AmLight Network Measurement Data Products, expanding with environmental sensor data

NSF Workshop on Internet Sensor Network Testbeds

August 4-5, 2025

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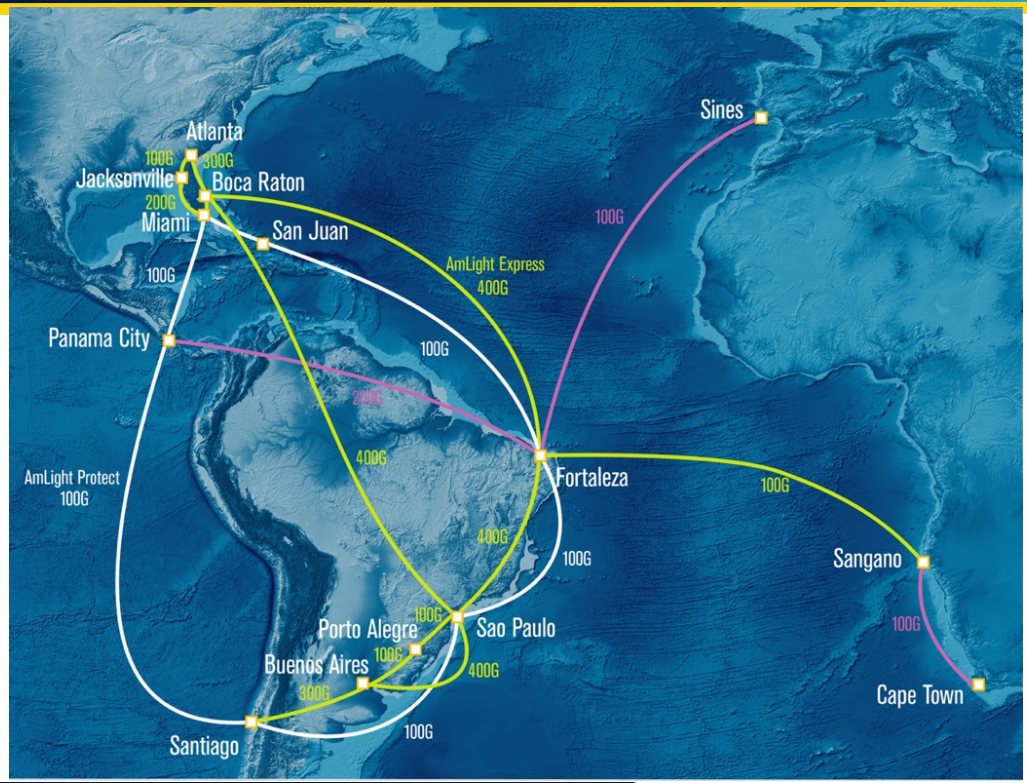
Outline

- About AmLight
- AmLight's Optical Network Infrastructure
- Amlight's Data Resources
- Data Curating and Sharing
- Support for Testbeds
- DAS and SoP on AmLight

AmLight Network Infrastructure

- 39x 100G links
  - 2.1+ Tbps of international connectivity
  - AmLight will reach 5+ Tbps of total capacity by 2025
  - Connections to 4 continents
- Production SDN Infrastructure since 2014
- Deeply programmable across the network stack
  - Programmable P4 Data Plane
  - Open Source SDN Controller (kytos-ng)
- Highly Instrumented
  - 10x 10G perfSonar nodes
  - 4x 100G DTN servers
  - 4x In-band Network Telemetry (INT) collectors
    - ~10Mpps & 96TB of telemetry data per day



