GLIF Research & Applications
Working Group Report

September 12, 2006

Maxine Brown
UNIVERSITY OF ILLINOIS AT CHICAGO
and
Larry Smarr
CALIT2, UNIVERSITY OF CALIFORNIA, SAN DIEGO

RAP WG

GLIF RAP Breakout Attendees

RAP WG Meeting, September 11, 2006

- Heidi Alvarez, FIU
- Tomonori Aoyama, Keio
- Maxine Brown, UIC
- John Charles, California State University
- Hans Döbbeling, DANTE
- Laurin Herr, Pacific Interface
- Hiroaki Harai, NICT
- Greg Hidley, Calit2/UCSD
- Anton Korotin, RIPN
- Kevin Jones, NASA/NREN
- Dan Jordt, UW/PNWGP
- George McLaughlin, PNWGP
- Don Riley, UMD, IEEAF, SURA
- Fay Sheu, NCHC Taiwan
- Stanislav Sima, CESnet
- Karel Vietsch, TERENA
- Eugene Yeh, NCHC Taiwan

Subscribe to RAP email list at

www.glif.is/working-groups/rap/

GLIF RAP: Goals

- **Train a new generation of scientists on the use of supernetworks**
- **Promote the LambdaGrid and advocate end-to-end solutions from the campus edge to the laboratory**
  - **Applications – Larry Smarr and Maxine Brown**
    - **Generate more users and applications using the GLIF infrastructure**
  - **Infrastructure – Jason Leigh**
    - ***Live the Dream:* create persistent interconnections among GLIF sites**
  - **Research – Cees de Laat**
    - **Advocate new research programs**
    - **advocate new commercial hardware/software**
    - **Coordinate research and roadmaps with other groups**

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GLIF RAP: Implementation Strategies

- GLIF provides a persistent infrastructure (versus a temporary demo environment) that motivates the research community to pay attention and explore new paradigms for distributed computing and collaboration
- Promote GLIF RAP activities (applications, infrastructure, research) on web
  - Provides a *resource* for groups trying to get funding for GLIF-related activities; GLIF "branding" adds credibility
  - Document applications (brief descriptions with URL pointers) (I will create template and forward to RAP email list)
  - Document enabling technologies (middleware, control plane software) and what applications they enable (e.g., DRAGON, UCLP, etc)
  - Document countries (feedback to NRENs)
- Help applications get started
  - *NRNs can support applications with connectivity, equipment, professional staff…but how do NRNs educate researchers within their countries, find international collaborators, provide direction?*
  - GLIF primer (how to find, educate, promote applications)
  - PR: What can GLIF do for you?
  - PR: Promote domain-specific applications (eVLBI, CineGrid, etc) (provide inspiration and motivation to potential new applications within countries)

GLIF RAP: Examples of Materials

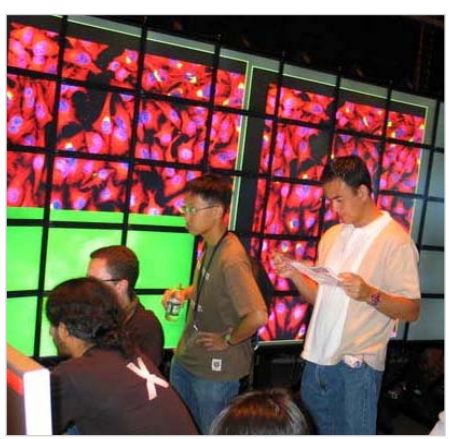
- **Examples of materials collected in the past week**
- **Will work with GLIF Secretariat to provide application resource listings on website**

GLIF RAP: Applications

iGrid 2005

iGrid 2005, San Diego, California, September 26-30, 2005

- 4th community-driven biennial International Grid event attracting 450 participants
  - An international testbed for participants to collaborate on a global scale
  - To accelerate the use of multi-10Gb international and national networks
  - To advance scientific research
  - To educate decision makers, academicians and industry about hybrid networks
- 49 demonstrations showcasing global experiments in e-Science and next-generation shared open-source LambdaGrid services
- 20 countries: Australia, Brazil, Canada, CERN, China, Czech Republic, Germany, Hungary, Italy, Japan, Korea, Mexico, Netherlands, Poland, Russia, Spain, Sweden, Taiwan, UK, USA
- 25 lectures, panels and master classes as part of a symposium
- 100Gb into the Calit2 building on the UCSD campus




www.igrid2005.org

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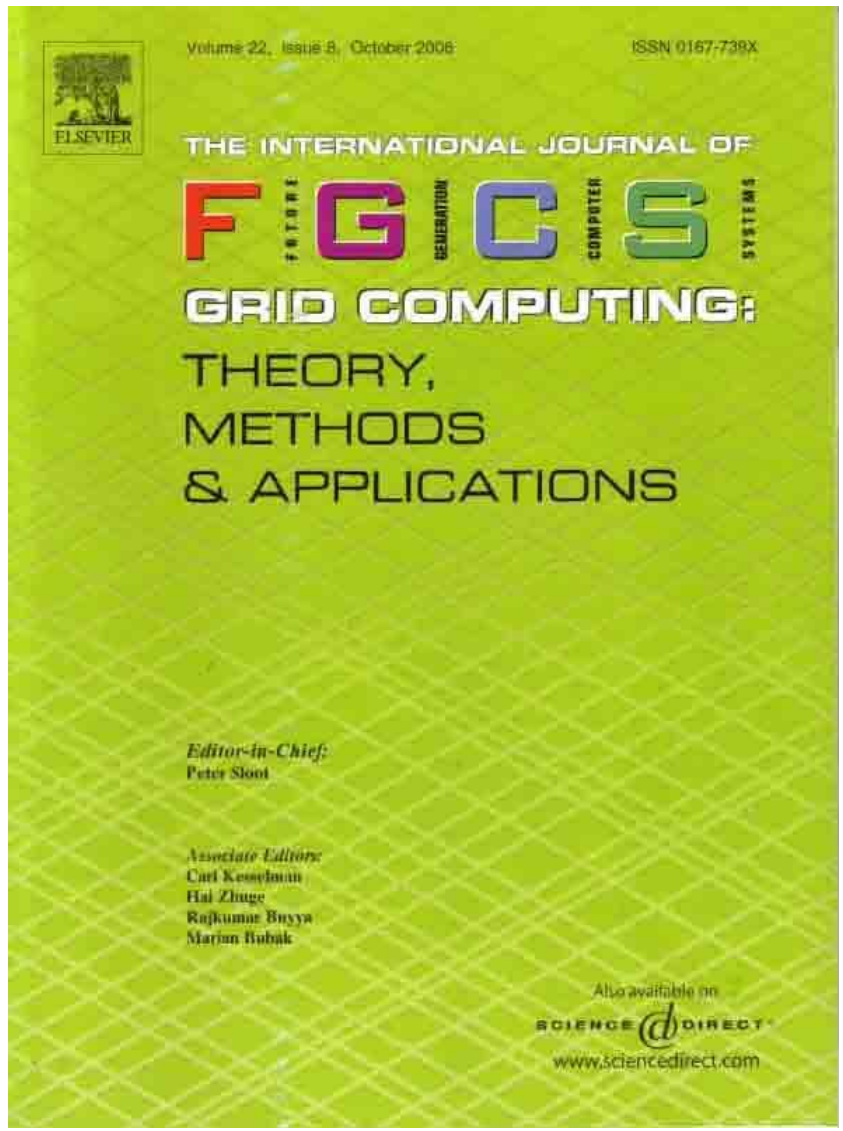
GLIF RAP: Applications

iGrid 2005

iGrid 2005 special issue:
The Global Lambda Integrated Facility
27 referred papers!

