Design and Implementation of an OpenFlow Hardware Abstraction Layer


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ABstraction layer for implementation of extensions in programmable networks
Motivation

• SDN is reshaping network infrastructure
  – From campus networks to data centers to global-scale network infrastructures to distributed cloud computing
  – Rethinking network control and operation
  – Assumption: An OpenFlow-based control plane will become common in the future

• But, a range of existing provider domains are not OpenFlow-ready
  – Support deployment beyond Ethernet-like networks
  – Shield implementation from velocity and scope of protocol specification changes
  – Consider real-world hardware platforms such as DOCSIS & DWDM
  – Transform (legacy) network elements into OpenFlow-capable devices
ALIEN Hardware Abstraction Layer

• Modular system and software architecture
  – Designed for a large array of devices
  • Programmable platforms (NetFPGA, traditional NPU, multicore CPUs with hardware network enhancements, standard CPUs with software network enhancements)
  • Lightpath devices (DWDM ROADM)
  • Point to multi-point access networks (DOCSIS, GEPON)
    – Decoupling of hardware-specific control and management logic from the network node abstraction
    – Software reusability
• Support multiple OpenFlow versions
• Hide device complexity, technology- and vendor-specific features from the control plane logic
HAL Functional Schematic

Network Control
- OpenFlow

Network Management
- VGW
- NETCONF/OF-CONFIG

Cross-Hardware Platform Layer
- OpenFlow
- Virtualization
- NETCONF / OF-CONFIG

Hardware Abstraction Layer
- AFA Configuration
- AFA Notification
- AFA Management

Hardware Specific Layer
- Translation
- Orchestration
- Discovery

Network Device(s)
HAL Components and Interfaces

- Cross-Hardware Platform Layer
  - OpenFlow Endpoint
  - OpenFlow Pipeline
  - Virtualization Agent
- Hardware Specific Layer
  - Discovery
  - Orchestration
  - Translation
- Abstract Forwarding API (AFA)
- Hardware Pipeline API (HPA)
- NETCONF/OF-CONFIG
HAL Implementation

HAL based on ROFL/xDPd

OpenFlow Protocol

Abstract Forwarding API

OpenFlow Endpoint

Cross-Hardware Platform Layer

OpenFlow Pipeline

Hardware Pipeline API

Programmable Platforms

Closed-box Platforms

Hardware Driver

EZappliance NP-3

Hardware Driver

Net FPGA

Hardware Driver

Dell Split Data Plane

Hardware Driver

ATCA with Octeon

Hardware Driver

DOCSIS

Hardware Driver

ADVA DWDM

Hardware Driver

GEPON

Abstraction Layer for Implementation of Extensions in Programmable Networks
• EWSDN 2014 (in two weeks, save the date!)

• FIA Athens 2014
  – Video-on-demand in OpenFlow networks
  – Distributed and version-agnostic OpenFlow slicing mechanism
  – Integration of legacy DOCSIS access network under OpenFlow control

• TERENA Networking Conference 2014
Conclusion

- OpenFlow support is lacking in production environments where most of the forwarding devices are based on either closed platforms or legacy hardware which is incompatible with the protocol.
- The ALIEN HAL addresses this gap:
  - Software architecture and implementation which aims to complement conventional hardware platforms.
  - Viable, experimentally-tested approach.
  - Platform for development and deployment of OpenFlow on network elements that do not support the protocol out-of-the-box.
- Decoupling of hardware-specific control and management logic from the OpenFlow node abstraction logic.
- Current work: Introduce HAL devices to the OFELIA pan-European SDN experimental facility.
Further Reading

- Software
  - Revised OpenFlow Library (ROFL)
  - eXtensible OpenFlow datapath daemon (xDPd)
  - xDPd-Virtualization plugin (git)
  - eXtensible Control Path daemon (xCPd)
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