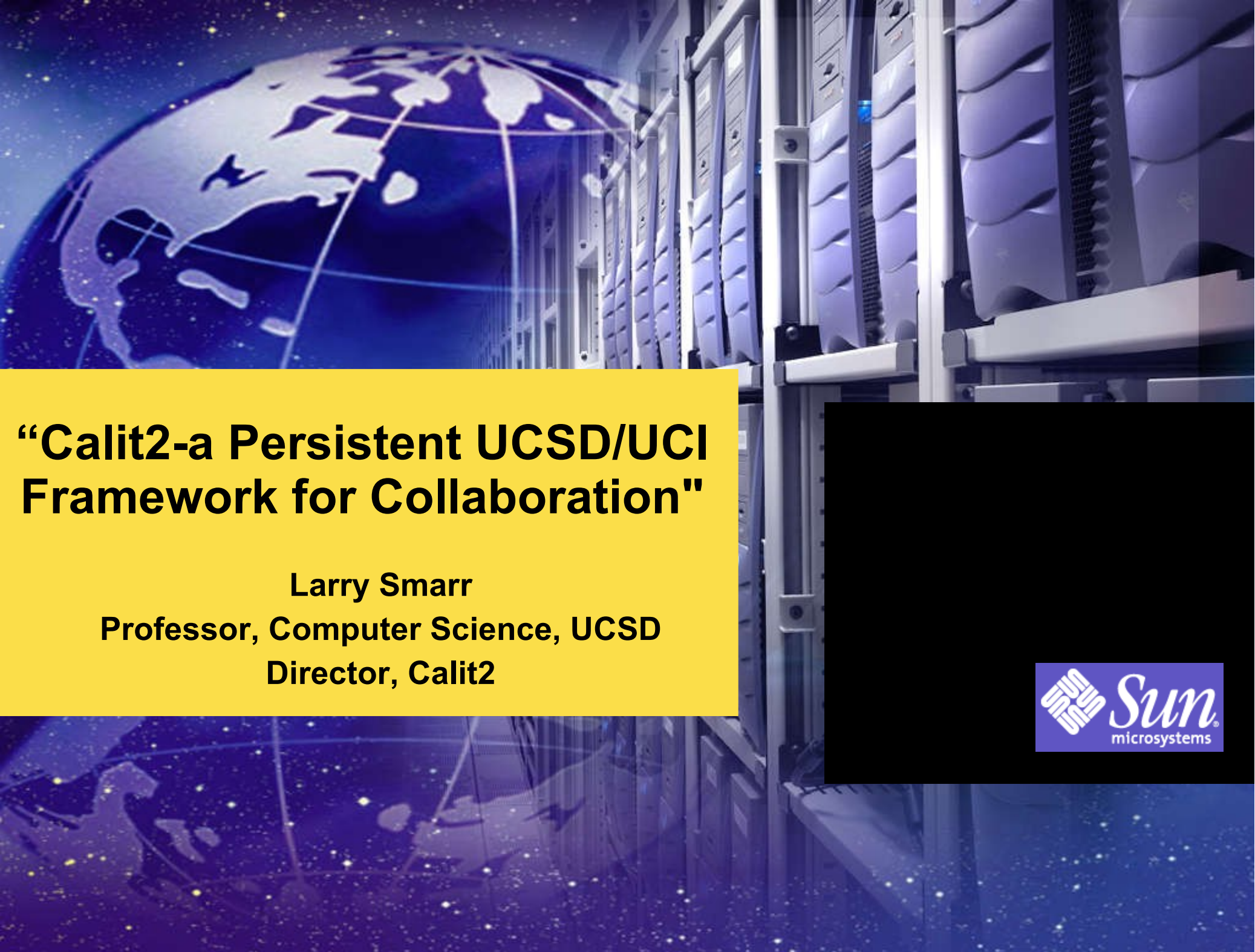


“Calit2-a Persistent UCSD/UCI Framework for Collaboration"

Larry Smarr

Professor, Computer Science, UCSD

Director, Calit2

Sun microsystems

“Calit2-a Persistent UCSD/UCI Framework for Collaboration"

Invited Talk

Sun Microsystems Global Education and Research Conference 2005

San Francisco, CA

February 16, 2005

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

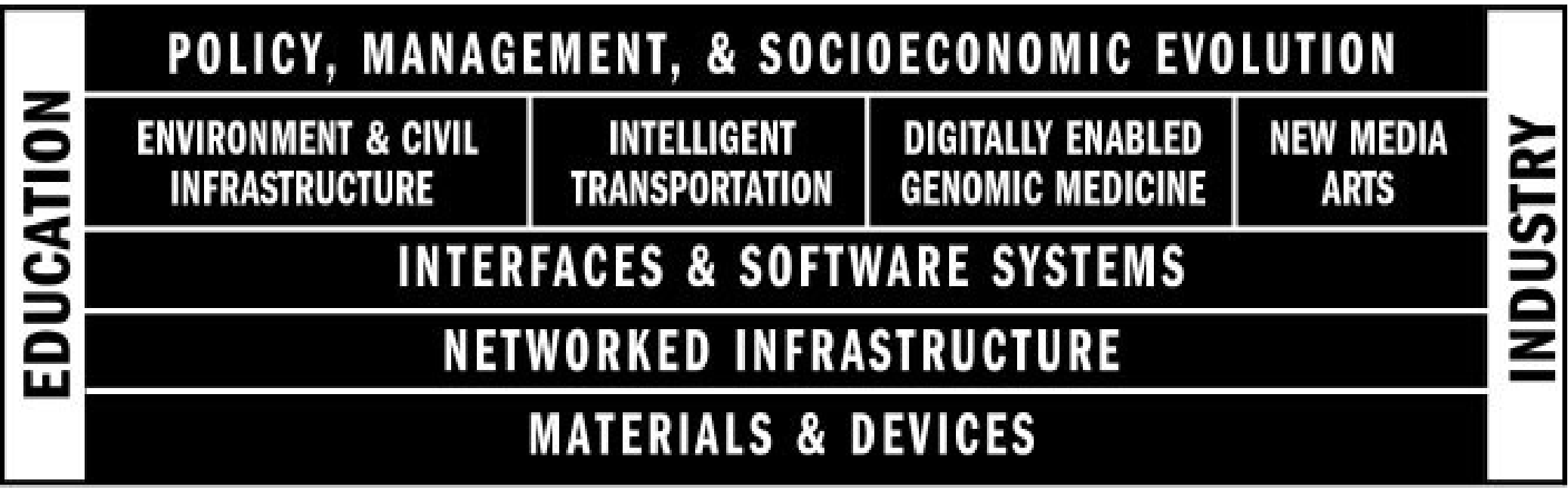
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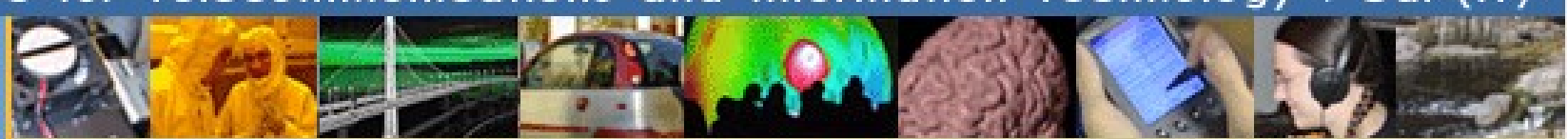
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Calit2 -- Research and Living Laboratories on the Future of the Internet

