25th LACNIC Meeting
Regional Interconnection Forum

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AMPATH: Current status and future challenges

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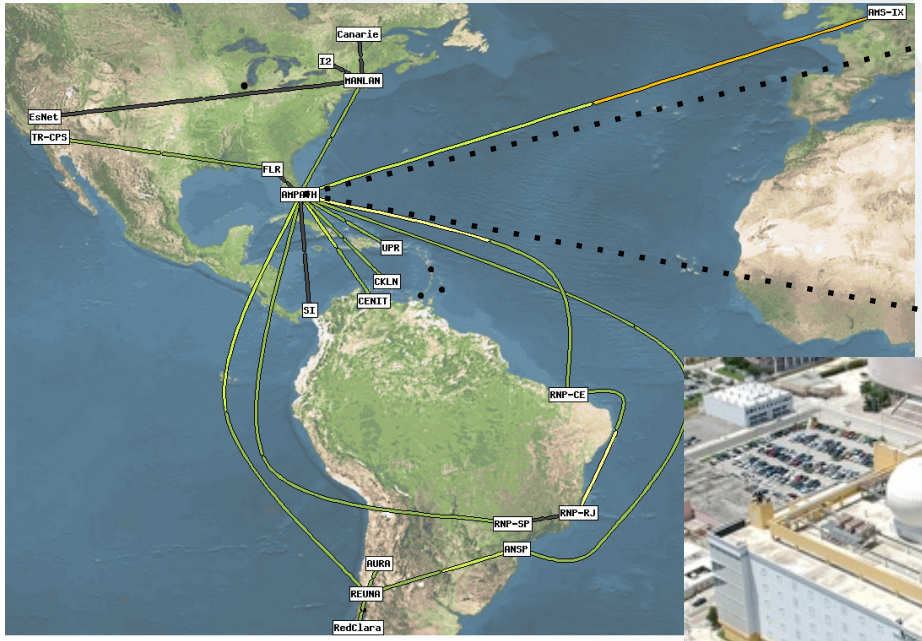
Outline

- AMPATH International Exchange Point
- Americas Lightpaths – AmLight
- AtlanticWave-SDX: a Software-Defined Exchange Point (SDX)

Who we are

AMPATH

- Open R&E IXP – **RXP** – based in Miami (NOTA)
- Main exchange point facility for Latin American and U.S RENs
- Supports science research and education programs of the NSF by



Who we are [2]