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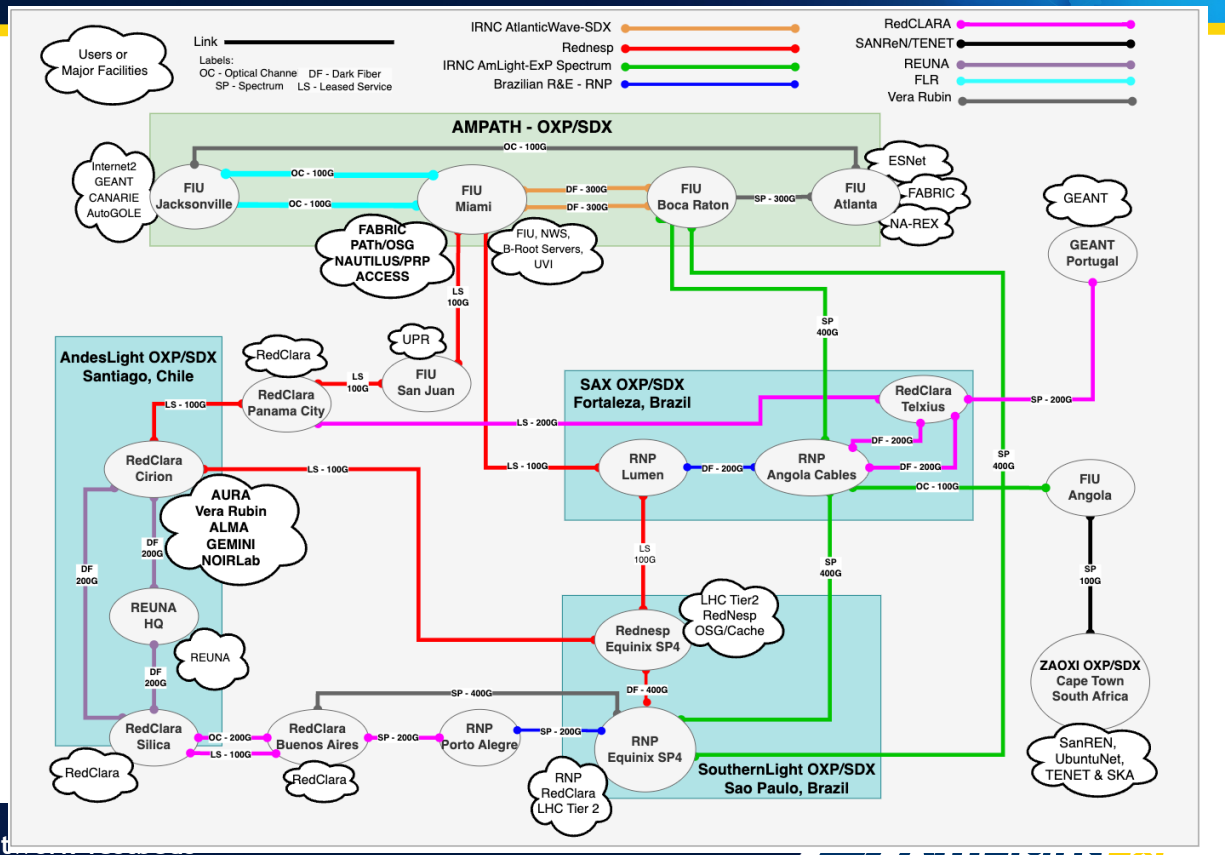
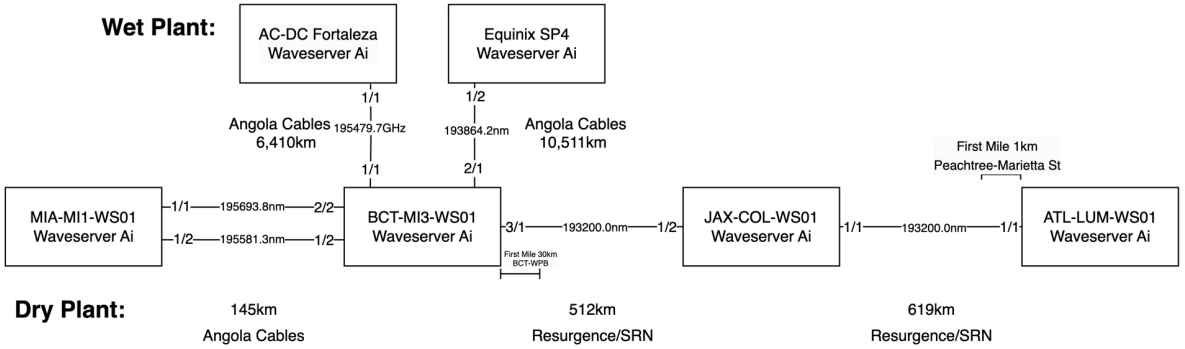
AmLight Network Infrastructure - Detailed

