



Introduction to OpenDaylight: Current Events and OpenStack Neutron Integration

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Note: This deck contains slides courtesy Colin Dixon and a cast of 1000s

Agenda

- What is OpenDaylight?
- History: Helium
- What's in store for Lithium
- Some Personal Learnings
- Neutron Integration?
- Q&A

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

Code	Acceptance	Community
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 <ul style="list-style-type: none">• 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.

Who is OpenDaylight?

PLATINUM MEMBERS



SILVER MEMBERS



GOLD MEMBERS



Who is OpenDaylight? (Really)

- Like any Open Source Project, OpenDaylight primarily consists of those who show up to do the work.
- Running around 150–200 commits per week
 - **30 Days:** ~400 commits, ~55 contributors
 - During releases this is \geq 1000 commits and \geq 100 committers
 - **12 Months:** ~10,000 commits, ~260 contributors
- Strong integration and testing community
 - This stuff *really* matters
 - Staffing I&T is well, challenging

Source: <https://www.openhub.net/p/opendaylight>

Why Open Source?



- **Short version:** this is how modern infrastructure is built
 - Modern way to build “undifferentiated” plumbing
- **Long version:**
 - Build more, better code faster via collaboration
 - Make better decisions with devs and users at the table
 - Spend more time on the code that matters
 - 80/20 rule: 80% of code is non-differentiating

Aside: Release Naming

Periodic Table of Elements

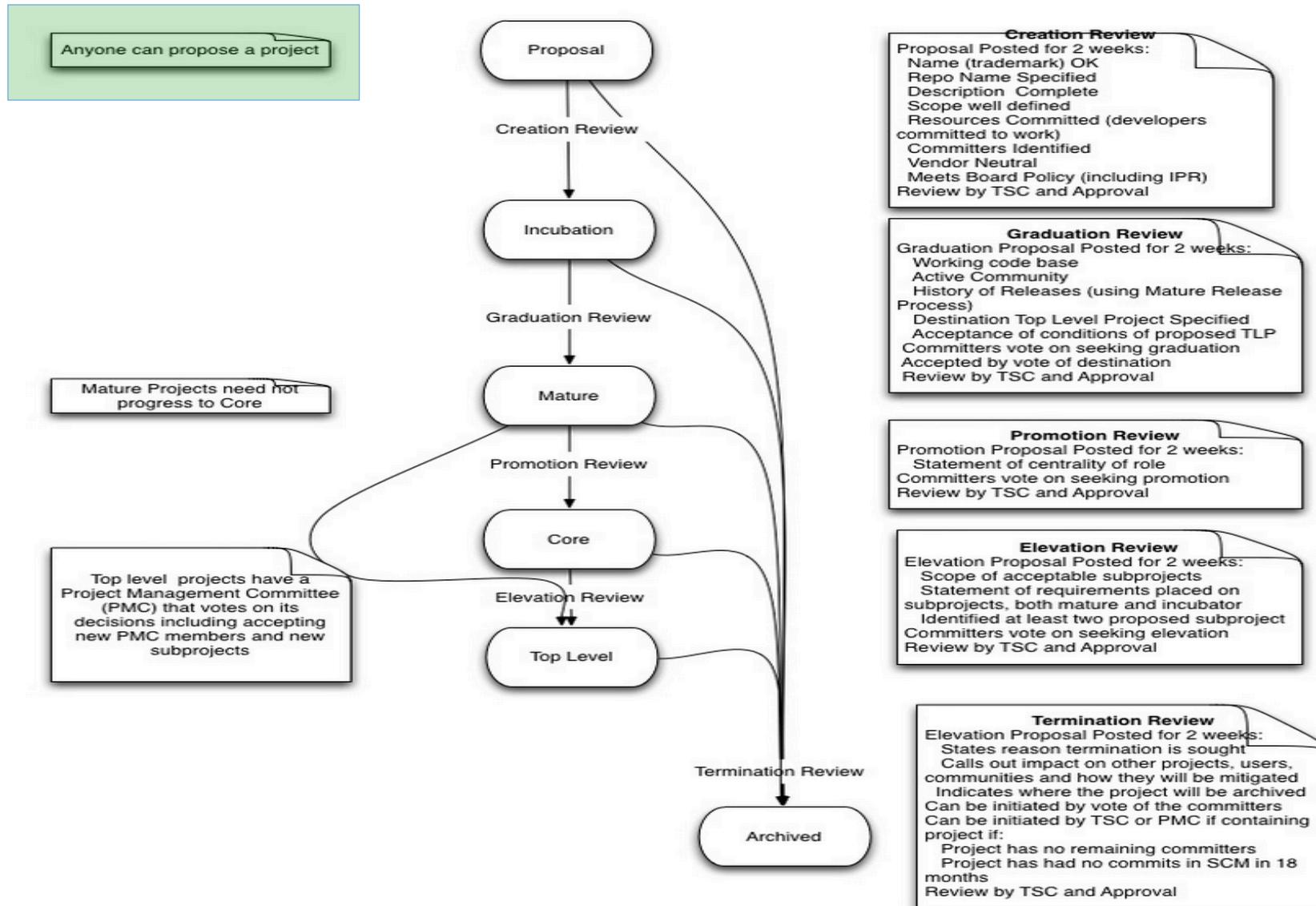
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 H Hydrogen 1.00794	2 He Helium 4.002602	3 Li Lithium 6.941	4 Be Beryllium 9.012162	5 C Solid	6 Hg Liquid	7 H Gas	8 Rf Unknown	9	10	11	12	13	14	15	16	17	18	
11 Na Sodium 22.98976928	12 Mg Magnesium 24.3050	13 B Boron 10.811	14 C Carbon 12.0107	15 N Nitrogen 14.0067	16 O Oxygen 15.9994	17 F Fluorine 18.9984032	18 Ne Neon 20.1797	K	K	K	K	K	K	K	K	K	K	
19 K Potassium 39.0963	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798	K
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.96	43 Tc Technetium 97.9072	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 103.42	47 Ag Silver 107.8882	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Tl Tin 118.710	51 Sn Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.50447	54 Xe Xenon 131.293	K
55 Cs Cesium 132.9054519	56 Ba Barium 137.327	57–71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.96669	80 Hg Mercury 200.59	81 Tl Thallium 204.3933	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (209.9824)	85 At Astatine (209.9871)	86 Rn Radon (222.0176)	K
87 Fr Francium (223)	88 Ra Radium (226)	89–103	104 Rf Rutherfordium (261)	105 Dub Dubnium (262)	106 Sg Seaborgium (265)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Uub Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (292)	117 Uus Ununseptium (293)	118 Uuo Ununoctium (294)	K

