GLOBAL cyberbridges

BRIDGING THE DIVIDE BETWEEN THE INFORMATION TECHNOLOGY AND SCIENCE COMMUNITIES

Workshop 03A - Global CyberBridges: A Model Global Collaboration Infrastructure for E-Science Between the United States and International Partners

Educause Learning Initiative (ELI) Annual Meeting—Orlando, FL

Date: January 20, 2009

FIU

CIARA

NSF

NSF AWARD N°. 0537464

Presentation Agenda

- GCB Program Overview
- U.S. & Global Research & Education Networks Program Support
- AMPATH International Exchange Point in Miami
- General Applications
- GCB Research Projects & Publications
- Collaborative Tools; Learning EVO
- Conclusion

Who's Who?

- Investigators

  -Heidi Alvarez, PI, Director of the Center for Internet Augmented Research and Assessment (CIARA) at FIU

  - Tom DeFanti, Co-PI (Calit2 at UCSD)

  -Julio Ibarra, Co-PI, Executive Director of CIARA

  -Kuldeep Kumar, Co-PI, Professor

  -S. Masoud Sadjadi, Co-PI, Assistant Professor of SCIS

External Assessment Committee

- **Paul Avery**, Professor of Physics, University of Florida
- **Hugh Gladwin**, Director of the Institute for Public Opinion Research
- **Thomas Greene**, Senior Research Fellow / Director of the Computer Science & Artificial Intelligence Laboratory (CSAIL) at MIT
- **Jane Klobus**, Professor and Senior Research Fellow, Dondena Centre for Social Research, Bocconi University, Milan, Italy & Professorial Fellow, Graduate School of Management, University of Western Australia

What is Global CyberBridges?

- **Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM)**
  - National Science Foundation Program Solicitation
  - http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf06548&org=NSF
- Three year award (Oct. 2006 - Dec. 2009) for $765,000 total to CIARA at FIU
- The program expands on CyberBridges, which was initiated in 2005 to help FIU scientists and engineers advance their research through cyberinfrastructure (CI).

Global CyberBridges Benefits

- Brings together graduate students & faculty from various disciplines
- Offers greater understanding of R&E CI
- Increases opportunity for cross-disciplinary R&E
- Increases scientists' rate of discovery
- Creates a CI empowered workforce.
- Research fellowship stipend of $5,000 total for Spring / Summer 2009
  - May be combined with other tuition waivers & stipends
  - May be split between 2 fellows working on a research project together

Activities Are on a Yearly Cycle; For Example

- 1st Semester: Feb. to May 2009
  - Participating in initial interviews
  - Attending the GCB training
  - Learning about HPC and how to use it
  - Team building
    - Brainstorming and planning for the project with your team
    - Weekly group meeting (EVO or Skype for video conferencing)
  - Preparing a lecture and delivering it in the class
- 2nd Semester: June to Nov. 2009
  - Working on the project
  - Running experiments
  - Attending weekly meetings
  - Writing a technical paper targeted to a conference
  - Participating in final interviews

Outcomes & Evaluation

- A new generation of scientists & engineers
  - Capable of fully integrating CI into the whole educational, professional, and creative process of their diverse disciplines.
- Short Term Outcome Measurement:
  - Proposed and realized timeline for implementing the activities
- Longer term Outcome Measurements:
  - Publication, presentation, and other metrics determined by the outside experts to be appropriate for the research activities

Fellowship Requirements Year 3 of 3

- Course begins in Spring 2009 at end of February
  - Advanced Networking
  - Grids/Distributed Computing
  - Virtual Teams
  - Scalable Adaptive Graphics Environment (SAGE)
- Course Continues through Summer 2009
  - Students and faculty will collaborate on a paper based on the research
  - Research results to be published & presented at a conference
  - Student's travel expenses covered
- Attendance at major conference in Fall 09 or Spring 10
  - Usually SuperComputing to present research findings

Fellowship Qualifications

- Candidates must be on a research path that can be augmented by CI
- Open to graduate students in science or engineering
  - PhD students preferred
- Some programming background desired
  - C or C++ preferred, JAVA or Fortran OK

How to Apply

- Submit a 1 page proposal
  - Describe a problem in your area of research
  - Provide a hypothesis on how the use of CI would benefit the research process.
- Attach a one-page bio/CV
  - Show any networking, grid, or related CI experience
- Submit all documents to info@cyberbridges.net
  - Faculty advisor must indicate support via letter of support
- Due by **November 14th, 2008**
- Selection announced by **December 1st, 2008**

Projects in 2006

- Unsupervised Pattern Discovery in Protein Structures
  - Computer Science & Bioinformatics
- Modeling Biological Tissue Scaffolds in Three Dimensions
  - Biomedical Engineering
- Interplay between Random Matrix Theory and Quantum Field
  - Physics
- Functionalities of a specific enzyme for certain reactions
  - Chemistry/Biochemistry

Projects in 2007

- Grid Enablement of Hurricane Simulation Application
  - Earth Sciences
- On Demand Weather Forecast Visualization via Efficient Resource Utilization in Grid Computing
  - Visualization
- Computational Modeling & Simulation of Biodegradable Starch based polymer composites
  - Computational Chemistry
- Collaboration Platform
  - e-Science and e-Society

Projects in 2008

- The Development of Collaborative Platform Based on SAGE
  - Computer Science - Visualization
- Innovative Grid-Enable Multiple-Scale Hurricane Modeling System
  - Earth Sciences
- Finding Repeat Structures in Genomic Sequences
  - Computer Science – Bioinformatics
- A Distributed Multimedia Data Management over the Grid
  - Computer Science – Multimedia

