AmLight: Updates since TPRE 2025

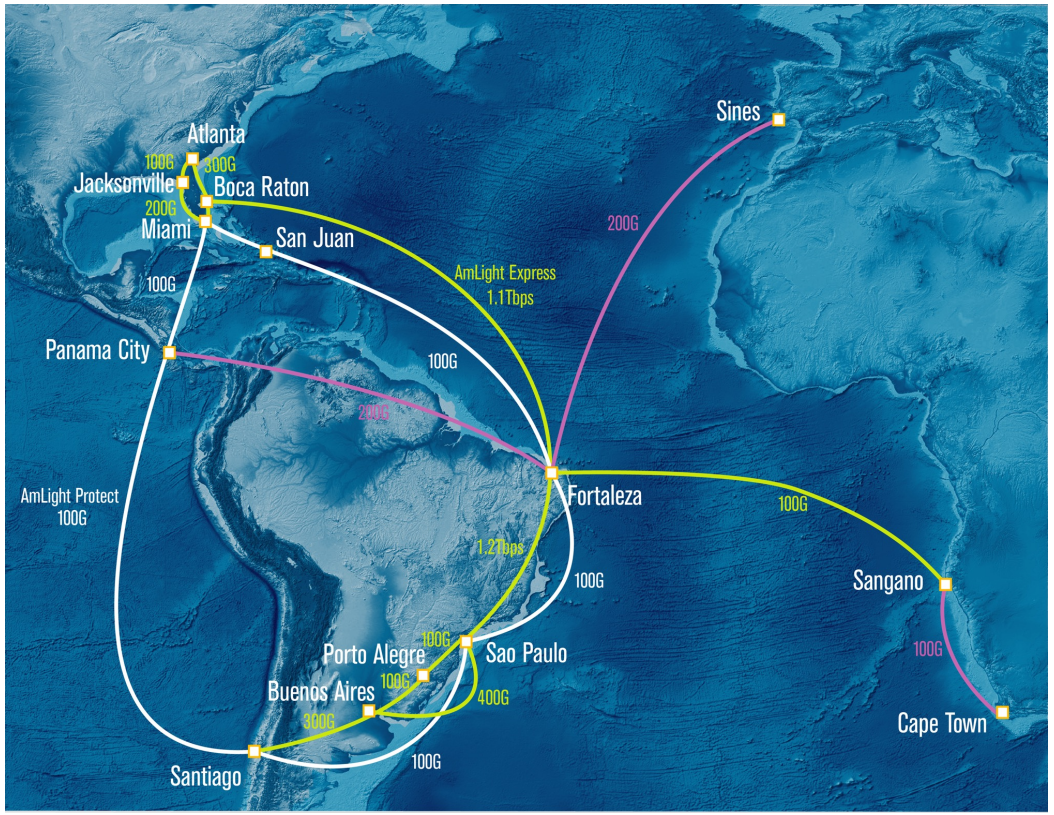
Jeronimo Bezerra - Chief Network Engineer/Co-PI - FIU/AmLight

Outline

- What is AmLight?
- 2020-2025 IRNC AmLight-ExP: Final Updates
- 2020-2025 IRNC AtlanticWave-SDX: Final Updates
- 2025-2030 AmLight: Next Frontier