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.242	61 Pm Promethium 145	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.9235	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668				
89 Ac Actinium (227)	90 Th Thorium 232.03806	91 Pa Protactinium 231.03588	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)				

Brief Note on Project Lifecycles



Agenda

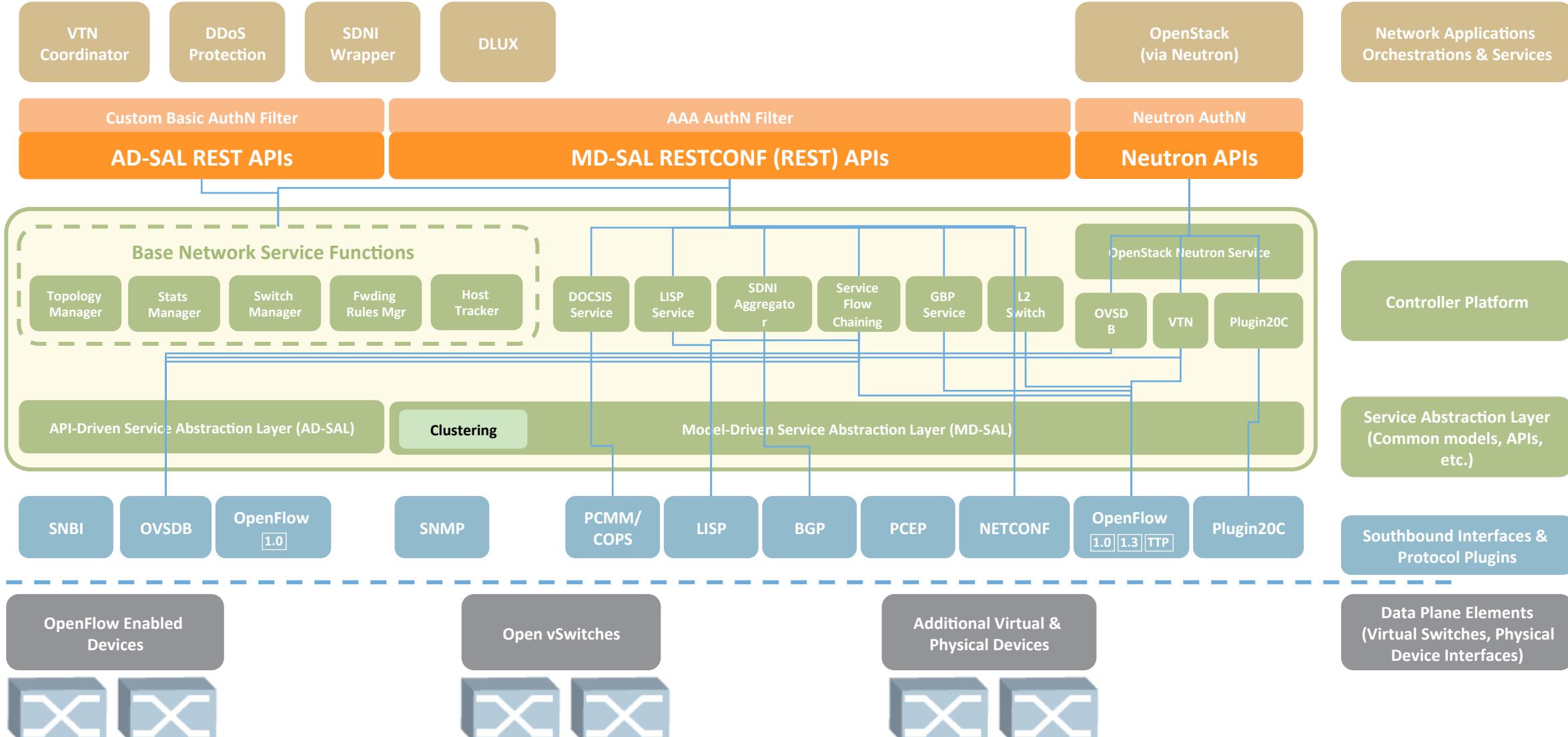
- ~~What is OpenDaylight?~~
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- What's in store for Lithium
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Legend