Publications

1. Selim Kalayci, Onyeka Ezenwoye, Balaji Viswanathan, Gargi Dasgupta, S. Masoud Sadjadi, and Liana Fong. Design and implementation of a fault tolerant job flow manager using job flow patterns and recovery policies. In *Proceedings of the 6th International Conference on Service Oriented Computing (ICSOC'08)*, Sydney, Australia, December 2008. Accepted for publication (acceptance rate 20.4%).
2. Hector A. Duran Limon, S. Masoud Sadjadi, *et al.* **Grid enablement and resource usage prediction of weather research and forecasting.** In *Proceedings of the Collaborative and Grid Computing Technologies Workshop*, Cancun, Mexico, April 2008.
3. Gargi Dasgupta1, Onyeka Ezenwoye, Liana Fong, Selim Kalayci, S. Masoud Sadjadi, and Balaji Viswanathan. **Design of a fault-tolerant job-flow manager for grid environments using standard technologies, job-flow patterns, and a transparent proxy.** In *Proceedings of the 20th International Conference on Software Engineering and Knowledge Engineering (SEKE'2008)*, San Francisco Bay, USA, July 2008.
4. Chi Zhang, Bin Liu, Xun Su, Heidi Alvarez, and Julio Ibarra. **Integrating heterogeneous network monitoring data.** In *Telecommunication Systems*, February, 2008, DOI 10.1007/s11235-008-9073-5.
5. Khalid Saleem, S. Masoud Sadjadi, and Shu-Ching Chen. **Towards a self-configurable weather research and forecasting system.** In *Proceedings of the 5th IEEE International Conference on Autonomic Computing (ICAC-2008)*, Chicago, IL, June 2008. (38% acceptance rate).
6. Yanbin Liu, S. Masoud Sadjadi, Liana Fong, Ivan Rodero, David Villegas, Selim Kalayci, Norman Bobroff, and Juan Carlos Martinez. **Enabling autonomic meta-scheduling in grid environments.** In *Proceedings of the 5th IEEE International Conference on Autonomic Computing (ICAC-2008)*, Chicago, IL, June 2008. (38% acceptance rate).
7. Gargi Dasgupta, Onyeka Ezenwoye, Liana Fong, Selim Kalayci, S. Masoud Sadjadi, and Balaji Viswanathan. **Runtime fault-handling for job-flow management in grid environments.** In *Proceedings of the 5th IEEE International Conference on Autonomic Computing (ICAC-2008)*, Chicago, IL, June 2008. (38% acceptance rate).
8. Norman Bobroff, Liana Fong, Selim Kalayci, Yanbin Liu, Juan Carlos Martinez, Ivan Rodero, S. Masoud Sadjadi, and David Villegas. **Enabling interoperability among meta-schedulers.** In *Proceedings of 8th IEEE International Symposium on Cluster Computing and the Grid (CCGrid-2008)*, Lyon, France, 2008.

Publications

9. S. Masoud Sadjadi, Shu Shimizu, Javier Figueroa, Raju Rangaswami, Javier Delgado, Hector Duran, and Xabriel Collazo. **A modeling approach for estimating execution time of long-running scientific applications.** In *Proceedings of the 22nd IEEE International Parallel & Distributed Processing Symposium (IPDPS-2008), the Fifth High-Performance Grid Computing Workshop (HPGC-2008),* Miami, Florida, April 2008.
10. S. Masoud Sadjadi, Liana Fong, Rosa M. Badia, Javier Figueroa, Javier Delgado, Xabriel J. Collazo-Mojica, Khalid Saleem, Raju Rangaswami, Shu Shimizu, Hector A. Duran Limon, Pat Welsh, Sandeep Pattnaik, Anthony Praino, David Villegas, Selim Kalayci, Gargi Dasgupta, Onyeka Ezenwoye, Juan Carlos Martinez, Ivan Rodero, Shuyi Chen, Javier MuÃ±oz, Diego Lopez, Julita Corbalan, Hugh Willoughby, Michael McFail, Christine Lisetti, and Malek Adjouadi. **Transparent grid enablement of weather research and forecasting.** In *Proceedings of the Mardi Gras Conference 2008 - Workshop on Grid-Enabling Applications,* Baton Rouge, Louisiana, USA, January 2008.
11. S. Masoud Sadjadi, Selim Kalayci, and Yi Deng. **A self-configuring communication virtual machine.** In *Proceedings of the 2008 IEEE International Conference on Networking, Sensing and Control (ICNSC-08),* Sanya, China, April 2008. (accepted for publication.).
12. Xing Hang, David Villegas Castillo, S. Masoud Sadjadi, and Heidi Alvarez. **Formative assessment of the effectiveness of collaboration in gcb.** In *Proceedings of the International Conference on Information Society (i-Society 2007),* Merrillville, Indiana, USA, October 2007.
13. Heidi L. Alvarez, David Chatfield, Donald A. Cox, Eric Crumpler, Cassian Dâ€™Cunha, Ronald Gutierrez, Julio Ibarra, Eric Johnson, Kuldeep Kumar, Tom Milledge, Giri Narasimhan, Rajamani S. Narayanan, Alejandro de la Puente, S. Masoud Sadjadi, and Chi Zhang. **Cyberbridges: A model collaboration infrastructure for e-Science.** In *Proceedings of the 7th IEEE International Symposium on Cluster Computing and the Grid (CCGrid'07),* Rio de Janeiro, Brazil, May 2007. (acceptance rate 33.5%).
14. S. Masoud Sadjadi, Javier MuÃ±oz, Diego Lopez, Javier Figueroa, Xabriel J. Collazo-Mojica, Alex Orta, Michael McFailand, David Villegas, Rosa Badia, Pat Welsh, Raju Rangaswami, Shu Shimizu, and Hector A. Duran Limon. **Transparent grid enablement of WRF using a profiling, code inspection, and modeling approach.** In *Poster Presented in the 5th Latin American Grid (LA Grid) Summit,* The IBM T.J. Watson Research Center, NY, U.S.A., September 2007.

