



Open Networking Summit Mar 16th 2016

Migrating AmLight from Legacy to SDN: Challenges, Results and Next Steps

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Outline

- Describing AmLight
- Motivations to migrate to an SDN approach
- Results
- Challenges for the near future
- Next steps

Describing AmLight



AmLight is a Distributed Academic Exchange Point

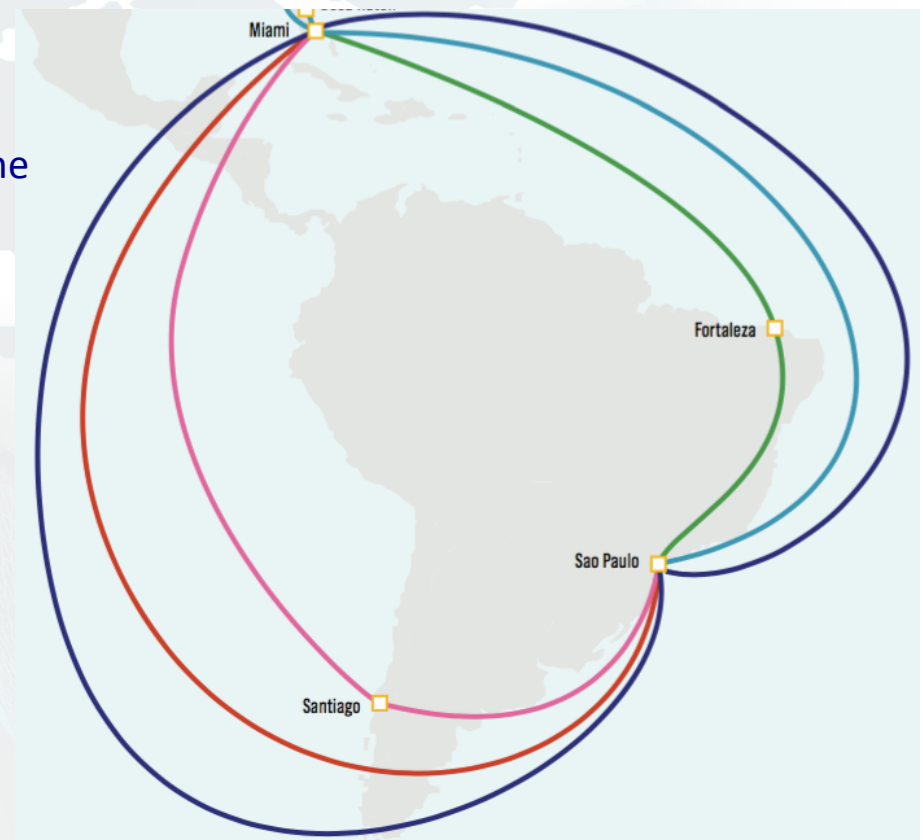
- Responsible to connect Latin America RENs to the U.S.
- Composed by multiple 10G links
- Fully OpenFlow 1.0:
 - Deployed in August/2014
 - Network virtualization support

Being installed this month:

- 1 x 100G between Sao Paulo and Miami

Total of **120Gbps** to upstreams (Internet2, FLR)

Most important: it is a **Production** network!



Motivations to migrate to an SDN approach



Improving operations efficiency

Introducing network programmability



Motivation 01: *Improving Operations Efficiency*

- Provisioning of multi-domain circuits requires a high level of coordination between multiple NOCs:
 - VLAN ID, redundancy, protocols, etc.
- Some circuits used to take days, weeks or even months to be provisioned