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



www.calit2.net



Calit2 is a UC Institutional Innovation -- A Persistent Framework for Collaboration

- **Cuts Across Academic Stovepipes**
  - Students, Faculty, Staff
  - Disciplines
  - Departments
  - Schools
  - Campuses
- **Links Outside of Campus**
  - Startups
  - Corporations
  - Non-Profits
  - Community
- **Supports Creating Multi-Disciplinary & Multi-Institutional Teams**

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Robotics

Networks

Collaboration

Digital Culture

Federal Government

Performing Arts

Industry

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Newsletter

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Overview
Grants
Layers
Living Labs
Briefing Papers
Projects

Campuses
UC Irvine
UC San Diego
UC System

EVENTS

February 10
Social Robotics and Robotic Socialization--Who Knows?
Guest Speaker: Natalie Jeremijenki

February 10
Data Riding on Data--An Auxiliary Channel for Optically Routed Networks
Guest Speaker: Vinay A. Vaishampayan

February 11
Unified Activity as a Paradigm for Supporting Collaboration
Guest Speaker: Thomas P. Moran



HIGHLIGHT



RADAR
[More]



LIVING LABORATORY RESEARCH

Technology-driven



NSF Director Freeman Gets Close-up View of ResCUE Program
1.24.05 - Dr. Peter Freeman, assistant director of Computer and Information Science and Engineering (CISE) at the National Science Foundation, ga[illegible] new insight into Calit2's ResCUE project last week. Freeman spent Friday, Jan. 21, visiting with ResCUE investigators, viewing posters and demos, and discussing project details with investigators and graduate student researchers.
[More]

Application-driven



Faculty Members Brief Industry Partners at CNS Research Review
1.26.05 - UCSD's Center for Networked Systems (CNS) held its first formal research review since the center's launch last July. On January 19 and 20, faculty researchers updated delegates from CNS's five industry members on the status of the center's seven inaugural projects, and laid the groundwork for a new round of projects as well as the center's first summer research program that will send UCSD students to work in the labs of members AT&T, Alcatel, Hewlett Packard, QUALCOMM, and Sun Microsystems.
[More]

Culture-driven



HDNews Interviews Irvine Division Director at Beall Center Exhibit

NEWSROOM

>> 01.31.2005 GRIDtoday- UCSD Expands Cyberinfrastructure Program to China, Thailand

>> 01.27.2005 Irvine World News- Technology Transfers Debated

>> 01.24.2005 Chicago Sun-Times- Major [illegible] put Chicago on map for grid computing

>> 01.24.2005 Orange County Business Journal- Broadcom: Hope for Unrealized Ambitions

MULTIMEDIA



Calit2 @ UCI Ribbon-Cutting Ceremony
Please install the latest version of Real Player to view.
[Video]

HIGHLIGHT



UCI Division to Administer Nicholas Foundation Prize; Call for Proposals Issued
1.20.05 - Calit2 at UC Irvine will award as many as five grants for collaborative research under the auspices of the Nicholas Foundation Prize

Two New Calit2 Buildings Will Become Collaboration Laboratories



- Will Create New Laboratory Facilities
- International Conferences and Testbeds
- 800 Researchers in Two Buildings

Calit2@UCSD Building Is Connected To Outside With 140 Optical Fibers



State of California Provided $100M Capital

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Innovation Driven by Calit2 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 Calit2 Events



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



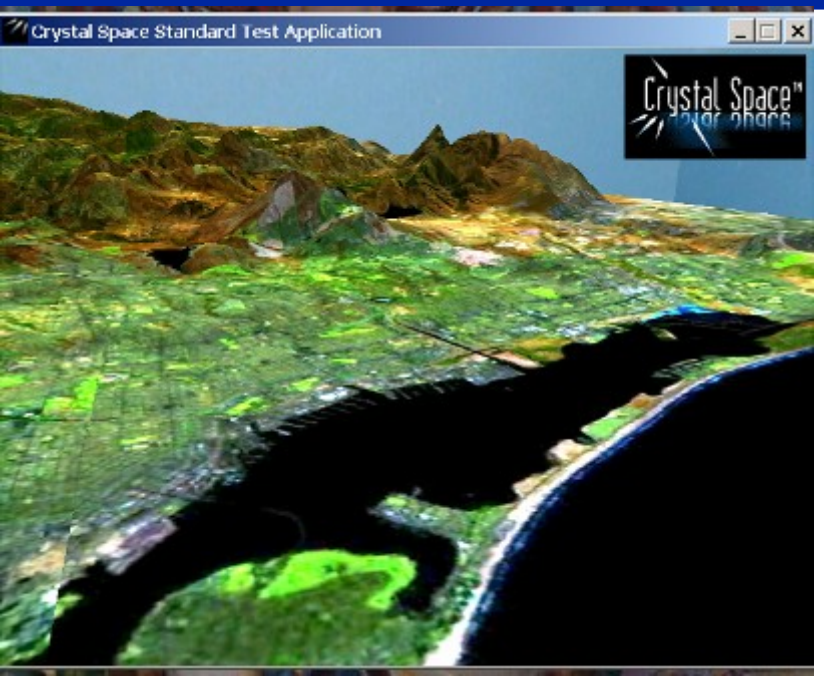
Sun's Emil Sarpa and Jeff Nagle
at Calit2 All-Hands Meeting
April 2004

