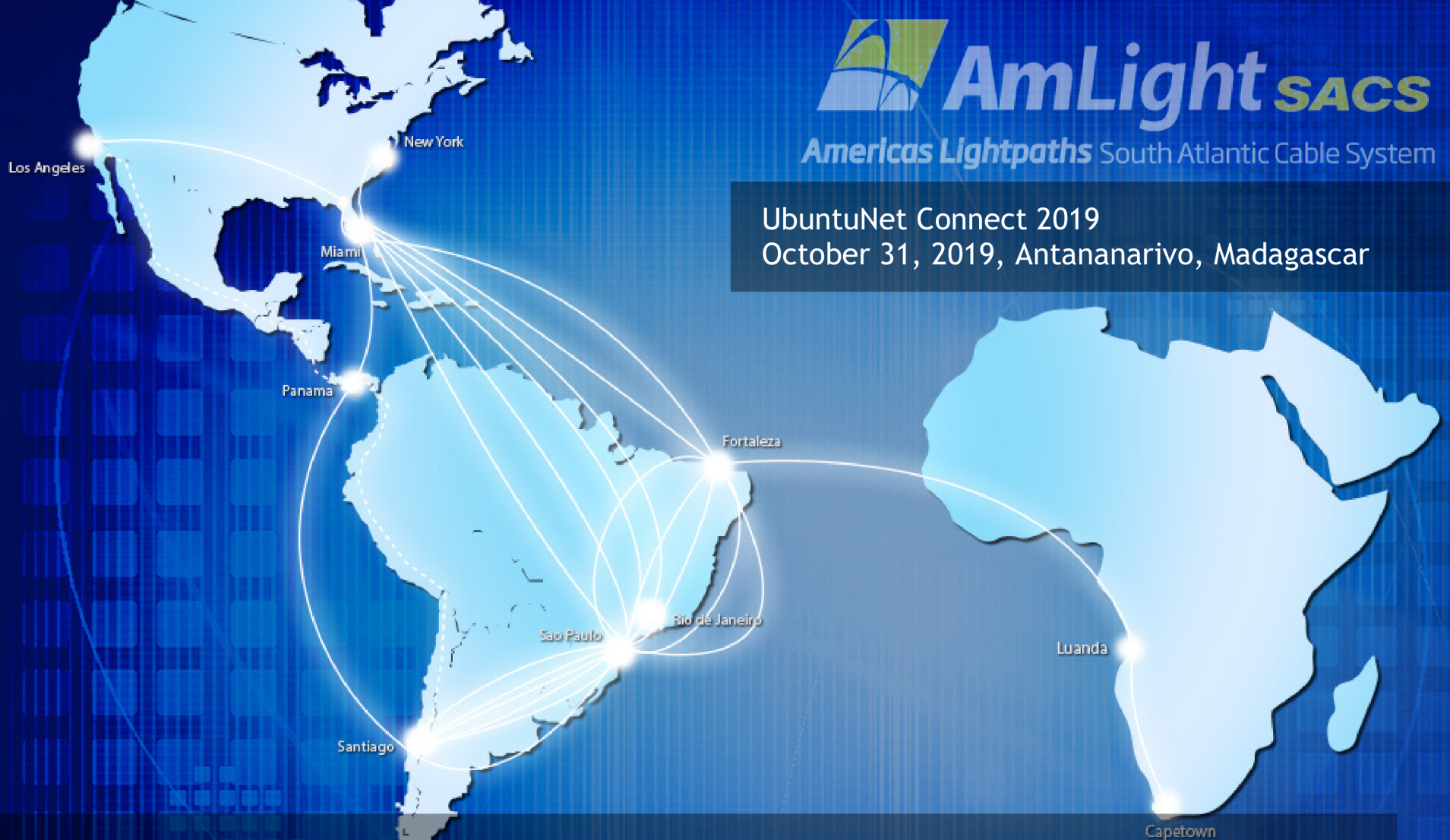


UbuntuNet Connect 2019

October 31, 2019, Antananarivo, Madagascar



Collaborating to leverage R&E network infrastructures between Africa, Brazil, and the U.S.

