The Open Networking Foundation:
Innovating in technology & standardization for user benefit
IEEE ComSoc SV chapter
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Points to cover

• Origins
• What we’re up to
• How we operate
Origins

1. Programmatic control of Enterprise networks
2. Global policy, directly enforced
3. Global vantage point
4. OpenFlow

Ethane

Martin Casado

Research Community:
How to deploy new ideas?

1. NSF/GENI
2. OpenFlow/SDN on 10 campuses
3. Research demonstrations
4. Now on 100+ campuses
5. US, Europe, Asia

Industry Trend:
Networks being built this way

1. Data Center Networks
2. WANs
3. Enterprise and WiFi
4. Vendors & startups emerging
Why we exist

Users
• Solving problems of scale, flexibility, east-west traffic (data centers)
• Solving problems of cost, service introduction (service providers)
• Solving problems of applications, administration, security (enterprises)

Networking
• Catching up to computing (distributed systems, virtualization)
• Becoming part of the computing infrastructure

Standards
• User-led
• Faster
SDN: OpenFlow + more

Abstract Network View
- Virtualization
  - Control Program C

Global Network View
- Network OS(s)
  - Control Program D

Slicing Layer: FlowVisor

Northbound API

Apps | Control Program A | Control Program B | Tools

Packet Forwarding

Control Program A

Tools

Control Program B

Control Program C

Control Program D

Packet Forwarding

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OpenFlow standards

Evolution path:

- OF 1.0 (03/2010): Most widely used version, MAC, IPv4, single table (from Stanford)
- OF 1.1 (02/2011): MPLS tags/tunnels, multiple tables, counters (from Stanford)
- OF 1.2 (12/2011): IPv6, extensible expression
- OF-Config 1.0 (01/2012): Basic configuration: queues, ports, controller assign
- OF 1.3.0 (04/2012): Tunnels, meters, PBB support, more IPv6
- OF-Config 1.1 (04/2012): Topology discovery, error handling
- OF-Test 1.0 (2H2012): Interoperability & conformance test processes, suites, labs

Goals:

- Widespread adoption, experimentation w/OF 1.3.x
- Accommodate current merchant silicon while moving beyond current limits
- Use market feedback to drive future development
Technical activities

Chartered Working Groups

• Extensibility (chair: Jean Tourrilhes, HP): OpenFlow protocol evolution
• Config-mgmt (chair: Deepak Bansal, Microsoft): basic switch configuration; OAM?
• Testing-interop (chair: Michael Haugh, Ixia): conformance, interop., benchmarking
• Hybrid (chair: Jan Medved, Cisco): mixed OpenFlow/legacy switches & networks

Discussion Groups

• OpenFlow-Future: forwarding-plane models
• NorthboundAPI: how the network relates to the applications (incl. OSS, BSS)
• NewTransport: OpenFlow for optical, circuits, wireless
• Market Education (chair: Isabelle Guis, Big Switch): marketing, customer value
ONF basics

ONF
• is a foundation for the advancement of SDN (including standardization)
• is not a simple SDO

Vision
• Make Software-Defined Networking the new norm for networks

Mission
• Foster a vibrant market for SDN products, services, applications, users

Goals
• Create the most relevant standards in record time to support a switching ecosystem based on the OpenFlow protocol
• Accelerate understanding of how to realize the abstractions above OpenFlow
A non-profit industry consortium 501(c)(6)

- Incorporated 2010, Launched March 22, 2011
- Funded by member dues
- Open to any org. that pays annual dues, agrees to bylaws, IPR policy

IPR policy

- RAND-Z: royalty-free use of protocol, OpenFlow trademark, logo
- Automatic cross-licensing of all related IP to all other members
- No licensing charges to members
- No protection for non-members
- ONF itself: no IP
- Open interfaces, not open source or reference implementations (yet)
ONF principles

Operation
• Fast, lean, efficient
• A startup ourselves, iterating with customers, agile, learning

Standards creation
• Driven by users and user needs
• Developed by those close to implementation/deployment
• Standardize as little as necessary
  • Vendor differentiation without lockin, market fragmentation
  • More and more like a software community
• No names on drafts
• Relevant, implementable now; protocol-agnostic eventually
• Rapid real-world experience
ONF governance

Board of Directors
- Users, not vendors

Executive Director (employee)
- Reports to the Board; vendor neutral

Technical Advisory Group
- Organizational CTO function

Working Groups
- Chartered by the Board
- Chaired by Board appointee
- Chair determines consensus
7 Board companies, 65 others

- Urs Hölzle (Sr. VP, Engineering, Google), chairman
- Najam Ahmad (Director, Network Engineering, Facebook)
- Adam Bechtel (VP, Infrastructure Group, Yahoo)
- Stuart Elby (VP, Network Architecture, Verizon)
- Axel Clauberg (VP, IP & Optical, Deutsche Telekom)
- Yukio Ito (Sr. VP, Services & Infrastructure, NTT Communications)
- Clyde Rodriguez (GM, Windows Azure Networking, Microsoft)
- Nick McKeown (Professor, EE and CS, Stanford)
- Scott Shenker (Professor, EECS, UC Berkeley and ICSI)

A10 Networks  
ADVA Optical  
Alcatel-Lucent  
Aricent  
Argela/Turk Telekom  
Big Switch Networks  
Broadcom  
Brocade  
Ciena  
Cisco  
Citrix  
Colt  
CompTIA  
Cyan Optics  
Dell/Force10  
Elbrys  
Ericsson  

ETRI  
Extreme Networks  
EZchip  
F5 Networks  
Freescale Semi  
Fujitsu  
Gigamon  
Goldman Sachs  
Hitachi  
HP  
Huawei  
IBM  
Infinera  
Infoblox  
Intel  
IP Infusion  

Ixia  
Juniper Networks  
Korea Telecom  
LineRate Systems  
LSI  
Luxoft  
Marvell  
Mellanox  
Metaswitch Networks  
Midokura  
NCL Comms K.K.  
NEC  
Netgear  
Netronome  
Nicira Networks  
Nokia Siemens Netw.  

NoviFlow  
Oracle  
Orange/France Telecom  
Pica8  
Plexxi Inc.  
Radware  
Riverbed Technology  
Samsung  
SK Telecom  
Spirent  
Telecom Italia  
Tencent  
Texas Instruments  
Tencent  
Vello Systems  
VMware  
ZTE
Conclusions

**ONF now the home of OpenFlow**
- Take OpenFlow 1.1 to commercial strength – Job One
- Family of standards: foundation, building blocks, choices
- Protocols; configuration and management; compliance and interoperability
- Development, deployment, experience, feedback

**More to SDN than OpenFlow**
- SDN abstractions, object models, interactions
- Ecosystem for new features, new players, new business models

**Technical standards + market education**
- Market pull to drive the ecosystem

[www.OpenNetworking.org](http://www.OpenNetworking.org)

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