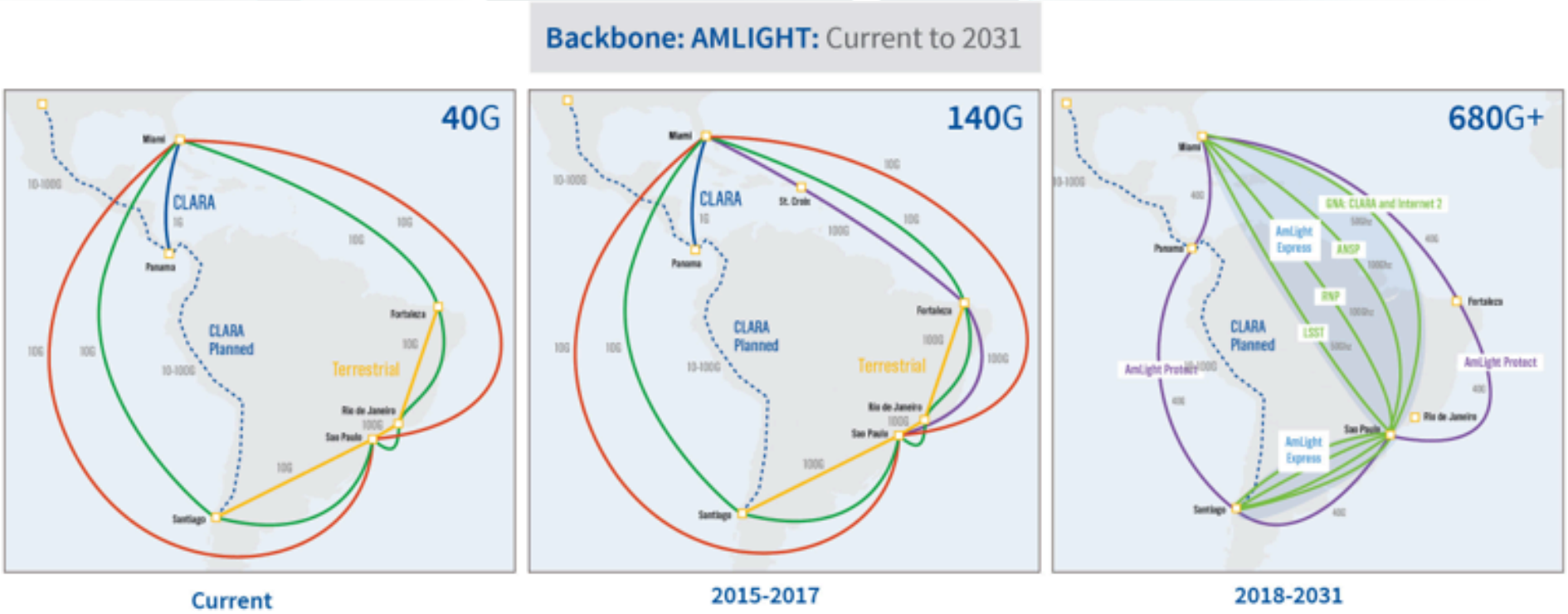
AMLIGHT

- Set of international links that interconnects exchange point facilities in Sao Paulo and Santiago to the AMPATH peering fabric creating a Distributed IXP

PARTNERSHIP AMONG

- ANSP - Academic Network of São Paulo
- AURA - Association of Universities for Research in Astronomy
- FIU - Florida International University
- NSF - National Science Foundation
- RedClara – Cooperación Latino Americana de Redes Avanzadas
- RNP - Rede Nacional de Ensino e Pesquisa
- REUNA - Red Universitaria Nacional

AmLight: Today and Future



NSF support for **AmLight** Express & Protect is part of a scalable rational architecture, designed to support the needs of the U.S.-Western Hemisphere research and education community that supports the evolving nature of discovery and scholarships.