Heidi Morgan, PhD / Co-PI AmLight-ExP
Information Science Institute
University of Southern California

AmLight Express & Protect Vision

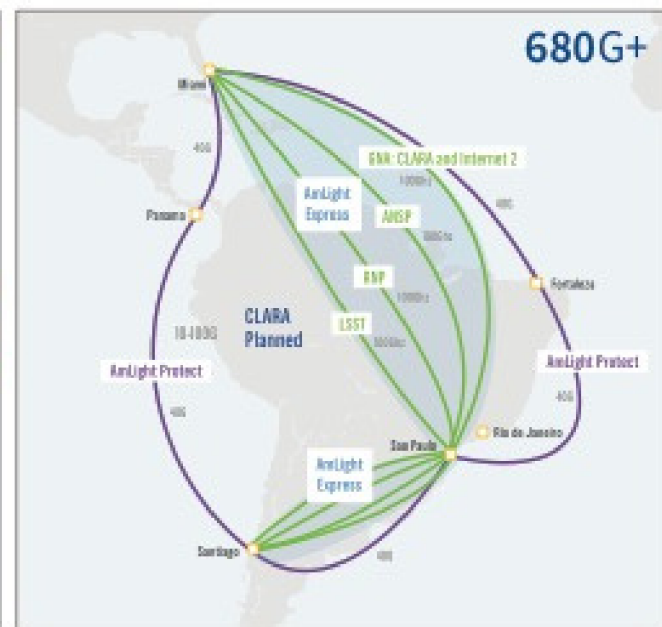
Backbone: AMLIGHT



Current



2015-2017



2018-2031

- Community-operated network infrastructure
- Leased capacity on two submarine cable systems, evolving to a hybrid model that includes spectrum from Boca Raton to Sao Paulo
- Express (spectrum) capacity will provide up to 6 optical channels, which are lit with 100G transponders
- Protect (leased) capacity 100G ring backs up the Express capacity