Introducing the AmLight Network

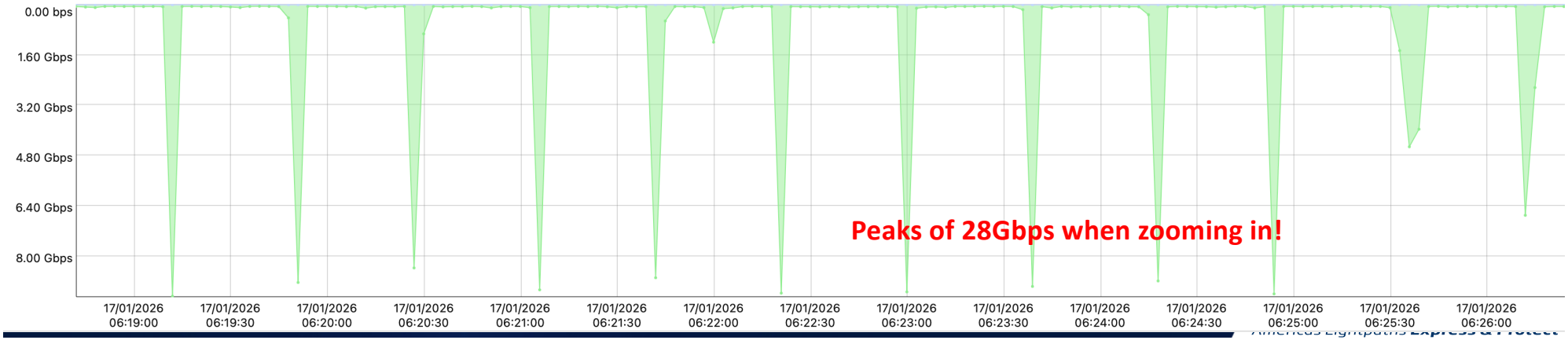
- A distributed academic exchange point built to enable collaboration among Latin America, Africa, and the U.S.
  - Members: FIU, AURA, Vera Rubin Observatory, RNP, Rednesp, RedClara, REUNA, FLR, SANReN, TENET, and Internet2
- Supported by NSF and the IRNC program under two awards (ExP and SDX) for the 2021-2025
  - *AmLight: The Next Frontier* **for 2026-2030!**
- 5.1+ Tbps of total connectivity
- NAPs: Florida(3), Atlanta, Brazil(2), Chile, Puerto Rico, Argentina, Panama, and South Africa
- Infrastructure managed by a our SDN controller: Kytos-ng (github.com/kytos-ng)



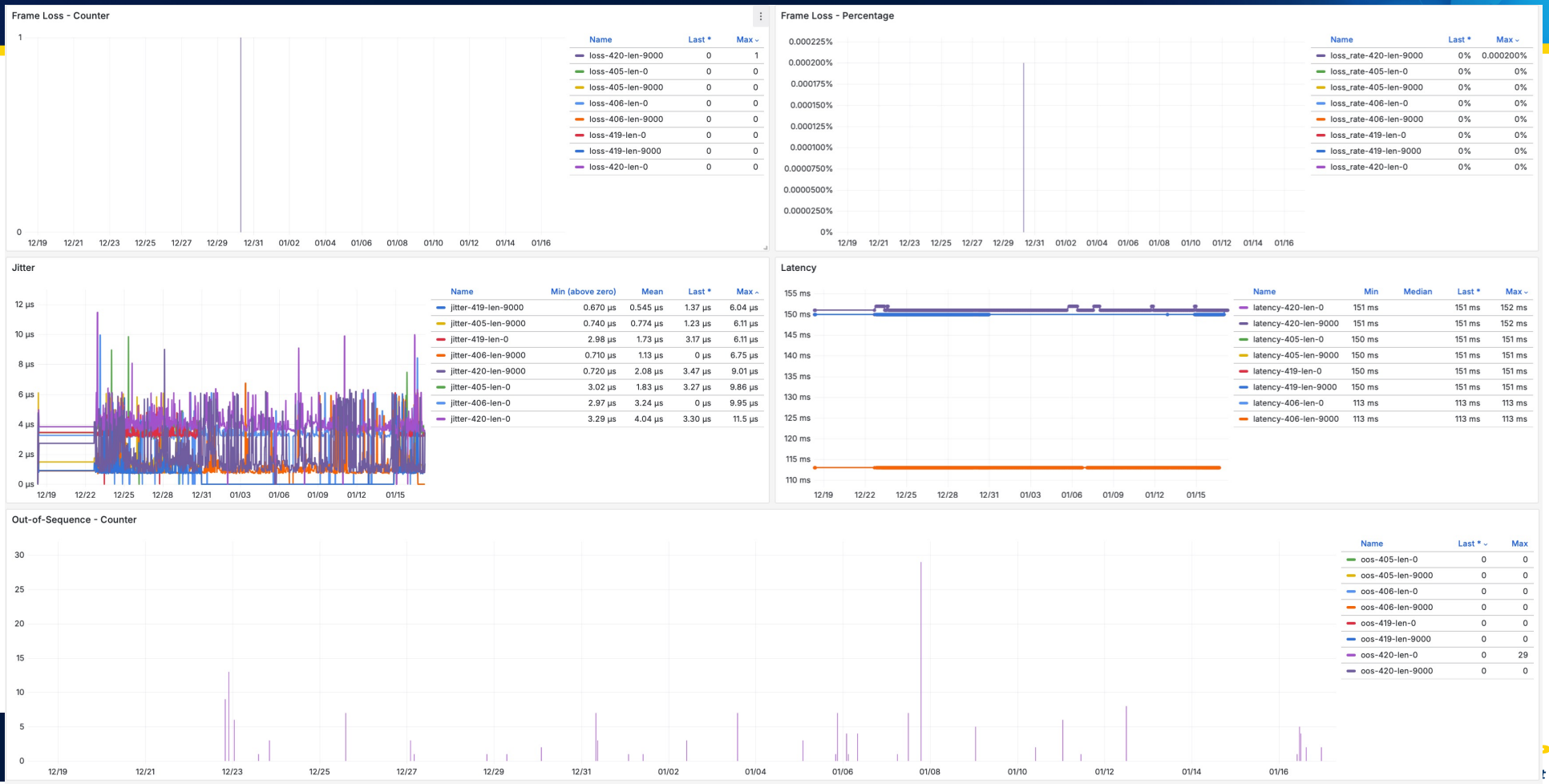
AmLight ExP
Americas Lightpaths Express & Protect

