AmLight ExP
Americas Lightpaths Express & Protect

AmLight Express and Protect (AmLight-ExP), #OAC-1451018

IRNC PI Meeting

Internet2 Global Summit

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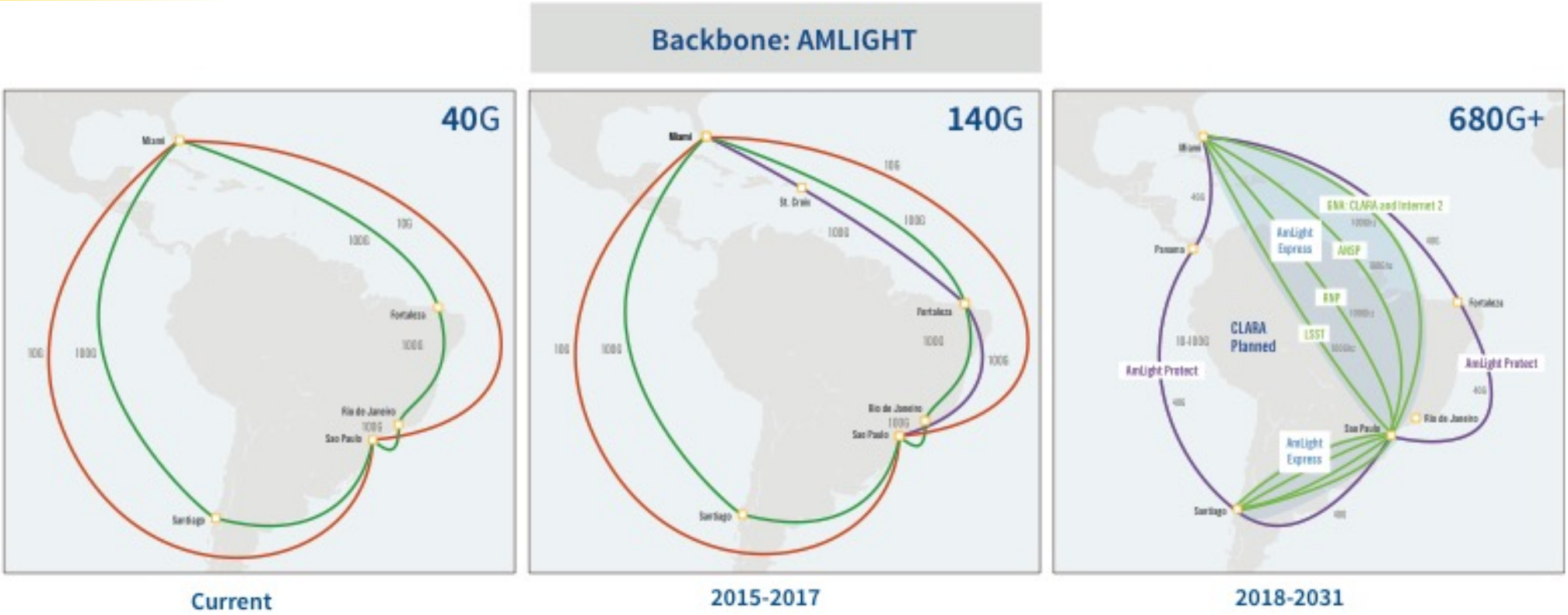
AmLight Express & Protect Vision



- Community-operated network infrastructure
- Leased capacity on two submarine cable systems, evolving to a hybrid model that includes spectrum from Boca Raton to Sao Paulo
- Express (spectrum) capacity will provide up to 6 optical channels, which will be lit with 100G transponders today
- Protect (leased) capacity ring will back up the Express capacity

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Partners and Goals

- AmLight-ExP interconnects the U.S. to key aggregation points in South and Central America (Brazil, Chile, Panama)
- Has cooperative partnership with ANSP, RNP, CLARA, REUNA, AURA, FLR, and Internet2
- Continues evolving a rational network infrastructure, using both optical spectrum and leased capacity