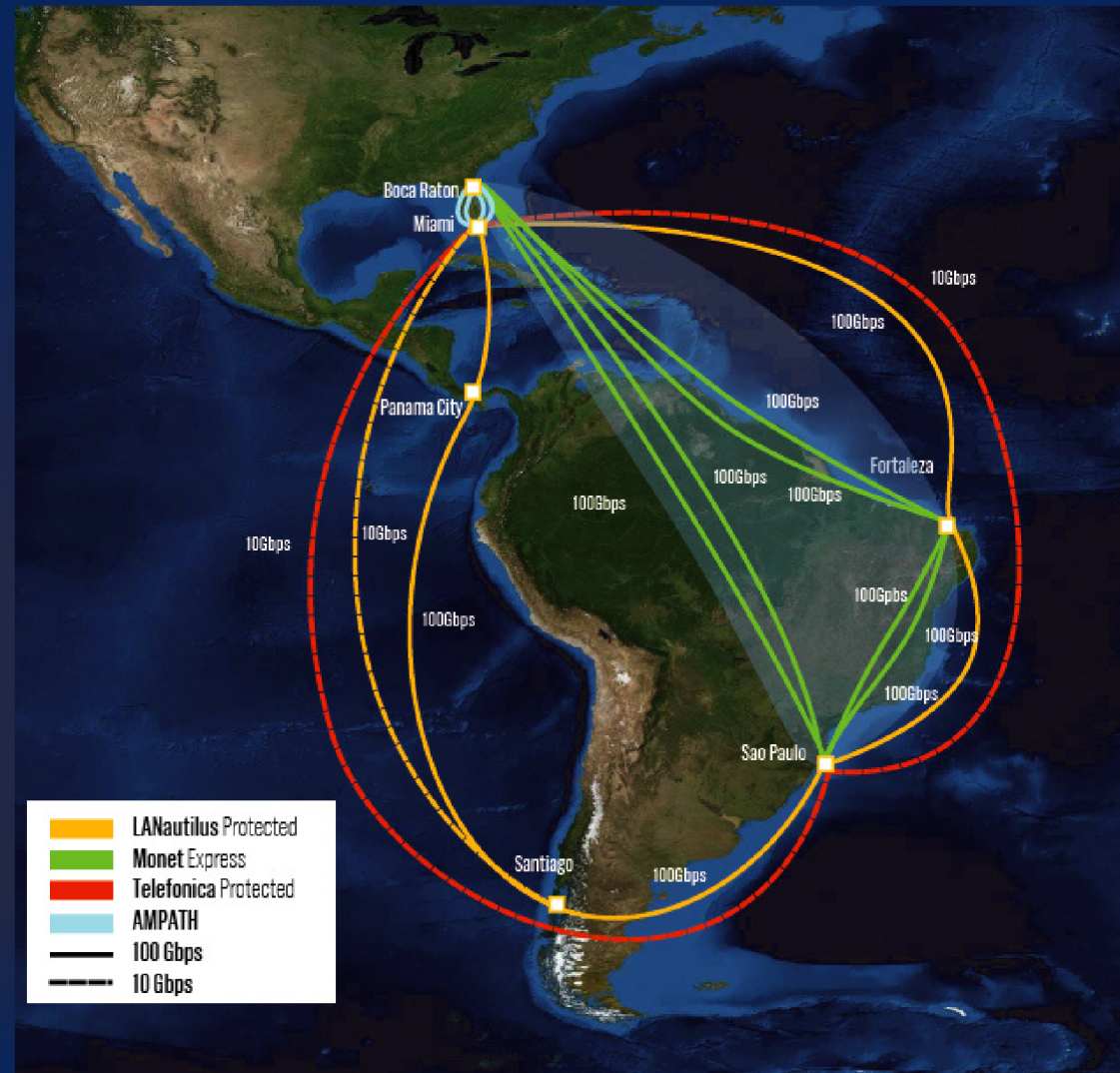
Partners and Goals

- AmLight-ExP interconnects the U.S. to key aggregation points in South and Central America (Brazil, Chile, Panama)
- 5-year Cooperative Agreement with the U.S. National Science Foundation
- Cooperative and collaborative partnerships with ANSP, RNP, CLARA, REUNA, AURA, FLR, and Internet2
- Continuously evolving rational network infrastructure using both optical spectrum and leased capacity



