Globally Distributed e-Science Collaborative Communities

Chinese American Networking Symposium

Supporting Research Collaborations with Advanced Networks Architecture and Applications

November 1, 2005

Shenzhen, CHINA

Julio Ibarra, Executive Director

Heidi Alvarez, Director

Center for Internet Augmented Research and Assessment (CIARA)

Outline

- The Phenomenon of e-Science
- Cyber Infrastructure Projects Enabling Scientific Work
  - Western-Hemisphere Research & Education Networks (WHREN) - Links Interconnecting Latin America (LILA)
  - AtlanticWave
- e-Science Collaborative Projects
  - Pan-American Advanced Studies Institute (PASI)
  - CHEPREO
  - UltraLight
  - Cybertools for Biodiversity
  - CyberBridges

Chinese American Networking Symposium

(CANS 200 4)

Toward Next Generation Advanced Networks

Nov. 30 – Dec. 2, 200 4
The Kovens Conference Center
Florida International University
Miami, Florida, USA

CANS Conference November 1, 2005

Phenomenon of e-Science

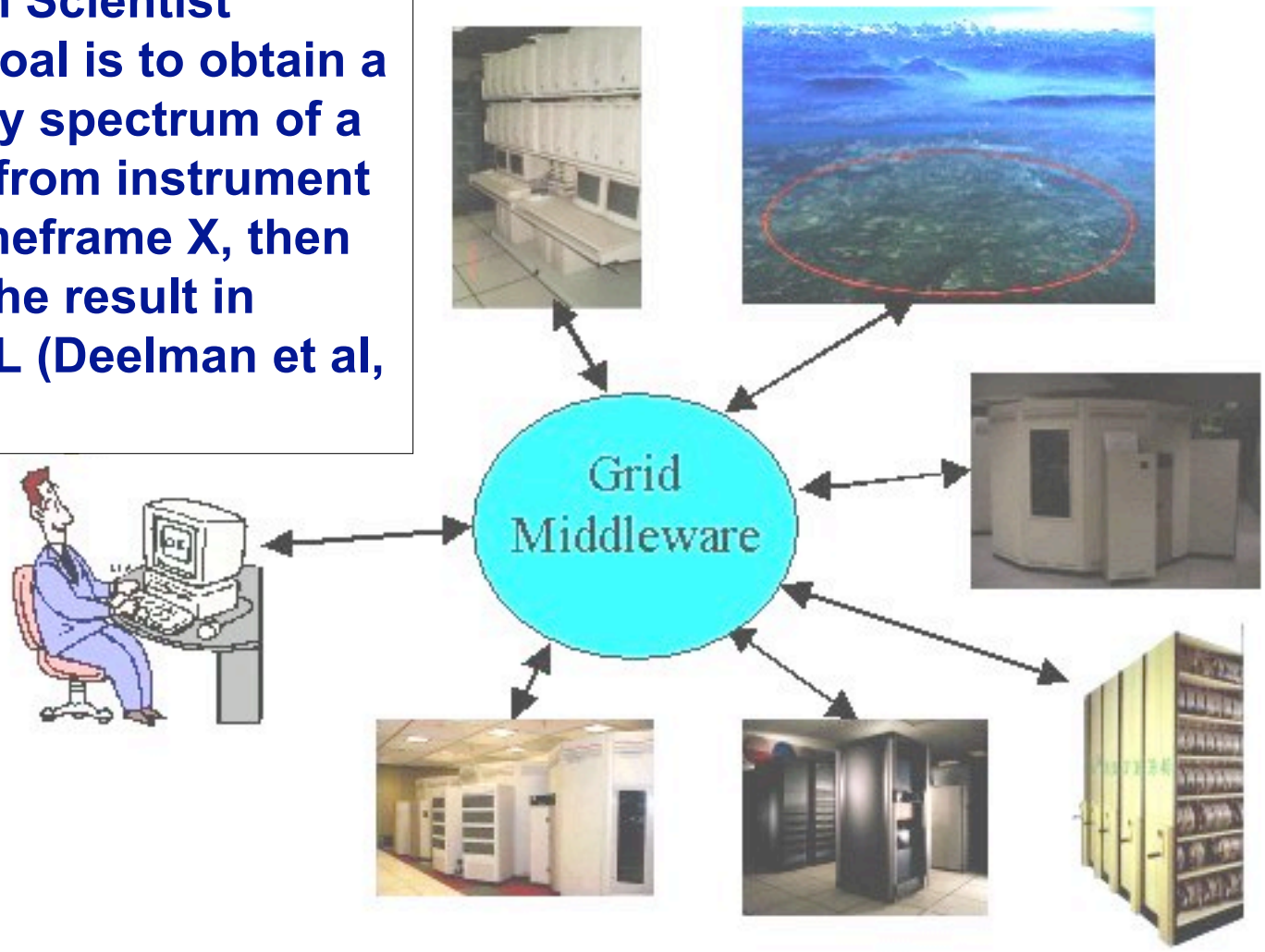
CIARA
research • collaboration • scholarship

