Introduction to OpenDaylight and Hydrogen, Learnings from the Year, and What’s Next for OpenDaylight

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Universal Laws, Architecture, and the Hidden Nature of Complexity (and what does this have to do with SDN?)

\[
\int_0^\infty \ln |S(i\omega)| d\omega = \int_0^\infty \ln \left| \frac{1}{1 + L(i\omega)} \right| d\omega = \pi \sum \text{Re}(p_k) - \frac{\pi}{2} \lim_{s \to \infty} sL(s)
\]
Gain/Sensitivity Tradeoff In Feedback Control
(understanding this is going to wind up being critically important for SDN)

\[ \int_0^\infty \ln |S(i\omega)| \, d\omega = \int_0^\infty \ln \left| \frac{1}{1 + L(i\omega)} \right| \, d\omega = \pi \sum \text{Re}(p_k) - \frac{\pi}{2} \lim_{s \to \infty} sL(s) \]

Bode Sensitivity Integral

Gain

Low

High

Precision

Precise

Sloppy

Theorem: \( G \leq \frac{1}{P} \)
Agenda

- What is OpenDaylight/Hydrogen
- Key Personal Learning from a Year Inside ODP
- A Few Hydrogen/ODP Metrics
- What Is Queued up for “Helium”
- Were we’re going
What is OpenDaylight

OpenDaylight is an **Open Source Software** project under the **Linux Foundation** with the goal of furthering the adoption and innovation of **Software Defined Networking (SDN)** through the creation of a common industry supported platform.

<table>
<thead>
<tr>
<th>Code</th>
<th>Acceptance</th>
<th>Community</th>
</tr>
</thead>
</table>
| To create a robust, extensible, open source code base that covers the major common components required to build an SDN solution | To get broad industry acceptance amongst vendors and users  
• using OpenDaylight code directly or through vendor products  
• Vendors using OpenDaylight code as part of commercial products | To have a thriving and growing technical community contributing to the code base, using the code in commercial products, and adding value above, below and around. |
What is OpenDaylight building?

OpenDaylight is an open community that is building:

- An evolvable SDN platform capable of handling diverse use cases and implementation approaches
- Common abstractions of capabilities NorthBound for people to program
- Intermediation of those capabilities to multiple Southbound implementations
- Programmable Network services
- Network Applications
- Whatever else we need to make it work
Who is OpenDaylight? (the corporate sponsors)

Platinum Members
- Brocade
- Cisco
- Citrix
- Ericsson
- IBM
- Juniper Networks
- Microsoft
- Red Hat

Gold Members
- NEC
- VMware

Silver Members
- ADVA Optical Networking
- Arista
- Ciena
- Cyan
- Dell
- Fujitsu
- Guavus
- HP
- Huawei
- Inocybe Technologies
- Intel
- Nuagenetworks
- Plexxi
- Plumgrid
- Radware
- Versa Networks
OpenDaylight Simultaneous Release

- OpenDaylight is multi-project
  - 15 projects currently in “bootstrap” or “incubation”

- Bringing components together in a simultaneous release
  - CodeName: Hydrogen
  - Due Date: Dec 9, 2013

- Several “editions” to group related functionality together
  - base, virtualization, service provider
  - virtualization edition will provide OpenStack integration
# Simultaneous Release Plan

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Offset 0 Date</th>
<th>Offset 1 Date</th>
<th>Offset 2 Date</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>6/24/2013</td>
<td>6/26/2013</td>
<td>6/28/2013</td>
<td>Simultaneous Release Open</td>
</tr>
</tbody>
</table>
| M1        | 7/22/2013     | 7/24/2013     | 7/26/2013     | 1. Projects must have declared intent to participate in Simultaneous Release  
2. Participating Projects must have published a candidate Release Plan for public comment |
| M2        | 8/19/2013     | 8/21/2013     | 8/23/2013     | Participating Projects must have declared their final Release Plan |
| M3        | 9/16/2013     | 9/18/2013     | 9/20/2013     | Latest possible Continuous Integration Test Start |
| M4        | 10/14/2013    | 10/16/2013    | 10/18/2013    | 1. API Freeze  
2. Latest possible Continuous System Test Start |
| M5        | 11/11/2013    | 11/13/2013    | 11/15/2013    | Code Freeze (i.e., fixes only from here)  
Substituting Freeze (all internationalizable strings frozen to allow for translation)  
Latest possible date for commencing User Facing Documentation |
| RC0       | 11/18/2013    | 11/20/2013    | 11/22/2013    | Participating Projects must hold their Release Reviews, including User Facing Documentation |
| Formal Release | 12/9/2013    |               |               | |
What Hydrogen Delivered

- OpenDaylight is multi-project
  - 14 projects
    - Project diversity v. mono-culture