- Dark fiber, spectrum, and lit services connect at OXPs (lines)
- 11 OXPs: Miami, Boca Raton, Jacksonville, Atlanta, San Juan, Panama City, Fortaleza, Sao Paulo, Santiago, Buenos Aires, and Cape Town (rectangles)
- Major facilities are connected in Chile, Brazil, USVI, Florida, Georgia, South Africa (clouds)
- Open Exchange Points provide the flexibility to place computation and storage closer to major facilities



AmLight Optical Network (Current)

- Ciena WaveServers that are managed by AmLight
  - Fiber between Miami (MIA) and Boca Raton (BCT)
  - Spectrum between BCT and Jacksonville (JAX)
  - Spectrum between JAX and Atlanta (ATL)
  - Spectrum between BCT and Fortaleza (FTZ) on Monet
  - Spectrum between BCT and Sao Paulo (SAO)



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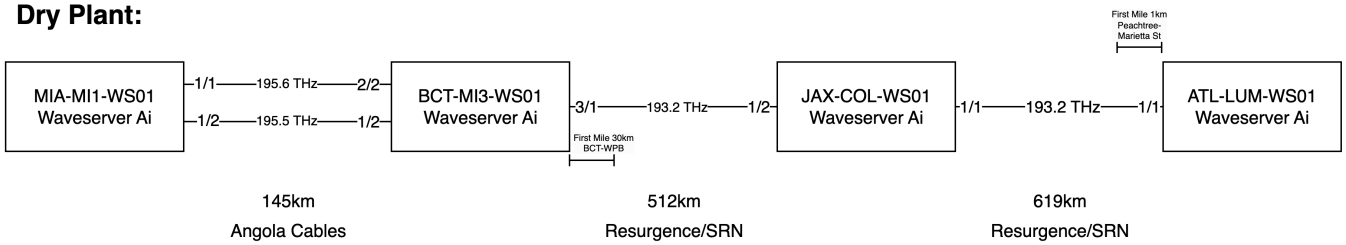
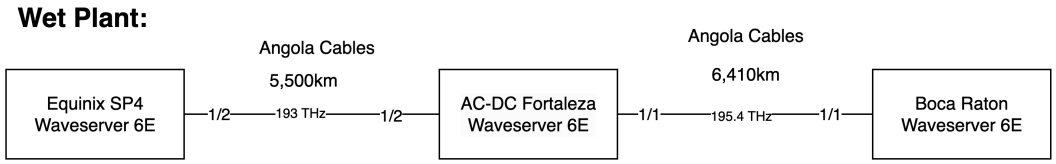
AmLight Optical Network (by Q4 2025)

- Upgrading wet plant to Ciena WaveLogic 6E transponders
- Objective is to support fiber sensing features