Sun Co-Hosted with Calit2
the GEON All Hands Meeting
Gala Dinner
August 2004



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Calit2/SDSC Multi-User Heterogeneous Gaming Living Laboratory

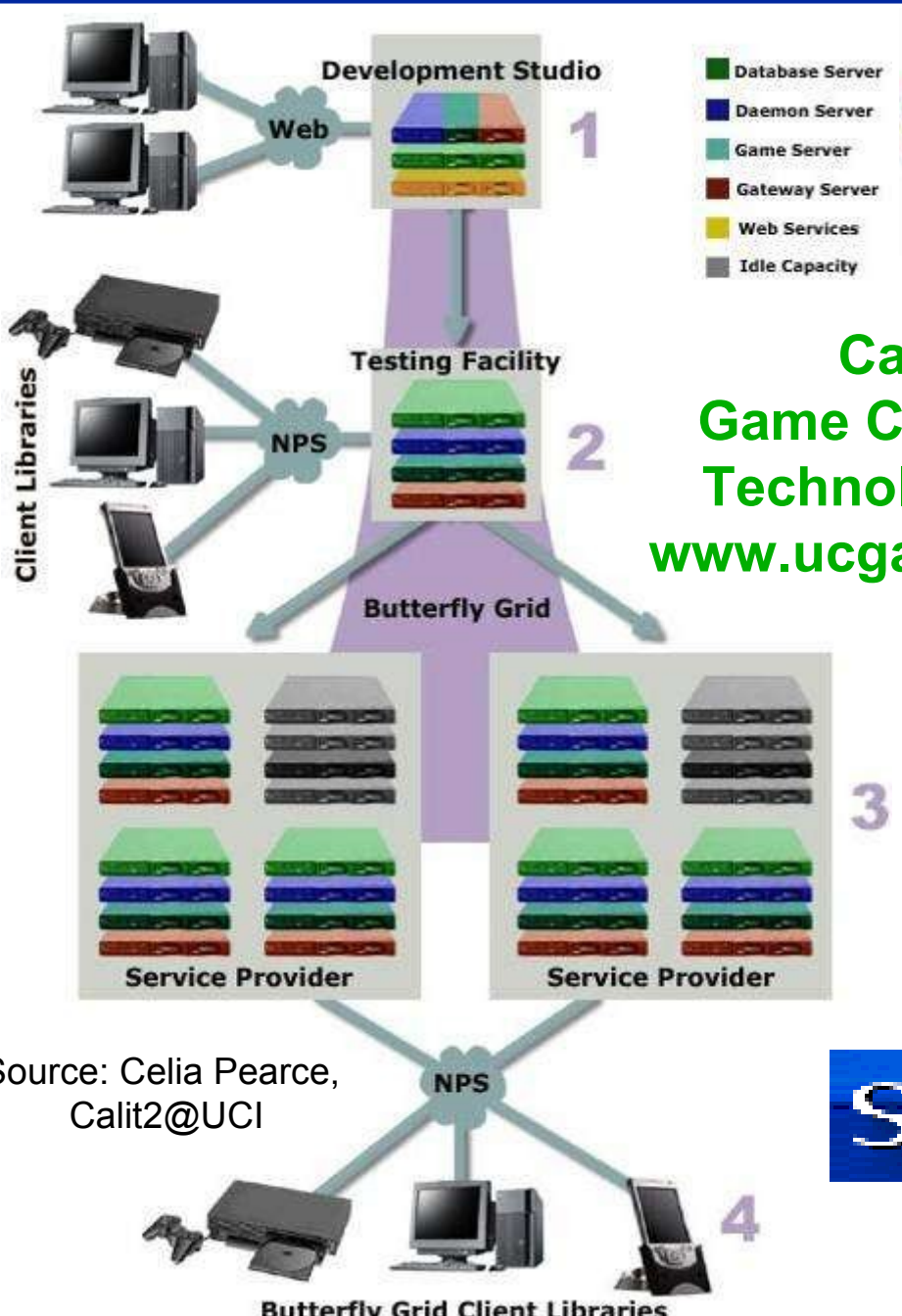


Linking to Cell Phone Games

Sun microsystems

Java

NOKIA
CONNECTING PEOPLE



Calit2
Game Culture & Technology Lab
www.ucgamelab.net

Source: Celia Pearce, Calit2@UCI

SDSC

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Athomas Goldberg
& Doug Twilleager,
Sun Game Technologies

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Calit2@UCI
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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Source: Celia Pearce, Calit2@UCI

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Presenting in Trade Shows With Calit2 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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Source: Celia Pearce, Calit2@UCI

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Calit2 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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The OptIPuter Project
Sun's Slogan Realized…



The Network is the Computer™

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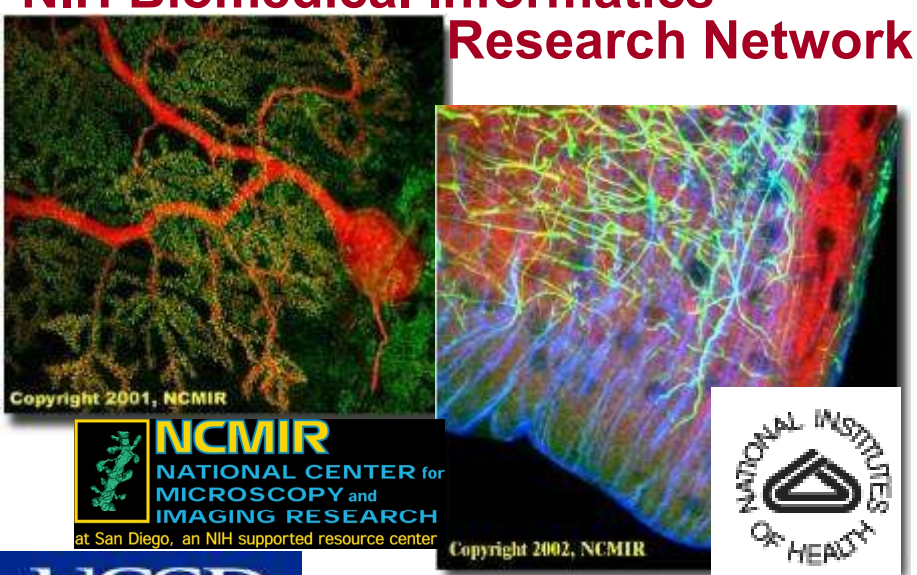
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The OptIPuter Project –
Removing Bandwidth as an Obstacle In Data Intensive Sciences