Publications

15. S. Masoud Sadjadi, Steve Luis, Khalid Saleem, Donald Llopis, Javier Munoz, Diego Lopez, Javier Figueroa, David Villegas Castillo, Selim Kalayci, Pat Welsh, Shu-Ching Chen, Anthony Praino, and Hugh Willoughby. **The latin american (la) grid weather research and forecast (WRF) portal.** In *Poster Presented in the 5th Latin American Grid (LA Grid) Summit,* The IBM T.J. Watson Research Center, NY, U.S.A., September 2007.
16. Liana Fong, S. Masoud Sadjadi, Yanbin Liu, Ivan Rodero, David Villegas, Selim Kalayci, Norman Bobrof, and Julita Corbalan. **The LA Grid meta-scheduling project.** In *Poster Presented in the 5th Latin American Grid (LA Grid) Summit,* The IBM T.J. Watson Research Center, NY, U.S.A., September 2007.
17. Gargi B Dasgupta, Liana Fong, S. Masoud Sadjadi, Onyeka Ezenwoye, Balaji Viswanathan, Selim Kalayci, David Villegas Castillo, and Norman Bobroff. **Fault-tolerant job-flow management in grid environment.** In *Poster Presented in the 5th Latin American Grid (LA Grid) Summit,* The IBM T.J. Watson Research Center, NY, U.S.A., September 2007.
18. S. Masoud Sadjadi, David Villegas, Javier Munoz, Diego Lopez, Alex Orta, Michael McFail, Xabriel J. Collazo-Mojica, and Javier Figueroa. **Finding an appropriate profiler for the weather research and forecasting code.** *Technical Report FIU-SCIS-2007-09-03,* School of Computing and Information Sciences, Florida International University, 11200 SW 8th St., Miami, FL 33199, August 2007.
19. S. Masoud Sadjadi, Javier Munoz, Diego Lopez, David Villegas, Javier Figueroa, Xabriel J. Collazo-Mojica, Michael McFail, and Alex Orta. **Weather research and forecasting model 2.2 documentation: A step-by-step guide of a model run.** *Technical Report FIU-SCIS-2007-09-02,* School of Computing and Information Sciences, Florida International University, 11200 SW 8th St., Miami, FL 33199, August 2007.
20. Onyeka Ezenwoye, S. Masoud Sadjadi, Ariel Carey, and Michael Robinson. **Grid service composition in bpel for scientific applications.** In *Proceedings of the International Conference on Grid computing, high-performAnce and Distributed Applications (GADA'07),* Vilamoura, Algarve, Portugal, November 2007. (accepted for publication.).

Research & Education Networks Overview

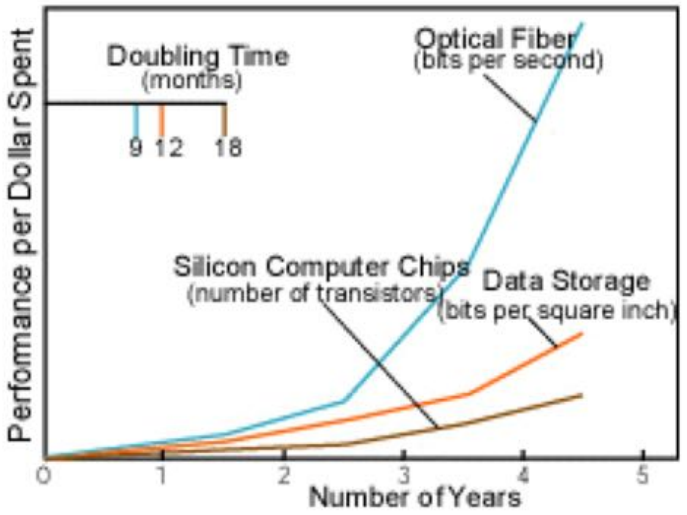
- What are Research and Education Networks and why?
- What relevance do they have to developing Global CyberBridges?
- How are they created and where do they exist?

What are National Research and Education Networks (NRENs)?

