



Introducing new technologies, innovations, and collaborations in R&E Networking between Africa, Latin America, Europe and the US through new international projects

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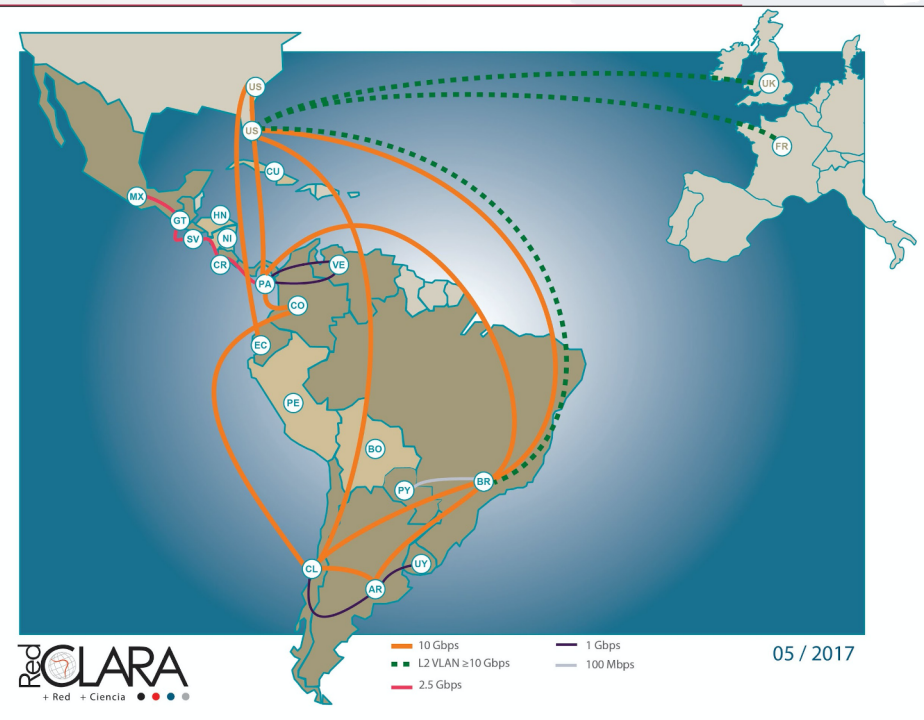
Outline

- Updates on connectivity to Latin American NRENs and RedCLARA, the regional REN in Latin America, with emphasis on the Bella (Building Europe Link to Latin America) initiative carried out with European RENs
- South Africa NREN Connectivity (TENET/SANReN)
- Updates on AmLight ExP & AtlanticWave SDX 2.0 (FIU CIARA)

RedCLARA

<https://www.redclara.net/index.php/en/>

- RedCLARA is the regional REN (research and education network) in Latin America.
- Created in 2003 and supported by the European Commission (CE) through the ALICE (2003-7) and ALICE2 (2008-12) projects, it currently connects 11 NRENs from 18 targeted countries.
- The map shows the internal topology as well as the direct external connections to the USA (Amlight), with currently no direct links to other countries/continents in 2017
- Since 2018, new transatlantic links to Africa and Europe are removing this limitation.



NEW Direct transatlantic links From Latin America to Africa and Europe

- Since 2018, 3 new transatlantic submarine cables have been laid from Fortaleza in Brazil:
2018: SACS (to Angola) and SAIL (to Camaroun);
2021: EllaLink to Portugal, with landings in Africa (Cape Verde, Mauretania and Morocco)
- These links provide increased opportunities for cooperation with African R&E communities.
- RedCLARA has already signed a cooperation agreement with UbuntuNet Alliance to foster and expand collaboration opportunities in Southern Africa.
- This provides, together with the Bella Project, a significant network, augmenting cooperation opportunities between Europe, USA, Latin America, and Africa.

The BELLA Initiative (Since 2016)

- Ever since the beginnings of RedCLARA in 2004, it was clear that other direct international R&E connections should be made to the neighbouring continents of Europe and Africa.
- After a feasibility study in 2010-12, the EC launched a call for connecting LA to Europe, and launched the BELLA project with GÉANT, RedCLARA and EU and LA NRENs in 2016.
- A major problem was to find a commercial company interested in laying a new cable between Europe and South America and offer acceptable terms for R&E use: the company selected by open call was ELLALINK
- ELLALINK signed a contract in 2018 with RedCLARA, GÉANT and NREN to provide 3/8 of the spectrum (45 channels (100 or 150 Gb/s)) on a fibre pair between Sines, Portugal and Fortaleza, Brazil, for the lifetime of the cable (25 years)

The BELLA Initiative (Since 2016)

- In March 2021, the transatlantic part of ELLALINK was completed, and service should be provided from June this year.
- This project is called BELLA-S, and is being complemented by the rebuilding of corresponding network infrastructure in South America – the BELLA-T project – a new release of RedCLARA with scalable capacity of Nx100Gb/s



RedCLARA: High capacity intercontinental access for Latin American NRENs (Project BELLA)

- The delivery of Nx100G connectivity using the new EllaLink cable (Brazil-Portugal) in 2021 also provides Nx100G connectivity between Europe and several NRENs in South America (initially Brazil, Chile, Colombia and Ecuador)
- GXPs (Global Exchange Points) in Fortaleza and São Paulo provide support for traffic to Africa via SACS, as well as to the US via Amlight Exp.