2020-2025 IRNC AmLight-ExP: Final Updates

- AmLight was engineered to address the Vera Rubin Observatory's SLA:
  - BER under $1x10^{-10}$
    - 10x perfSONAR nodes and 1x EXFO FTB-1 packet tester running continuously (BERToD)
  - MTBF of 180 days, MTTR of less than 9 hours.
    - 4x submarine systems, two switches per site, city-redundancy, 3 paths 100% disjoint from Chile to ESnet (JAX/ATL)
- Vera Rubin Observatory is production since November 2025!
  - The Long Haul Network (LHN) is performing as expected!



Monitoring Vera Rubin LHN with BERToD



2020-2025 IRNC AmLight-ExP: Final Updates [2]

- Expanding AmLight's capacity to South America:
  - All optical channels on Monet submarine system grouped into one larger 202.5Ghz optical channel
  - Ciena Waveserver 6E solutions deployed in Boca Raton/Florida, Fortaleza and Sao Paulo/Brazil
  - Total Capacity: 1x800Gbps (initial) with possibility of reaching 1.2Tbps with new Ciena software release (700 GBaud -> 200 Gbaud)
    - A second 800Gbps channel was lit during SC25.

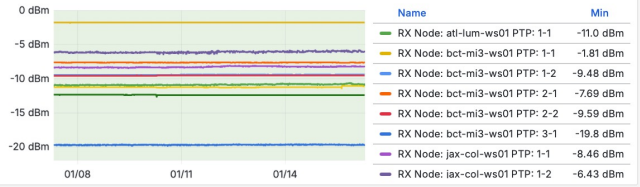
- Connecting AmLight/AMPATH to StarLight, WIX, and PacificWave over Internet2's NA-REX infrastructure:
  - 1.2Tbps deployed over 3x400Gbps links

- Enhancing AmLight's SDN and monitoring capabilities:
  - Reinstalled our switches with Debian Linux and a fully customized forwarding pipeline
  - New optical telemetry gathering solution built to monitor Ciena Waveservers's transponders (AI and 6E)