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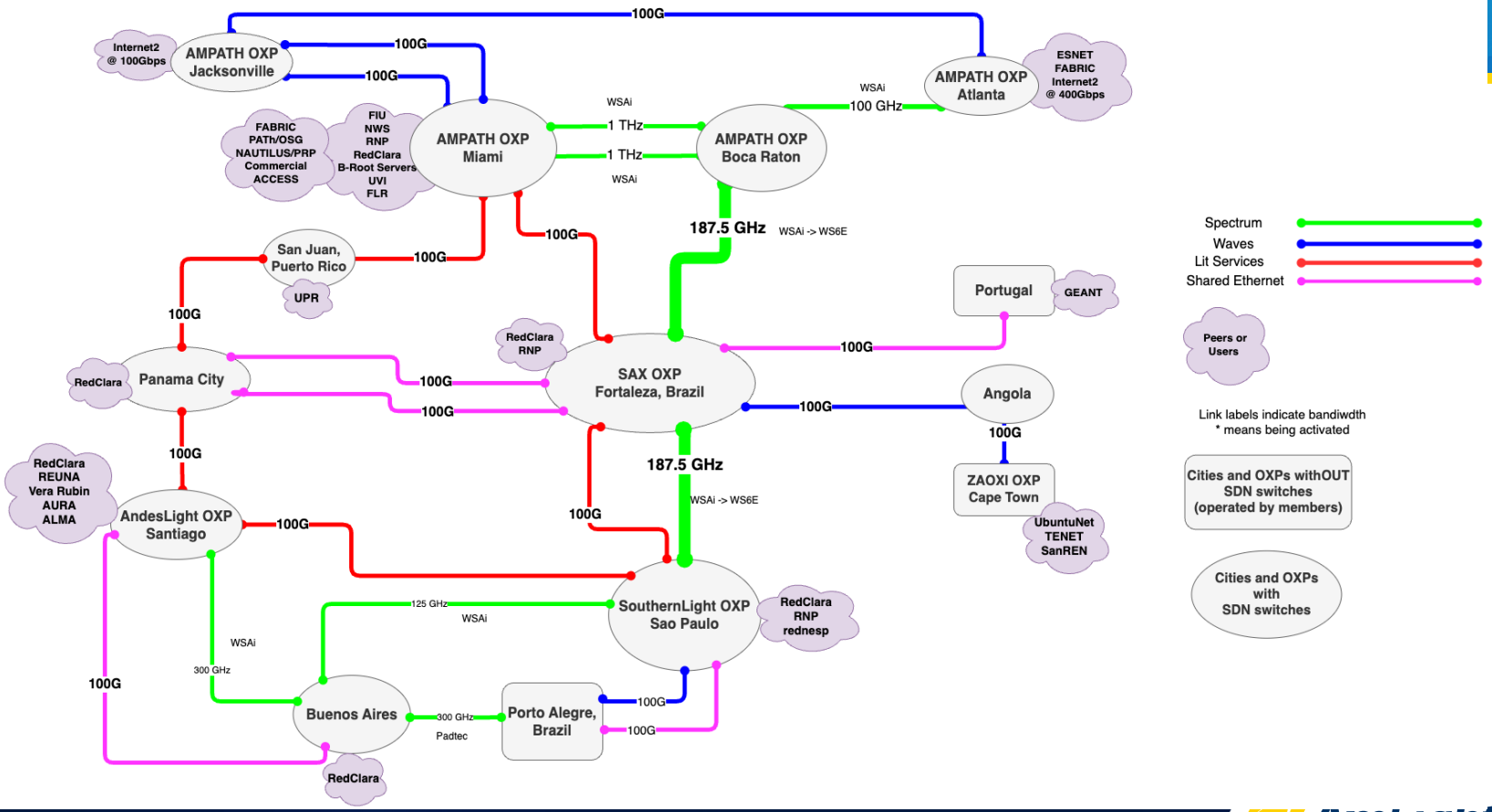
AmLight-ExP Network Infrastructure: Fiber Sensing



