AmLight SDN/SDX: Updates
SAACC 2018
May 18, 2018

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Outline

• AmLight SDN/SDX – Jeronimo

• Cooperative Troubleshooting between ALMA and NERSC - Vinicius
Software-Defined Networking @ AmLight

• AmLight became an SDN network in 2014:
  – Optimized provisioning time
  – Network Virtualization

• Researchers can use virtualization to prototype their own 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
Challenging Projects

• New scientific instruments being designed and deployed will increase the need for large, real-time data transfers among scientists throughout the world:
  – LSST will produce 12.7 GB data sets that must be transmitted to the U.S. in 5 seconds and it will be remotely operated;
  – LHC performing massive data transfer to multiple sites
  – ScienceDMZ data transfers, SKA, ...

• End-to-end paths must provide high resilience, low delay, multiple paths, high bandwidth and an efficient control plane to act in all status changes
Challenging Projects [2]

• Most of the R&E networks can accommodate some of these requirements:
  – Multiple paths with multiple 100G links
  – Dynamic provisioning, bandwidth reservation, network programmability, etc.

• But R&E networks are interconnected through Academic Exchange Points:
  – Almost no support for programmability

• High demanding end-to-end applications require that all networks in the path support QoS and Programmability
  – Including at the Academic Exchange Points

• *Software Defined Exchanges/SDX as a possible solution*
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
IRNC: AtlanticWave-SDX

- AtlanticWave-SDX (Awave-SDX) is building a distributed intercontinental experimental SDX in response to a growing demand to:
  - Support end-to-end services capable of
    - Spanning multiple SDN domains
    - Dynamic provisioning of end-to-end circuits
    - Providing network programmability
  - Provide more intelligent network services to
    - Foster innovation
    - Increase network efficiency

- Florida International University (FIU) and Georgia Institute of Technology (GT) are implementing AtlanticWave-SDX, in collaboration with other exchange points supporting SDN

- Four sites will be part of the AtlanticWave-SDX:
  - SOX (Atlanta), AMPATH (Miami), SouthernLight (Sao Paulo), and AndesLight (Chile)
Current Network Design

• The SDX Controller:
  • Interfaces with external requests
  • Coordinates intra and inter-domain provisioning

• Each site will have its Local Controller:
  • Bootstrapping, topology discovery, southbound translation
Multiple Interfaces

- User requests via WEB UI or REST calls
- Interface for Network Engineers and Domain Scientists

```json
{"l2tunnel": {
    "starttime": "2016-10-12T23:20:50",
    "endtime": "2016-10-13T23:20:50",
    "srcswitch": "atl-switch",
    "dstswitch": "mia-switch",
    "srcport": 5,
    "dstport": 7,
    "srcvlan": 1492,
    "dstvlan": 1789,
    "bandwidth": 1
}}

{"dtntunnel": {
    "quantity": "7TB",
    "deadline": "2016-10-30T23:59:59",
    "srcdtn": "gt-dtn",
    "dstdtn": "fiu-dtn"}
```
More Policy examples

- On-demand Virtual Circuit provisioning

  ```java
  if (current_latency > SLA_latency)
      secondary = findSecondaryPath()

  while (current_latency > SLA_latency)
      LoadBalance(primary, secondary)
  ```

- Bandwidth Calendaring

  ```java
  scheduled_time = 21:00:00 GMT -5
  if (current_time == scheduled_time) {
      BW = 90 // Bandwidth in Mbps
      t = 60 // Reservation time
      OnDemandVC(BW, t)
  }
  ```
AtlanticWave-SDX: Current Features

- Layer 2 Point-to-Point and *Point-to-Multipoint* circuits with bandwidth reservation and MAC learning
- Web UI and REST calls customized per user profile
- REST supporting HTML and *JSON* replies
- Support for complex data plane pipelines and arbitrary advanced rules
- Support for Inbound NSI requests for inter-domain provisioning
- Support for Docker and Vagrant images
- Shibboleth
Features Planned for 2018

• Per-User Resource Authorization

• In-Band Controller Communication/Bootstrapping

• *Investigation* of possible integration with compute resources
Deployment Plans for 2018

• Installation of SDX switches in Brazil and Chile
• A L2VPN will be created connecting SOX to AMPATH via Internet2
• L2VPNs will connect AMPATH, AndesLight, and SouthernLight’s SDX switches

• An Awave-SDX prototype will connect all sites

Astronomers/Domain Scientists will be invited to try it out!
Cooperative Troubleshooting perfSonar data transfer between ALMA and NERSC

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Abstract Topology

- Several NRENs involved:
  - ALMA perfSonar at Simons Observatory
  - REUNA
  - RedClara
  - AmLight
  - ESNET
  - NERSC perfSonar at Berkeley
Abstract Topology

- Poor performance for data transfers identified between ALMA Simons and NERSC in Berkeley
Abstract Topology

- Data transfer between ALMA Simons and NERSC in Berkeley:

Where is the packet loss?
Abstract Topology

- Isolating link faults in each domain....

Let’s zoom in on each cloud.....
It has to be between Miami - Santiago
Let's try to isolate the packet loss, using a different link.
Let's try to isolate the packet loss, using a different link.

No more packet drops!
When the bypass circuit was provisioned
• Thank you all Engineers involved:
  
  ○ Eli Dart, Alejandro, Albert, Sandra, Marco Teixeira, Gustavo, and many others.
• Thank you all Engineers involved!
• There’s a long road of troubleshooting ahead!
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• The collaboration happened in a short time frame.
• SDN/SDX can bring even more agility to support data science!