AtlanticWave and AMPATH Update
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Julio Ibarra

Executive Director

Center for Internet Augmented Research and Assessment

Florida International University

Outline

- About AtlanticWave
- NSF IRNC WHREN-LILA Project
- Brazil – AtlanticWave Collaboration
- AMPATH International Exchange Point
- Caribbean Activities
- AtlanticWave Achievements
- Summary and Conclusions

AtlanticWave Project

- AtlanticWave has established a 10GigE wave 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 and transport services to Sao Paulo
- AtlanticWave partners include SURA, FIU-AMPATH, IEEAF, FLR, MAX, SLR/SoX, Internet2/MANLAN

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AtlanticWave Concept

- Collaborating exchange points with a common set of goals
- Each exchange point operates independently and manages its connectors
  - Do not disrupt business and operating models
- Provide international connectors with the option to peer from multiple points across a common layer2 exchange fabric

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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

Governance Structure

- Governance Committee (GC)
  - Responsible for the overall strategy, finances, operations, and external relations of the Collaboration
  - Voting committee, comprised of one representative designated by each Collaborating Exchange Point

- Engineering Committee (EC)
  - Responsible for developing recommendations to the Governance Committee for technical design and operational practices
  - Non-voting committee, comprised of one or more engineers from each exchange point

Western Hemisphere Research & Education Networks – Links Interconnecting Latin America (WHREN-LILA)
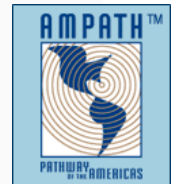
- 5-year NSF Cooperative Agreement
- Connectivity to Brazil is supported through a coalition effort through the WHREN-LILA projects
  - Florida International University (award #0441095)
  - Corporation for Education Network Initiatives in California (CENIC)
  - Project support from the Academic Network 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

Exchange Point Coordination

- An outcome of the NSF IRNC program is enhanced communication and coordination among exchange points in the U.S.
- Several meetings among North American exchanges have been organized to share knowledge on services and operations, with emphasis on international activities
- U.S. Research and Education Exchanges (US-REX), June 2008, Denver, CO.
- GLIF North America (GLIF-NA)
  - Outcome of the US-REX meeting. Broadening participation to GLIF North American activities, along with exchange points
  - Coincides with GLIF annual workshops
  - First meeting in Prague, Czech Republic, Sept., 2007
 - Second meeting in Seattle, U.S., Sept., 2008

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Exchange Point Topology in the Americas

- **AtlanticWave (current)**
  - Distributed Layer2 peering fabric
  - 10GigE from MIA to NYC
  - 2.5G from MIA to Sao Paulo
- **Extension to Chicago using Cavewave from McLean to StarLight**
- **AtlanticWave Interconnects two IRNC links at layer2**
- **Vlans framework extendible to PacificWave**

Legend:
- AtlanticWave
- TransLight
- PacificWave
- LILA East & West
- CAnet 4
- RedClara

