OpenDaylight and the Past, Present and Future of Open Source Networking

David Meyer, CTO and Chief Scientist, Brocade
Interop Tokyo June 11-13 2014
http://www.interop.jp/2014/english/keynotes
dmm@{brocade.com,uoregon.edu,cs.uoregon.edu,1-4-5.net,}...
http://www.1-4-5.net/~dmm/vita.html
@dmm613
Agenda

- What is Hydrogen
  - And What Did We Learn?
- Introduction to Helium
- Next Steps – Beyond Helium
- Discussion/Question and Answer
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>
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<tbody>
<tr>
<td>To create a robust, extensible, open source code base that covers the major common components required to build an SDN solution</td>
<td>To get broad industry acceptance amongst vendors and users</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>• Using OpenDaylight code directly or through vendor products</td>
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<tr>
<td></td>
<td>• Vendors using OpenDaylight code as part of commercial products</td>
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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
  - Including engineering systems
Project Framework

- Network applications, orchestration, and services
  - User interfaces
  - Network applications, orchestration, and services

- Controller platform
  - OpenDaylight APIs (REST)
  - Network service functions
  - Platform services
  - Extensions

- Southbound interfaces & protocols
  - Service Abstraction Layer (SAL)
    - OpenFlow
    - Other standard protocols (ONF, IETF, ...)
    - Vendor-specific interfaces

- Data plane elements (virtual switches, physical device interfaces)
Who is OpenDaylight Project?
OpenDaylight Simultaneous Release

- OpenDaylight is multi-project
  - 20+ projects in Bootstrap or Incubation State

- Bringing components together in a simultaneous release
  - CodeName: Hydrogen
  - Planned release date: Dec 12, 2013

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

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<th>Offset 1 Date</th>
<th>Offset 2 Date</th>
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<td>6/26/2013</td>
<td>6/28/2013</td>
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| 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 (long fixes only from here)  
|           |               |               |               | String Freeze (all internationalizable strings frozen to allow for translation) |
| RC0       | 11/18/2013    | 11/20/2013    | 1/21/2013     | Latest possible date for commencing User Facing Documentation |
| RC2       | 12/2/2013     | 12/4/2013     | 12/6/2013     | Participating Projects must hold their Release Reviews, including User Facing Documentation |

03 Feb 2014
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
**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, ...)

**OpenDaylight APIs (REST)**

**Controller Platform**

**Southbound Interfaces & Protocol Plugins**

**OpenFlow**
- 1.0
- 1.3

**NETCONF**

**OpenFlow Enabled Devices**

**Open vSwitches**

**Additional Virtual & Physical Devices**

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

**Management**
- GUI/CLI

**Network Applications Orchestration & Services**

**Network Applications**
- Orchestration & Services
- Topology Mgr
- Stats Mgr
- Switch Mgr
- Host Tracker
- Shortest Path Forwarding
- Network Config

**Open vSwitches**

**Additional Virtual & Physical Devices**

**Base Edition**

**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**
Service Provider 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, …)

Affinity Service
LISP Service

Controller Platform

Southbound Interfaces & Protocol Plugins

OpenFlow
- 1.0
- 1.3

NETCONF

SNMP
BGP-LS
PCEP
LISP

OpenFlow Enabled Devices

Open vSwitches

Additional Virtual & Physical Devices

Data Plane Elements
(Virtual Switches, Physical Device Interfaces)

DDoS Protection

Network Applications Orchestration & Services

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

Management GUI/CLI

VTN Coordinator

DDoS Protection

OpenStack Neutron

OpenDaylight APIs (REST)

Controller Platform

Southbound Interfaces & Protocol Plugins

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

OpenFlow

NETCONF

OVSDB

OpenFlow Enabled Devices

Open vSwitches

Additional Virtual & Physical Devices

OpenStack Service

VTN Manager

DOVE Mgr

Network Applications Orchestration & Services

Data Plane Elements
(Virtual Switches, Physical Device Interfaces)

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

- **ML2 Driver available in Icehouse release!**
  - Supports VXLAN and GRE tunnel networks
  - devstack support merged upstream
    - *Run OpenDaylight as a top-level service in devstack!*
- **OpenStack Neutron API Service** available now in OpenDaylight
  - provides Neutron API handling for multiple implementations
- Initial ML2 plugin focused on core Neutron functionality
  - Still uses Neutron [DHCP, L3] agents
OpenStack Integration: Next Steps

- Updates planned for Helium and Juno:
  - VIF plugging changes for stability improvements
    - Notify from ODL to MechanismDriver once ODL has setup the port on the host
  - Security groups implemented using OpenFlow rules
  - L3 routing handled by OpenDaylight
    - Removes the need for the L3 agent
  - Additional refinements and bug fixes
OpenDaylight project creation

