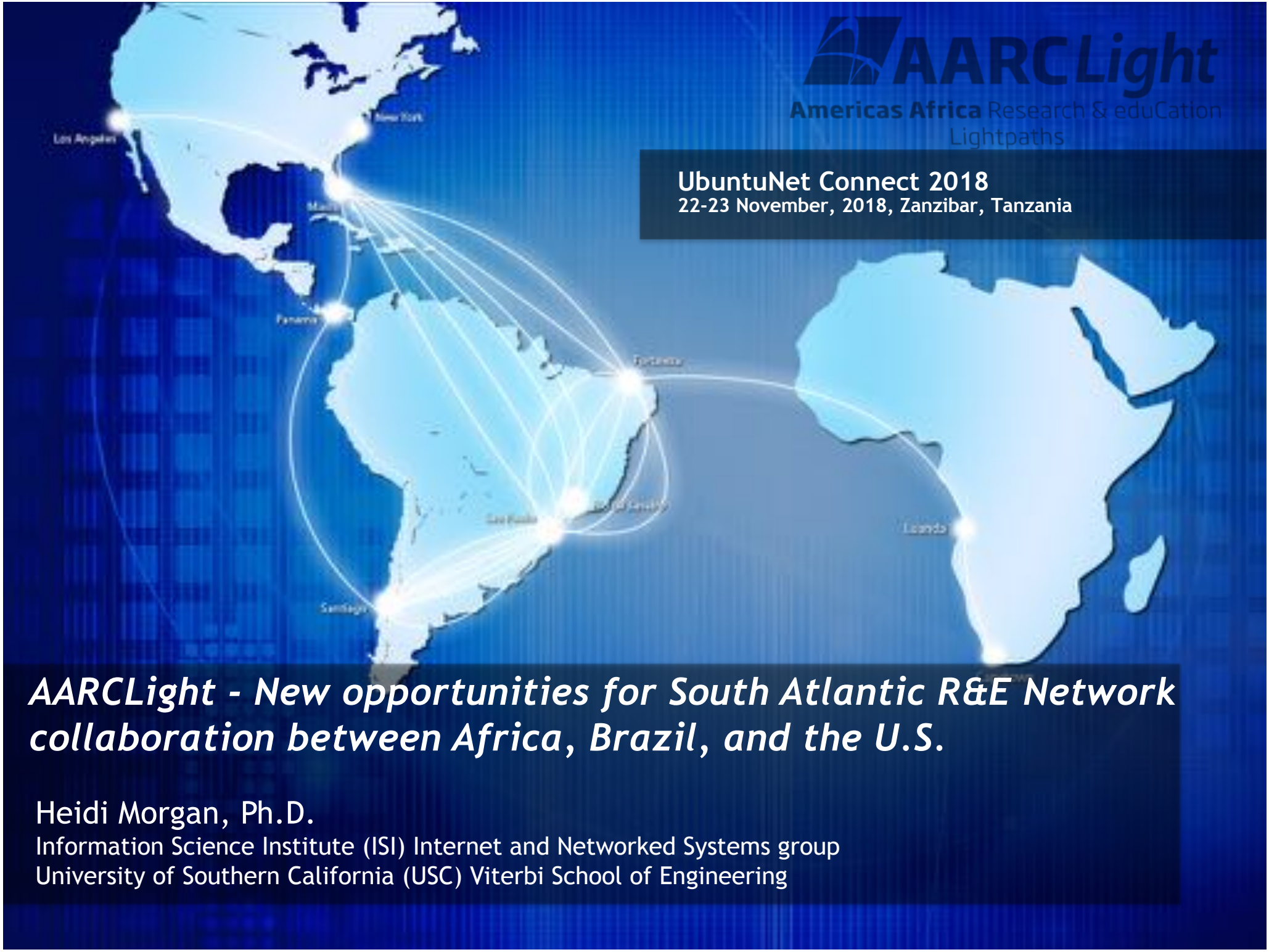