- Cyber Infrastructure innovations are increasingly changing how science is practiced
  - Science used to about test tubes, wet labs and researchers working individually
  - Science is moving to networks, distributed computers and global collaborations
- Science is increasingly being conducted in virtual laboratory environments
- For a growing number of scientists, “data” is now found on the Web, not in the field (Foster, Science 2005)
- Scientists and organizations are forming virtual working environments where they can share data and computing resources and collectively collaborate to derive new knowledge (Hey, Science 2005)

Cyber Infrastructure: Enabling Scientific Work

CIARA
research • collaboration • scholarship

Research Scientist Larry's goal is to obtain a frequency spectrum of a signal S from instrument Y and timeframe X, then placing the result in location L (Deelman et al, 2003)



WHREN-LILA
IRNC Award 0441095

- 5-year NSF Cooperative Agreement
  - Florida International University (IRNC awardee)
  - Corporation for Education Network Initiatives in California (IRNC awardee)
  - Project support from the Academic Network of Sao Paulo (award #2003/13708-0)
  - CLARA, Latin America
  - CUDI, Mexico
  - RNP, Brazil

- 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

Links Interconnecting Latin America

- Miami - Sao Paulo link: 1.2Gbps by year end, evolving to 2.5Gbps
- Connects State of Sao Paulo academic network (ANSP) and Exchange Point, regional network (CLARA), Brazilian NREN (RNP), other international networks
- San Diego - Tijuana link: operating at 1 Gbps, providing dedicated GigE links to regional network (CLARA) and Mexican NREN (CUDI)
- East and west coast connectivity to I2 Abilene and other US and global R&E networks