New Optical Monitoring System at AmLight

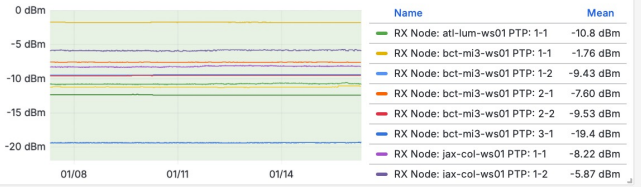
Optical Power Levels

Receiving (RX) Optical Power Levels - Line - Minimum



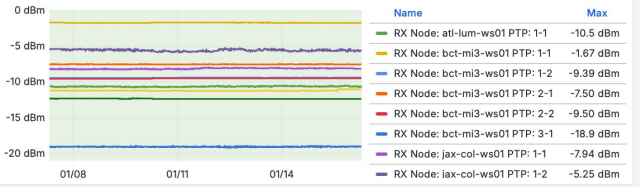
Name	Min
RX Node: atl-lum-ws01 PTP: 1-1	-11.0 dBm
RX Node: bct-mi3-ws01 PTP: 1-1	-1.81 dBm
RX Node: bct-mi3-ws01 PTP: 1-2	-9.48 dBm
RX Node: bct-mi3-ws01 PTP: 2-1	-7.69 dBm
RX Node: bct-mi3-ws01 PTP: 2-2	-9.59 dBm
RX Node: bct-mi3-ws01 PTP: 3-1	-19.8 dBm
RX Node: jax-col-ws01 PTP: 1-1	-8.46 dBm
RX Node: iax-col-ws01 PTP: 1-2	-6.43 dBm

Receiving (RX) Optical Power Levels - Line - Average



Name	Mean
RX Node: atl-lum-ws01 PTP: 1-1	-10.8 dBm
RX Node: bct-mi3-ws01 PTP: 1-1	-1.76 dBm
RX Node: bct-mi3-ws01 PTP: 1-2	-9.43 dBm
RX Node: bct-mi3-ws01 PTP: 2-1	-7.60 dBm
RX Node: bct-mi3-ws01 PTP: 2-2	-9.53 dBm
RX Node: bct-mi3-ws01 PTP: 3-1	-19.4 dBm
RX Node: jax-col-ws01 PTP: 1-1	-8.22 dBm
RX Node: iax-col-ws01 PTP: 1-2	-5.87 dBm

Receiving (RX) Optical Power Levels - Line - Maximum



Name	Max
RX Node: atl-lum-ws01 PTP: 1-1	-10.5 dBm
RX Node: bct-mi3-ws01 PTP: 1-1	-1.67 dBm
RX Node: bct-mi3-ws01 PTP: 1-2	-9.39 dBm
RX Node: bct-mi3-ws01 PTP: 2-1	-7.50 dBm
RX Node: bct-mi3-ws01 PTP: 2-2	-9.50 dBm
RX Node: bct-mi3-ws01 PTP: 3-1	-18.9 dBm
RX Node: jax-col-ws01 PTP: 1-1	-7.94 dBm
RX Node: iax-col-ws01 PTP: 1-2	-5.25 dBm

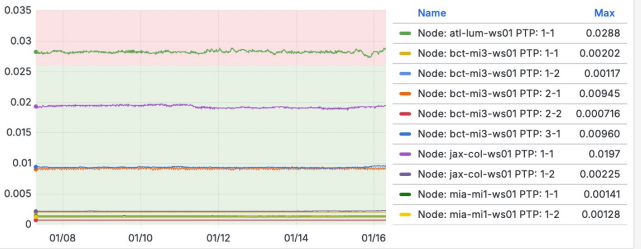
› FEC Error *(3 panels)*

Pre-FEC Bir Error Rate (BER)

Pre-FEC Bit Error Rate

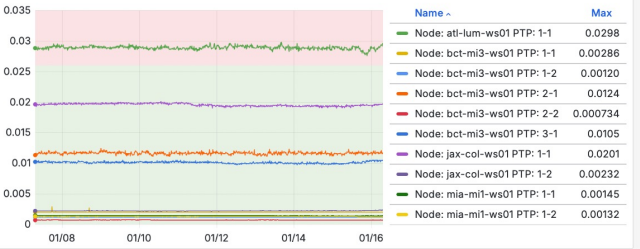
For pre-fec BER, Ciena does not provide a minimum measurement