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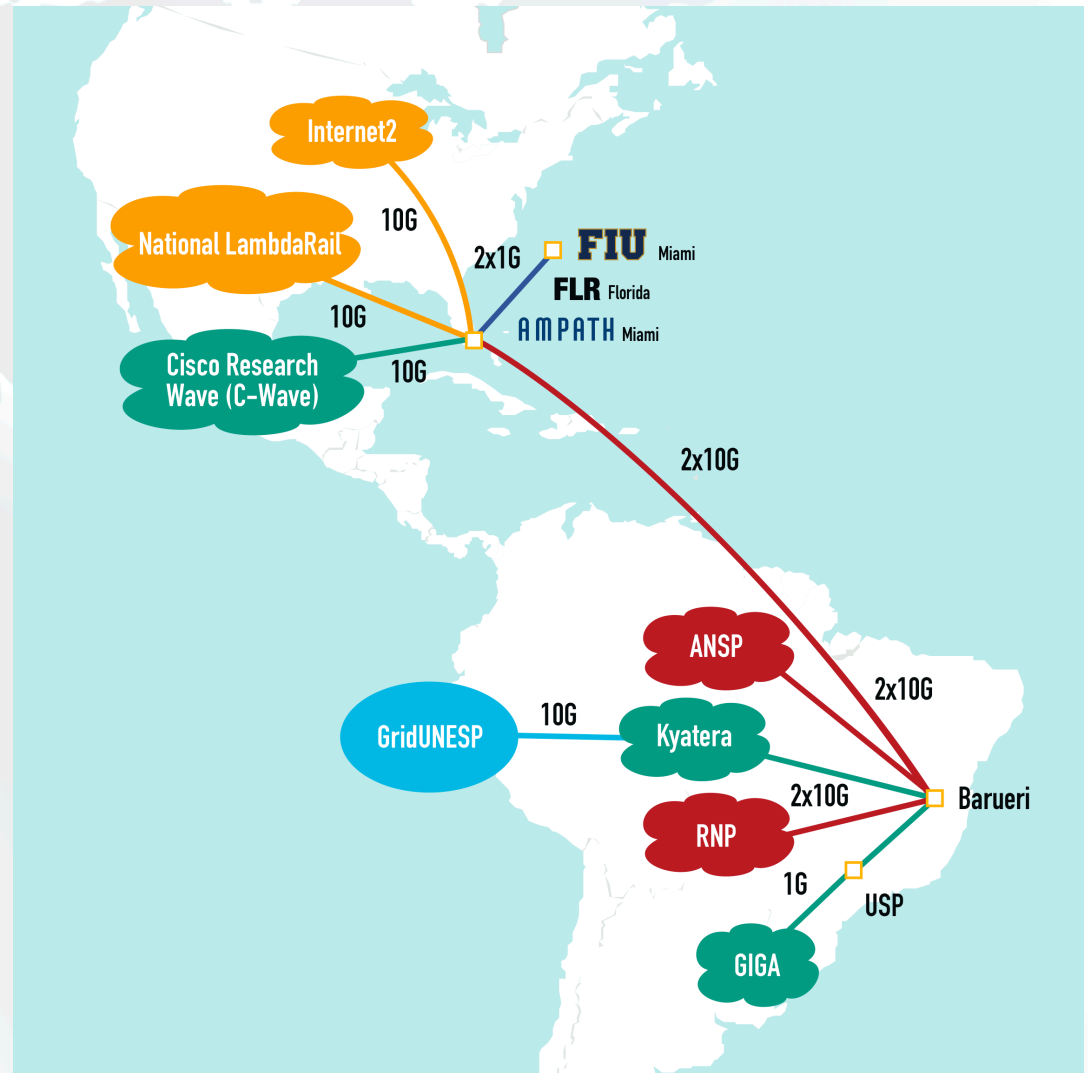
AMPATH