SA NREN – 100G and Beyond

The SA NREN has steadily been implementing backbone enhancements to support current and future research and education activities.

Network Enhancements:

- National DWDM Backbone
- National and International Gateway Router Upgrades
- International 10G Link Consolidations
- International Collaboration

SA NREN – Network Enhancements

National DWDM Backbone

- 96 Channel – Gridless and Directionless Optical Line System
- 100G DWDM Transport – Long Haul
- 200G DWDM Transport – Metro
- 400G/600G/800G transport ready!

SA NREN – Network Enhancements

National and International Gateway Router Upgrades

- Seven Gateway Nodes
- Medium Density 100G (24 ports)

International 10G link consolidations

- 100G Cape Town – London (WACS)
- 100G Mtunzini – Amsterdam (SEACOM)

SA NREN – Network Enhancements

International Collaboration

- Established ZAOXI (South Africa Open Exchange One)
- 100G WACS to Angola for SACS Interconnect
- AMPATH GXP Miami
- ANSP, CANARIE, CSTNET, Internet2 and RedClara
- AARNet (in planning)
- US IP Transit

SA NREN – Network Enhancements

International Collaboration - Future

- Enable ZAOXI for Atlantic-Wave SDX Integration
- DTN (Data Transfer Nodes) and PerfSONAR 100G Upgrades
- Invitation to WACREN to join ZAOXI

Americas-Africa Lightpaths Express and Protect (AmLight-Exp)

The goal of the newly funded AmLight Exp project (NSF Award #2029283) is to operate and continuously improve production and experimental network connections between the USA, Latin America and Africa:

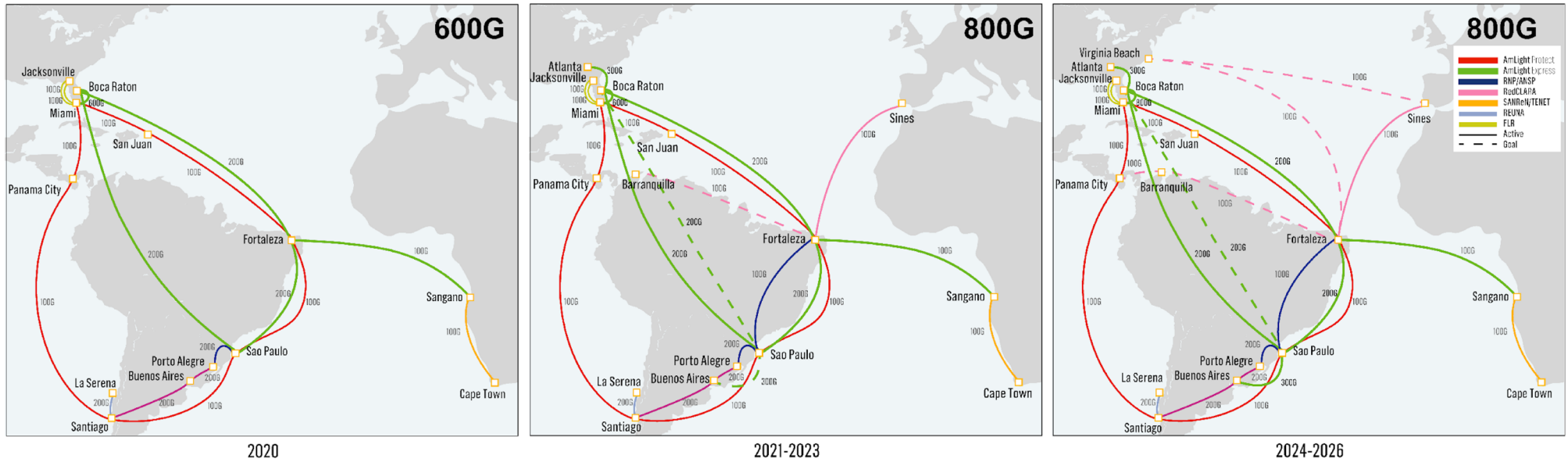
- **Evolving the AmLight-Exp physical infrastructure:** The upgraded network infrastructure will support new high-demand SLA-based science drivers.
- **Evolving the AmLight-Exp SDN Controller:** With the existing infrastructure, AmLight Exp has presence in 3 continents, 10 data centers, and a forwarding layer that includes 25+ 100Gbps links. On top of this complex infrastructure, many services are provided, such as L2VPNs, L3VPNs, cloud services, R&E IP Transit, including dynamic services and testbeds. The AmLight-Exp SDN Controller will be enhanced to increase automation of many network functions and improve resiliency.