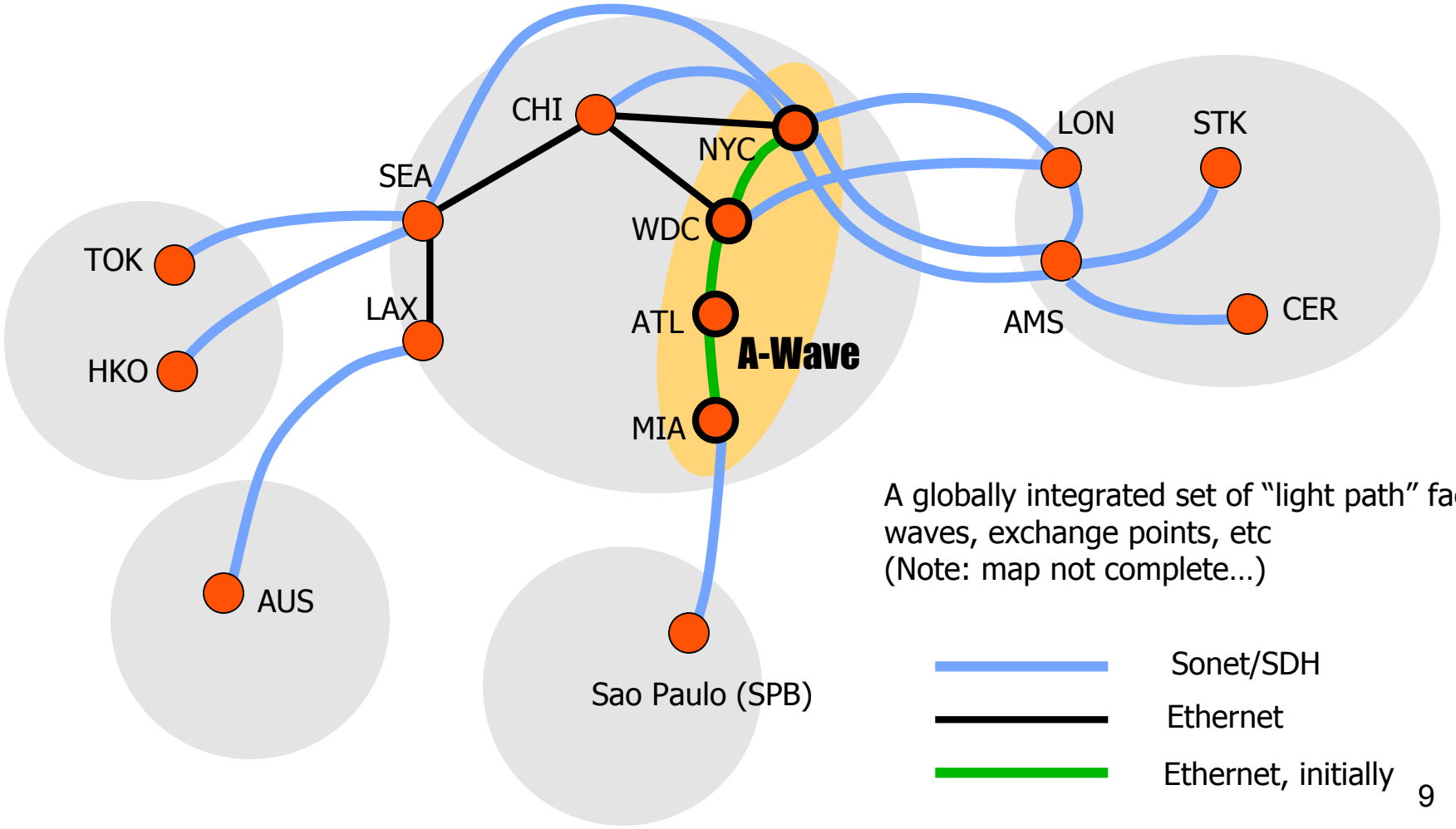
http://www.whren-lila.net

AtlanticWave

- AtlanticWave is an International Peering Fabric
  - US, Canada, Europe, South America
  - Distributed IP peering points and add/drops in:
    - NYC, WDC, ATL, MIA, SPB
- SURA, FIU-AMPATH, IEEAF, MAX, SoX, MANLAN, and in partnership with the Academic Networks of Sao Paulo (ANSP) are combining efforts to establish AtlanticWave
- A-Wave is an integral component of the NSF IRNC WHREN-LILA project to create an open distributed exchange and transport service along the Atlantic rim
- Complements the PacificWave distributed peering facility on the Pacific rim

The Global Picture

AtlanticWave
NEW YORK WASHINGTON ATLANTA MIAMI SAO PAULO



A globally integrated set of "light path" facilities: waves, exchange points, etc
(Note: map not complete…)