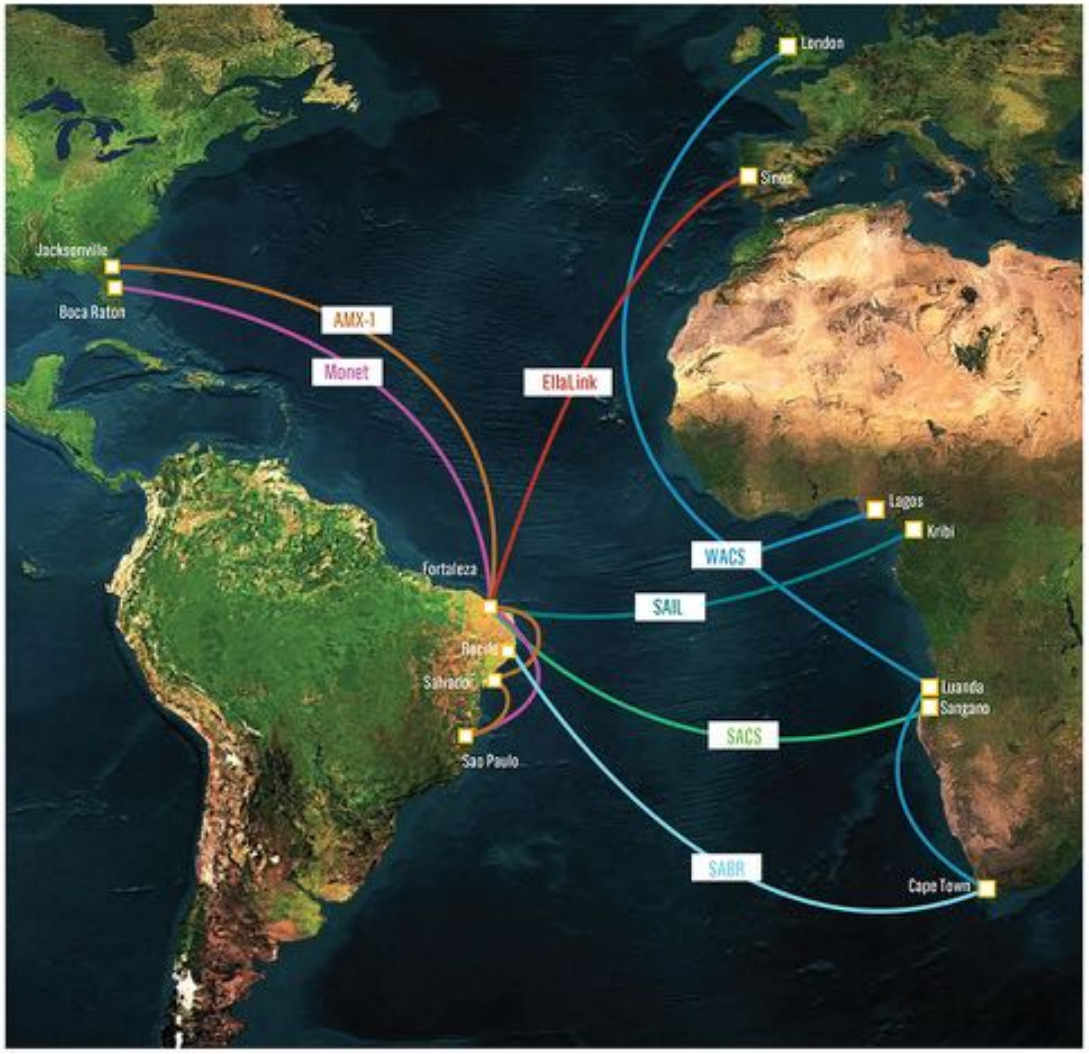