NSF Award# ACI-1451018

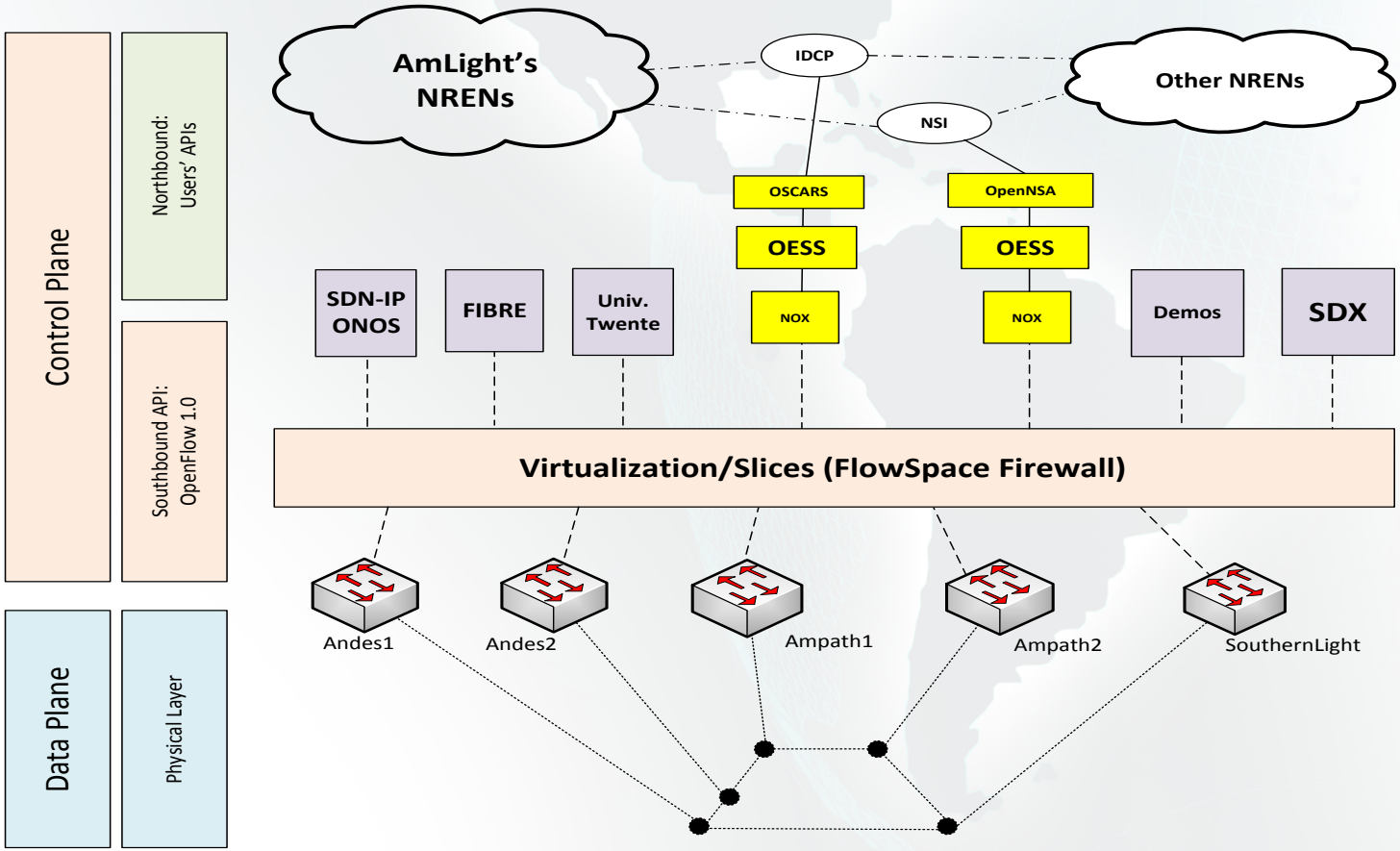
AmLight: Under the Hood

AMLIGHT SDN

Moved to SDN/OpenFlow approach in 2014

Hybrid approach: support for both SDN and legacy (VLAN)

Main benefits: network virtualization and programmability



AMPATH: the International Exchange Point

FABRIC ARCHITECTURE

http://measurements2.ampath.net/

AMPATH connectors are interconnected using OpenFlow circuits or legacy VLANs that runs on top of the AmLight SDN network

No route-servers: each peer need to agree with other party in order to exchange traffic

Isolation between Academic and Commodity traffic – different VLANs/ Flows for each service

AMPATH: the International Exchange Point

15+ ACADEMIC CONNECTORS

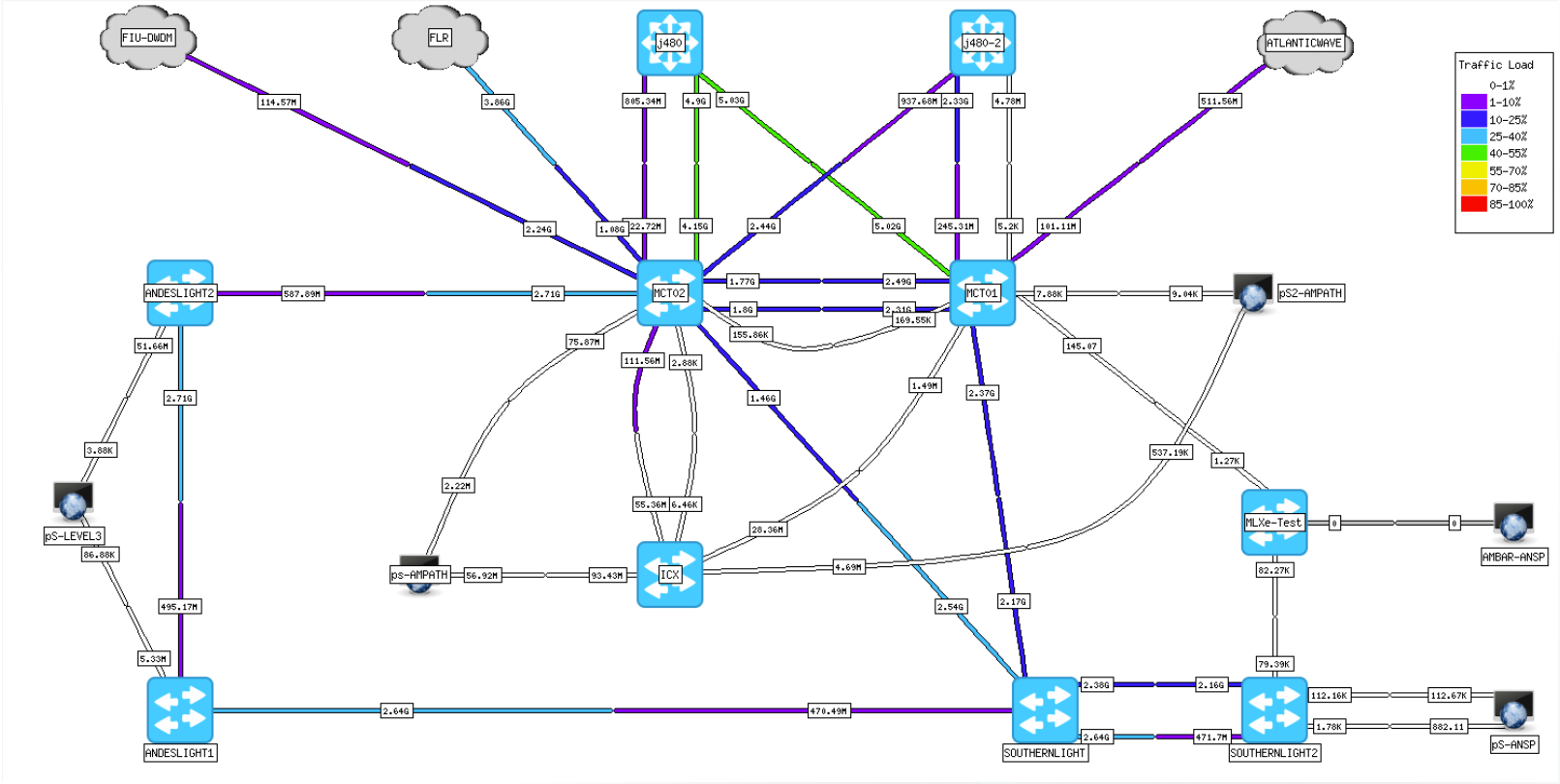
COMMODITY: 550+ Settlement Free Peering Agreements