Sonet/SDH
Ethernet
Ethernet, initially

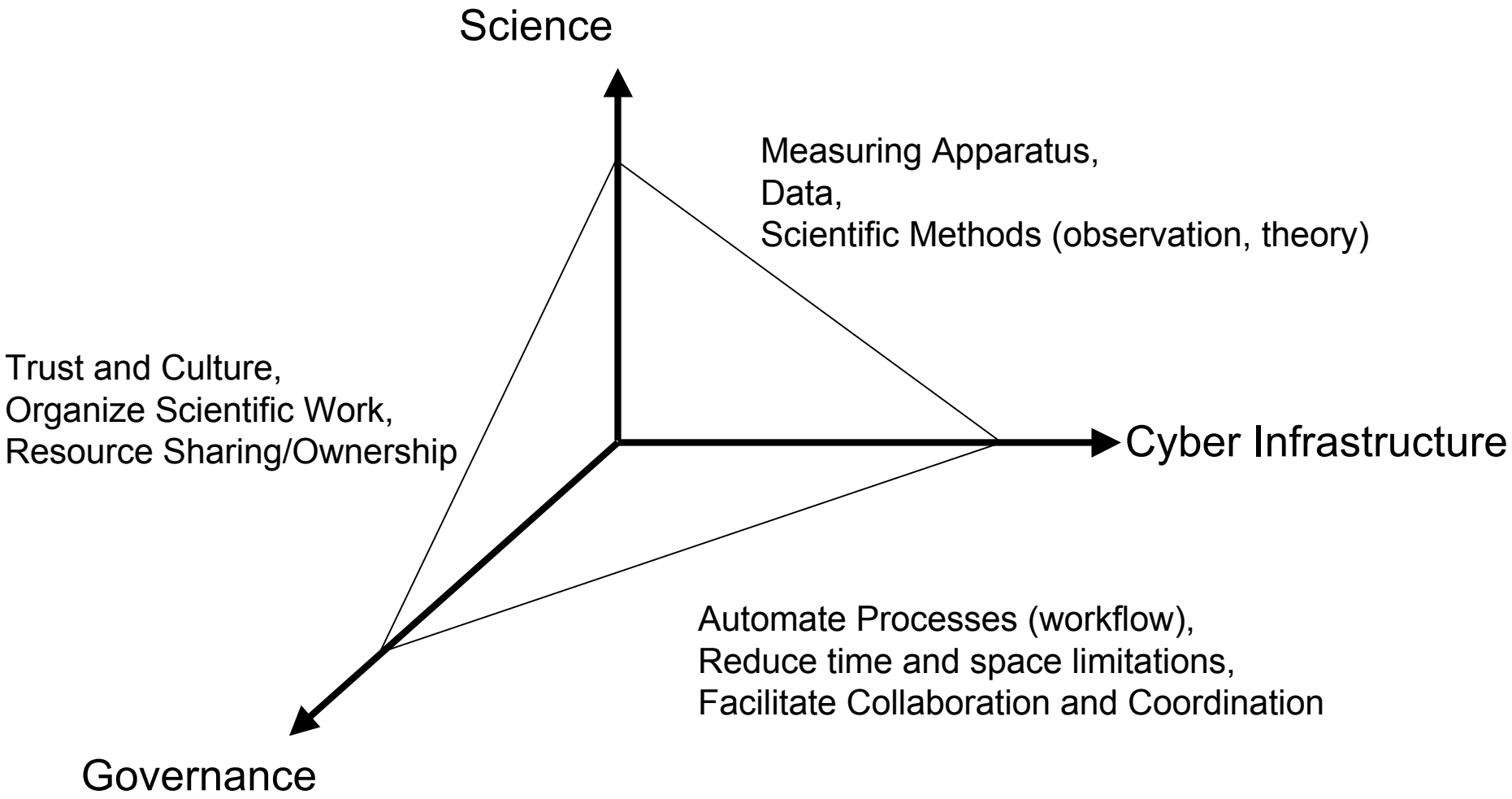
Pan-American Advanced Studies Institute

- NSF Award# 0418366, OISE Americas Program
- Series of lectures at the advanced graduate and postgraduate level involving domain researchers, students and practitioners.
- Dissemin ng knowledge
- Stimulate on among the as
- CIARA, and Brazil, held, "Grid Computing and Advanced Networking for High-Energy Physics and Astronomy"
- 40 students from the Americas explored the growing interdependence between science and technology for global e-Science collaborations