Enhancing interregional collaboration

- LILA East link enhancing from shared 2.5G to shared 2x10G links
- While the infrastructure will be 85% funded from Brazil, the U.S. has equal access to benefit from this resource
- First 10G link is under construction and arriving very soon
- Second 10G link will arrive shortly after
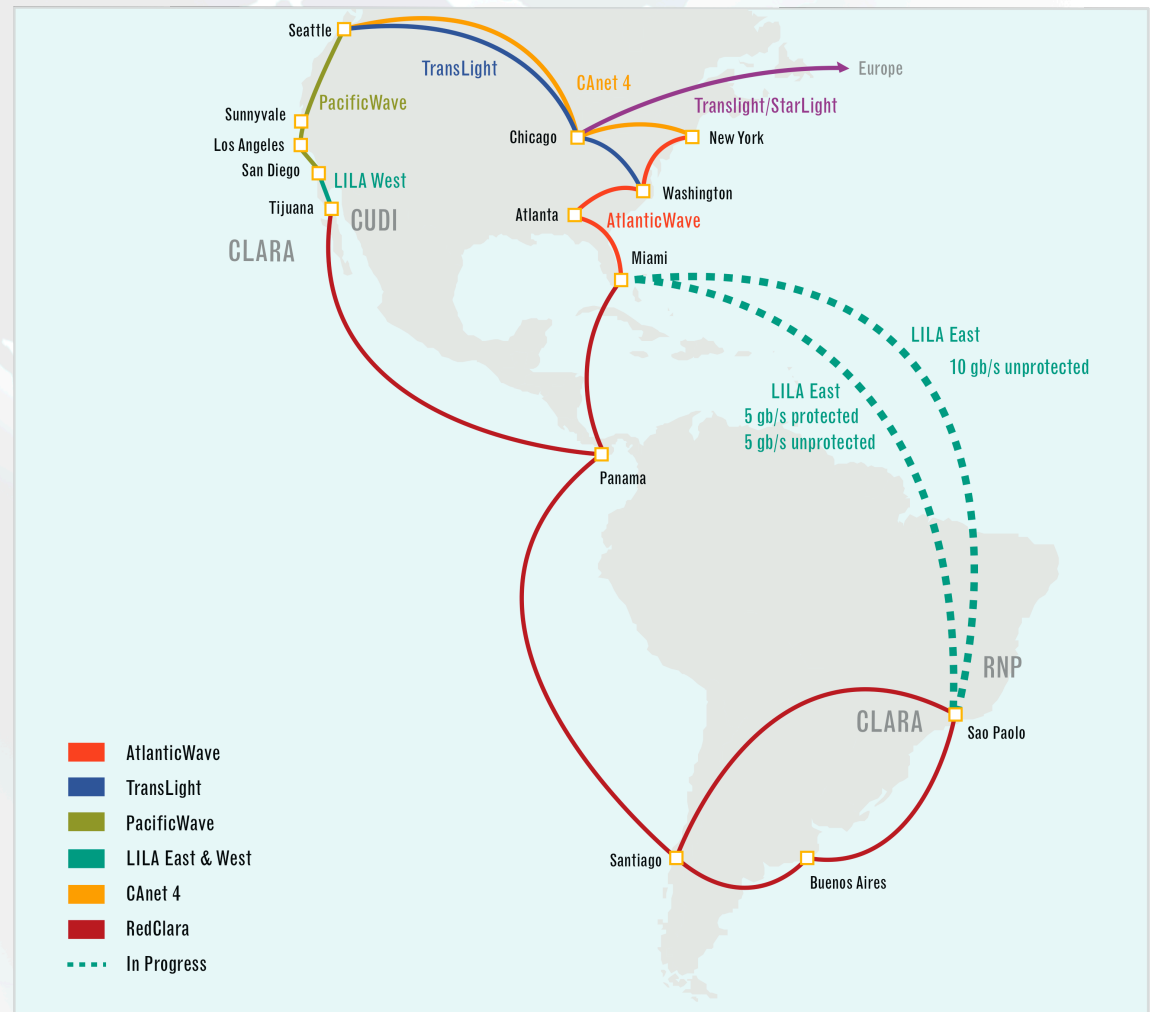
Brazil - AtlanticWave Collaboration

- Bandwidth increase enhances AtlanticWave extension to Brazil
- Brazil's participation in AtlanticWave progressing to a full Collaborating XP
  - Participation in Governance Committee
  - Participation in Engineering Committee and other committees
- SouthernLight Exchange Point is supported by both ANSP and RNP, and interconnects 3 of Brazil's R&E networks: Project GIGA, Kyatera and RNP