Current Status: Network Infrastructure

- 100G ring Miami-Fortaleza, Fortaleza-Sao Paulo, Sao Paulo-Santiago, Santiago-Miami
  - Panama being added Q2 2018
- 10G ring from Miami-Sao Paulo-Miami for protection (red)
- 10G Miami-Santiago for protection
- 100G and 10G rings are diverse, operating on multiple submarine cables
- Total upstream capacity presently at 230Gbps

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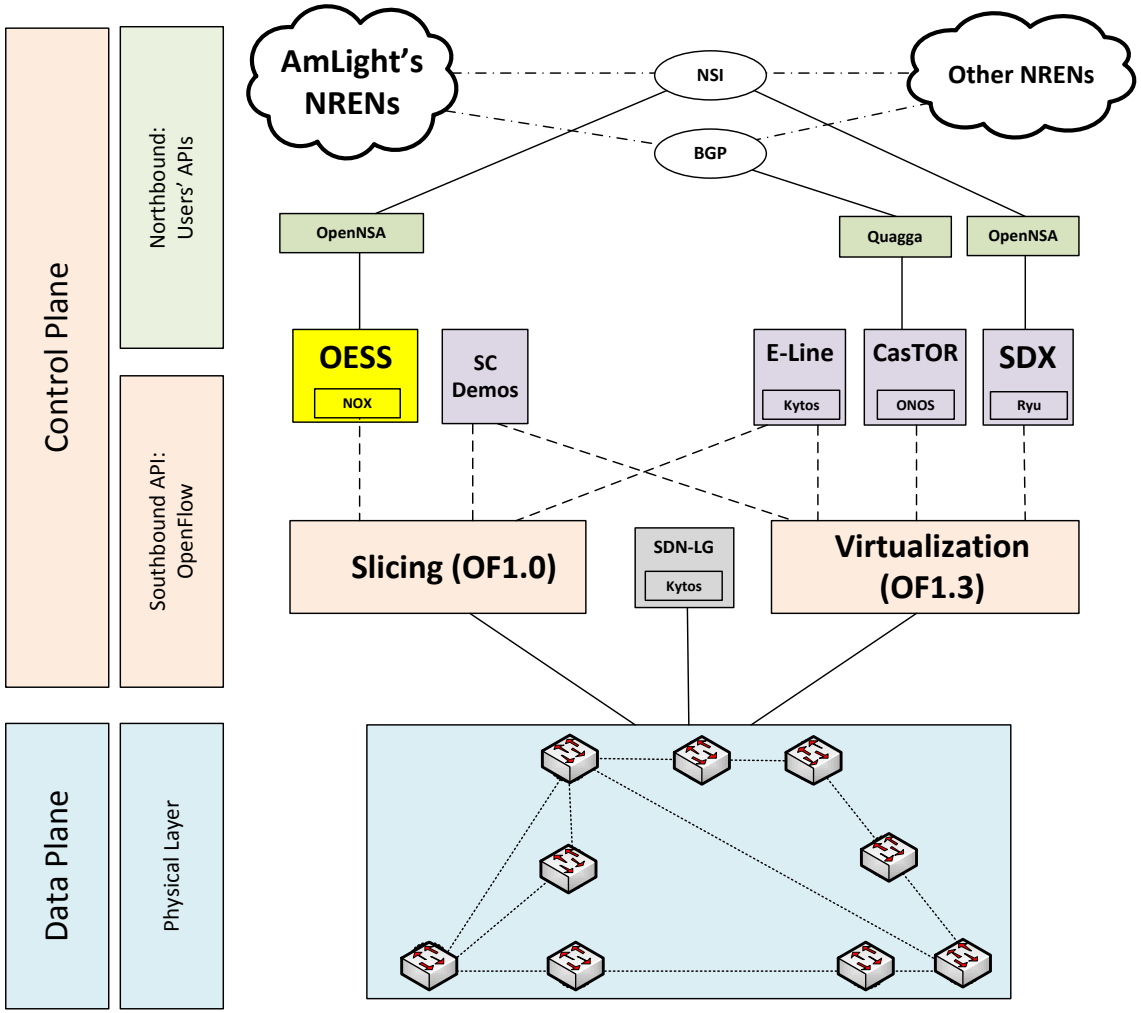
Current Status: Network Virtualization and Programmability