For CANS-2004, this PASI facilitated the creation of linkages between Latin America and China to share knowledge on e-Science

http://ciara.fiu.edu/pasi/

PASI: Dimensions of e-Science



Center for High-Energy Physics Research and Educational Outreach (CHEPREO)

- **An integrated program of research, cyberinfrastructure development, and educational outreach**
  - **Collaboration with FIU, Caltech, University of Florida, Florida State University, the State University of Rio de Janeiro, University of Sao Paulo**
- **Joint funding from**

NSF (MPS-0312038)

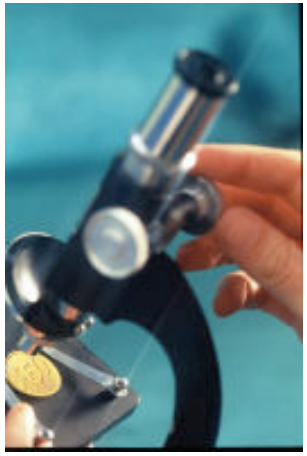
State of Sao Paulo Research Foundation (FAPESP-#2003/13708-0

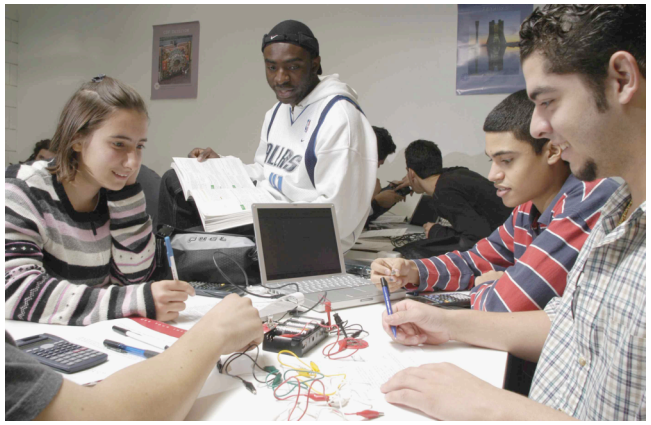
CHEPREO
CENTER FOR HIGH ENERGY PHYSICS RESEARCH & EDUCATION OUTREACH

EDUCATION AND OUTREACH

CIARA
h • collaboration • scholarship

- Raises involvement in science and research
- Engages HS, Undergrads, Grads in active learning & mentoring
- Builds and sustains a collaborative Community of Scholars
- Motivates students to pursue careers in science
- Facilitates discovery and innovation





CHEPREO
CENTER FOR HIGH ENERGY PHYSICS RESEARCH & EDUCATION OUTREACH

PHYSICS LEARNING CENTER

- Increases exposure to educational resources
- Promotes collaboration of students and teachers
- Provides experience for grads and undergrads
- Develops tutoring programs and workshops

