VII Workshop Pesquisa Experimental da Internet do Futuro (WPEIF)
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AmLight's OpenFlow Sniffer dissected: Troubleshooting production networks

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Outline

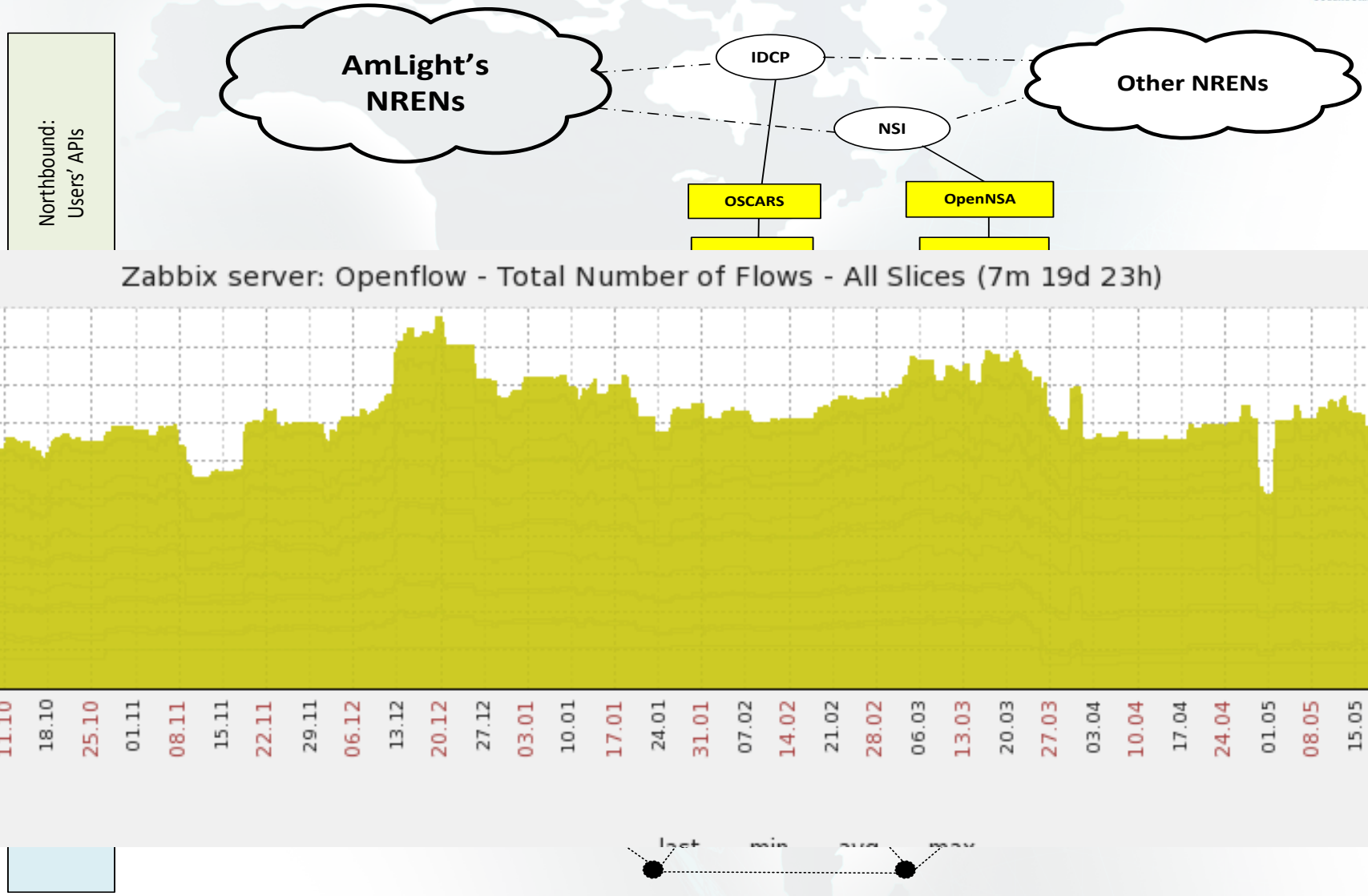
- Context
- Motivation
- Features
- Outputs
- Roadmap