- Interconnect a country's higher education institutions
  - and often government research institutions, primary and secondary schools, libraries, hospitals, museums, other public institutions
- Provide a dedicated network
  - Separate from the commercial Internet
  - With dedicated connections to other countries' NRENs

Factors motivating High Performance Networks

- Network vs. computer performance
  - Computer speed doubles every 18 months
  - Network speed doubles every 9 months
  - Difference = order of magnitude per 5 years
- 1986 to 2000
  - Computers: x 500
  - Networks: x 340,000
- 2001 to 2010
  - Computers: x 60
  - Networks: x 40,800

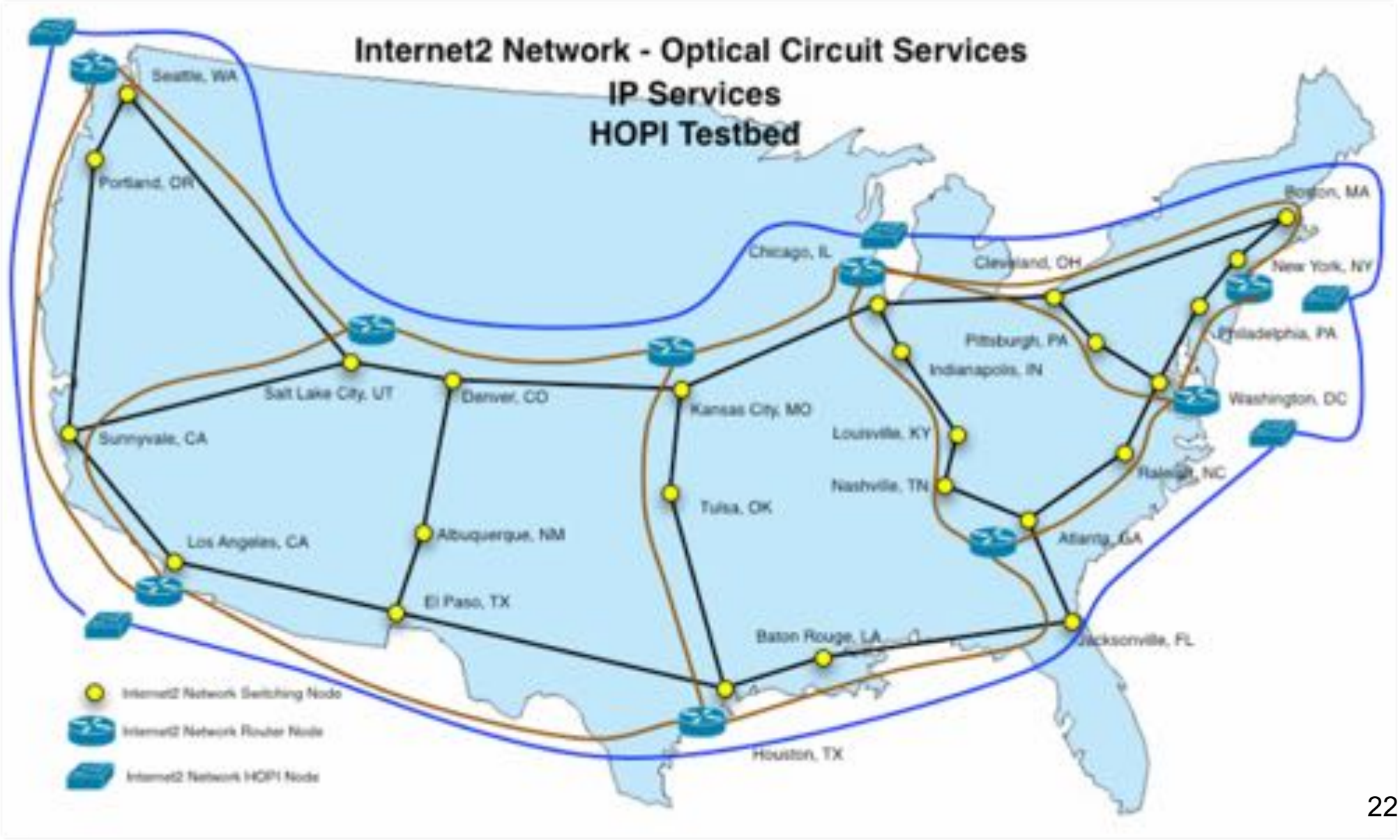


Moore's Law vs. storage improvements vs. optical improvements. Graph from Scientific American (Jan-2001) by Cleo Vilett, source Vined Khoslan, Kleiner, Caufield and Perkins.

Adapted from Shawn McKee U of Michigan

National Lambda Rail

Internet2 Network



International Research & Education Network connections

- The NSF IRNC program provides network connections linking U.S. research networks with peer networks in other parts of the world to support science and engineering research and education applications
- Awards:
  - TransPAC2 (U.S. - Japan and beyond)
  - GLORIAD (U.S. - China, Russia, Korea)
  - Translight/PacificWave (U.S. - Australia)
  - TransLight/StarLight (U.S. - Europe)
  - WHREN-LILA (U.S. - Latin America)
- The GLIF map shows links and networks that offer their bandwidth capacity for use by international research communities for applications-driven and computer-system experiments
- http://www.glif.is

WHREN-LILA

- 5-year NSF Cooperative Agreement
  - Florida International University (IRNC awardee)
  - Corporation for Education Network Initiatives in California (CENIC)
  - Project support from the Academic Network of Sao Paulo (award #2003/13708-0)
  - CLARA, Latin America
  - CUDI, Mexico
  - RNP, Brazil
  - REUNA, Chile
- Links Interconnecting Latin America (LILA) aims to Improve connectivity in the Americas through the establishment of new inter-regional links
- Western-Hemisphere Research and Education Networks (WHREN) serves as a coordinating body whose aim is to leverage participants' network resources to foster collaborative research and advance education throughout the Western Hemisphere

Sharing scarce educational, research resources.
Access to scientific instruments for research, teaching and learning

Expensive resources can be shared between institutions, across distance

- Laboratory instruments
- Computers
- Databases
- Library materials

Why not the commercial Internet?