AARCLight - New opportunities for South Atlantic R&E Network collaboration between Africa, Brazil, and the U.S.

Heidi Morgan, Ph.D.
Information Science Institute (ISI) Internet and Networked Systems group
University of Southern California (USC) Viterbi School of Engineering

New submarine cables in the South Atlantic

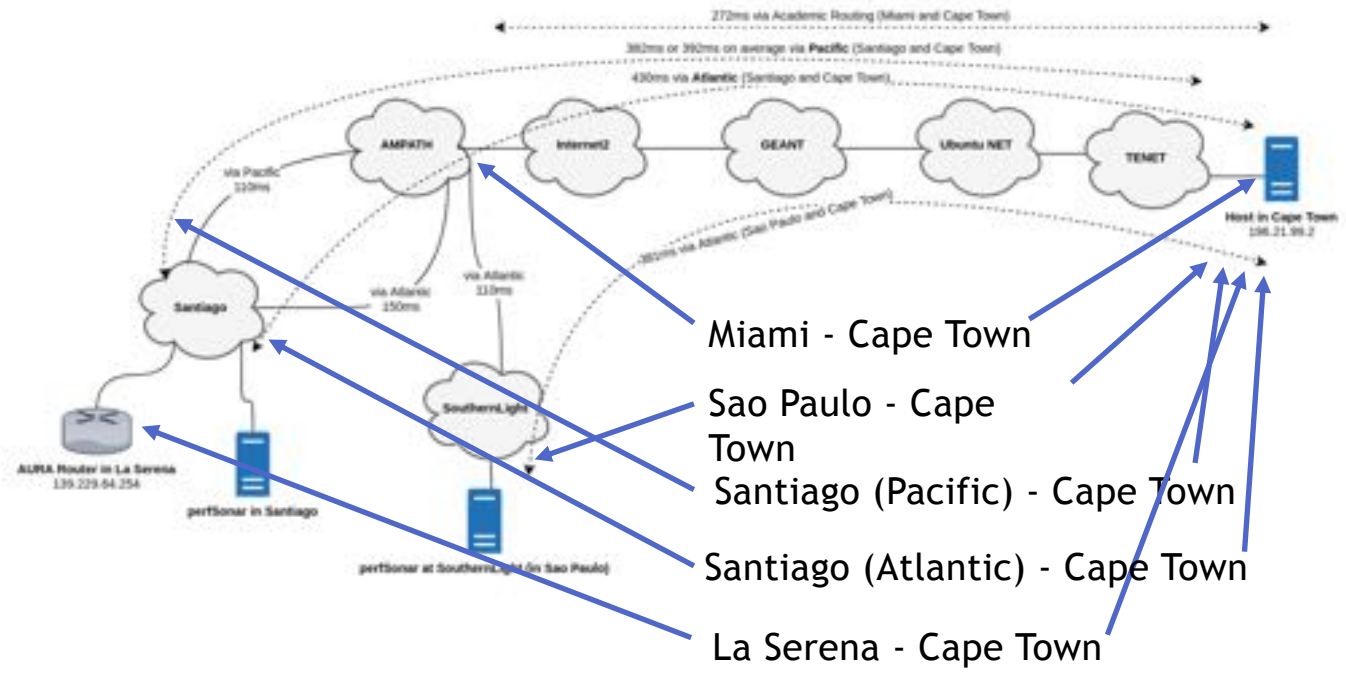
- **Monet**: Boca Raton, FL-Fortaleza, BR. Operational
- South Atlantic Cable System (SACS): Fortaleza, BR– Sangano, Angola. Operational
- America Movil (AMX-1): Fortaleza, BR – Jacksonville and Hollywood, FL. Operational
- SABR: Cape Town, SA – Recife, BR. RFS 2019
- South Atlantic Inter Link (SAIL): Fortaleza, BR – Kribi, Cameroon. Q3 2018 (TBD)
- EllaLink: Fortaleza, BR – Sines, Portugal. RFS 2020
- Fortaleza is a landing point for all cables, except for SABR



AARCLight
Americas Africa Research & eduCation Lightpaths

Network performance to Latin America

Current Academic networks transited were TENET, UbuntuNet, GEANT, Internet2, AmLight, REUNA, RNP and ANSP



From Cape Town to:	Currently via TENET, UbuntuNet, GEANT, and I2 *	Estimated via SACS	Possible Improvement
New York	241ms	192ms	20%
Miami	272ms	161ms	41%
Fortaleza, Brazil	336ms	97ms	71%
Sao Paulo, Brazil	381ms	142ms	63%
Santiago, Chile	382ms	183ms	52%
La Serena, Chile	392ms	193ms	51%

* Data column 2 provided by Len Lotz June 2018, except NY. All else from Angola Cables.