www.chepreo.org

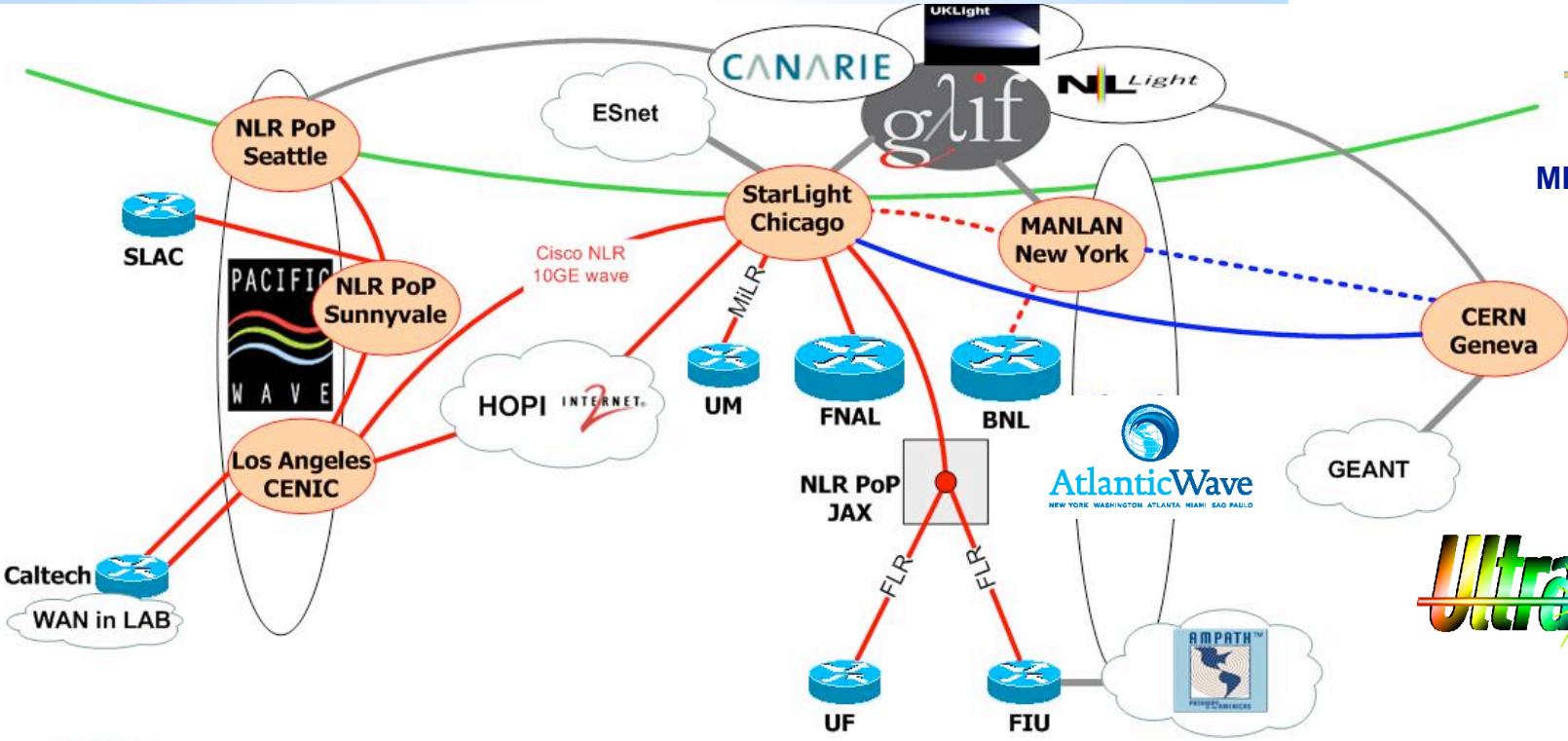
CHEPREO
CENTER FOR HIGH ENERGY PHYSICS RESEARCH & EDUCATION OUTREACH

Physics Modeling Workshops

- Emphasize the Hestenes Modeling Pedagogy
- Socratic Method for scientific discourse
- Structured inquiry approach to physics
- Incorporates Network & Grid teaching
- Compliment to QuarkNet HS program

www.chepreo.org

UltraLight: Advanced Network Services for Data Intensive HEP Applications



C I A R A
research • collaboration • scholarship

NSF

MPS #0427110

UltraLight

- Extend and augment existing grid computing infrastructures (currently focused on CPU/storage) to include the network as an integral component
- A next-generation hybrid packet- and circuit-switched *dynamic* network infrastructure
- Partners: Caltech, UF, FIU, UMich, I2, SLAC, FNAL; UERJ, USP, ANSP, RNP; GLORIAD (cn, kr, ru), GLIF
- Strong support from Cisco, CENIC, NLR, FLR

