Supporting Major Facilities in Latin America and Caribbean

CI4MF 2024 - Collaboration in Action
Coordinating and Combining Data Processing, Movements, and Storage

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Outline

- About AmLight Express and Protect (AmLight-ExP)
- Major Facilities Supported by AmLight-ExP
- SLA-Driven science use case: Vera Rubin Observatory

About AmLight Express and Protect (AmLight-ExP)

AmLight Express and Protect Project

- AmLight-ExP is an international R&E network built to enable collaboration among Latin America, Africa, the Caribbean and the U.S.

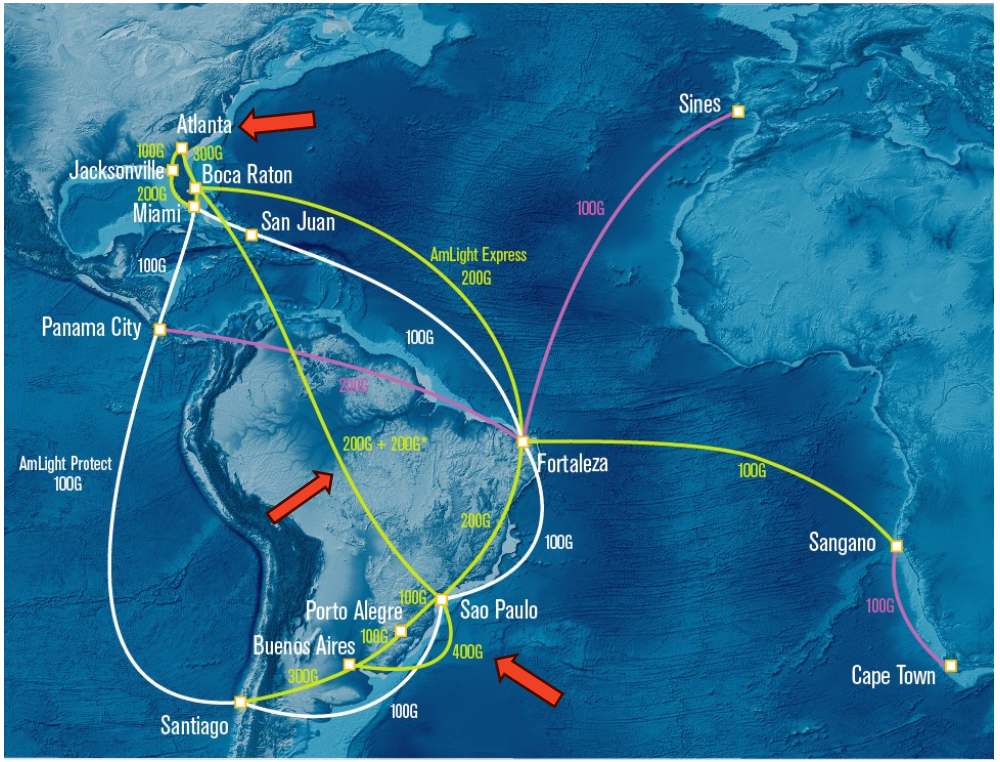
- Supported by NSF and the IRNC program under award #OAC-2029283

- Partnerships with R&E networks in the U.S., Latin America, Caribbean and Africa, built upon layers of trust and openness by sharing:
  - Infrastructure resources
  - Human resources

AmLight ExP
Americas Lightpaths Express & Protect
(NSF Award # OAC-2029283)

AmLight-ExP Network Infrastructure

- 600G of upstream capacity between the U.S., Latin America, Caribbean and 100G to Africa
  - +400Gbps in 2024 and +200Gbps in 2024
- OXPs: Florida(3), Brazil(2), Chile, Puerto Rico, Panama, and South Africa
  - New: Georgia (Atlanta), Argentina (Buenos Aires)
- Production SDN Infrastructure since 2014
- Deeply programmable across the network stack
  - Programmable P4 Data Plane
  - Open Source SDN Controller
  - Fine-grained telemetry
  - Run-time network verification
  - Closed-Loop Orchestration
- Highly instrumented
  - PerfSonar, sFlow, Juniper Telemetry Interface (JTI), In-band Network Telemetry (INT)