7 new project proposals pending

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

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Code, Comments and Blank Lines

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

www.opendaylight.org
Project comparisons (ohloh.net)

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)

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Quick Reference
- Project Links:  [Homepage](#)
- Code Locations: [14 Locations](#)
- Licenses: EPL-1.0
- Similar Projects: [CDO Model](#), [Centreon](#), [Re...](#), [Netty](#), [OpenNMS](#)
- Managers: mavenugo
Membership — who wants to play
Agenda

- What is Hydrogen
  - A bit of personal learning
- Introduction to Helium
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Key Personal Learning: Open Source is the New Way to Develop Non-Differentiated “Plumbing”

- **Community building** is a core Open Source objective
- **Code** is the coin of the realm
- **Engineering systems** are as important as artifacts

*Putting this all together ➔*
Implication: 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 the only source of sustainable advantage/innovation consists of:

- Engineering Systems
- Culture
- People/Process

http://www.sdncentral.com/education/david-meyer-reflections-opendaylight-open-source-project-brocade/2014/03/
Said Another Way: Open Source has Transformed the Good-Cheap-Fast Development Cycle

Why? Because you can build Good or Cheap from Fast by using OS Development methodologies and leveraging the OS communities (this is a form of leveraged Investment)

Pick any Two
Agenda

- What is Hydrogen
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### Periodic Table of Elements

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<tr>
<td>71</td>
<td>Lu</td>
<td>Lanthanum</td>
<td>174.97</td>
<td>5</td>
<td>6</td>
<td>f</td>
</tr>
</tbody>
</table>

*For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.*
# Helium Simultaneous Release Plan

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>4/14/2014</td>
<td>Simultaneous Release Open</td>
</tr>
<tr>
<td>Last call for new projects eligible to join</td>
<td>4/30/2014</td>
<td>This is the latest date a project proposal can be brought and still have the two week public comment period before its project creation review at the last TSC meeting before it needs to declare its intent to join the Simultaneous Release at M1.</td>
</tr>
</tbody>
</table>
| M1          | 5/12/2014 | 1. Projects must have declared intent to participate in Simultaneous Release  
2. Participating Projects must have published a candidate Release Plan for public comment (Release Plan Template)  
3. TSC commits to initiate public discussion of Lithium Simultaneous Release Plan |
| M2          | 6/09/2014 | 1. Participating Projects must have declared their final Release Plan  
2. TSC commits to finalize basic dates and Milestones for the Lithium Simultaneous Release Plan (some details of requirements and Milestone contents may be decided later).  
3. TSC commits to initiate public discussion of Release Vehicles |
| M3          | 7/07/2014 | 1. Latest possible Continuous Integration Test Start  
2. TSC commits to decide on Final Release Vehicles Defined  
3. Latest possible date for commencing Documentation |
| M4          | 8/04/2014 | 1. API Freeze  
2. Latest possible Continuous System Test Start  
3. TSC commits to begin public discussion of Stable Update Expectations |
| M5          | 9/1/2014  | 1. Code Freeze (bug fixes only from here)  
2. String Freeze (all internationalizable strings frozen to allow for translation)  
3. TSC commits to have finalized Stable Update Expectations |
| RC0         | 9/9/2014  |                                                                                                                                          |
| RC1         | 9/15/2014 |                                                                                                                                          |
2. Latest possible date for each project to add a stable/helium branch |
| SU1 (Stable Update 1 aka Helium.1) | 11/10/2014 | First Stable Update for Helium. See Stable Update section. NOTE: This date is provisional, but will not move earlier. Please note, event based Updates (security/critical bugs) are distinct and may occur at any point. |
| SU2 (Stable Update 2 aka Helium.2) | 01/12/2015 | Second Stable Update for Helium. See Stable Update section. NOTE: This date is provisional, but will not move earlier. Please note, event based Updates (security/critical bugs) are distinct and may occur at any point. |
What’s in the queue for Helium? (projects that have advanced to Incubation state)

- Group Based Policy Plugin (Application Policy Plugin)
- Packet Cable PCMM Manager
- SDNi App
- Southbound Plugin to the OpenContrail Platform
- L2 Switch
- Secure Network Bootstrapping Infrastructure
- AAA Service
- ODL Toolkit
- Dynamic Resource Reservation
- TTPs
- Opflex
- Root Parent
- Documentation
- And more…

https://wiki.opendaylight.org/view/Project_Proposals:Main
Brief Note on Project Lifecycles