Pre-FEC Bit Error Rate - Average



Name	Max
Node: atl-lum-ws01 PTP: 1-1	0.0288
Node: bct-mi3-ws01 PTP: 1-1	0.00202
Node: bct-mi3-ws01 PTP: 1-2	0.00117
Node: bct-mi3-ws01 PTP: 2-1	0.00945
Node: bct-mi3-ws01 PTP: 2-2	0.000716
Node: bct-mi3-ws01 PTP: 3-1	0.00960
Node: jax-col-ws01 PTP: 1-1	0.0197
Node: jax-col-ws01 PTP: 1-2	0.00225
Node: mia-mi1-ws01 PTP: 1-1	0.00141
Node: mia-mi1-ws01 PTP: 1-2	0.00128

Pre-FEC Bit Error Rate - Maximum



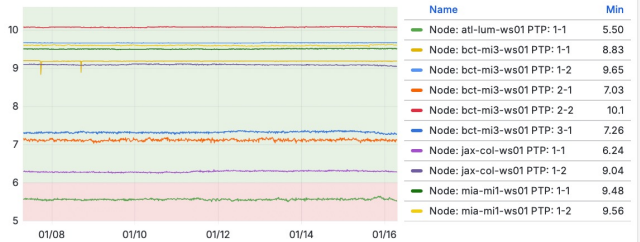
Name	Max
Node: atl-lum-ws01 PTP: 1-1	0.0298
Node: bct-mi3-ws01 PTP: 1-1	0.00286
Node: bct-mi3-ws01 PTP: 1-2	0.00120
Node: bct-mi3-ws01 PTP: 2-1	0.0124
Node: bct-mi3-ws01 PTP: 2-2	0.000734
Node: bct-mi3-ws01 PTP: 3-1	0.0105
Node: jax-col-ws01 PTP: 1-1	0.0201
Node: jax-col-ws01 PTP: 1-2	0.00232
Node: mia-mi1-ws01 PTP: 1-1	0.00145
Node: mia-mi1-ws01 PTP: 1-2	0.00132

Q-Factor refers to a performance monitoring metric that indicates the signal quality of an optical transmission link, essentially measuring the ratio of the signal strength to the noise level on the link; a higher Q-factor signifies a better signal quality with less noise, which is crucial for reliable data transmission on the network.

The Q-factor is calculated based on the received optical signal power and the noise level, providing a single value to assess signal quality.

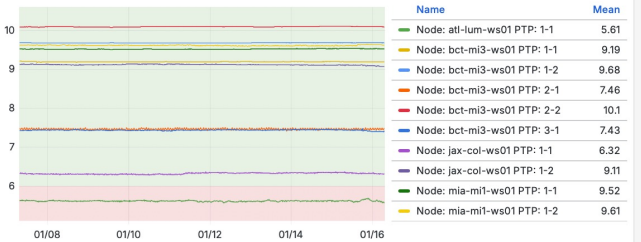
Q-Factor Measurements

Q-Factor - Minimum



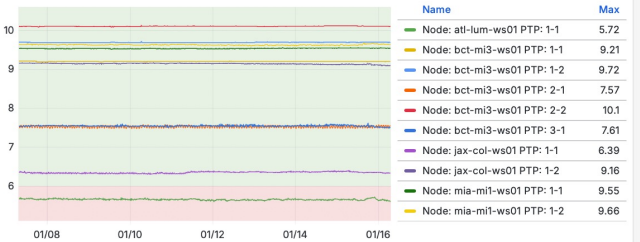
Name	Min
Node: atl-lum-ws01 PTP: 1-1	5.50
Node: bct-mi3-ws01 PTP: 1-1	8.83
Node: bct-mi3-ws01 PTP: 1-2	9.65
Node: bct-mi3-ws01 PTP: 2-1	7.03
Node: bct-mi3-ws01 PTP: 2-2	10.1
Node: bct-mi3-ws01 PTP: 3-1	7.26
Node: jax-col-ws01 PTP: 1-1	6.24
Node: jax-col-ws01 PTP: 1-2	9.04
Node: mia-mi1-ws01 PTP: 1-1	9.48
Node: mia-mi1-ws01 PTP: 1-2	9.56