AARCLight
Americas Africa Research & eduCation Lightpaths

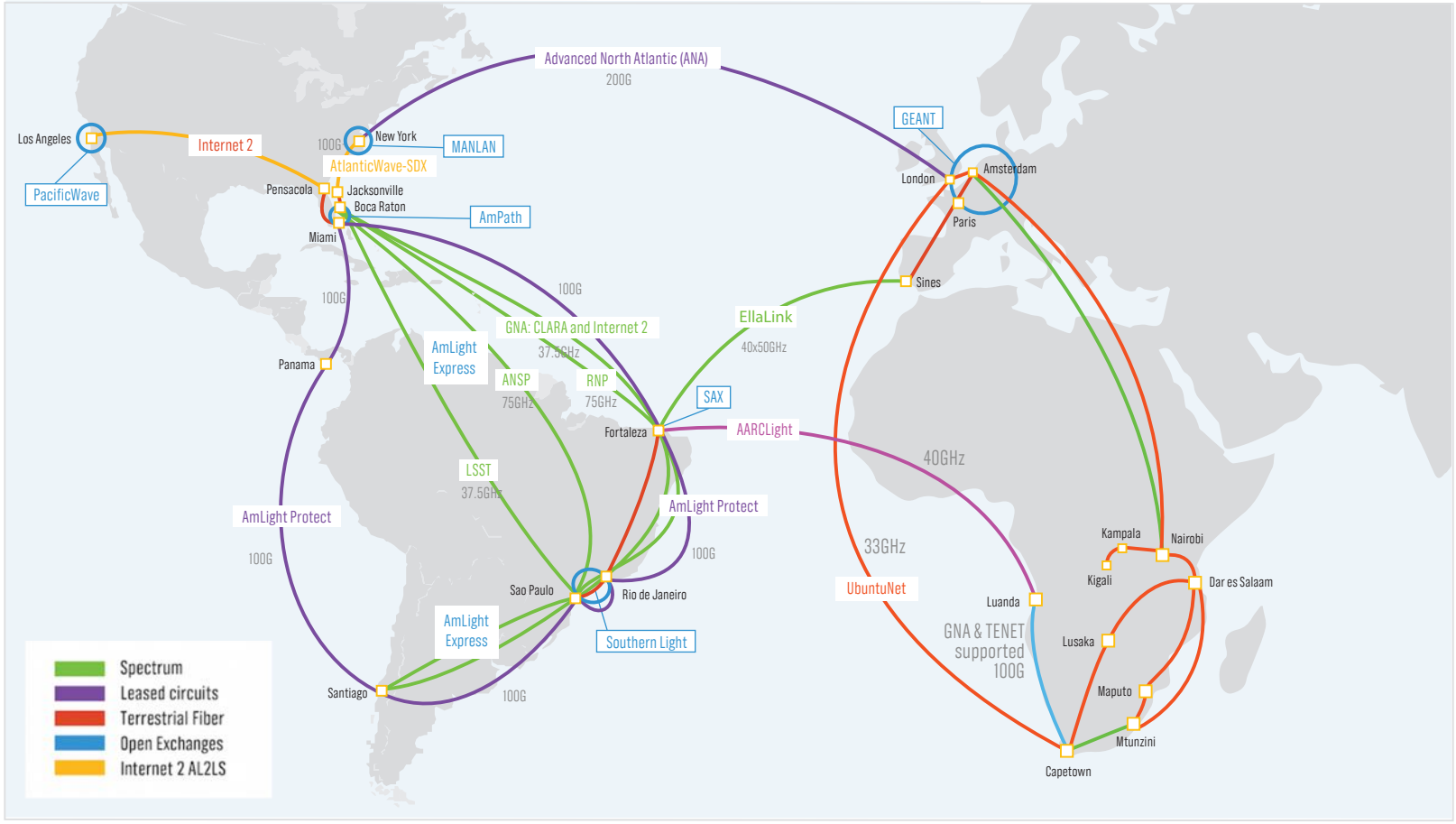
Americas Lightpaths Express and Protect (ExP)

AmLight ExP

(NSF Award# ACI-1451018 2015-2020)

- AmLight ExP is a hybrid network that uses
  - Optical spectrum (Express) and
  - Leased capacity (Protect)
  - to build a reliable leading-edge network infrastructure for research and education
- Links:
  - 100G ring Miami-Fortaleza, Fortaleza-Sao Paulo, Sao Paulo-Santiago, Santiago-Panama City, Panama City-Miami
  - 10G ring from Miami-Sao Paulo-Miami for protection
  - 10G Miami-Santiago for protection
  - 100G and 10G rings are diverse, operating on multiple submarine cables
  - Total upstream capacity presently at 230Gbps