Education Workshop June, 2005 @ FIU

- **Workshop Highlights**
  - ❑ 15+ Students
  - ❑ Lecturers / Leaders UltraLight coPIs / Outside Experts
  - ❑ Topics: Grid Computing, Advanced Networking Engineering, Network Montioring using MonALISA, Netflow, AMP data
  - ❑ Early Summer
  - ❑ Graduate Student Preparation
  - ❑ Summer Project Preparation
  - ❑ Participants from the US, Brazil and Argentina
  - ❑ Provided a follow on activity to the PASI

www.ultralight.caltech.edu

Cyber Infrastructure for International Biodiversity Research Collaboration Workshop

CIARA
research • collaboration • scholarship

- **Purpose: Examine trends where Cyber Infrastructure is likely to effect change in biodiversity research informatics**
- **Scientific collaboration between U.S., Mexico and Central America**
- **Program bridge between Biodiversity, Conservation and Cyber Infrastructure**
- **Collaborative workshop coordinated by FIU CIARA and University of Kansas**
- **Week of January 10, 2006 in Panama**

NSF

Award #0549456

cyberbridges

CI-TEAM Demonstration

By understanding Research & Education Cyber Infrastructure, we will bridge the divide between IT and the Sciences

NSF Award # OCI-0537464

Oct 1, 2005 - Sept 30, 2006

Heidi Alvarez, PI CIARA
Julio Ibarra, Co-PI CIARA
Chi Zhang, Co-PI CS
Eric Johnson, Co-PI CS

www.cyberbridges.net

4 Science & Engineering Graduate Student Fellowships

- **Research Stipend**
- **Tuition for Spring and Summer 2006**
- ***CIARA IT Science Certificate***
- **Collaborative publication & conference participation**

cyberbridges

BRIDGING THE DIVIDE BETWEEN THE INFORMATION TECHNOLOGY AND SCIENCE COMMUNITIES

High-Performance Networking with Eric Johnson

Spring 2006

Tuesdays, 17:00 – 20:00

Introduction to Ethernet physical components
Copper
Fiber
Switches
Debugging Tools
Introduction to IP networking
Address space
Routing
Debugging Tools
Review of issues in high performance computing
TCP BWD
Frame size
Latency/Jitter
Design of cluster networks
Implement cluster networks

