AmLight’s SDN Looking Glass - A Network Monitoring System for SDN Networks

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AmLight: a Distributed Academic Exchange Point

- Production SDN Infrastructure since Aug-2014
- 5 x NAPs: Miami, Brazil(2), Chile and Panama with 10G and 100G links
- 2000+ institutions connected
- Carries Academic and Commercial traffic
- Control Plane: OpenFlow 1.0 (with an OF1.3 overlay)
- Network Programmability/Slicing
  - OESS/NOX, ONOS, Kytos and Ryu
- Currently, operating with more than a 1000 flow entries

Collaboration: FIU, NSF, ANSP, RNP, CLARA, REUNA and AURA
Why troubleshooting a SDN network is so complex?

- OpenFlow has minimum support for troubleshooting
  - For instance, there are no special/reserved flow cookies

- Current SDN applications only consider network provisioning
  - Need for troubleshooting features only appears once things start falling apart

- Many academic papers suggesting solutions that do not fit in production
  - Heuristic and Machine Learning per unknown packet do not scale

- SDN concept itself makes things harder sometimes
  - Because datapaths have no intelligence at all, controllers always have to be involved
• Troubleshooting production networks has different requirements
  – Has to be agile, least disruptive as possible and needs historical data
  – Tools have to be handy

• More than ever, deep knowledge of the hardware and software platforms are required:
  – Use of ”hidden” commands and application logs become part of your routine
Our Vision

- A single side-application for troubleshooting makes more sense:
  
  - Pros:
    - Frees the provisioning developers to focus on provisioning
    - Avoids duplicated data when multiple SDN applications are running production
    - Eases auditing
    - Centralizes all troubleshooting data, making it easier to correlate events
  
  - Cons:
    - Parallel OpenFlow applications is still a challenge
    - No East-West protocol standardized
    - Another application to maintain
AmLight SDN Looking Glass

• Central point for SDN troubleshooting:
  – Centralizes all monitoring and troubleshooting information being slice/app-independent
  – Stores all statistical data (flow, ports, etc.) and OpenFlow messages into a persistent backend
  – Tracks real time OpenFlow control plane messages
  – Tracks non-OpenFlow information (for instance, CPU utilization)
  – Runs trace paths ("traceroute"), including inter-domain
  – Sends alerts via e-mail and Slack
  – Takes network snapshots: save the network state for future troubleshooting and capacity planning
  – Provides REST to be used by external SDN apps, auditing tools and external NMS
  – Supports active and passive topology discovery (LLDP or input file)

• Development team: FIU and ANSP
• Collaboration with State University of Sao Paulo / Kytos developers
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- Developed in Python 3.6
- Leverages the `python-openflow` library
- Built as a Napp on top of Kytos SDN framework
- Uses Influxdb, Mongodb and MySQL for persistence
- Uses Grafana and JavaScript for visualization
- Supports both OpenFlow 1.0, OpenFlow 1.3 and SNMP
- Saves all control plane messages for later troubleshooting
- Inter-domain trace using our own protocol (soon with NSI)
- Open Source/GPL - GitHub: [https://github.com/amlight](https://github.com/amlight)
Topology Discovery
# List of Flows

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### Table: List of Flows

<table>
<thead>
<tr>
<th>in_port</th>
<th>cookie</th>
<th>priority</th>
<th>Match</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50001</td>
<td></td>
<td>ee:ee:ee:ee:ee:03</td>
<td>action_output</td>
</tr>
<tr>
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<td>50001</td>
<td></td>
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<td>action_output</td>
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<tr>
<td>0</td>
<td>50001</td>
<td></td>
<td>ee:ee:ee:ee:ee:02</td>
<td>action_output</td>
</tr>
</tbody>
</table>

- **3 items**
- **1 item**
Trace Path (Control Plane)
Trace Path (Data Plane)
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Roadmap

• **Version 0.2: Nov 2017**
  – Topology Discovery
  – Control Plane Monitoring
  – Alerts
  – Trace path and real-time statistics

• **Version 0.3: Dec 2017**
  – Persistence of Historical Data
  – Network Configuration Snapshot
  – Dynamic and Automated Trace Path with alerts
THANK YOU!

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