Americas Lightpaths Express and Protect (ExP) (Conceptual)



AARCLight
Americas Africa Research & eduCation Lightpaths

SA NREN

- SA NREN (TENET and SANReN) operates an exchange point in Cape Town – ZAOXI.
- SA NREN has ownership of 7.4% of the WACS cable allowing it to light capacity between any 2 landing stations.
- AARCLight and AmLight are forming a collaborative partnership with SA NREN.
- Ubuntunet can participate in this project by connecting to ZAOXI.
- Once an exchange point is established in Luanda, SA NREN can light capacity between ZAOXI and the new exchange point using WACS
- Collaborative partners can utilize capacity as needed on the SACS cable, WACS cable, AARCLight etc. to connect to AmLight in Fortaleza, ZAOXI in Cape Town or any other connected Exchange point
- SA NREN's WACS connectivity may be extended to reach other landing stations to add new collaborative partners to the project.

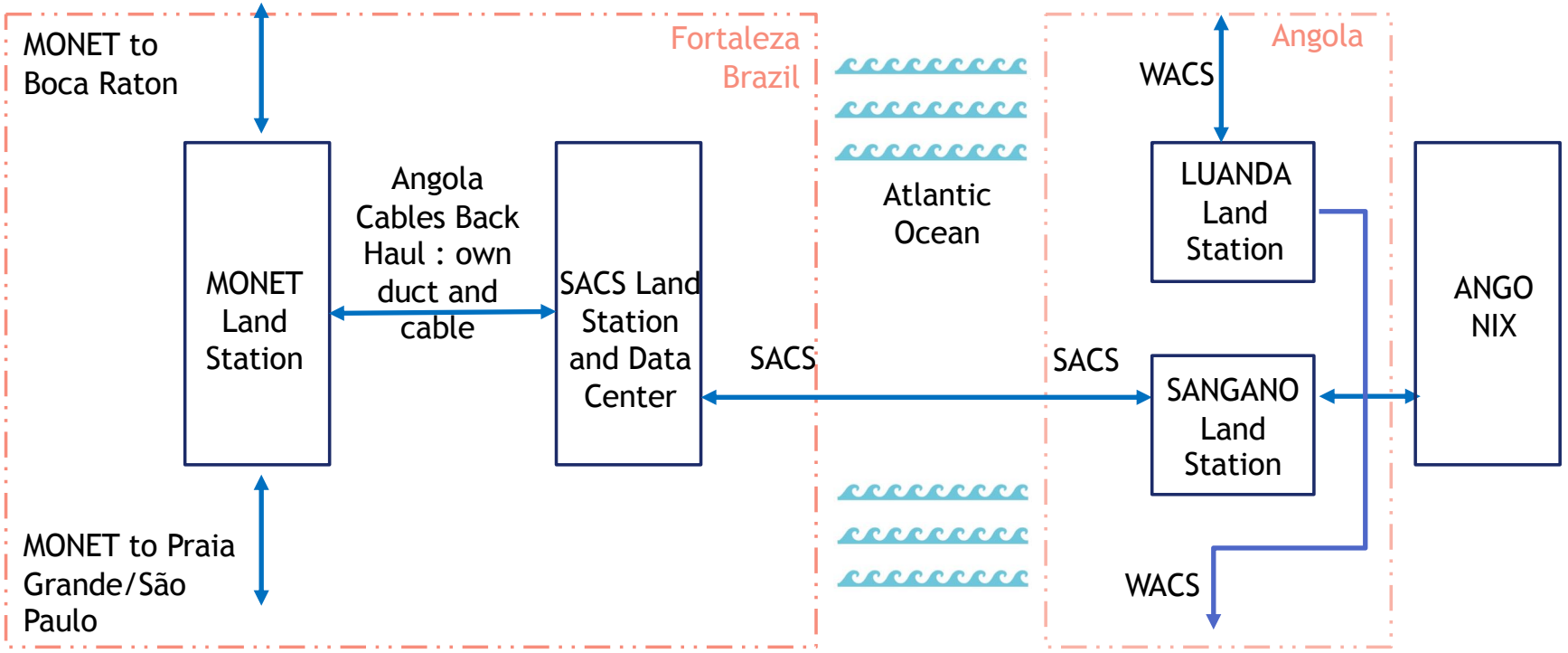
SANReN South African National Research Network