Yahoo, Google, Verisign, Akamai, Microsoft, LimeLight Networks, Impsat, Packet Clearing House (PCH), Peer1 Networks, Terremark NOTA Peering, GNAPS, Sunrise Telecom (TDC Switzerland), Free.fr (France Telecom), DALNet, Host.net, Cache Networks, ComSat, Prolexic, NeuStar, PowerMedium, WV Fiber, BitGravity, OCCAID.

AMPATH: the International Exchange Point

AMPATH LAYER-3 SERVICE

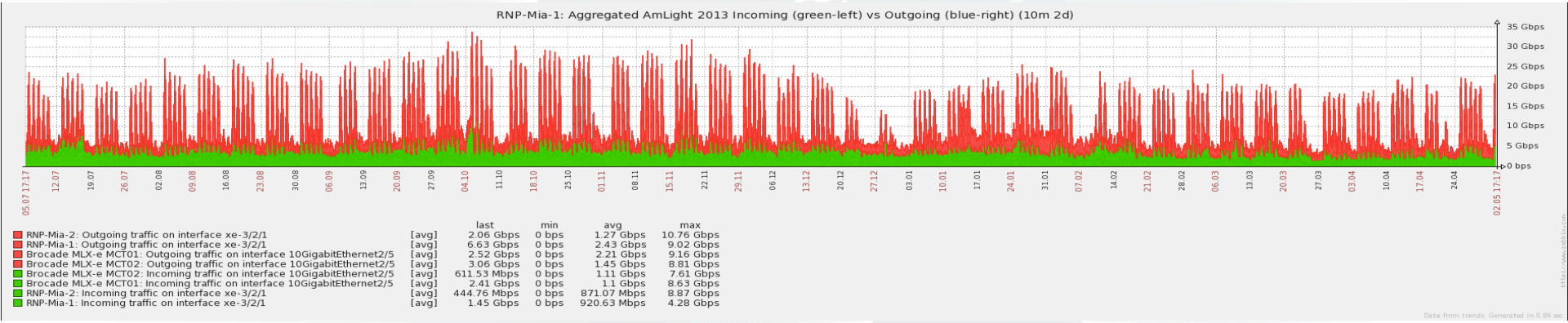
- Operate ASN 20080
- Support 1/10/100G links
- Support both IPv4/IPv6
- Multi-homed to Tier-1 providers in U.S.
- Also exchanging traffic at NOTA, FL-IX and AMS-IX