Context

AmLight is a Distributed Academic Exchange Point

- Production SDN Infrastructure (since Aug 2014)
- Connects AMPATH and SouthernLight GOLES - *GLIF Open Lightpath Exchanges*
- Carries Academic and Non-Academic traffic
  - L2VPN, IPv4, IPv6, Multicast
- Supports Network Virtualization/Slicing
  - Openflow 1.0
  - Flow Space Firewall for Network Virtualization/Slicing
  - OESS for L2VPNs
  - NSI enabled
    - Including AMPATH and SouthernLight
  - Currently 5 slices for experimentation (including ONOS SDN-IP)

Context (2)


Northbound:
Users' APIs
AmLight's NRENs
IDCP
NSI
Other NRENs
OSCARS
OpenNSA
Zabbix server: Openflow - Total Number of Flows - All Slices (7m 19d 23h)
1.0 K
0.8 K
0.6 K
0.4 K
0.2 K
0
06.10 09:34
11.10
18.10
25.10
01.11
08.11
15.11
22.11
29.11
06.12
13.12
20.12
27.12
03.01
10.01
17.01
24.01
31.01
07.02
14.02
21.02
28.02
06.03
13.03
20.03
27.03
03.04
10.04
17.04
24.04
01.05
08.05
15.05
23.05 09:23

Motivation

- As troubleshooting SDN is still complex, a few tools are being developed at AmLight:
  - Testbed Sanitizer
  - **An OpenFlow Sniffer**
  - A multi-slice SDN Traceroute
  - Integration tools: Zabbix NMS w/ OESS and FSFW

- Why a new OpenFlow sniffer?
  - Wireshark requires X or capture/send and dissector for OF
    - OF 1.0: < 50% dissected
  - Tshark uses Wireshark dissectors
  - There are other tools, but they are not specific for real time and command line OpenFlow troubleshooting (lack of OpenFlow filters)

Features

- OpenFlow 1.0 support
- Completely passive/libpcap
- Runs on Linux shell
  - No need for X Windows
- Colors important user fields
- Easy to install (*install python-pcapy && git clone*)
- Supports OpenFlow type filtering using a JSON file
- Converts FlowMods to OVS-OFCTL commands
  - Help “reproduce” some problems
- Apache License
- https://github.com/jab1982/ofp_sniffer

Outputs (1/2)

```
2015-10-04 22:14:36.263133 190.103.184.135:6633 -> 200.136.88.6:7801 Size: 142
OpenFlow Version: 1.0(1) Type: FlowMod(14) Length: 88  XID: 4959165
4959165 OpenFlow Match - wildcards: 4194300 dl_vlan: 1116 in_port: 4
4959165 OpenFlow Body - Cookie: 0x00 Command: Add(0) Idle/Hard Timeouts: 0/0 Priority: 32768 Buffer ID:
4959165 OpenFlow Action - Type: SetVLANID Length: 8 VLAN ID: 3221 Pad: 0
4959165 OpenFlow Action - Type: OUTPUT Length: 8 Port: 67 Max Length: 65535
ovs-ofctl add-flow tcp:200.136.88.6:7801 "dl_vlan=1116,in_port=4, action=mod_vlan_vid:3221,output:67,"
```

```
2015-09-15 11:10:29.658553 10.0.2.15:44950 -> 190.103.187.35:6633 Size: 126
OpenFlow Version: 1.0(1) Type: FlowMod(14) Length: 72  XID: 2
2 OpenFlow Match - wildcards: 3678453 dl_vlan: 31 dl_dst: 10:00:00:01:20:00
2 OpenFlow Body - Cookie: 0x00 Command: Delete(3) Idle/Hard Timeouts: 0/0 Pri
ovs-ofctl del-flows tcp:190.103.187.35:6633 "priority=32768 dl_vlan=31,dl_dst
```

```
2015-09-14 19:00:49.591812 190.103.187.35:6633 -> 10.0.2.15:44797 Size: 66
OpenFlow Version: 1.0(1) Type: Error(1) Length: 12  XID: 2
2 OpenFlow Error - Type: BadRequest Code: BadVendor
```