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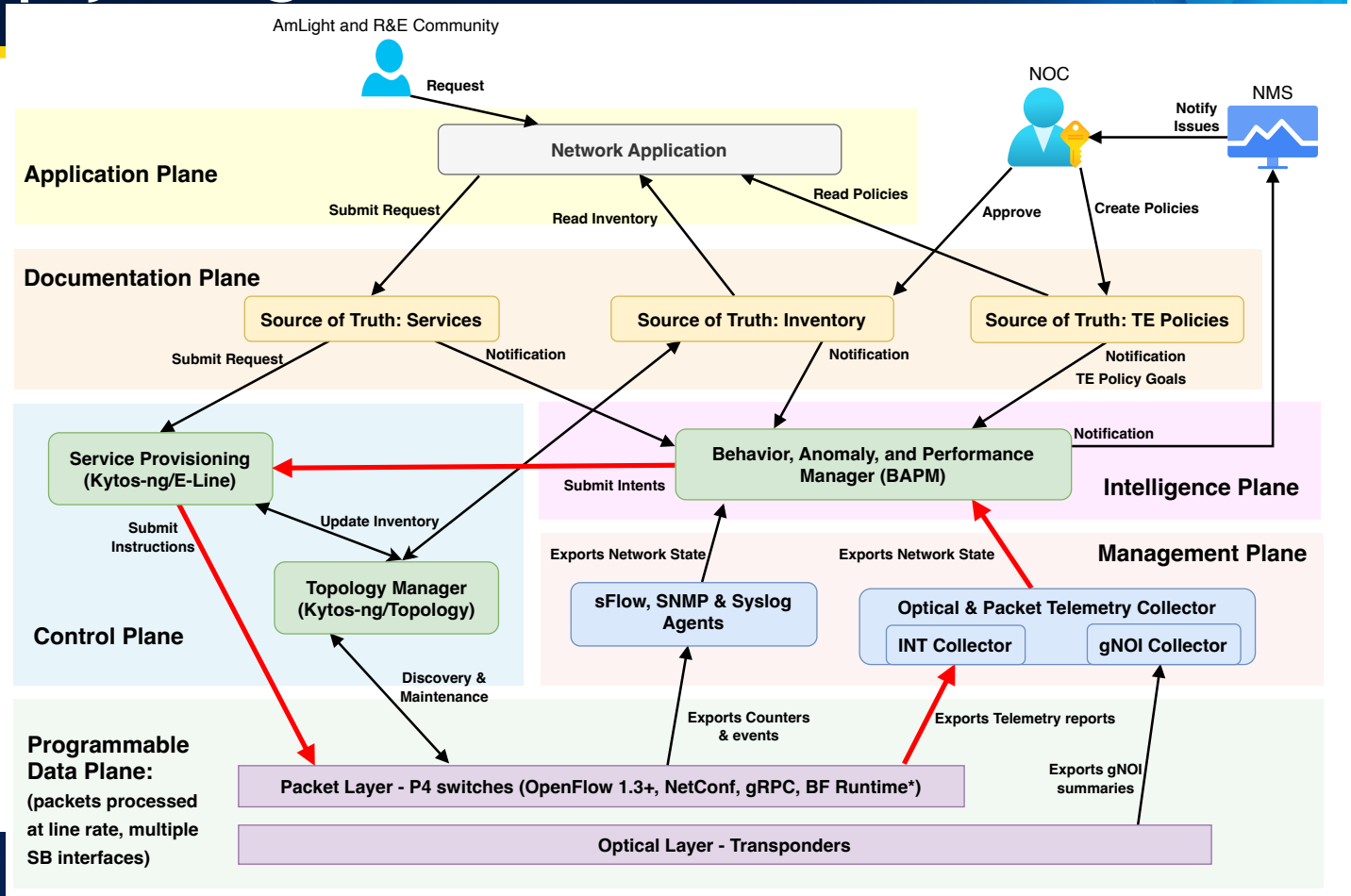
AmLight's Deeply Programmable Network Stack

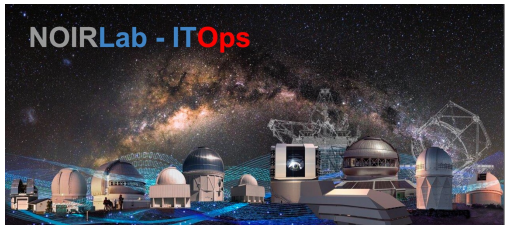
- Closed-Loop Orchestration:
  - Fine-grained telemetry reports from the Data Plane
  - Network State from the Management Plane
  - Notifications result from the interpretation of network state by the Intelligence Plane
  - Notifications and TE policy goals trigger intents to the Control Plane
  - Instructions are submitted to the Data Plane to reprogram the forwarding path
- Network Verification and Packet Provenance
- Reduces the need for operator intervention