(NSF Award # ACI-2029283)



Americas-Africa Lightpaths Express and Protect (AmLight-ExP)

Backbone: Americas Lightpaths Express and Protect (AmLight-ExP)

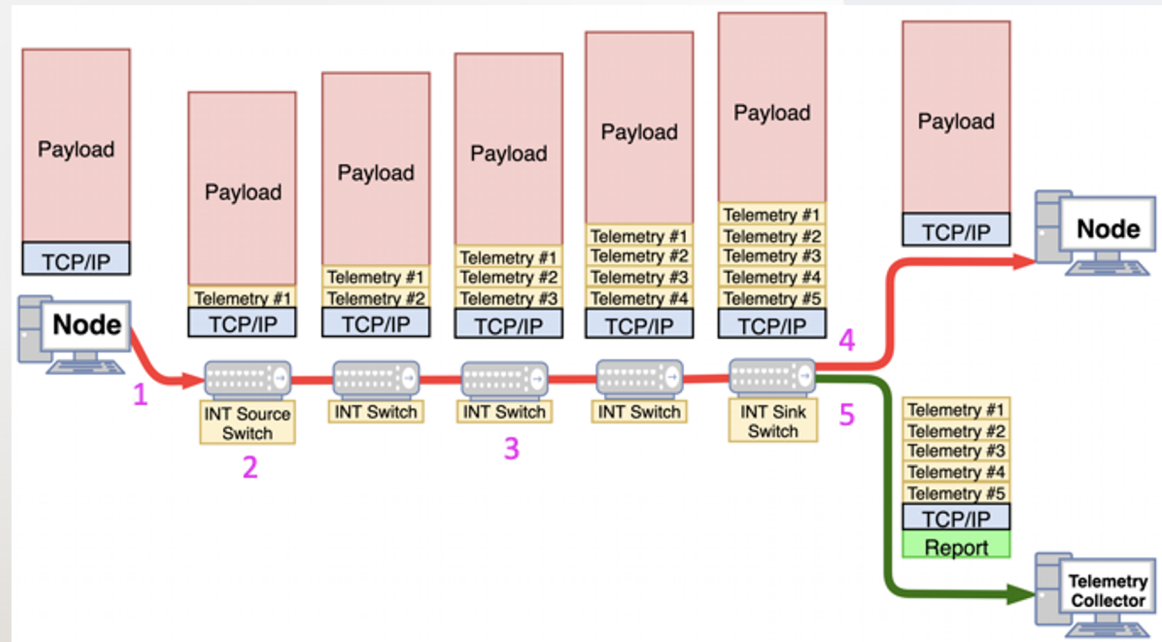


(NSF Award # ACI-2029283)

Increasing Automation and Improving Resiliency

AmLight In-band Network Telemetry (INT)

- Leverages new programmable network devices on the AmLight ExP network
- Highly granular network telemetry
- Enables at scale per-packet monitoring
- Enables real-time troubleshooting and traffic engineering in sub-second interval



(NSF Award #OAC-1848746)



AtlanticWave-SDX 2.0

A Distributed Experimental SDX Supporting Research, Experimental Deployments, and Interoperability Testing at Global Scale

GOALS:

To build a distributed SDX between the Americas and Africa

- Building a distributed intercontinental experimental SDX by leveraging Open Exchange Points (OXPs) connected to AmLight ExP
- The project also includes collaboration with the Open Science Grid (OSG) and Pegasus workflow management system.

To enable domain scientists to reserve network resources through a multi-domain SDX by

- Simplifying the interface for domain scientists to request network resources
- Providing interfaces to program the forwarding plane to respond to application requirements

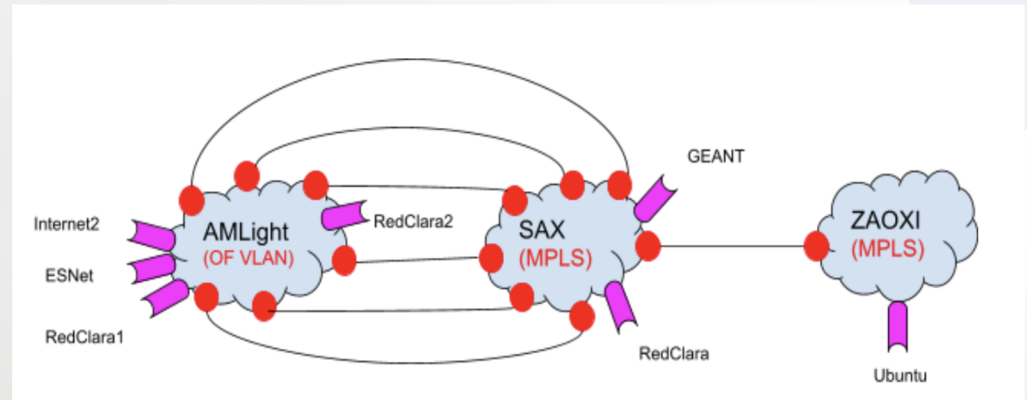
(NSF Award #2029278)