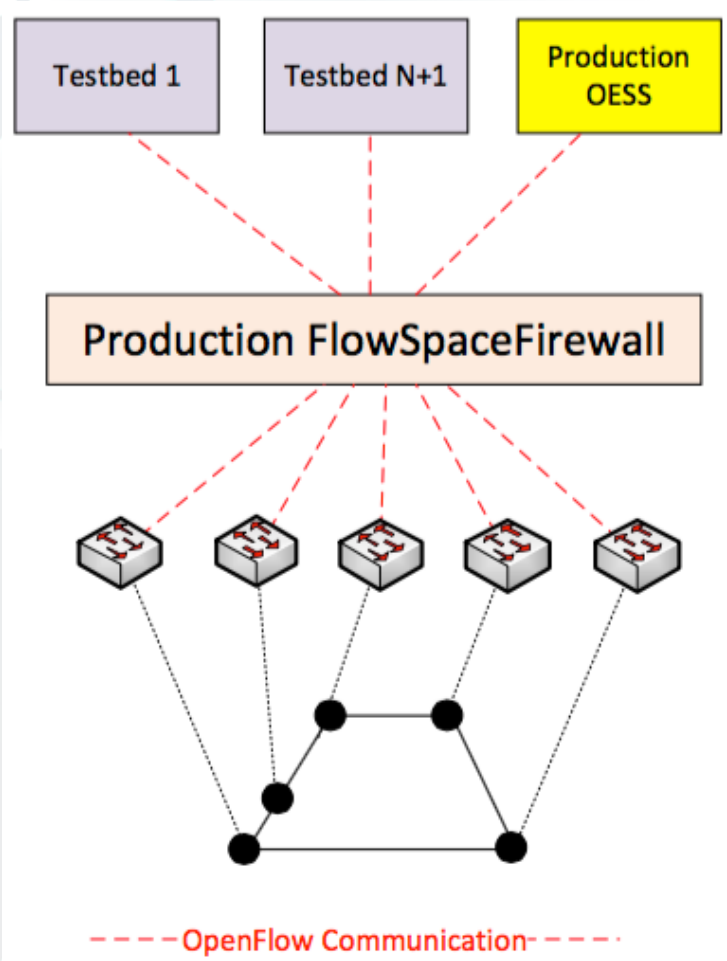
```
2015-09-15 11:10:29.736198 190.103.187.35:6633 -> 10.0.2.15:44950
OpenFlow Version: 1.0(1) Type: BarrierRes(19) Length: 8  XID: 3
3 OpenFlow Barrier Reply
```

Outputs (2/2)