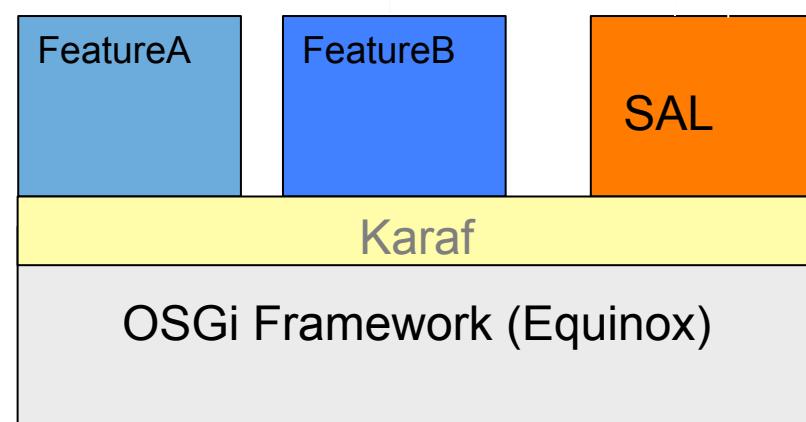
AAA: Authentication, Authorization & Accounting
AuthN: Authentication
BGP: Border Gateway Protocol
COPS: Common Open Policy Service
DLUX: OpenDaylight User Experience
DDoS: Distributed Denial Of Service
DOCSIS: Data Over Cable Service Interface Specification
FRM: Forwarding Rules Manager
GBP: Group Based Policy
LISP: Locator/Identifier Separation Protocol

OVSDB: Open vSwitch DataBase Protocol
PCEP: Path Computation Element Communication Protocol
PCMM: Packet Cable MultiMedia
Plugin2OC: Plugin To OpenContrail
SDNI: SDN Interface (Cross-Controller Federation)
SFC: Service Function Chaining
SNBI: Secure Network Bootstrapping Infrastructure
SNMP: Simple Network Management Protocol
TTP: Table Type Patterns
VTN: Virtual Tenant Network



ODL Helium: Karaf

- Java chosen as an enterprise-grade, cross-platform compatible language
- Java Interfaces are used for event listening, specifications and forming patterns
- Maven – build system for Java
- OSGi:
 - Allows dynamically loading bundles
 - Allows registering dependencies and services exported
 - For exchanging information across bundles
- Karaf: Light-weight Runtime for loading modules/bundles
 - OSGi based. Primary distribution mechanism for Helium



ODL Helium: Karaf

```
$ wget  
http://nexus.opendaylight.org/content/groups/public/org/opendaylight/integration/distribution-karaf/0.2.0-Helium/distribution-karaf-0.2.0-Helium.zip  
$ unzip distribution-karaf-0.2.0-Helium.zip  
$ cd distribution-karaf-0.2.0-Helium  
$ ./bin/karaf  
  
opendaylight-user@root> feature:list  (get all apps available)  
opendaylight-user@root> feature:install odl-dlux-core  
opendaylight-user@root> feature:install odl-openflowplugin-all  
opendaylight-user@root> feature:install odl-l2switch-all  
opendaylight-user@root> bundle:list | grep Active
```

Now your controller is ready to connect to switches and handle incoming flows.