- AmLight became an SDN network in 2014
- Slicing for network testbeds using OpenFlow 1.0
- Virtualization using Corsa switches for network testbeds using OpenFlow 1.3
- Researchers use slicing/virtualization to prototype network-aware applications
  - Can implement testbeds with real network devices
  - Can validate their research in a production environment, and at scale
- Current testbeds:
  - ONOS/CasTOR, FIBRE, Kytos E-Line, Awave-SDX
- SDN Looking Glass tool for troubleshooting the data plane



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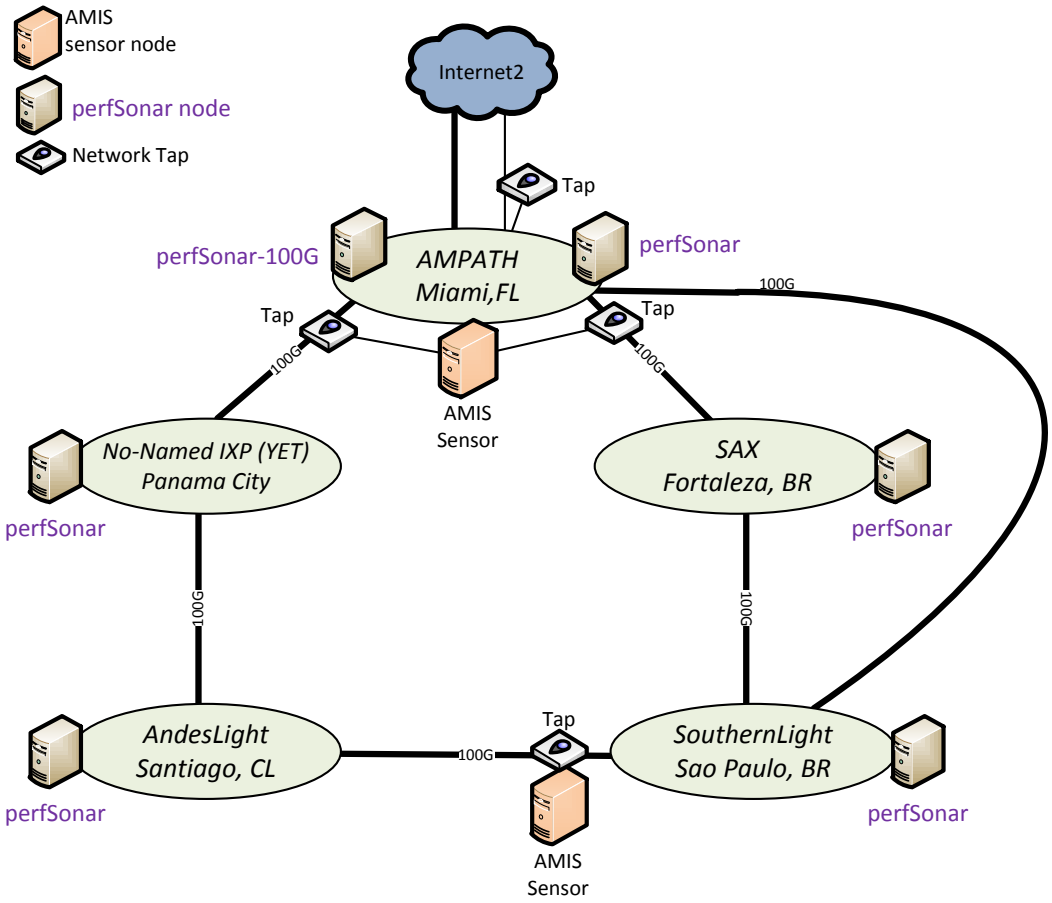
Current Status: Monitoring and Measurement