Guest Editors:
Smarr, Larry, Maxine Brown, Tom DeFanti and Cees de Laat

Future Generation Computer Systems, Volume 22, Issue 8, Elsevier, October 2006, pp. 849-1054



www.igrid2005.org
www.elsevier.com/locate/future

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GLIF RAP: Applications

CineGrid™ Initiative

CineGrid Initiative

CineGrid is an initiative to provide media professionals access to global cyberinfrastructure capable of carrying ultra-high-performance digital media using photonic networks, middleware, transport protocols and collaboration tools originally developed for scientific research, visualization, and Grid computing. In the process, "learn by doing," train the next generation, and cultivate global interdisciplinary communities to help advance the state of the art. CineGrid is people, facilities, networks and a not-for-profit organization.

The 2nd CineGrid Workshop will be held December 13-15, 2006, at UCSD/Calit2 in San Diego, California. For more information, contact Tom DeFanti <tdefanti@ucsd.edu>.

- UCSD/Calit2, USA
- Keio/DMC, Japan
- USC/CNTV, USA
- UIC/EVL, USA
- UW/Research Channel, USA
- UCI/Calit2, USA
- UIUC/NCSA, USA
- Tohoku University, Japan
- TUT/CTL, Japan
- SFSU/INGI, USA
- Ryerson University, Canada
- NTT Labs, Japan
- Cisco, USA
- City University of Hong Kong, School Creative Media, Hong Kong
- Italian National Cinema School, Italy
- USC/Entertainment Technology Center, USA
- LSU/Center for Computation and Technology, USA
- Digital Cinema Technology Forum, Japan
- Connecticut State Library, USA
- Canadian Film Center, Canada
- University of Amsterdam, Netherlands
- De Waag (Netherlands), Netherlands

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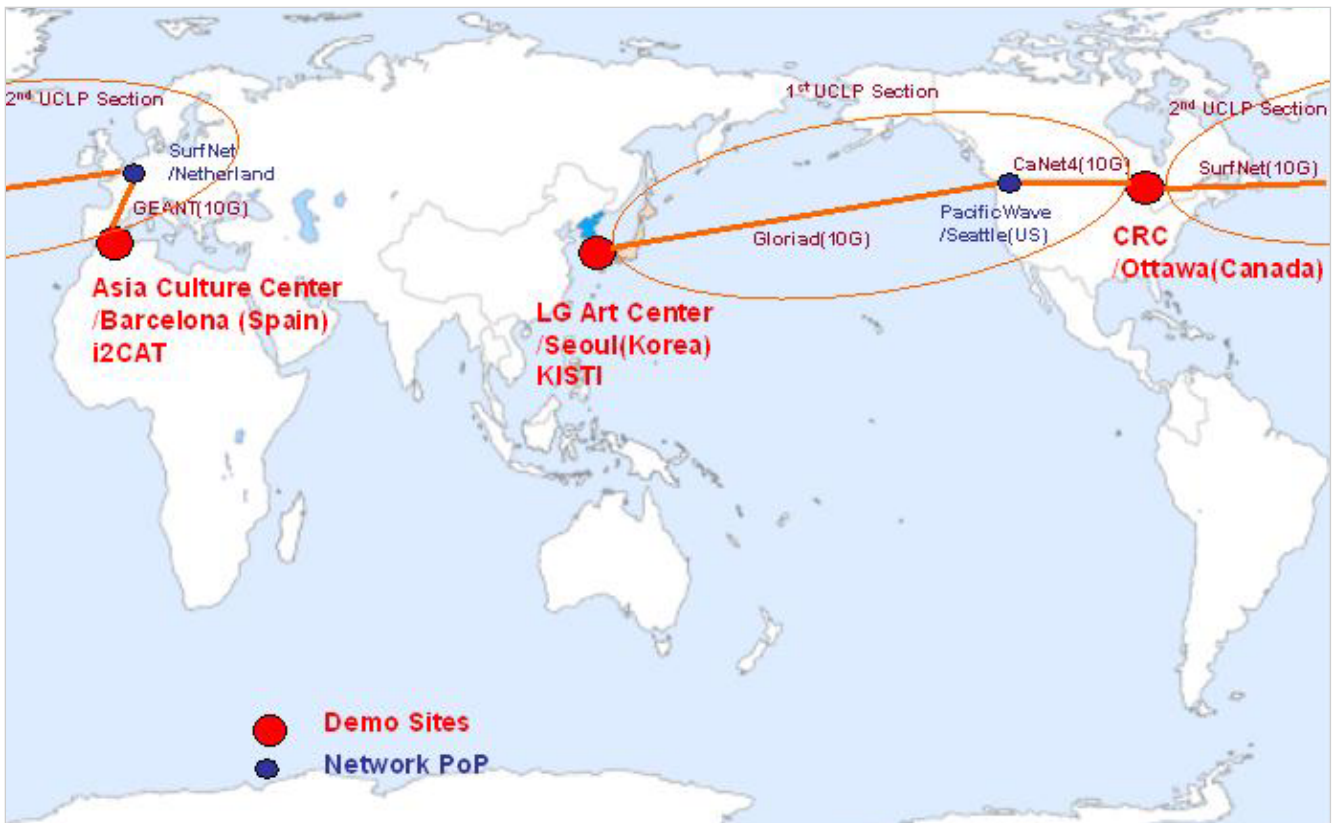
GLIF RAP: Applications

Dancing 2006

Dancing 2006 – Korea/Barcelona Dance Performance 29 September 2006

www.i2cat.net

- i2CAT, Universitat Politècnica de Catalunya (UPC), Spain
- KISTI, Korea
- Advanced Network Forum (ANF) HDTV Taskforce, Korea
- Communication Research Centre, Canada



Using CANARIE/CRC's UCLPv2 technology, i2CAT uses LambdaGrids to support HD videoconferencing to promote culture(s). Global live performances are demanding testbeds. On September 29, ANF will send, in real time, a dance performance by the Korean Nulhui Dance Company from the LG ArtCenter Auditorium in Seoul to CRC in Canada and to the Culture Center in Barcelona using uncompressed HDTV over IP, requiring a 1Gbps (~860Mbps) network environment.

