International Research Network Connections Western-Hemisphere Research & Education Networks – Links Interconnecting Latin America (WHREN-LILA): Project Status and Plans

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Outline

- Introduction and Background
- Evolution of the network infrastructure
- Activities
  - NREN-to-NREN peering
  - Emerging GOLE in Sao Paulo
  - Emerging networks of the Caribbean
  - International Science Collaborations

WHREN-LILA
IRNC Award 0441095

- 5-year NSF Cooperative Agreement
- Connectivity to Brazil is supported through a coalition effort through the WHREN-LILA project partners
  - Florida International University (award #0441095)
  - 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)
  - Improves U.S.-Latin America connectivity
- Western-Hemisphere Research and Education Networks (WHREN)
  - Coordination among R&E network providers and users
  - Leverage participants' network resources
  - Enhance international collaborative science research and education

http://www.whren-lila.net

WHREN-LILA Funded Plan starting in 2005

- (1) 1.2Gbps link (east) + (1) GigE shared link over dark fiber segment (west)
- U.S. landings in Miami and San Diego
- Latin America landing in Sao Paulo and Tijuana
- $5M over 5 years

AtlanticWave Project

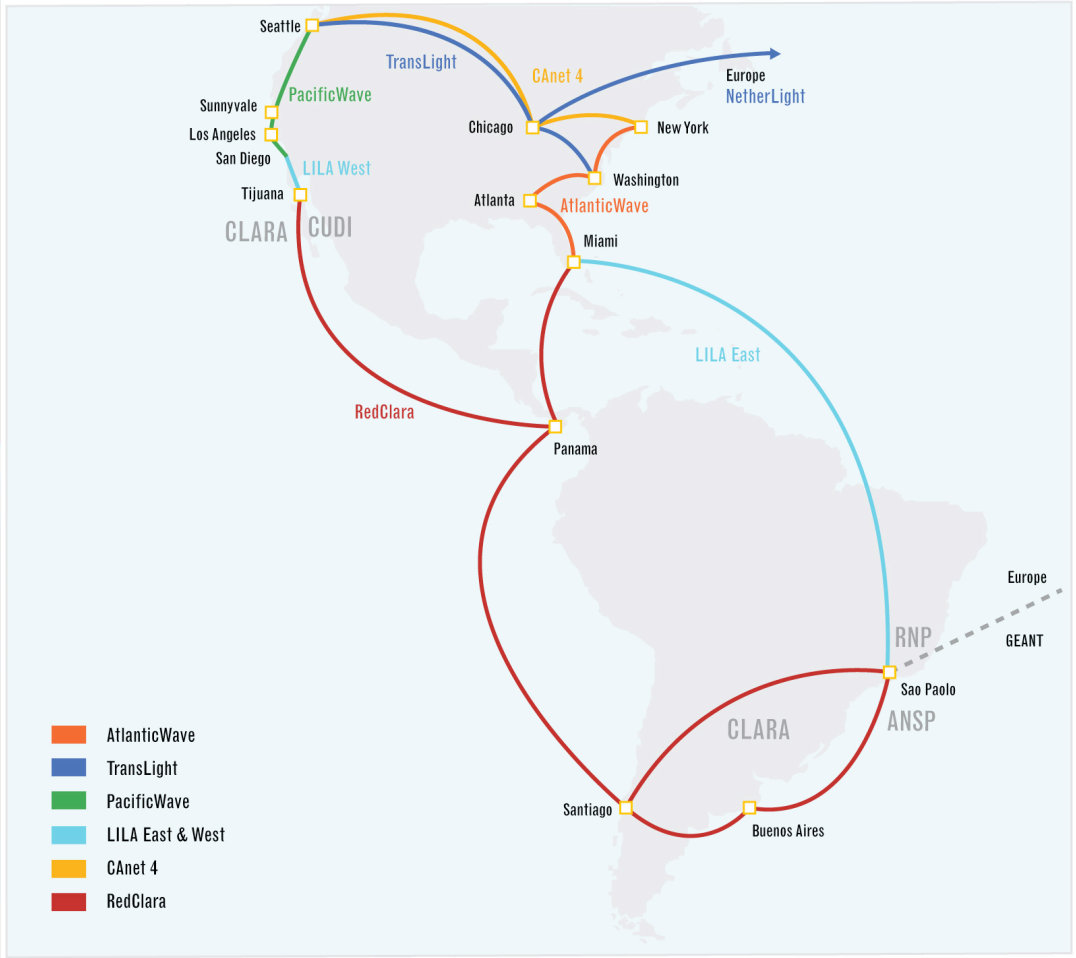
- AtlanticWave is a distributed Ethernet exchange service along the Atlantic rim, from NYC to Miami
- AtlanticWave connects the key exchange points on the U.S. East Coast:
  - International Exchange Points MANLAN in NYC and AMPATH in Miami
  - MAX gigapop and NGIX-East in Washington, DC
  - SoX gigapop in Atlanta
- AtlanticWave is an integral component of the NSF IRNC WHREN-LILA project, extending open distributed exchange services to Sao Paulo
- AtlanticWave partners include SURA, FIU-AMPATH, IEEAF, FLR, MAX, SLR/SoX, Internet2/MANLAN