- Each AmLight PoP has a 10G perfSonar node with two NICs (BWCTL and OWAMP)
- Two 100G network taps installed in Miami to support the IRNC AMIS project
- One 100G network tap being installed between Sao Paulo and Santiago
- Maddash portal available



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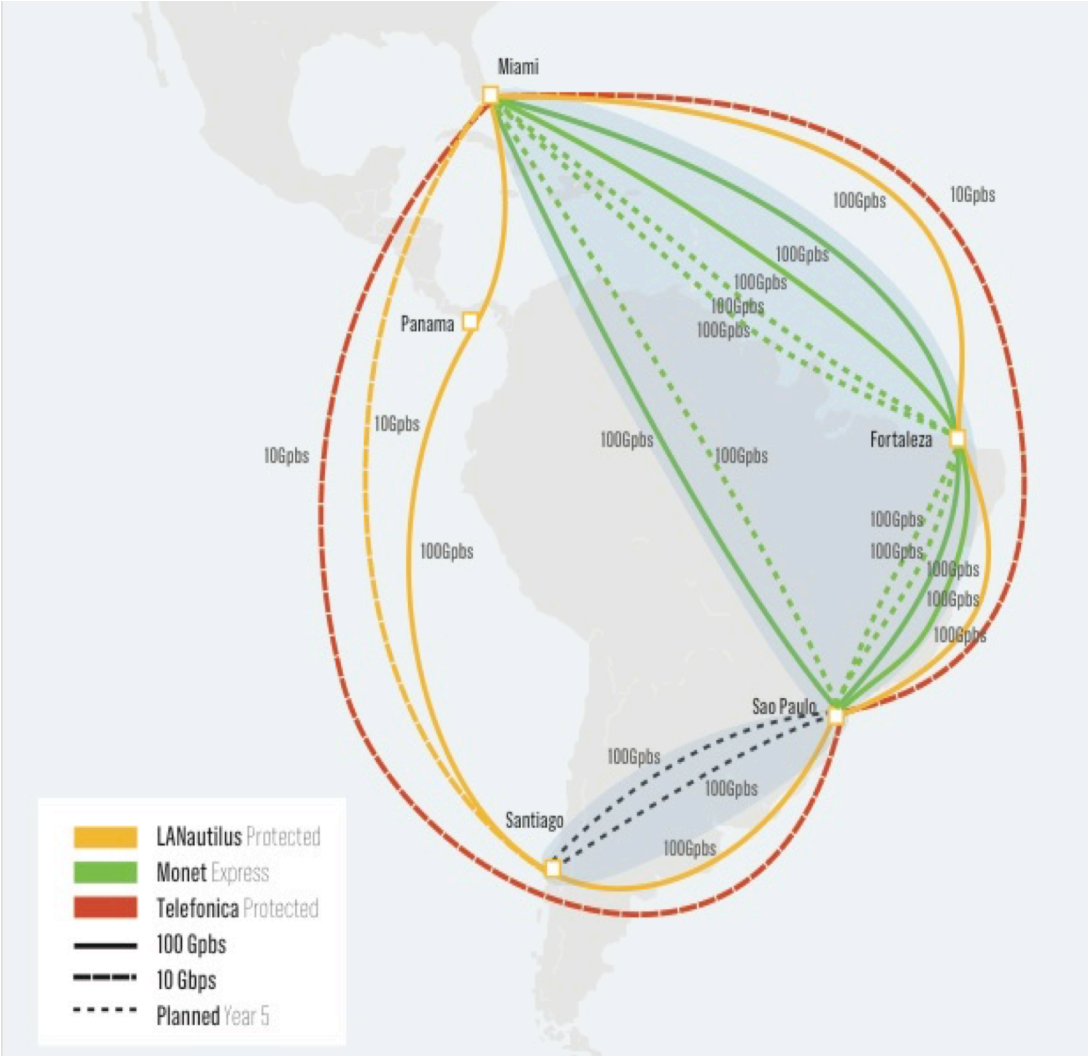
Plans for year 4: Build Express backbone, and enhance Protect ring