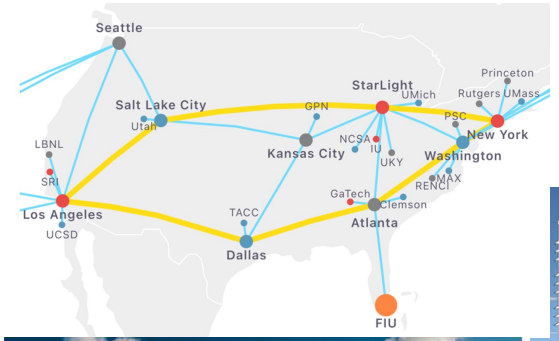


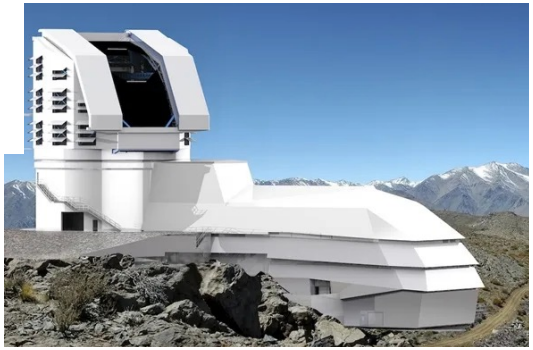
Major facilities supported by AmLight-ExP

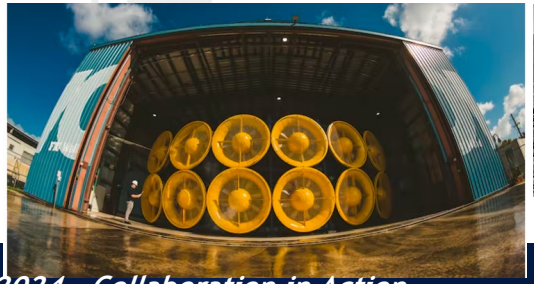
Major Facilities

- NOIRLab
- ALMA
- Vera Rubin
- VLA (USVI)
- FABRIC
- Wall of Wind
- Open Science Grid and PATh



