The State of SDN & NFV: 5 Years In

Neela Jacques, Executive Director, OpenDaylight
@NeelaJacques
There is a Wave Sweeping the IT Industry
The Era of Standards Wars is Over
Collaboration
With your team ...but also with your competitors!
Significant Industry Investment in Open SDN

Total Contributors
- Total: 1,336
- Floodlight: 76
- Ryu: 88
- ONOS: 133
- Contrail: 141
- Open vSwitch: 279
- OpenDaylight: 629

Total Code Commits
- Total: 59,145
- Floodlight: 2597
- Ryu: 2996
- ONOS: 8,003
- Contrail: 8,028
- Open vSwitch: 11,546
- OpenDaylight: 28,892

Source: OpenHub.net, Feb '16
ODL User Survey, February 2016 (Link to Survey)
ODL User Survey, February 2016 (Link to Survey)
From Lithium to Beryllium

- Growing ecosystem
- Increasing number of end users
- Maturing code base
- Additional competitors
- Applications emerging

![Number of Contributors](chart.png)
OpenDaylight Deployments are a Community Affair
Solutions Based on OpenDaylight
Balancing Innovation and Standardization
Exploration vs. Rationalization
Open + [Value]
Platforms create large and diverse markets
Strong Desire for One Common Platform

“Open Programmable Network”

- Supports a wide range of use cases (similar to Linux’s reach)
- Takes a modular/approach to architecture (deploy only what you need)
- Supports the full range of operator hardware (multiple southbound interfaces)
- Provides easy way to write once, work everywhere (service abstraction layer)
Over 2000+ Participants World Wide!
Vibrant Advisory Group
Standardizing the SDN Platform

Some Questions Have Been Addressed...

- Need to support multiple protocols
- YANG models

While Others Still Remain:

- The role of policy / intent
- How to scale out logically centralized control
- Evolving role of OpenFlow
- How to measure end-to-end controller performance
ODL Platform: Broadest Set of Use Cases

Automated Service Delivery
Network Resource Optimization
Visibility and Control
Cloud and NFV
Research, Education and Government
ODL Be: Automated Service Delivery

Key Challenges: Instantiate new service to customer across multiple HW

ODL Use Cases

- Telco enabling new subscribers
- Provisioning MEO satellite based communications to mining customers

ODL Case Studies

- AT&T Bandwidth on Demand
- Serro Solutions
- Telstra
- Orange
- Large Hadron Collider (Caltech)
# ODL Be: Network Resource Optimization

**Key Challenge:** Exponential growth in traffic requirements and increased costs due to suboptimal network utilization efficiency.

## ODL Use Cases

- Rearranging Label Switched Paths
- Reconfiguring interior (e.g., OSPF) or exterior (e.g., BGP) routing protocols
- Dynamically reprovisioning Carrier Ethernet Services (e.g., E-LAN)
- Adjusting OpenFlow forwarding rules
- Multilayer WAN controller (e.g. Ericsson)

## ODL Case Studies

- KT Corporation
- Orange
- Tencent
- Tata Consultancy Services (TCS)
**ODL Be: Visibility and Control**

**Key Challenge:** Provide single dashboard view and basic control of physical and physical network topology, configuration and performance

**ODL Use Cases**

- Gather Network Statistics (e.g. SNMP/S-Flow data) across multi-vendor environment
- Monitor application performance (e.g. Skype for Business - Meru Network)

**ODL Case Studies**

- Telefonica
- Brocade Flow Optimizer
- Tata Consultancy Services (TCS) - Flow-Aware Real Time Analytics
Key Challenge: OpenStack Neutron by itself provides a tenant-facing cloud networking API but is limited what it exposes to cloud operators. NFV requires significant new functionality (e.g. Service Function Chaining)

**ODL Use Cases**
- Network Virtualization for OpenStack
- Multi-tenant Network
- NFV Telco Services
- Policy and Intent
- OVS Virtualization for Software Switches
- SFC Support with a Virtualized Environment

**ODL Case Studies**
- China Mobile
- Orange
- Massachusetts Open Cloud
Key Challenge: Flexible/Agile network that support new and future innovations

ODL Use Cases
- High perf campus for research
- SmartGrid/SmartCity
- Research w/ flow level control, Bandwidth on Demand

ODL Case Studies
- Cornell University
- City of Bristol, England
- SURFNet / GEANT
How AT&T is Leveraging OpenDaylight