- Simultaneous Release

- Release Date: Dec 9, 2013 ~ Feb 03 2014

- Various Issues/Learnings
Impressive List of Projects in H₂:

- Controller
- VTN
- OpenDove
- Affinity Management Service
- LISP Mapping Service
- Yang Tools
- Defense4All
- BGP-LS/PCEP

- OpenFlow Protocol
- OpenFlow SB Plugin
- OVSDB
- SNMP4SDN
- DLUX
- STI
Hydrogen Release (Jan 2014)

VTN: Virtual Tenant Network
DOVE: Distributed Overlay Virtual Ethernet
DDoS: Distributed Denial Of Service
LISP: Locator/Identifier Separation Protocol
OVSDB: Open vSwitch DataBase Protocol
BGP: Border Gateway Protocol
PCEP: Path Computation Element Communication Protocol
SNMP: Simple Network Management Protocol
Base Edition

**Management**
- GUI/CLI

**OpenDaylight APIs (REST)**

**Base Network Service Functions**
- Topology Mgr
- Stats Mgr
- Switch Mgr
- Host Tracker
- Shortest Path Forwarding
- Network Config

**Service Abstraction Layer (SAL)**
(plug-in mgr., capability abstractions, flow programming, inventory, …)

**Controller Platform**

**Southbound Interfaces & Protocol Plugins**

**Data Plane Elements**
- (Virtual Switches, Physical Device Interfaces)

**OpenFlow**
- 1.0
- 1.3

**NETCONF**

**OpenFlow Enabled Devices**

**Open vSwitches**

**Additional Virtual & Physical Devices**

**Network Applications Orchestration & Services**

**Vocabulary**
- VTN: Virtual Tenant Network
- DOVE: Distributed Overlay Virtual Ethernet
- DDoS: Distributed Denial Of Service
- LISP: Locator/Identifier Separation Protocol
- OVSDB: Open vSwitch DataBase Protocol
- BGP: Border Gateway Protocol
- PCEP: Path Computation Element Communication Protocol
- SNMP: Simple Network Management Protocol
Base Network Service Functions

- Topology Mgr
- Stats Mgr
- Switch Mgr
- Host Tracker
- Shortest Path Forwarding
- Network Config
- Affinity Service
- LISP Service

Service Abstraction Layer (SAL)
(plug-in mgr., capability abstractions, flow programming, inventory, ...)

OpenDaylight APIs (REST)

Controller Platform

OpenFlow
- 1.0
- 1.3

NETCONF

SNMP

BGP-LS

PCEP

LISP

Southbound Interfaces & Protocol Plugins

Data Plane Elements
(Virtual Switches, Physical Device Interfaces)

Management
GUI/CLI

DDoS Protection

Network Applications
Orchestration & Services

OpenFlow Enabled Devices

Open vSwitches

Additional Virtual & Physical Devices

VTN: Virtual Tenant Network
DOVE: Distributed Overlay Virtual Ethernet
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Virtualization Edition

Management GUI/CLI

VTN Coordinator

DDoS Protection

OpenStack Neutron

Network Applications Orchestration & Services

OpenDaylight APIs (REST)

Controller Platform

Service Abstraction Layer (SAL)
(plug-in mgr., capability abstractions, flow programming, inventory, …)

OpenFlow

Network Config

Overlay Services

Topology Mgr

Stats Mgr

Switch Mgr

Host Tracker

Shortest Path Forwarding

OpenStack Service

VTN Manager

DOVE Mgr

Controller Platform

Southbound Interfaces & Protocol Plugins

Data Plane Elements (Virtual Switches, Physical Device Interfaces)

OpenFlow Enabled Devices

Open vSwitches

Additional Virtual & Physical Devices

OpenFlow

1.0

1.3

NETCONF

OVSDB

Virtualization Edi8on

DDoS Protection

Open vSwitches

OVSDB

Open vSwitch DataBase Protocol

VTN: Virtual Tenant Network

DOVE: Distributed Overlay Virtual Ethernet

DDoS: Distributed Denial Of Service

LISP: Locator/Identifier Separation Protocol

OVSDB: Open vSwitch DataBase Protocol

BGP: Border Gateway Protocol

PCEP: Path Computation Element Communication Protocol

SNMP: Simple Network Management Protocol
OpenStack Integration

- OpenDaylight exposes a single common OpenStack Service Northbound
  - API exposed matches Neutron API precisely
  - multiple implementations of Neutron networks in OpenDaylight
- OpenDaylight OpenStack Neutron Plugin simply passes through
  - simplifies OpenStack plugin
  - pushes complexity to OpenDaylight
OpenStack Integration: Status and Next Steps

• *OpenStack Neutron API Service* available now in OpenDaylight
  o provides Neutron API handling for multiple implementations

• Initial ML2 plugin focused on core Neutron functionality
  o L4-L7 service support as a next step