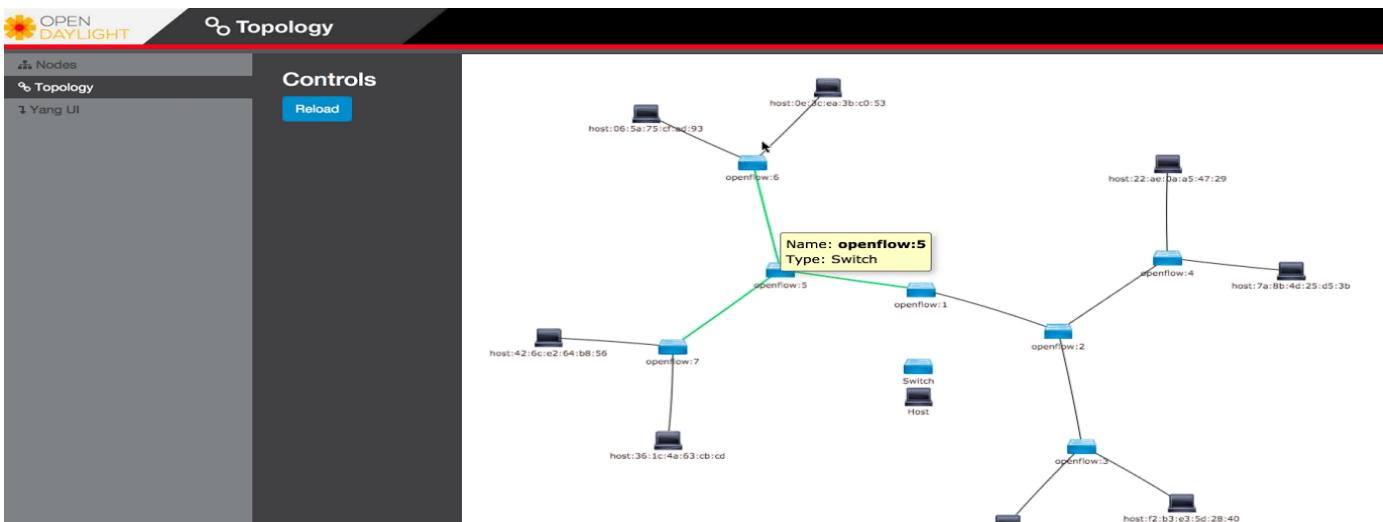
ODL Helium: Clustering

- The MD-SAL data store, notifications and RPCs now work in a cluster
 - Built using the RAFT consensus algorithm on top of Akka messaging
 - Tolerates f controller failures if you have $2f+1$ controllers
 - Uses sharding for scale-out performance
- Lithium work items
 - Finer-grained, configurable sharding
 - Migrating plugins to take advantage of clustering and support failover
 - Provide clearer models for building clustered applications

ODL Helium: DLUX

The screenshot shows the 'Nodes' section of the DLUX interface. On the left, a sidebar lists navigation options: Nodes, Topology, Connection Manager, Flows, Container, Network, and Yang UI. The main area contains a table with columns: Node Id, Node Name, Node Connectors, and Statistics. The table lists seven nodes, all named 'openflow:<id>' where <id> ranges from 1 to 7. Each node has 4 or 3 connectors, and each row has a 'Flows | Node Connectors' link.

Node Id	Node Name	Node Connectors	Statistics
openflow:6	None	4	Flows Node Connectors
openflow:7	None	4	Flows Node Connectors
openflow:4	None	4	Flows Node Connectors
openflow:5	None	4	Flows Node Connectors
openflow:2	None	4	Flows Node Connectors
openflow:3	None	4	Flows Node Connectors
openflow:1	None	3	Flows Node Connectors

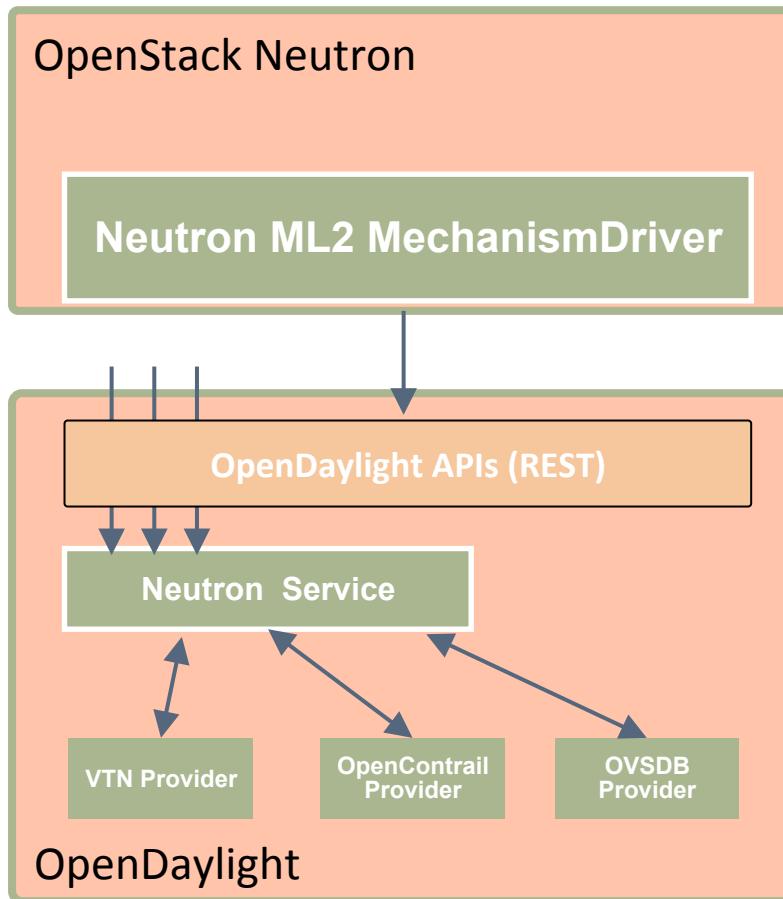


- Based on modern frameworks: node.js, AngularJS
- Completely decoupled from the core controller
 - Run it from any location
 - Modular, easy to extend