TENET Tertiary Education and Research Network of South Africa

AARCLight Americas Africa Research & eduCation Lightpaths

Opportunities in Angola

- SACS and WACS are connected at Sangano Cable Station in Angola, with possibility of being extended to Luanda via AC backhaul
- AC DC in Luanda would be an interesting exchanging point to the local REN
- SACS creates an opportunity to connect West Africa to Brazil, and the USA

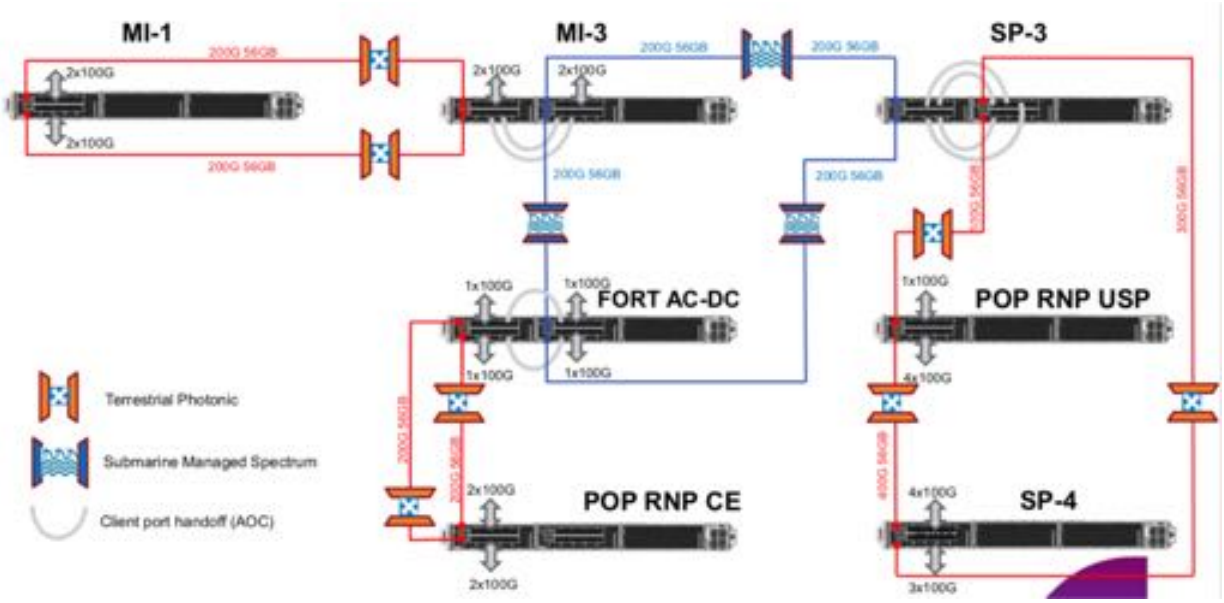


AARCLight
Americas Africa Research & eduCation Lightpaths

New GOLE/GXP in Fortaleza: South Atlantic Crossroads (SAX)

- Fortaleza is a key aggregation point in the South Atlantic
  - 2018: Monet (to US)
  - 2019: SACS (to Angola) + Replacement of leased lines
  - 2020: Ellalink (to EU), RedCLARA (to Los Angles, CA), and open to discuss future connections with other partners

- RNP's Global Exchange Point, SAX, to be deployed in Fortaleza, CE, Northeast Brazil as a hub for multiple international connections in the region
- SAX is designed to be compliant with both GNA and GLIF initiatives
- International partners, such as CLARA, Ampath and GEANT, are crucial to providing the new circuits reaching SAX.