AMPATH International Exchange Point

- 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 and 2.5 Gbps SDH
- Jumbo frame support
- IPv4/IPv6
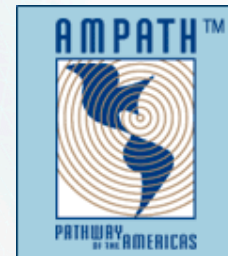
- AMPATH provides multiple layer2 and layer3 paths to U.S. and international R&E backbone networks
- Production layer2 10GigE transport service via AtlanticWave
- Experimental layer2 10GigE transport via Cisco Research Wave (C-Wave)
- Production layer2 10GigE shared transport to Internet2
- Layer 3 routed connections via Florida LambdaRail

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AMPATH and the Caribbean

- Recent connections from the Caribbean to AMPATH are:
  – University of the U.S. Virgin Islands
  – University of the West Indies at Trinidad
- Existing connections to the University of Puerto Rico and the Arecibo observatory
- Future connections in progress to the University of the West Indies Jamaica and Barbados campuses

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Caribbean Connections

Legend

— STM-1

-- Proposed STM-1

— Gigabit Ethernet

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AtlanticWave achievements

- Enhancing international peering
- Enhancing international LHC CMS collaborations
- Enabling Arecibo's participation in e-VLBI experiments

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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

Complete list at http://www.atlanticwave.net/network.html

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International CMS Collaborations

- AtlanticWave facilitates access to 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

e-VLBI Radio Astronomy

- Arecibo is participating in e-VLBI experiments using AtlanticWave

- Collaboration involves Jive, SurfNet, AtlanticWave, CaveWave, Translight/ StarLight, University of Puerto Rico and Arecibo

- First trans-Atlantic eVLBI fringes at a data rate of 512 Mbits/sec on 9 September 2008. Fulfills an ExPRES project milestone

- Regular use of AtlanticWave by Arecibo for e-VLBI activities

Data leaving Arecibo
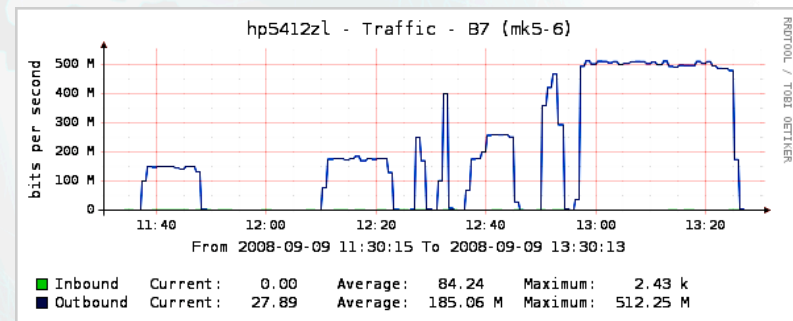
Data arriving at JIVE
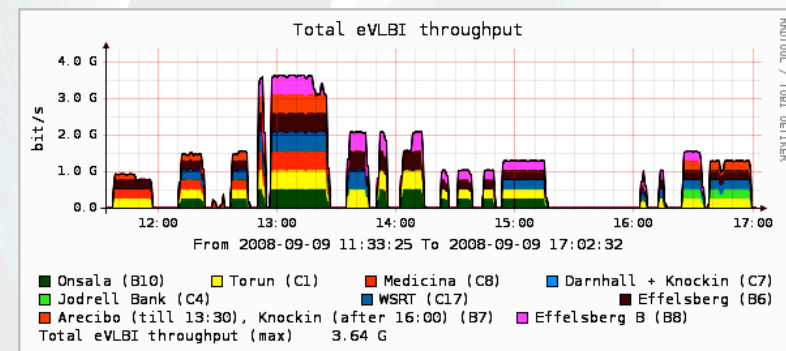
Conclusions

- AtlanticWave is enhancing international peering for R&E networks and international science collaborations

- AtlanticWave is facilitating access to NSF IRNC links to Latin America and Europe

- AtlanticWave is providing a low-cost and very simple approach by which to enhance international science collaborations

Thank You
julio@fiu.edu