Motivation 02: Introducing Network Programmability

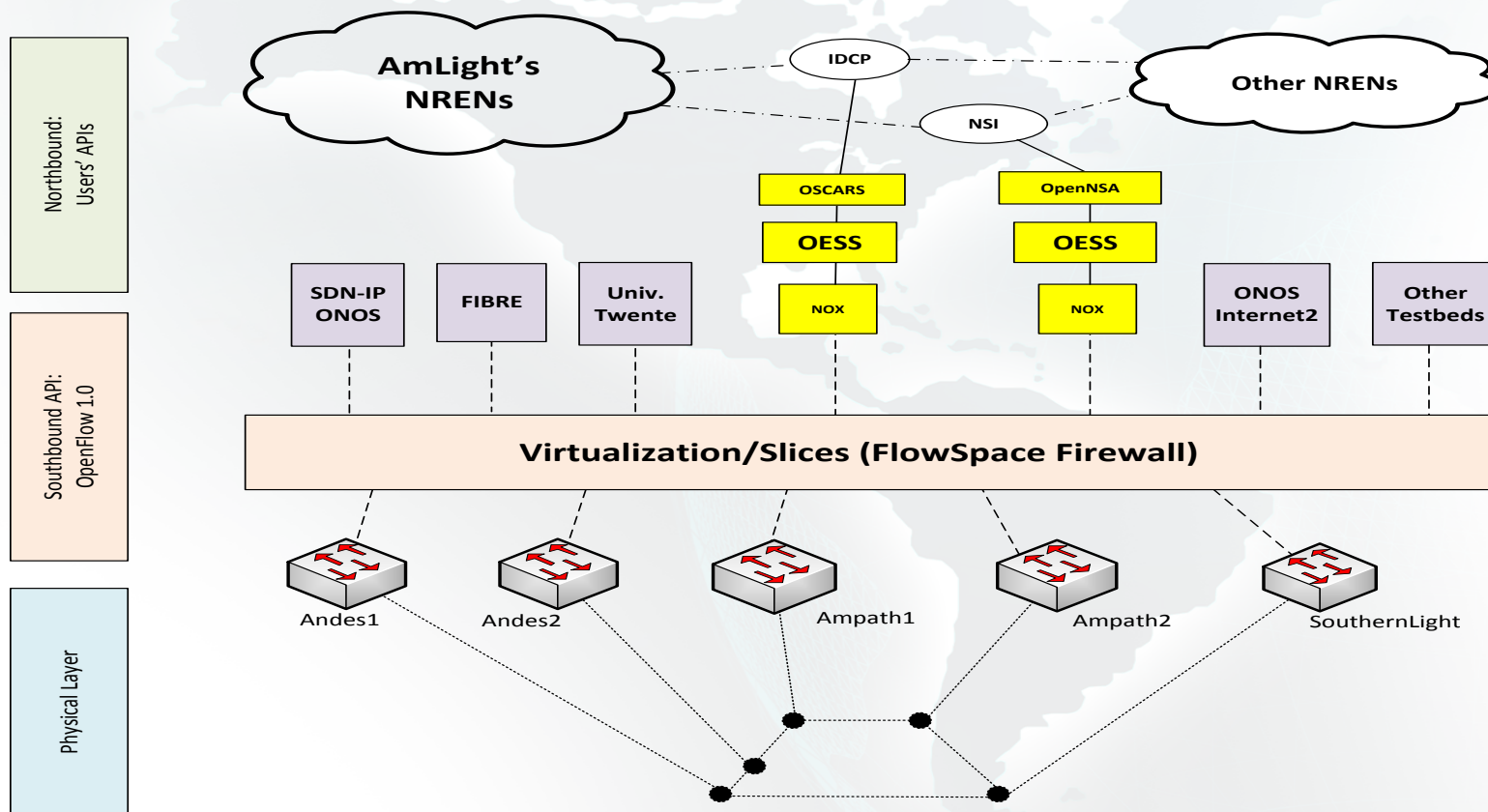
- The lack of support for network programmability compromises network-aware demos and applications
- Researchers could only view the network status via SNMP
- Engineers had no chance to try new control planes



AmLight SDN

- Migrate on August/2014
- OpenFlow 1.0 activated on 5 x Brocade MLXe switches
- Virtualization Layer deployed with Flow Space Firewall
- Production L2VPN application: Internet2 OESS
- Experimental Applications: ONOS/SDN-IP, ODL, etc.
- Paper presented on IEEE IM 2015:
 - *“Benefits brought by the use of OpenFlow/SDN in the AmLight intercontinental research and education network”*