WHREN-AtlanticWave Goals

- Facilitate international peering along the Atlantic rim of North and South America
- Support communities that need network resources for research between North and South America, and other countries and continents
- Enhance international science collaborations through the uptake and use of NSF IRNC links

Current network infrastructure

- 2.5Gbps circuit (LILA east) + two 1Gbps circuits (LILA west)
- 10GigE distributed peering service from MIA to NYC
- Layer2 services extended to StarLight, then Europe using IRNC Translight/Startlight
- Interconnections with RedCLARA in Sao Paulo, Tijuana and Miami



Activities

- Enhancing NREN-to-NREN peering
- Emerging GOLE in Sao Paulo
- Emerging networks of the Caribbean
- Facilitating International Science Collaborations
  - Enhancing LHC Compact Muon Solenoid (CMS) detector research collaborations
  - Augmenting Participation in e-VLBI experiments

Distributed International Peering

- Enhancing nren-to-nren exchange through
  - Distributed exchange peering fabric
  - Multiple peering relationships across multiple exchange points

Peers	A Location	Z Location
RedCLARA-Internet2	Sao Paulo	Washington, DC
RedCLARA-NLR	Sao Paulo	New York
ANSP-NLR	Sao Paulo	New York
RedCLARA-Esnet (v4)	Sao Paulo	Washington, DC
RedCLARA-Esnet (v6)	Sao Paulo	Washington, DC
RNP-Internet2	Sao Paulo	Washington, DC
RedCLARA-CAnet4	Sao Paulo	New York
RedCLARA-Internet2	Miami	New York

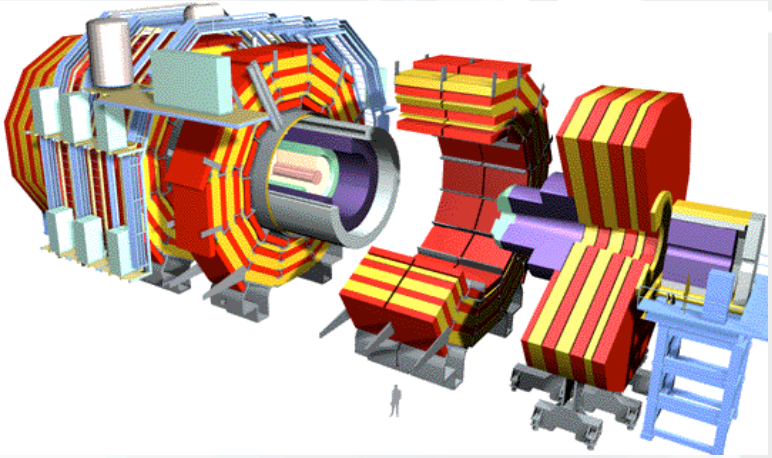
Emerging GOLE in Sao Paulo: SouthernLight

- SouthernLight GOLE interconnects three R&E networks in Sao Paulo
  - RNP, Brazil's NREN
  - Project GIGA optical testbed
  - Kyatera optical research network in Sao Paulo state
  - Dispersed sites interconnected with redundant fiber links
- SouthernLight connects to the AMPATH GOLE in Miami via the WHREN-LILA link
- http://www.glif.is/meetings/2008/plenary/stanton-southernlight.pdf