ODL Helium: Policy

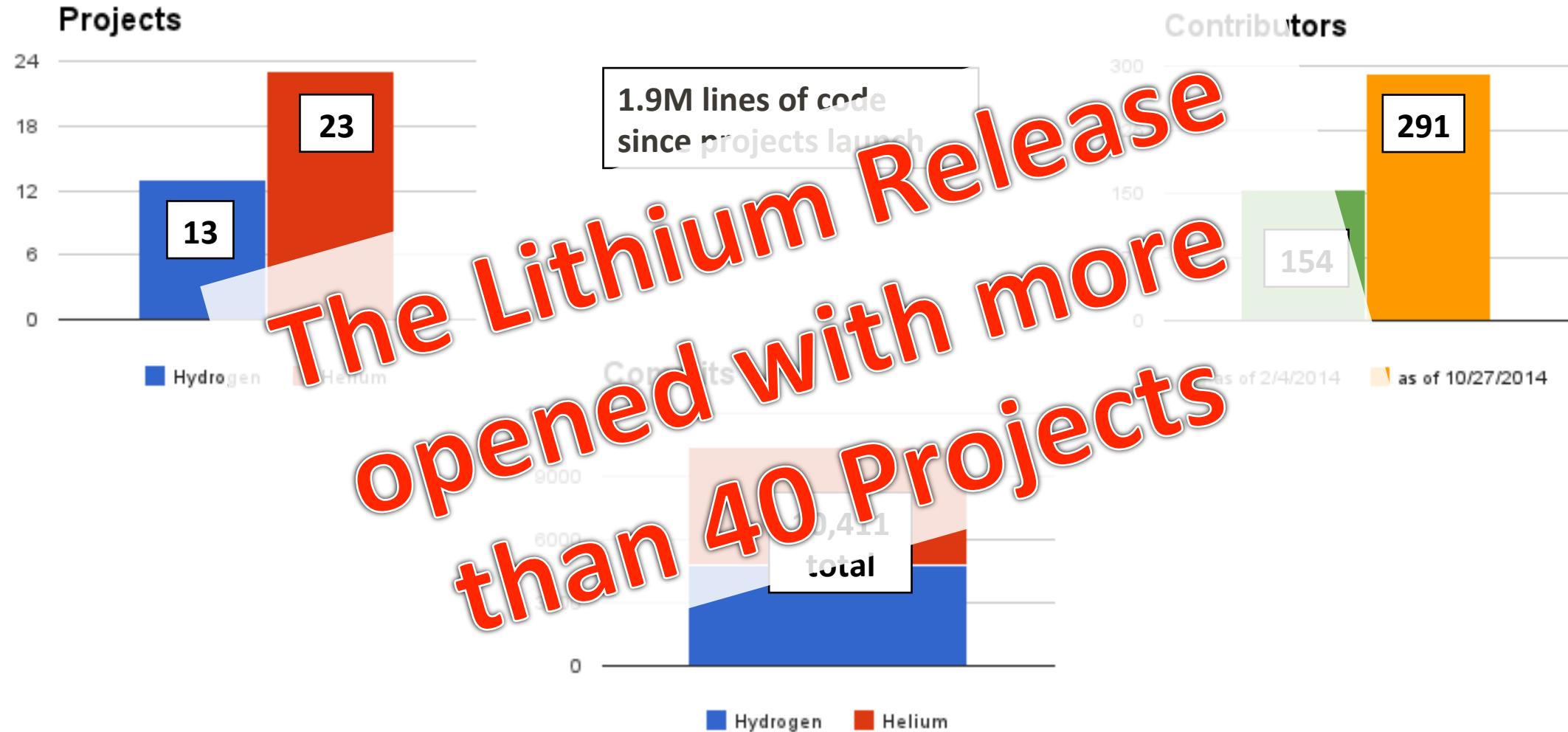
- Policy is everywhere at them moment
 - Group-based Policy, Congress, Intent, ACI, ...
- At least three policy-oriented projects in ODL
 - Service Function Chaining
 - Group-based Policy
 - Network Intent Composition
- ODL is acting as a proving ground for policy approaches where engineers and users can play with different approaches

ODL Helium: OpenStack Integration



- OpenDaylight exposes a single common OpenStack Service Northbound
 - Matches Neutron API precisely
 - *Multiple implementations* of Neutron in OpenDaylight
- New features in Helium
 - Distributed L3 forwarding
 - OpenStack Security Groups
 - LBaaS implementation