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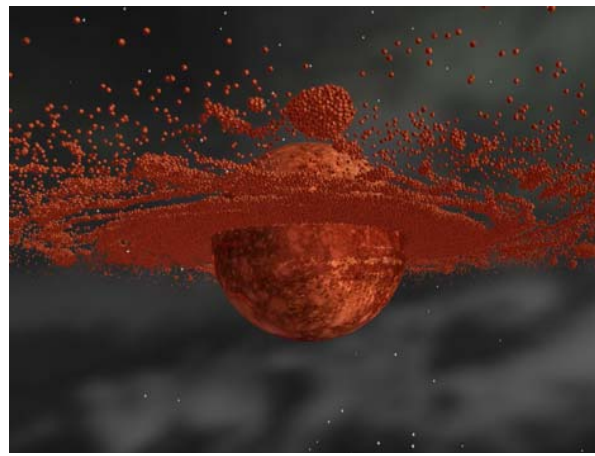
GLIF RAP: Applications

Data Reservoir Project

- Goal to create a global grid infrastructure to enable distributed data sharing and high-speed computing for data analysis and numerical simulations
- Online 2-PFLOPS system (part of the GRAPE-DR project), to be operational in 2008



- University of Tokyo, WIDE Project, JGN2 network, APAN, Fujitsu Computer Technologies, NTT Communications, Japan
- Chelsio Communications
- StarLight, PNWGP, IEEAF, USA
- CANARIE, Canada
- SURFnet, SARA and University of Amsterdam, The Netherlands

Won April 26, 2006 Internet2 Land Speed Records (I2-LSR) in theIPv4 and IPv6 single and multi-stream categories. For IPv4, created a network path over 30,000 kilometers crossing eight international networks and exchange points, and transferred data at a rate of 8.80Gbps, or 264,147 terabit-meters per second(Tb-mps). For IPv6: created a path over 30,000 kilometers, crossing five international networks, and transferred data at a rate of 6.96 Gbps, or 208,800 Tb-mps.

http://data-reservoir.adm.s.u-tokyo.ac.jp

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GLIF RAP: Applications

e-Very Long Baseline Interferometry (e-VLBI)

Optical connections dynamically managed using the DRAGON control plane and Internet2 HOPI network

- Real-time e-VLBI data correlation from telescopes in USA, Sweden, Netherlands, UK and Japan
- Achieved 512Mb transfers from USA and Sweden for iGrid 2005

- Mid Atlantic Crossroads (MAX) GigaPoP, USA
- Information Sciences Institute, USA
- Westford Observatory, MIT Haystack, USA
- Goddard Geophysical and Atmospheric Observatory, NASA, USA
- Kashima, NiCT, Japan
- Onsala, Sweden
- Jodrell Bank, UK
- JIVE, The Netherlands
- Westerbork, Observatory/ ASTRON, The Netherlands

http://dragon.maxgigapop.net

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GLIF RAP: Applications

EnLIGHTened Testbed

GMPLS E-NNI Japan/USA Demonstration

http://enlightenedcomputing.org/

- National Institute of Advanced Industrial Science and Technology (AIST), Japan
- KDDI R&D Laboratories, Japan
- NTT Network Innovation Laboratories, Japan
- National Institute of Information and Communications Technologies (NICT), Japan
- MCNC, USA
- Louisiana State University, USA
- North Carolina State University, USA
- Cisco, USA
- IBM, USA
- Calient, USA
- AT&T Research, USA
- Special thanks to NLR/Cisco for the Enlightened, LONI and UltraLight waves; StarLight (Calient and support); and KDDI, NTT, and NICT (for the G-Lambda testbed)

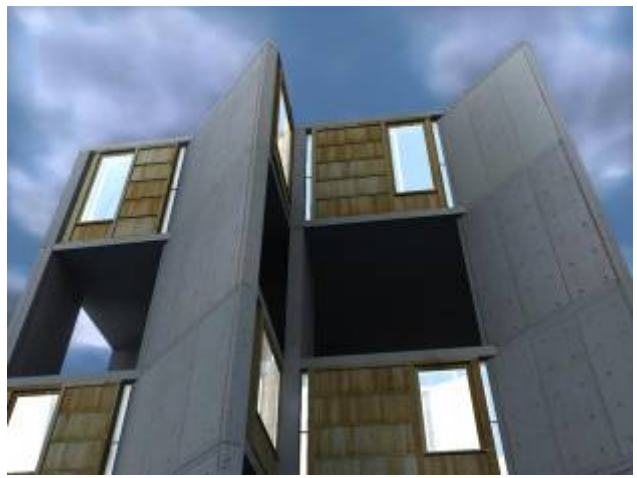
Two applications invoke middleware capable of creating an end-to-end international lightpath to co-schedule computing and networking resources across two national testbeds (Japan's G-Lambda and US's Enlightened) via a GMPLS control plane. One application is a G-Lambda molecular dynamics simulation; the other is an Enlightened distributed visualization demo.

GLIF RAP: Applications

Eucalyptus Participatory Design Studio Grid – using UCLP and SOA

Eucalyptus Participatory Design Studio Grid – Using UCLP and SOA

www.cims.carleton.ca/60.html



- Carleton Immersive Media Studio (CIMS), Carleton University, Canada

The Participatory Design Studio will allow architects and industrial designers at multiple locations to collaborate in real time by sharing computational resources, geometry datasets, and multimedia content. The expected result is the development and field testing of a Service Oriented Architecture utilizing User Controlled Light Paths (UCLPv2) on CA*net 4 that provides university architecture staff and students in Ottawa and Montreal with on-demand simultaneous shared access to visualization, modeling, and visual communication tools. The project is innovative because commercially available architectural tools not originally intended for long-distance use will become easy-to-use powerful enablers of long-distance design participation.

GLIF RAP: Applications
GLEON/CREON

- **Global Lake Ecological Observatory Network (GLEON)**
  - http://gleon.org
  - A grassroots association of limnologists, information technology experts and engineers who are building a scalable, persistent network of lake ecology observatories. Data from these observatories will help researchers better understand key processes, such as the effects of climate and land use change on lake function, the role of episodic events such as typhoons in resetting lake dynamics, and carbon cycling within lakes. The observatories will consist of instrumented platforms on lakes around the world capable of sensing key limnological variables and moving the data in near-real time to web-accessible databases.
- **Coral Reef Environmental Observatory Networks (CREON)**
  - www.coralreefeon.org
  - A grassroots association of scientists and engineers working to design and build marine sensor networks to view marine worlds in real time and in many dimensions, such as temperature in 3D. In particular, coral reefs are exhibiting signs of decay around the world as global warming, over-fishing, and pollution have an impact.
- **GLEON and CREON bring together lake and coral reef ecologists and biologists, computer scientists, and sensor network IT engineers and experts to help exploit the new opportunities that cyberinfrastructure has to offer.**
  - 3rd GLEON/CREON workshop, October 2006
  - www.nchc.org.tw/event/2006/creon_gleon

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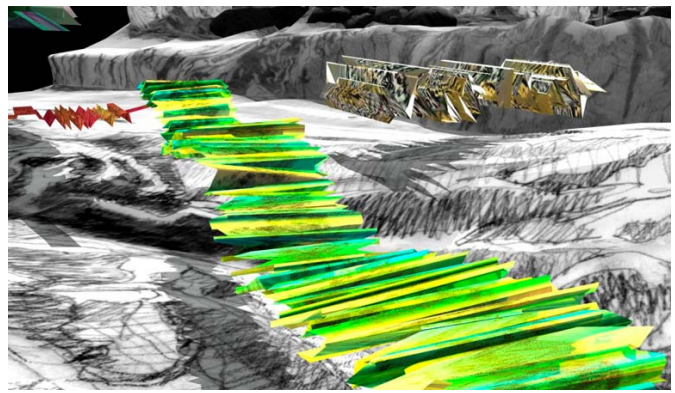
GLIF RAP: Applications