Emerging Networks of the Caribbean

- University of the Virgin Islands (UVI)
  - STM-1 Connection from St. Croix to AMPATH in Miami; in service
- University of the West Indies
  - STM-1 Connection from Trinidad St. Augustine Campus to AMPATH in Miami
  - MoU Agreement with Internet2 Signed over the summer
  - Expected to be online by November, 2008

Compact Muon Solenoid (CMS) detector



CMS is a general-purpose particle physics experiment, designed to detect a wide range of particles and phenomena

Main features of the CMS (Compact Muon Solenoid) detector:

- Its relatively small size (compact)
- Its optimization for tracking muons
- The powerful solenoid magnet

- Goals of the experiment are to:
  - Search for evidence of physics beyond the standard model, such as super symmetry, and extra dimensions
  - discover the Higgs boson
  - Answer questions of particle physics and cosmology
- "Networks are key for success of the US LHC Program - Harvey Newman"

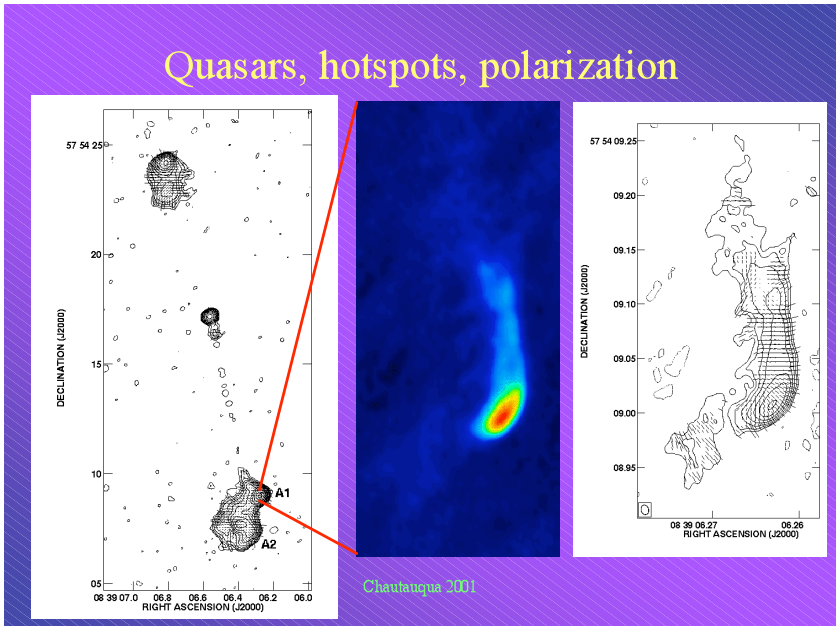
International CMS Collaborations

- Facilitating access to two NSF IRNC links
  - U.S.-Latin America (WHREN-LILA)
  - U.S.-Europe (TransLight/StarLight)
- IRNC links enable Tier2s in the Western hemisphere to connect to Tier1s in Europe
- Access to IRNC links by Brazil's Tier2s lessens the burden on U.S. Tier1
  - IRNC links are enabling a division of labor to augment U.S. Tier1 and Tier2 capabilities by including Brazil's Tier2 facilities, providing both human and machine resources
- Two 1GigE vlans connect Brazil's Tier2s to CERN using WHREN-LILA, AtlanticWave, CaveWave and TransLight/ StarLight, NetherLight, and U.S. LHCnet