Growth from Hydrogen to Helium

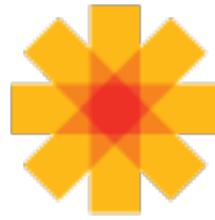


Adoption



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OPEN DAYLIGHT

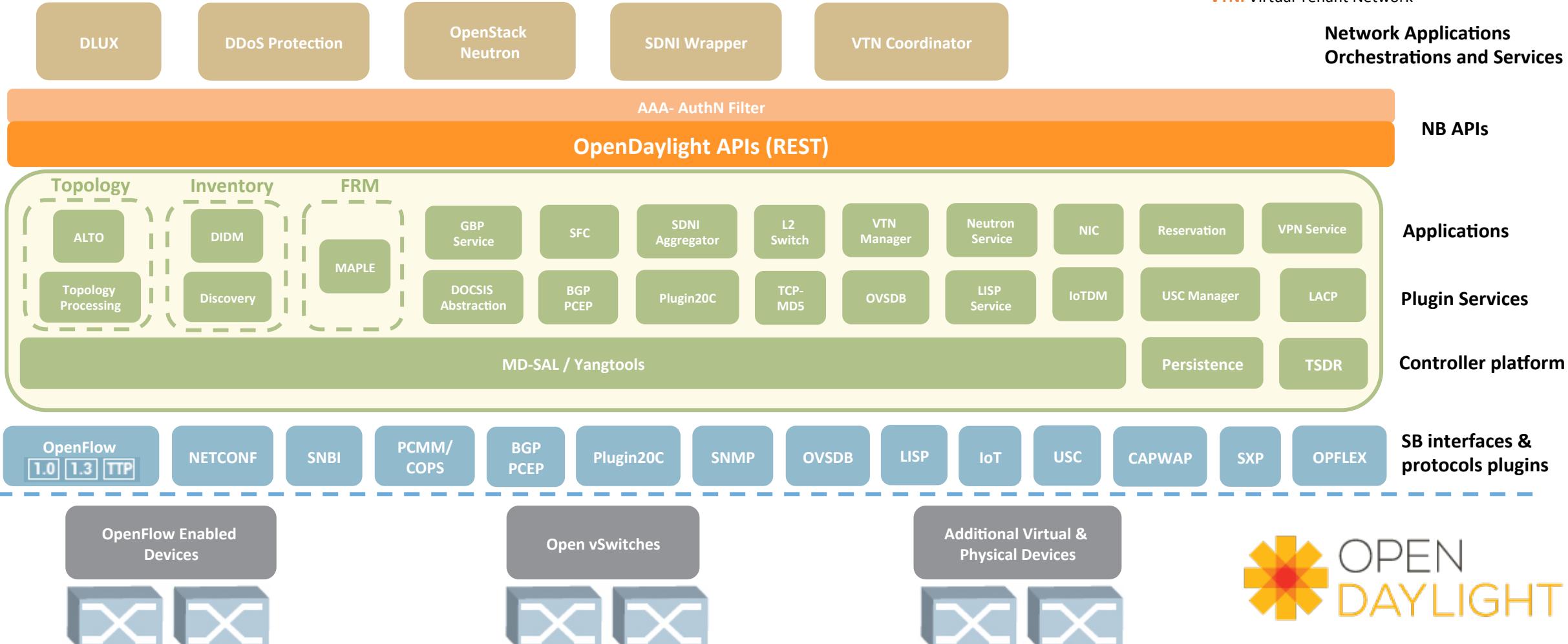
“LITHIUM”

Legend

AAA: Authentication, Authorization & Accounting
ALTO: Application Layer Traffic Optimization
AuthN: Authentication
BGP: Border Gateway Protocol
CAPWAP: Control and Provisioning of Wireless Access Points
COPS: Common Open Policy Service
DIDM: Device Identification and Driver management
DLUX: OpenDaylight User Experience
DDoS: Distributed Denial Of Service

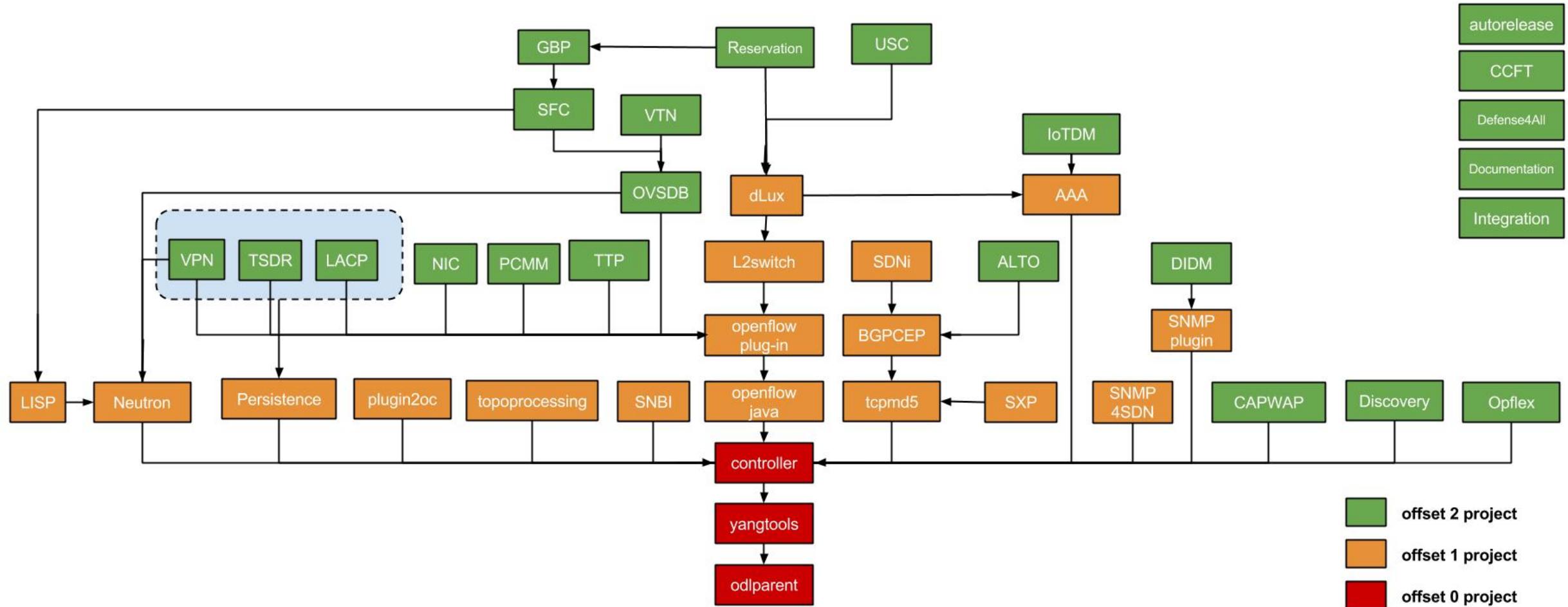
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FRM: Forwarding Rules Manager
GBP: Group Based Policy
IoTDM: Internet of Things Data Broker
LACP: Link Aggregation Control Protocol
LISP: Locator/Identifier Separation Protocol
MAPLE: Maple Programming
NIC: Network Intent Proposal
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TTP: Table Type Patterns
USC: Unified Secure Channel
VTN: Virtual Tenant Network