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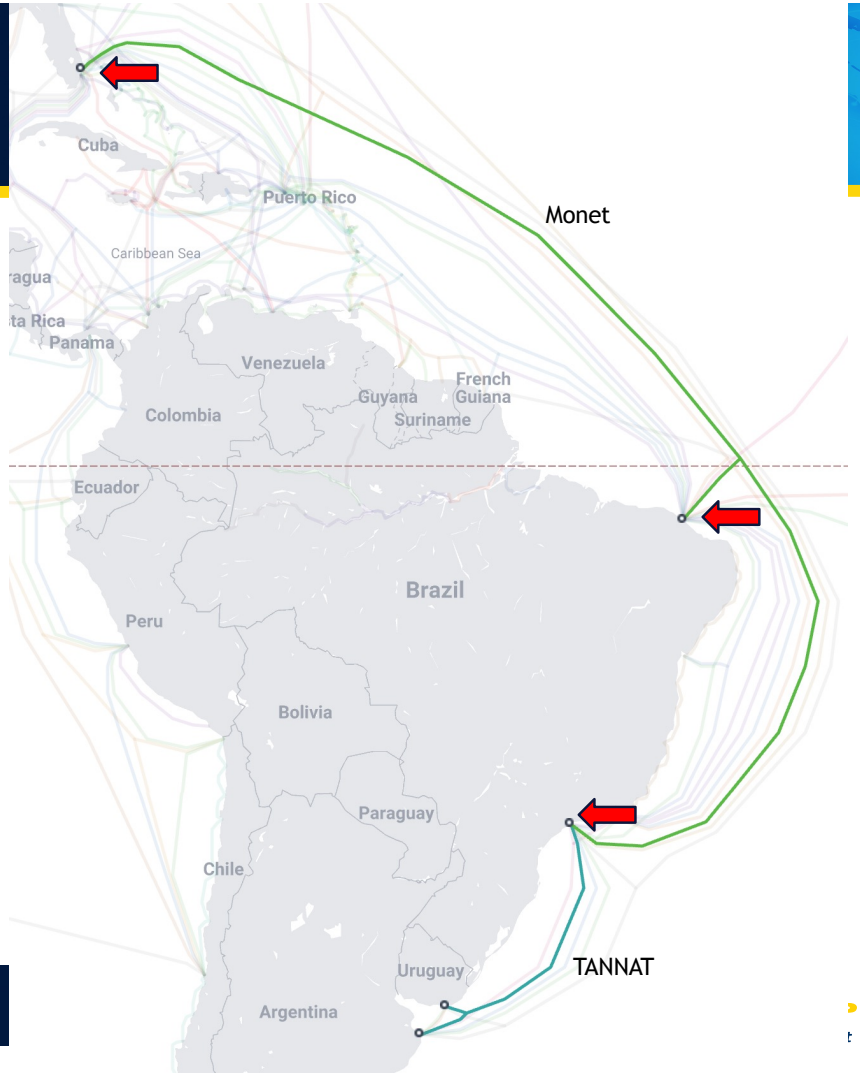
Fiber sensing on AmLight

- Monet
  - Ciena WaveLogic 6E Transponders managed by AmLight
    - Adds fiber sensing features
  - 6,410km, Boca Raton to Fortaleza
  - 10,511km, Boca Raton to Sao Paulo
- TANNAT
  - Transponders managed by provider
  - 2,410km, Sao Paulo to Buenos Aires