Q-Factor - Average



Name	Mean
Node: atl-lum-ws01 PTP: 1-1	5.61
Node: bct-mi3-ws01 PTP: 1-1	9.19
Node: bct-mi3-ws01 PTP: 1-2	9.68
Node: bct-mi3-ws01 PTP: 2-1	7.46
Node: bct-mi3-ws01 PTP: 2-2	10.1
Node: bct-mi3-ws01 PTP: 3-1	7.43
Node: jax-col-ws01 PTP: 1-1	6.32
Node: jax-col-ws01 PTP: 1-2	9.11
Node: mia-mi1-ws01 PTP: 1-1	9.52
Node: mia-mi1-ws01 PTP: 1-2	9.61

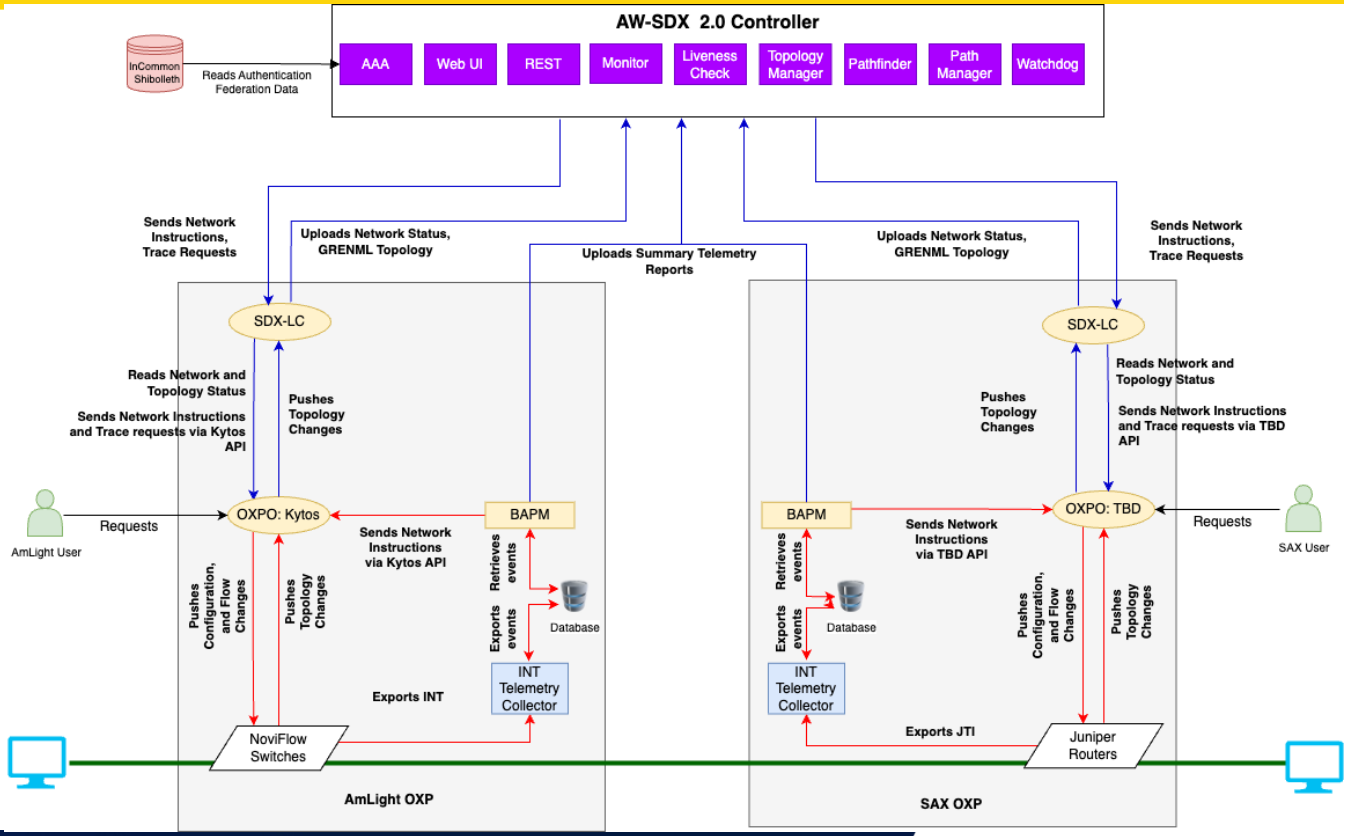
Q-Factor - Maximum



Name	Max
Node: atl-lum-ws01 PTP: 1-1	5.72
Node: bct-mi3-ws01 PTP: 1-1	9.21
Node: bct-mi3-ws01 PTP: 1-2	9.72
Node: bct-mi3-ws01 PTP: 2-1	7.57
Node: bct-mi3-ws01 PTP: 2-2	10.1
Node: bct-mi3-ws01 PTP: 3-1	7.61
Node: jax-col-ws01 PTP: 1-1	6.39
Node: jax-col-ws01 PTP: 1-2	9.16
Node: mia-mi1-ws01 PTP: 1-1	9.55
Node: mia-mi1-ws01 PTP: 1-2	9.66

2020-2025 IRNC AtlanticWave-SDX: Final Updates

- Goal:
  - Enable dynamic provisioning wit path protection across OXPs
  - Give users full visibility of their services
- Per-OXP Orchestration:
  - Bring your own Orchestrator
  - OXP decides what Autonomic Functions to support
- Inter-Domain Orchestration
  - SDX defines interfaces and data models for OXPs
  - OXPs produce and consume data from the SDX Controller
  - SDX creates a full topology
  - SDX supports all inter-domain network functions



AmLight ExP
Americas Lightpaths Express & Protect

