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Design and Implementation of an OpenFlow Hardware Abstraction Layer

**D. Parniewicz, R. Doriguzzi Corin, L. Ogirodowczyk, M. Rashidi Fard, J. Matias, M. Gerola,
V. Fuentes, U. Toseef, A. Zaalouk, B. Belter, E. Jacob,
Kostas Pentikousis**

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ABSTRACTION LAYER FOR IMPLEMENTATION OF EXTENSIONS IN PROGRAMMABLE NETWORKS

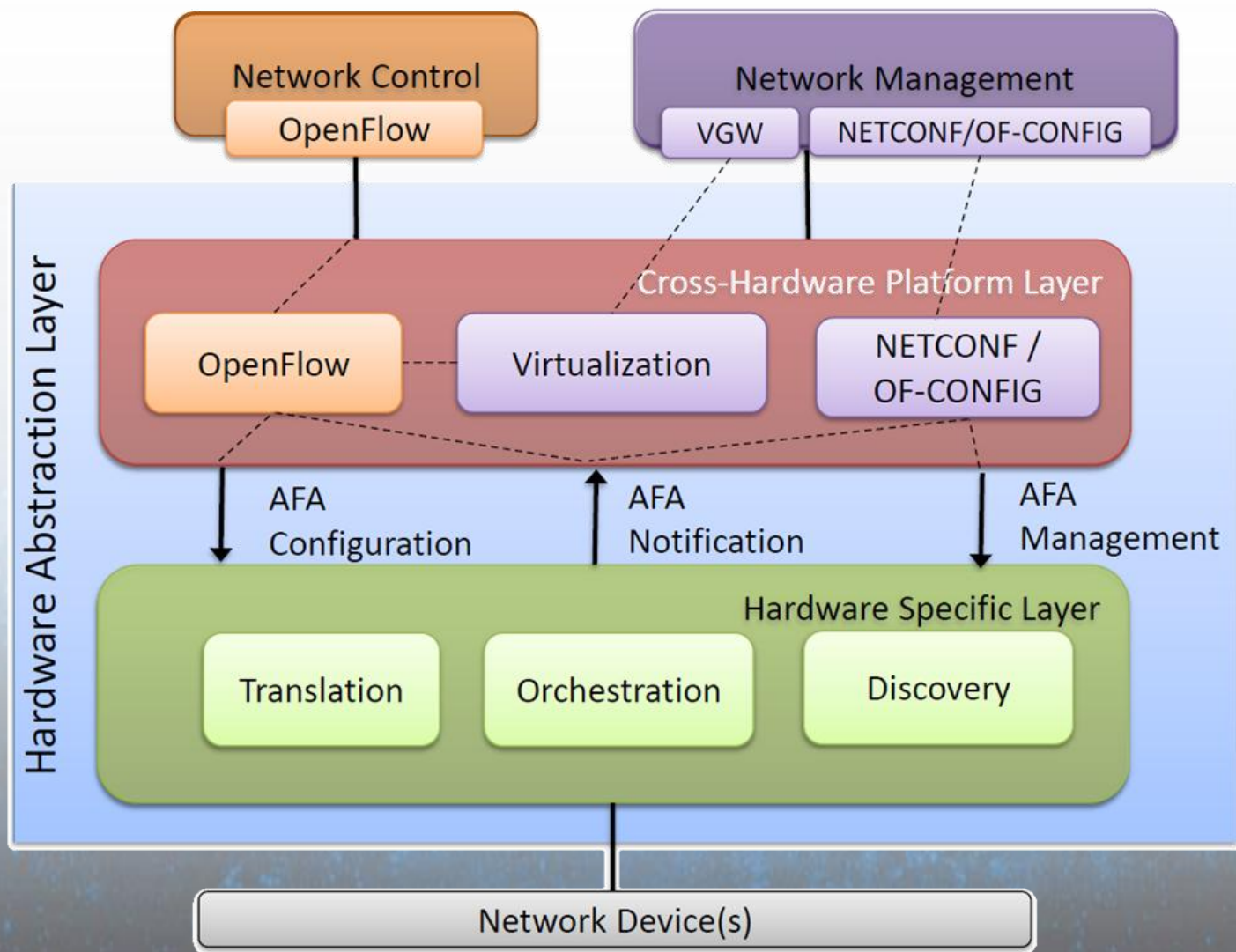
Motivation

- 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

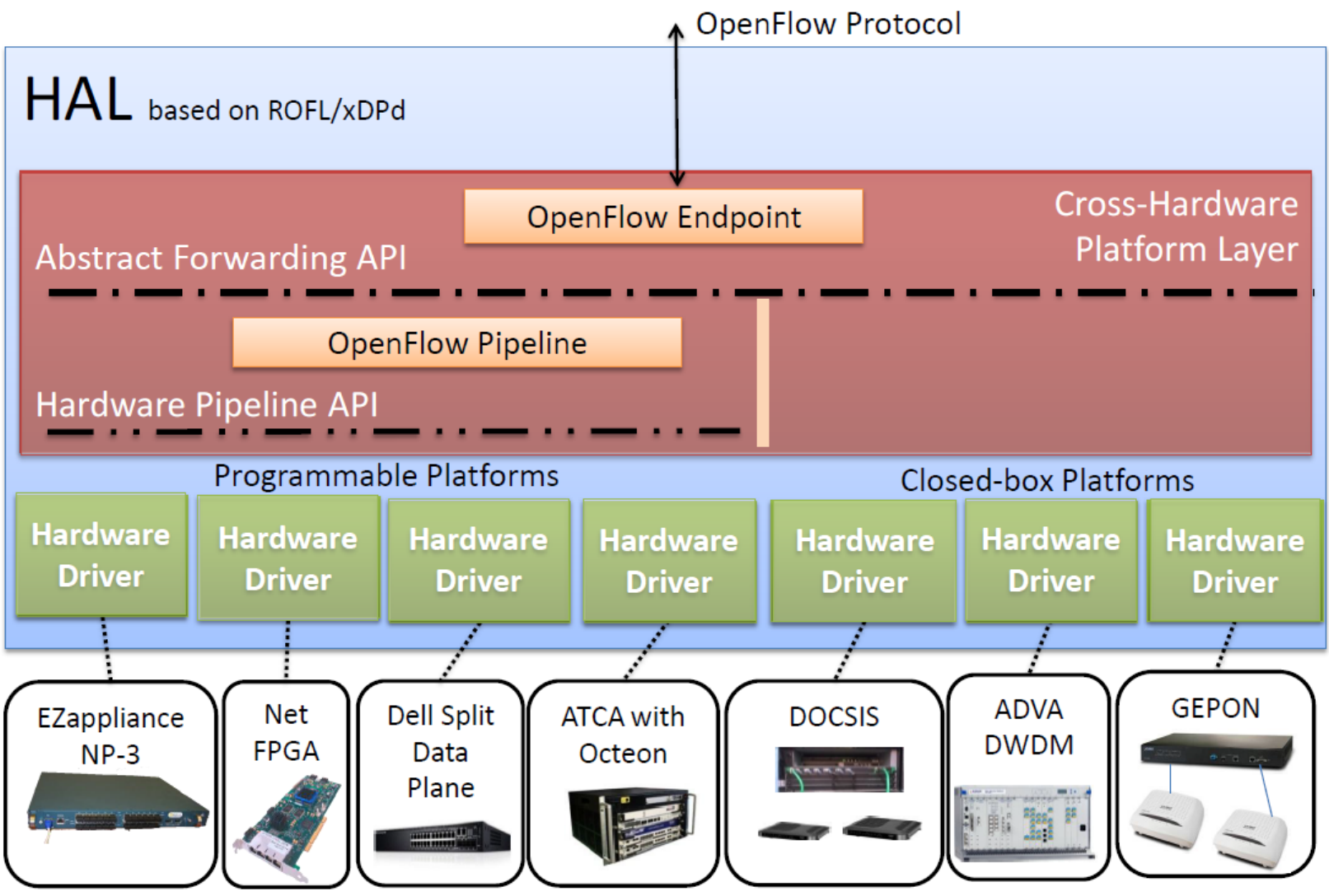
HAL Functional Schematic



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

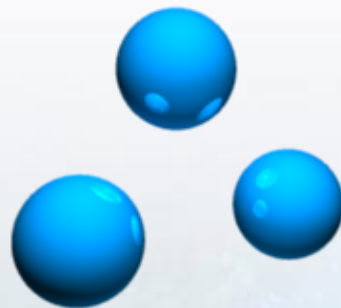
HAL Implementation





HAL in Action

- EWSDN 2014 (in two weeks, save the date!)



EWSDN 2014

European Workshop on
Software Defined Networking

- 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

- D. Parniewicz, R. Doriguzzi Corin, et al., “Design and Implementation of an OpenFlow Hardware Abstraction Layer”, *Proc. SIGCOMM DCC 2014*, Chicago, USA, August 2014.
- L. Ogrodowczyk, B. Belter, et al., “Hardware Abstraction Layer for non-OpenFlow capable devices”, *Proc. TERENA Networking Conference*, Dublin, Ireland, May 2014
- M. Rashidi (Ed.) et al., *Specification of Hardware Abstraction Layer*. FP7 ALIEN Deliverable D2.2, available at www.fp7-alien.eu, 2014.
- U. Toseef (Ed.) et al., *Report on implementation of the Common Part of an OpenFlow Datapath Element and the Extended FlowVisor*. FP7 ALIEN Deliverable D2.3, available at www.fp7-alien.eu, 2014.
- Software
 - Revised OpenFlow Library ([ROFL](#))
 - eXtensible OpenFlow datapath daemon ([xDPd](#))
 - xDPd-Virtualization plugin ([git](#))
 - eXtensible Control Path daemon ([xCPd](#))



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Acknowledgement

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