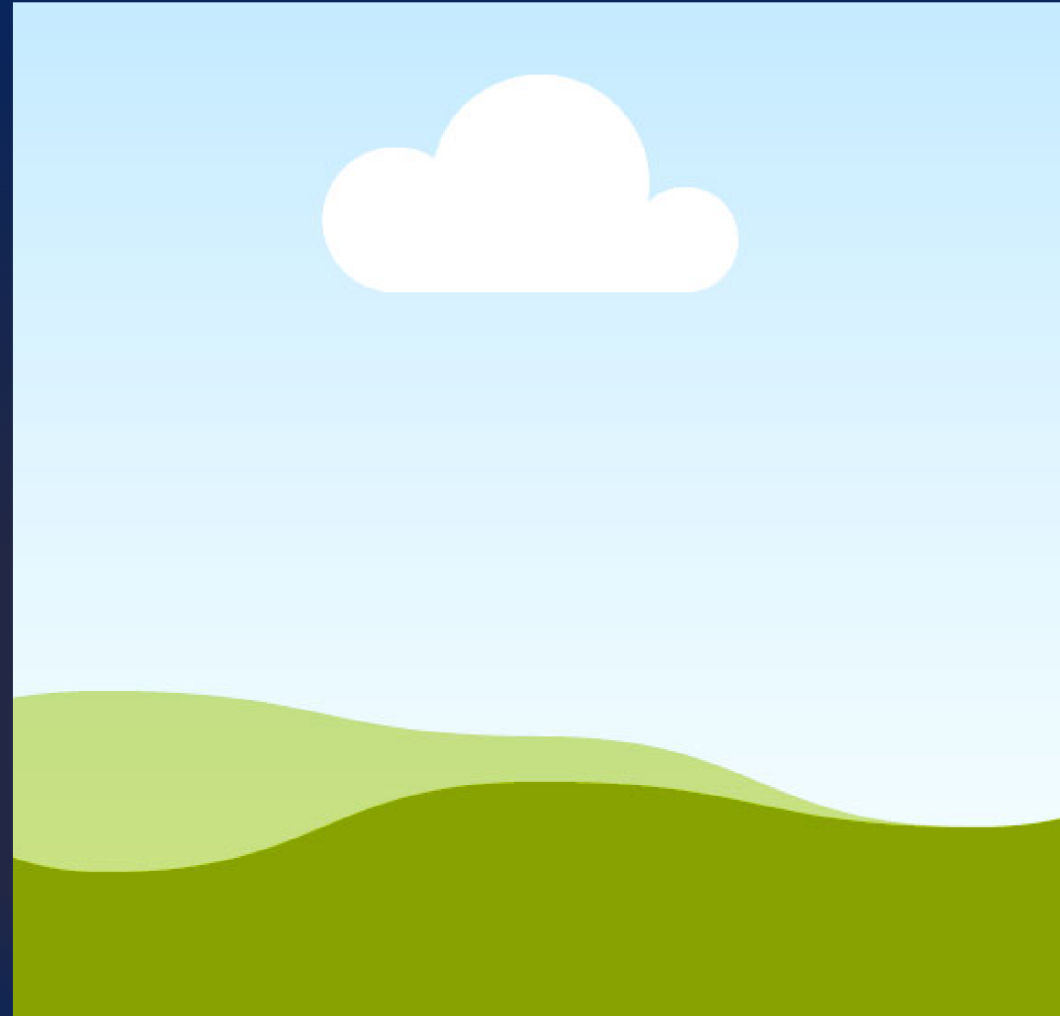
AmLight- ExP Network Infrastructure Today

- **Express Ring:** Boca Raton, Fortaleza, Sao Paulo
 - 6 (green lines) x 100G links
 - 4 managed by RNP
 - 2 managed by FIU/ANSP/LSST
- **100G Protect Ring:** Miami-Fortaleza, Fortaleza-Sao Paulo, Sao Paulo-Santiago, Santiago-Panama, and Panama-Miami (solid orange)
- 10G ring from Miami-Sao Paulo-Miami for protection (red dashed)
- 10G Miami-Santiago for protection (orange dashed)
- 100G and 10G rings are diverse, operating on multiple submarine cables
- Total upstream capacity presently at **630Gbps!**