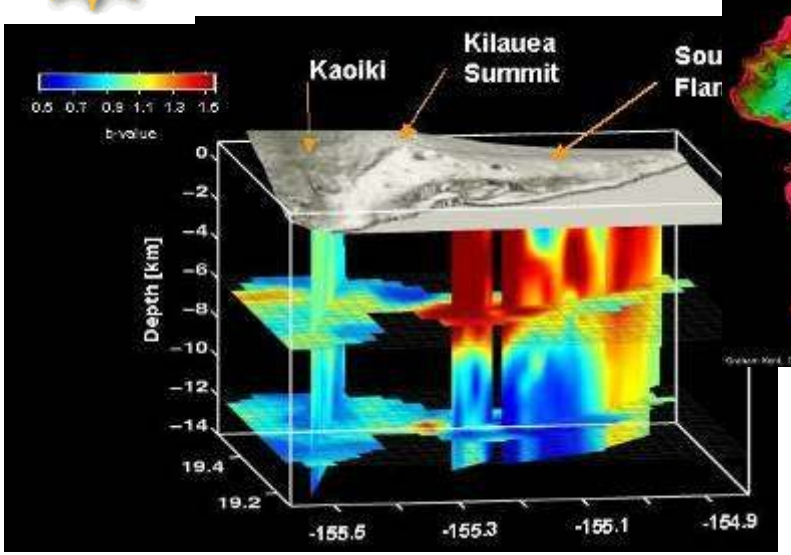
- **NSF Large Information Technology Research Proposal**
  - Calit2 (UCSD, UCI) and UIC Lead Campuses—Larry Smarr PI
  - Partnering Campuses: USC, SDSU, NW, TA&M, UvA, SARA, NASA
- **Industrial Partners**
  - IBM, Sun, Telcordia, Chiaro, Calient, Glimmerglass, Lucent
- **$13.5 Million Over Five Years**
- **Driven by Global Scale Science Projects**

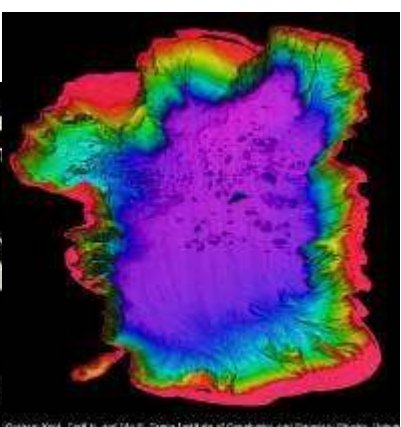
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NIH Biomedical Informatics Research Network



NSF EarthScope and ORION





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

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

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The Dream: 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



Sun & ATT





"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

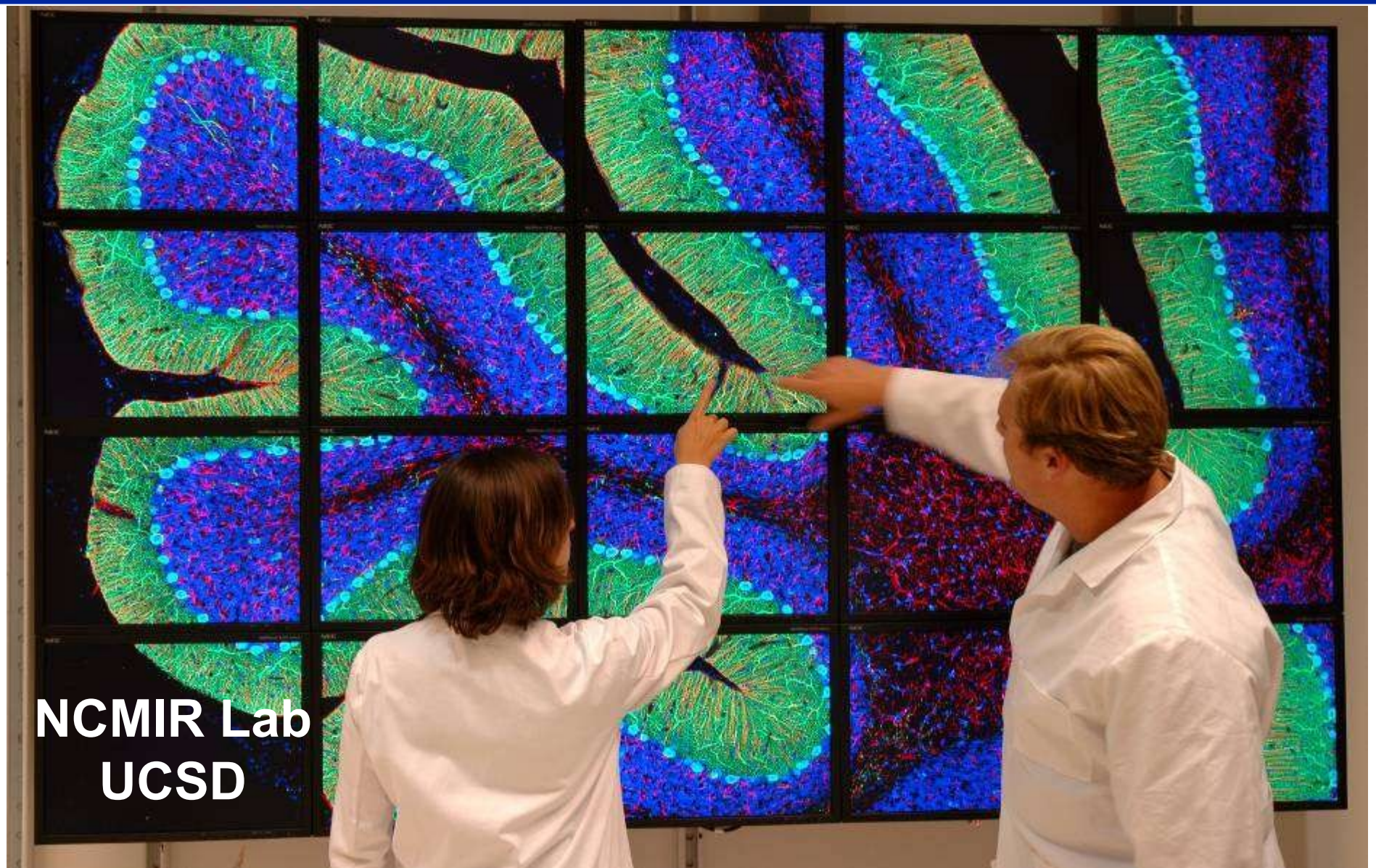
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NCSA™