- Spectrum activation planned for Year 4:
  - Two 100G channels via Fortaleza (RNP and ANSP) (Q3 2018)
  - One direct 100G channel from Miami to Sao Paulo (ANSP) (Q4 2018)
- Add Panama to the 100G Protect ring: (Q2 2018)
  - Miami, Fortaleza, Sao Paulo, Santiago, Panama, Miami



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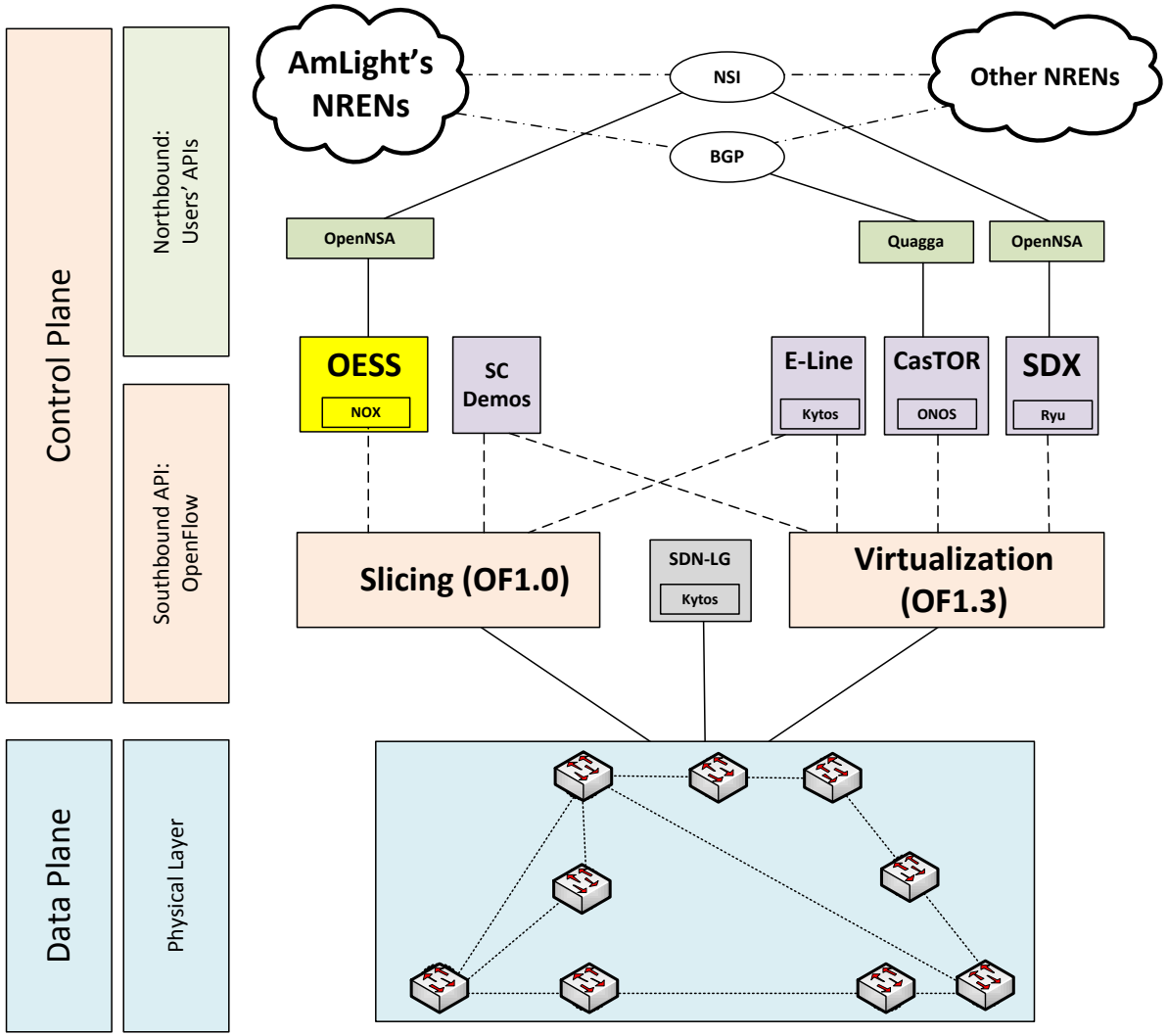
Plan for year 4: Network virtualization and programmability