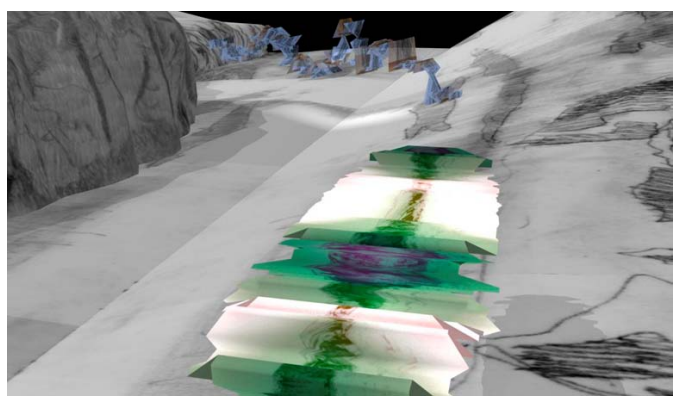
GridJam

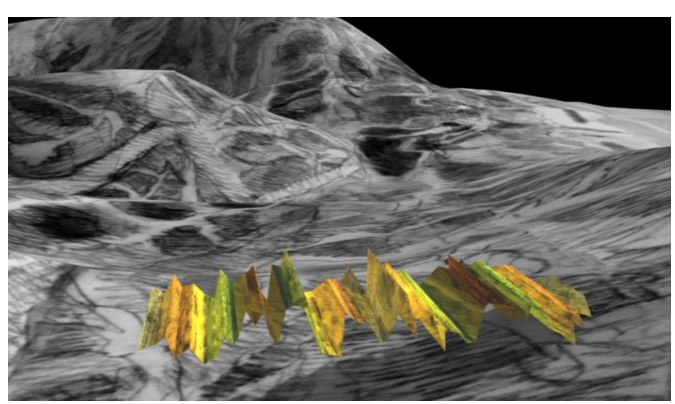
GridJam: A Networked 3D Immersive Performance

- Fine Arts Department, ARTSLab and Center for High Performance Computing, University of New Mexico
- Mills College, CA
- Calit2, UCSD, CA
- University of Alberta, Canada
- De Waag, NL (tentative)
- V2_, Institute for the Unstable Media, NL (tentative)

Gridjam is an art and research project to study real-time, interactive, low-latency, partly improvised, 3D visualized, musical performances. The Virtual Color Organ (VCO) is a 3D immersive environment in which music is visually realized in colored and image-textured shapes as it is heard. The VCO visually illustrates information in a music's score, the composer's instructions to the musicians, and the musicians' contributions to the score as they improvise in reaction to one another's performances and to the immersive visual experiences. The VCO displays the emergent properties within the meaning of music, both as information and as art.







http://jackox.net/pages/gridjampages/Gridjam1.html

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GLIF RAP: Applications

High Quality Internet for Higher Education and Research

HDTV Streaming to Student Dormitories: High Quality Internet for Higher Education and Research

http://www.surfnet.nl/info/en/artikel_content.jsp?objectnumber=148490

- **SURFnet, The Netherlands**

SURFnet launched a project to upgrade the network facilities of Dutch student accommodations in several cities in the Netherlands. As a result, about 5,000 students will be able to view high-definition video (HDTV) and use other advanced educational internet services on their computer. Every student will have a network connection of at least 20 megabits per second, roughly ten times the speed of an ADSL connection. At the same time the local network will be multicast enabled. Multicast is an important technique for receiving HDTV video.

Universities and telephone companies face the same problem of having small numbers of heavy users consuming expensive Internet bandwidth. The University solution is to cap bandwidth from dormitories and/or block types of traffic. The telecom solution is to build a two-tiered Internet or doing volume capping (e.g., a high-speed channel for carrying video). Universities can play a leadership role in piloting new last-mile (hundred feet) architectures that address the problems of dormitories. ***University students are ideal early adopters and were instrumental in diffusion of the Internet throughout larger community.***

One possible solution would be to work with a few universities on developing a ***student-empowered network***. For example, enable students to lease or control dedicated fiber/copper to a university colo point where they could set up point-to-point VLANs to directly peer with other students in their dormitory, with service providers, and/or with other students across Internet2, CA*net 4, GLORIAD, GLIF, SURFnet, i2CAT, KREONet2, etc. The primary application could be collaborative video, such as YouTube and/or CineGrid and/or OSTN. − Bill St. Arnaud, CANARIE

http://www.multichannel.com/article/CA6332098.html
http://www.news.utoronto.ca/bin6/060222-2074.asp

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GLIF RAP: Applications

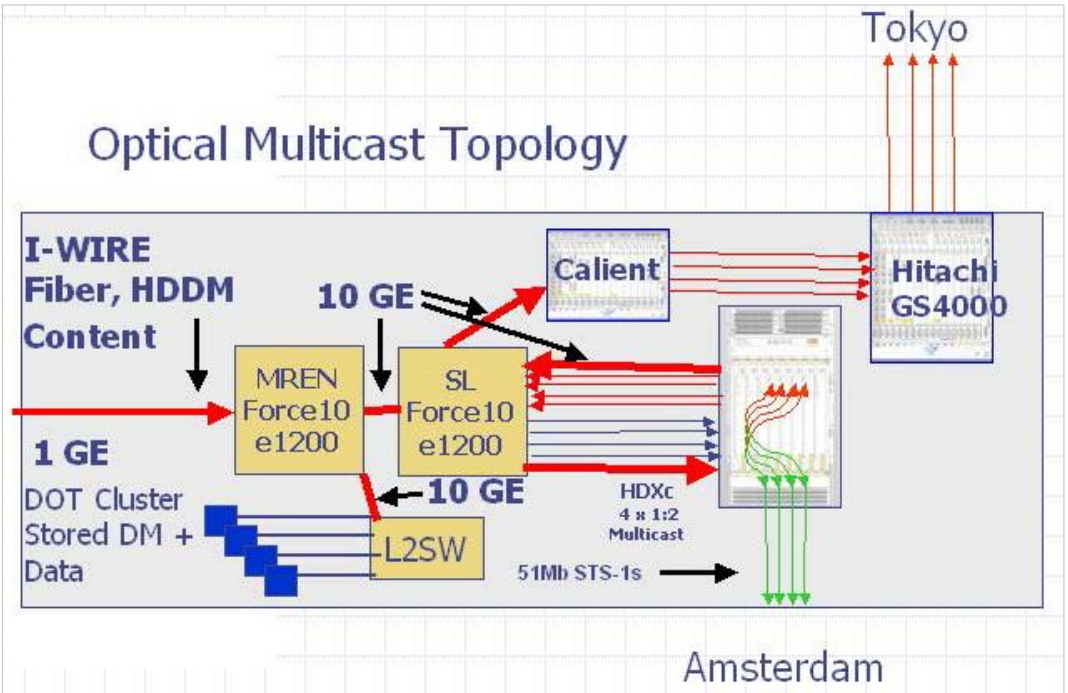
High-Performance Digital Media With Dynamic Optical Multicast

International High Performance Digital Media With Dynamic Optical Multicast

www.icair.org

To be demonstrated at SC|06

- **International Center for Advanced Internet Research (iCAIR), Northwestern University, USA**



Using L1/L2 transport to multicast digital media, a number of significant benefits can be obtained, including higher performance, enhanced management, cost effectiveness, quality of service, etc. Optical multicast allows for much larger streams than packet routed networks, e.g., multicast at multiple Gbps. In this context, high-performance refers to reliable, consistent, high-quality delivered service, with minimal jitter and latency over very long distances.