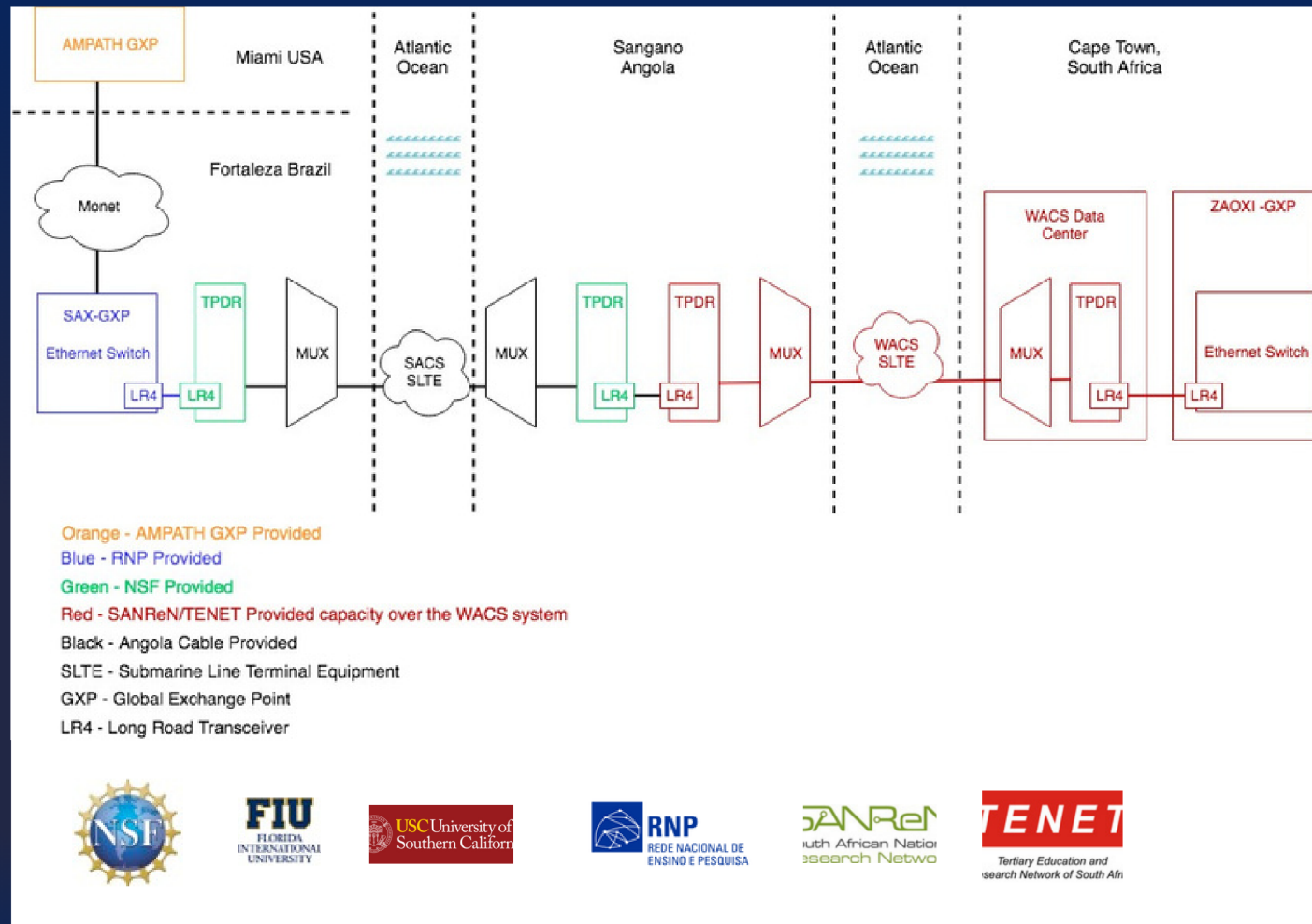
Network infrastructure resources in the Southern Hemisphere

- AmLight-South Atlantic Cable System (SACS) is a project of AmLight-Exp
- Three 200G waves on Monet committed in AmLight-Exp project
- 100G Ethernet on SACS will soon be available to the R&E community
- TENET/SANREN operates >800G of capacity on WACS to connect to SACS in Sangano, Angola
- South Atlantic eXchange point (SAX) in Fortaleza, led by RNP
- R&E exchange point in Cape Town operated TENET/SANREN



AmLight-SACS

- Establishes a new South Atlantic route
- Creates a new R&E network connection between the U.S., South America and Africa by
 - Interconnecting SACS to Monet and WACS
- Operated by AmLight-Exp, RNP and TENET/SANREN