- Access to the commercial Internet for education and research institutions is important
  - NRENs can pool demand, provide access to the commercial Internet at 'bulk buy' rates
- Commercial Internet goal is to make money
  - Serve many with common-denominator capabilities
  - Optimize capacity for profit
- NRENs who control and build their own network:
  - Optimize capacity (bandwidth utilization), topology (latency), services for needs of research, teaching, learning
  - Deploy capabilities the commercial Internet hasn't yet deployed or isn't interested in deploying

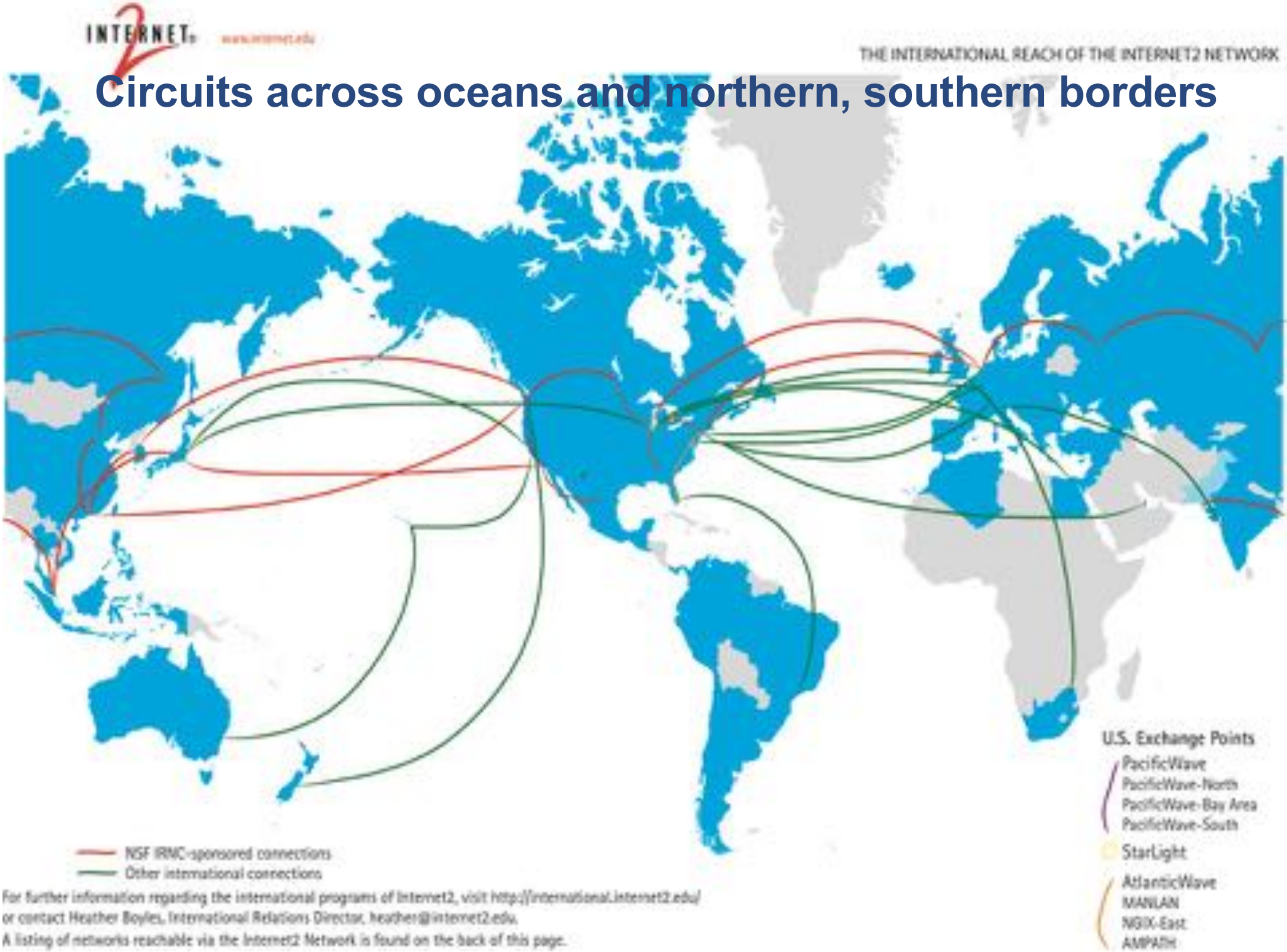
International Connectivity Pieces

1. US-based international exchange points
2. Circuits across oceans and northern, southern borders
3. Infrastructure within other countries, regions
   - Transit across partner networks

US-based international exchange points

- Based around “coasts” of US
- Typically run by members of Internet2 community
- Provide fabric for interconnecting R&E networks with presence in those geographic areas
- StarLight, PacificWave, MAN LAN, **AMPATH**, AtlanticWave

Circuits across oceans and northern, southern borders



Infrastructure within other countries, regions

- NRENs around the world
  - Pre-existed Internet2
  - Continuing to grow in number
- Regional (continental-scale) connectivity between NRENs

How are NRENs being used today?