Source: Maxine Brown

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Realizing the Dream: High Resolution Portals to Global Science Data



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

Source: Mark Ellisman, David Lee, Jason Leigh

it²

Brain Imaging Collaboration -- UCSD & Osaka Univ. Using Real-Time Instrument Steering and HDTV

Most Powerful Electron Microscope in the World -- Osaka, Japan





HDTV



Southern California OptIPuter

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

OSAKA UNIVERSITY

KDDI GROUP KDDI Labs USA

Source: Mark Ellisman, UCSD

Telepresence Using Uncompressed HDTV Streaming Over IP on Fiber Optics—Jan 2005





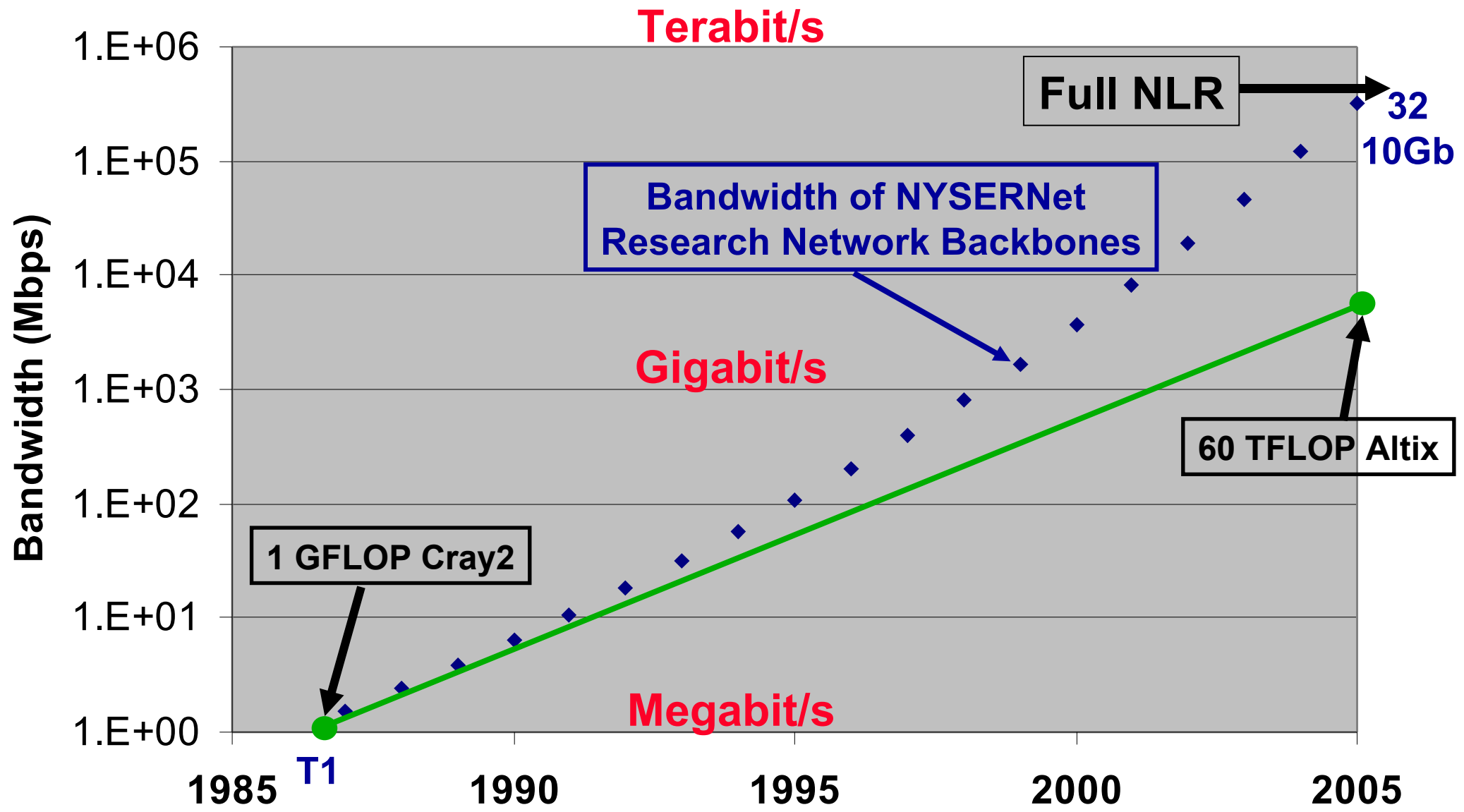


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JGN II Workshop
January 2005

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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

it²

The OptIPuter Philosophy

Bandwidth is getting cheaper faster than storage.
Storage is getting cheaper faster than computing.
Exponentials are crossing.