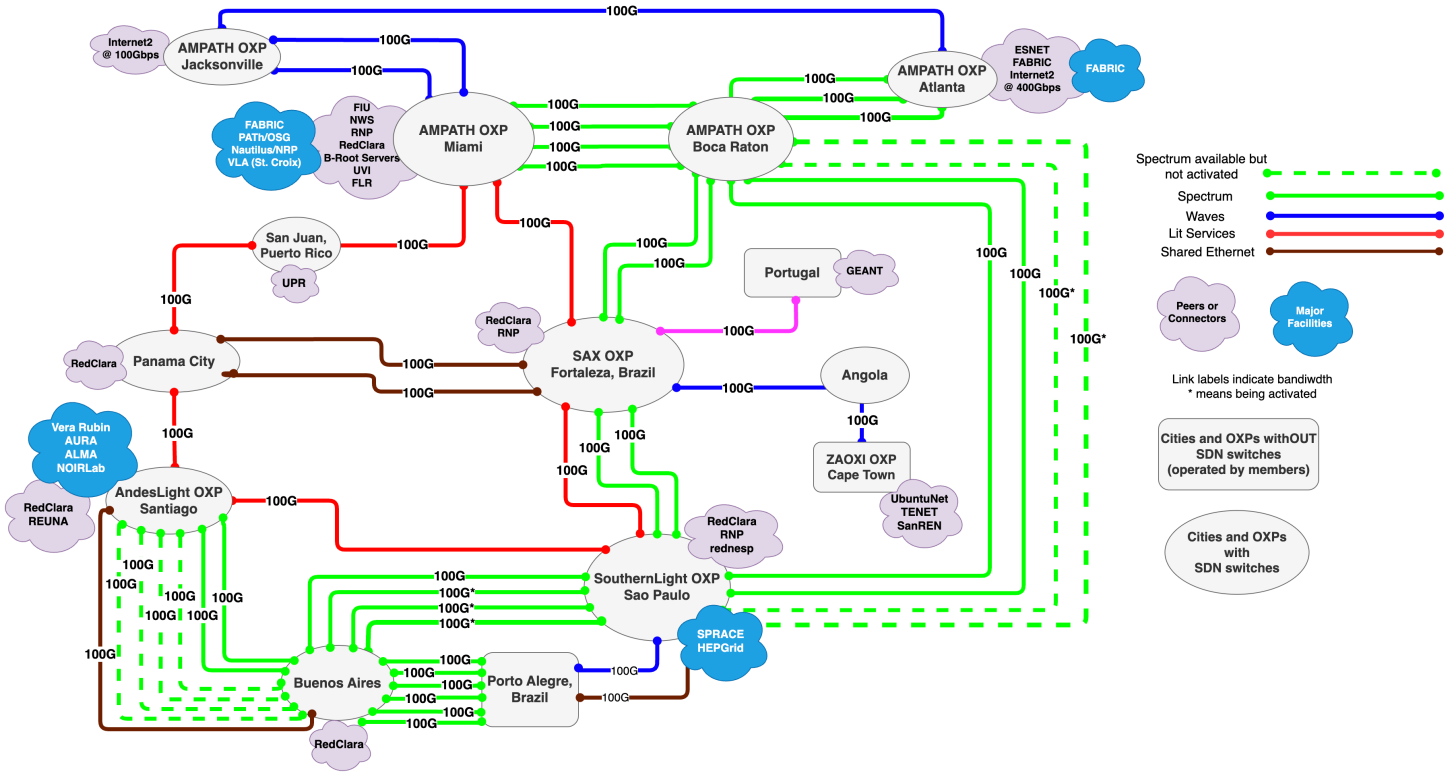






Major Facilities supported by AmLight

- Major facilities are supported in Chile, Brazil, USVI, Florida, Georgia
- Multiple network diverse paths and bandwidth capacity are provisioned to provide high availability
- Open Exchange Points provide the flexibility to place computation and storage closer to major facilities



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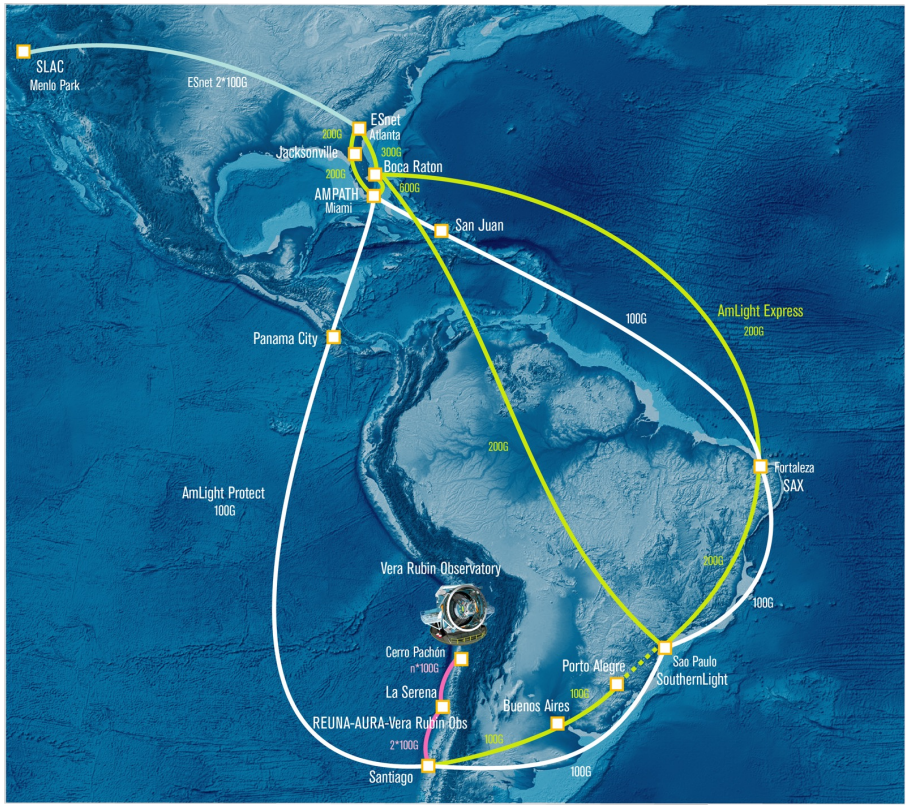
SLA-driven science use case: Vera Rubin Observatory

Vera Rubin Observatory operation use case

- Vera Rubin is a large-aperture, wide-field, ground-based optical telescope under construction in northern Chile
- The telescope will take a picture of the southern sky every 27 seconds, and produce a 13 Gigabyte data set
- Each data set must be transferred to the U.S. Data Facility at SLAC, in Menlo Park, CA, within 5 seconds, inside the 27 second transfer window
- Challenges
  - High propagation delay in the end-to-end path
  - RTT from the Base Station to the USDF is approximately 180+ ms
  - 0.001% of packet loss will compromise the Rubin Observatory application
- Under Closed-Loop Control, AmLight's SDN infrastructure will continuously monitor the network substrate and reprogram the forwarding path in response to SLA requirements



AmLight ExP
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AmLight supports SLA-driven science applications

- AmLight has many links and multiple paths between its sites:
  - From Chile to Atlanta, there are more than 28 possible paths to take
  - With its deep programmable SDN architecture, AmLight effectively load balances network services across network paths, while respecting user constraints and requirements

- AmLight supports SLA-driven packet-loss-intolerant and sub-second-response-time-expected science applications:
  - With per-packet telemetry and sub-second network profiling capacities, AmLight can react to network conditions under 1 second
  - With optical telemetry, AmLight can anticipate issues with its substrate and steer traffic out of the substrate before adverse events happen

- AmLight network engineers are focused on building networks that run autonomously:
  - With the closed loop control, some time-consuming operational activities will be performed without human intervention
  - With deep programmability, AmLight network engineers can verify that the network is responding to SLA requirements

THANK YOU

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