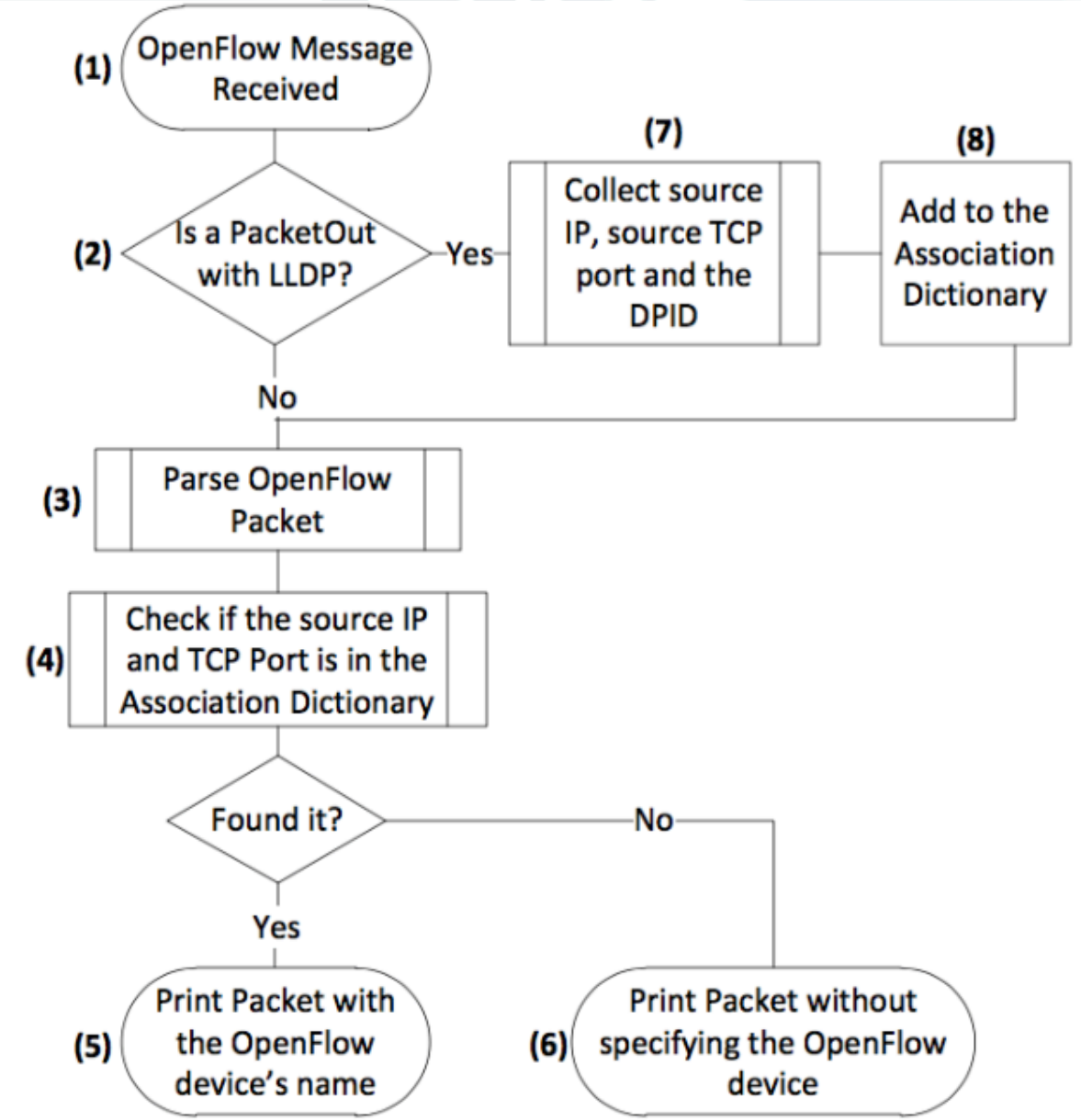
```
2015-09-15 08:33:18.349577 190.103.187.35:6633 -> 10.0.2.15:44835 Size: 362
OpenFlow Version: 1.0(1) Type: StatsRes(17) Length: 308  XID: 4
4 StatRes Type: Flow(1)
4 StatRes Length: 96 Table_id: 0 Pad: 0
4 StatRes  OpenFlow Match - wildcards: 3678447 dl_type: 0x806
4 StatRes duration_sec: 372922, duration_nsec: 889000000, priority: 1, idle_timeout: 0, ha
4 StatRes Type: Flow(1)
4 StatRes Length: 96 Table_id: 0 Pad: 0
4 StatRes  OpenFlow Match - wildcards: 3678447 dl_type: 0x88cc
4 StatRes duration_sec: 372922, duration_nsec: 889000000, priority: 100, idle_timeout: 0,
4 StatRes Type: Flow(1)
4 StatRes Length: 104 Table_id: 0 Pad: 0
4 StatRes  OpenFlow Match - wildcards: 3678455 dl_dst: 10:00:00:01:20:00
4 StatRes duration_sec: 68231, duration_nsec: 128000000, priority: 32768, idle_timeout: 0,
```