Lithium Dependency Graph

Opendaylight Lithium Project Dependencies

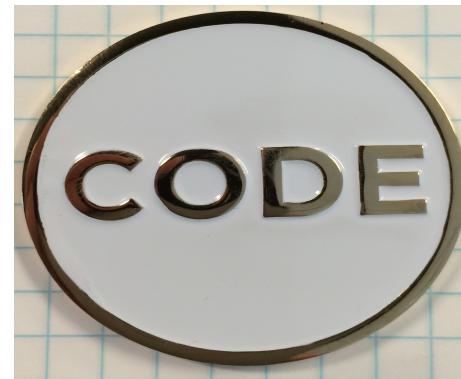


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Key Personal Learning:

Open Source is the Modern Way to Develop Non-Differentiated “Plumbing”



- ***Community building*** is a core Open Source objective
 - Both intra and inter project
- ***Code*** is the coin of the realm
 - But don't forget the importance of testing and integration, documentation, ...
- ***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

What you build isn't as important as how you build it

<http://www.1-4-5.net/~dmm/talks/nrg88.pdf>

Source of sustainable advantage/innovation consists of

- Engineering Systems
- Culture
- People/Process

Bio-techno Convergence and The Hidden Nature of Complexity



David Meyer
CTO and Chief Scientist, Brocade
Director, Advanced Technology Center, University of Oregon
Network Complexity Research Group

