




# Benefits brought by the use of OpenFlow/ SDN in the AmLight intercontinental research and education network

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# Who we are

AMPATH:

- Academic IXP in Miami
- Interconnects all Latin America RENs to other RENs in the world

SouthernLight:

- Academic IXP in Sao Paulo
- Interconnects all Brazilian RENs and RedCLARA

AmLight:

- Academic network that connects SounthernLight to AMPATH and other RENs in the world

Partners: FIU, NSF, ANSP, RNP, RedCLARA, REUNA and AURA

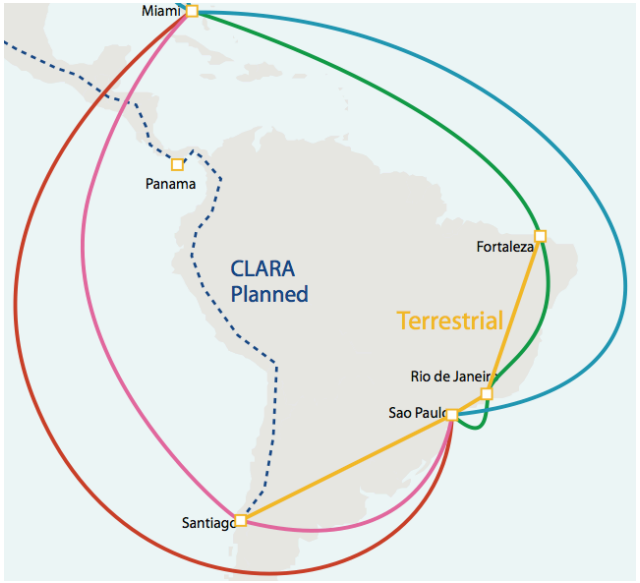
# AmLight Today

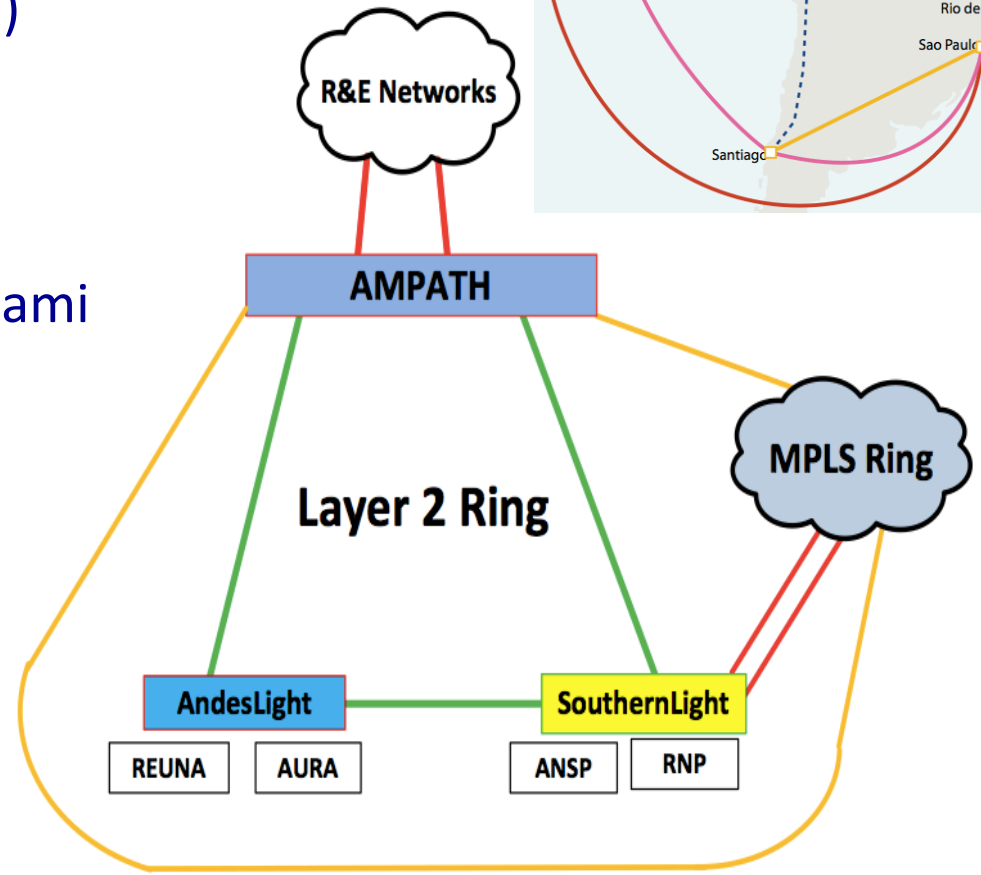
A set of 4 x 10G links with two topologies:

- SDN Ring
  (Miami-Sao Paulo-Santiago)
- MPLS Ring
  (Miami-Brazil-Miami)
- Later this year: 100G link between Sao Paulo and Miami
- Mutual Redundancy

Connections:

- 13 RENs
- > 1000 Universities and Research Centers



# AmLight Before SDN

- Configuration based on static VLANs
- Multiple instances of per-VLAN RSTP
- Mutual redundancy created wth:
  - IEEE 802.1ad (QinQ) + L2VPNs

# Why has AmLight moved towards SDN?

*Key motivations:*

***Improving operations efficiency***

***Introducing network programmability***

# Motivation 01: *Improving Operations Efficiency*

Amount of layer 2 circuits requested and networks involved makes the provisioning a complex process:

- Some circuits involve up to seven different networks
  - High level of coordination required with diverse network teams
- Multiple technologies involved
  - From Layer 1 to MPLS
- Some circuits took weeks or even months to be provisioned

# Motivation 02: Introducing Network Programmability

- The lack of support for network programmability compromises network-aware demos and applications
- Researchers could only view the network status (SNMP)

# Scenario Deployed (1/2)

Activated Openflow 1.0 + Hybrid Ports

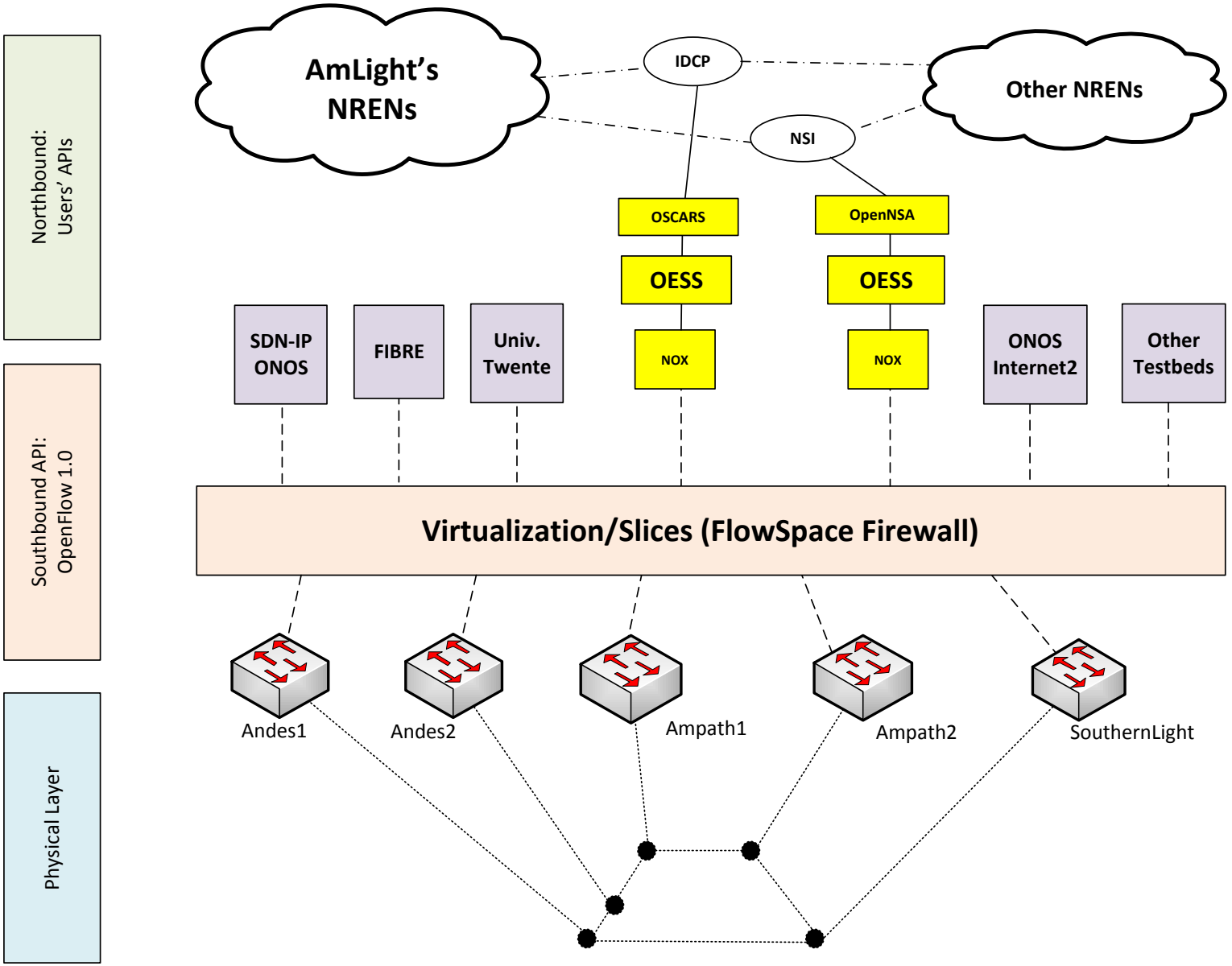
A. Improving operations efficiency:

- Internet2's OESS
- OSCARS - IDCP
- OpenNSA - NSI

B. Introducing network programmability

- Internet2's Flow Space Firewall

# Scenario Deployed (2/2)



# Findings (1/2)

## A. Improving operations efficiency

| | Average time to provision a new circuit | | Avg. number of e-mails exchanged | |
|---|---|---|---|---|