• “AT&T open source is 5% of our code; our goal is to move to >50% by 2020.”—John Donovan, Senior Executive Vice President, AT&T Technology and Operations

• OpenDaylight powers AT&T’s Network on Demand Enterprise L2 Service in over 100 markets

• The company is leveraging OpenDaylight for its global SDN controller

• AT&T is contributing to a new ODL project to support YANG models:

“We configure devices in our software-based network using a tool built on a data modeling language called YANG. We’ll submit our customized YANG design tool into open source through the OpenDaylight Community. Innovators will be able to create services that plug into our software-defined framework.” –John Donovan, AT&T
How AT&T is Leveraging OpenDaylight
Korea Telecom: T-SDN

CHALLENGE:

OPEX increase by segmented operations
  • For E2E Service Configuration, many domain operators should participate
  • Delayed service deployment because of manual planning and provisioning

SOLUTION:

Simplify and automate provisioning processes using T-SDN
Korea Telecom:T-SDN

KT Architecture
Adopted open source SDN controller (OpenDaylight Helium release)
• To reduce time and cost for development

Integrated with legacy transport NMS
• Share inventory, topology and fault information
• Define YANG-model use in memory data store for fast path computation
• Real-time synchronization for resource changes
• Adopted MSPP, OXC, and PRN plugins
NovoDC: An Example in Public/Private Cloud

Considerations & Observations

- VPC+Service Chain are the basic services in both Public/Private Cloud
- Openstack is the integral part
- vSwitch performance improved; vFW, vLB ready for certain deployments
- Service Chaining: multiple technologies including VxLAN extended/Openflow/NSH/other tags
OpenDaylight in the WAN

- **Objective:** Self-provisioned dynamic network services

- **What:** Telstra PEN Platform - Layer 2 Ethernet virtual cross connect (VXC) forwards frames between any 2 endpoints on the network

- **How:** MD-SAL application, leveraging OpenFlow protocol

- **Reach:** 25 POPs and growing
How Tencent is Leveraging OpenDaylight

CHALLENGE

One of the largest web-scale companies in the world experienced **low bandwidth** usage of expensive WAN connections, low service redundancy scheduling efficiency.

SOLUTION

Built DCI controller based on ODL achieved **real bandwidth usage improvement** + **network service quality enhancement**.
Why OpenDaylight?

Great **scalability** of the architecture and **extensible** with rich southbound protocols / healthy ecosystem, resilient architecture, increasingly rich features and **southbound protocols**, clear version evolution rhythm and its reputation in the open source community.

“We request all our partners to be OpenDaylight compatible by end of 2015”

Marty Ma, Chief Architect
ODL Managing Satellite Networking

**CHALLENGE:**

Atypical data flows: weather, finance, airlines, government, energy -- mapping packet switch infrastructure to optical transport networks

**SOLUTION:**

Leverage ODL as a **global controller** to enable SDN on MEO satellite network, which provides consistent and on-demand connection
How Caltech is Leveraging OpenDaylight

• **Who:** CalTech – Large Hadron Collider team

• **What:** Distribute 200+ TB data beyond 13 Tier 1 sites to 160 Tier 2 research sites and 300 Tier 3 sites

• **How:** Controller based on ODL leveraging OpenFlow to setup up flow rules for data distribution. First based on Hydrogen, then Helium, soon to be on Lithium

• **Quote:** “ODL has become the De-Facto Standard Controller”
How the City of Bristol is Leveraging OpenDaylight for Smart City / IoT

**Who:** Bristol, England is building a fully programmable, citywide network using ODL

**What:** Developing an open programmable city region

**How:** An OpenDaylight-based SDN controller will integrate traffic across Bristol’s fiber optic network, LTE and experimental 5G wireless networks, and a mesh network of 1,500 connected lamp posts. NEC will provide equipment and support for the network’s radio elements
How to Get Started with OpenDaylight

**Download**
People can download directly from OpenDaylight.org.

**Find a Solution or Provider**
ODL is the only open source SDN platform with a robust ecosystem of products, solutions, distributions, and other providers who can help you deploy open SDN in your network.

**Getting Started Guide**
A comprehensive guide for newbies and advanced users to learn about, install and deploy OpenDaylight.

http://www.opendaylight.org/start
Thank You

Neela Jacques, Executive Director, OpenDaylight
@NeelaJacques