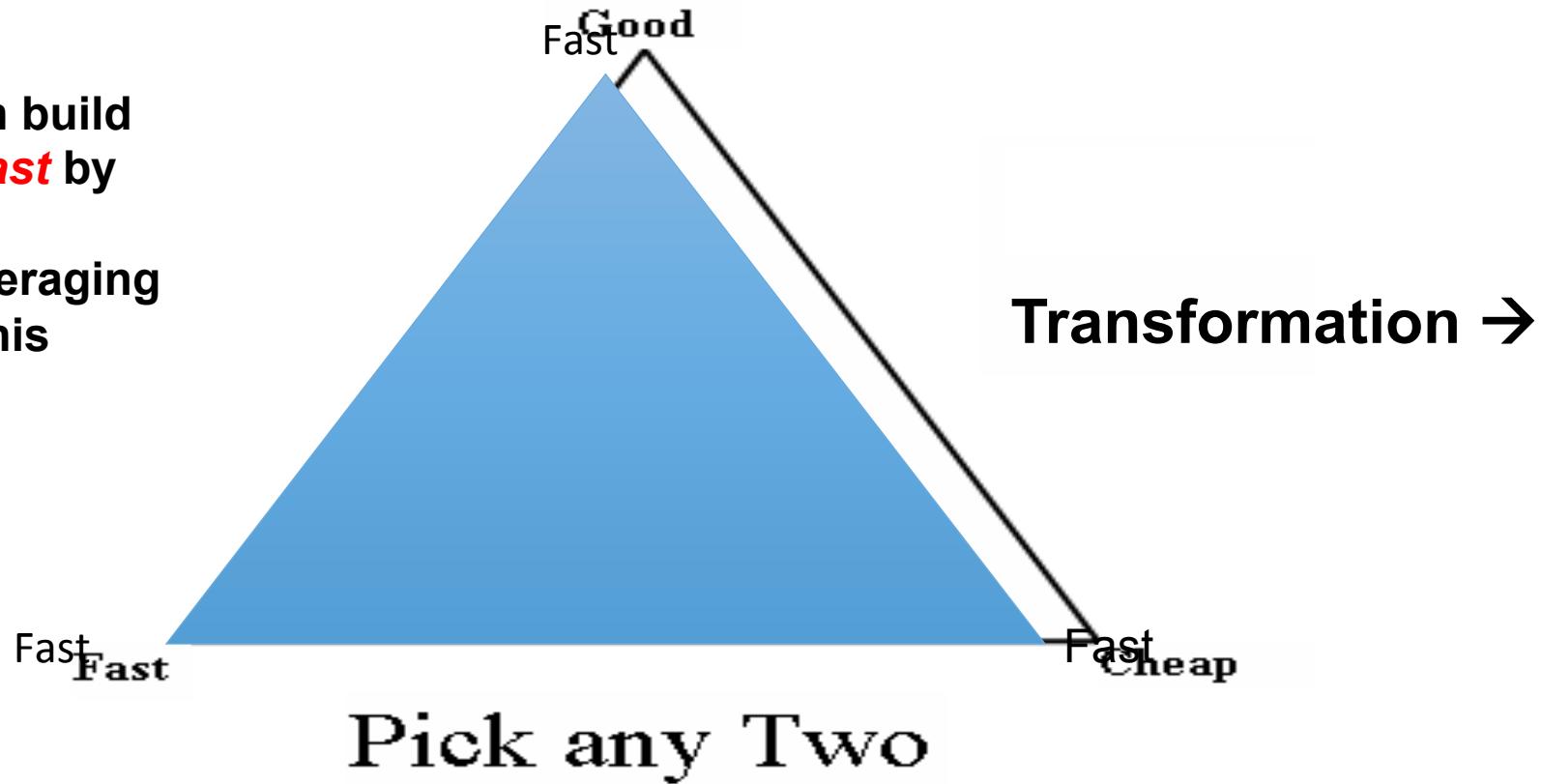
IETF 88
Vancouver, BC

dmm@{brocade.com,uoregon.edu,1-4-5.net,...}

<http://www.1-4-5.net/~dmm/talks/ncrg88.pdf>

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)



Transparency

- Transparency matters
- When there are disagreements in the community
 - Transparency makes everyone feel heard
 - Transparency makes sure the community does not fracture
- OpenDaylight is transparent to the extreme
 - Calls, mailing lists, wikis... are open to anyone
 - Even the technical steering committee calls

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Neutron Update

- 5+ projects wanting to do Neutron integration
- Includes VTN, Dove, GBP, OVSDB, LISP Flow Mapping, VPN Service, ...
- What's missing?
- Clearly need an abstraction for projects wanting to use Neutron

Neutron-ODL Stack Evolution -- Proposal

Current World



Major needed work:

1.) Factor apart two halves of the OVSDB project—network virt. layer and OVSDB library.

2.) Migrate network virt. layer to use the MD-SAL.

3.) Turn OVSDB protocol library into a plugin—not just a library.

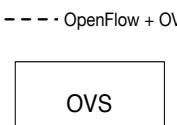
4.) Migrate OVSDB protocol plugin to use the MD-SAL.

5.) Close feature gap between network virt. layer and OVS OS plugin, e.g., FWaaS, VPNaas.

6.) Test/improve scale, stability, and performance of the stack.

7.) Migrate network virt. layer's NB API from Neutron (REST) to Neutron (YANG) to Policy/Intent.

8.) Migrate network virt. layer's SB APIs from OVS-specific to tunnel management and traffic direction (into tunnels).



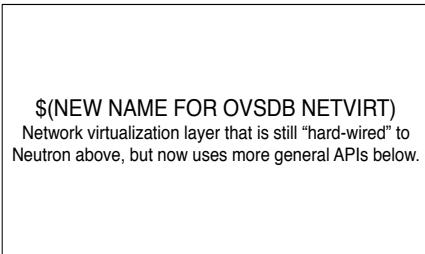
Near Future



- Neutron (REST) --



- Neutron (YANG) --



----- Tunnel Mgmt ----- ----- Traffic Direction -----



----- Relevant Southbound Protocol -----

Many h/w- and v-switches

Lithium Release?



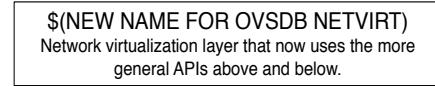
- Neutron (REST) --



- Neutron (YANG) --



----- Higher-Level Network Virtualization API -----



----- Tunnel Mgmt ----- ----- Traffic Direction -----



----- Relevant Southbound Protocol -----

Many h/w- and v-switches

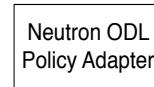
Long-Term Strategy



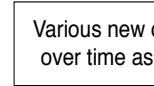
- Neutron (REST) --



- Neutron (YANG) --



----- Higher-Level Network Virtualization API -----



----- Tunnel Mgmt, Traffic Dir, Flow Prgmming, etc... -----



----- Relevant Southbound Protocol -----

Many h/w- and v-switches

Possible Future API Layers



- Neutron (REST) --



- Neutron (YANG) --



----- Higher-Level Network Virtualization API -----

----- Generic Overlay Network ----- ??? -----

----- Tnnl Mgmt ----- ??? ----- ??? -----

----- Tunnel Mgmt, Traffic Dir, Flow Prgmming, etc... -----



----- Relevant Southbound Protocol -----

Many h/w- and v-switches

Quasi-technical things we're working on (necessarily incomplete list)

- Continue to build/refine our community
 - Including increasing committer diversity within and across the projects
 - Code Quality and Coverage
 - Stability, Security, Performance, Bug fixes (\$Major.\$Minor)
 - Distributed Systems Issues
 - **S3P – Stability, Scalability, Security, and Performance**
- “Staffing”
 - Release engineering
 - Testing and Integration
 - 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

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Get Involved!

- Pull code and try it out
- TSC weekly calls open to everyone
- <http://wiki.opendaylight.org>
- Keep informed and join the conversation
 - IRC: #.opendaylight on irc.freenode.net
 - Email: lists.opendaylight.org
 - Facebook: @openDaylightSDN
 - Twitter: #OpenDaylight

Q&A

Thanks!