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GLIF RAP: Applications

Large Hadron Collider

- Analysis tools for use on advanced networks are being developed that will enable physicists to control worldwide grid resources when analyzing major high-energy physics events
- Components of this "Grid Analysis Environment" are being developed by such projects as UltraLight, FAST, PPDG, GriPhyN and iVDGL

- Caltech, Stanford Linear Accelerator Center, Fermi National Accelerator Laboratory, University of Florida, University of Michigan, Cisco, USA
- CERN
- Korea Advanced Institute of Science and Technology, Kyungpook National University, Korea
- Universidade do Estado do Rio de Janeiro, Brazil
- University of Manchester, UK

First prize for the SC|05 Bandwidth Challenge went to the team from CalTech, Fermi and SLAC for their entry "Distributed TeraByte Particle Physics Data Sample Analysis," which was measured at a peak of 131.57 Gbps of IP traffic. This entry demonstrated high-speed transfers of particle physics data between host labs and collaborating institutes in the USA and worldwide. Using state-of-the-art WAN infrastructure and Grid Web Services based on the LHC Tiered Architecture, they showed real-time particle event analysis requiring transfers of Terabyte-scale datasets.

http://ultralight.caltech.edu/web-site/igrid

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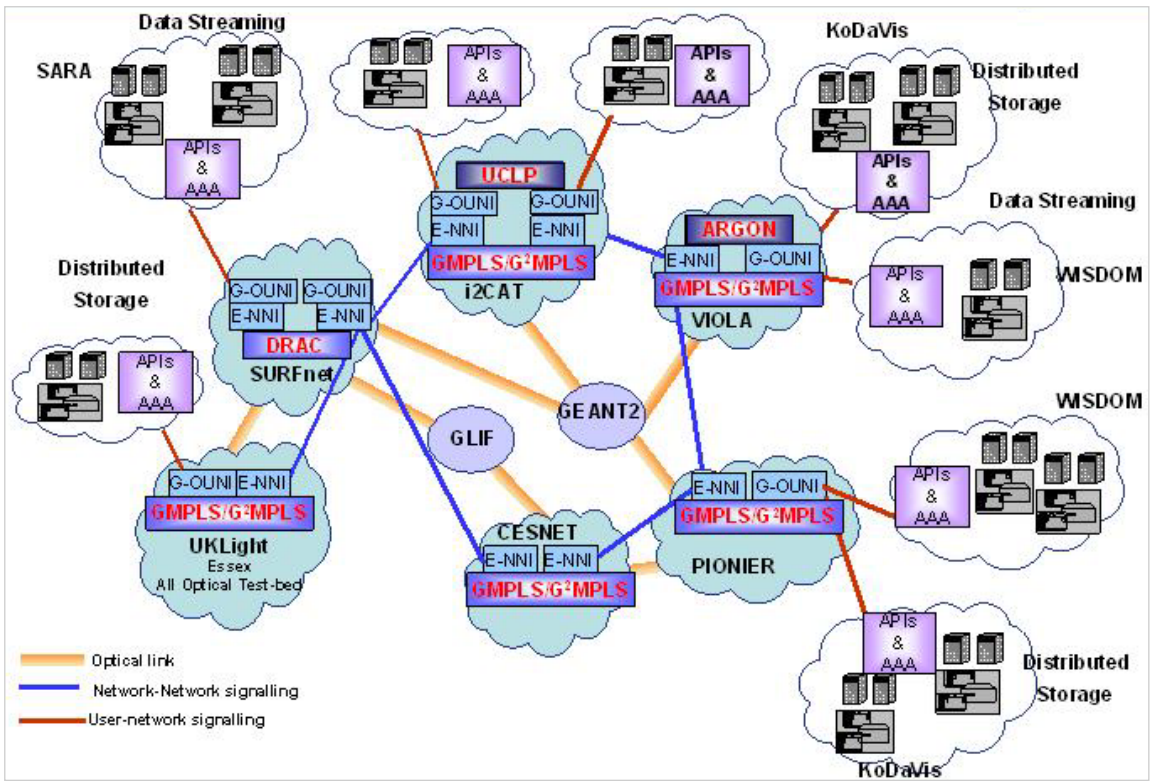
GLIF RAP: Applications

Phosphorus

Phosphorus: Lambda User Controlled Infrastructure For European Research

- European Union (EU) Research Networking Testbeds IST program
  - 30-month project, to begin October 2006
- An alliance of European and Global partners to develop advanced solutions of application-level middleware and underlying management and control plane technologies



- Project Vision and Mission
  - To address key technical challenges in enabling on-demand end-to-end network services across multiple domains
  - To treat the underlying network as a first-class Grid resource
  - To demonstrate solutions and functionalities across a testbed involving European NRENs, GÉANT2, Cross Border Dark Fibre and GLIF connectivity infrastructures

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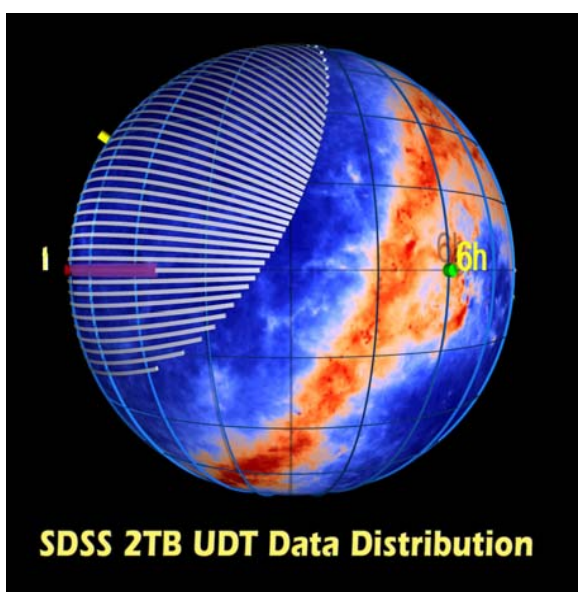
GLIF RAP: Applications

Sloan Digital Sky Survey

- **SDSS-I**
  - Imaged 1/4 of the Sky in Five Band passes
    - 8000 sq-degrees at 0.4 arc sec accuracy
  - Detecting Nearly 200 Million Celestial Objects
  - Measured Spectra Of:
    - > 675,000 galaxies
    - 90,000 quasars
    - 185,000 stars
- **SDSS-II**
  - Underway until 2008



- Johns Hopkins University, USA
- National Center for Data Mining (NCDM), University of Illinois at Chicago, USA
- University of California, San Diego
- NASA Goddard Space Flight Center; US
- Korea Astronomy and Space Science Institute, KISTI, Korea
- Institute for Cosmic Ray Research, University of Tokyo, Japan
- National Astronomical Observatory, Chinese Academy of Sciences, China
- University of Melbourne, Australia
- Max-Planck-Institut fur Plasmaphysik, Germany
- SARA, The Netherlands
- University of Amsterdam, Netherlands

www.sdss.org

RAP WG

GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites

- **Global Lambda Visualization Facility (GLVF)**
  - **Problem: Optical networks and LambdaGrids enable large-scale global science collaborations − but interoperable visualization and collaboration tools are missing!**
  - **Solution: Launched in September 2005, a group of iGrid 2005 Workshop participants who were designing and developing complementary, distributed visualization and collaboration technologies decided to pool expertise, build on each other's successes, and integrate their work into a coherent whole, providing a unique model for international partnerships.**