AARCLight
Americas Africa Research & eduCation Lightpaths

About AARCLight

- Project of the U.S. National Science Foundation, Award #OAC-1638990, at FIU
- Aims to define a strategy for research and education network connectivity between the US and West Africa
- Aims to coordinate planning efforts among stakeholders in the U.S., Africa, and Brazil
- Aims to create economies of scale
  - Making use of the offered spectrum
  - Towards serving the broadest communities of interest in research and education

Planned Activities:

1. Establish collaborative partners
2. Establish a contract with Angola Cable for Spectrum
3. Develop a network design in coordination with AARCLight partners
4. Develop a plan to integrate the science disciplines with the network strategy
5. Develop a community engagement plan
6. Preparing a case study to present to the communities of interest and National Science Foundation (NSF)
7. NREN operators survey: https://fiu.qualtrics.com/jfe/form/SV_1CcwpFrr72r5ZC5

AARCLight
Americas Africa Research & eduCation Lightpaths

Science Drivers: South African Astronomical Observatory (SAAO)

- SAAO is a facility of the National Research Foundation
  - Operates under the Department of Science and Technology
- The **Southern African Large Telescope** (SALT) is the largest single optical telescope in the southern hemisphere and among the largest in the world.
- SALT is funded by a consortium of international partners from South Af
  USA, Germany, Poland, India, the UK, and New Zealand
- SAAO Hosted Research Telescopes: BiSON, KELT-South, LCOGT, MONET, SuperWASP-South
- SALT generates 5-50 GB/night, with future instrumentation ~250 GB/night



Science Drivers: South African's radio telescopes MeerKAT & Square Kilometre Array (SKA)

- The MeerKAT 64-antenna array radio telescope in the Karoo region
- Collaborators: USA, Canada, India, Japan, China, Australia, France, UK, Italy, Finland, Germany
- MeerKAT is a precursor to the SKA
  - Will be merged into the SKA1 (2020)
  - SKA will be the largest array telescope in the southern hemisphere (2024)
- Currently data at a rate of 4.7 Gbps

https://www.ska.ac.za/science-engineering/meerkat/about-meerkat/



- SKA will generate ~160 Gb/s
  - (109) bits per second from each radio dish to a central processor
  - High frequency dishes will produce ten times the current global internet traffic!
  - Phase two will include telescopes from New Zealand, Botswana, Ghana, Kenya, Mauritius, Madagascar, Mozambique, Namibia and Zambia.
- The SKA will generate 960,000 Tb/day

https://www.skatelescope.org



AARCLight
Americas Africa Research & eduCation Lightpaths

Science Drivers: Brazilian Research and Educational Network (RNP) Applications

- Agricultural research [Embrapa/Min. of Agriculture]
  - pest control - army worm (lagarta do cartucho) which attacks maize and sorghum (Brazil, USA, South Africa + 9 other African countries)
- Medical research [FIOCRUZ/ Min. of Health] – collaboration with African nations of the Community of Portuguese-Speaking Countries (CPLP)
  - Infectious diseases: Malaria, STI, AIDS, Viral Hepatitis, Tuberculosis
  - AIDS in Angola: genotyping and resistance of HIV-1 to anti-retroviral drugs
- Atlantic International Research Centre (AIR-Centre), Azores, Portugal
  - Potentially large scale multilateral collaboration
  - Agreement between EU-BR-ZA
- MoRENeT (Mozambique NREN) [RNP]
  - Close relationship with RNP for training and exchange of information

Slide courtesy of M. Stanton and P. de Ameida RNP

Julio Ibarra – *Assistant VP of Technology Augmented Research*, Florida International University (FIU)

Jeronimo Bezerra- *Assistant Director, Chief Network Engineer*, Florida International University (FIU)

Luis Fernandez Lopez – *Principal Investigator* of the Academic Network at São Paulo (ANSP Brazil)

Vasilka Chergarova – *Research Coordinator,* Florida International University (FIU)

Donald A. "Chip" Cox III – *Research Assistant Professor Department of Physics & Astronomy Vanderbilt University.* (USA)

Gabriella E. Alvarez – *Researcher* at Harvard-Smithsonian Center for Astrophysics, Dept. Astrophysics at Vanderbilt University (USA)

Michael Stanton - Ne*twork Scientist* at Rede Nacional de Ensino e Pesquisa (RNP Brazil)

Aluizio Hazin - *Engineering and Operation* at Rede Nacional de Ensino e Pesquisa (RNP Brazil)

Len Lotz - *Executive Officer*, Tertiary Education and Research Network (TENET South Africa)

Siju Mammen - *Head of Network Engineering* at the South African Research Network (SANReN South Africa)

THANK YOU!

Heidi Morgan Ph.D.
Co-Principal Investigator AARCLight
hlmorgan@isi.edu