VLBI Science

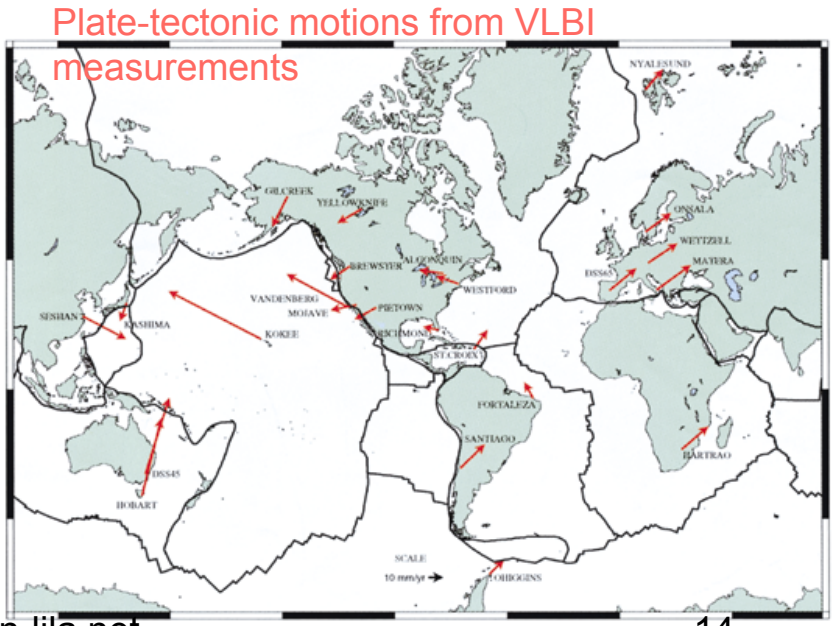
ASTRONOMY

- Highest resolution technique available to astronomers – tens of microarcseconds
- Allows detailed studies of the most distant objects – quasars, gravitational lenses, GRBs; as well as black hole at center of Milky Way



PRECISION GEODESY

- Highest precision (few mm) technique available for global tectonic measurements
- Highest spatial and time resolution of Earth's motion in space for the study of Earth's interior
  - Earth-rotation measurements important for military/civilian navigation
  - Fundamental calibration for GPS constellation within Celestial Ref Frame

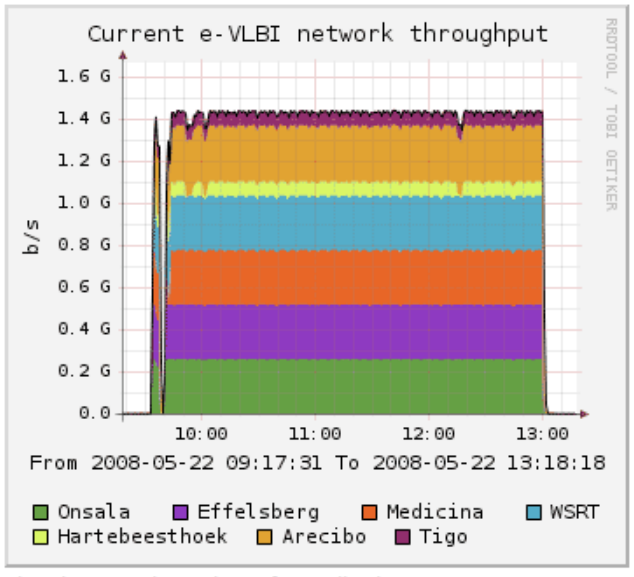


e-VLBI is a natural fit dedicated circuits (Alan Whitney)

e-VLBI Radio Astronomy

- Arecibo is now participating in e-VLBI experiments using international layer2 connection
- Collaboration involves Jive, SurfNet, AtlanticWave, CaveWave, Translight/StarLight, University of Puerto Rico and Arecibo
- Demonstration at the Terena8 conference (May 2008): telescopes in Chile, Germany, Italy, the Netherlands, Puerto Rico (256Mbps), South Africa and Sweden streamed data to the Joint Institute for VLBI in Europe (JIVE), then correlated in real-time
- September 9, 2008, Arecibo achieved the1st e-VLBI fringes over the baseline using a data bandwidth of 512 (Mbps)
- Future use for e-VLBI collaboration between MIT and ROEN observatory near Fortaleza, Brazil

Networks create 11,000km real-time virtual telescope



Links of Interest

- http://www.irnclinks.net/ (IRNC project)
- http://www.whren-lila.net/ (WHREN-LILA project)
- http://www.atlanticwave.net/ (AtlanticWave project)
- http://www.internet2.edu/international/intl_connect/carib_sig.html (Caribbean REN Special Interest Group)
- http://ciara.fiu.edu/ (CIARA center projects website)

Sponsors and Collaborators

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- Academic Network of Sao Paulo (award #2003/13708-0)
- Florida International University
- Latin American Research and Education community
- Our many national and international collaborators

Thank You
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