Anyone can propose a project

Proposal
  - Creation Review
    - Proposal Posted for 2 weeks:
      - Name (trademark) OK
      - Repo Name Specified
      - Description Complete
      - Scope well defined
      - Resources/Committers (developers committed to work)
      - Committers Identified
      - Vendor Neutral
      - Meets Board Policy (including IPR)
    - Review by TSC and Approval
  - Incubation
  - Graduation Review
    - Graduation Proposal Posted for 2 weeks:
      - Working code base
      - Active Community
      - History of Releases (using Mature Release Process)
      - Destination Top Level Project Specified
      - Acceptance of conditions of proposed TLP
      - Committers vote on seeking graduation
      - Accepted by vote of destination
    - Review by TSC and Approval
  - Mature
  - Promotion Review
    - Promotion Proposal Posted for 2 weeks:
      - Statement of centrality of role
      - Committers vote on seeking promotion
    - Review by TSC and Approval
  - Core
  - Elevation Review
    - Elevation Proposal Posted for 2 weeks:
      - Statement of acceptable subprojects
      - Identifies at least two proposed subproject
      - Committers vote on seeking elevation
    - Review by TSC and Approval
  - Top Level
  - Termination Review
    - Elevation Proposal Posted for 2 weeks:
      - States reason termination is sought
      - Calls out impact on other projects, users, communities and how they will be mitigated
      - Indicates where the project will be archived
      - Can be initiated by vote of the committers
    - Review by TSC or PMC if containing project:
      - Project has no remaining committers
      - Project has had no commits in SCM in 18 months
    - Review by TSC and Approval

Mature Projects need not progress to Core

Top level projects have a Project Management Committee (PMC) that votes on its decisions including accepting new PMC members and new subprojects.
Agenda

- What is Hydrogen
  - A bit of personal learning

- Introduction to Helium

- Next Steps – Beyond Helium

- Discussion/Question and Answer
Next Steps
A Few Technical Details

- MD-SAL
- Stable Release
- Simultaneous Release Cadence
- Future Release Vehicles/Package
  - Small OSGi runtime/containerization
- Quasi-technical Issues
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 Linux Foundation!

- We need more code that writes code
  - MD-SAL is an example
  - Fewer humans in the loop
  - More automation more better
Lithium?

- Release after Helium
- Target Release Date: 04.20.2015
- Simultaneous Release Plan
- Regularized/Deterministic Release Cadence
- Too early for projects
# Lithium Simultaneous Release Plan

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<thead>
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<th>Milestone</th>
<th>Date</th>
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</tr>
</thead>
<tbody>
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<td>10/6/2014</td>
<td>Simultaneous Release Open</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last call for new projects eligible to join 10/17/2014</td>
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3. Latest possible date for commencing Documentation |
| M4        | 2/20/2015  | 1. API Freeze  
2. Latest possible Continuous System Test Start  
3. TSC commits to begin public discussion of Stable Update Expectations |
| M5        | 3/23/2015  | 1. Code Freeze (bug fixes only from here)  
2. String Freeze (all internationalizable strings frozen to allow for translation)  
3. TSC commits to have finalized Stable Update Expectations |
| RC0       | 3/30/2015  | Participating Projects must hold their Release Reviews, including User Facing Documentation. |
| RC1       | 4/6/2015   |                                                                                                                                         |
| RC2       | 4/13/2015  |                                                                                                                                         |
| Formal Lithium Release | 4/20/2015 | 1. Formal Lithium Release  
2. Latest possible date for each project to add a stable/Lithium branch |
| SU1 (Stable Update 1 aka Lithium.1) | 6/1/2015 | First Stable Update for Lithium. See Stable Update section. NOTE: This date is provisional, but will not move earlier. Please note, event based Updates (security/critical bugs) are distinct and may occur at any point. |
| SU2 (Stable Update 2 aka Lithium.2) | 7/13/2015 | Second Stable Update for Lithium. See Stable Update section. NOTE: This date is provisional, but will not move earlier. Please note, event based Updates (security/critical bugs) are distinct and may occur at any point. |
Agenda

- What is Hydrogen
  - A bit of personal learning

- Introduction to Helium

- Next Steps – Beyond Helium

- Discussion/Question and Answer
Get Involved!

- TSC weekly calls open to everyone

- [http://wiki.opendaylight.org](http://wiki.opendaylight.org)

- Keep informed and join the conversation
  - IRC: #opendaylight on irc.freenode.net
  - Email: lists.opendaylight.org
  - Facebook: @openDaylightSDN
  - Twitter: #OpenDaylight
Thanks!