- Astronomy
- Bio-sciences
- High Energy and Nuclear Physics
- Earth observation, environment
- Health Sciences
- Veterinary Medicine
- Surgery and clinical care
- Humanities
- Arts Performance

- Distributed computation
- Virtual laboratories
- Digital libraries
- Distributed learning
- Interactive digital video and audio
- Remote instrument access and manipulation
- Tele-immersion
- All of the above in combination

INTERNET2 NETWORK INTERNATIONAL REACH

AMERICAS
Argentina (RETINA)
Brazil (RNP2/ANSP)
Canada (CA*net)
Chile (REUNA)
Colombia (RENATA)
Costa Rica (CR2Net)
Ecuador (CEDIA)
El Salvador (RAICES)
Guatemala (RAGIE)
Mexico (Red-CUDI)
Panama (RedCyT)
Peru (RAAP)
Uruguay (RAU2)
Venezuela (REACCIUN2)

EUROPE and MIDDLE EAST
Albania (ASA/INIMA)
Austria (ACOnet)
Belgium (BELNET)
Bosnia-Herzegovina (BIHARNET)
Bulgaria (ISTF)
Croatia (CARNet)
Cyprus (CYNET)
Czech Republic (CESNET)
Denmark (Forskningsnettet)
Estonia (EENet)
Finland (Funet)
France (Renater)
Germany (G-WIN)

EUROPE and MIDDLE EAST cont'd
Greece (GRNET)
Hungary (HUNGARNET)
Iceland (RHnet)
Ireland (HEAnet)
Israel (IUCC)
Italy (GARR)
Jordan (JUNET)
Latvia (LATNET)
Lithuania (LITNET)
Luxembourg (RESTENA)
Macedonia (MARNET)
Malta (Univ. Malta)
Netherlands (SURFnet)
Norway (UNINETT)
Palestinian Territories (Gov't Computing Center)
Poland (PIONIER)
Portugal (RCTS2)
Qatar (Qatar FN)
Romania (RoEduNet)
Serbia-Montenegro (AMREJ, UoM/MREN)
Slovakia (SANET)
Slovenia (ARNES)
Spain (redIRIS)
Sweden (SUNET)
Switzerland (SWITCH)
Syria (HIAST)
Ukraine (URAN)
United Kingdom (JANET)
Turkey (ULAKBYM)

ASIA and PACIFIC
Australia (AARNET)
China (CERNET,CSTNET,NSFCNET)
Fiji (USP-SUVA)
Hong Kong (HARNET)
India (ERNET)
Indonesia (ITB)
Japan (SINET, WIDE, JGN2)
Korea (KOREN, KREONET2)
Malaysia (MYREN)
New Zealand (KAREN)
Philippines (PREGINET)
Russia (RBnet, RUNNET)
Singapore (SingAREN)
Taiwan (TANet2, ASNet)
Thailand (UNINET, ThaiSARN)
Vietnam (VINAREN)

MULTINATIONAL NETWORKS
APAN
GEANT2
redCLARA

AFRICA
Algeria (CERIST)
Egypt (EUN/ENSTINET)
Morocco (CNRST)
South Africa (TENET)
Tunisia (RFR)

CENTRAL ASIA
Armenia (ARENA)
Georgia (GRENA)
Kazakhstan (KAZRENA)
Tajikistan (TARENA)
Uzbekistan (UZSCI)

GLOBAL cyberbridges

...MATION TECHNOLOGY AND SCIENCE COMMUNITIES

AMPATH™
INTERNATIONAL EXCHANGE POINT IN MIAMI

Operated by the Center for Internet Augmented Research and Assessment (CIARA) at Florida International University Miami, FL U.S.A

Julio Ibarra, AMPATH Principal Investigator / CIARA Exec. Director

Heidi Alvarez, Director CIARA

Chip Cox, AMPATH Chief Operating Officer

NSF

FIU
FLORIDA INTERNATIONAL UNIVERSITY
Miami's public research university

CIARA
research • collaboration • scholarship

SAO PAULO, BRAZIL, CNIC OF CAS CHINA, CITY U HONG KONG

GLOBAL cyberbridges

BRIDGING THE DIVIDE BETWEEN THE INFORMATION TECHNOLOGY AND SCIENCE COMMUNITIES

CIARA was created in 2003 as a State of Florida Type II Research Center at FIU. CIARA services institutional collaborators in the U.S. and internationally as a bridge linking researchers and educators with the infrastructure and knowledge they need to perform their work.

CIARA

research • collaboration • scholarship

AMPATH

PATHWAY OF THE AMERICAS

WHREN

Western Hemisphere Research & Education Networks

LILA

CHEPREO

CENTER FOR HIGH ENERGY PHYSICS RESEARCH & EDUCATION OUTREACH

SAO PAULO, BRAZIL; CNIC OF CAS CHINA; CITY U HONG KONG

GLOBAL cyberbridges

AMPATH International Exchange Point

- AMPATH provides Global CyberBridges fellows and faculty with connectivity to R&E computational grid resources at institutions and laboratories around the world
- Connectors are U.S. and international research and education networks
- Located at the NAP of the Americas in Miami
- Ethernet and ATM peering fabrics
- Connection types are
  - 100 Mbps, 1 Gbps and 10Gbps Ethernet
  - 45 Mbps, 155 Mbps and 622 Mbps ATM
  - 155 Mbps, 622 Mbps 2.5 and 10 Gbps SDH
- http://www.ampath.net for more information

AMPATH™
PATHWAY OF THE AMERICAS

Western Hemisphere Research and Education Network – Links Interconnecting Latin America