2020-2025 IRNC AtlanticWave-SDX: Final Updates [2]

- AtlanticWave-SDX Controller has been running in production since 2024
  - OXPs: AMPATH (Florida and Atlanta), SAX and SouthernLight (Brazil), AndesLight (Chile) fully integrated

- In 2025 we …:
  - … completed integration with FABRIC:
    - SDX uses FABRIC tokens to avoid dual authentication when using SDX resources
    - Several FABRIC notebooks were created to demonstrate the SDX-FABRIC integration
    - Demonstrated at FABRIC KNIT 10 and KNIT 11
  - … integrated SDX with AutoGOLE/SENSE:
    - SENSE to SDX: Completed. SENSE users can provision AtlanticWave-SDX resources directly from SENSE
    - SDX to SENSE: Under development. Goal is to finish it by May 2026.

Introducing the NSF "*AmLight: The Next Frontier Towards Discovery in the Americas and Africa*" award *(#2537489)*

AmLight ExP
Americas Lightpaths Express & Protect

AmLight: The Next Frontier: 2025-2030

- Maintaining the AmLight Physical Infrastructure
  - Colocation, links, maintenance contracts
- Maintaining the AmLight Software Infrastructure
  - SDN and SDX Controllers
- **Sharing datasets with research communities**
  - 19 data sources to be shared via OSDF and Comunda
- Enabling new capabilities to improve network services
  - SmartNICs and AI-driven operations
- Supporting the Vera Rubin Observatory Long-Haul Network

