Moving Towards SDN @ AmLight

4th Annual Global LambdaGrid Workshop
Oct 1st 2014
Queenstown, New Zealand

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Who we are

AMPATH:
  – GLIF GOLE and Academic IXP in Miami
  – Interconnects all Latin America RENs to other NRENs in the world

SouthernLight
  – GLIF GOLE and Academic IXP in Sao Paulo
  – Interconnects all Brazilian RENs and RedCLARA to AmLight

AmLight:
  – A set of trans-continental high-bandwidth links connecting SouthernLight, REUNA and AURA/Chile to AMPATH

Partners: Florida International University/FIU, NSF, ANSP, RNP, RedCLARA, REUNA and AURA
AmLight Today

A set of 4 x 10G links connecting South America to AMPATH

• Academic Layer 2 Ring
  (Miami-Sao Paulo-Santiago)
• MPLS Ring
  (Miami-Fortaleza-Rio-Sao Paulo)
• Later this year: 100G link between Sao Paulo and Miami
  (OpenWave)

Connections:
• 13 RENs
• > 1000 Universities and Research Centers
AmLight Layer 2 Ring
Up to two months ago

• Mostly used for academic/research collaboration
• Configuration based on static VLANs
• Multiple instances of Brocade per-VLAN RSTP
• Receives redundancy from Academic Layer 3 Ring:
  – IEEE 802.1ad (QinQ) deployed in Sao Paulo
  – 3x 10G ports dedicated to this redundancy
• Very resilient, 100% availability in 2013 (assuming minimum of 10Gbps)

*If everything was working fine, why change it?*
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

*It was necessary to find a way to improve this situation...*
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)
How has AmLight addressed these motivations? (1)

• Is it possible to use SDN to address these issues?

• Is it the right moment for using SDN?

• Do my devices support Openflow?

• Are we going to lose features?
How has AmLight addressed these motivations? (2)

• Is it possible to use SDN to address these issues?
  – Yes!

• Is it the right moment for using SDN?
  – For AmLight, which only supports Layer 2, Yes!

• Do our devices support Openflow?
  – After diverse tests and simulations, we confirmed: Yes! 1.0

• Are we going to lose features?
  – Yes
    • Some modules don’t support Openflow counters
    • LACP is not supported
  – But we have workarounds. Move forward!
Scenario Deployed (1)

- **Devices:**
  - Brocade MLXe (8x10G)
  - Brocade XMR (4x10G)
  - Brocade CES
    - Version 5.6d
- **Improving Operations Efficiency:**
  - Internet2’s OESS
- **Adding Network Programmability:**
  - Internet2’s FlowSpace Firewall
- **Final Approach:**
  - Openflow 1.0
  - Sao Paulo has a “Hybrid” port
  - Chile is “full SDN”
  - Controllers installed in Miami, mirror in SP*
  - Integration with Internet2 via OSCARS
    - NSI in the future
  - Non-Academic traffic remains “legacy/protected”
  - 7 new 10G connections required
Scenario Deployed (2)

- **OESS UI:**

Traffic Statistics since beginning of September:

- Peak of 7.3Gbps
- OF interfaces only!
Findings (1)

A. Improving operations efficiency

<table>
<thead>
<tr>
<th>Domains involved in the path</th>
<th>Average time to provision a new circuit</th>
<th>Avg. number of e-mails exchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNP, ANSP, RedCLARA, AmLight, Internet2, ESnet</td>
<td>before SDN: 5 days</td>
<td>after SDN: &lt; 5 minutes</td>
</tr>
<tr>
<td></td>
<td>before SDN: 10</td>
<td>after SDN: 0</td>
</tr>
<tr>
<td>Other domains using OSCARS or NSI support</td>
<td>before SDN: 12 days</td>
<td>after SDN: &lt; 5 minutes</td>
</tr>
<tr>
<td></td>
<td>before SDN: 65</td>
<td>after SDN: 0</td>
</tr>
<tr>
<td>Other domains not using OSCARS or NSI support, &lt; 3 networks in the path</td>
<td>before SDN: 5 days</td>
<td>after SDN: *</td>
</tr>
<tr>
<td></td>
<td>before SDN: 10</td>
<td>after SDN: *</td>
</tr>
<tr>
<td>Other domains not using OSCARS or NSI support, &gt;3 networks in the path</td>
<td>before SDN: 12 days</td>
<td>after SDN: *</td>
</tr>
<tr>
<td></td>
<td>before SDN: 65</td>
<td>after SDN: *</td>
</tr>
<tr>
<td>With domains in other continents not using OSCARS or NSI support</td>
<td>before SDN: 45 days</td>
<td>after SDN: *</td>
</tr>
<tr>
<td></td>
<td>before SDN: 100</td>
<td>after SDN: *</td>
</tr>
</tbody>
</table>

* - Not tested yet
Findings (2)

B. Introducing network programmability

<table>
<thead>
<tr>
<th></th>
<th>Network Access and Programmability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before SDN</td>
</tr>
<tr>
<td>Network View</td>
<td>SNMP</td>
</tr>
<tr>
<td>Provisioning Defined by</td>
<td>-</td>
</tr>
<tr>
<td>the User</td>
<td></td>
</tr>
<tr>
<td>Multipath experiments</td>
<td>Static paths offered</td>
</tr>
<tr>
<td>Flow controlled hop-by-</td>
<td>-</td>
</tr>
<tr>
<td>hop</td>
<td></td>
</tr>
</tbody>
</table>

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

• Lack of the Hybrid port feature can derail the SDN deployment

• Out-of-band/Control Plane network could be challenging

• “Having a testing environment with the same devices is mandatory”

• 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

• Find researchers interested in using the AmLight infrastructure

• Migrate to Openflow 1.3
  – Metering and improve the network convergence
Moving Towards SDN @ AmLight

Visit our website: www.sdn.amlight.net!

Thanks!
Questions?

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