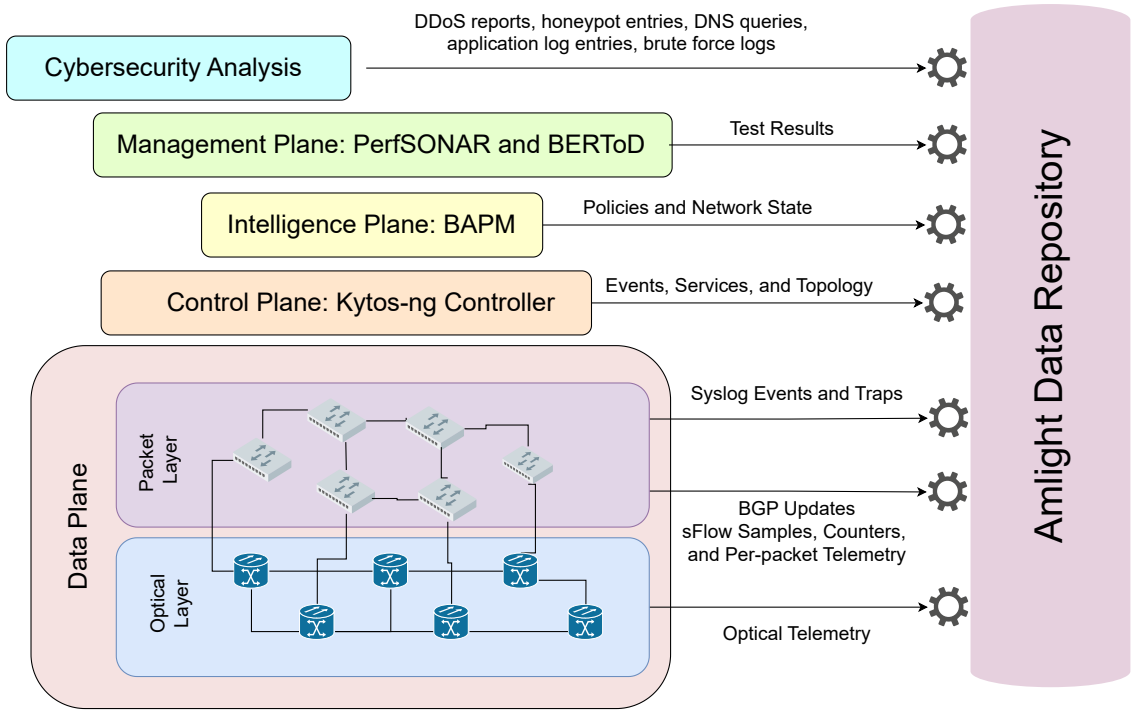
Amlight's Data Resources

- Amlight gathers 24 unique data sources for network measurement and monitoring

Function	Related Data Sources
Topology & Configuration	Network topology, network state, network services, SNMP counters
Event Monitoring	Syslog interface/BFD/BGP flap events, network events, network topology events, SDN events
Performance Monitoring	perfSONAR test results, BERToD test results, interface counters, optical measurements, streaming telemetry data, Zabbix alerts
Traffic Analysis	sFlow samples, per-packet telemetry, per-packet telemetry collector counters
Cybersecurity	DDoS reports, honeypot entries, DNS queries, application log entries, brute force logs

Amlight's Data Resources Across Network Layers

- Data resources are collected from different network layers
- AmLight data is curated, then stored in a database repository



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Dataset Curating and Sharing: Labeling

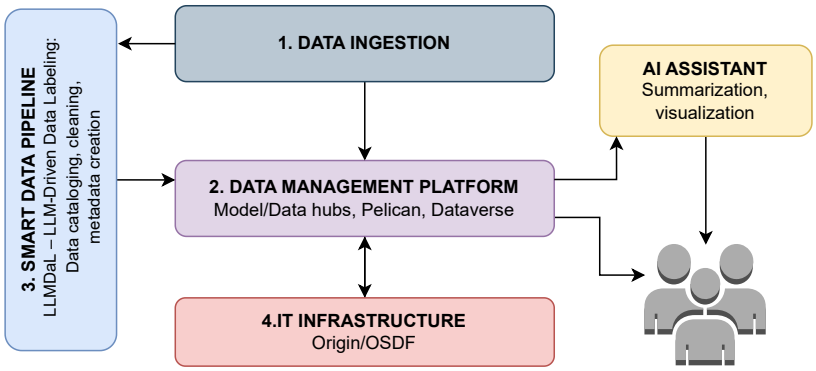
- Labeled Security Information Capture (LaSIC) (NSF OAC award# 2232864)
  - Captures and labels real traffic from AmLight for use by cybersecurity researchers to secure scientific data and artifacts
  - Packet headers and unsampled flows
  - IDS alerts from AmLight's commercial intrusion detection systems
  - In-band Network Telemetry (INT) reports collected from AmLight switches
  - Authentication failure data (e.g. SSH logins, OAuth exchanges)