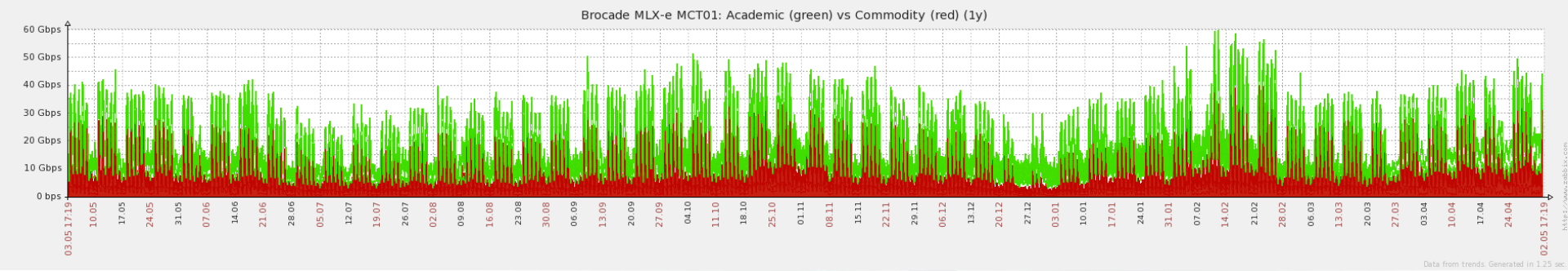
AMPATH: the International Exchange Point

UTILIZATION

Average AmLight links utilization: 35Gbps



AMPATH (switched + SDN) traffic peaks: 60Gbps



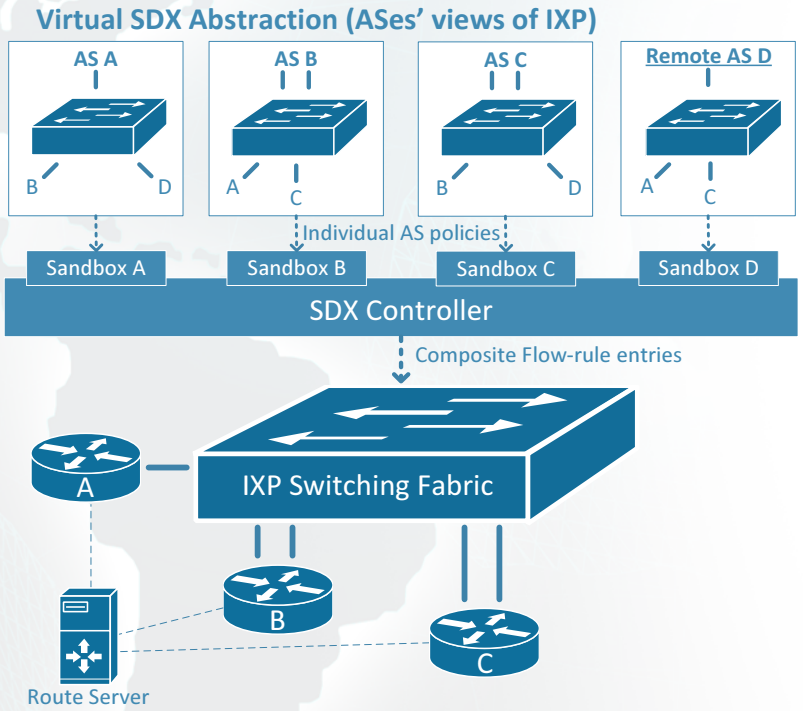
So, what’s next?