"A global economy designed
to waste transistors, power, and silicon area
-and conserve bandwidth above all-
is breaking apart and reorganizing itself
to waste bandwidth
and conserve power, silicon area, and transistors."
George Gilder Telecosm (2000)

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Optical Networking, Internet Protocol, Computer
Bringing the Power of Lambdas to Users

- **Extending Grid Middleware to Control:**
  - Jitter-Free, Fixed Latency, Predictable Optical Circuits
    - One or Parallel Dedicated Light-Pipes (1 or 10 Gbps WAN Lambdas)
    - Uses Internet Protocol, But Does NOT Require TCP
    - Exploring Both Intelligent Routers and Passive Switches
  - Clusters Optimized for Storage, Visualization, and Computing
    - Scalable Clusters With 1 or 10 Gbps I/O per Node
    - Scalable Visualization Displays Driven By OptIPuter Clusters
- **Applications Drivers:**
  - Earth and Ocean Sciences
  - Biomedical Imaging
  - Digital Media at SHD resolutions (Comparable to 4K Digital Cinema)

The OptIPuter Envisions a Future When the Central Architectural Element Becomes Optical Networks-NOT Computers - Creating "SuperNetworks"

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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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Global Lambda Integrated Facility (GLIF)
Integrated Research Lambda Network

Many Countries are Interconnecting Optical Research Networks

to form a Global SuperNetwork



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Visualization courtesy of
Bob Patterson, NCSA

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Announcing…

Call for Applications Using the GLIF SuperNetwork

iGrid 2005

THE GLOBAL LAMBDA INTEGRATED FACILITY

www.startap.net/igrid2005/

September 26-30, 2005
University of California, San Diego
California Institute for Telecommunications and Information Technology

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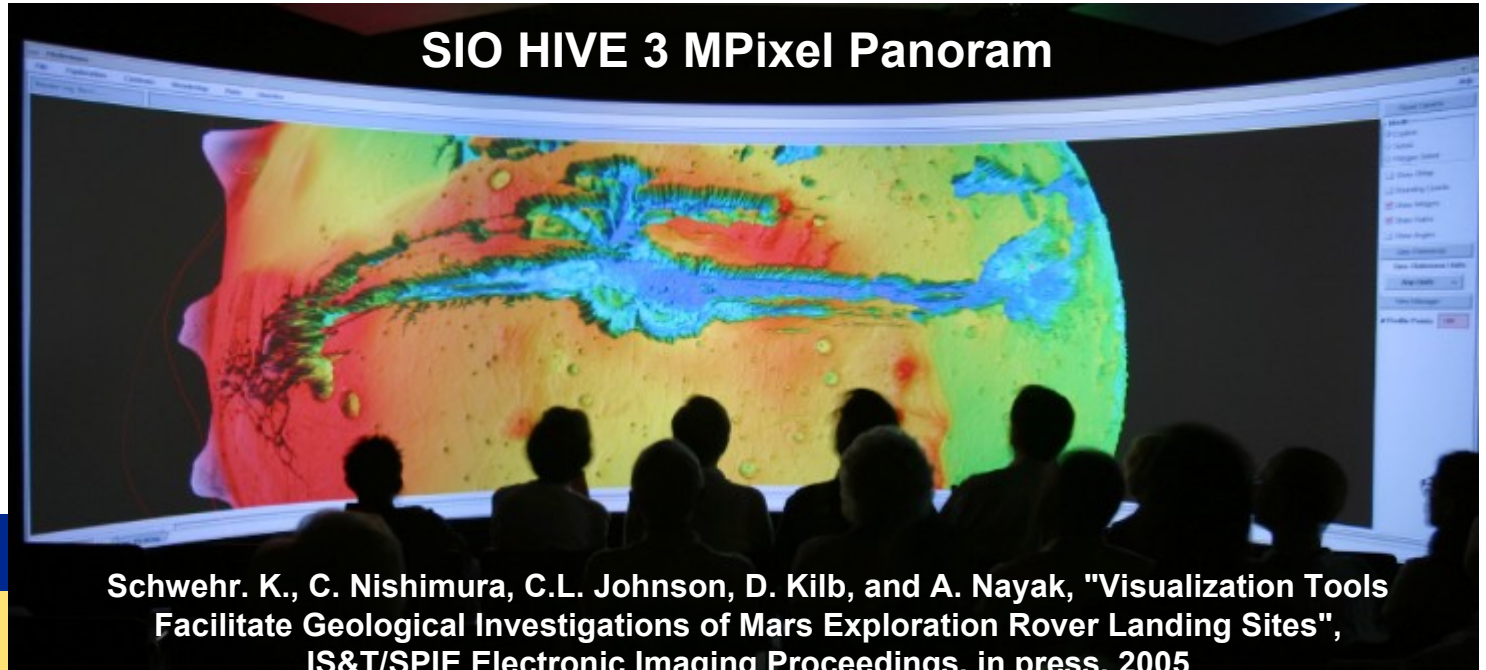
Maxine Brown, Tom DeFanti, Co-Organizers

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Earth and Planetary Sciences are an OptIPuter Large Data Object Visualization Driver