- New sites with network virtualization using Corsa switches:
  - Sao Paulo, Brazil; and Santiago, CL
- Experimental deployment of bandwidth prioritization and reservation
  - In a multi-vendor environment (Corsa, Brocade, Dell)
- Integration of both optical and packet domains for a complete network visualization (SDN-LG for troubleshooting)



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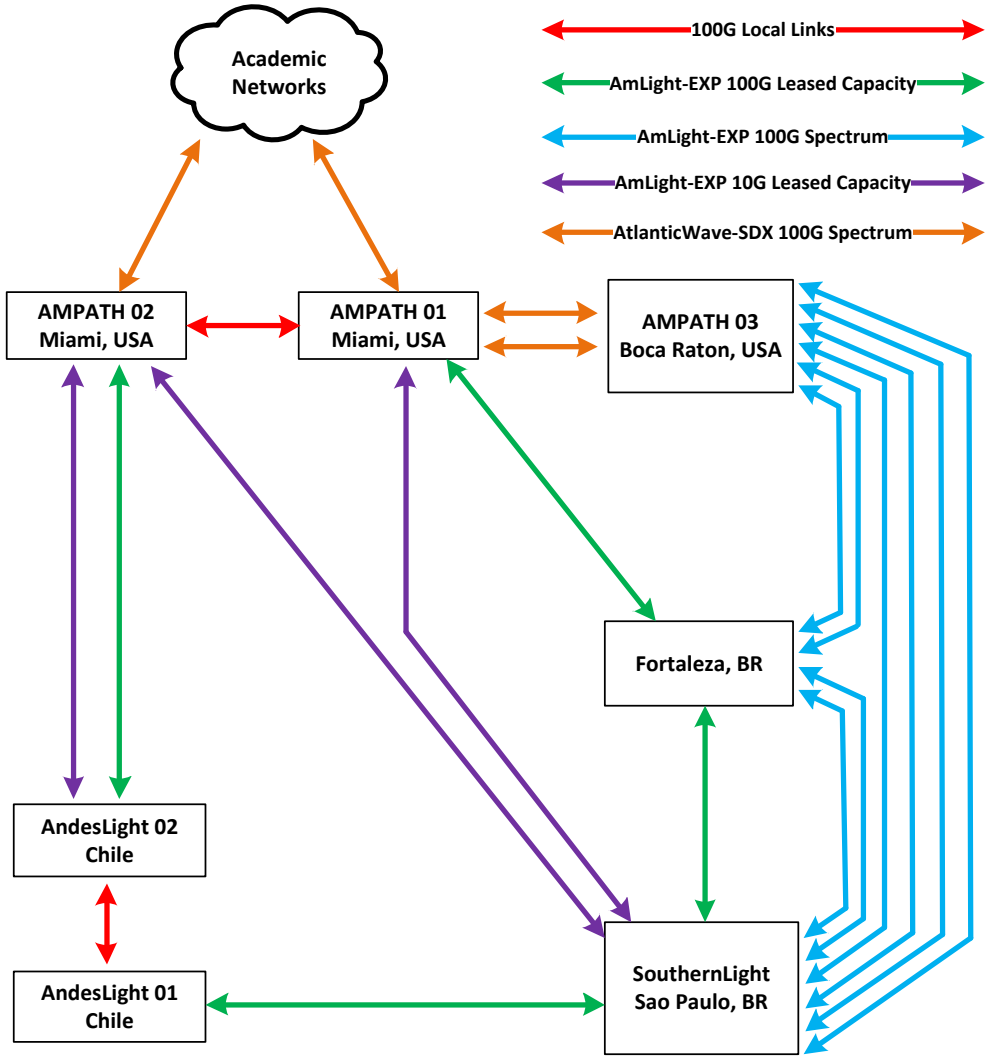
Challenge: Managing bandwidth abundance