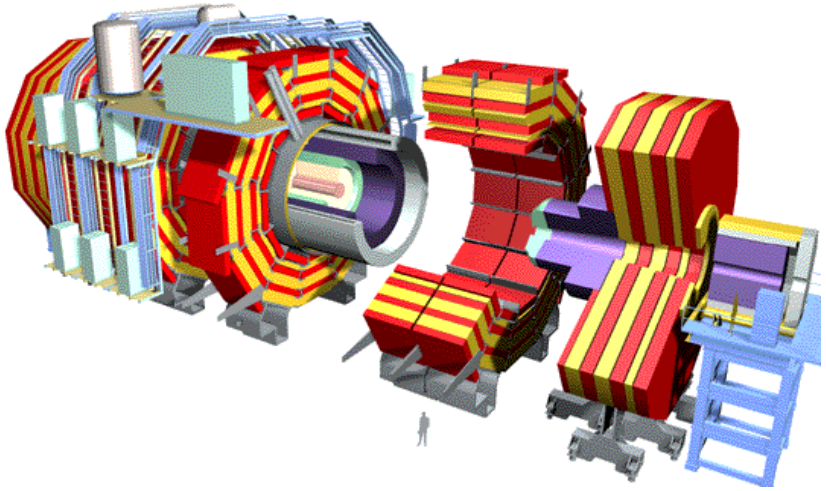
- 2.5Gbps circuit + dark fiber segment
- U.S. landings in Miami and San Diego
- Latin America landing in Sao Paulo, Tijuana and Miami
- Interregional links improve connectivity in the Americas
- Fosters collaborative research and advance education throughout the Western Hemisphere

GCB Course: Grid Enablement of Scientific Applications

- Dr. S. Masoud Sadjadi, Computer Science
- Time of class must be coordinated with Chinese and Brazilian collaborators
- May be early in the morning (7:30 – 10 am) TBD
- Details on the course curriculum will be presented by Dr. Sadjadi
- e-Science applications slides follow…

CHEPREO
CENTER FOR HIGH ENERGY PHYSICS RESEARCH & EDUCATION OUTREACH

http://www.chepreo.org

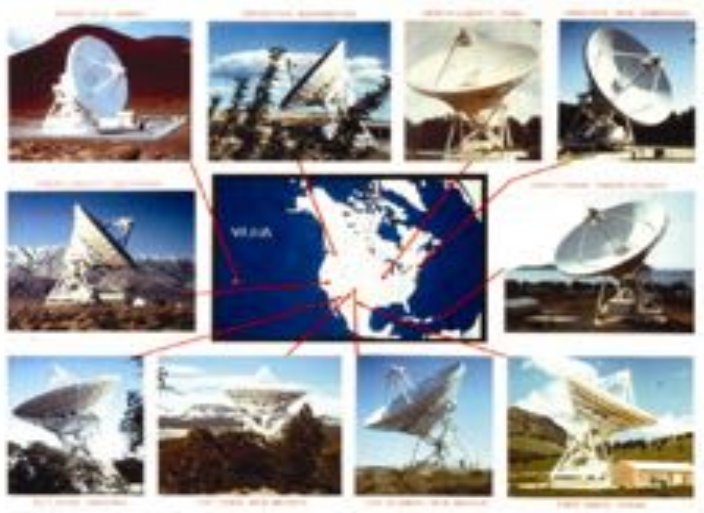


An integrated program of research, network infrastructure development, and education and outreach at one of the largest minority schools in the US

- Supports Brazil's and South America's access to Tier2s and Tier1s in the U.S. and to CERN
- Collaboration with Florida State University (FSU), the University of Florida (UF), the California Institute of Technology (Caltech)
- Leverages IRNC WHREN-LILA infrastructure to support data-intensive science from High-Energy Physics and Astronomy communities
- Collaborations with Open Science Grid, GridUNESP, Kyatera, UltraLight and others to enable data intensive science in the western hemisphere

Electronic Very-Long-Baseline Interferometry (eVLBI)

- Astronomers collect data about a star from many different earth based antennae and send the data to a specialized computer for analysis on a 24x7 basis.
  - Previously via tape and truck
  - Limited number of 'campaigns' per year
  - Network may fundamentally change the science