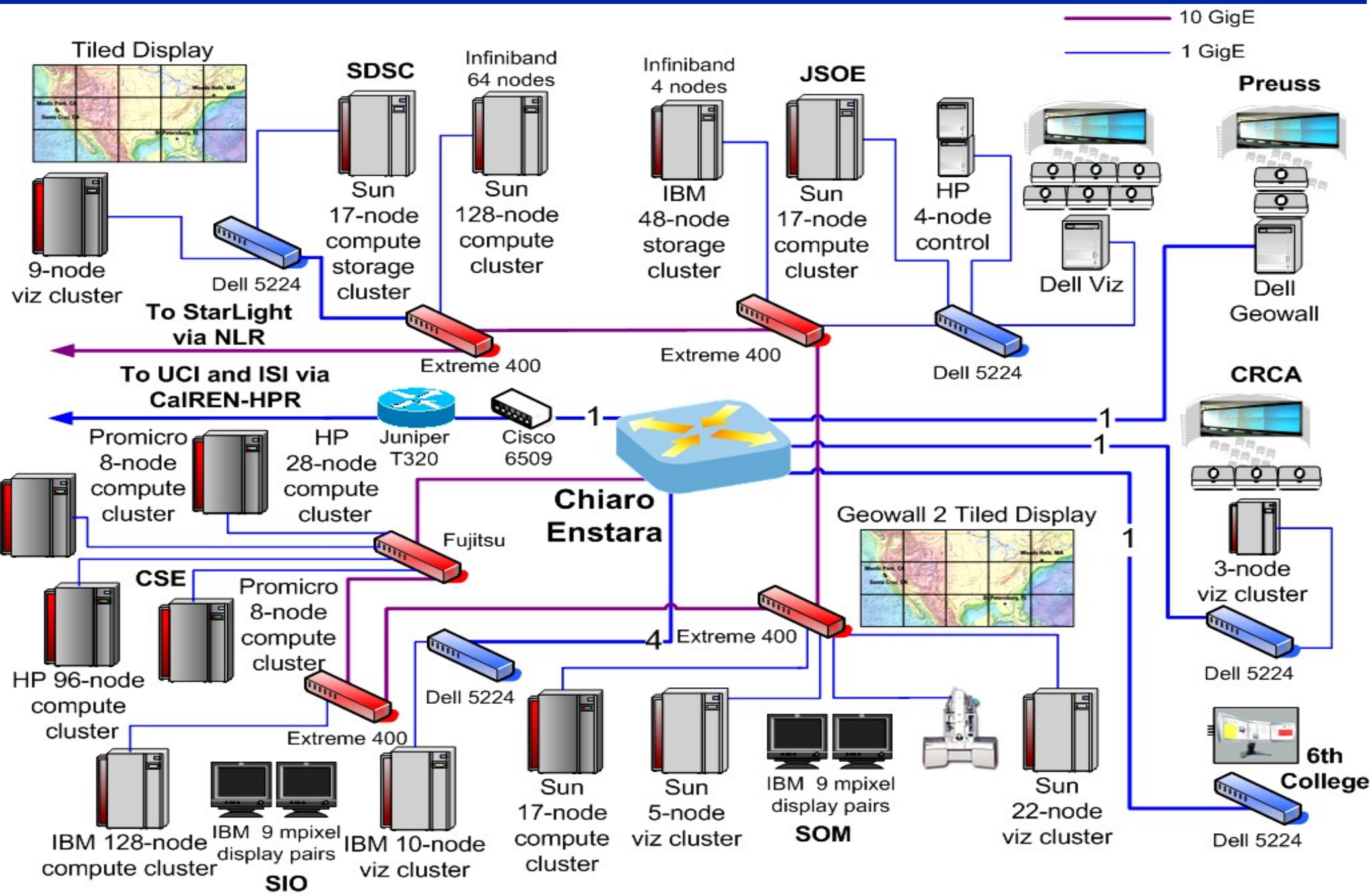




Schwehr. K., C. Nishimura, C.L. Johnson, D. Kilb, and A. Nayak, "Visualization Tools Facilitate Geological Investigations of Mars Exploration Rover Landing Sites", IS&T/SPIE Electronic Imaging Proceedings, in press, 2005

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UCSD Campus-Scale Routed OptIPuter with Nodes for Storage, Computation and Visualization



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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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The Optical Network Can be Routed or Switched:
The Optical Core of the UCSD Campus-Scale Testbed

Goals by 2007:

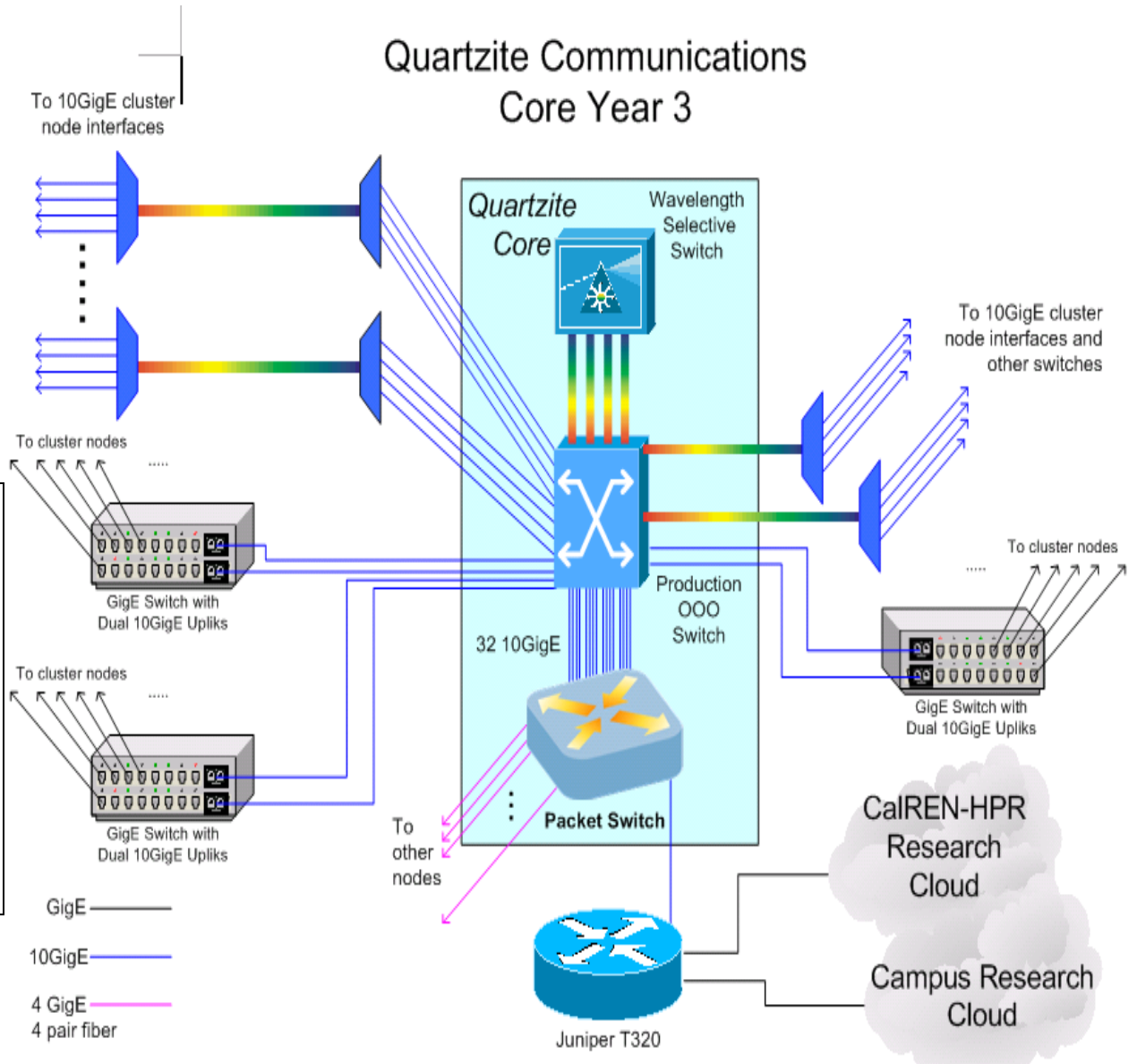
>= 50 endpoints at 10 GigE

>= 32 Packet switched

>= 32 Switched wavelengtl

>= 300 Connected endpoin

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



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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