- LLM-Driven Data Labeling for Training ML Models (LLMDaL Project, OAC award# 2530965)
  - LLMDaL will fine tune an LLM with cybersecurity-specific domain knowledge, and
    - Use the LLM to classify and label production network measurement data from AmLight
  - LLMDaL aims to establish a pipeline for automated domain-specific data labeling by using AmLight's multi-layer data resources

Dataset Curating and Sharing: Storing and Sharing

AmLight adopts best practices for creating datasets that adhere to FAIR (Findable, Accessible, Interoperable, Reusable) principles

- COMUNDA, Community Understanding of Network Datasets (NSF CRI award# 8115780)
- Open Science Data Federation (OSDF)
- EnviStor storage project at FIU (NSF OAC award# 2322308)



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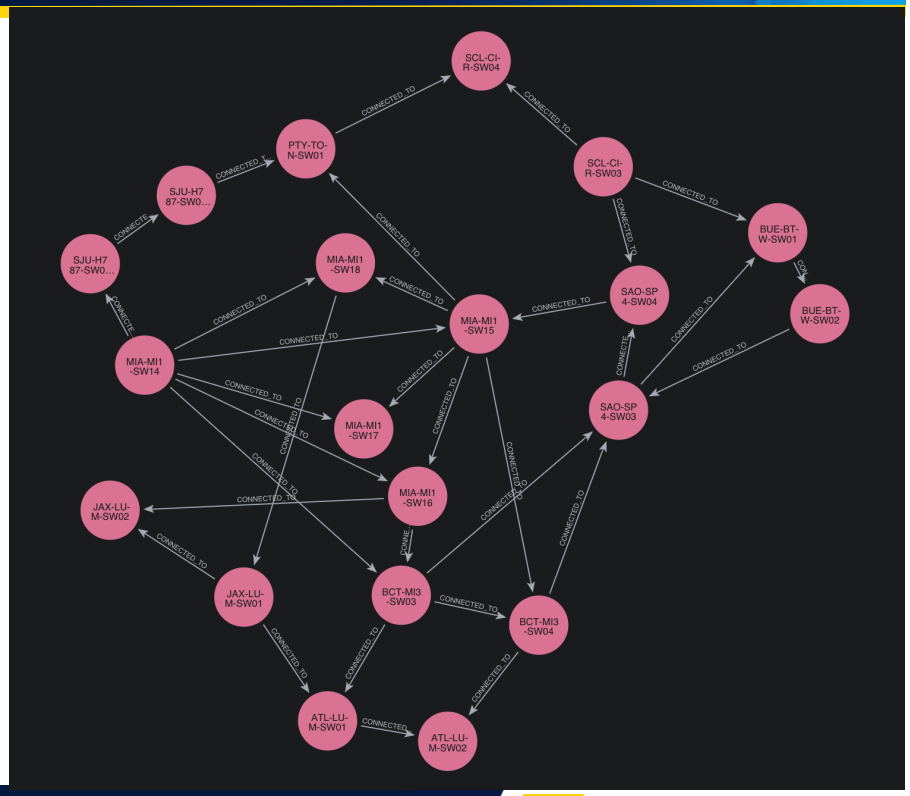
Support for Testbeds

- AmLight has deployed a geographically distributed SDN production network, spanning from Santiago, Chile to Florida and Atlanta
- AmLight supports slicing, enabling isolated, parallel testbed environments within the production infrastructure
- AmLight also maintains dedicated infrastructure to support advanced network experimentation and research



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DAS and SOP: Physical-Layer visibility

- Currently monitoring optical metrics, such as:
  - TX/RX Power Levels, Q-Factor and Pre-FEC Bit Error Rate
  - These parameters are device-level metrics, typically monitored at transponders

Optical Metric Explorer

Start Date: 02/15/2025

End Date: 07/16/2025

Select Node:

jax-col-ws01

Select Port:

1-1

Select Metric Group:

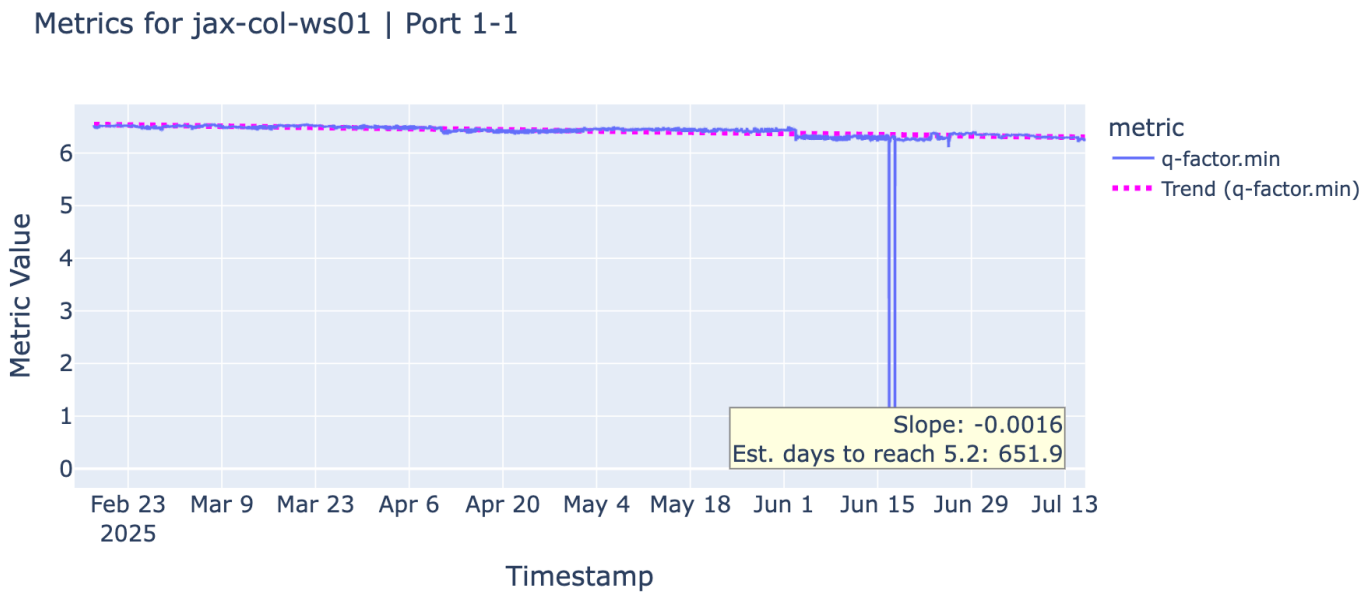
q-factor

Select Metric(s):

× q-factor.min

Target Value (for trend estimate):

5.2



DAS and SOP: Physical-Layer visibility

- Currently monitoring optical metrics, such as:
  - TX/RX Power Levels, Q-Factor and Pre-FEC Bit Error Rate
  - These parameters are device-level metrics, typically monitored at transponders
- Adding DAS and SoP will allow physical-layer visibility and proactive detection
  - **DAS** detects *where* disturbances occur (e.g., digging, vibration)
  - **SoP** shows *how* stress affects signal quality (e.g., bending, microbending)
  - Faster root cause analysis and fault localization
  - Proactive mitigation before signal impact
- **Goal: Include DAS and SoP data in AmLight publicly available data products**
  - Anticipating information from Ciena about the features of the 6E and their API

DAS and SoP: Environmental Network Sensing

- **Goal: Explore using AmLight optical telemetry for environmental sensing**
  - Researchers can use AmLight's optical telemetry data to explore and test environmental sensing applications
  - Subsea providers have expressed interest to participate in environmental sensing activities
  - Open Exchange Points (OXPs) can host instruments for calibration or supplemental data collection

THANK YOU

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AmLight ExP International Distributed Exchange Point
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Extra Slides