AmLight-SACS Global Exchange Points

Facilities in the South Atlantic & Miami, FL USA

- Interconnecting the REN exchange points AMPATH (Miami), SAX (Fortaleza) and ZAOXI (Cape Town)
 - The SACS cable, between Brazil and Angola, is operational
 - The WACS cable, between South Africa and Europe, is operational and connects to SACS in Angola
 - SACS and the AmLight ExP cables scheduled to interconnect at the SAX GXP in Fortaleza by end of 2019
- Thus we have the ingredients to create a resilient South Atlantic REN interconnection reaching N. America and beyond via AMPATH,
- Greatly reducing the latency of traffic between the Americas and Africa

AMPATH
Miami



SAX
Fortaleza



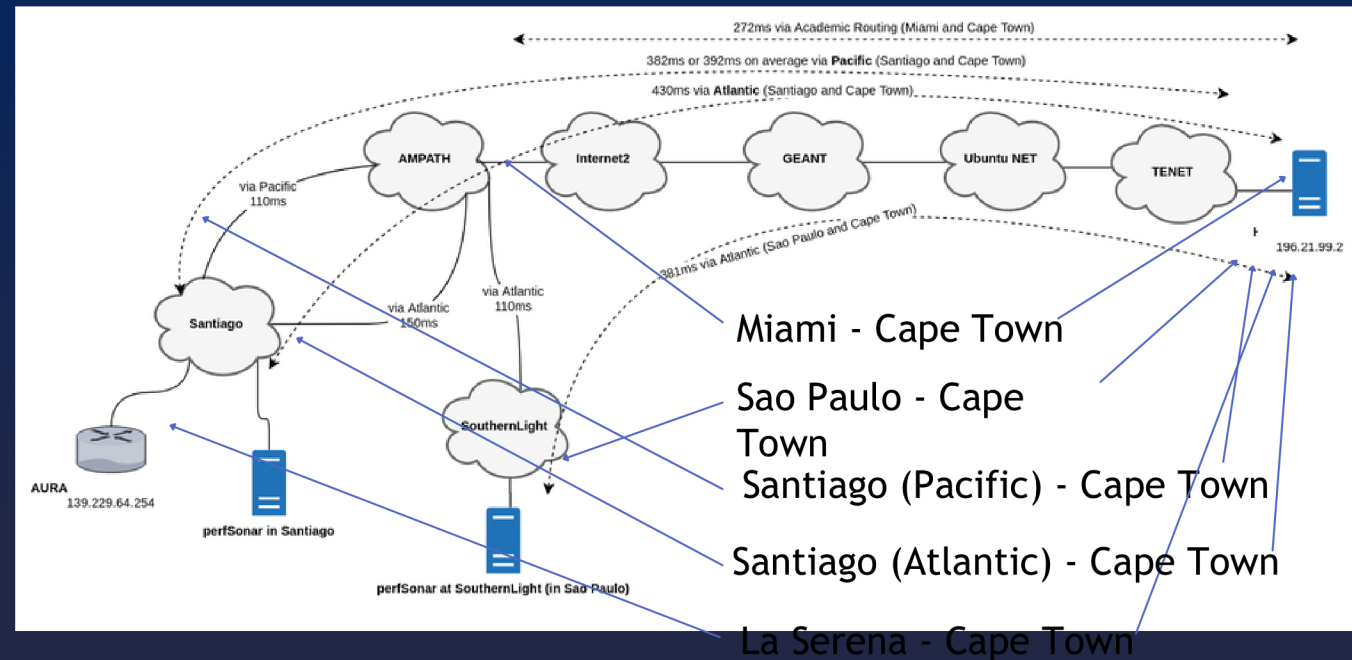
ZAOXI
Cape Town



Slide borrowed from Michael Stanton

Network performance to the US and Latin America

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

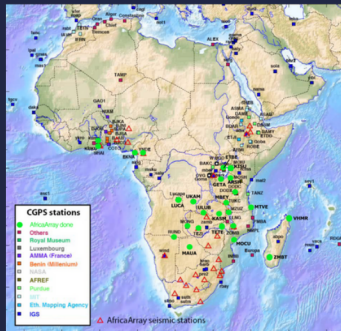


From Cape Town to:	Currently via TENET/SANREN, UbuntuNet, GEANT, and I2	Actual via SACS	Possible Improvement
New York	241ms	192ms	126%
Miami	272ms	161ms	169%
Fortaleza, Brazil	336ms	97ms	346%
Sao Paulo, Brazil	381ms	142ms	268%
Santiago, Chile	382ms	143ms	250%
La Serena, Chile	392ms	153ms	256%