High-Performance Grid Computing with Chi Zhang

Spring 2006

Wednesdays, 17:00 – 20:00

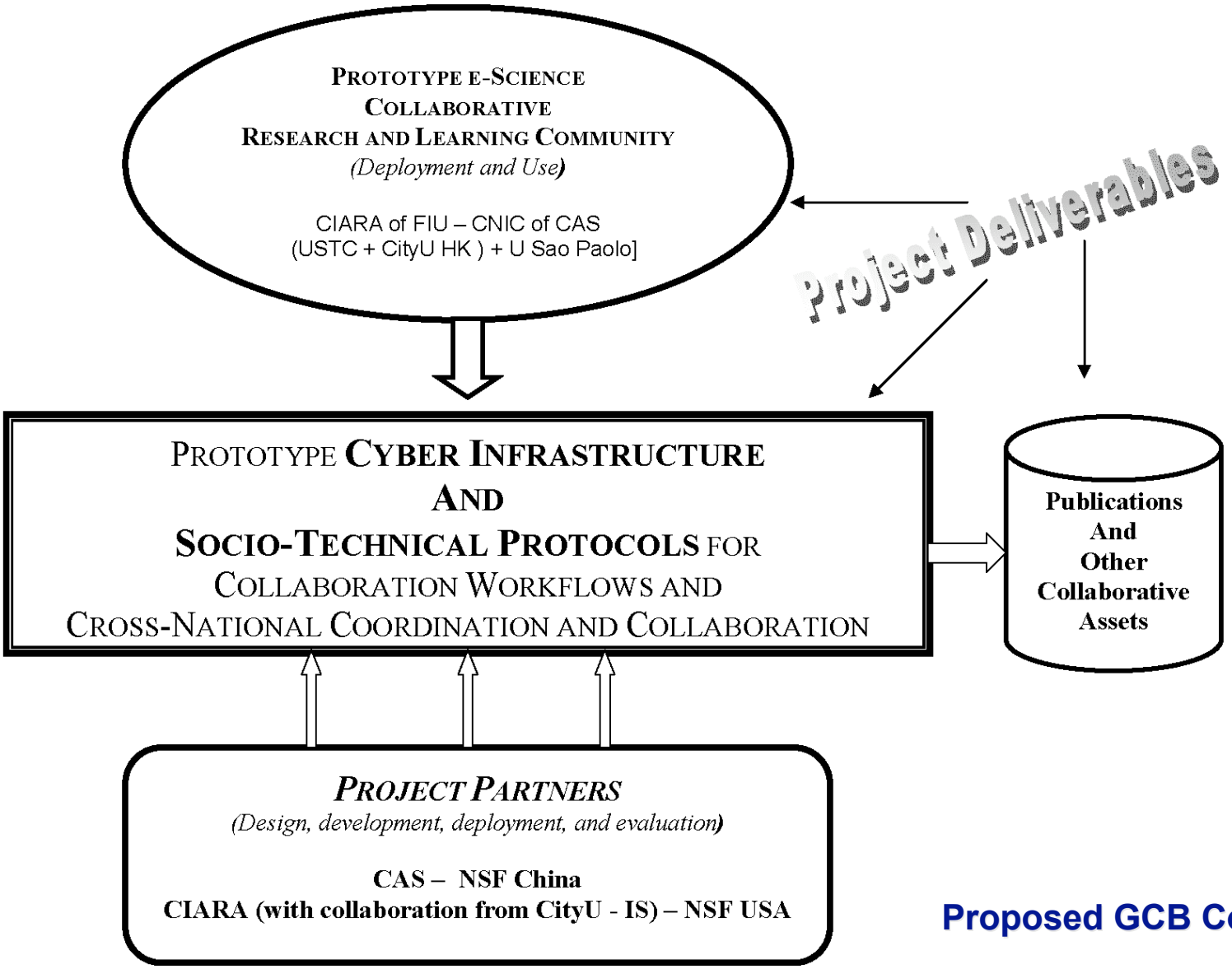
Cluster Computing
Hardware and Software Concepts
MPI
XML and Web Service
XML and XML Schema
SOAP
WSDL and UDDI
Grid Computing
Introduction
Globus Toolkit
OGSA
High-Performance Networking
Gigabit Ethernet
High-Speed TCP

Independent Study Summer 2006

Students will work on a collaborative project resulting in a research paper, with the help of the CyberBridges Co-PIs and their faculty advisors. The paper will be based on class research and experiment results, and will be published and presented at an upcoming conference.

Proposed Next Steps

- Expand program to multiple globally distributed institutions
- More students, More faculty, More technologists
- Call the program "Global CyberBridges" (GCB)
- Provide a Model Global Collaboration Infrastructure for e-Science between US and China
- This model infrastructure could be developed through a partnership between CIARA of FIU and CNIC of CAS
- Bridging facilitators at City University Hong Kong
- Partner with University of Sao Paulo, Brazil



Proposed GCB Concept

Thank You!

CIARA
research • collaboration • scholarship

- **WHREN-LILA, AMPATH infrastructure, CHEPREO, CyberBridges, science application support, education, outreach and community building efforts are made possible by funding and support from:**
  - **National Science Foundation (NSF) awards STI-0231844, MPS-0312038, OISE-0418366, OISE-0549456, OCI-0537464, and SCI-0441095**
  - **Florida International University**
  - **Latin American Research and Education community**
  - **The many national and international collaborators who support our efforts**