• Plugin planned to be upstreamed into OpenStack Neutron during the Icehouse release
Agenda

- What is OpenDaylight/Hydrogen
- Key Personal Learnings from a Year Inside ODP
- A Few Hydrogen/ODP Metrics
- What Is Queued up for “Helium”
- Were we’re going
Key Learnings (at least for me)

• **Community building** is a core objective
  - In fact, *innovation through collaboration* is one of the most powerful features of OSD

• **Code** is the coin of the realm

• **Engineering systems** are as important as artifacts

Putting this all together ➔

http://www.sdncentral.com/education/david-meyer-reflections-opendaylight-open-source-project-brocade/2014/03/
Trend: Engineering artifacts are no longer the source of sustainable advantage and/or innovation

Perhaps surprisingly, the “hyper-scale” and open source communities have taught me that actual artifacts (in our case network applications as well as HW/SW) are ephemeral entities and that the only source of sustainable advantage/innovation consists of

- Engineering Systems
- Culture
- People/Process

http://en.wikipedia.org/wiki/Aeroelasticity - Flutter
One Way To Think About OSD

David Meyer
March 28 · Edited

One way to think about open source development: Early on things are chaotic, there is a lot of stuff orbiting anything with enough gravity, there are epic collisions and everything is molten (e.g., like the surface of the earth during the LHB [0]). But if you wait a couple of billion years and let things evolve you can wind up with a beautiful blue planet or the Linux kernel or ...

[0] http://en.wikipedia.org/wiki/Late_Heavy_Bombardment

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Michael Howard, Chris Grundemann, Ken’ichiro Hashimoto and 11 others like this.
Agenda

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- Were we’re going
7 new project proposals pending

OpenDaylight project creation

- April: 2
- May: 2
- June: 3
- July: 12
- August: 13
- September: 14
- October: 15
- November: 15
- December: 15
- January: 16
- February: 16

www.opendaylight.org
OpenDaylight code volume (ohloh.net)

Languages

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<tr>
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Code, Comments and Blank Lines

Java: 461,768
C++: 291,849
C: 146,115
Python: 33,539

www.opendaylight.org
In a Nutshell, OpenDaylight...

--- has had 4,759 commits made by 154 contributors representing 1,045,938 lines of code

--- is mostly written in Java with an average number of source code comments

--- has a young, but established codebase maintained by a very large development team with stable Y-O-Y commits

--- took an estimated 292 years of effort (COCOMO model)

<table>
<thead>
<tr>
<th>Project</th>
<th>LOC</th>
<th>Contributors</th>
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<tbody>
<tr>
<td>OpenStack</td>
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<td>CloudStack</td>
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<td>OpenDaylight</td>
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<td>contrail-vrouter</td>
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<tr>
<td>contrail controller</td>
<td>258K</td>
<td>53</td>
</tr>
</tbody>
</table>

Quick Reference

- Project Links: [Homepage](#)
- Code Locations: [14 Locations](#)
- Licenses: EPL-1.0
- Similar Projects: [CDO Model](#), [Centreon](#), [Re...](#), [Netty](#), [OpenNMS](#)
- Managers: mavenugo

www.opendaylight.org
Membership — who wants to play
Agenda

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What’s in the queue?

https://wiki.opendaylight.org/view/Project_Proposals:Main

- Application Policy Plugin
- Python OpenDaylight Client
- Packet Cable PCMM Manager
- Dynamic Resource Reservation
- SDN Simulation Platform
- Data Persistence
- Distributed Systems (Infinispan, Akka, …)
- Developer Toolkit (archetypes, etc)
- Security, security, security
Agenda

- Key Personal Learning from a Year Inside ODP
- Quick Level Set: What is Hydrogen
- A Few Hydrogen/ODP Metrics
- What Is Queued up for “Helium”
- Were we’re going
Quasi-technical things we want to work on (necessarily incomplete list)

- Continue to build/refine our community
  - Including increasing committer diversity across the projects
  - Code Quality and Coverage
    - Stability, Performance, Bug fixes ($Major.$Minor)
    - Distributed Systems Issues (Akka, Inifinspan)
- “Staffing”
  - Release engineering
  - Documentation
- Continue to refine our engineering systems
  - Thanks Andrew!
  - Versioning
  - Fewer humans in the loop
- We need more code that writes code
  - MD-SAL is an example
  - Fewer humans in the loop
  - More automation more better
And of course

- Sustaining Engineering
  - No end to the number of bugs we find

- Performance and scalability

- Again, Code Quality

- New Projects
  - I mentioned a few
  - Several others were informally proposed at the ODP Summit
Resources

- More information and to join:
  - wiki.opendaylight.org
- Keep informed and join the conversation
  - IRC: #opendaylight on irc.freenode.net
- Open mailing lists: lists.opendaylight.org
- @openDaylightSDN
- #OpenDaylight
Thanks!