− Jason Leigh, Electronic Visualization Laboratory, University of Illinois at Chicago (organizer)

I think we need a more proactive commitment among all GLIF contributors to not only provide lambdas but also to support infrastructure (and funding or people) to build leading-edge applications OURSELVES. At the RAP, I suggest we try to identify one or two key application areas that we can deploy ourselves without waiting for domain scientists and try to get commitment of resources from all members of GLIF for those applications. − Bill St. Arnaud, CANARIE

www.evl.uic.edu/cavern/glvf

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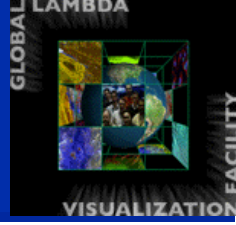
GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites



- **GLVF Goals**
  - to create de-facto international standards and integrated tools for real-time, interactive visualization and distance collaboration
  - to work with global domain science teams on the social science of collaboration, to both learn from and educate them on how to use these new technologies to transform the ways they do science
  - to train students and junior faculty, the next-generation workforce
- **Participants**
  - **Canada:** Simon Fraser University; University of Alberta; Communications Research Centre
  - **Japan:** Grid Technology Research Center, National Institute of Advanced Industrial Science and Technology (GTRC/AIST); Cybermedia Center, Osaka University
  - **Netherlands:** SARA Computing and Networking Services
  - **South Korea:** Networked Media Lab, Gwangju Institute of Science & Technology, GIST (GIST); Korea Institute of Science and Technology Information (KISTI)
  - **US:** Electronic Visualization Laboratory, University of Illinois at Chicago (UIC); National Center for Data Mining, UIC; Calit2 @ University of California, San Diego (UCSD); National Center for Microscopy and Imaging Research, UCSD; Scripps Institution of Oceanography, UCSD; International Center for Advanced Internet Research, Northwestern University; National Center for Supercomputing Applications (NCSA), University of Illinois at Urbana Champaign; NCSA-ACCESS; NCSA-TRECC; Envision Center, Purdue University; Collaboratory for Research on Electronic Work, University of Michigan; Earth Resources Observation Systems, US Geological Survey (USGS)
  - **Potential new partners from Brazil, China, Czech Republic, India, Mexico, Taiwan**

Underlined institutions may participate in SC|06 GLVF demonstration

www.evl.uic.edu/cavern/glvf/institutions.html

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glif

GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites

- **GLVF Visualization Technologies**

www.optiputer.net
www.evl.uic.edu/cavern/glvf

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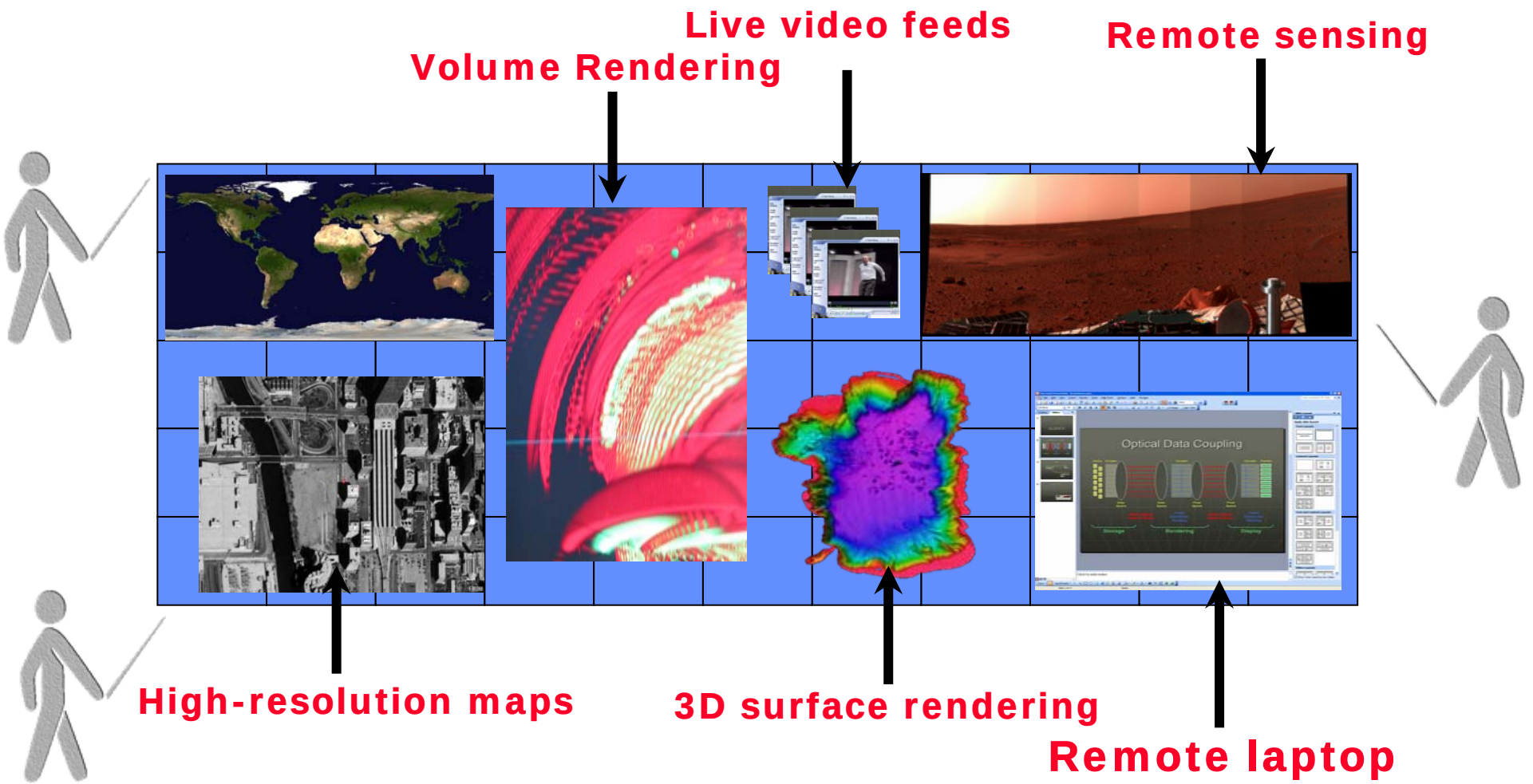
GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites

- **GLVF/OptIPuter SAGE Software Manages Multiple Applications**



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GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites

- **GLVF − SC|06 SAGE "Visual Casting" Proposed Experiment**

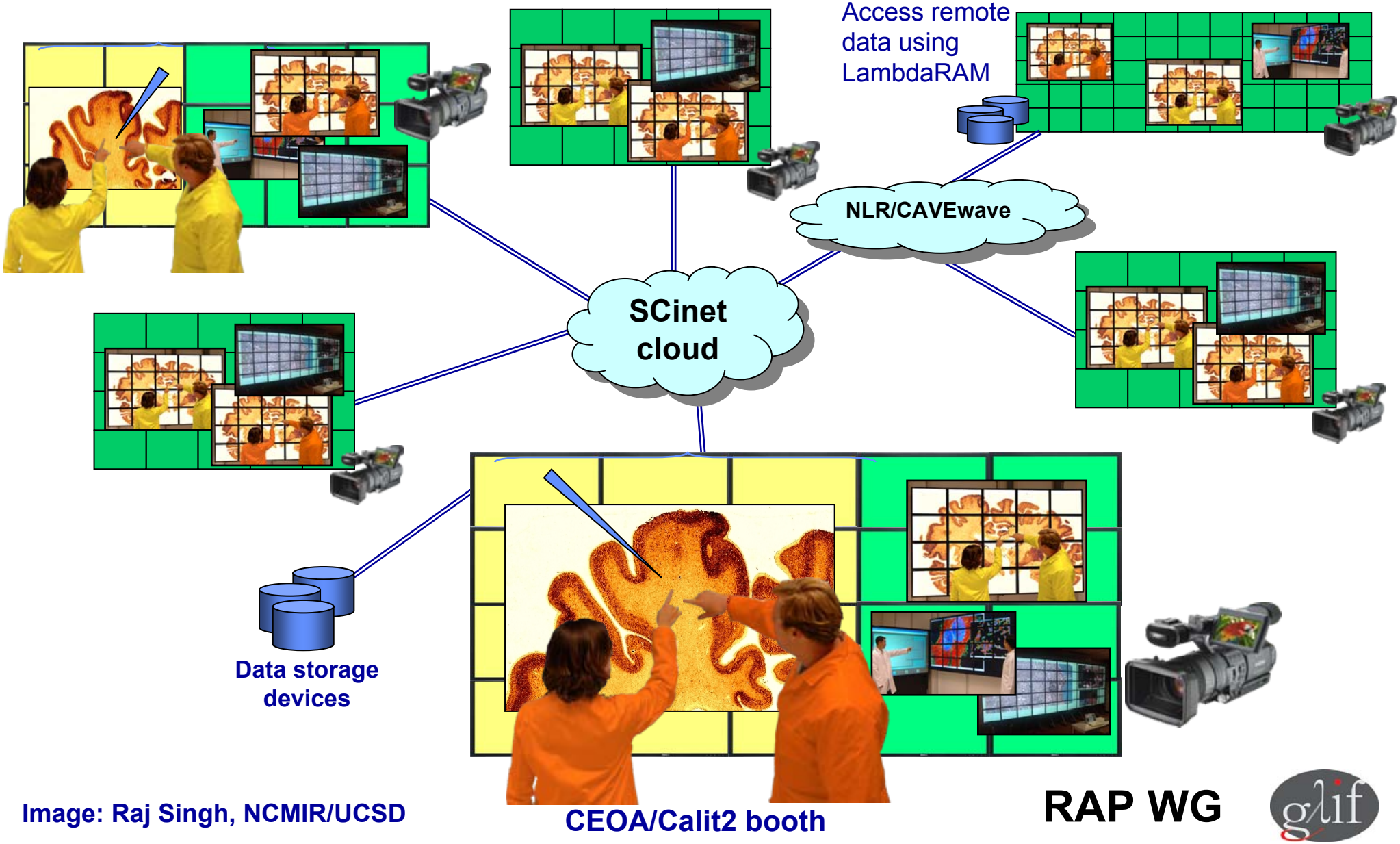

Image: Raj Singh, NCMIR/UCSD

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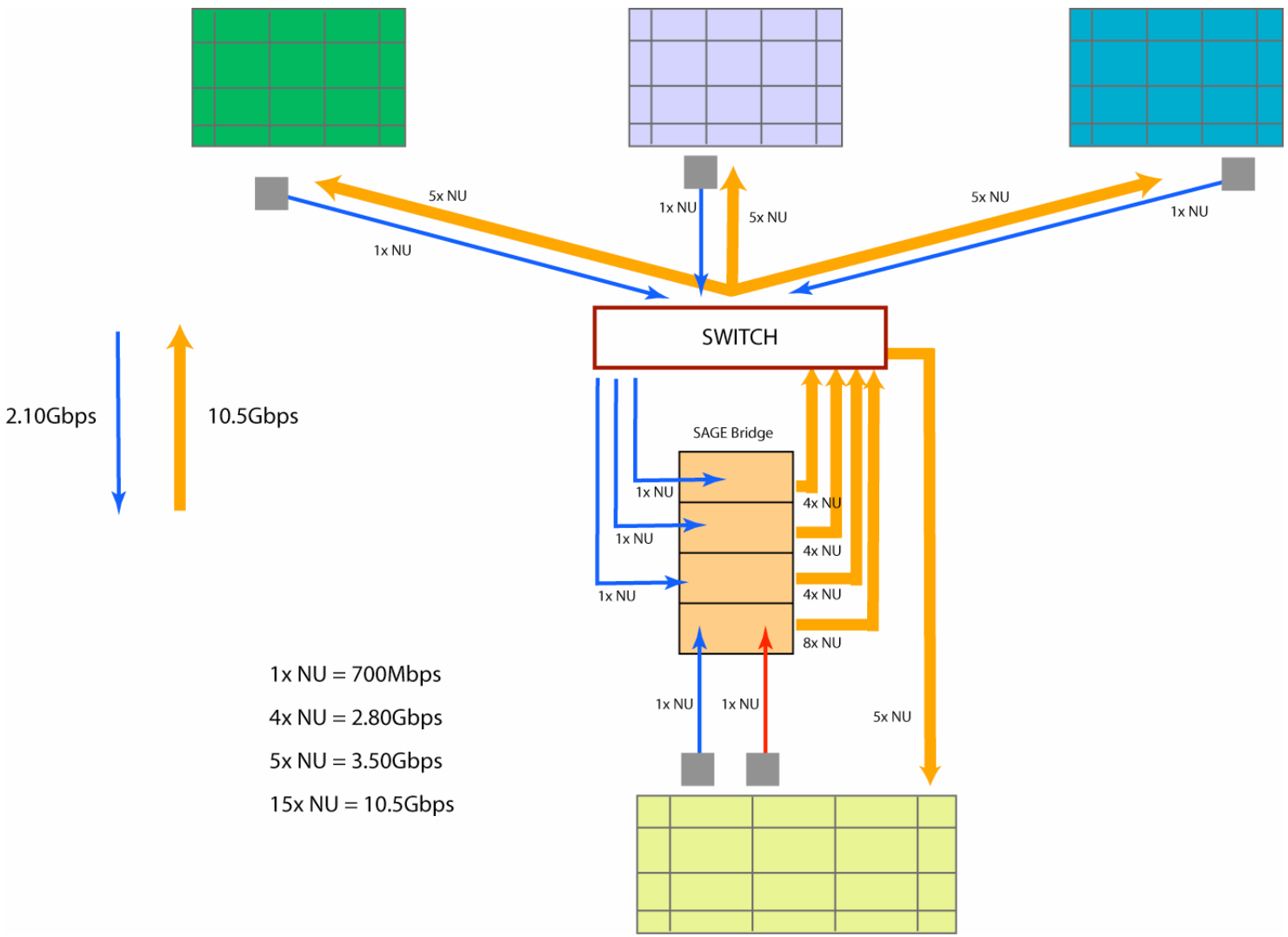
GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites

- **GLVF – SC|06 SAGE "Visual Casting" Proposed Experiment**



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GLIF RAP: Infrastructure

Live The Dream: Persistent Connectivity Among GLIF Sites

- **GLVF – SAGE Streams**

	Format	*Bandwidth*
HDV compressed	1080i/720p MPEG2	~ 30 Mbps
HDV uncompressed	1440x1080 RGB16	~ 700 Mbps
HDV video	1920x1080 RGB16	~ 1 Gbps
HD animation	1920x1080 RGB24	~ 1.4 Gbps
HD animation stereo	1920x1080 RGB24	~ 2.8 Gbps
SHD animation	3840x2160 RGB24	~ 5 to 6 Gbps

GLIF RAP: Research

Roadmaps

- **Optical Network Testbeds 2 Workshop, Sept 2005**

  The NASA/DOE ONT2 provided a forum for the US R&E advanced networking community and partner advanced networks and regional optical networks (RONs) to develop clear objectives, roadmaps and processes for transitioning its networking infrastructure to leading-edge next generation optical networks.