Rocks Team is Working with Sun to Understand How to Apply These Techniques to Solaris X – Based Clusters.
Make it Possible to Match the Installation Speed of the Linux Version

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

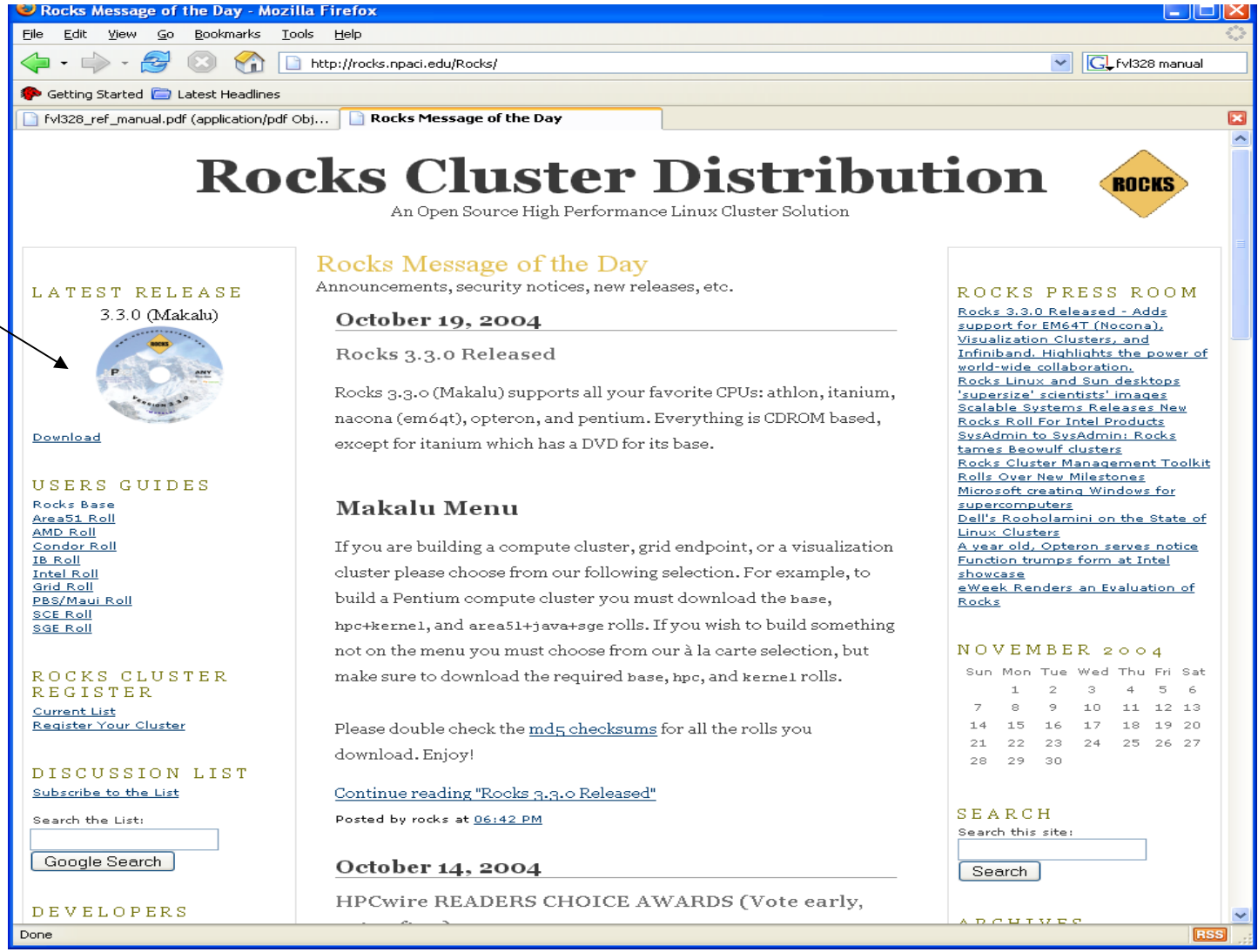
Rocks Cluster Web Site: Software Distribution and Discussion

Downloadable CDs

Optional Components (rolls)

Over 350 Rocks Clusters Around the World

Active Discussion List (800+ people)



UCSD UCIrvine ROCKS

Source: Phil Papadopoulos, SDSC

SDSC NPACI

Viewing UCSD as a Proving Ground for Scalable Utility Computing

- Test Bed is Dedicated to Next-Generation Network Experiments
- Dark Fiber Plant is Being Lit with Multiple 10GigE Pipes
- Hundreds of Endpoint Nodes—All with 1 or 10 GigE I/O
- Opportunity: Utility Computing and Scalability Development = Next-Gen Optical Network + UCSD App. Scientists + Rocks Rapid Deployment + Sun HW + Solaris X + Sun/UCSD CS Grid Know-How

Idea: Give Research Scientists Utility Computing Grants ("$1"/hr) to Evaluate the Capabilities Required by Using UCSD Scalable Utility Computing Testbed

Source: Phil Papadopoulos, SDSC

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OptIPuter is Prototyping The User Interface of 2010

- Terabits to the Desktop…
- 100 Megapixels Display
  - 55 HiRes LCD Panels
- 1/3 Terabit/sec I/O
  - 30 x 10GE interfaces
  - Linked to OptIPuter
- 1/4 TeraFLOP
  - Driven by 30 Node Cluster of 64-bit Dual Opterons
- 1/8 TB RAM
- 60 TB Disk



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Source: Jason Leigh, Tom DeFanti, EVL@UIC
OptIPuter Co-PIs

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