| **Domains Involved in the path** | **before SDN** | **with SDN** | **before SDN** | **with SDN** |
| RNP, ANSP, RedClara, AmLight, Internet2, ESNET | 5 days | < 5 minutes | 10 | 0 |
| Other networks (if IDCP or NSI supported) | 12 days | < 5 minutes | 65 | 0 |
| Other networks with NO IDCP or NSI - < 3 networks in the path | 5 days | - | 10 | - |
| Other networks with NO IDCP or NSI - > 3 networks in the path (Americas) | 12 days | - | 65 | - |
| Other networks in other continents not using IDCP or NSI | 45 days | - | 100 | - |

# Findings (2/2)

## B. Introducing network programmability

| | Network Access and Programmability | |
|---|---|---|
| | Before SDN | After SDN |
| Network View | SNMP | SNMP and Openflow |
| Provisioning Defined by the User | - | Full Openflow access through a dedicated slice |
| Multipath experiments | Static paths offered | |
| Flow controlled hop-by-hop | - | |

*Network programmability is the main achievement of this project:*

- *Network-aware applications will have AmLight as a real platform for innovation*

# Some Lessons Learned

- Some legacy protocols and old switching line cards could increase the complexity
  - LACP, Counters, Ethertypes
- Out-of-band/Control Plane network could be challenging
- Convergence methodology has to be improved
  - Specially in long-haul links

# Future

- Explore and add new features related to troubleshooting and security
- Create a *Software-Defined Internet Exchange* (SDX) involving AmLight and AtlanticWave
- Migrate to Openflow 1.3
  - Metering and improve the network convergence

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