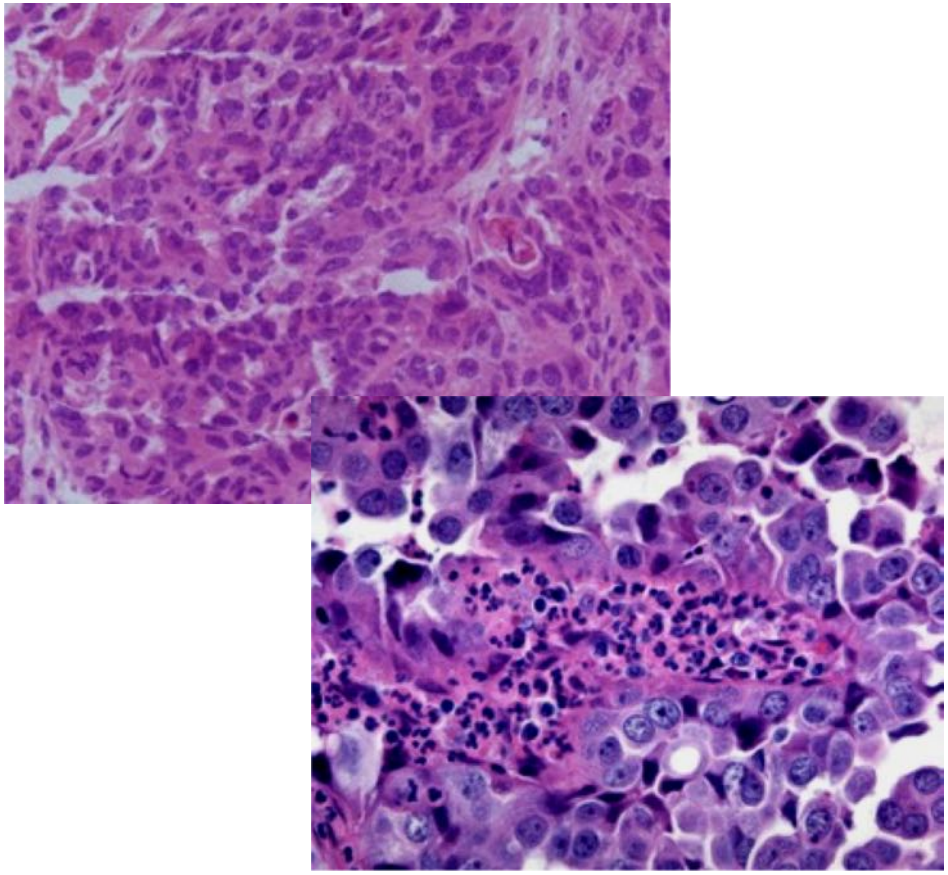
3D Brain Map

- Provides insight into brain functions in real time
  - Very large multi-dimensional, multi-modal, time-varying data sets
- Patient, supercomputer and doctor do not need to be in the same location– all data is transferred over the network:
- Real time visualization will aid in surgical planning and disease diagnosis

Showcases:

- Real-time data gathering and dynamic visualization
- GRID technologies
- End to end performance optimizations
- Dynamic visualization

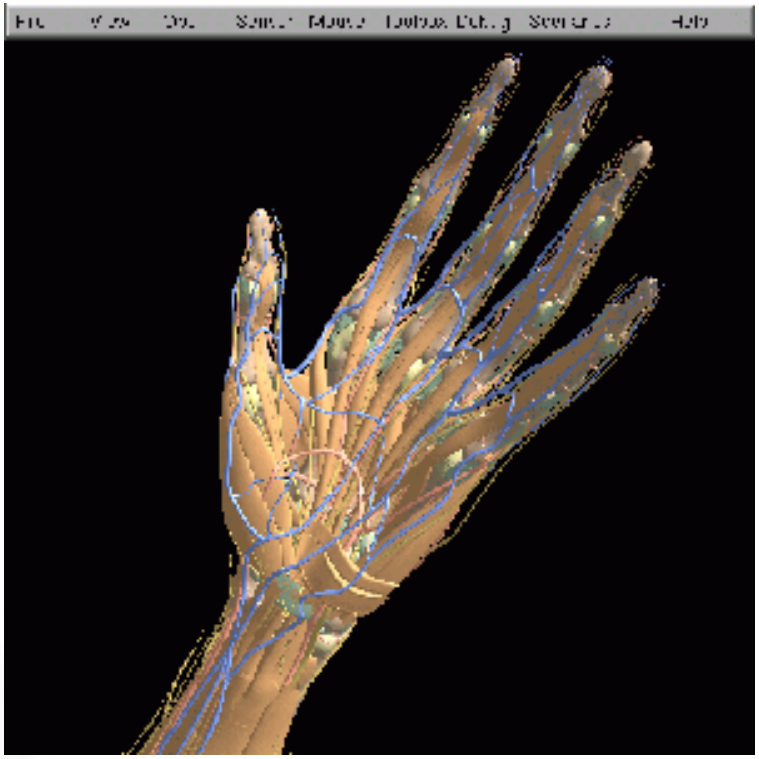
Real-time collaboration between students, teachers, researchers, clinicians



- Beyond video-conferencing: pathologists share images in real-time requires high-quality images

Orthopedic Surgery

- International Society of Orthopaedic Surgery and Traumatology (SICOT)
- California Orthopaedic Research Network (CORN)
  - USC, Stanford, UCLA, UC San Diego, and CENIC's CalREN
- Live surgery over Internet2
  - Education of medical school students
  - Interactive 3-D virtual reality imagery



Music Master Classes

- Catering to the needs of musicians
  - High fidelity video and audio via MPEG2
  - Optimized for latency, audio/video synchronization
- Connecting Oklahoma with the New World Symphony in Miami, Florida
  - Removing physical distance as the reason why a student and instructor cannot interact

Showcases:

- **Distance Teaching and Learning**
- **Video (and audio) as data**
- **Extending the reach of resources**

GCB Overview
Conclusion;
Important Dates

- Submit a 1 page proposal by November 14th to info@cyberbridges.net
- Advisory Committee Meets by November 29th
- Announcement of fellowships by December 1st

Proposal Information Summary

- 1 Page
- Submitted by student and faculty advisor
  - Faculty letter of support required
- Describe research interest and problem
- How might CI augment the research?
- Is there any multidisciplinary synergy?
- Include qualifications including any previous programming experience

GLOBAL cyberbridges

BRIDGING THE DIVIDE BETWEEN THE INFORMATION TECHNOLOGY AND SCIENCE COMMUNITIES

Questions?

LambdaVision 100-Megapixel display and SAGE (Scalable Adaptive Graphics Environment) software developed by the Electronic Visualization Laboratory at the University of Illinois at Chicago. Major funding provided by NSF.

Email info@cyberbridges.net

Website www.cyberbridges.net

Credits

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