AmLight: Updates since TPRE 2025

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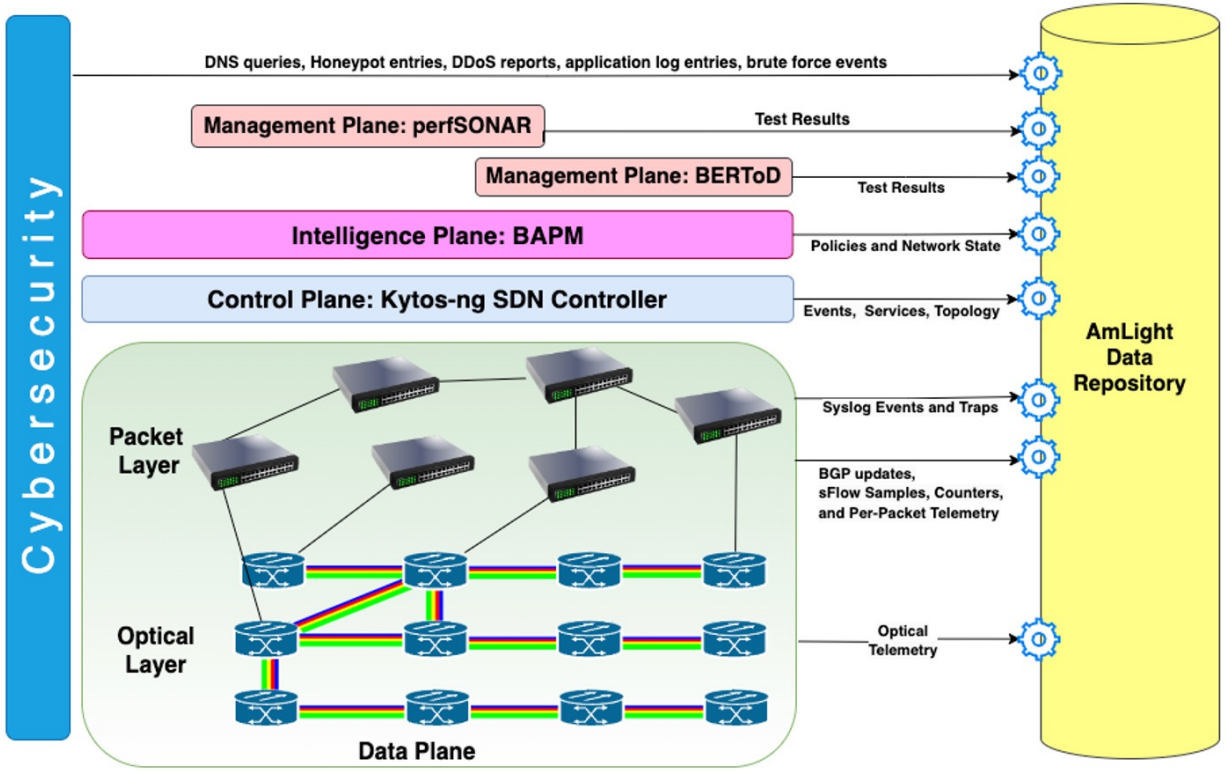
Sharing datasets with research communities [1]

- ***AmLight: Next Frontier*** is highly focused on supporting ML and AI communities, especially for **cybersecurity** and **environmental sensing**.

- 19 labeled data sources will become available openly.

- DDoS traces (Kentik reports and INT pcap files) will be the first datasets to be made available
  - Currently, 6TB of raw data.



AmLight ExP
Americas Lightpaths Express & Protect

Sharing datasets with research communities [2]

- Data exporting and sharing will be accomplished by leveraging several projects:
  - FIU's CICI **EnviStor** (200TB)
  - Open Science Data Federation (**OSDF**)
  - LaSIC: Labeled Security Information Capture **(LaSIC)**
  - Community Understanding of Network Datasets (**Comunda**)
- Findable, Accessible, Interoperable, and Reusable (**FAIR**) principles will guide our efforts
  - https://www.go-fair.org/fair-principles

Data Source	Main Fields of Research	Description	Data Type	Data Format	Dataset Size	Requires Anonymization?
DNS queries	Cybersecurity	DNS queries transported over AmLight	text	RFC 5424	MB	Yes
Honeypot entries		Attemps to attack AmLight honeyport	text	RFC 5424	MB	No
DDoS reports		DDoS reports	text	RFC 5424	KB	Yes
Application log entries		Attemps to attack AmLight applications	text	RFC 5424	KB	No
Brute force event logs		Attemps to brute force AmLight applications	text	RFC 5424	MB	No
perfSONAR test results	Performance Evaluation	perfSONAR test results	text	JSON	MB	No
BERToD test results		BERToD test results	text	CSV	MB	No
Implemented policies	Capacity Planning, Network Management	TE and Security policies implemented	text	YAML	KB	No
Network state		State of the network and topology	text	YAML	KB	No
Network events			text	JSON	MB	No
Network services			text	JSON	MB	Yes
Network topology			text	JSON	KB	Yes
Syslog interface flap events	Performance Optimization, Capacity Planning, Network Management, Performance Evaluation	Counters and events observed by the data plane	text	RFC 5424	MB	No
Syslog BFD flap events			text	RFC 5424	MB	No
Syslog BGP flap events			text	RFC 5424	MB	No
sFlow samples			binary	libpcap	GB	Yes
Interface counters			text	csv	KB	No
per-packet telemetry			binary	libpcap	GB+	Yes
optical measurements			text	JSON	MB	No