SDX Motivation

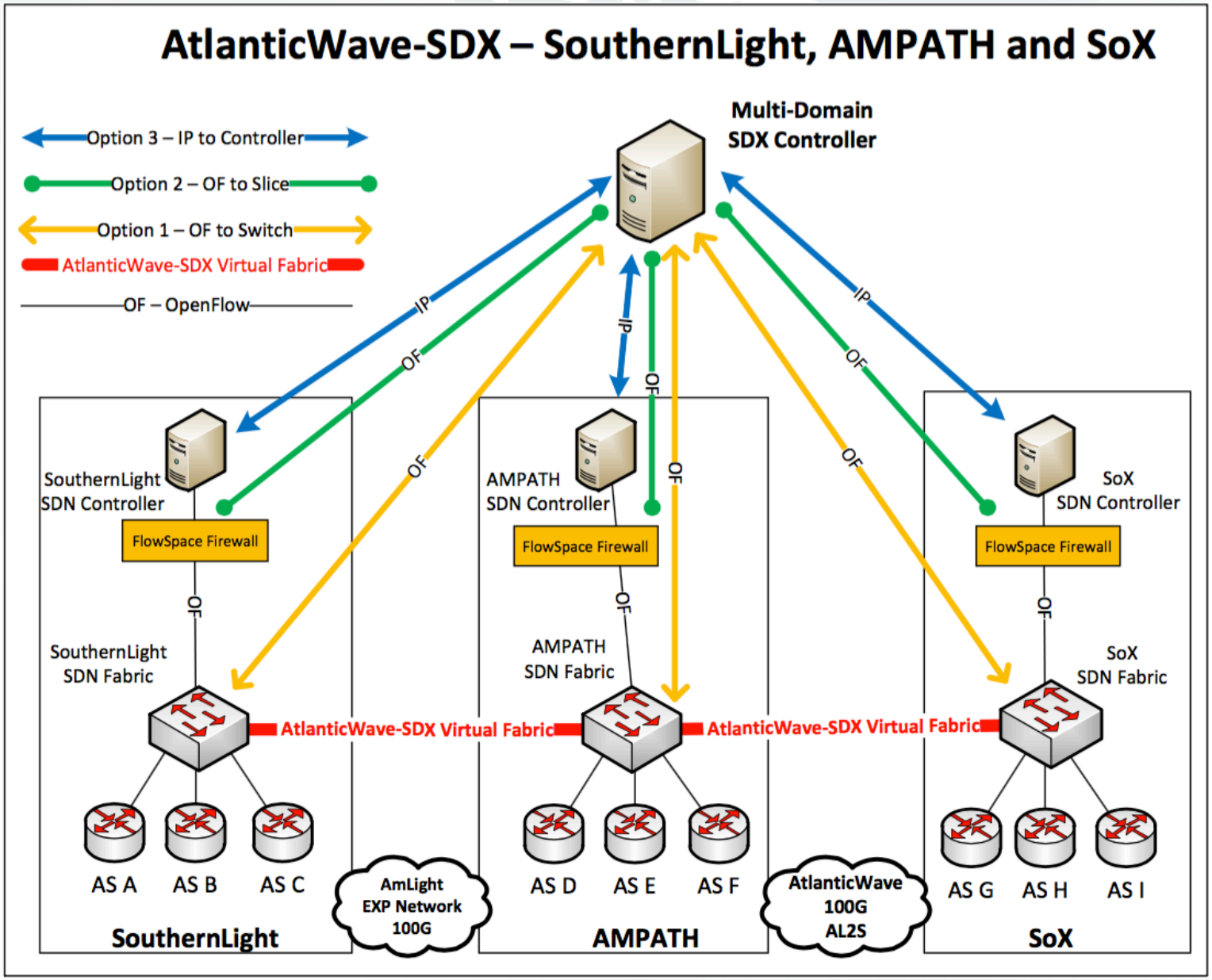
- A Software Defined eXchange (SDX) seeks to introduce Software Defined Networking (SDN) technologies into Academic Exchange Points to optimize resource sharing and allocation
  - Inter-domain R&E network programmability
  - End-to-End QoS coordination and enforcement

Virtual SDX Abstraction

- In a traditional IXP
  - Each participating AS connects a BGP speaking border router to a shared layer2 network, and
  - A BGP route server
- In an SDX
  - Each AS can run SDN applications that specify policies
  - The SDX combines the policies of multiple ASes into a single coherent policy for the physical switches
  - The SDX controller gives each AS the illusion of its own virtual SDN switch connecting its border router to each of its peer ASes
- The Virtual SDX concept is important for both:
  - Scaling the SDX architecture, and
  - Providing end users (or their application developers) with direct control over their own traffic throughout the network



SDX Architectures



SDX Applications

- Application-specific peering
- Inbound traffic engineering
- Wide-area load balancing
- Redirection through middle boxes

A. Gupta, E. Katz-Bassett, L. Vanbever, M. Shahbaz, S. P. Donovan, B. Schlinker, N. Feamster, J. Rexford, S. Shenker, and R. Clark, "SDX," ACM SIGCOMM Comput. Commun. Rev., vol. 44, no. 4, pp. 551–562, Aug. 2014.