AmLight SDN Stack





Results

A. Improving operations efficiency

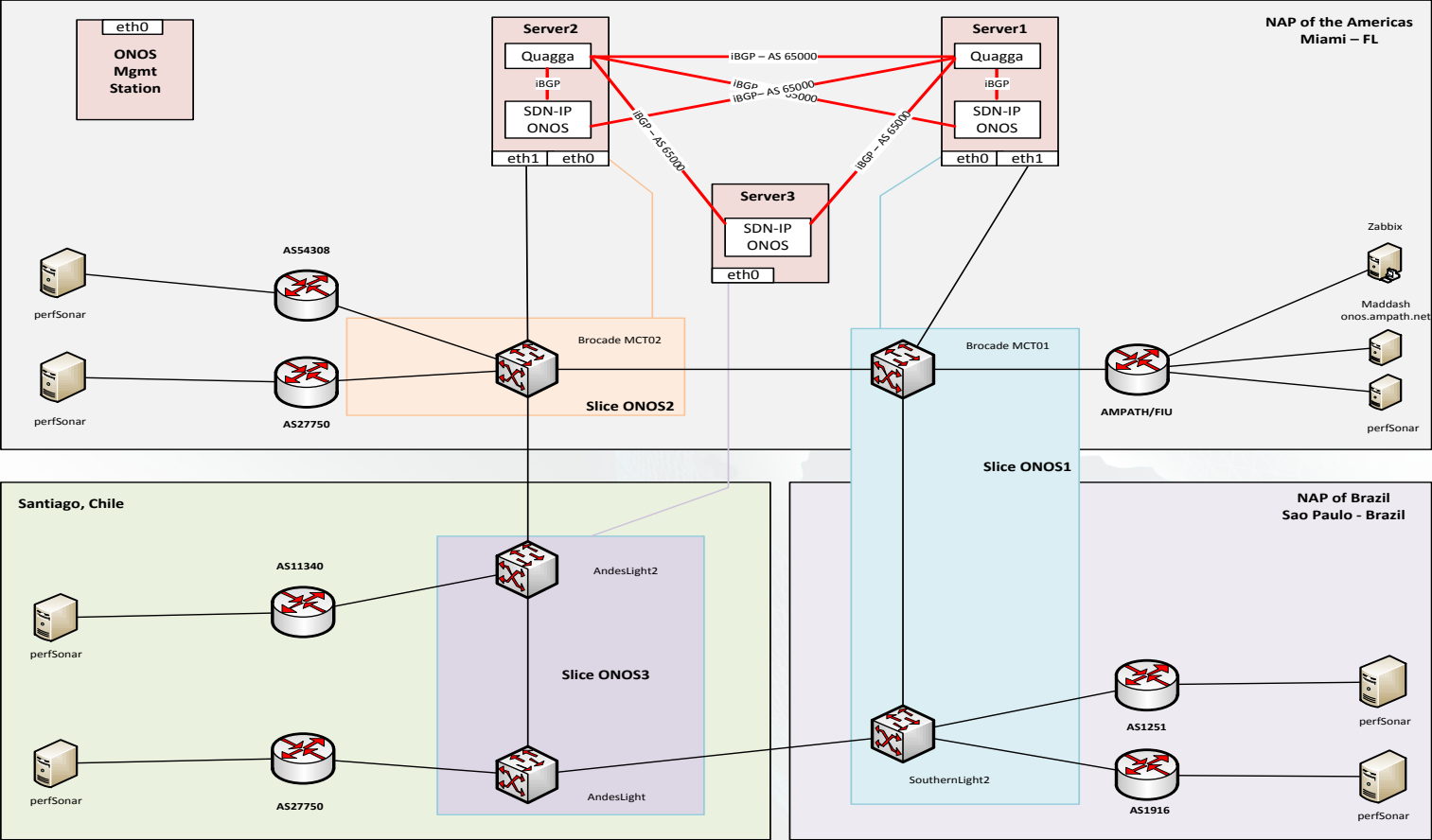
Domains Involved in the path	Average time to provision a new circuit		Avg. number of e-mails exchanged	
	before SDN	with SDN	before SDN	with SDN
RNP, ANSP, RedClara, AmLight, Internet2, ESNET	5 days	< 5 minutes	10	0
Other networks (if IDCP or NSI supported)	12 days	< 5 minutes	65	0

B. Network Virtualization:

	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 Virtualization: ONOS/SDN-IP

ONOS at AmLight Testbed



Network Virtualization: ONOS/SDN-IP



ONOS Global SDN-IP deployment

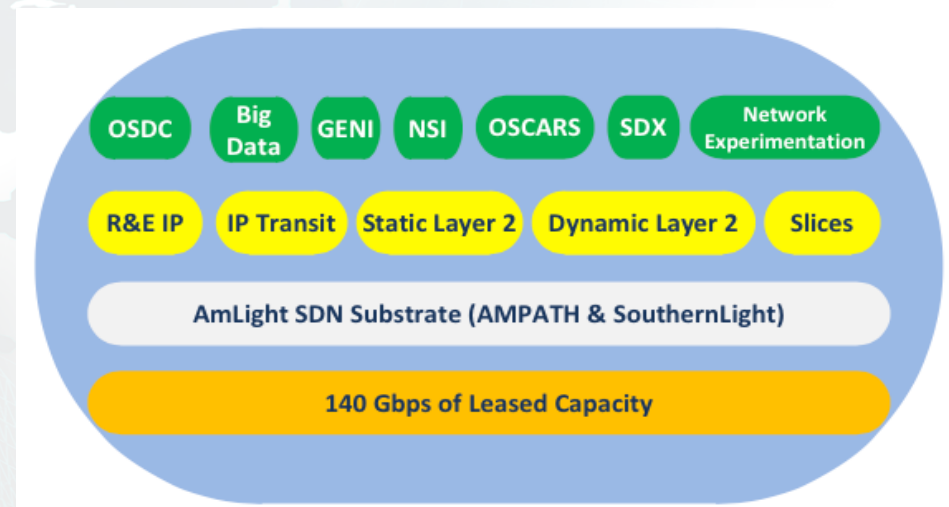


Live directly from booth 25-B!!

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Challenges for the near future

- **!!!Troubleshooting!!!!**
 - Flow consistence among layers
 - Isolate issues
- **Quality of Service**
 - Bandwidth Guarantee
 - Dynamic application load-balance
- **Security**
 - Secure access with network virtualization
 - Isolation between applications
- **Networking**
 - Scalability (# of flows)
 - IP/IPv6/Multicast Routing



Next Steps

- ONOS/SDN-IP for production:
 - Another virtual network is already available
 - AmLight peers will exchange IPv4 traffic using ONOS only
 - Moving towards an OpenFlow-only network
- ONOS/VPLS application:
 - Another virtual network might be provided
 - Try a new application for L2VPNs
- Upgrade to OpenFlow 1.3:
 - Major change
 - Add new features to the network:
 - QoS: bandwidth guarantee, prioritization
 - Routing/Forwarding IPv6
 - Multiple tables, complex pipelines



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Questions?

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