Supporting Research Experimentation and Testing at International Scale

AtlanticWave-SDX 2.0 facilitating the use of the international distributed REN network built for domain scientists and science applications for:

- Distributed High Throughput Computing (dHTC)
- Real-time high-availability applications (e.g., Vera Rubin Observatory, MeerKAT, SKA, HERA, PAPER)
- International research testbeds (e.g., FABRIC)
- Bulk data transfer applications (e.g., BigData Express).



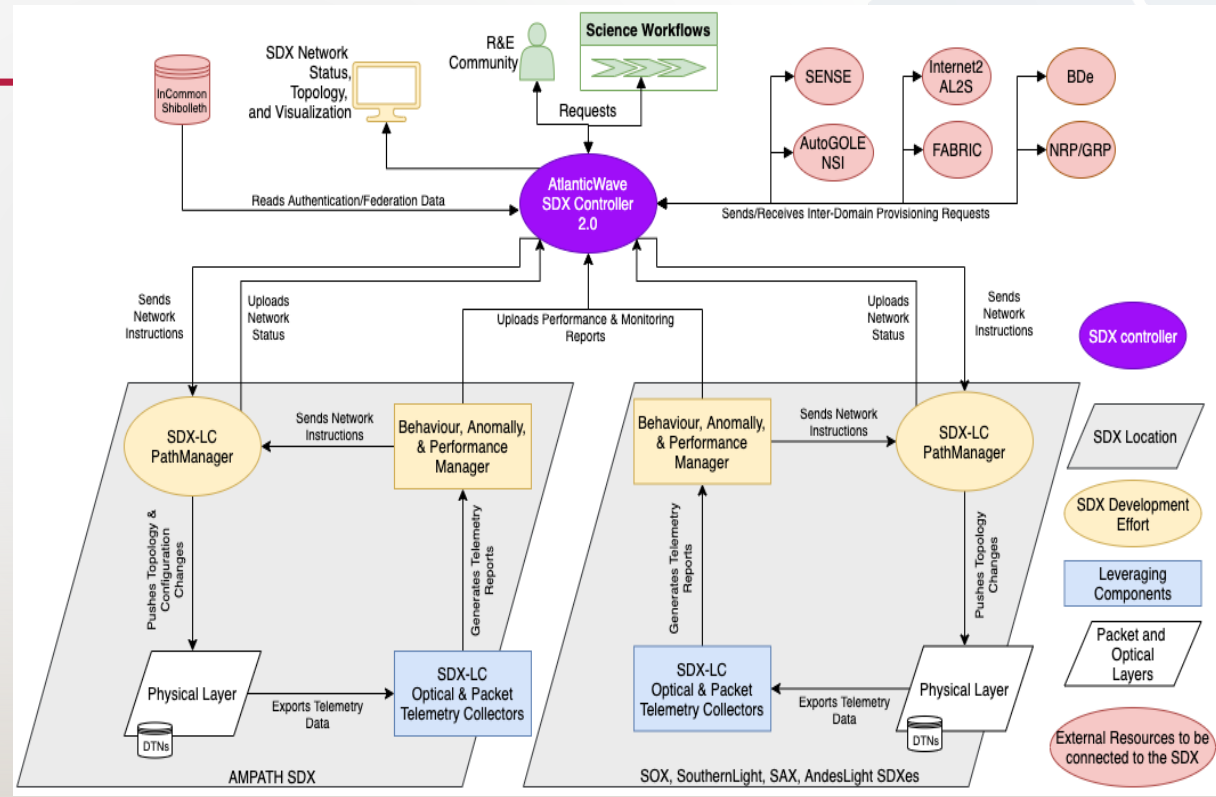
AW-SDX Data Plane

(NSF Award #2029278)



AtlanticWave-SDX 2.0 Architecture

- Closed-Loop Orchestration
- Dynamic provisioning of Layer3 services
- Integration with SENSE, AutoGOLE and FABRIC orchestrators
- Compute and Storage integration
- Integration with science applications by
 - Exporting topology information
- Network Management tools
 - Inventory, Monitoring, Debugging, SDX configuration, Telemetry



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THANK YOU!

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