- AmLight-ExP will have access to 225GHz of linear spectrum on Monet
  - Goal is to channelize this spectrum in 6x37.5GHz channels
  - Resulting in 6x100G ethernet circuits, initially
  - 200G of Protect (leased) capacity
- Florida currently has
  - 2x100G ports to Internet2
  - 1x100G port to SoX



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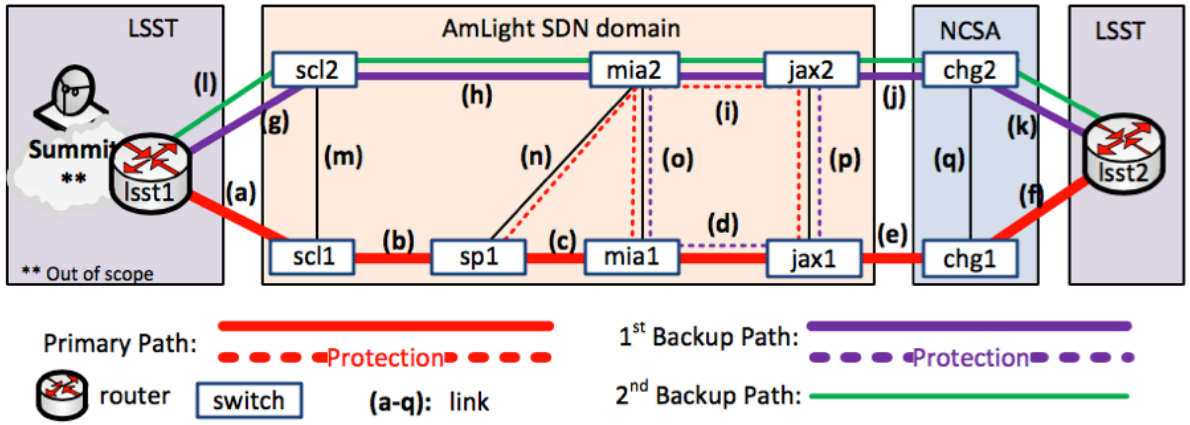
Challenges: Complex Hybrid Network Operation

- Intra-domain coordination is changing
  - Integrating spectrum and leased capacity into the SDN operation
  - More complexity in the SDN Controller configuration

- Inter-domain coordination across multiple network operators is becoming more complex
  - Social engineering challenge
    - Impact to application will involve ALL network operators in the path
  - Multiple vendor technology interoperability challenges
  - Inter-domain troubleshooting challenges

Challenge: LSST Use Case

- Inter-domain coordination challenge example
- Hybrid networks, multiple network paths, multiple vendors equipment, multiple network operators
- Strict SLA:
  - MTBF (180 days in a year)
  - MTTR (48 hours)
  - 5 sec 13GB image transfer time, every 27 seconds



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THANK YOU!

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