Handling Network Virtualization (1/2)

- Supporting Network Testbeds is a new trend
  - But creates another layer
- Applications don't talk to OF switches directly
  - Virtualization layer interfaces both entities
- Network Sniffers don't see the end-to-end flow:
  - Or it sees OF switch talking to Virtualization Layer
  - Or it sees Virtualization Layer talking to Application
- OpenFlow messages don't identify the OF switch:
  - How to associate OF switch to Application?
    - Specially for OFP_ERROR messages?



Handling Network Virtualization (2/2)



Handling Network Virtualization (2/2)

```
Packet #13213 - 2016-05-25 23:09:22.337974 190.103.187.70:6633 -> 190.103.184.133(sol2):50806 Size: 138 Bytes
OpenFlow Version: 1.0(1) Type: FlowMod(14) Length: 72  XID: 21
Match - wildcards: 0x3fffef dl_type: ARP(0x806)
Body - Cookie: 0x100005d483efc Command: Delete(3) Idle/Hard Timeouts: 0/0
Body - Priority: 32768 Buffer ID: 0xffffffff Out Port: None(0xFFFF) Flags: SendFlowRem(1)

Packet #13214 - 2016-05-25 23:09:22.339059 190.103.187.70:6633 -> 190.103.184.133(sol2):50806 Size: 74 Bytes
OpenFlow Version: 1.0(1) Type: BarrierReq(18) Length: 8  XID: 21

Packet #13218 - 2016-05-25 23:09:22.339222 190.103.187.70:6633 -> 190.103.184.133(mct01):50814 Size: 138 Bytes
OpenFlow Version: 1.0(1) Type: FlowMod(14) Length: 72  XID: 24
Match - wildcards: 0x3fffef dl_type: ARP(0x806)
Body - Cookie: 0x10000c58802b5 Command: Delete(3) Idle/Hard Timeouts: 0/0
Body - Priority: 32768 Buffer ID: 0xffffffff Out Port: None(0xFFFF) Flags: SendFlowRem(1)
```

Roadmap

- Version 0.3 – By June 2016
  - Full OF 1.3 (.5) support
  - Read from Libpcap files
  - Better documentation
  - Better code organization
  - Support for virtualization
  - Interface for extra filters ➔

```
{
  "allowed_of_versions": {
      "1.0": {
            "rejected_of_types": [
                2,3,10, 13, 17, 16
            ]
      },
      "1.3": {
            "rejected_of_types": [
            ]
      }
  },
  "filters":{
      "ethertypes": {
          "lldp" : 1,
          "fvd"  : 0,
          "arp"  : 1,
          "others": [ "88b5" ]
      },
      "packetIn_filter": {
          "switch_dpid": "any",
          "in_port": "any"
      },
      "packetOut_filter": {
          "switch_dpid": "dpid:5",
          "out_port": "any"
      }
  }
}
```

- Version 0.4 - ?
  - Full NICIRA/OVS support
  - SSL/TLS support
  - Traffic Profile?
  - Suggestions??

Use Cases

- Teaching/Learning:
  - Great tool to teach/learn SDN and OpenFlow
  - Easy to see all OpenFlow messages and fields
- Coding:
  - Great way to see if your controller (Ryu, POX, ONOS) is sending the OpenFlow message the way you expect
  - Example: Malformed OF messages are not send by Ryu and no alarm is generated
- and Troubleshooting:
  - SDN networks are very hard to debug: lack of tools, protocols and logs
  - Most OF switch agents are in a beta deployment phase
- More information:
  - www.sdn.amlight.net
  - Papers, Presentations, Videos, etc.

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Questions?

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