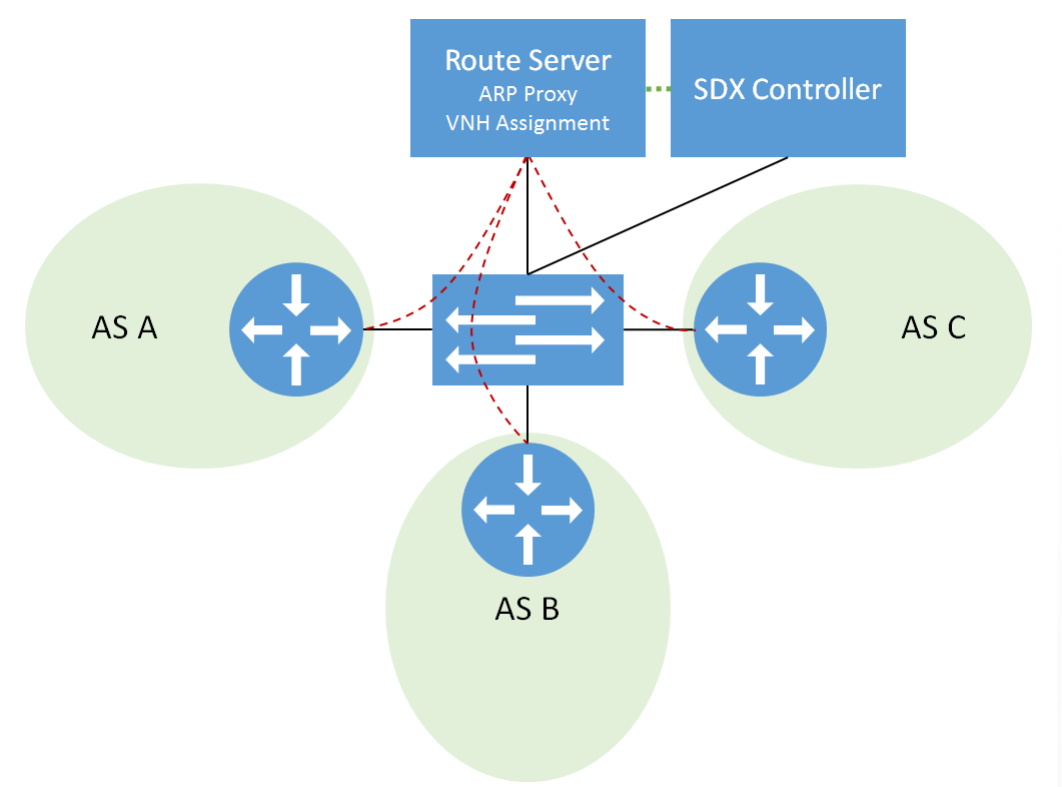
SDX Policies

- Policies based on packet header field:
  - Match TCP or UDP source and destination ports,
  - Match source and destination IP address or
  - Match source and destination MAC addresses
  - Apply actions accordingly.

- Policies based on external data:
  - Collect information from other systems such as: network monitoring systems, user databases, DNS or NTP server
  - Match parameters such as network latency, bandwidth, user name, domain name, date and time
  - Apply actions accordingly.

Example: Application Specific Peering

```
if (dstport == 80)
    forward to B
else if (dstport == 4321 || dstport == 4322)
    forward to C
```



AtlanticWave-SDX Status

- SDX Controller is being specified and documented:
  - Classes, interfaces and API
- A prototype is planned for the Internet2 Technology Exchange 2016 (September)
  - Possibly a demo will be presented

Conclusion

- AmLight and AMPATH plays a crucial role in the field of advanced network connectivity to support research and education in the LATAM and Caribbean regions
  - This infrastructure makes a significant contribution to developing connectivity in these areas, by delivering high-speed connections to researchers and by providing access to the commercial Internet.

- Acting as a Distributed IXP imposes several challenges to AMPATH, and the ability to program the network is needed to foster networ innovation between the U.S. and the LATAM and Caribbean regions.
  - AtlanticWave-SDX is a response to the demand for more intelligent network services to foster innovation and increase network efficiency.

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Thank you!

Questions?

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