The results from latency measurements taken from the TENET/SANREN network in Cape Town, traversing research networks UbuntuNet, GEANT, Internet2, AmLight, RNP and REUNA to reach sites in New York (USA), Miami (USA), Fortaleza (Brazil), Sao Paulo (Brazil), Santiago (Chile), and La Serena (Chile).

Science Driver collaborations Africa & The Americas

- Astronomy
- Medical
- Other Science Disciplines



Global Positioning System (CGPS) in Africa. Source: https://www.unavco.org/community/publications_and_reports/reports/reports.html



Earth Observation Institutions Torman, Y. (2017). AfREN and AfriGEOSS. Paper presented at the AfriGEOSS Symposium 2017, Sunyani, Ghana.



Human Heredity and Health in Africa (H3Africa) Nordling, L. (2017). How the genomics revolution could finally help Africa. Nature News, 544(7648), 20.



Telescope sites across Africa, with its core in the Northern Cape Potgieter, P. (2015). GIS in constructing the SKA. Retrieved from <https://www.ee.co.za/article/gis-constructing-ska.html>

Science Drivers: South African Astronomy Projects



- The MeerKAT 64-antenna array radio telescope in the Karoo region
- South African's radio telescopes MeerKAT & Square Kilometre Array (SKA) to merge in 2020. SKA will generate 960,000 Tb/day
- [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 Africa, the USA, Germany, Poland, India, the UK, and New Zealand
- SAAO Hosted Research Telescopes: [BiSON](#), [KELT-South](#), [LCOGT](#), [MONET](#), [Solaris](#), [SuperWASP-South](#)
- SALT generates 5-50 GB/night, with future instrumentation ~250 GB/night



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



<https://www.skatelescope.org>

Science Drivers: Genomic, Proteomic and HIV Research

- A number of South African Universities and Research Institutions including University of Cape Town, University of Witwatersrand, University of the Western Cape, Centre for Proteomic & Genomic Research, The Medical Research Council and the Agricultural Research Council are interacting with Research Entities globally in these fields.
- Participation of UbuntuNet and WACREN:
 - Access to a wealth of Research undertakings by their Member NRENs
 - Letters of Collaboration from the CEO's
 - Cape Town is an aggregation point for these networks until more are opened by African NRENs



NIH Projects in Africa. Source: <https://report.nih.gov/award/#tab4>

AARCLight Planning Grant Conclusions

- Funded by the NSF AARCLight studied the potential benefits of SACS to the R&E Networking community and came to these conclusions with your help;
 - We can add network resiliency and reduce latency between Africa, Brazil, and the US
 - AmLight-Exp connection WACS -SACS required in Sangano cable land station.
 - Angonix Data Center in Sangano, Angola near Luanda is operated by Angola Cables is a potential future African / Angolan switch location.
 - AARCLight findings support lighting SACS at 100G Ethernet for R&E Network as part of a 100G pathway
 - AmLight-SACS ordered 2 x 100G Transponders; 1 for Fortaleza and 1 for Sangano to make the connections to WACS and MONET to be installed by Angola Cables
 - FIU and TENET/SANREN have signed an MOU to interconnect SACS to WACS
 - Benefits to astronomical science and other disciplines immediate



NSF AmLight-Exp, AARCLight, AMPATH infrastructure, science application support, education, outreach and community building efforts are made possible by funding and support from: National Science Foundation (NSF) awards OAC-1451018, OAC-1638990

THANK YOU!

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