  - **US**
    - **Abilene/ Hybrid and Optical Packet Infrastructure Network (HOPI), CHEETAH, DRAGON, DREN/ Global Information Grid Evaluation Facility (GIG-EF), ESnet/ UltraScience Net, National Institutes of Health (NIH)/ National Library of Medicine, National Oceanic and Atmospheric Administration (NOAA), NASA Research and Engineering Network (NREN), National LambdaRail, North Carolina Research and Education Network and RONs, OMNInet, OptIPuter, United States Geological Survey (USGS)**
  - **CA*net4**
  - **GÉANT2**
  - **GLIF**
  - **GLORIAD**
  - **Japan Gigabit Network 2 (JGN2)**
  - **SURFnet and SURFnet6 Network Testbed**
  - **VIOLA (Germany)**
  - **Industry Optical Network Testbeds**
    - **Ciena, Cisco Systems, Glimmerglass, Infinera, Juniper, Level 3, Meriton, Movaz, Nortel, Obsidian Research, Qwest, WilTel**

www.nren.nasa.gov/workshop8/agenda.html
www.nren.nasa.gov/workshop8/pdf/ONT2_Report_Full.pdf (full report)

GLIF RAP: Research

Research Programs

- **US New Research Programs**
  - **NSF Global Environment for Networking Innovations (GENI) <www.geni.net>**
  - **NSF Petascale Computing Environment for Science and Engineering <www.nsf.gov/funding/pgm_summ.jsp?pims_id=13649&org=OCI>**
  - **DARPA Dynamic Multi-Terabit Core Optical Networks: Architecture, Protocols, Control and Management (CORONET) <www.darpa.mil/ato/solicit/CORONET/index.htm>**
- **Other?**

GLIF RAP: Research

Liaisons With Other Groups

- **Open Grid Forum (OGF) (formerly the Global Grid Forum)**
  - **Infrastructure Area Directors**
    - **Cees de Laat and Franco Travostino**
    - **Explore the interface between grid middleware and lower layer resources (including networks and network devices, computers, storage, visualization devices, instruments, and sensor technologies)**
    - **www.ggf.org/ggf_areas_infrastructure.htm**
  - **Advanced Collaborative Environments Research Group (ACE-RG), part of the Technology Innovators Area**
    - **Jason Leigh, Mike Papka and Rick Stevens, co-chairs**
    - **Complements GGF activities by providing human-centered techniques and technologies for facilitating interactive, collaborative, and immersive access of Grid resources from anywhere and at any time**
    - **https://forge.gridforum.org/projects/ace-rg**
- **PRAGMA**
  - **Steering Committee Member, Maxine Brown**
  - **www.pragma-grid.net**

GLIF RAP: Research

Analyzing Applications Requiring Lightpaths

- **SURFnet/GigaPort draft overview of determining applications that need dedicated lightpaths versus the routed internet cloud.**

	e-VLBI	LHC	DAS-3	DEISA	OptIPuter	SURFnet OPN	SCORE	LOFAR
Bandwidth	<1Gbps	<10Gbs	>10Gbps	<10Gbps	>10Gbps	<10Gbps	<1Gbps	>10Gbps
Topology	Global	Global	Within country	Global	Global	Global	Global	Global
Dynamics	Permanent	Permanent	<1 minute	Permanent	<1 day	Permanent	Permanent	Permanent
Internat'l	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Predictable Low Latency	No	No	Yes	No	Yes	Yes	Yes	Yes
Privacy	Yes	Yes	Yes	No	No	Yes	No	Yes
Security	No	No	Yes	No	No	Yes	No	Yes
Application Specific Needs	Yes	Yes	No	Yes	Yes	No	No	Yes

RAP WG

GLIF RAP: Publications

Papers, Presentations, Reports

- US/EU Workshop on Key Issues and Grand Challenges in Optical Networking, Brussels, Belgium, June 27-28, 2005
  - Sponsored by NSF (US) and ePHOTON/One, COST (EU)
  - Co-chairs Biswanath Mukherjee (US) and Fabio Neri (Italy)
  - Goals: to determine the future research needs and opportunities in optical networking and to explore and define methods to facilitate stronger research collaboration between US and EU researchers.
  - Workshop: http://networks.cs.ucdavis.edu/~mukherje/US-EU-wksp-June05.html
  - Report: http://networks.cs.ucdavis.edu/~mukherje/US-EU-wksp-June05/US-EU-wksp-June05-Final-Report.pdf
- Olivier H. Martin, "The Ongoing Evolution from Packet Based Networks to Hybrid Networks in Research & Education Networks," NEC 2005 conference proceedings
  - www.jinr.ru/NEC/NEC-2005/proceeding2005/Martin.doc
  - www.ictconsulting.ch/reports/NEC2005.doc

GLIF RAP: Education & Outreach

Educational Programs

- **Enlighten Your Research, The Netherlands**

  http://lichtpad.surfnet.nl

  - **Contest for Dutch university and institute researchers who want to use lightpaths in their research**
  - **Winners receive a research budget of 20,000 Euros and a dedicated lightpath to their campus laboratory**
  - **Contact: Kees Neggers, SURFnet**

- **Cyberbridges, US**

  - **Bridges the divide between the Information Technology communities and the science disciplines by presenting students with an avenue where they can explore applications of Cyberinfrastructure within their domains**
  - **Global Cyberbridges recently funded by NSF**
  - **Contact: Heidi Alvarez, FIU, US**
  - **www.cyberbridges.net**

GLIF RAP: Education & Outreach

Educational Programs

- **PRAGMA (Pacific Rim Applications and Grid Middleware Assembly)**
  www.pragma-grid.net
  - **Pacific Rim organization enabling institutions to more formally collaborate on grid-enabled applications and deploy the necessary infrastructure to enable data, computing, and other resource sharing.**
  - **Contact: Peter Arzberger, Calit2/UCSD, US**
- **PRIUS (Pacific Rim International UniverSity), Japan**
  http://prius.ics.es.osaka-u.ac.jp/en/
  - **An educational program to nurture students and provide them with leadership skills to advance 21st century science and technology from a global perspective**
  - **Contact: Susumu Date, Osaka University, Japan**

Thank You!

http://www.glif.is/working-groups/rap/

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